



HEART &  
STROKE  
FOUNDATION

CANADIAN  
**Stroke**  
**BEST PRACTICE**  
RECOMMENDATIONS

# CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

## **Stroke Rehabilitation** Update 2015

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# Canadian Stroke Best Practice Recommendations

## Stroke Rehabilitation ~ Fifth Edition, 2015

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# Canadian Stroke Best Practice Recommendations

## STROKE REHABILITATION

### Section One: INTRODUCTION and OVERVIEW

#### Introduction

The *Canadian Stroke Best Practice Recommendations* (CSBPR) are intended to provide up-to-date evidence-based guidelines for the prevention and management of stroke, and to promote optimal recovery and reintegration for people who have experienced stroke (patients, families and informal caregivers). The CSBPR are under the leadership of the Heart and Stroke Foundation, Canada (HSF) and involved a broad network of stroke professionals, healthcare providers, managers, patients, families and caregivers.

The goal of disseminating and implementing these recommendations is to reduce practice variations in the care of stroke patients across Canada, and to reduce the gap between current knowledge and clinical practice. Combined these goals will lead to optimal levels of recovery and better outcomes for people who experience a stroke.

#### Why is better stroke management important?

- Every year, approximately 62,000 people with stroke and transient ischemic attack are treated in Canadian hospitals. Moreover, it is estimated that for each symptomatic stroke, there are nine “silent” strokes that result in subtle changes in cognitive function and processes.
- Stroke and other cerebrovascular diseases are the third leading cause of death in Canada.
- Stroke is a leading cause of adult disability, with hundreds of thousands of Canadians living with the effects of stroke.
- The annual cost of stroke is approximately \$3.6 billion, taking into account both healthcare costs and lost economic output.
- The human cost of stroke is immeasurable.

The HSF works closely with national and provincial stakeholders and partners to develop and implement a coordinated and integrated approach to stroke prevention, treatment, rehabilitation, and community reintegration in every province in Canada. The CSBPR provides a common set of guiding principles for stroke care delivery, and describes the infrastructure necessary at a system level, and the protocols and processes that are needed at a clinical level to achieve and enhance integrated, high-quality, and efficient stroke services for all Canadians. Through the innovations embodied within the stroke best practices, these guidelines contribute to health system reform in Canada and internationally.

The *Canadian Stroke Best Practice Recommendations* are developed and presented within a continuous improvement model and are written for healthcare professionals, administrators, health system planners, and funders, all of whom have important roles in the optimization of stroke prevention and care and who are accountable for results. A strong stroke research literature base is drawn upon to guide the optimization of stroke prevention and care delivery. Many implementation tools are provided to facilitate uptake into practice, 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. Recent stroke quality monitoring activities have compelling results which continue to support the value of adopting evidence-based best practices in organizing and delivering stroke care in Canada.

This is the fifth edition of the *Canadian Stroke Best Practice Recommendations*, which were first released

in 2006. The theme for the 2014 – 2015 update is ***Working Together with Stroke Survivors and their Caregivers to Achieve Optimal Outcomes***. This theme emphasizes the need for a committed interprofessional team approach to stroke care across the continuum, and to ensure consistent patient-centred care delivery. With stroke patients and family members at the core, the entire team must be supported and actively engaged at every stage of care and in every setting. The HSF *Canadian Stroke Best Practice Recommendations* provide healthcare professionals with the most current evidence and expert guidance on how to engage in patient-centred optimal stroke care for patients and family members. Patients and family caregivers in particular should receive education and supported as active participants throughout their journey of recovery to ensure meaningful contributions to goal setting, treatment planning, and active therapy. This theme aligns with and supports the HSF survivorship mission priority and is included as part of each module for the 2014-15 update of the *Canadian Stroke Best Practice Recommendations*.

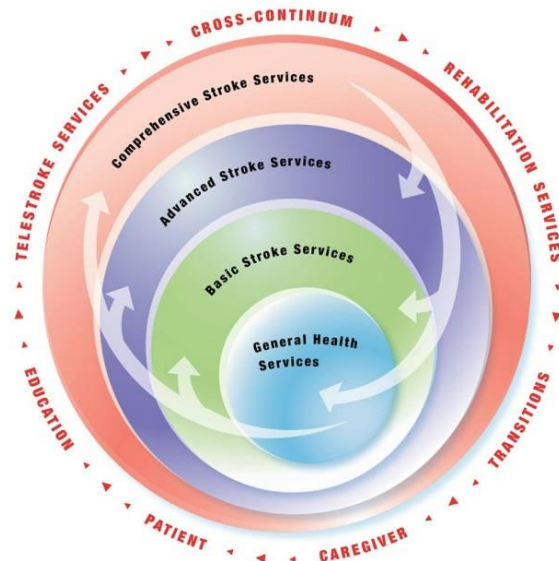
## Organization of Stroke Care in Canada

The Heart and Stroke Foundation, in collaboration with the CSBPR advisory committee and key stakeholders have developed a framework to facilitate system improvement through the adoption of evidence-based best practices in stroke across the continuum of care.

Optimal stroke services include access to stroke experts, diagnostic equipment and expertise, and a range of emergent and timely evidence-based acute and rehabilitation treatment options. These services can be considered along a continuum from minimal, non-specialized services in organizations that provide *general* health care, followed by higher levels with increasing levels of service and resources, such as providing *basic* diagnostic services and management, then *advanced* care at a single site, and at the highest level, to *comprehensive* stroke care across a region.

The Canadian Stroke Best Practices Optimal Stroke Services Framework, as visualized in Figure 1 is meant to organize and prioritize stroke services based on resource availability for a regional or geographic area. It is important to emphasize that the approach stroke care delivery will necessarily differ across Canada. The overarching goal set forth within this framework is for each organization involved in the delivery of stroke care services to engage in an ongoing cycle of developing the expertise, processes and protocols needed to provide optimal stroke patient care, taking into consideration the organization's geographic location, patient population, structural and human resources, and relationship to other centres within their healthcare region or system. Once a level of stroke services has been achieved, the organization should strive to develop and incorporate components of the next higher level for ongoing growth of stroke services where appropriate, as well as continuous quality improvement within the level of service currently provided.

**Figure 1: Canadian Stroke Best Practices Optimal Stroke Services Framework**



*For more information, refer to the Canadian Stroke Best Practices Overview and Methodology Module at [www.strokebestpractices.ca](http://www.strokebestpractices.ca).*

## Stroke Rehabilitation Module Overview

***Working Together with Stroke Survivors and their Caregivers to Achieve Optimal Outcomes*** is imperative within stroke rehabilitation and recovery, and applies to systems of care, healthcare providers, patients, families and caregivers, and the broader community. The primary underpinnings of ‘rehabilitation’ require these individuals and groups to work together to develop individualized treatment plans to optimize functional, cognitive and emotional recovery.

A critical concept within stroke rehabilitation is that ‘rehabilitation’ does not refer to a specific place or time where care is received. Rather, stroke rehabilitation is a goal-oriented set of therapies and activities as part of patient care post-stroke. Rehabilitation starts shortly after the stroke event occurs and continues as long as required for each individual to achieve their maximum potential recovery. Therefore, it crosses all ‘stages’ and ‘settings of care’ and a broad range of clinical experts, care providers and caregivers are included as active members of the rehabilitation ‘team’, along with the patient.

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. The 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 clearly describes 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 is 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.

Individualized rehabilitation plans need to be specific. Many patients with stroke will present with unique challenges such as expressive or receptive aphasia or some alteration of cognitive function. These challenges should not preclude participation in rehabilitation. In fact the individualized rehabilitation plans should clearly describe the methods and activities required to meet all rehabilitation needs using evidence-based approaches and tools validated for these subgroups. For example, including the use of specific assessment and outcome tools designed to evaluate areas such as mood or function in stroke patients with communication issues, and using supportive conversation approaches to assessments and treatment for patients with aphasia.

***Working Together*** in stroke rehabilitation and recovery involves healthcare providers, policy makers, individuals with stroke, their families and caregivers, and the public. A critical component of stroke rehabilitation and recovery is access to specialized stroke services, ideally provided by dedicated stroke rehabilitation providers in acute care, inpatient rehabilitation and community settings.

Recent reports on the quality of stroke rehabilitation and recovery services across Canada and within provinces have shown considerable variation in access to services, availability of specific types of therapies, intensity and duration of therapy, and follow-up care after an inpatient rehabilitation stay [HSF Stroke Report 2014; EBRSR survey Meyer et al]. These reports also show limited access to rehabilitation for those with severe stroke. The disparity in access to rehabilitation is occurring in both urban areas where large volumes of patients post-stroke reside, and rural settings where there are fewer people post-stroke, and fewer rehabilitation professionals available who have stroke expertise.

## Stroke Rehabilitation Definition and Considerations

**Stroke Rehabilitation** is a progressive, dynamic, goal orientated process aimed at enabling a person with impairment to reach their optimal physical, cognitive, emotional, communicative, and social functional level.

Rehabilitation is NOT a setting, rather it is a set of activities, and begins soon after the initial stroke event, once the patient is medically stable and can identify goals for rehabilitation and recovery.

### Considerations Regarding Stroke Rehabilitation:

- **Settings:** rehabilitation interventions, a key component of comprehensive stroke care, are provided in a range of settings, such as: acute care or sub-acute care; within rehabilitation units, on general or mixed rehabilitation units; in ambulatory or community settings such as outpatient or day clinics, early supported discharge services, home-based services, recreation centres, and outreach teams.
- **Duration:** length of service or stay for stroke rehabilitation varies depending upon factors such as the types of services required, accessibility of those services, goals and needs of the stroke survivor and family.
- **Timeframe:** Stroke rehabilitation requirements often continue for many months and even years after an index stroke. Current healthcare systems tend to allow for stroke rehabilitation interventions within the first six months following stroke onset, even though many stroke patients will require some of these services beyond that arbitrary time frame, since rehabilitation is an ongoing process.
- **Available Evidence:** The research literature in this area is rapidly evolving, with new evidence emerging for innovative therapies applicable at different stages of care. The writing group has carefully and thoughtfully examined all therapies with respect to the timing of the evidence. [Refer to methodology section for further details.](#)

## Updates and Changes in Stroke Rehabilitation 2015 Update

The 2015 update of the *Canadian Stroke Best Practice Recommendations* Stroke Rehabilitation module reinforces the growing and changing body of research evidence available to guide assessment, diagnosis and management of stroke related impairments in the days, weeks and months following a stroke.

Highlights of the moderate and significant updates as well as new additions to the Stroke Rehabilitation module recommendations for 2015 include:

- ✓ Many recommendations have been revised to higher levels of evidence as the evidence is strong and compelling and continues to emerge at a rapid pace.
- ✓ The recommendations continue to evolve to become more specific to guide clinicians in tailoring their treatment to the individual based on time post stroke, severity of impairment and their goals.
- ✓ Emphasis that rehabilitation and recovery after stroke is a dynamic and ongoing process that occurs in all settings and over time (days, weeks, months, years).
- ✓ The recommendation sections are grouped into two parts: the first addressing organization of stroke rehabilitation within a system of care; the second part addressing specific functional areas of stroke recovery and direct clinical care.
- ✓ Some previous recommendation sections have been combined together for comprehensiveness, as seen in the lower limb topic in Section 6. The new sections of rehabilitation recommendations provide guidance for providers to ensure a holistic approach to the rehabilitation of the person with stroke by addressing their physical, functional, cognitive and emotional status to help them return to their normal life roles.

- ✓ Advocacy in system implications for system funders to commit to improving the stroke rehabilitation system. Analyses suggest that investing in effective and efficient rehabilitation services could actually reduce costs of taking care of stroke patients.
- ✓ Family members and informal caregivers play a key role in post-stroke rehabilitation and recovery.
- ✓ Development of specific recommendations for paediatric stroke rehabilitation that reflects emerging research findings. These are grouped together in a new section (Section 12) of these recommendations.

## Guideline Development Methodology:

The *Canadian Stroke Best Practice Recommendations* present high-quality, evidence-based stroke care guidelines in a standardized framework to support healthcare professionals across all disciplines. Implementation of these recommendations is expected to reduce practice variations and close gaps between evidence and practice.

The recommendations are targeted to health professionals throughout the health system who care for those affected by stroke. Health system policy makers, planners, funders, senior managers, and administrators who are responsible for the coordination and delivery of stroke services within a province or region will also find this document relevant and useful to their work.

The methodology for updating the recommendations includes twelve distinct steps to ensure a thorough and rigorous process. These steps are overseen by the CSBPR Advisory Committee, and include the following (details available online):

1. Establish an expert interprofessional writing group for module, as well as stroke survivors and/or caregivers
2. Systematic search, appraisal and update of research literature.
3. Systematic search and appraisal of external reference guideline recommendations.
4. Update of evidence summary tables.
5. Writing group review and revision of existing recommendations and development of new recommendations as required.
6. Submission of proposed module update to the Canadian Stroke Best Practices Advisory Committee.
7. Internal review of proposed module update, feedback to writing group, and completion of edits.
8. External review, and final edits based on feedback.
9. Update of educational materials and implementation resources.
10. Final approvals, endorsement and translation of module.
11. Public release and dissemination of final updated module.
12. Continue with ongoing review and update process.

The detailed methodology and explanations for each of these steps in the development and dissemination of the *Canadian Stroke Best Practice Recommendations* is available in the *Canadian Stroke Best Practice Recommendations Overview and Methodology* manual available on the Canadian stroke best practices website at [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/CSBPR2014\\_Overview\\_Methodology\\_ENG.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/CSBPR2014_Overview_Methodology_ENG.pdf)

Conflicts of Interest: All potential participants in the recommendation development and review process are required to sign confidentiality agreements and to declare all actual and potential conflicts of



interest in writing. Any conflicts of interest that are declared are reviewed by the Chairs of the Advisory committee and appropriate HSF staff members for their potential impact. Potential members of any writing group who have conflicts that are considered to be significant are not selected for advisory or writing group membership.

**Assigning Evidence Levels:** The writing group was provided with comprehensive evidence tables that include summaries of all high quality evidence identified through structured literature searches. The writing group discusses and debates the value of the evidence and through consensus develops a final set of proposed recommendations. Through their discussions, additional research may be identified and added to the evidence tables if consensus on the value of the research is achieved. All recommendations are assigned a level of evidence ranging from A to C, according to the criteria defined in Table 1 (below). When developing and including “C-Level” recommendations, consensus is obtained among the writing group and validated through the internal and external review process. “C-level” evidence is used cautiously, and only when there is a lack of stronger evidence for topics that are agreed to be important system drivers for stroke care (e.g., transport using ambulance services or some screening practices). Recommendations with “C-level” evidence may also be made in response to requests from healthcare professionals who seek guidance and direction from national stroke experts in *the absence* of strong evidence regarding certain topics that are of high clinical importance.

As noted earlier, some therapies and management strategies included in this rehabilitation module of the CSBPR have evidence only for specific time periods. In consideration of these realities, some of the recommendations provided in this module may have two different levels of evidence accompanying them.

We have grouped the evidence into two categories to better reflect what is known at this time and provide more specific guidance to clinicians:

- ‘**Early**’ stages of rehabilitation describes the strength of research evidence for a given therapy tested in patients from stroke occurrence through the first 6 months post-stroke;
- ‘**Late**’ stages of rehabilitation describe the strength of research evidence for a given therapy tested in patients beyond the first 6 months following an index stroke.

**Table 1: Summary of Criteria for Levels of Evidence Reported in the *Canadian Best Practice Recommendations for Stroke Care (Update 2014)***

Level of Evidence	Criteria*
<b>A</b>	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 vice versa.
<b>B</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 vice versa.
<b>C</b>	Writing group consensus and/or supported by limited research evidence. Desirable effects outweigh or are closely balanced with undesirable effects or vice versa, as determined by writing group consensus.

\* (adapted from Guyatt et al. 2008) [12]



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## Citing the Stroke Rehabilitation 2015 Module

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## Comments

We invite comments, suggestions, and inquiries on the development and application of the *Canadian Stroke Best Practice Recommendations*.

Please forward comments to the Heart and Stroke Foundation's Stroke Team at [strokebestpractices@hsf.ca](mailto:strokebestpractices@hsf.ca)

## Canadian Stroke Best Practice Recommendations

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## Canadian Stroke Best Practice Recommendations

### STROKE REHABILITATION

## Section Two: RECOMMENDATIONS

### A. Organization of a Stroke Rehabilitation System for Optimal Service Delivery

#### 1. Initial Stroke Rehabilitation Assessment

Stroke Rehabilitation	1. Initial Stroke Rehabilitation Assessment
<b>Update 2015</b>	
All patients with acute stroke should be assessed to determine the severity of stroke and early rehabilitation needs.	
<ul style="list-style-type: none"> <li>i. All patients <b>admitted to hospital</b> with acute stroke should have an initial assessment, conducted by rehabilitation professionals, as soon as possible after admission [Evidence Level A]. <ul style="list-style-type: none"> <li>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].</li> <li>b. Additional team members may include recreation therapists, psychologists, vocational therapists, educational therapists, kinesiologists, and rehabilitation therapy assistants [Evidence level C].</li> <li>c. All professional members of the rehabilitation team should have specialized training in stroke care and recovery [Evidence Level C].</li> <li>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].</li> </ul> </li> <li>ii. Initial screening and assessment should be commenced within 48 hours of admission by rehabilitation professionals in direct contact with the patient [Evidence Level C]. <ul style="list-style-type: none"> <li>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].</li> <li>b. Issues related to transition planning should be considered during the initial assessment [Evidence Level C].</li> </ul> </li> <li>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]. <i>Refer to Appendix, Table 1: Stroke Rehabilitation Screening and Assessment Tools.</i></li> <li>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].</li> <li>v. All patients who present with acute stroke or TIA who are <b>not admitted to hospital</b> should be screened for the need to undergo a comprehensive rehabilitation assessment to determine the</li> </ul>	

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 *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 centres and services [Evidence Level C]. *Refer to Box One for key elements of rehabilitation admission criteria.*

## BOX ONE: Eligibility and Admission Criteria for Stroke Rehabilitation

### DETERMINING IF A PATIENT IS A CANDIDATE FOR REHABILITATION

*The following criterion has been developed as part of the Canadian Stroke Best Practice Recommendations 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.*

### 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 in 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 behavioural 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.

#### **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.

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#### **Characteristics to Consider in Planning Rehabilitation of Stroke Patients**

##### **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 hours).
- 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 early supported discharge (ESD) program and criteria for patient appropriateness for ESD.

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**Notes about Pediatric Stroke Rehabilitation:**

**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 or cerebral sinovenous thrombosis hemorrhagic stroke (diagnosed acutely at stroke and hospitalized at acute care hospital);
- neonates (term birth to 1 month age) with acutely diagnosed arterial ischemic stroke or cerebral sinovenous thrombosis hemorrhagic stroke (diagnosed acutely as stroke and hospitalized at acute care hospital);
- presumed pre-perinatal ischemic stroke (PPIS) with diagnosis in later infancy and congenital hemiparesis (usually diagnosed as out-patient rarely admitted to hospital).

**Considerations in Planning for Stroke Rehabilitation in Children:**

- The full impact of a stroke in a child may not be known for years as the child grows and matures, and 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.
- 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 patients) or acquired brain injury rehabilitation programs (older children).

- Rehabilitation goals are similar to adults with stroke; and they also include additional goals such as educational and vocational rehabilitation, re-integration into play roles, growth and development, and developmental psychology.
- The child with stroke may 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 and harnessing the increased plasticity.
- 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.
- The focus in rehabilitation of children with stroke is more often on developing 'new' skills rather than relearning.
- Pediatric stroke 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).

### Rationale

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. Early consultation with rehabilitation professionals enhances the process of discharge planning, whether patients are going to transition from acute care to specialized rehabilitation units or back to the community.

### System Implications

To ensure patients receive timely stroke rehabilitation assessments, the acute care, rehabilitation, and community organizations require:

- An adequate complement of clinicians experienced in stroke and stroke rehabilitation.
- A clear process referral of patients to rehabilitation professionals and programs after acute admission.
- An interprofessional team that is resourced to provide prescribed levels of rehabilitation therapy.
- A defined geographic area or unit where individuals with stroke are assured access to an experienced team.
- Standardized, validated, and expert consensus-based screening assessment tools and training.
- A process for timely referral to specialized stroke inpatient services in all centres (for example, electronic referral system and standardized assessment tools).
- Access to a follow-up clinic for secondary stroke prevention to ensure assessment of mild stroke-related difficulties and referral to rehabilitation services and programs when deficits and issues are identified that is amenable to rehabilitation.
- Development or expansion of stroke rehabilitation expertise in children's hospitals and children's treatment centres, as needed; and integration of stroke rehabilitation needs into school supports.
- Mechanisms to periodically re-evaluate those patients with severe stroke who are admitted to nursing homes, continuing care, or other settings to ensure that they have access to rehabilitation as appropriate, if the patient progresses sufficiently and has goals amenable to rehabilitation.
- Coordination and development of strong partnerships in the community, and adequate resources to

ensure access to comprehensive stroke rehabilitation. This is especially important in more rural and remote geographic locations where telehealth technologies should be optimized.

### Performance Measures

1. Proportion of stroke patients with a rehabilitation assessment within 48 hours of hospital admission for acute stroke by at least one stroke rehabilitation specialist as appropriate to patient needs (core).
2. Median time from hospital admission for stroke to initial rehabilitation assessment for each of the rehabilitation disciplines (Target is within 48 hours of hospital admission).
3. Proportion of acute stroke patients discharged from acute care to inpatient rehabilitation (core).
4. Percentage of stroke patients discharged to the community who receive a referral for outpatient rehabilitation before discharge from acute and/or inpatient rehabilitation (either facility-based or community-based programs).
5. Median length of time between referral for outpatient rehabilitation and admission to a facility-based or community rehabilitation program.
6. Median length of time between referral for outpatient rehabilitation to commencement of therapy (Target is within 30 days).
7. Percentage of those patients with severe stroke reassessed for rehabilitation following initial assessment within one month, 3 months and six months of index stroke event.
8. Percentage of patients with severe stroke admitted to inpatient rehabilitation.
9. Percentage of Telehealth/Telestroke coverage to remote communities to support organized stroke care across the continuum, including providing rehabilitation assessments and therapies for stroke patients.

### Measurement Notes

- Referral information may be found through primary audit of inpatient charts (nurses' notes, discharge summary notes, copies of referral forms) or through databases maintained by organizations that receive and process referrals. These community databases will vary in the amount of information included, and there may be challenges in accessing information contained in these databases.
- Most home care organizations monitor when the first service started but cannot determine easily the onset of rehabilitation therapy.
- For Performance Measure 3, when analyzing these data consider also looking at appropriateness of referral and location of facility.
- Performance Measure 5, the timing being measured if from referral to acceptance into a program, and not specifically the start of therapy (Performance Measure 6 measures time to start of therapy).
- For Performance Measure 7, this reassessment should be done at all transition points and ideally at least monthly thereafter. This includes admission to complex care, long-term care or return to other community setting. The denominator will be a challenge and should be clearly identified and applied consistently by all groups who adopt this measure (e.g., denominator could be all severe stroke patients admitted to a long term care facility).

### Implementation Resources and Knowledge Transfer Tools

#### Health Care Provider Information

- Table 1: Stroke Rehabilitation Screening and Assessment Tools.
- Canadian Stroke Best Practices *Taking Action Towards Optimal Stroke Care*:  
[http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- FIM® Instrument: <http://www.strokengine.ca/assess/fim/>

- AlphaFIM® Instrument: [http://www.udsmr.org/WebModules/Alpha/Alp\\_About.aspx](http://www.udsmr.org/WebModules/Alpha/Alp_About.aspx)
- Modified Rankin Scale [http://strokengine.ca/assess/module\\_mrs\\_family-en.html](http://strokengine.ca/assess/module_mrs_family-en.html)
- Evidence-Based Review of Stroke Rehabilitation (Triage Module):  
[http://www.ebrsr.com/sites/default/files/Chapter4\\_Triage\\_FINAL\\_16ed.pdf](http://www.ebrsr.com/sites/default/files/Chapter4_Triage_FINAL_16ed.pdf)
- The Certificate of Stroke Rehabilitation Program, University of Alberta Department Rehabilitation Medicine  
<http://www.rehabilitation.ualberta.ca/ContinuingProfessionalEducation/CertificateinStrokeRehabilitation.aspx>
- Ryerson University Interprofessional Certificate in Advanced Neuroscience-Stroke Care  
<http://ce-online.ryerson.ca/ce/default.aspx?id=2873>
- Aphasia United Best Practice Recommendations: <http://www.shrs.uq.edu.au/best-practice-recommendations>
- Australian Aphasia Rehabilitation Pathway: <http://www.aphasiapathway.com.au/?name=About-the-statements>
- Aphasia Institute: <http://www.aphasia.ca/home-page/health-care-professionals/>

### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://www.strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery, <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)

### Summary of the Evidence

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 (Evans et al., 2002). 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 World Health Organization's International Classification of Functioning (ICF) model is commonly used by rehabilitation professionals to guide assessment and treatment of stroke patients in the acute and post-acute phases of care (World Health Organization, 2010). The ICF considers three perspectives: the body, the individual and societal perspectives. It also includes the two components of *body function and structure* and *activity and participation*, all within the context of one's *environment*. Early rehabilitation assessments for stroke, as well as goal setting and treatment planning, should incorporate aspects of the ICF model during the short and long term recovery of stroke patients (Ustun et al., 2013; Miller et al., 2010).

**Definition of functional assessment:** Standardized or non-standardized method of evaluating a person's ability to perform basic self-care activities (such as dressing, grooming, personal hygiene, feeding, functional mobility and communication) and instrumental activities of daily living (including meal preparation, home management, communication activities, financial management, shopping and community living skills). Ability to interact socially may also be a component of a functional assessment.

**Benefits of early stroke rehabilitation assessment:** A screening examination for rehabilitation should be performed by a person experienced in rehabilitation as soon as the patient's medical and neurological condition permits (Gresham et al., 1995). The screening examination should incorporate medical information, a neurological examination, use of a well-standardized disability instrument (e.g., activities of daily living), and a mental status-screening test. Asberg and Nydevik suggest that the optimal timing for stroke rehabilitation assessment is five to seven days post-stroke onset (Asberg and Nydevik, 1991), although recent trends have been towards completing this within 72 hours of stroke onset.

Threshold criteria for admission to a comprehensive rehabilitation program should include medical stability, the presence of a functional deficit, the ability to learn, and physical endurance to sit unsupported for at least one hour and to participate actively in rehabilitation (Gresham et al., 1995). Admission to an interprofessional program should be limited to patients who have more than one type of disability and who, therefore, require the services of two or more rehabilitation disciplines. Patients with a single disability can benefit from individual services, but generally, do not require an interprofessional program (Gresham et al., 1995).

Several studies have demonstrated the positive benefit of rehabilitation as soon as possible following stroke. Reviews by Cifu & Stewart (1999) and Ottenbacher & Jannell (1993) reported a positive correlation between early rehabilitation interventions and improved functional outcomes. However, it is not evident whether the relationship is causal. One prospective comparative trial by Paolucci et al. (2000) looked at the outcomes of stroke patients admitted to rehabilitation at differing times following stroke. They found that those stroke patients who received rehabilitation early did better functionally than those whose rehabilitation was delayed.

Interprofessional rehabilitation has also been demonstrated to be an integral component for optimal stroke recovery. Specialized nursing care promotes early recognition of complications and management of skin, bowel and bladder problems. Research suggests that physical therapy will promote better recovery through early mobilization of the patient and management of any lung problems caused by immobility. Occupational therapists focus on improving activities that are meaningful to the patient (self-care, productivity and leisure activities) by reducing stroke-related impairments. Assessment of patient's discharge environment addresses suitability for discharge home, need for equipment and/or home modification for function and safety. Speech-language pathologists assess swallowing difficulties and provide swallowing therapy and compensatory techniques. The speech-language pathologist is also able to assess the degree of difficulty with communication, and initiate appropriate therapy. Augmentative or alternative communication devices may be introduced if necessary. Medical specialists in physical medicine and rehabilitation address complications such as pain, spasticity (increased resistance in the muscles), and bowel and bladder incontinence. Neuropsychology, social work and other allied health professionals may help with the cognitive and psychosocial sequelae of stroke (Consensus Panel on the Stroke Rehabilitation System to the Ministry of Health and Long-Term Care, 2007).

Ongoing assessment of patients is an important component of stroke care, and the initial severity of impairment has been consistently demonstrated to have a relationship with one's ability to functionally recover (Ween et al. 1996). Interpretation of early rehabilitation assessments relies on the use of standardized assessment tools. In Canada, the FIM® Instrument is widely used within inpatient rehabilitation settings, with the AlphaFIM® Instrument becoming increasing predominant as an acute assessment tool (Oczkowski & Barreca, 1993); it serves to measure a patient's functional status and track recovery over time (Lo et al. 2012). Ween et al. (1996) prospectively analyzed 536 consecutive stroke rehabilitation admissions to try and identify the influence of preselected factors on functional improvement and discharge destination. Nearly all patients with an admission FIM® above 80 went home following

rehabilitation. It was recommended that patients with early functional independence measure (FIM®) scores greater than 80 (the mildly disabled) are best managed at home given appropriate supports are in place. Conversely, patients admitted to rehabilitation with a FIM® score of less than 40 almost always required long-term care in a nursing home facility. It was recommended that those with FIM® scores less than 40 (the more severely disabled) may be better suited to a slower paced or less intensive rehab facility, or a discharge decision should be postponed at the time of initial assessment and reassessed weekly. An admission score of 60 or more was associated with a larger FIM® improvement, but the absence of a committed caregiver at home increased the risk of nursing home discharge. Therefore, it was recommended that intensive rehabilitation units are most likely to be effective with moderately severe stroke patients with early FIM® scores between 40 and 80. These patients are generally able to participate fully, show substantial improvement during rehabilitation and have a high probability of discharge home (Alexander, 1994). A study by Lo et al. (2012) was able to demonstrate the usefulness of the AlphaFIM® Instrument, an abbreviation of the FIM® for use in acute care, as an assessment tool in predicting stroke rehabilitation outcomes in terms of functional ability to recover. The AlphaFIM® instrument was found to be significantly correlated with admission and discharge FIM® ratings at rehabilitation, but a weak correlation with FIM® gain and length of stay was reported as well as no association with FIM® efficiency.

A number of other factors have been demonstrated to correlate with the ability to make functional improvements following a stroke. Age had been shown have a strong relationship with functional recovery in a number of individual studies and systematic reviews (Ween et al., 1996; Hakkennes et al., 2011; Ones et al., 2009; Van Bragt et al. 2014; Ng et al. 2013). Other factors such as stroke type and location (Ween et al., 1996; Hakkennes et al., 2011; Ng et al. 2013), stroke severity (Van Bragt et al. 2014; Abdul-Sattar & Godab 2013), the presence of comorbidities (Ween et al., 1996), level of cognitive function (Hakkennes et al., 2011; Ones et al., 2009; Toglia et al., 2011; Abdul-Sattar & Godab 2013), and the presence of aphasia and communication deficits (Gialanella, 2011) have also shown to affect functional recovery. The presence of depressive symptoms (Gillen et al., 2001; Abdul-Sattar & Godab 2013), obesity (Kalichman et al., 2007) and a lower functional score upon admission (Van Bragt et al. 2014; Abdul-Sattar & Godab 2013) may negatively impact the recovery process. These factors may all be considered when determining candidacy for both inpatient and outpatient stroke rehabilitation.

[Link to Evidence Table and References for Section 1](#)



## 2. Stroke Rehabilitation Unit Care

### Stroke Rehabilitation

### 2. Stroke Rehabilitation Unit Care

**Update 2015**

#### 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].  
*Refer to Recommendation 6.4 for additional information.*
  - 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].  
*Refer to Recommendations 6.1 and 6.2 for additional information.*
  - i. 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, with the addition of educators and child-life workers [Evidence Level B].
  - j. All team members should be trained and capable of interacting with people with communication limitations such as aphasia, by using supported conversation techniques [Evidence Level C].
- ii. 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)*

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 hours 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. *Refer to Appendix, Table 1: Stroke Rehabilitation Screening and Assessment Tools.*

### Rationale

There is strong and compelling evidence in favour of admitting patients with moderate and severe stroke to a geographically defined stroke rehabilitation unit staffed by an interprofessional team. Death and disability are reduced when post-acute stroke patients receive coordinated, interprofessional evaluation and intervention on a stroke rehabilitation unit. For every 100 patients receiving organized inpatient interprofessional rehabilitation, an extra five return home in an independent state (Stroke Unit Trialists' Collaboration, 1997).

### System Implications

To ensure patients receive best practice stroke rehabilitation care, health systems funders and organizations must plan for:

- Timely access to specialized inpatient stroke rehabilitation services.
- An adequate number of geographically defined stroke rehabilitation units with a critical mass of trained staff with expertise in stroke rehabilitation; interprofessional team care during the rehabilitation period following stroke.
- Resources to enable patient access to appropriate type and intensity of rehabilitation professionals throughout their stay (including weekends when required).
- Protocols and strategies to prevent complications and the recurrence of stroke developed and communicated to all staff.
- System and process changes to allow therapists to ensure effective therapist to patient ratios in rehabilitation settings, with the goal of therapists spending approximately 80% of their time providing direct care to patients.

### Performance Measures

1. Number of stroke patients treated in a geographically defined stroke rehabilitation unit at any time during their inpatient rehabilitation phase following an acute stroke event (core).
2. Final discharge disposition for stroke patients following inpatient rehabilitation: percentage discharged to their original place of residence; percentage discharged to a long-term care facility or nursing home; percentage requiring readmission to an acute care hospital for stroke-related causes; percentage of patients discharged back to the community who were residing in a community setting prior to their stroke (core).
3. Number of stroke patients assessed by a physiotherapist, occupational therapist, speech–language pathologist, dietitian, and social workers during inpatient rehabilitation.
4. Proportion of total time during inpatient rehabilitation following an acute stroke event that is spent on a stroke rehabilitation unit.

5. Frequency, duration and intensity of therapies received from rehabilitation professionals while in an inpatient rehabilitation setting following stroke.
6. Change in functional status measured with a standardized measurement tool, from time of admission to an inpatient rehabilitation unit for stroke patients to the time of discharge.

#### Measurement Notes

- Performance measure 1: The denominator should be the total number of stroke patients admitted to inpatient rehabilitation.
- Performance measure 2: Data should be correlated with stroke severity scores during analysis.
- To determine the duration and intensity of services by rehabilitation professionals, a chart review is required or the availability of consistent use of reliable workload measurement tools that are implemented locally or regionally.

### Implementation Resources and Knowledge Transfer Tools

#### Health Care Provider Information

- Canadian Stroke Best Practices *Taking Action Towards Optimal Stroke Care*:  
[http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- FIM® Instrument: <http://www.stroking.ca/assess/fim/>
- AlphaFIM® Instrument: [http://www.udsmr.org/WebModules/Alpha/Alp\\_About.aspx](http://www.udsmr.org/WebModules/Alpha/Alp_About.aspx)
- Modified Rankin Scale: [http://stroking.ca/assess/module\\_mrs\\_family-en.html](http://stroking.ca/assess/module_mrs_family-en.html)
- Evidence-Based Review of Stroke Rehabilitation (Triage Module):  
[http://www.ebrsr.com/sites/default/files/Chapter4\\_Triage\\_FINAL\\_16ed.pdf](http://www.ebrsr.com/sites/default/files/Chapter4_Triage_FINAL_16ed.pdf)
- The Certificate of Stroke Rehabilitation Program, University of Alberta Department Rehabilitation Medicine:  
<http://www.rehabilitation.ualberta.ca/ContinuingProfessionalEducation/CertificateinStrokeRehabilitation.aspx>
- Ryerson University Interprofessional Certificate in Advanced Neuroscience-Stroke Care  
<http://ce-online.ryerson.ca/ce/default.aspx?id=2873>
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.
- Aphasia United Best Practice Recommendations: <http://www.shrs.uq.edu.au/best-practice-recommendations>
- Australian Aphasia Rehabilitation Pathway: <http://www.aphasiapathway.com.au/?name=About-the-statements>
- Aphasia Institute: <http://www.aphasia.ca/home-page/health-care-professionals/>

#### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery:  
[http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory:  
[http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.97294](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.97294)

[6853.1415208838](#)

- Aphasia Institute: <http://www.aphasia.ca/people-with-aphasia-and-families/>
- Stroke Engine: <http://www.strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery, <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)

## Summary of the Evidence

The benefits of stroke unit care are substantial, both in terms of improving activities of daily living and reducing disabilities (Zhang et al. 2014). 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 (Stroke Unit Trialists' Collaboration, 2013; Foley et al., 2007). 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 (Stroke Unit Trialists' Collaboration, 2013; Foley et al. 2013; Zhang et al. 2014; Saposnik et al. 2011), and often within a geographically defined space (Langhorne & Pollock, 2002). Stroke units also typically include staff members who have a specialist interest in stroke, participate in routine team meetings and continuing education/training, and involve caregivers in the rehabilitation process (Langhorne & Pollock, 2002). In addition to professional services rendered, it is encouraged that patients and their caregivers alike engage in early active involvement in the rehabilitation process (Scottish Intercollegiate Guidelines Network, 2010).

The Stroke Unit Trialists' Collaboration identified 28 randomized and quasi-randomized trials (n=5,855) comparing stroke unit care with an alternative, less organized form of care (e.g., general medical ward) (Stroke Unit Trialists' Collaboration, 2013). At a median one-year follow-up, stroke unit care was associated with a significant reduction in death (OR=0.76, 95% CI 0.66 to 0.88, p=0.0001), death or institutionalization (OR=0.76, 95% CI 0.67 to 0.86, p=0.0001), and death or dependency (OR=0.80, 95% CI 0.67 to 0.97, p<0.0001), as compared to an alternative form of care. Moreover, stroke unit care was found to be beneficial regardless of sex, age, or stroke severity, with benefits maintained in follow-up studies 5-10 years post-stroke (Stroke Unit Trialists' Collaboration, 2013).

Seenan and colleagues identified 25 (n=42,236) observational studies to explore the benefits of stroke unit care in clinical practice (Seenan et al., 2007). As in pooled analyses of clinical trials, stroke unit care provided in clinical practice was found to be associated with a significant reduction in the odds of death (odds ratio=0.79, 95% CI=0.73 to 0.86; p<0.001) and of death or poor outcome (odds ratio=0.87, 95% CI=0.80 to 0.95; p=0.002; I<sup>2</sup>=45.5%) within one-year of stroke. Similar findings were reported for a secondary analysis limited to multi-centered trials (OR=0.82, 95% CI 0.77 to 0.87, p<0.001; I<sup>2</sup>=0%) (Seenan et al., 2007).

In another systematic review and meta-analysis, Foley and colleagues identified 14 trials comparing stroke unit care to conventional care (Foley et al., 2007). Included studies were categorized on the basis of the model of care provided (i.e., acute care, combined acute/rehabilitation, or rehabilitation). Based on the pooled results of 5 studies, post-acute rehabilitation stroke units were found to be associated with reduced odds of death (OR=0.60, 95% CI 0.44 to 0.81, p<0.05) and death or dependency (OR=0.63, 95% CI 0.48 to 0.83, p<0.05). Similar findings were reported with respect to combined acute/rehabilitation stroke units (death: OR=0.71, 95% CI 0.54 to 0.94; death/dependency: OR=0.50, 95% CI 0.39 to 0.65). Although Foley et al. (2007) reported that stroke rehabilitation units do not have a significant impact on length of stay (weighted mean difference=-13.2, 95% CI -48.3 to 21.9, p>0.05), there is evidence that patients with moderately severe strokes treated in stroke rehabilitation units are more likely to be discharged home (75% v. 52%, p<0.001) and are less likely to require institutionalization (22% vs. 44%, p<0.001) (Kalra et al. 1993).

[Link to Evidence Table and References for Section 2](#)

### 3. Delivery of Inpatient Stroke Rehabilitation

Stroke Rehabilitation Update 2015	3. Delivery of Inpatient Stroke Rehabilitation
<ul style="list-style-type: none"> <li>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].</li> <li>ii. Frequent, out-of-bed activity in the very early time frame (within 24 hours 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]. <ul style="list-style-type: none"> <li>a. All patients admitted to hospital with acute stroke should start to be mobilized early (between 24 hours and 48 hours of stroke onset) if there are no contraindications [Evidence Level B].</li> <li>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.</li> </ul> </li> <li>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].</li> <li>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].</li> <li>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].</li> <li>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].</li> <li>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].</li> <li>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].</li> <li>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].</li> <li>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: <ul style="list-style-type: none"> <li>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].</li> <li>b. Assessment of the safety of the patient's home environment and the need for equipment and home modification [Evidence Level C].</li> <li>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].</li> <li>d. Patients and families should be introduced to resources which will enable self-</li> </ul> </li> </ul>	

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].

## Rationale

In order to obtain maximum benefit from inpatient stroke rehabilitation, a number of essential elements are required. These elements include adequate intensity of therapy, task-oriented training, excellent team coordination and early discharge planning. Both animal and human research suggests that the earlier rehabilitation starts, the better the outcome. Early, intensive rehabilitation care for patients in both the acute and subacute stage of stroke helps to improve arm and leg motor recovery, language and communication function, which in turn improves mobility, independence in self-care and participation in leisure activities. It is important that the rehabilitation therapies be tailored to the tasks that need to be retrained and developed, as well as to the activities of the patient's choice and to their social roles. The need for a highly-coordinated, specialized team, who meet regularly to discuss the rehabilitation goals and progress, is also vital. Early discharge planning, including a home assessment and caregiver training, support and education, is required to identify and remove potential barriers to discharge and facilitate efficient transition back to the community.

## System Implications

Working together to achieve optimal functional outcomes after stroke requires the health system and organizations to ensure:

- Timely access to specialized, interprofessional stroke rehabilitation services, regardless of geographic location of the patients' home community and the patient's financial means.
- A critical mass of trained healthcare providers functioning as a coordinated interprofessional team during the rehabilitation period following stroke.
- Adequate clinician resources to provide the recommended intensity of individualized therapies for stroke patients. Current estimates suggest the ratio of patients to therapists should be no more than 6:1 in order to achieve these targets.
- Establishment of protocols and partnerships between inpatient rehabilitation and community care providers to ensure safe and efficient transitions between hospital and community. Particular considerations should be made for patients residing in more rural or remote locations.
- Communication strategies to facilitate the sharing of all information concerning the patient, including assessments, rehabilitation goals and results between healthcare providers and settings.
- Access to all stroke rehabilitation services for patients who have communication limitations such as aphasia.
- Optimization of strategies to prevent the recurrence of stroke through health promotion and education.
- Stroke rehabilitation support initiatives for caregivers to increase patient/caregiver understanding of rehabilitation plans and improve adherence.
- Processes for patients and caregivers to re-access the rehabilitation system as required. Financial barriers should not limit access to rehabilitation services.
- All rehabilitation hospital services have mechanisms established to contribute to the CIHI National Rehabilitation Reporting System.



Performance Measures
<ol style="list-style-type: none"> <li>1. Median length of time from stroke admission to an acute care hospital to assessment of rehabilitation potential by a rehabilitation healthcare professional.</li> <li>2. Median length of time from stroke onset to stroke rehabilitation referral.</li> <li>3. Median length of time from stroke rehabilitation referral to and admission to stroke inpatient rehabilitation.</li> <li>4. Percentage of stroke patients who are discharged from acute care without rehabilitation referrals in place.</li> <li>5. Number or percentage of patients admitted to a stroke unit — either a combined acute care and rehabilitation unit or a rehabilitation stroke unit in an inpatient rehabilitation facility — at any time during their hospital stay (acute and/or rehabilitation) (core).</li> <li>6. Final discharge disposition for stroke patients following inpatient rehabilitation: percentage discharged to their original place of residence, percentage discharged to a long-term care facility or nursing home, percentage discharged to supportive housing or assisted living (core).</li> <li>7. Percentage of patients requiring readmission to an acute care hospital for stroke-related causes (core).</li> <li>8. Median length of time spent on a stroke rehabilitation unit during inpatient rehabilitation.</li> <li>9. Average number of days spent in <u>active</u> rehabilitation (i.e., length of stay less days unable to participate due to service interruptions, such as illness or short-term readmission to acute care).</li> <li>10. Median number of days spent waiting for transfer to an inpatient rehabilitation setting (i.e. from the time a patient is ready for rehabilitation to the time of admission to inpatient rehabilitation).</li> <li>11. Change (improvement) in functional status scores using a standardized assessment tool from admission to an inpatient rehabilitation program to discharge (e.g., FIM® Instrument, AlphaFIM®, Modified Rankin Scale).</li> <li>12. Median number of hours of direct therapy for each type of service received while in inpatient rehabilitation.</li> <li>13. Total number of days spent in inpatient rehabilitation, by stroke type.</li> <li>14. Number of patients screened for cognitive impairment using valid screening tool during inpatient rehabilitation.</li> <li>15. Number of patients screened for depression using valid screening tool during inpatient rehabilitation.</li> <li>16. Time from stroke onset to mobilization: sitting, standing upright, and walking with or without assistance.</li> <li>17. Time from stroke onset to independence in feeding, dressing, grooming, toileting and bathing and other self-care.</li> <li>18. Median number of days spent in alternate level of care or inpatient rehabilitation while waiting for return to home or placement in a residential or long-term care setting.</li> </ol>
<p>Measurement notes</p> <ul style="list-style-type: none"> <li>• Some acute care hospitals provide combined acute and rehabilitation stroke units, where patients progress to being ready to start rehabilitation, and may not actually move beds, or change locations. This information could be found in patient records through primary chart audit.</li> <li>• Many performance measures require primary chart audit of inpatient rehabilitation records. Quality of documentation (good or poor) by rehabilitation staff will impact validity of these measures.</li> <li>• The Canadian Institute for Health Information has a database known as the National Rehabilitation Reporting System. This database includes data on inpatient rehabilitation encounters to designated rehabilitation beds. It is mandated in some provinces to submit data to the National Rehabilitation Reporting System; in other provinces, it is optional. The National Rehabilitation Reporting System (NRS) has information on an estimated 80% of all inpatient rehabilitation encounters in Canada and can distinguish stroke cases from other rehabilitation patients by diagnosis.</li> <li>• Duration or intensity of services by rehabilitation professionals requires a chart review or</li> </ul>



consistent use of reliable workload measurement tools implemented locally or regionally.

- For performance measure 2, efforts should be made to collect information on reasons for delay, if any, in admission to inpatient rehabilitation from acute care. These may include such issues as bed availability, patient health status and other aspects of the referral and transfer process. This information may provide direction on areas to target quality improvement initiatives.
- Workload measurement systems are a key source of data and information on intensity and frequency of services, but these are not consistently or widely implemented in Canada. Use of such systems should be encouraged in addition to the NRS.
- Performance measures 8 and 9 can be combined to calculate a FIM® efficiency value: Change in FIM® score from admission to discharge/total days in stroke rehabilitation.

## Implementation Resources and Knowledge Transfer Tools

### Health Care Provider Information

- Canadian Stroke Best Practices *Taking Action Towards Optimal Stroke Care*: [http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- FIM® Instrument: <http://www.strokengine.ca/assess/fim/>
- AlphaFIM® Instrument: [http://www.udsmr.org/WebModules/Alpha/Alp\\_About.aspx](http://www.udsmr.org/WebModules/Alpha/Alp_About.aspx)
- Modified Rankin Scale: [http://strokengine.ca/assess/module\\_mrs\\_family-en.html](http://strokengine.ca/assess/module_mrs_family-en.html)
- Evidence-Based Review of Stroke Rehabilitation (Triage Module): [http://www.ebrsr.com/sites/default/files/Chapter4\\_Triage\\_FINAL\\_16ed.pdf](http://www.ebrsr.com/sites/default/files/Chapter4_Triage_FINAL_16ed.pdf)
- The Certificate of Stroke Rehabilitation Program, University of Alberta Department Rehabilitation Medicine: <http://www.rehabilitation.ualberta.ca/ContinuingProfessionalEducation/CertificateinStrokeRehabilitation.aspx>
- Ryerson University Interprofessional Certificate in Advanced Neuroscience-Stroke Care <http://ce-online.ryerson.ca/ce/default.aspx?id=2873>
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.
- Stroke Engine: <http://strokengine.ca/>

### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://www.strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery, <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: <http://www.strokebestpractices.ca/wp->

[content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](#)

## Summary of the Evidence

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. In particular, the establishment of stroke units as the optimal organization of care for patients in the acute and rehabilitation phases post stroke has garnered evidence for the importance of these factors in delivery of inpatient rehabilitation. A Cochrane systematic review and meta-analysis (Stroke Trialists' Collaboration, 2013) included a total of 28 RCTs and quasi-randomized trials and compared stroke patients who received organized stroke unit care to those who received an alternative, less organized service. Patients receiving organized care benefited from this service in terms of being more likely to be alive, independent and living at home 1 year after stroke compared to patients receiving less organized care. The specifics of a stroke unit vary between sites, but are typified by a multidisciplinary team of stroke specialists that offer comprehensive and intensive services to patients, often with the involvement of the caregiver. Organized and comprehensive inpatient stroke rehabilitation services were also found to be beneficial in an observational study by Woo and colleagues (Woo et al., 2008), who compared the functional outcomes at discharge for patients receiving care from one of three inpatient rehabilitation facilities. The authors found that the patients who received care from the facility that offered multidisciplinary services (including weekly team meetings between care providers) and discharge planning/support had greater functional improvements per day over the course of their care compared to patients receiving care from the other two facilities ( $P < 0.0001$ ) (Woo et al., 2008).

Early mobilization post stroke is thought to improve recovery. Findings from three pilot studies by the AVERT Trial Collaboration Group demonstrated positive outcomes for individuals receiving very early mobilization. However, the much anticipated findings from the final report by the AVERT Trial Collaboration Group (2015) appear to counter this notion. This large parallel-group, single-blind, randomized controlled trial spanning 56 acute stroke units in five countries randomized patients (aged  $\geq 18$  years) with ischemic or hemorrhagic stroke to very early mobilization (mean 18.5 hours post stroke) or usual care (mean 22.4 hours post stroke). Treatment with tissue plasminogen activator was allowed. The primary outcome was a favorable outcome 3 months post stroke defined as a Modified Rankin Scale score of 0–2. The authors reported that fewer patients in the very early mobilization group had a favorable outcome compared to those in the usual care group ( $n=480$  [46%] vs  $n=525$  [50%]; adjusted odds ratio [OR] 0.73,  $p=0.004$ ). Overall, 8% and 7% patients died in the very early mobilization versus usual care group, respectively (OR 1.34,  $p=0.113$ ). Approximately 19% of patients in the very early mobilization group and 20% of those in the usual care group had a non-fatal serious adverse event, with no reduction in immobility-related complications with very early mobilization. Despite that early mobilization after stroke is recommended in many clinical practice guidelines worldwide, the findings from the AVERT trial demonstrate that it may be associated with a reduction in favourable outcomes and challenge this pre-existing notion.

Adequate intensity is another important element of successful inpatient rehabilitation interventions. An early review of the effects of intensive rehabilitation interventions on patient outcomes was completed by Kwakkel and colleagues in 1997 (Kwakkel et al., 1997). This review found positive effects, albeit small effects, of increased rehabilitation frequency on patient outcomes. Several studies since then have found a similar positive relationship between therapy intensity and patient outcomes (Wang et al., 2013; Horn et al., 2005; Foley et al., 2012); two retrospective cohort studies (Wang et al., 2013; Foley et al., 2012) and one prospective cohort study (Horn et al., 2005). Wang and colleagues assessed a cohort of 360 patients with stroke who were discharged from an inpatient rehabilitation facility and found that more than 3 hours of total combined therapy time from a physiotherapist (PT), occupational therapist (OT) and speech language pathologist (SLP) was associated with improved functional outcomes when compared to patients receiving less than 3 hours of therapy (Wang et al., 2013). When therapy time was assessed separately for each type of specialist, there was variability in the type of FIM® gain (i.e. activities of daily living (ADL), motor, cognitive or total) (Wang et al., 2013). Foley et al (2012) found that total ( $P < 0.0001$ ) and average daily PT ( $P=0.005$ ) and OT ( $P < 0.0001$ ) therapy time was significantly correlated with total

FIM® gain (Foley et al., 2012). However, in the multivariate model, only total OT time and total FIM® at admission were significant predictors of total FIM® gain (Foley et al., 2012). The prospective study, a larger cohort consisting of 830 patients, found that more intensive therapy (based on number of minutes) and more intensive therapy in the early stages (first therapy session) was associated with greater discharge FIM® scores. These findings applied to patients with both moderate and severe strokes (Horn et al., 2005).

A narrative review by Cifu and Stewart (1999) summarizes the importance of timing, organization and intensity of rehabilitation interventions after stroke, as well the importance of type of rehabilitation provided (Cifu & Stewart, 1999). Their review of 8 studies related to type of rehabilitation suggested that there is some evidence, although weak, for task specific therapy compared to general therapy in improving functional outcomes post stroke. A more recent systematic review by Legg and colleagues (2007) compiled literature assessing the effect of personal activities of daily living focused interventions for improvement in patient functioning (Legg et al., 2007). Findings from this study indicated that task focused therapy was effective in increasing patient independence (SMD 0.18; 95% CI 0.04 to 0.32;  $P=0.01$ ); studies assessing task specific interventions in the inpatient setting ( $n=4$ ) were excluded from this review (Legg et al., 2007). Evidence for task specific interventions in the inpatient rehabilitation setting are more limited, however, a pre-post study was conducted for a group based dressing retraining program in this setting by Christie and colleagues (Christie et al., 2011). From a sample of 119 patients admitted to an inpatient rehabilitation facility there were significant increases in upper and lower body dressing FIM® scores from admission to discharge ( $P=0.0001$ ). Task specific and impairment based walking interventions were compared to usual care provided by a physiotherapist. Compared to the usual care group, patients in the two intervention groups experienced gains in walking speed, walking frequency, stroke impact scale (SIS) participation, SIS mobility, SIS ADLs/Instrumental ADLs, Fugl-Meyer score and confidence in balance (Nadeau et al., 2013). A cohort study by Chan et al. (2013) evaluated the effect of type of rehabilitation site used post stroke on functional outcomes. Stroke patients receiving different forms of post-acute care were assessed for function using the Activity Measure for Post Acute Care (AM-PAC), which tests for basic mobility, daily activities and applied cognition. The patients received either no treatment, home health care, inpatient rehabilitation facility (IRF), or skilled nursing facility (SNF). Patients who went to an IRF scored higher on the AM-PAC across all three domains compared to patients who went to a SNF and across one domain (cognition) compared to patients who received home health care, indicating that including an IRF in post acute stroke care may be beneficial in terms of making functional gains. However, it should be noted that patients who participated in an IRF did not differ in AM-PAC scores when compared to patients who were receiving no treatment.

Patients and caregivers often struggle and feel overwhelmed with the transition home after inpatient rehabilitation (Gustafsson & Bootle, 2012). A recent Cochrane review including 24 studies aimed to assess the impact of discharge planning interventions on the use of acute care services, patient and carer outcomes, and health care costs during transition in recovery (Shepperd et al., 2013). Due to the heterogeneity between studies, not all studies were included in individual meta-analyses for each outcome. A reduced length of stay in hospital (MD -0.91; 95% CI -1.55 to -0.27), and a decreased risk of readmission to hospital (RR 0.82; 95% CI 0.73 to 0.92) was found for patients in the discharge planning group compared to control group in a subset of 10 and 12 trials respectively (Shepperd et al., 2013). A detailed review of the challenges that exist at the transition point between hospital and community offers further research on this topic, highlighting the importance of continuity of care, patient self-management, communication between care provider and patient, and ensuring appropriate up to date communication of a patient's medication regimen (Kripalani, Jackson, Schnipper, & Coleman, 2007). Recommended approaches to addressing these challenges include a pre-discharge planning meeting with the care team, patient and caregiver, the coordination of home visits, and implementing strategies to ensure patient educational resources and support are in place (Kripalani et al., 2007).

[Link to Evidence Table and References for Section 3](#)

## 4. Outpatient & Community Based Stroke Rehabilitation (including Early Supported Discharge)

### Stroke Rehabilitation

### 4. Outpatient & Community Based Rehabilitation

Update 2015

#### 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 hours of discharge from an acute hospital or within 72 hours 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 *BOX 1: Eligibility and Criteria for Stroke Rehabilitation* [Evidence Level B].

#### 4.2 Early Supported Discharge (ESD)

- i. Early supported discharge 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 hours of discharge from an acute hospital or within 72 hours 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]

### Rationale

Some patients with mild impairments can be safely transferred back to their homes to continue their rehabilitation and achieve outcomes that are as good as or better than those that would have been attained had they remained in hospital. This form of service provision, known as early-supported discharge (ESD) may be desirable where resources exist and may have the added benefit of being less costly.

Many patients who have completed a course of inpatient rehabilitation will still require ongoing therapy provided in the community to achieve their desired goals once discharged from hospital. Community-based rehabilitation may be defined as care received once the patient has passed the acute stage and has transitioned back to their home and community environment. In smaller communities and rural and remote settings, access to outpatient and/or community rehabilitation presents a significant challenge, and as such, innovative measures such as in-home therapy and telemedicine technology should be utilized.

The evidence suggests that community reintegration takes up to one year post-stroke and individuals make the most gains within the first 6 months post-stroke.

### System Implications

There is a marked lack of available outpatient and community-based rehabilitation resources. Therefore, the health system should aim to provide the following:

- Timely access to stroke rehabilitation services in the community following discharge.
- Organized and accessible stroke care in communities, including for patients with communication challenges.
- Increased numbers of skilled clinicians who have experience practicing in outpatient and community rehabilitation.
- Optimization of strategies to prevent the recurrence of stroke, including regular screening for stroke risk factors and use of standardized screening tools.
- Stroke rehabilitation support for caregivers to increase patient/caregiver understanding of rehabilitation plans and improve adherence.
- Long-term rehabilitation services widely available, and without financial barriers, in nursing and continuing care facilities, and in outpatient and community programs, including in-home visits.
- Increased use of telemedicine technologies to broaden access to outpatient rehabilitation services.
- Mechanisms for prospective data collection for evaluation and monitoring. All programs should have these in place or be developing them.

### Performance Measures

1. Percentage of stroke patients discharged to the community who receive a referral for ongoing rehabilitation before discharge from hospital (acute and/or inpatient rehabilitation) (core).
2. Median length of time between referral for outpatient rehabilitation to admission to a community rehabilitation program.



3. Frequency and duration of services provided by rehabilitation professionals in the community.
4. Magnitude of change in functional status scores, using a standardized measurement tool, for stroke survivors engaged in community rehabilitation programs.
5. Length of time between referral for ongoing outpatient/community rehabilitation to commencement of therapy.
6. Percentage of persons with a diagnosis of stroke who receive outpatient or community-based therapy following completion of a hospital admission to hospital for an acute stroke event.
7. Percentage of persons receiving ambulatory rehabilitation assessment, follow-up and treatment in all districts/sections/communities served by the stroke rehabilitation service/program. (This would include telehealth, clinic, in-home).
8. Number of stroke patients assessed by physiotherapy, occupational therapy, speech–language pathologists and social workers in the community.

Use of health services related to stroke care provided in the community for stroke rehabilitation, including timing and dose of services.

#### **Measurement notes**

- Many performance measures require targeted data collection through audits of rehabilitation records and community program records. Documentation quality may create concerns about data availability and data quality.
- For performance measure 3, information regarding frequency and duration of services by rehabilitation professionals requires a chart review or consistent use of reliable workload measurement tools that are implemented locally or regionally. This data should include the total number of visits or therapy sessions by discipline that the patient receives over a defined time frame (such as first 6 weeks post stroke) and the median length of each session.
- Data availability regarding community programs varies considerably across programs, regions and provinces. Efforts should be made to introduce standard audit tools for collection of these data.
- FIM® Instrument data is available in the National Rehabilitation Reporting System (NRS) database at the Canadian Institute of Health Information (CIHI) for participating organizations.

### **Implementation Resources and Knowledge Transfer Tools**

#### **Health Care Provider Information**

- Canadian Stroke Best Practices *Taking Action Towards Optimal Stroke Care*:  
[http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- FIM® Instrument: <http://www.strokengine.ca/assess/fim/>
- AlphaFIM® Instrument: [http://www.udsmr.org/WebModules/Alpha/Alp\\_About.aspx](http://www.udsmr.org/WebModules/Alpha/Alp_About.aspx)
- Chedoke-McMaster Stroke Assessment Scale:  
[http://strokengine.ca/assess/module\\_cmmsa\\_intro-en.html](http://strokengine.ca/assess/module_cmmsa_intro-en.html)
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.
- Evidence-Based Review of Outpatient Stroke Rehabilitation:  
[http://www.ebrsr.com/sites/default/files/Chapter7\\_Outpatients\\_FINAL\\_16ed.pdf](http://www.ebrsr.com/sites/default/files/Chapter7_Outpatients_FINAL_16ed.pdf)
- Reintegration to Normal Living Index: [http://strokengine.ca/assess/module\\_rnli\\_family-en.html](http://strokengine.ca/assess/module_rnli_family-en.html)
- Leisure section of the Assessment of Life Habits (LIFE-H):  
[http://strokengine.ca/assess/module\\_lifeh\\_family-en.html](http://strokengine.ca/assess/module_lifeh_family-en.html)
- Stroke Impact Scale: [http://strokengine.ca/assess/module\\_sis\\_family-en.html](http://strokengine.ca/assess/module_sis_family-en.html)
- Table 7.1, Screening and Assessment Tools for Post-Stroke Depression
- Fall Prevention Screening Tools: <http://www.albertahealthservices.ca/4354.asp>

### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://www.strokingengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery, <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)

### Summary of the Evidence

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, at the time of recruitment, were living at home prior to stroke and were within 1 year of stroke onset, to receive specialized outpatient therapy-based interventions or usual care (often no additional treatment). Service interventions examined included those that were outpatient based (home-based n=2, day hospital or outpatient clinic n=12). In these trials, provision of services included physiotherapy, occupational therapy services or interprofessional staff working with patients primarily to improve task-oriented behaviour and hence increase activity and participation. 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. The authors concluded that therapy-based rehabilitation services targeted toward stroke patients living at home appear to improve independence in personal activities of daily living. There is also some evidence that quality of life improves following outpatient rehabilitation. In a recent systematic review by Fens et al. (2013), the authors identified two trials that assessed quality of life and reported favourable effects associated with outpatient rehabilitation for up to 3 months post discharge home.

In studies that provided additional occupational therapy (OT) as a sole therapy to patients within 6 months of stroke who were living at home, the results from studies are mixed. Sackley et al. (2006) randomized 118 patients with moderate to severe stroke (Barthel Index [BI] scores of 4–15) who had been admitted to



12 nursing homes to receive a 3 month occupational therapy (OT) program that was client-centred and targeted towards independence in ADL, or to receive no OT. At 6 months, although there were no significant differences between groups in terms of improvement in BI or Rivermead Mobility Index scores, significantly fewer patients in the OT group had a poor global outcome (51% vs. 76%,  $p=0.03$ ), defined as deterioration of BI scores or death. In a trial that randomized 138 patients who planned to return home following discharge from hospital, to receive either 6 weeks of domiciliary OT or to receive routine post-stroke follow-up care, there were significantly improved outcomes for approximately half of the outcomes assessed. There were no significant differences at 6 months between groups for Nottingham EADL scores (primary outcome), BI or London Handicap scores. There were significant differences favouring the OT group for selected components of Canadian Occupational Performance Measure (COPM) and Dartmouth COOP Charts (Gilbertson et al. 2000, Gilbertson & Langhorne 2000). When 185 patients who had sustained a stroke within the previous 6 months and had not have been admitted to hospital received outpatient OT for up to five months, there were significantly greater improvements in Nottingham EADL scores at 6 months and one year, compared with patients in the control group who received usual care (Walker et al. 1999).

There is some evidence that patients who receive outpatient rehabilitation in their homes may have better short-term outcomes compared with those who received services in a day hospital or clinic setting. A systematic review and meta-analysis (Hillier & Inglis-Jassiem 2010) compiled the results from 11 RCTs that included patients who were discharged from inpatient rehabilitation to home following a stroke and who had been living in the community prior to the event. Home-based therapy was associated with a 1-point mean difference in BI gain at 6–8 weeks following the intervention and a 4-point difference at 3–6 months. By 6 months following treatment, there were no longer significant differences between groups. The majority of the trials that have examined the comparison between home and community-based and hospital-based rehabilitation programs have failed to identify the superiority of one service provision model over the other. The interventions most commonly assessed were physiotherapy and/or occupational therapy and the outcomes usually included scales of ADL or extended ADL performance, gait speed and/or quality of life (Young & Forester, 1992, Gladman et al. 1993, 1994, Lincoln et al. 2004, Bjorkdahl et al. 2006). In a trial evaluating the benefit of hospital vs. community-based physiotherapy for patients whose rehabilitation goals included independent ambulation, while patients in both groups had improved after a 7-week program, there were no differences between groups in gait speed or performance on the 6MWT (Lord et al. 2009).

There is also high-quality evidence that rehabilitation in the home or community is less costly than inpatient rehabilitation. In a recent systematic review and meta-analysis, Brusco et al. (2014) identified four studies ( $n=732$ ) comparing the cost of inpatient rehabilitation to that of home or community-based rehabilitation for patients with moderate to severe stroke. Based on these results, inpatient rehabilitation was found to be more costly, as compared to outpatient programs offered at home, with an overall effect size of 0.31 (95% CI 0.15–0.48) (Brusco et al. 2014).

### Early Supported Discharge

Early-supported discharge (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. It is intended as an alternative to a complete course of inpatient rehabilitation and is most suitable for patients recovering from mild to moderate stroke. An argument in favour of ESD programs is that, since the goal of rehabilitation is to establish skills that are appropriate to the home setting, the home provides the optimal rehabilitation environment. Key components of ESD that have been reported as contributing to favorable outcomes include: in-hospital and discharge planning; a case manager or 'key worker' based in the stroke unit who constituted the link between the stroke unit and the outpatient care, guaranteeing continuity in both time and personnel, and enabling the smooth transition from the hospital to the home.

Patients who are recovering from mild strokes and are recipients of ESD programs have been shown to achieve similar outcomes compared with patients who receive a course of inpatient rehabilitation. The effectiveness of ESD programs following acute stroke has been evaluated most comprehensively by the Early Supported Discharge Trialists. In the most updated version of the review (Fearon et al. 2012), the

results from 14 RCTs were included. The majority of the trials evaluated ESD using a multidisciplinary team which, coordinated discharge from hospital, and provided rehabilitation and patient care at home. 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,  $p=0.019$ ). The ESD groups showed significant reductions ( $p<0.0001$ ) in the length of hospital stay equivalent to approximately eight days. There were no significant differences between groups on the outcomes associated with patients' carers (subjective health status, mood or satisfaction with services).

Langhorne et al. (2005) reported additional patient level analysis from their original Cochrane review, which examined the effects of patient characteristics and differing levels of service provision (more coordinated v. less organized) on the outcome of death and dependency. The levels of service provision evaluated were: (1) early supported discharge team with coordination and delivery, whereby an interprofessional team coordinated discharge from hospital and post discharge care and provided rehabilitation therapies in the home; (2) early supported discharge team coordination, whereby discharge and immediate post-discharge plans were coordinated by an interprofessional care team, but rehabilitation therapies were provided by community-based agencies; and (3) no early supported discharge team coordination, whereby therapies were provided by uncoordinated community services or by healthcare volunteers. There was a reduction in the odds of a poor outcome for patients with a moderate initial stroke severity (BI 10-20), (OR= 0.73; 0.57-0.93), but not among patients with severe disability (BI< 9) and also among patients who received care from a coordinated multidisciplinary ESD team (0.70; 0.56- 0.88) compared to those without an ESD team. Based on the results of this study, it would appear that a select group of patients, with mild to moderately disabling stroke, receiving more coordinated ESD could achieve better outcomes compared to organized inpatient care on a stroke unit.

### Home Exercise Programs

The effectiveness of home-based exercise programs for mobility improvement was recently the subject of a Cochrane review (Coupar et al. 2012). The results from four RCTs ( $n=166$ ) examining home-based therapy program targeted at the upper limb were included. The effectiveness of therapy was compared with usual care in three studies (Duncan et al. 1998, 2003; Piron et al. 2009). The primary outcomes were performance on ADL and functional movement of the upper limb. The results were not significant for both outcomes (MD 2.85 95% CI -1.43–7.14 and MD 2.25 95% CI -0.24–4.73, respectively). No significant treatment effect was observed for secondary outcome measures as well (performance on extended ADL and upper limb motor impairment). The authors concluded that there was insufficient evidence to draw conclusions regarding the effectiveness of home-based therapy programs compared to usual care.

A number of individual trials, not included in the aforementioned Cochrane review, compared the effectiveness of home-based therapy with usual care, placebo, or no intervention. Nadeau et al. (2013) randomized 408 patients admitted to inpatient rehabilitation within 45 days of stroke, to receive locomotor training program (LTP), home exercise program (HEP), or standard care, for up to 12 to 16 weeks. Both LTP and HEP groups improved significantly in functional walking level and balance, compared to the usual therapy group, with no significant difference separating the two treatment groups. Harris et al. (2009) compared the effectiveness of home-based self-administered program to that of non-therapeutic education program and found significant treatment-associated effects on paretic upper limb performance, which was maintained for up to 3 months post treatment. In a RCT by Langhammer et al. (2007), the intensive exercise group demonstrated significantly greater improvements in motor assessment scale from admission to discharge from acute care, as well as from 6 months to 1 year post stroke, compared with the regular exercise group.

[Link to Evidence Table and References for Section 4](#)

## Part B. Providing Stroke Rehabilitation to Address Physical, Functional, Cognitive and Emotional Issues to Maximize Participation in Usual Life Roles

This section includes recommendations that address therapies for specific functional areas of stroke recovery and direct clinical care.

### 5.1 Management of the Upper Extremity following Stroke

#### Stroke Rehabilitation

#### 5.1 Management of the Upper Extremity following Stroke

#### Update 2015

**Evidence Grading System:** For the purposes of 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.

#### 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)].

### Rationale

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 do not regain normal function; however, many therapeutic techniques have been developed for those individuals who have minimal arm movement.

### System Implications

To achieve timely and appropriate assessment and management of upper extremity function the organization requires:

- Initial standardized arm and hand function assessment performed by clinicians experienced in the field of stroke.
- Timely access to specialized, interprofessional stroke rehabilitation services where therapies of appropriate type and intensity are provided.
- Access to appropriate equipment (such as functional electrical stimulation).
- Long-term rehabilitation services widely available in nursing and continuing care facilities, and in outpatient and community programs.
- Robotics are an emerging and developing area and stroke rehabilitation programs should begin to

build capacity to integrate robotic technology into stroke rehabilitation therapy to appropriate patients as the research evidence suggests, and in the future incorporate this therapy as part of comprehensive therapy where available.

### Performance Measures

1. **Extent of change (improvement) in functional status scores using a standardized assessment tool from admission to an inpatient or community-based rehabilitation program to discharge.**
2. **Extent of change in arm and hand functional status scores using a standardized assessment tool from admission to an inpatient or community-based rehabilitation program to discharge.**
3. Median length of time from stroke admission in an acute care hospital to assessment of rehabilitation potential by a rehabilitation healthcare professional.
4. Median length of time spent on a stroke unit during inpatient rehabilitation
5. Median hours per day of direct task-specific therapy provided by the interprofessional stroke team.
6. Average days per week of direct task specific therapy provided by the interprofessional stroke team (target is a minimum of five days).

### Measurement Notes

- A data entry process will need to be established to capture the information from the outcome tools such as the Chedoke-McMaster Stroke Assessment (**e.g., ARAT or WMFT**).
- FIM® Instrument data is available in the National Rehabilitation Reporting System (NRS) database at the Canadian Institute of Health Information (CIHI) for participating organizations.
- For Performance Measure 5, the direct therapy time is considered 1:1 time between therapist and patient and does not include group sessions or time spent on documentation.

### Implementation Resources and Knowledge Transfer Tools

#### Health Care Provider Information

- Table 1: Stroke Rehabilitation Screening and Assessment Tools.: Summary of Validated and Frequently Used Screening and Assessment Tools for Stroke Rehabilitation
- FIM® Instrument: <http://www.strokengine.ca/assess/fim/>
- AlphaFIM® Instrument: [http://www.udsmr.org/WebModules/Alpha/Alp\\_About.aspx](http://www.udsmr.org/WebModules/Alpha/Alp_About.aspx)
- Chedoke-McMaster Stroke Assessment: [http://strokengine.ca/assess/module\\_cmmsa\\_intro-en.html](http://strokengine.ca/assess/module_cmmsa_intro-en.html)
- Chedoke-McMaster Arm and Hand Activity Inventory: [http://strokengine.ca/assess/module\\_cahai\\_intro-en.html](http://strokengine.ca/assess/module_cahai_intro-en.html)
- Modified Ashworth Scale [http://strokengine.ca/assess/module\\_mashs\\_intro-en.html](http://strokengine.ca/assess/module_mashs_intro-en.html)
- Box and Block Test [http://strokengine.ca/assess/module\\_bbt\\_intro-en.html](http://strokengine.ca/assess/module_bbt_intro-en.html)
- Nine Hole Peg Test [http://strokengine.ca/assess/module\\_nhpt\\_intro-en.html](http://strokengine.ca/assess/module_nhpt_intro-en.html)
- Fugl-Meyer Assessment of Sensory-Motor Recovery  
<http://www.rehabmeasures.org/Lists/RehabMeasures/DispForm.aspx?ID=908&Source=http%3A%2F%2Fwww%2Erehabmeasures%2Eorg%2Frehabweb%2Fallmeasures%2Easpx%3FView%3D%257b0C859D90%252d7478%252d4C9B%252d9575%252d784C4A9A2D85%257d%26PageView%3DShared>
- Chedoke-McMaster Arm and Hand Activity Inventory (CAHAI): [http://strokengine.ca/assess/module\\_cahai\\_intro-en.html](http://strokengine.ca/assess/module_cahai_intro-en.html)
- Action Research Arm Test: [http://strokengine.ca/assess/module\\_arat\\_intro-en.html](http://strokengine.ca/assess/module_arat_intro-en.html)
- Wolf Motor Function Test: [http://strokengine.ca/assess/module\\_wmft\\_family-en.html](http://strokengine.ca/assess/module_wmft_family-en.html)

- Graded Repetitive Arm Supplementary Program (GRASP): <http://neurorehab.med.ubc.ca/grasp/>
- Stroke Engine: <http://strokengine.ca/>

### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- StrokEngine: <http://strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery: <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)

### Summary of the Evidence

There are many therapeutic approaches and treatment modalities that can be used to improve hand and upper-limb function following stroke.

### Task-Oriented Training

Task-oriented training involves practicing real-life tasks (such as answering a telephone), with the intention of acquiring or reacquiring a skill (defined by consistency, flexibility and efficiency). The tasks should be challenging and progressively adapted and should involve active participation. This approach differs from repetitive training, whereby a task is usually divided into component parts and then reassembled into an overall task once each component is learned. Repetitive training is usually considered a bottom-up approach, and is missing the end-goal of acquiring a skill. In a systematic review of motor recovery following stroke, Langhorne et al. (2009) identified 8 randomized controlled trials (RCTs) of repetitive task training, specific to the upper-limb, from a Cochrane review including trials of both upper and lower-limb therapy (French et al. 2007). In these trials, treatment duration varied widely from a total of 20 to 63 hours provided over a 2 week to 11 week period. Therapy was not associated with significant improvements in arm function (SMD=0.19, 95% CI -0.01 to 0.38) or hand function (SMD= 0.05, 95% CI -0.18 to 0.29). Perhaps the inclusion of trials that evaluated repetitive task training in addition to task-oriented training was, in part, responsible for the null result. Patten et al. (2013) conducted a cross-over RCT with 19 participants in the chronic phase of stroke (12.96 months). Participants were randomized into one of two groups: 1) functional task practice (FTP), or 2) HYBRID (combined FTP plus power training). Treatment was delivered in two, 4-wk blocks of twelve, 75min sessions interspersed with a 4-wk washout period. Wolf Motor Function Test-Functional Abilities Scale (WMFT-FAS) scores were significantly greater following HYBRID vs. FTP ( $p=0.049$ ) regardless of the order of treatment. These improvements were retained 6-months post intervention ( $p=0.03$ ). Shimodzone et al. (2012) evaluated 49 participants in the sub-acute phase of stroke in a RCT. Participants were randomized to one of two groups: 1) repetitive facilitative exercise (RFE), or 2) control-conventional rehabilitation program; both groups received 40 min sessions 5x/wk. for 4 weeks of their allocated treatment. Both groups performed 30 min/day of dexterity-related training immediately after each treatment session and continued their participation in a standard inpatient rehabilitation program (e.g., physical therapy, mobility, speech).



Action Research Arm Test (ARAT), Fugl-Meyer Assessment (FMA) was assessed at baseline, and at week 2 and 4. After 4 weeks of treatment, significantly larger improvements on the ARAT ( $p=0.009$ ) and FMA ( $p=0.019$ ) was demonstrated by the RFE group compared to the control group. Han et al. (2012) carried out a RCT studying 32 participants, on average, 40 days post stroke. Participants were randomized into one of three groups. All groups received arm training (5x/wk. for 6 wks.) including correct positioning and caring of the arm, passive, assisted and active movements, strength training, and functional activities with varying intensities: 1) Group A-1 hr, 2) Group B-2 hr, or 3) Group C-3 hr. After two weeks, there were no significant between-group differences in FMA or ARAT scores ( $p>0.05$ ). After four weeks of treatment, there were significant improvements in FMA scores in group C compared to groups A and B ( $p<0.05$ ) but no significant differences in FMA scores between groups A and B ( $p>0.05$ ). There were no significant differences in ARAT scores between all groups ( $p>0.05$ ). After six weeks of treatment, the FMA and ARAT scores had increased significantly in each group ( $p<0.05$  for all); FMA and ARAT scores improved more significantly in groups C and B than in group A ( $p<0.05$ ) but no significant difference between groups B and C ( $p<0.05$ ).

### **Constraint Induced Movement Therapy**

Traditional constraint-induced movement therapy (CIMT) involves restraint of the unaffected arm for at least 90 percent of waking hours, and at least six hours a day of intense upper extremity (UE) training of the affected arm every day for two weeks. This form of therapy may be effective for a select group of patients who demonstrate some degree of active wrist and arm movement and have minimal sensory or cognitive deficits. Evidence from the VECTORS trial (Dromerick et al. 2009) suggests that traditional (intensive) CIMT should not be used for individuals in the first month post stroke. In this RCT, patients who were randomized to receive 3 hours of intensive therapy in addition to wearing a constraint for 6 hours/day had lower Action Research Arm Test (ARAT) scores at 3 months compared with patients who had received conventional occupational therapy or standard CIMT for 2 hours each day. In one large RCT (Wolf et al. 2009), which included 222 patients 3-9 months post stroke, patients in the CIMT group had significantly higher Wolf Motor Function Tests (WMFT) scores and Motor Activity Log (MAL) (Amount of Use and Quality of Movement sub scores) at 3 months, compared with patients in the control group who received usual care, which could range from no therapy to a formal structured therapy program.

Modified constraint-induced movement therapy (m-CIMT) is a more feasible therapy option when resources are limited. In the most common variation of traditional CIMT, the unaffected arm is restrained with a padded mitt or arm sling for five hours a day, and with half-hour blocks of 1:1 therapy provided for up to 10 weeks (Page et al. 2013). The results from several good-quality RCTs suggest that patients who received mCIMT in the subacute or chronic phase of stroke experienced greater functional recovery compared with patients who received traditional occupational therapy. A Cochrane review (Sirtori et al. 2009) including the results from 19 trials reported a moderate improvement in arm function and a significant reduction in disability at the end of the treatment period, although treatment effects were not maintained at 3-6 months post treatment. The results from this review are difficult to interpret since trials of all forms of CIMT were included as were patients in all stages of stroke recovery. Singh et al. (2013) evaluated 40 participants in the sub-acute phase of stroke. Participants were randomized into one of two groups: 1) experimental - 2 hours of structured m-CIMT therapy 5x/wk. for 2 wk. plus use of a mitt to restrain affected arm 10h/day for 2 week, or 2) control - conventional rehabilitation time-matched to experimental group. For both groups, WMFT ( $p=0.003$  and  $p<0.001$ , respectively) and FMA ( $p<0.001$  for both) scores improved significantly between baseline and post intervention. No between-group statistics were reported, although the difference in scores between pre and post were greater on both the WMFT and FMA for the experimental group compared to the control group.

Evidence from a single trial evaluating the Graded Repetitive Arm Supplementary Program (GRASP) program suggests that this type of therapy can increase the number of hours of therapeutic upper limb use received by a patient (Harris et al. 2009). In this RCT, 103 patients recruited an average of 21 days following stroke with upper-extremity Fugl Meyer scores between 10 and 57, were randomized to participate in a 4 week (one hour/day x 6 days/week) home-based, self-administered program designed to improve ADL skills through strengthening, ROM and gross and fine motor exercises or to a non-therapeutic education control program. At the end of the treatment period, participants in the GRASP



group had significantly higher Chedoke Arm & Hand Activity Inventory, ARAT and MAL scores compared with the control group. The improvement was maintained at 3 months.

### **Mental Practice**

Similarly, the use of mental practice has been shown to improve arm function compared with traditional therapy alone. It may also be a valuable adjunct to other upper limb interventions and used as a precursor to mCIMT. A large treatment effect (SMD=1.37, 95% CI 0.60 to 2.15,  $p<0.0001$ ) was reported in a Cochrane review, (Barclay-Goddard et al. 2011) which included the results from 6 RCTs. Length of treatment ranged from 3 to 10 weeks. Subgroup analysis based on stroke chronicity and dosage was not possible due to small numbers of trials. In a RCT by Timmermans et al. (2013), 42 participants (2-6 weeks post stroke) were randomized into one of two groups and trained 3x/day for 6 weeks: 1) conventional rehabilitation plus 10 min mental practice-based training for 10 min per session, or 2) usual therapy and additional bimanual upper extremity techniques based on neurodevelopmental principles for 10 min per session. There were no significant differences between groups over time on either the FMA or WMFT ( $p>0.05$  for both).

### **Virtual Reality**

Results from two systematic reviews suggest that patients with mild to moderate upper-limb impairment may benefit from treatment using commercially available non-immersive virtual reality devices. A Cochrane review (Laver et al. 2011) included the results from 19 RCTs and reported that arm function, assessed using the FMA, was significantly improved following treatment (mean difference=4.43, 95% CI 1.98 to 6.88,  $p<0.0001$ ). Improvements in hand function approached statistical significance (MD=3.55 95% CI -0.20 to 7.3,  $p=0.063$ ). In sub group analysis, based on time since stroke onset, treatment provided in both the acute and chronic phase of stroke was effective. Saposnik et al. (2011) reported similar findings in their review, which included the results from 12 studies. There was significant improvement in motor impairment, assessed using the FMA, but no improvement in performance on the Box & Block test (BBT) or the WMFT (manual function). In a recent RCT by Kiper et al. (2014), 44 participants within one year of a first-ever stroke were randomized into one of two groups: 1) reinforced feedback in virtual environment (RFVE) 1hr/day plus traditional rehabilitation (TR), or 2) TR only. Training occurred for 2 hr/day, 5x/wk, for 4 wk. Fugl-Meyer Upper Extremity Scale (F-M UE) and Functional Independence Measure (FIM®) were assessed at baseline and at 4 wk follow-up. F-M UE scores significantly increased in only the RFVE group ( $p<0.001$ ) but not the TR group ( $p<0.053$ ). FIM® was significantly increased in both the RFVE ( $p<0.001$ ) and TR groups ( $p<0.006$ ). Furthermore, Lee et al. (2014) conducted a RCT with 59 participants (<1 month post-stroke) and randomized individuals into one of three groups: 1) Group A-cathodal tDCS, 2) Group B-virtual reality (VR), or 3) Group C- tDCS plus VR. All participants received standard therapy. Manual Muscle Test (MMT), Manual Function Test (MFT), FMA, BBT, Korean-Modified Barthel Index (K-MBI); assessed at pre- and post-treatment. Changes in scores on the MFT and FMS were significantly different between the three groups ( $p=0.021$ ,  $p=0.03$  respectively). Improvement in Group C was significantly greater compared to Group A and B on MFT (Group C vs. Group A,  $p=0.016$ ; Group C vs. Group B,  $p<0.01$ ). Group B also had a significantly greater improvement in MFT score compared to Group A ( $p<0.01$ ). FMS score improvement was significantly greater in Group C than Group A ( $p=0.013$ ) and Group B ( $p<0.01$ ). Further, Group A was significantly improved compared to Group B ( $p=0.035$ ). In all three groups, significant increases were noted in the MMT (shoulder) and K-MBI. Only Group C showed a significant increase on the Box and Block Test ( $p$ -values not provided). A RCT by Sin et al. (2013) randomized 40 hemiplegic participants (>6 month post stroke) into one of two groups: 1) virtual reality (VR) training using the Xbox Kinect for 30 min followed by standard occupational therapy for 30 min, or 2) standard occupational therapy alone. Therapy occurred 3x/wk for 6 wks. Between groups, FMA and BBT scores differed significantly ( $p<0.05$ ), with the VR group experiencing a greater improvement. Significant improvements were observed in the AROM of flexion, extension and abduction of the shoulder, flexion of the elbow, and flexion and extension of the wrist. Significant differences between the two groups were noted at follow up for the shoulder and flexion of the elbow ( $p<0.05$ ).

Turolla et al. (2013) assigned 376 post-stroke patients to one of two of groups: 1) upper limb conventional

(ULC) rehabilitation, or 2) reinforced feedback in the virtual environment (RFVE) group. Participants received 40 sessions of therapy 5x/wk for 4 wks. A significant improvement in the FM-UE scores were noted for both groups following treatment, a 4% increase in the ULC group ( $p<0.001$ ), and a 10% increase in the RFVE group ( $p<0.001$ ). FIM scores were significantly higher among the RFVE group compared to the ULC group post-treatment ( $p=0.007$ ). An analysis based on Stroke to Rehabilitation Interval (SRI) sub-groups on the FM-UE scores showed significant improvements for the RFVE group compared to the ULC group on all three sub-groups ( $p<0.001$ ). In a RCT, Yin et al. (2014) randomized 23 post-stroke patients to one of two groups: 1) 30 minutes of non-immersive virtual reality training for nine weekdays within two weeks (five days a week) and conventional therapy, or 2) only conventional therapy. FMA-UE was assessed at baseline, post intervention and 1-month post intervention. Participants' feedback and adverse effects were recorded. All participants improved in FM-UE scores (mean change (SD) =11.65 (8.56),  $P<.001$ ). These effects were sustained at one month after intervention (mean (SD) change from baseline=18.67 (13.26),  $P<.001$ ). All other outcome measures showed similar patterns. There were no significant differences in improvement between both groups. The majority of the participants found VR training useful and enjoyable, with no serious adverse effects reported.

### **Mirror Therapy**

Mirror therapy is a technique that uses visual feedback about motor performance as a means to enhance upper-limb function following stroke and to reduce pain. Evidence from a Cochrane review (Thieme et al. 2012), which included the results from 14 RCT, suggests a modest benefit associated with treatment. There were significant improvements in motor function, the primary outcome, both immediately following treatment (SMD=0.61; 95% CI 0.22 to 1.0,  $p= 0.002$ ) and at 6 months (SMD=1.09; 95% CI 1.09 to 1.87,  $p= 0.0068$ ). There were also improvements in performance of ADLs (SMD=0.33, 95% CI 0.05 to 0.60,  $p=0.02$ ) and pain (SMD= -1.1, 95% CI -2.10 to -0.09,  $p=0.03$ ).

In a recent RCT, Radajewska et al. (2013) randomized 60 right-handed participants (mean 9.25 wk post stroke) to mirror therapy ( $n=30$ ) or a control group ( $n=30$ ). Within each group, patients were divided into left- versus right-arm paresis subgroups. Both groups received standard rehabilitation. The treatment group received 15 minute sessions of mirror therapy 2x/day, 5d/wk for 3 wk. Functional Index 'Repty', Frenchay Arm Test, and MSS were assessed at baseline, post intervention and at 3-week follow-up. No significant differences were shown for the left or right groups on all outcome measures ( $p>0.05$  for all). Wu et al. (2013), RCT, 44 community dwelling individuals, within 2 years post stroke, meeting the following criteria: first-ever unilateral stroke, FMA-UE score of 26-56, and MAS of  $<3$ . Patients were stratified based on FMA-UE scores 26-40 or 40-66. Patients then received either mirror therapy or traditional therapy (control group). Treatment was 1.5 hrs/d, 5d/wk, for 4 weeks. Specifically, the treatment group had 1hr mirror therapy and 0.5hr task-oriented practice. FMA-UE, Revised Nottingham Sensory Assessment (rNSA), Motor Activity Log (MAL), and ABILHAND questionnaire were assessed; mirror therapy group showed significantly greater improvement compared to the control group on FMA-UE ( $p=0.009$ ). No significant between-group differences were found for the Motor Activity Log ( $p>0.05$ ) and ABILHAND ( $p>0.05$ ).

### **EMG-biofeedback**

There is evidence that EMG-biofeedback is associated with modest improvements in arm function. In a review which included the results 4 small RCTs that compared a 3-12 week program of EMG-biofeedback treatment + physiotherapy with physiotherapy alone in the upper limb, there was a significant improvement in arm function (SMD=0.41, 95% CI 0.05 to 0.77,  $p<0.05$ ) (Langhorne et al. 2009). Nevertheless, its use in routine clinical practice is the subject of ongoing debate.

### **Neuromuscular Electrical Stimulation**

Meilink et al. (2008) examined the effectiveness of EMG-triggered neuromuscular electrical stimulation (NMES) applied to the extensor muscles of the forearm to improve hand function following stroke. This systematic review included the results of 8 studies (157 patients,  $>6$  months post stroke). Compared with usual care, there was a non-statistically significant treatment effect for all outcomes assessed (FMA:

SMD=0.10, 95% CI -0.43 to 0.64,  $p=0.35$ BBT: SMD=0.37, 95% CI -0.27 to 1.01,  $p=0.13$ ; ARAT: SMD=0.0, 95% CI -0.56 to 0.57,  $p=0.5$ ; and reaction time: SMD=0.41, 95% CI -0.20 to 1.03). The results of a small RCT authored by Page et al. (2012) suggest that 2 hours of daily therapy for 8 weeks using the commercially-available Bioness device reduced impairment from baseline levels for patients in the chronic stage of stroke; however, when compared with the results of patients in the control group who participated in a 30-minute per weekday home-exercise program, there was no difference in mean FMA scores between groups.

Boyaci et al. (2013) randomized 31 hemiplegic subjects (>4 wk post stroke) into three groups; 1) EMG triggered active NMES, 2) passive NMES, and 3) sham stimulation. Treatments occurred for 45 min/day, 5x/wk for 3 wk. FMA, self-care of FIM, MAL, and MAS were assessed pre- and post-intervention. Significant improvements were noted in the FMA-UE, MAL, self-care FIM, wrist extension, and grip strength among the active NMES and passive NMES treatments ( $p<0.05$  for all); these improvements were significantly better in the active and passive NMES groups compared with the control group at the end of treatment ( $p<0.05$  for both). There were no significant differences for any parameters between active NMES group and the passive NMES group. De Jong et al. (2013) randomized 46 subjects (2-8 weeks post stroke) into one of two groups. Both groups received conventional rehabilitation in accordance with Dutch guidelines. Subjects in the experimental group received arm stretch positioning (60 hr) plus NMES (51 hr) whereas the control group received sham stretching treatment and low-intensity TENS (51 hr). Passive ROM were assessed at baseline, mid-treatment, at the end of the treatment period (8 weeks) and at follow-up (20 weeks). There were no significant group effects or time-by-group interactions on any of the passive range of arm motions.

### Functional Electrical Stimulation

Three recent studies have evaluated the effect of function electrical stimulation (FES) in improving upper limb function post stroke (Langhorne et al. 2009; Page et al. 2012; Kim et al. 2014). Most recently, Kim et al. (2014) conducted a RCT where 23 participants <6 months post-stroke were randomized into one of two groups. Both groups were given conventional rehabilitation therapy for 60 min/day, 5 days/wk for 4 wk. For 30 minutes/day, 5 days/wk for 4 wk, the experimental group also received FES with mirror therapy (MT+) while the control group received FES without mirror therapy (MT-). FMA, BMRS, MFT, BBT were assessed pre- and post-intervention. FMA scores for shoulders, lower arms, wrists, hands and upper limb coordination increased significantly in both groups ( $p<0.05$ ). Both groups demonstrated a significant improvement in BMRS scores post intervention ( $p<0.05$ ), but with hand recovery in the experimental group showing significantly greater increases than the control group ( $p<0.05$ ). Both groups improved MFT scores significantly in shoulder and hand function ( $p<0.05$ ); the experimental group showed a more significant improvement in hand function than the control group ( $p<0.05$ ). BBT demonstrated significant improvement in both groups ( $p<0.05$ ).

### Transcranial Direct Current Stimulation

Transcranial direct-current stimulation (tDCS) has been shown to improve shoulder abduction (Khedr et al. 2013), spasticity (Wu et al. 2013), and upper extremity motor function (Lee et al. 2014). In a RCT, Khedr et al. (2013) randomized 40 subjects (mean 12.9 days post stroke) into one of three groups: 1) anodal tDCS over affected hemisphere, 2) cathode tDCS over unaffected hemisphere, or 3) sham stimulation. Treatment lasted 25 min for 6 consecutive days over the motor cortex hand area. Orgogozo's MCA scale (OMCASS), Barthel Index (BI), Friedman test were assessed at baseline, post treatment, 1, 2, and 3 months post treatment. There was a significant time x group (real vs. sham) effect on the OMCASS ( $p=0.005$ ) and BI ( $p=0.006$ ). A significant time x group effect for anodal vs. sham was noted on OMCASS ( $p<0.001$ ), BI ( $p=0.002$ ) and marginally significant effect for cathodal vs. sham OMCASS ( $p=0.033$ ) and BI ( $p=0.017$ ). A significant improvement of strength was noticed in all groups post-treatment on the Friedman Test ( $p<0.0001$ ). A greater improvement was found in the combined group than in the sham group for shoulder abduction, foot dorsiflexion, and hip flexion ( $p=0.005$ ). In another RCT, Lee et al. (2014) randomized 59 subjects (<1 months post stroke) with impaired unilateral UE motor function. Subjects were randomized into one of three groups: 1) Group A-cathodal tDCS, 2) Group B-virtual reality (VR), or 3) Group C- tDCS plus VR. In addition to their specified group treatments, all participants

received standard therapy. In total, 15 treatments were received over a 3-wk period. MMT, Manual Function Test (MFT), FMA, BBT, K-MBI were assessed at pre- and post-treatment. Changes in scores on the MFT and FMS were significantly different between the three groups ( $p=0.021$ ,  $p=0.03$  respectively). Improvement in Group C was significantly greater compared to Group A and B on MFT (Group C vs. Group A,  $p=0.016$ ; Group C vs. Group B,  $p<0.01$ ). Group B also had a significantly greater improvement in MFT score compared to Group A ( $p<0.01$ ). FMS score improvement was significantly greater in Group C than Group A ( $p=0.013$ ) and Group B ( $p<0.01$ ). Further, Group A was significantly improved compared to Group B ( $p=0.035$ ). In all three groups, significant increases were noted in the MMT (shoulder) and K-MBI. Only Group C showed a significant increase on the BBT ( $p$ -values were not provided). Wu et al. (2013) randomized 90 subjects (2-12 months post stroke) into one of two groups: 1) tDCS to the primary sensorimotor cortex of the affected hemisphere with cathodal stimulation, or 2) sham stimulation to the same area. Stimulation sessions lasted 20 minutes/day, 5 days/week, for 4 wk. Both groups also received physiotherapy for two 30 min sessions per day, for 4 wk. FMA of motor recovery, BI, and MAS were assessed pre-, post-treatment and 4-wk follow up. Compared to the sham group, the tDCS group showed greater improvements on FMA ( $p<0.001$ ) and BI ( $p<0.05$ ) post intervention. At the four week follow up, the tDCS group showed significantly greater improvement on FMA ( $p<0.001$ ) and BI ( $p<0.01$ ) than the sham group.

### **Transcutaneous Electrical Nerve Stimulation**

In an RCT, Au-Yeung et al. (2014) 73 subjects ( $\leq 46$  hr post-stroke) were randomized to one of three groups: 1) Group 1-Transcutaneous Electrical Nerve Stimulation (TENS), 2) Group 2-sham stimulation, or 3) Group 3-standard rehabilitation. Groups 1 and 2 also received standard rehabilitation therapy. Electrical Stimulation Treatment was received for 60 min/day, 5 days/wk, for 4 wk. Hand grip, pinch strength, ARAT were assessed at pre-, 4, 12, and 24 wk post-treatment. The TENS group improved significantly more than the control group in hand grip ( $p=0.015$ ) and pinch strength ( $p=0.007$ ) compared to controls beginning at week 4; improvements were maintained at follow up ( $p\leq 0.006$ ). No significant differences were found between the sham stimulation group and the control group for hand grip or pinch strength. There were no significant differences in ARAT scores between groups ( $p>0.05$  for all).

### **Bilateral/Unilateral Arm Training**

While clinicians often place an emphasis on the use of bilateral upper limb activity, evidence from a Cochrane Review (Coupar et al. 2010) and a systematic review (Van Delden et al. 2012) suggests that bilateral upper limb training is no more effective than unilateral training for improving arm function. There were no significant differences between treatment and control groups on any of the impairment of activity outcomes assessed in either study.

In a systematic review, including 13 RCTs, (Harris & Eng 2010) therapy programs including a strength training or resistance training component were associated with significant improvements in grip strength (SMD=0.95, 95% CI 0.05 to 1.85,  $p=0.04$ ), but not performance of ADLs (SMD=0.26, 95% CI -0.10 to 0.63,  $p=0.16$ ). There is currently no evidence that strength training increases spasticity or reduces range of movement. Furthermore, Dispa et al. (2013), conducted a crossover-RCT, with 10 Participants (6 months post-stroke) having the ability to lift and hold an object of 250 g between the thumb and the index finger for a few seconds. Participants were randomized into two groups: 1) started with the bilateral movement therapy, 2) started with the unilateral movement therapy. Therapy sessions occurred for 1 hr 3x/wk for 4wk followed by another 4wk of the opposite treatment. Two-way repeated measure analysis of variance (RM-ANOVA) was assessed at inclusion ( $t_0$ ), baseline ( $t_1$ ), 4 weeks ( $t_2$ ), and 8 weeks ( $t_3$ ). RM-ANOVA comparison between  $t_0$  and  $t_1$  results did not show any significant difference. Results of the paretic hand at  $t_1$ ,  $t_2$ , and  $t_3$  did not detect any difference between the bilateral and unilateral movement therapies ( $p>0.144$  in all instances). A highly significant difference between both hands was detected for digital dexterity ( $p<0.001$ ). The temporal grip-lift parameters tended to take longer; however, only the loading phase showed a significant difference between both hands ( $p=0.048$ ). The grip-lift dynamics showed no significant difference between the paretic and the non-paretic hand ( $p>0.507$  in all instances).

### **Repetitive Transcranial Magnetic Stimulation (rTMS)**

Le et al. (2014) conducted a systematic review and meta-analysis of 8 RCTs (273 participants, >18 yr) published in English between 1990 and 2012 that examined the effect of rTMS on hand function and plasticity of the motor cortex; time since stroke onset ranged from 5 days to 10.7 years. The frequency of rTMS ranged from 1 Hz to 25 Hz. Stimulation sites of low-frequency rTMS included the primary motor cortex and premotor cortex whereas high-frequency rTMS occurred at M1. Seven studies examined rTMS compared to a control and in the remaining study it was compared to constraint induced movement therapy. Treatments duration ranged from 1 day to 10 days, with a frequency of 0.4-1 sec to 25 min. Finger coordination and hand function (at 3Hz) demonstrated a significant standard mean difference of 0.58 ( $p=0.01$ ) and -0.82 ( $p=0.007$ ), respectfully. No improvement was demonstrated for hand function at 10Hz ( $p=0.34$ ) compared to control groups (Lee et al. 2014).

In a RCT, Ji et al. (2014) randomized 35 participants (mean 8.9 months post stroke) into one of three groups: 1) combined mirror therapy plus rTMS (MT+rTMS), 2) mirror therapy alone (MT), or 3) sham stimulation. All participants received physical therapy 30 min/day, 5 times/wk, for 6 wk. FMA and BBT scores of all groups significantly improved following treatment ( $p<0.05$ ). Scores were significantly better for MT+rTMS compared to MT ( $p<0.05$ ) and sham ( $p<0.05$ ) groups. In another RCT, Wang et al. (2014) randomized 48 participants (2-6 wk post stroke) into one of three groups: 1) Group A received rTMS (10 sessions, 1 Hz) over the unaffected hemisphere and then intermittent theta burst stimulation (iTBS) over the affected area (3 sessions, 50Hz), 2) Group B received had the same protocol as Group A but in the reverse order, 3) Group C received sham stimulation in the same order as Group A. Treatment lasted 4 weeks and all participants received physiotherapy for one hour (task orientation). Group A demonstrated the largest improvement among all groups. Group A demonstrated improvements in MRC proximal (from  $2.6\pm1.5$  to  $3.9\pm1.0$ ,  $p<0.01$ ), MRC distal (from  $2.3\pm1.6$  to  $3.4\pm1.4$ ,  $p<0.05$ ), FMA (from  $26.2\pm21.6$  to  $36.6\pm24.0$ ,  $p<0.001$ ), and WMFT (from  $30.4\pm14.5$  to  $40.3\pm29.1$ ,  $p<0.001$ ). Group B demonstrated less improvement on motor skills than Group A with MRC proximal (from  $2.6\pm1.3$  to  $3.8\pm1.5$ ,  $p<0.01$ ), MRC distal (from  $2.4\pm1.3$  to  $3.7\pm1.3$ ,  $p<0.01$ ), FMA (from  $28.4\pm24.1$  to  $34.7\pm28.3$ ,  $p<0.01$ ), and WMFT (from  $30.9\pm15.7$  to  $36.5\pm23.5$ ,  $p<0.05$ ). FMA was particularly improved in Group A but not in other groups. Group C in comparison to the other groups showed the least improvement.

In a RCT, Kim et al. (2014) 31 participants post stroke were randomly assigned to either rTMS (10 sec, 10 Hz), or rTMS with sessions lasting 10 min, 5x/wk for 4 wk. Participants also received 30 min of task orientation training (maneuvering of objects along with increasing the number of repetitions and difficulty). MFT was assessed at baseline and 4 wk follow-up. There was a significant improvement in MFT at 4 weeks in the rTMS group (from  $13.20\pm5.00$  to  $22.20\pm2.86$ ,  $p<0.05$ ). The sham rTMS also demonstrated an improvement in MFT but to a smaller degree at 4 weeks (from  $14.20\pm2.82$  to  $16.90\pm2.13$ ,  $p<0.05$ ). Improvements in the rTMS group were significantly greater compared to the sham rTMS group ( $p<0.05$ ).

[Link to evidence tables and reference list for Section 5.1](#)

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

Stroke Rehabilitation Update 2015	5.2 Range of Motion and Spasticity in the Shoulder, Arm and Hand
	<p><b>Definition:</b> For the purposes of these recommendations <b>'early'</b> refers to strength of evidence for therapies applicable to patients who are less than 6 months post stroke, and <b>'late'</b> refers to strength of evidence for therapies applicable to patients who are more than 6 months from index stroke event.</p> <ol style="list-style-type: none"> <li>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]. <ol style="list-style-type: none"> <li>a. Routine use of splints is not recommended [Evidence Levels: Early- Level A; Late-Level B]. <b>however, optimal protocols for utilizing splinting for improvement or preservation of tissue length and spasticity management have not yet been determined.</b></li> <li>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].</li> </ol> </li> <li>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].</li> <li>iii. Oral medications can be prescribed for the treatment of disabling spasticity: <ol style="list-style-type: none"> <li>a. Tizanidine can be used to treat more generalized, disabling spasticity. [Evidence Levels: Early-Level C; Late-Level B].</li> <li>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.</li> <li>c. Benzodiazepines should be avoided due to sedating side effects, which may impair recovery [Evidence Level: Early-Level C; Late-Level C].</li> </ol> </li> <li>iv. The presence of spasticity should not limit the use of strength training in the arm [Evidence Level: Early-Level C; Late-Level C].</li> </ol>
	<p><b>Rationale</b></p> <p>Spasticity, defined as a velocity dependent increase of tonic stretch reflexes (muscle tone) with exaggerated tendon jerks can be painful, interfere with functional recovery and hinder 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.</p>
	<p><b>System Implications</b></p> <p>To achieve timely and appropriate assessment and management of shoulder, arm and hand range and spasticity the organization requires:</p> <ul style="list-style-type: none"> <li>• Availability of and access to organized stroke care, including stroke rehabilitation units with critical mass of trained interprofessional staff during the rehabilitation period following stroke.</li> <li>• Timely access to specialized, interprofessional stroke rehabilitation services, where assessments and therapies of appropriate type and intensity are provided.</li> <li>• Expertise within the interdisciplinary stroke team to prevent and/or ameliorate post stroke spasticity and remediate its complications and functionally related limitations.</li> </ul>



- Optimization of strategies to prevent or manage spasticity both initially post stroke and at follow-up assessments.
- Funding for chemodenervation and associated post injection rehabilitation services where necessary.
- Long-term rehabilitation services widely available in nursing and continuing care facilities, and in outpatient and community programs.

### Performance Measures

1. Change (improvement) in functional status scores using a standardized assessment tool from admission to an inpatient rehabilitation program to discharge.
2. Change in shoulder, arm and hand functional status scores using a standardized assessment tool (such as the Chedoke-McMaster Stroke Assessment pain scale or the Modified Ashworth Scale) from admission to an inpatient rehabilitation program to discharge.
3. Median length of time from stroke admission in an acute care hospital to assessment of rehabilitation potential by a rehabilitation healthcare professional.
4. Median length of time spent on a stroke rehabilitation unit during inpatient rehabilitation

### Measurement Notes

- A data entry process will need to be established to capture the information from the outcome tools such as the Disability Assessment Scale
- FIM® Instrument data is available in the National Rehabilitation Reporting System (NRS) database at the Canadian Institute of Health Information (CIHI) for participating organizations.

### Implementation Resources and Knowledge Transfer Tools

#### Health Care Provider Information

- Canadian Stroke Best Practices *Taking Action Towards Optimal Stroke Care*: [http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- FIM® Instrument: <http://www.strokengine.ca/assess/fim/>
- AlphaFIM® Instrument: [http://www.udsmr.org/WebModules/Alpha/Alp\\_About.aspx](http://www.udsmr.org/WebModules/Alpha/Alp_About.aspx)
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.
- Modified Ashworth Scale: [http://strokengine.ca/assess/module\\_mashs\\_intro-en.html](http://strokengine.ca/assess/module_mashs_intro-en.html)
- Pain scales: <http://www.painedu.org/Downloads/NIPC/Pain%20Assessment%20Scales.pdf>

#### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: <http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d->



[b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)

- Stroke Engine: <http://strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery: <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)

## Summary of the Evidence

Spasticity, defined as a velocity dependent increase of tonic stretch reflexes (muscle tone) with exaggerated tendon jerks can be painful, interfere with functional recovery and hinder 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. Although it is a common in clinical practice to use range-of-motion or stretching exercises and splints to prevent or treat spasticity or contracture following stroke, there is a lack of evidence supporting their benefit.

Turton & Britton (2005) randomized 13 participants with no hand function, admitted to a stroke rehabilitation unit, within 4 weeks of stroke to a program of twice daily stretches for wrist and finger flexors and shoulder adductors and internal rotators, for up to 12 weeks post stroke. By the end of follow-up, patients in both groups had lost an average of 30 degrees of wrist extension and shoulder external rotation ROM of the affected side, but the difference between groups was not significant. Compliance with treatment was poor. Horsley et al. (2007) recruited 40 patients admitted to a rehabilitation service (19 with stroke). All patients received routine upper-limb retraining five days a week. In addition, the experimental group (n=20) received 30 minutes daily stretch of the wrist and finger flexors five days a week for four weeks. There was no difference in the development of contracture, the primary outcome, five weeks after treatment. There were also no differences in pain at rest measured on a 10-cm visual analogue scale, or upper-limb activity measured using the Motor Assessment Scale.

Splints have been widely-used in clinical practice with the aim of the prevention of contractures and reducing spasticity; however, evidence of their effectiveness is lacking. The results from 3 small RCTs suggest that splinting is not effective (Harvey et al. 2006, Lanin et al. 2007, and Basaran et al. 2012). Most recently, Basaran et al. (2012) randomized 39 participants to participate in a 5 week, home-based exercise program in which patients were advised to stretch wrist and finger flexors for 10 repetitions and to try reaching and grasping an object for 10 repetitions 3x/day, in addition to conventional therapy. Patients in the 2 experimental groups wore either a volar or dorsal splint for up to 10 hours overnight throughout the study period, while patients in the control group wore no splint. At the end of the study period, there were no significant differences among groups in terms of reductions in spasticity or wrist passive range of motion. Furthermore, Doucet et al. (2013) evaluated 6 participants, on average, 67.92 months post stroke using a pre-post design. Custom-fitted dynamic progressive wrist extension orthotic was worn for 4 hours daily, 4 times a week for 12 weeks. Modified Ashworth Scale (MAS) scores of the wrist were assessed at baseline and 12 weeks. Half of the sample demonstrated improvement in MAS scores. Andringa et al. (2013) conducted a pre-post study among 6 participants, on average 64 months (range: 22-110) post stroke. Custom-made dynamic orthotics was worn 8 hours daily, for 6 months. MAS scores of the elbow, wrist and fingers were assessed at baseline, 3 months and 6 months. There were no significant differences within or among groups on MAS.

While it is well-established that treatment with Botulinum toxin–type A (BTX-A) reduces focal spasticity in the finger, wrist and elbow, it remains uncertain whether there is also improvement in upper-limb function. In 2 recent, large placebo-controlled RCTs, one which recruited participants within the first month (Shaw et al. 2012) and the other an average of 6 years following stroke (McCrory et al. 2009), significant reductions in spasticity, assessed using the Modified Ashworth Scale scores were reported in both studies. Shaw et al. (2012) reported there was no significant difference in the percentage of patients who had achieved a successful outcome (defined by 3 different levels of improvement on the Action Research Arm Test, depending on baseline arm function) at one month following treatment: 25% of patients in the

treatment group compared with 19.5% of patients in the control group ( $p=0.232$ ). However, significant differences in favor of the intervention group were seen in muscle tone at 1 month; upper limb strength at 3 months; basic arm functional tasks (hand hygiene, facilitation of dressing) at 1, 3, and 12 months, and pain at 12 months. McCrory et al. (2009) reported there were no significant between group differences in Assessment of Quality of Life scale change scores, pain, mood, disability or carer burden at 20 weeks. Coban et al. (2014) reported results from a pre-post study of 17 patients with upper limb spasticity at least 1 year post-stroke. Two preparations of Botox and Dysport were used. Injections were administered in one distal part of the upper limb (the upper limb spasticity group, 15 patients) or lower limb (the lower limb spasticity group, 12 patients). MAS of elbow flexors, forearm pronators, wrist flexors and finger flexors were assessed after the first, second, and fifth injection. Only forearm pronators showed a statistically significant change in MAS scores between the first versus second injection ( $p=0.021$ ) and first versus fifth injection ( $p=0.021$ ). An RCT evaluating 18 participants with upper limb spasticity (MAS=1-2) who were 4-6 months post stroke was conducted (Hesse et al. 2012). Participants were randomized into two groups: 1) 150 U BTX-A injected into the deep and superficial finger (100 U) and wrist flexors (50 U), or 2) no injection. MAS of fingers were assessed at baseline, 4 weeks and 6 months. Individuals in the treatment group experienced significantly less finger flexor stiffness at 4 weeks ( $p<0.001$ ) and 6 months ( $p=0.025$ ) (Hesse et al. 2012).

Santamoto et al. (2013) conducted a pre-post of 25 patients with upper limb spasticity (AS  $\geq 2$ ) who were  $\geq 6$  months post stroke. Participants received one set of injections of BTX-A, in their hypertonic upper and lower limb; maximum total dosage in the upper limbs was 840 U (range 750-840 U). Disability Assessment Scale (DAS) was assessed 30- and 90-days post injections. Mean DAS scores decreased at 30 and 90 days after treatment ( $p<0.05$ ). However, the rate of response was higher for investigators than patients; 40% of investigators and 28% of patients rated their clinical picture as "marked improvement." Takekawa et al. (2013) studied participants with upper limb spasticity 64.8 months post stroke. BTX-A was injected into the elbow flexors, wrist flexors, forearm pronators or finger flexors with a total dosage less than 240 U. After the injection, participants participated in one-on-one home-based functional training for 15 minutes with an occupational therapist. MAS of elbow flexors, wrist flexors, forearm pronators and finger flexors were assessed at baseline, and at 1-, 3- and 6-month follow-up. A significant reduction in MAS scores were noted in all muscles examined, at 1-, 3-, and 6-month follow-up compared to baseline ( $p<0.001$  for all).

In cases where spasticity is generalized, and it would be impractical, or contrary to patients' wishes to inject multiple muscle groups with BTX-A, the use of oral agents may be considered as an alternative treatment. Traditional pharmacotherapies for spasticity include centrally acting depressants (baclofen and tizanidine) and muscle relaxants; (dantrolene) however; these treatments are only partially effective in treating spasticity and have the negative side effects of weakness and sedation. Treatment with oral baclofen has not been studied in the stroke population and is used more frequently in patients recovering from spinal cord injury. Tizanidine has been well-studied in other conditions including multiple sclerosis and acquired brain injury, and has a better side effect profile than other oral agents. There is only a single open-label trial of the use of tizanidine post stroke (Gelber et al. 2001). Following 16 weeks of treatment in which 47 patients received a maximum daily dose of 36 mg (mean 20 mg), there was a decrease in mean combined total modified Ashworth Scale scores (9.3 vs. 6.5,  $p=0.038$ ). There were also significant improvements in pain, quality of life, and physician assessment of disability.

[Link to evidence tables and reference list for Section 5.2](#)

## 5.3 Management of Shoulder Pain & Complex Regional Pain Syndrome (CRPS) following Stroke

Stroke Rehabilitation Update 2015	5.3 Management of Shoulder Pain & CRPS following Stroke
<p><b>Definition:</b> For the purposes of these recommendations <b>'early'</b> refers to strength of evidence for therapies applicable to patients who are less than 6 months post stroke, and <b>'late'</b> refers to strength of evidence for therapies applicable to patients who are more than 6 months from index stroke event.</p> <p><b>Note:</b> Causes of shoulder pain may be due to the hemiplegia itself, injury or acquired orthopedic conditions due to compromised joint and soft tissue integrity.</p>	
<p><b>A. Prevention of Hemiplegic Shoulder Pain and Subluxation</b></p> <ol style="list-style-type: none"> <li>Joint protection strategies should be used during the early or flaccid stage of recovery to prevent or minimize shoulder pain. These include: <ol style="list-style-type: none"> <li>Positioning and supporting the arm during rest [Evidence Level B].</li> <li>Protecting and supporting the arm during functional mobility [Evidence Level C].</li> <li>Protecting and supporting the arm during wheelchair use by using a hemi-tray or arm trough [Evidence Level C].</li> <li>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) EBRSR [Evidence Level C].</li> </ol> </li> <li>For patients with a flaccid arm (i.e., Chedoke-McMaster Stroke Assessment &lt;3) electrical stimulation should be considered [Evidence Levels: Early- Level B; Late- Level B].</li> <li>Overhead pulleys should not be used [Evidence Level A].</li> <li>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].</li> <li>Healthcare staff, patients and family should be educated to correctly handle the involved arm [Evidence Level A]. <ol style="list-style-type: none"> <li>For example, careful positioning and supporting the arm during assisted moves such as transfers; avoid pulling on the affected arm [Evidence level C].</li> </ol> </li> </ol>	
<p><b>B. Assessment of Hemiplegic Shoulder Pain</b></p> <ol style="list-style-type: none"> <li>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].</li> </ol>	
<p><b>C. Management of Hemiplegic Shoulder Pain</b></p> <ol style="list-style-type: none"> <li>Treatment of hemiplegic shoulder pain related to limitations in range of motion includes <b>gentle</b> stretching and mobilization techniques, and typically involves increasing external rotation and abduction. [Evidence Level B]. <ol style="list-style-type: none"> <li>Active range of motion should be increased gradually in conjunction with restoring alignment and strengthening weak muscles in the shoulder girdle [Evidence Level B].</li> </ol> </li> <li>If there are no contraindications, analgesics (such as acetaminophen or ibuprofen) can be used for pain relief [Evidence Level C].</li> <li>Injections of botulinum toxin into the subscapularis and pectoralis muscles could be used to</li> </ol>	

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. Complex Regional Pain Syndrome (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 Complex Regional Pain Syndrome (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].

### Rationale

The incidence of shoulder pain following a stroke is high. As many as 72 percent of adult stroke patients report at least one episode of shoulder pain within the first year after stroke. 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.

### System Implications

To achieve timely and appropriate assessment and management of shoulder pain the organization requires:

- Organized stroke care, including stroke rehabilitation units with a critical mass of trained interprofessional staff during the rehabilitation period following stroke.
- Equipment for proper limb positioning (e.g. pillows, arm troughs).

To achieve timely and appropriate assessment and management of shoulder pain the organization should provide:

- Initial assessment of active or passive upper extremity range of motion of shoulder, based on Chedoke-McMaster Stroke Assessment score and assessment of external rotation performed by clinicians experienced in stroke rehabilitation.
- Timely access to specialized, interprofessional stroke rehabilitation services for the management of

shoulder pain.

- Timely access to appropriate rehabilitation therapy intensity/ treatment modalities for management or reduction of shoulder pain in stroke survivors.
- Long-term rehabilitation services in nursing and continuing care facilities, and in outpatient and community programs.
- Physicians trained in stroke care and, where needed, intra-articular shoulder injections and botulinum toxin injections.

### Performance Measures

1. Proportion of stroke patients who experience shoulder pain in acute care hospital, inpatient rehabilitation and following discharge into the community (NRS tool has a self-report question about pain on admission/discharge).
2. Length of stay during acute care hospitalization and inpatient rehabilitation for patients experiencing shoulder pain (versus patients not experiencing shoulder pain).
3. Proportion of stroke patients who report shoulder pain at three-month and six-month follow-up.
4. Pain intensity rating change, from baseline to defined measurement periods.
5. Motor score change, from baseline to defined measurement periods.
6. Range of shoulder external rotation before and after treatment for shoulder pain.
7. Proportion of patients with restricted range of motion related to shoulder pain.

### Measurement notes

- Performance measure 4: Standardized rating scales should be used for assessment of pain levels and motor scores.
- Some data will require survey or chart audit. The quality of documentation related to shoulder pain by healthcare professionals will affect the quality and ability to report some of these performance measures.
- Audit tools at a local level may be helpful in collecting shoulder pain data on patients who experience shoulder pain.

### Implementation Resources and Knowledge Transfer Tools

#### Health Care Provider Information

- Canadian Stroke Best Practices *Taking Action Towards Optimal Stroke Care*:  
[http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.
- Pain scales: <http://www.painedu.org/Downloads/NIPC/Pain%20Assessment%20Scales.pdf>
- Chedoke-McMaster Shoulder Pain Subscale:  
<http://www.rehabmeasures.org/pdf%20library/cmsa%20manual%20and%20score%20form.pdf>

#### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery:  
[http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory:  
[http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Direct](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Direct)



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- Your Stroke Journey: [http://www.heartandstroke.com/att/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/att/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery: <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)

## Summary of the Evidence

The use of supportive slings and supports has been shown to reduce the amount of subluxation (evident upon radiographic examination) and may also help to reduce hemiplegic shoulder pain. A Cochrane review authored by Ada et al. (2005) included the results from 4 RCTs evaluating the use of strapping (n=3) and hemisling (n=1). All patients were in the acute phase of stroke (less than 4 weeks) with a flaccid arm with no history of shoulder pain. The number of pain-free days associated with treatment was significantly greater; (mean difference: 13.6 days, 95% CI 9.7 to 17.8,  $p < 0.0001$ ); however, the results from only two studies were included in the pooled result. Among two RCTs that examined the use of strapping, specifically to prevent the development of shoulder pain, the results were conflicting (Hanger et al. 2000, Griffin & Bernhardt 2006). In a recent RCT, the use of the tri-pull method of taping paired with conventional therapy (experimental group) was compared to a sham taping with therapy; results demonstrated a significant reduction in pain among the experimental group (Pandian et al. 2013). A recent meta-analysis, including the results from five RCTs, reported that shoulder positioning programs were not effective in preventing or reducing the range of motion loss in the shoulders' external rotation (Borisova & Bohannon 2009).

Ada and Foongchomcheay (2002) conducted a meta-analysis to examine the effect of electrical stimulation on shoulder subluxation following stroke. Participants with subluxation or shoulder muscle paralysis in both the acute and chronic stages of stroke, from seven RCTs were included. The results suggested that early treatment, starting with electrical stimulation for 2 hours per day increasing to between 4 and 6 hours per day, in addition to conventional therapy helps to prevent the development of hemiplegic shoulder while later treatment helps to reduce pain. A systematic review of 14 studies conducted by Mathieson et al. (2014) found that the use of functional electrical stimulation (FES) plus imagery (mirror therapy or mental imagery) was the most effective treatment compared to passive and active assisted therapy, while usual care plus FES was also beneficial. In a RCT by Manigandan et al. (2014), participants received either electrical stimulation to the supraspinatus and posterior deltoid plus physio- and occupational therapy for 5 weeks (group 1), or electrical stimulation to the supraspinatus, posterior deltoid and long head of the bicep plus physio- and occupational therapy for 5 weeks (group 2). The authors found that group 2 improved significantly compared to group 1 in the reduction of shoulder subluxation, improvement of passive pain free external rotation, and improvement in range of active shoulder abduction ROM. Church et al. (2006) randomized 176 patients to receive active or sham surface FES treatments in addition to conventional therapy, for four weeks following acute stroke. There was no significant difference in prevalence of pain between groups post intervention. Koyuncu et al. (2010) also reported no differences in shoulder pain of all patients during resting, passive range of motion or active range of motion following 20 sessions of surface FES in addition to inpatient rehabilitation, compared with patients who did not receive electrical stimulation treatments. An RCT by de Jong et al. (2013) compared the effects of arm stretch positioning combined with motor amplitude NMES in relation to sham arm positioning with sham NMES. No significant differences in shoulder pain between the control and experimental group were observed at 8 weeks.

There is evidence that treatment with botulinum toxin type a (BTX-A) may help to improve hemiplegic shoulder pain, but the results from systematic reviews and RCTs are not consistent. A Cochrane review (Singh & Fitzgerald 2010) examined the efficacy of the use of BTX-A toxin in the treatment of shoulder

pain. Six RCTs were included, five of which included patients with post-stroke shoulder pain. Treatment with BTX-A was associated with reductions in pain at 3 and 6 months, but not at 1 month following injection. De Boer et al (2008) randomized 22 patients, an average of 6 months following stroke with significant shoulder pain to receive a single injection of 100 U Botox or placebo to the subscapularis muscle. In addition, all patients received some form of physical therapy. While pain scores improved in both groups over time, there was no significant difference at 12 weeks following treatment, nor was there significant improvement between groups in degree of humeral external rotation.

Intra-articular corticosteroids injections may also help to improve symptoms of shoulder pain. Rah et al. (2012) randomized 58 patients with chronic shoulder pain (at least 3/10 on a Visual Analog Scale (VAS)) to receive a single subacromial injection of 40 mg triamcinolone acetonide or lidocaine (control condition). All patients participated in a standardized exercise program. There was significant reduction in the average shoulder pain level at day and night, measured on a 10 cm VAS at 8 weeks associated with steroid injection. In contrast, Snels et al. (2000) reported that in 37 patients with hemiplegic shoulder pain ( $\geq 4$  on a 0 to 10 VAS) randomized to receive three injections (1-2 weeks apart) of 40 mg triamcinolone acetonide or placebo, active treatment was not associated with improvements in pain scores three weeks later. Dogan et al. (2013) found that compared to traditional rehabilitation alone, the addition of intra-articular steroid, and intra-articular steroid plus hydraulic distention significantly improved range of motion immediately after treatment and at 1 month follow-up. Both steroid groups had significant improvements on VAS score at rest and during activity but the group which received steroid plus hydraulic distention were significantly more effective than only the intra-articular steroid injection and therapy.

There is no definitive therapeutic intervention for complex regional pain syndrome (CRPS). Although a wide variety of preventative measures and treatments have been used including exercise, heat, contrast baths, hand desensitization programs, splints, medications, and surgical options, there is little evidence that many of the commonly-used treatments are effective. Although physiotherapy is regarded as the cornerstone of integrated treatment, no controlled trials have been conducted to evaluate its effect in preventing the development of CRPS. There is some evidence that a two-week, tapering dose of 32 or 40 mg of oral corticosteroids is more effective than either NSAIDs or placebo in improving symptoms of CRPS (Bruas et al. 1994, Kalita et al. 2006). An overview conducted by O'Connel et al. (2013) evaluated 19 studies that used a variety of interventions to treat pain, disability, and CRPS. The authors found moderate quality evidence that intravenous regional blockade with guanethidine is not effective in CRPS and is associated with adverse events. Low quality evidence was found for biphosphates, calcitonin or daily IV of ketamine for the treatment of pain compared to a placebo. Both motor imagery and mirror therapy may be effective for the treatment of pain compared to a control condition. There is some evidence that local anaesthetic sympathetic blockade, physiotherapy, and occupational therapy are not effective for CRPS.

[Link to evidence tables and reference list for Section 5.2](#)



## 6.1 Mobility, Balance and Transfer

### Stroke Rehabilitation Update 2015

### 6.1 Mobility, Balance and Transfer

***Definition:** For the purposes of 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.*

#### 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 over-ground training is not available or appropriate. [Evidence Level: Early-Level A; Late-Level A].
- iv. Electromechanical (robotic) assisted gait training devices could be considered for patients who would not otherwise practice walking. They should not be used in place of conventional gait therapy. [Evidence Level: Early -Level A; Late-Level A].
- v. Rhythmic auditory stimulation (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. Functional electrical stimulation (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].

#### Rationale

Stroke frequently affects balance and the use of the legs. Walking is a valued function by patients to facilitate every day interaction. Along with the goal of increasing a patient's safety and ability to walk, basic abilities to stand and transfer safely must also be addressed. To ambulate safely, patients may require assistive devices such as a cane or walker. For walking to be a feasible alternative to wheelchair mobility, critical elements would include having a reasonable walking speed, endurance and balance.

Unfortunately, some individuals may not achieve independence in walking and may require a wheelchair.

### System Implications

To achieve timely and appropriate assessment and management of basic mobility, postural control, lower extremity function, gait, and transfer skills, the organization/rehabilitation setting requires:

- Organized stroke care, including stroke rehabilitation units with a critical mass of trained staff and an interprofessional team during the rehabilitation period following stroke.
- Initial and ongoing standardized assessment performed by clinicians trained and experienced in stroke rehabilitation.
- Timely access to specialized, interprofessional stroke rehabilitation services as defined in recommendations.
- Timely access to appropriate intensity of rehabilitation for stroke survivors, including sit to stand training as defined in recommendations.
- Access to required supportive devices and equipment to promote safety and independence. This equipment should be affordable. Processes should be in place to ensure proper assessment of patients to meet equipment needs (e.g., seating assessments).
- Access to ECG monitored exercise stress testing and experienced physician to develop appropriate intensity of aerobic exercise.

### Performance Measures

1. Extent of change (improvement) in functional status on the 6-Minute Walk Test from admission to an inpatient rehabilitation program to discharge. Change (improvement) in functional status scores (e.g., FIM® Instrument sub score locomotion) from admission to an inpatient rehabilitation program to discharge.
2. Median length of time from stroke admission in an acute care hospital to assessment of rehabilitation potential by a rehabilitation healthcare professional.
3. Median length of time spent in active rehabilitation on a stroke rehabilitation unit during inpatient rehabilitation.
4. Median hours per day (minimum of three) of direct task-specific therapy provided by the interprofessional stroke team.
5. Median days per week (minimum of five) of direct task specific therapy provided by the interprofessional stroke team.
6. Extent of change (improvement) in functional status score (e.g., CMSA lower limb sub scale) from admission to an inpatient rehabilitation program to discharge.
7. Extent of change in functional status scores using a standardized assessment tool (e.g., FIM® Instrument) from admission to an inpatient rehabilitation program to discharge (average and median).
8. Extent of change in lower limb functional status using a standardized assessment tool (e.g., Chedoke-McMaster Stroke Assessment sub scale) from admission to an inpatient rehabilitation program to discharge.
9. Extent of change in lower limb spasticity scores using a standardized assessment tool (e.g., Modified Ashworth Scale) from admission to an inpatient rehabilitation program to discharge.

### Measurement Notes:

- Therapy time may be extracted from rehabilitation professional workload measurement systems where available.
- The 5m or 10m gait speed test may be used as the most basic measurement for those not able yet to do 6 minute walk test.

- Ensure consistency in start time for any time-sensitive

## Implementation Resources and Knowledge Transfer Tools

### Health Care Provider Information

- Canadian Stroke Best Practices *Taking Action Towards Optimal Stroke Care*: [http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- FIM® Instrument: <http://www.strokengine.ca/assess/fim/>
- AlphaFIM® Instrument: [http://www.udsmr.org/WebModules/Alpha/Alp\\_About.aspx](http://www.udsmr.org/WebModules/Alpha/Alp_About.aspx)
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.
- Chedoke-McMaster Stroke Assessment: <http://www.rehabmeasures.org/pdf%20library/cmsa%20manual%20and%20score%20form.pdf>
- Modified Ashworth Scale: [http://strokengine.ca/assess/module\\_mashs\\_intro-en.html](http://strokengine.ca/assess/module_mashs_intro-en.html)
- 6 minute walk test: [http://strokengine.ca/assess/module\\_6mwt\\_intro-en.html](http://strokengine.ca/assess/module_6mwt_intro-en.html)
- Fugl-Meyer Assessment: [http://strokengine.ca/assess/module\\_fma\\_intro-en.html](http://strokengine.ca/assess/module_fma_intro-en.html)
- Functional Ambulation Categories: [http://strokengine.ca/assess/module\\_fac\\_intro-en.html](http://strokengine.ca/assess/module_fac_intro-en.html)
- Timed Up and Go Test: [http://strokengine.ca/assess/module\\_tug\\_family-en.html](http://strokengine.ca/assess/module_tug_family-en.html)
- 6-Minute Walk Test: [http://strokengine.ca/assess/module\\_6mwt\\_family-en.html](http://strokengine.ca/assess/module_6mwt_family-en.html)
- Berg Balance Scale: [http://strokengine.ca/assess/module\\_bbs\\_intro-en.html](http://strokengine.ca/assess/module_bbs_intro-en.html)

### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery: <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)

## Summary of the Evidence

### Physiotherapy Approaches

Many studies have examined specific therapeutic approaches to improve functioning of the lower extremity. A

Cochrane review by Pollock et al. (2007) examined the efficacy of various treatment approaches for lower limb rehabilitation. The results from 21 RCTS were included; eight trials examined neurophysiological approaches, eight examined motor learning approaches, and eight examined mixed approach. The authors reported that a mixed approach 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.

### **Task Oriented Training (Task-Specific Training)**

Task oriented training (also called task-specific training) involves practicing real-life tasks, with the intention of acquiring or reacquiring a skill. The tasks should be challenging and progressively adapted and should involve active participation. Evidence suggests that this type of therapy helps to improve gait speed and endurance. A Cochrane review by English and Hillier (2010) pooled findings from six RCTs that examined repetitive practice of functional tasks arranged in a circuit with the aim of improving mobility. Compared with the control condition, there were significant improvements in performance on the 6-Meter Walk Test (6MWT; MD=76.6 m, 95% CI 38.4 to 114.7,  $p<0.0001$ ) and gait speed (MD=0.12, 95% CI 0.0 to 0.24,  $p=0.043$ ), but not on measures of balance or on Timed Up and Go (TUG). More recently, Van de Port et al. (2012) recruited 250 stroke in-patients who were able to walk 10 m without physical assistance and were randomized to receive a graded task specific circuit training program or usual outpatient physiotherapy. After 24 weeks, patients in the task-specific therapy group had significantly higher scores on the mobility sub-scale of the Stroke Impact Scale (SIS) and increased distance walked on the 6MWT, compared with patients in the control group. Salbach et al. (2004, 2005) randomized 91 community-dwelling participants with a residual walking deficit within one year of stroke to an intervention group which comprised 10 functional tasks designed to strengthen the lower extremities and enhance walking balance, speed and distance or to a control intervention focusing on upper extremity activities. Patients in the active intervention group walked a further distance on the 6MWT and increased their comfortable and maximal walking speed to a greater degree compared with patients in the control group.

### **Treadmill Training without Body Weight Support**

Treadmill training can also be used to increase walking speed, endurance and distance late post stroke. Macko et al. (2005) reported that 61 chronic stroke patients with hemiparetic gait patients who received 6 months of progressive treadmill aerobic exercise program had significantly greater improvement in ambulatory performance and mobility function compared with patients in a control group who received a program of stretching plus low-intensity walking. Langhammer and Stanghelle (2010) reported that patients in the treadmill group had better walking speed, endurance, and walking distance following an intervention consisting of 30 minute treadmill training sessions, five days per week for 2.5 weeks versus a control intervention consisting of outdoor walking. Nadeau et al. (2013) conducted an RCT in which participants received one of three treatment options: 1) a locomotor training program (LTP) consisting of treadmill training with over ground training; 2) a home exercise program (HEP) with a focus on balance, strengthening, and coordination; or 3) usual care. Treatment consisted of a total of 30-36 sessions, 3 times per week, each lasting 90 minutes. Improvements in walking speed, the Fugl-Meyer, Berg Balance Scale (BBS), and the modified Rankin Scale were demonstrated by all groups. Greater improvements were demonstrated by both the LTP and HEP groups compared to the usual care group on the BBS and physical mobility.

### **Treadmill Training with Body Weight Support (BWSTT)**

Treadmill training with body weight support may also be effective for patients with initial poor ambulatory status, although the evidence is less clear. Duncan et al. (2011) randomized 408 community-dwelling patients with stroke onset of 2 months, who were able to walk 3 metres with maximum of one person assist, to receive a 3-4 month course of early or delayed treadmill training with partial body-weight support or to a home-based exercise program. At one-year, 52% of all patients had improved functional walking ability. There was no difference in the proportion of improvement found among the 3 groups. In the MOBILISE trial, (Ada et al. 2010, Dean et al. 2010) 126 patients within 28 days of stroke were randomized to an experimental or a control group and received treatment until they achieved independent walking or for as long as they remained in hospital. Participants in both groups received 30 minutes of walking practice 5 days/week. Additional lower-limb therapy was provided for an additional 30 minutes/day. Participants in the experimental group undertook up to 30 minutes per day of treadmill walking with sufficient body weight support such that initially, the knee was within 15 degrees of extension in mid stance. The control group received up to 30 minutes of over-ground walking training, with the use of aids, if required. Although there were no differences in the proportion of independent ambulators between groups at one, two or 6 months, participants in the experimental group achieved independence in ambulation a median of 14 days sooner. Kelley et al. (2013) randomized individuals to receive either robotic-assisted body weight supported treadmill training on the Lokomat or traditional over-ground gait training. Treatment sessions were 1 hour in length, 5 days a week, for 8

weeks. No significant differences were identified between groups at post intervention, or at the 3 month follow-up. In a study comparing treadmill training based real-world video recording (TRWVR) to normal treadmill walking, with all participants still receiving standard therapy, Cho and Lee (2014) found significant improvements by both groups on the BBS, TUG test, gait speed, cadence, single limb support period, double limb support period, step length and stride length. On these same measures the TRWVR group improved significantly more than the control group. Furthermore, Riberio et al. (2013) evaluated the effects of treadmill training with partial body-weight support (TPBWS) to proprioceptive neuromuscular facilitation (PNF). Following training, both groups improved significantly on the Stroke Rehabilitation Assessment of Movement (STREAM), Functional Independence Measure (FIM®), and symmetry ratio. Maximum ankle dorsiflexion over the swing phase was significantly greater than the TPBWS group. Lee et al. (2013) compared body weight support treadmill training with power assisted FES to BWSTT alone. It was found that both groups improved significantly on the BBS, TUG, STREAM, velocity, cadence, paretic side step length and stride length, with the BWSTT with FES group improving more on every measure. Bonnyaud (2014) conducted a similar study in which participants received experimental Lokomat training with a negative kinematic constraint on the non-paretic limb and a positive kinematic constraint on the paretic limb, or conventional Lokomat training. No statistically significant between-group differences were noted on any of the measures such as gait velocity, step length, and cadence. In addition, Ada et al. (2013) compared three different treatments: 1) treadmill and over ground walking for 30 minutes, 3 times per week, for either 2 or 4 months; or 2) no intervention. The authors found that there were no between-group differences on walking speed, the EuroQoL, the Adelaide Activities Profile, or the Walking Self-Efficacy Scale. The 4-month training group walked further than the control group at 2 and 4 months, but not at 12 months; furthermore, the 2-month training group walked further than the control at 2 months but not at 4 months.

### **Aerobic Training**

Aerobic training can be used to improve measures of gait performance. A Cochrane review (Brazzelli et al. 2011) included the results from 32 trials of patients in both the acute and chronic stages of stroke. Interventions were classified as 1) Cardiorespiratory training versus usual care, 2) Resistance training versus usual care and 3) Mixed training interventions, which included combinations of cardiorespiratory and resistance training methods. At the end of follow-up, cardiorespiratory training was not associated with reductions in disability (measured by FIM), but maximal and preferred walking speed and walking capacity were significantly improved. Increased gait speed and improved walking capacity were also associated with mixed training interventions. Pang et al. (2006) also conducted a systematic review of aerobic exercise following stroke, which included the results from 7 RCTs, evaluating patients in all stages of stroke recovery. Exercise intensity in the included studies ranged from 50% to 80% of heart rate reserve, while duration varied from 20-40 min for 3-5 days a week for 3-19 weeks. Regardless of the stage of stroke recovery, there was a significant benefit of therapy. Improvements were noted in the parameters of peak  $\text{VO}_2$ , peak workload, walking speed and endurance. Jin et al (2012) and Globas et al. (2012) reported significant improvements in measures of cardiovascular fitness, walking ability and performance in patients more than 6 months post stroke who had received a progressive graded, high-intensity aerobic treadmill exercise or aerobic cycling exercise, with lower extremity weights. MacKay-Lyons et al. (2013) reported that a 12-week aerobic conditioning program using body-weight supported treadmill training was associated with improvements in cardiovascular fitness and walking ability that were sustained for one year. According to the Aerobic Exercise Recommendations to Optimize Best Practices in Care After Stroke (AEROBICS) 2013 guidelines, there is a strong recommendation for the inclusion of aerobic training into stroke rehabilitation, as well as the use of task-specific exercises that engage large muscle groups. The panel also strongly recommends a minimum of 8 weeks of aerobic exercise to ensure clinically meaningful training effect, but they also recommend aerobic exercise indefinitely in order to maintain the health benefits. Moreover, the guidelines strongly recommend physical activity for a minimum of 3 days per week, but they suggest most days of the week. A strong recommendation is also made for exercise session to last a minimum of 20 minutes with a cool-down portion lasting between 3 and 5 minutes. Finally, to ensure safe aerobic exercise, there is a strong recommendation to adjust the intensity of aerobic activity based on individual parameters (e.g., stress test, health status, etc.).

### **Electromechanical/Robot-Assisted Gait Training Devices**

In an updated Cochrane review (Mehrholtz et al. 2014), 23 studies (999 subjects) were examined to determine the effectiveness of electromechanical and robot-assisted gait training for improving walking after stroke. Treatments included electromechanical and robot-assisted gait training devices (with or without electrical stimulation) which are designed to assist stepping cycles by supporting body weight and automating the walking therapy process with the addition of physiotherapy compared with physiotherapy or routine care only. Treatment was not associated with increases in gait speed. The odds of becoming an independent ambulator was significantly increased for all patients (OR 2.39, 95% CI 1.67-3.43;  $p < 0.00001$ ), but particularly more so for those who had experienced their stroke  $< 3$  months previously (OR=2.75, 95% CI 1.86 to 4.08,  $p < 0.00001$ ). Morone et al. (2011, 2012) included 48 participants, an average of 20 days post stroke, stratified by motor impairment (high vs. low). All patients underwent standardized rehabilitation for 3 months. After one week of therapy, participants in the robotic group underwent additional robotic-



assisted gait training instead of a second therapy session (20 sessions in total). Participants in the control group participated in a second therapy session. At the end of treatment participants in the low impairment robot group had improved significantly more than participants in the low impairment control group on the Functional Ambulation Category (FAC) ( $p<0.001$ ), the Rivermead Mobility Index ( $p=0.001$ ) and the 6-Minute Walk test ( $p=0.029$ ). Although participants in the high impairment groups also improved over time, there were no significant between-group differences on any of the outcomes. At 2 year follow-up, patients in the low impairment robot group continued to demonstrate significantly improved scores, while there were no significant differences between groups for highly-impaired patients. In a recent RCT by Dragin et al. (2014), the use of the Walkaround was compared to conventional training. Sessions lasted 30 minutes per day, 5 days per week, over a period of 4 weeks. After treatment concluded, the experimental group improved significantly greater than the control group in terms of gait speed and Berg Balance Scale score, these differences were also demonstrated at 6 months post treatment.

### **Balance Training**

In a recent RCT by Mohan et al. (2013), participants engaged in either mirror therapy with conventional therapy, or conventional rehabilitation alone. Both groups improved significantly on the FMA-LE, and Brunel Balance Assessment; however, there were no between-group differences. On the Functional Ambulation Categories, the mirror therapy group improved significantly, while the conventional treatment did not.

### **Strength Training**

Strength training is an essential component of lower limb rehabilitation following stroke. Flansbjerg et al. conducted an RCT (2008) and a 4 year follow-up (2012) study comparing chronic stroke patients who underwent supervised progressive resistance training of the knee extensors and flexors (80% of maximum; 2 times per week for 10 weeks) to those who continued their usual daily activities. The authors found that muscle strength in the intervention group improved significantly compared to the control group and these results were maintained at the 4 year follow-up. There was no reduction in strength in the control group; however, between-group differences were still significant for both isotonic and isokinetic strength. Following the intervention there was an increase in gait performance for both groups; however, at the 5 month follow-up in the first study only the TUG and perceived participation were significantly better among the training group participants. There were no significant between-group differences in muscle tone, gait performance, or perceived participation at the four year follow-up. Furthermore, in an RCT by Cooke et al. (2010), participants with subacute stroke (mean 1 month) were randomized to one of three treatment groups for 6 weeks: 1) conventional physiotherapy (CPT) + Functional Strength training (FST); 2) extra intensity training (CPT + CPT); or 3) CPT alone. At post intervention both experimental groups showed improvement in walking speeds over the CPT alone group, but this reached significance in the CPT + CPT group. The CPT + CPT group also showed significant improvement in the number of participants with a walking speed over 0.8m/s compared to the CPT group. No significant differences were noted between-groups for torque about the knee, symmetry step length, symmetry step time, the Rivermead score, or on the EuroQoL. At the 12 week follow-up no significant differences were identified between groups.

### **Virtual Reality**

An RCT by McEwan et al. (2014) compared the effectiveness of a virtual reality exercise program for balance (that challenged balance) plus standard rehabilitation to a VR program (that did not challenge balance) plus standard rehabilitation. The experimental group improved significantly more than the control group on the Chedoke McMaster Stroke Scale leg domain post treatment and at 1 month follow-up. The two groups did not differ significantly on the TUG or TMWT.

### **Ankle-Foot Orthoses (AFO)**

The use of ankle-foot orthoses is widespread, although there are few controlled trials examining its benefit. When patients who had been wearing an AFO regularly for the previous 6 months were assessed with and without the orthosis, measures of gait speed were significantly better when the AFO was worn (de Wit et al. 2004). Similarly, when 58 patients who had never worn the device previously were assessed with, and without an AFO two hours apart, measures of balance and gait speed were significantly better when the AFO was worn (Wang et al. 2007). In 32 chronic stroke survivors who were randomized to wear or not wear an AFO for a period of three months, gait speed was significantly increased as was and Physiological Cost Index (beats/min) in patients who had worn the device. Tyson and Kent (2013) recently conducted a systematic review, including the results from 13 crossover RCTs. During a single testing session, participants performed significantly better on measures on balance (weight distribution:  $SMD=0.32$ , 95% CI -0.52 to -0.11,  $p=0.003$ ) and mobility (gait speed:  $MD=0.06$  m/s, 95% CI, 0.03 to 0.08,  $p<0.0001$  and stride length:  $SMD=0.28$ , 95% CI 0.05 to 0.51,  $p=0.02$ ) while wearing an AFO compared with control condition where an AFO was not worn. There were no significant treatment effects associated with the

outcomes of postural sway and timed mobility tests. In another RCT, Clark and Patten (2013) evaluated chronic stroke participants who received either concentric resistance training (CON) or eccentric resistance training (ECC); both groups also received gait training. Both groups improved significantly on self-selected walking speeds, and fast walking speed; however, no significant between-group differences were noted for either measure.

### Functional Electrical Stimulation (FES)

Functional electrical stimulation (FES) can be used to improve gait quality in selected patients who are highly motivated and able to walk independently or with minimal assistance. FES has been studied extensively with RCTs; however, the results of a Cochrane review (Pomeroy et al. 2006) including the results from 24 RCTs, of which 12 included interventions and outcomes associated with mobility, suggest that treatment is not associated with significant increases in gait speed (SMD= -0.02, 95% CI -0.30 to 0.26) or stride length (SMD=0.36, 95% CI -0.93 to 1.63). Ambrosini et al. (2011) did report significant improvement in Motricity Index scores (leg subscale) and the Trunk Control Test in 35 lower-functioning patients randomized to receive FES-induced cycling training using a motorized cycle-ergometer. Tan et al. (2014) performed a RCT evaluating 45 participants who sustained a first time ischemic stroke (within 3 months of onset) and received FES or placebo. A significant difference in Fugl Meyer Assessment – Lower extremity motor (FMA-LE) scores after treatment was found between the four channel and dual-channel groups ( $p = 0.024$ ), but not between the four-channel and placebo groups ( $p = 0.062$ ). After treatment a significant difference between the four-channel and placebo groups was found in the PASS ( $p = 0.031$ ) and Berg Balance Scale (BBS) ( $p = 0.022$ ). On the Modified Barthel Index (MBI), the four-channel group had significantly greater improvement compared to the placebo ( $p = 0.039$ ) and dual channel groups ( $p = 0.021$ ). Significant differences were found only between the four-channel and placebo groups on the BBS ( $p = 0.028$ ), and MBI ( $p = 0.047$ ) at the 3 month follow up. In study examining 18 participants with stroke and receiving FES or sham, Chung et al. (2014) reported that participants had a manual muscle test grade below 2 and ability to walk 10m without assistance. The experimental group showed a significant improvement in gait velocity ( $p = 0.010$ ), cadence ( $p = 0.040$ ), stride length of the affected side ( $p = 0.015$ ), and stride length of the less affected side ( $p = 0.030$ ). No significant improvements were shown in the control group. Therefore, greater improvements were shown for the experimental versus control group ( $p < 0.05$ ). Greater improvements were shown through the mean BBS scores for the experimental versus control group ( $p < 0.001$ ). Spaich et al. (2014) conducted an RCT evaluating 30 individuals within 9 weeks from post stroke. Participants were capable of walking a maximum of 10 metres without help from therapists. Participants all received intensive physiotherapy-based gait training; however, the treatment group had gait training in combination with activation of the nociceptive withdrawal reflex by FES (NWR-FES). Preferred walking velocity and maximum walking velocity was significantly faster for the NWR-FES group post-treatment ( $p < 0.001$ ). Those with severe walking impairment at inclusion in the treatment group showed the best improvement on duration of stance on paretic side ( $p < 0.002$ ), and a shorter duration of gait cycle ( $p < 0.002$ ). Stance symmetry ratio was also significantly better for the treatment group after training ( $p < 0.02$ ).

### Neuromuscular Electrical Stimulation (NMES)

Neuromuscular stimulation is another form of stimulation that has been used for improving functionality in a variety of populations. An RCT by Knutson et al. (2013) involving 24 stroke patients (onset  $\geq 6$  months) with foot drop during ambulation and less than normal ankle dorsiflexion strength (Medical Research Council Scale score of  $\leq 4/5$ ) were enrolled. Patients were randomized into 6 weeks of treatment in either the contralaterally controlled neuromuscular electrical stimulation (CCNMES) group ( $n = 12$ ) or the cyclic neuromuscular electrical stimulation (NMES) group ( $n = 12$ ). The assigned stimulator was used at home and both groups also received conventional post-stroke gait training from a physiotherapist in lab sessions. The primary outcome was FMA-LE; there were no significant differences between groups in the outcome trajectories for any of the measures. When the data after treatment from both groups was pooled, there were significant changes shown for the modified Emory Functional Ambulation Profile ( $p = 0.01$ ) and the FMA-LE ( $p < 0.01$ ).

### Foot Drop Stimulators

Foot drop stimulators have been used to improve foot drop post stroke. Kluding et al. (2013) reported results from a randomized cross-over study of 197 participants who sustained a stroke  $\geq 3$  months before intervention and had a gait speed of  $\leq 0.8$  m/s. Patients were randomized into either the foot drop simulator (FDS) or the standard AFO group. Both groups received physical therapy treatment as well. At 30 weeks, the AFO group switched to FDS and continued for 12 weeks, whereas the FDS group continued with the same treatment. At 30 weeks, significant improvements were identified in both groups for comfortable and fast gait speed ( $p < 0.001$ ). However, between groups, immediate device effects were shown for fast gait speed ( $p = 0.018$ ) and BBS ( $p = 0.039$ ) and for long-term effect on the BBS ( $p = 0.022$ ). User Satisfaction was significantly higher in the FDS group compared to the standard treatment with the AFO ( $p < 0.001$ ). Sheffler et al. (2013) conducted a RCT including 110 individuals with hemiparetic stroke ( $\geq 12$  weeks post stroke). Participants could ambulate  $\geq 30$  ft. without an AFO and  $\geq 24$  on the BBS. Participants

were placed in either an ambulation training group with peroneal nerve stimulator (PNS – Odstock Dropped-Foot Stimulator), or usual care group (AFO or no device). The primary outcome was FMA-LE. There was no significant treatment group main effect on the FMA-LE ( $p=0.797$ ), the mEFAP ( $p=0.968$ ), or the SSQOL scale ( $p=0.360$ ). Another study examined the use of Walkaide and Ankle Foot Orthosis (AFO) (Everaert et al. 2013). The participants were randomized into three groups: 1) WalkAide then AFO; 2) AFO then WalkAide; or 3) AFO for both phases. Each phase lasted 6 weeks. All groups significantly improved on the Figure-8 task, the 10m walk, and the modified Rivermead Mobility Index. Walking performance, as measured by the Figure-8 and 10m walk were not significantly different between the WalkAide and AFO after the first or second phase. Greater orthotic effect was shown at phase 1 and 2 for the AFO compared to the WalkAide.

[Link to evidence tables and reference list for Section 6.1](#)

## 6.2 Lower Limb Spasticity following Stroke

Stroke Rehabilitation Update 2015	6.2 Lower Limb Spasticity following Stroke
<ol style="list-style-type: none"> <li>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].</li> <li>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].</li> <li>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].</li> <li>iv. Oral medications can be prescribed for the treatment of disabling spasticity: <ol style="list-style-type: none"> <li>i. Tizanidine can be used to treat more generalized, disabling spasticity. [Evidence Levels: Early-Level C; Late-Level B].</li> <li>ii. Baclofen can be used as a lower cost alternative to treat more generalized disabling spasticity [Evidence Levels: Early-Level C; Late-Level C].</li> <li>iii. Benzodiazepines should be avoided due to sedating side effects, which may impair recovery [Evidence Level: Early-Level C; Late-Level C].</li> </ol> </li> <li>v. The presence of spasticity should not limit the use of strength training in the leg [Evidence Level: Early-Level C; Late-Level C].</li> <li>vi. Intrathecal Baclofen should be considered for specific cases of severe intractable and disabling/painful spasticity [Evidence Level: Late-Level B].</li> </ol>	
Rationale	
<p>Spasticity, defined as a velocity dependent increase of tonic stretch reflexes (muscle tone) with exaggerated tendon jerks can be painful, interfere with functional recovery and hinder rehabilitation efforts. If not managed appropriately, stroke survivors may experience a loss of range of motion at involved joints of the ankle and foot, which can cause difficulties with ambulation.</p>	
System Implications	
<p>To achieve timely and appropriate assessment and management of lower limb spasticity the organization requires:</p> <ul style="list-style-type: none"> <li>• Organized stroke care, including stroke rehabilitation units with a critical mass of trained staff and an interprofessional team during the rehabilitation period following stroke.</li> <li>• Initial and ongoing assessments performed by clinicians experienced in stroke rehabilitation both in hospital and in the community.</li> <li>• Assessment for an orthotic/splint/brace should be considered to ensure safety.</li> <li>• Timely access to specialized, interprofessional stroke rehabilitation services as defined within the best practice recommendations.</li> <li>• Timely access to appropriate intensity of rehabilitation for stroke survivors as defined within the best practice recommendations.</li> <li>• Funding for chemodenervation and associated post injection rehabilitation services where necessary. May require access to electromyography or ultrasound to facilitate localization of the motor points for injections.</li> </ul>	

## Performance Measures

1. Extent of change in functional status scores using a standardized assessment tool (e.g., FIM® Instrument) from admission to an inpatient rehabilitation program to discharge (average and median).
2. Extent of change in lower limb functional status using a standardized assessment tool (e.g., Chedoke-McMaster Stroke Assessment sub scale) from admission to an inpatient rehabilitation program to discharge.
3. Extent of change in lower limb spasticity scores using a standardized assessment tool (e.g., Modified Ashworth Scale) from admission to an inpatient rehabilitation program to discharge.
4. Median length of time from stroke admission in an acute care hospital to assessment of rehabilitation potential by a rehabilitation healthcare professional.
5. Median length of time spent in active rehabilitation on a stroke rehabilitation unit during inpatient rehabilitation.
6. Median total length of time spent on a stroke rehabilitation unit during inpatient rehabilitation.

### Measurement Notes:

- Ensure consistency in start time for all time-based measures, and document the definition of start and stop times for transparency and replication.

## Implementation Resources and Knowledge Transfer Tools

### Health Care Provider Information

- Canadian Stroke Best Practices *Taking Action Towards Optimal Stroke Care*:  
[http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- FIM® Instrument: <http://www.strokengine.ca/assess/fim/>
- AlphaFIM® Instrument: [http://www.udsmr.org/WebModules/Alpha/Alp\\_About.aspx](http://www.udsmr.org/WebModules/Alpha/Alp_About.aspx)
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.: Summary of Validated and Frequently Used Screening and Assessment Tools for Stroke Rehabilitation
- Chedoke-McMaster Stroke Assessment:  
<http://www.rehabmeasures.org/pdf%20library/cmsa%20manual%20and%20score%20form.pdf>
- Modified Ashworth Scale: [http://strokengine.ca/assess/module\\_mashs\\_intro-en.html](http://strokengine.ca/assess/module_mashs_intro-en.html)

### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery:  
[http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory:  
[http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.97294](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.97294)

[6853.1415208838](#)

- Stroke Engine: <http://strokengine.ca/> Heart and Stroke Foundation Canadian Partnership for Stroke Recovery: <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)

## Summary of the Evidence

Few studies have been published examining the prevention or treatment of spasticity or contracture using antispastic pattern positioning, range of motion exercises, stretching and/or splinting in the lower extremity. 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. 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 lower extremity is not as well-studied compared with the upper extremity. A meta-analysis (Foley et al. 2010), which included the results from 8 studies reported a moderate increase in gait speed associated with BTX-A (SMD= 0.193±0.081, 95% CI 0.033 to 0.353,  $p < 0.018$ ). In a recent randomized controlled trial Picelli et al. (2014) compared three different treatments among chronic stroke patients. Individuals were randomized to receive ultrasound, transcutaneous electrical stimulation, or Botox®. Picelli et al. (2014) reported that patients receiving Botox® had significantly greater improvement of spasticity (modified Ashworth Scale) compared to individuals in the other treatment groups. Dunne et al. (2012) randomized 85 stroke patients ( $\geq 6$  weeks post stroke) to receive a single injection of 200 U ( $n=28$ ), 300 U Botox® ( $n=28$ ) or saline. When the results from the two Botox® groups were combined, there was significantly greater improvement in Ashworth Scale scores, pain, spasm frequency, and the number of patients who experienced at least a 15% increase in ankle dorsiflexion, at 12 weeks. Kaji et al. (2010) randomized 120 patients with lower limb spasticity following stroke greater than six months to receive a single treatment of 300 U Botox® or placebo. There was a significantly greater mean reduction in modified Ashworth Scale scores at weeks four, 6 and 8 in the treatment group compared with the control group; however, there were no significant differences between groups at week 10 or 12. Two pre-post studies studied the effect of Botox® on lower limb spasticity (modified Ashworth Scale) and found significant improvement at both 30 and 90 days post-injection (Sanamato et al. 2013a, 25-100 U; Sanamato 2013b, 250-340 U). Pittock et al. (2003) compared escalating doses of BTX-A with placebo and found that the highest dose (1,500 U Dysport®) was associated with the greatest relief of calf spasticity compared with placebo at four, eight and 12 weeks following treatment. Lower doses (500 and 1,000 U) resulted in significant reductions in spasticity at week four only. Burbaud et al. (1996) randomized 23 adult hemiparetic stroke patients with ankle plantar flexor and foot inverter spasticity to receive a single injection of BTX-A and one of placebo in random order, at day 0 and day 90). Following active treatment, there was a significant reduction in spasticity associated with the ankle movement (extensors and invertors).

Intrathecal baclofen is popular treatment for spasticity in many populations including stroke, spinal cord injury, and cerebral palsy. Meythaler et al. (2002) performed a cross-over randomized controlled trial among individuals with chronic stroke. At one year the authors noted that spasticity had improved, as evidenced by a decline in Ashworth scores and reflex scores ( $p < 0.01$  for both); spasm frequency scores did not improve ( $p > 0.05$ ).

[Link to evidence tables and reference list for Section 6.2](#)



## 6.3 Falls Prevention and Management

Stroke Rehabilitation Update 2015	6.3 Falls Prevention and Management
<ol style="list-style-type: none"> <li>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]. <i>Refer to Appendix Table 3: Suggested Screening/Assessment Tools for Risk of Falling Post Stroke. Refer to section 6.2 for recommendations regarding balance.</i></li> <li>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].</li> <li>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].</li> <li>iv. Based on risk assessment findings, an individualized falls prevention plan should be implemented for each patient [Evidence Level B]. <ol style="list-style-type: none"> <li>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].</li> <li>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].</li> <li>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].</li> <li>d. External hip protectors should be considered in stroke patients who are identified as high risk for falls [Evidence Level B].</li> </ol> </li> <li>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].</li> </ol> <p><i>Note: For treatment strategies for risks of falling (e.g. leg weakness, impaired balance, visual disturbances, cognitive impairment, sensory loss), refer to appropriate topics within this module.</i></p>	
<b>Rationale</b>	
<p>Patients with stroke are at higher risk for falls than many other hospitalized patients. The reported incidence ranges from 14 to 65 percent. Falls occur often within the first week following stroke during the acute phase, and then again as patient mobility increases. The interprofessional care team must be cognizant of the risk for falls and ensure appropriate assessments and interventions take place.</p>	
<b>System Implications</b>	
<p>Organizations should provide a falls prevention and management strategy that includes:</p> <ul style="list-style-type: none"> <li>• regular and ongoing education for staff in all hospital settings about risk assessment and prevention strategies related to falls, including transfer and mobilization training;</li> <li>• use of a falls screening tool in all organizations for early recognition of fall risk;</li> <li>• patient transferring and mobilization instructions provided to all staff by physiotherapists and occupational therapists, and provided to patients and families by trained staff members;</li> <li>• delivery of all therapies by trained professionals capable of interacting with people with</li> </ul>	

- communication limitations such as aphasia, by using supported conversation techniques;
- standardized falls risk assessment process within each organization that addresses timing of fall assessments, components, and the need for documentation;
- Universal falls precautions in all environments where stroke patients receive care.

## Performance Measures

1. Fall incidence rate for stroke patients admitted to hospital (acute care or rehabilitation).
2. Percentage of patients with falls who experience injuries during the fall.
3. Percentage of patients with falls who experience a prolonged length of stay as a result of the fall.

## Measurement Notes

- Falls assessments are included as separate documentation in some organizations, and included in interprofessional clinical notes in others.
- The absence of documentation may not reflect whether or not assessments were done.

## Implementation Resources and Knowledge Transfer Tools

### Health Care Provider Information

- Canadian Stroke Best Practices Taking Action Towards Optimal Stroke Care: [http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.: Summary of Validated and Frequently Used Screening and Assessment Tools for Stroke Rehabilitation
- Table 6: Suggested Screening/Assessment Tools for Risk of Falling Post Stroke
- RNAO Prevention of Falls and Fall Injuries in the Older Adult Best Practice Guideline: <http://rnao.ca/bpg/guidelines/prevention-falls-and-fall-injuries-older-adult>
- Berg Balance Scale [http://strokengine.ca/assess/module\\_bbs\\_intro-en.html](http://strokengine.ca/assess/module_bbs_intro-en.html)
- Function in Sitting Test <http://www.samuelmeritt.edu/fist>
- Fall Prevention Screening Tools: <http://www.albertahealthservices.ca/4354.asp>

### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)

- Stroke Engine: <http://strokingengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery: <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)
- Reduce Your Risk for Falls: [http://rmao.ca/sites/rmao-ca/files/Reduce\\_Your\\_Risk\\_for\\_Falls.pdf](http://rmao.ca/sites/rmao-ca/files/Reduce_Your_Risk_for_Falls.pdf)
- Fall prevention brochures and pamphlets: <http://www.health.gov.bc.ca/prevention/fallbrochures.html>

## Summary of the Evidence

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%-39%. Upon return to the community, the risk increases further. Forster & Young (1995) 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. Although observational studies by Maeda et al. (2009) and Said et al. (2013) suggest that patients of an older age are at higher risk of falls ( $p < 0.05$  and  $p = 0.039$ , respectively), Aizen et al. (2007) found that the presence of vertigo was the only significant predictor of falling (OR=9.67, 95% CI 1.15 to 81.85) with age, use of anti-depressants and use anti-hypertensives found to be insignificant. In regards to screening for the potential risk of falls, Nystrom and Hellstrom (2013) reported that the Predict FIRST assessment tool (OR=5.21, 95% CI 1.10 to 24.78,  $p = 0.038$ ) and the Modified Motor Assessment Scale (OR=0.65, 95% CI 0.44 to 0.95,  $p = 0.026$ ) significantly predicted the risk of falling. Additional research from Pinto et al. (2014) suggests that the Timed Up and Go (TUG) test, a tool that measures the patient's ability to stand from a seated position, walk 3 metres then sit back down, was a significant predictor of falling (OR=1.035, 95% CI 1.196 to 5.740,  $p = 0.016$ ).

Teasell et al. (2002) reported that one third of patients on a stroke rehabilitation unit sustained at least one fall during their stay. Of 238 patients, 88 (37%) experienced at least 1 fall, and almost half of these (45 patients [19%]) experienced at least 2 falls, over the 5-year study period. Injuries were reported in 22% of the falls. There were no differences in stroke type ( $P = 0.393$ ), stroke location ( $P = 0.926$ ), or gender ( $P = 0.741$ ) between fallers and nonfallers; however, there were differences in the scores of all functional measurement scores between the groups. The arm, leg, and foot components of the admission Chedoke McMaster scores were significantly lower for fallers compared with nonfallers ( $P < 0.05$ ). Admission Berg Balance Scale scores were significantly lower in fallers when compared with nonfallers ( $19.0 \pm 13.9$  vs.  $30.7 \pm 16.6$ ,  $P < .0001$ ). FIM® scores of nonfallers were higher than fallers ( $P < 0.001$ ) and there was an inverse relationship between admission FIM® scores and the number of falls. The average admission FIM® score for one-time fallers was  $72.4 \pm 19.1$  but declined to  $43.6 \pm 22.9$  for those who had experienced four or more falls ( $P < .0001$ ). When functional deficits between the two groups were compared fallers were more likely to be apraxic ( $P = 0.014$ ) and have cognitive deficits ( $P = 0.010$ ).

Czernuszenko & Czlonkowska (2009) assessed the incidence and circumstances of falls in patients during inpatient stroke rehabilitation, the frequency of fall-related fractures and identified the risk factors for single and repeated falls. Two hundred fifty-two falls were reported in 189 (16.3%) patients during the observation period. The incidence rate for any fall was 7.6 per 1000 patient-days (95% CI 6.6–8.5). Almost two-thirds (65%;  $n = 163$ ) of falls occurred in the first two weeks after admission. Most falls ( $n = 207$ ; 82%) occurred during the day between the hours of 6 am and 8 pm with a peak incidence between 11 am–1 pm. Patients fell during activities that included transfers (34%;  $n = 85$ ), while sitting (21%;  $n = 54$ ) and during position changes such as going from a sitting to standing or standing to sitting position (13%;  $n = 32$ ). Falls from bed accounted for 10 percent ( $n = 24$ ) of the events  $n = 24$  of the events. In 24 cases, falls resulted from inadequate or insufficient staff assistance (5 falls from bed, 19 falls from a wheelchair or toilet bowl). In three cases, patients slid on a wet floor, and falls occurred in three cases due to inadequate assistance by visitors. Seventy-two per cent ( $n = 182$ ) of falls resulted in no injury; 27 percent ( $n = 67$ ) resulted in bruises grazes or lacerations; and 1.2 percent ( $n = 3$ ) resulted in fractures (proximal femur,

humeral bone and pelvis). Other observational studies have found incidence rates varying from 14.7% to 56.3% with mixed stroke (Baetens et al. 2013), lower functional mobility at admission (Mansfield et al. 2013), and 6 and 10-metre walking tests (Morone et al. 2014) being significant predictors of falling. Patients prone to falling have also been shown to have a greater likelihood of being older ( $p=0.05$ ), Caucasian ( $p=0.02$ ) and having lower diastolic blood pressure ( $p=0.01$ ) (Schmid et al. 2013).

There have been very few RCTs conducted evaluating therapies to specifically reduce the occurrence of falls following stroke. Batchelor et al. (2010) conducted a systematic review and meta-analysis to examine the effectiveness of interventions that reduce falls following stroke. The results from 13 RCTs were included. The intervention types examined were classified as: physical therapy, modifying the environment or increasing knowledge, models of stroke care and medications designed to improve bone density. It should be noted that the incidence of falls was often a secondary outcome in the majority of these trials (i.e., they were not designed specifically to reduce falls). Pooling of results was limited to two treatment contrasts (exercise vs. usual care and bisphosphonate use vs. placebo) in three studies. There was no significant effect of exercise on fall rate (rate ratio=1.22; 95% CI, 0.76 –1.98) or proportion of fallers (Relative Risk= 0.77: 95% CI, 0.24- 2.43). Bisphosphonate usage was also associated with a non-significant reduction in the proportion of fallers (Relative risk=0.95; 95% CI, 0.73–1.22).

More recently, the results from two RCTs, designed specifically as therapy to reduce the incidence of falls suggest that falls prevention programs are not effective. Dean et al. (2012) randomized 151 community-based stroke patients to an intervention group that received exercise and task related training or control group that performed an upper-extremity strength training program and cognitive tasks. At 12 month follow up, although patients in the experimental group showed significantly improvement in gait speed, there was no significant difference between groups in the number of patients who fell ( $n=129$ , experimental group vs.  $n=133$ , control group). Batchelor et al. (2012) randomized 156 patients at high risk of falls into a tailored multifactorial falls prevention group or the control group which consisted of usual care. The falls prevention program consisted of an individualized home-based exercise program, falls risk strategies, education, and injury risk minimization strategies. Patients in the control group received usual care. There was no difference in the falls rate between groups. The intervention group had 1.89 falls/person-year, and the control group had 1.76 falls/person-year, incidence rate ratio=1.10,  $P=0.74$ ). The proportion of fallers did not differ significantly between groups (risk ratio=0.83, 95% CI, 0.6-1.14), nor was the injurious fall rate (intervention group 0.74 vs. control group 0.49 injurious falls/person-year, incidence rate ratio=1.57,  $P=0.25$ ). Further, Verheyden et al. (2013) reviewed 10 studies and revealed that although there were no significant reduction in number of falls for both acute and subacute stages post-stroke after exercise interventions, medication interventions revealed promising results with reductions for patients prescribed alendronate (95% CI 25% to 72%,  $p=0.0021$ ) and Vitamin D supplements (95% CI 28% to 82%,  $p=0.003$ ).

However, Taylor-Piliae et al. (2014) randomized 145 community-based patients into three exercise programs; a Tai Chi group, a strength and range of motion exercise group, and a usual care group. Patients in the Tai Chi exercise group demonstrated significantly fewer falls than the usual care group ( $p=0.04$ ). Furthermore, both the Tai Chi and strength and range of motion groups displayed significant improvements in aerobic endurance whereas usual care patients did not ( $p=0.02$  and  $p<0.01$  respectively). All three groups significantly improved in Short Physical Performance Battery (SPPB) scores ( $p<0.01$ ), SF-36 perceived physical health ( $p=0.04$ ) and SF-36 perceived mental health ( $p<0.01$ ). In addition, Van Swigchem et al. (2014) revealed who adopted a long-step strategy in a treadmill obstacle-avoidance intervention demonstrated a 62.9% success rate whereas short-steps resulted in a 29.1% success rate.

[Link to evidence tables and reference list for Section 6.3](#)

## 7. Assessment and Management of Dysphagia and Malnutrition following Stroke

### Stroke Rehabilitation

### 7. Assessment and Management of Dysphagia and Malnutrition following Stroke

Update 2015

#### 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]. *Refer to Appendix Table 3: Canadian Stroke Best Practices Swallow Screening and Assessment Tools for more information.*
- 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 hours 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].

### Rationale

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, including pneumonia. 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 often do not receive sufficient caloric intake, which may result in poorer outcomes as a result of malnutrition.

### System Implications

In order to manage dysphagia and malnutrition post stroke organizations should:

- develop and deliver educational programs to train appropriate staff to perform an initial swallowing screen for stroke patients. This may include staff across the continuum, such as in emergency departments, acute inpatient units, rehabilitation facilities, and community and long-term care settings;
- ensure access to appropriately trained healthcare professionals such as speech–language pathologists, occupational therapists, and/or dietitians who can conduct in-depth assessments and recommend appropriate management to prevent malnutrition and aspiration.

### Performance Measures

1. Proportion of stroke patients with documentation that an initial dysphagia screening assessment was performed in the emergency department or during hospital admission (core).
2. Proportion of stroke patients who fail an initial dysphagia screening who then receive a comprehensive assessment by a speech–language pathologist, occupational therapist, dietitian, or other appropriately trained healthcare professional.
3. Median time in minutes from patient arrival in the emergency department to initial swallowing screening by a trained clinician.
4. Incidence of malnutrition among patients admitted to inpatient care for stroke which is leads to delays in discharge.

### Measurement Notes:

- In chart audits, dysphagia screening has been poorly documented. Clinical providers should be educated and made aware of the importance of documenting dysphagia screening for valid and reliable measurement and monitoring.
- Measure 1 is a mandatory reporting indicator for the Accreditation Canada Stroke Distinction Program

### Implementation Resources and Knowledge Transfer Tools



### Health Care Provider Information

- Canadian Stroke Best Practices Taking Action Towards Optimal Stroke Care: [http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- Table 7: Summary of Swallowing Screening and Assessment Tools
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.
- Mini Nutritional Assessment: [http://www.nestle-nutrition.com/clinical\\_resources/Mini\\_Nutritional\\_Assessment.aspx](http://www.nestle-nutrition.com/clinical_resources/Mini_Nutritional_Assessment.aspx)
- Malnutrition Universal Screening Tool (MUST): <http://www.bapen.org.uk/screening-for-malnutrition/must/introducing-must>
- Canadian Nutrition Screening Tool: <http://nutritioncareincanada.ca/resources/>
- Comparison of nutrition screening tools: <http://nutritioncareincanada.ca/resources/>

### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery: <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)
- Eating and Swallowing: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8562095/k.9286/Physical\\_changes.htm?\\_ga=1.133261766.972946853.1415208838#eating-tab](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8562095/k.9286/Physical_changes.htm?_ga=1.133261766.972946853.1415208838#eating-tab)

### Summary of the Evidence

Evidence suggests a standardized program for screening, diagnosis and treatment of dysphagia following acute stroke results in reductions in the incidence of pneumonia, feeding tube dependency and length of hospital stay (Hinchey et al. 2005, Lakshminarayan et al. 2010). Bedside screening may include components related to a patient's level of consciousness, an evaluation of the patient's oral motor function and oral sensation, as well as the presence of a cough. It may also include trials of fluid. Coughing during and up to one minute following test completion, and/or "wet" or hoarse voice are suggestive of an abnormal swallow. Silent aspiration may occur in patients who do not cough or complain of any problems with swallowing or have no wet-sounding voice. If there is silent aspiration, the patient may not display any signs or symptoms on the trial swallows. It is possible for them to not demonstrate obvious problems during the initial screen and still be aspirating. Therefore, all stroke patients, regardless of their screening

result, should be informally monitored during their hospital stay for symptoms of swallowing problems.

The effectiveness of a variety of treatments for dysphagia management was recently the subject of a Cochrane review (Geeganage et al. 2012). The results from 33 RCTs examining acupuncture, behavioural interventions, drug therapy, neuromuscular electrical stimulation, pharyngeal electrical stimulation, physical stimulation (thermal, tactile), transcranial direct current stimulation, and transcranial magnetic stimulation, were included. Pooling of results was not possible due to the small number of studies available evaluating similar interventions/outcomes. Death or dependency at end of trial was the primary outcome, although only two RCTs were included in the pooled result. The results were not significant (OR=1.05, 95% CI 0.63 to 1.75,  $p=0.86$ ). Acupuncture and behavioural modifications were associated with a reduction in the incidence of dysphagia at the end of treatment. No significant treatment effect was associated with subgroup analysis by therapy type (behavioural interventions, drug therapy, and electrical stimulation) for the outcome of chest infections. These findings appear to be inconsistent with those from an earlier systematic review by Speyer et al. (2010), who concluded that a variety of treatments available for the management of dysphagia are generally effective. However, given the inclusion of patients with non-stroke etiologies of dysphagia and relatively small number of RCTs, these findings should not be compared directly with those reported by Geeganage et al. (2012).

Dietary modifications, including altered textured solids and fluids and the use of restorative swallowing therapy, and compensatory techniques, are the most commonly used treatments for the management of dysphagia in patients who are still safe to continue oral intake. Unfortunately, there is little direct evidence of their benefit. The effectiveness of behavioural modifications and dysphagia therapy has been examined in two RCTs. Carnaby et al. (2006) randomized 306 patients with dysphagia admitted to hospital within 7 days of acute stroke, to receive usual care, standard low-intensity intervention (composed of environmental modifications, safe swallowing advice and appropriate dietary modifications), or standard high-intensity intervention and dietary prescription (daily direct swallowing exercises, dietary modification), for up to one month. When the results from the high-intensity and low-intensity groups were combined and compared with the usual care group, patients in the active therapy group regained functional swallow sooner and had a lower risk of chest infections at 6 months. There were no differences between groups for the risk of death, death or dependency, death or institutionalization, or return to normal diet within 6 months. De Pippo et al. (1994) did not report a reduction in the incidence of pneumonia, dehydration, recurrent upper-airway obstruction or death associated with daily sessions with a speech language therapist during hospitalization on a stroke rehabilitation unit.

Enteral feeding is used when patients' swallowing impairment precludes safe oral feeding. In the early days following stroke, treatment decisions usually centre on the type of feeding type to use (i.e., nasogastric or enteric feeding tubes). The evidence relating to the superiority of one type is lacking. In one arm of the FOOD trial (2005), patients were randomized to receive either a percutaneous endoscopic gastrostomy (PEG) or nasogastric (NG) feeding tube within 3 days of enrolment into the study. PEG feeding was associated with an absolute increase in risk of death of 1.0% (−10.0 to 11.9,  $p=0.9$ ) and an increased risk of death or poor outcome of 7.8% (0.0 to 15.5,  $p=0.05$ ). In a later systematic review by Foley et al. (2008), the authors (on the basis of 3 RCTs including the FOOD trial) concluded that NG feeding tube is not associated with a higher risk of death compared with PEG feeding. However, they suggested that PEG feeding is associated with fewer tube failures and fewer declines in nutritional status.

Treatment with neuromuscular electrical stimulation may be effective in the rehabilitation of dysphagia, although it is a treatment option not commonly used in clinical practice in Canada. Carnaby-Mann & Crary et al. (2007) conducted a systematic review and meta-analysis, which included the results from 7 studies of patients with oropharyngeal dysphagia secondary to stroke, cancer or other disease. A moderate treatment effect was reported for the outcome of change in swallowing score assessed using the Mann Assessment of Swallowing Ability score or the Functional Oral Intake Scale (SMD=0.66, 95% CI 0.47 to 0.85,  $p<0.001$ ). Evidence of improvement in swallowing ability associated with NMES treatment has also been reported in RCTs which included only patients recovering from stroke (Kim et al. 2009, Xia et al. 2011, and Park et al. 2013).

Oral supplementation can be used for patients who are not able to consume sufficient energy and protein to maintain body weight, or for those with premorbid malnutrition. The FOOD trial (2005) aimed to establish whether routine oral nutritional supplementation in patients who could safely swallow and were

prescribed a regular hospital diet, was associated with improved outcome after stroke. A total of 4,023 patients were randomized to receive or not receive an oral nutritional supplement (540 Kcals) in addition to a regular hospital diet, provided for the duration of their entire hospital stay. At 6 month follow-up, there were no significant differences between groups on the primary outcome of death or poor outcome (OR=1.03, 95% CI 0.91 to 1.17,  $p>0.05$ ). The absolute risk of death or poor outcome was 0.7%, 95% CI - 2.3 to 3.8. Only 314 (8%) patients were judged to be undernourished at baseline. The anticipated 4% absolute benefit for death or poor outcome from routine oral nutritional supplements was not evident. The FOOD trial results would be compatible with a 1% to 2% absolute benefit or harm from oral supplements. Results from RCTs examining nutrition-related outcomes suggest that oral supplements can increase the amount of energy and protein patients consume, and prevent unintentional weight loss (Gariballa et al. 1998, Ha et al. 2010).

It is also suggested that lifestyle modifications help improve an individual's nutritional and physiological status. A recent RCT by Kono et al. (2013) demonstrated that 35 patients with stroke randomized to receive lifestyle modifications, in the form of education, counselling, and regular exercise, showed significantly lower salt intake ( $p=0.018$ ), blood pressure ( $p<0.001$ ), and HDL-C levels ( $p=0.022$ ) compared to those receiving advice only ( $n=35$ ). Lifestyle modifications are an important part of the rehabilitation process post stroke; all health care professions should advocate for appropriate lifestyle modifications that are individualized and appropriate for their patients.

[Link to evidence tables and reference list for Section 7](#)

## 8. Rehabilitation of Visual Perceptual Deficits

Stroke Rehabilitation Update 2015	8. Rehabilitation of Visual Perceptual Deficits
<ul style="list-style-type: none"> <li>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].</li> <li>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.</li> <li>iii. Treatment of neglect can include visual scanning techniques, phasic alerting, cueing, imagery, virtual reality, hemispheric (limb) activation and trunk rotation [Evidence Level C].</li> <li>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].</li> <li>v. Patients with suspected limb apraxia should be treated using errorless learning, gesture training and graded strategy training [Evidence Level B].</li> <li>vi. Mirror therapy may be considered as an intervention for unilateral inattention [Evidence Level B].</li> </ul>	
Rationale	
<p>Visual perceptual disorders are a common clinical consequence of stroke. They include unilateral neglect, which has a major impact on rehabilitation outcome. Visual perceptual disorders result in processing changes in the integration of visual information with other systems. These changes decrease a patient's ability to adapt to the basic requirements of daily life. The incidence of unilateral spatial neglect is estimated to be approximately 23%. The presence of neglect has been associated with both severity of stroke and age of the individual.</p>	
<p>Limb apraxias are more common in those with left hemisphere involvement (28 – 57%) but can also be seen in right hemisphere damage (0 – 34%) (Donkervoort et al., 2000). While apraxia improves with early recovery, up to 20 percent of those initially identified will continue to demonstrate persistent problems. Severity of apraxia is associated with changes in functional performance.</p>	
System Implications	
<p>To achieve timely and appropriate assessment and management of perceptual deficits, the organization should provide:</p>	
<ul style="list-style-type: none"> <li>• Initial standardized assessment of visual perceptual deficits (including inattention and apraxia) performed by clinicians experienced in the field of stroke.</li> <li>• Timely access to specialized, interprofessional stroke rehabilitation services where therapies of appropriate type and intensity are provided.</li> <li>• Access to appropriate equipment to aid in recovery when necessary without financial barriers.</li> <li>• Long-term rehabilitation services widely available in nursing and continuing care facilities, and in outpatient and community programs.</li> </ul>	

## Performance Measures

1. Proportion of stroke patients with documentation that an initial screening for visual perceptual deficits was performed as part of a comprehensive rehabilitation assessment.
2. Proportion of stroke patients with poor results on initial screening who then receive a comprehensive assessment by appropriately trained healthcare professionals.

## Implementation Resources and Knowledge Transfer Tools

### Health Care Provider Information

- Canadian Stroke Best Practices Taking Action Towards Optimal Stroke Care: [http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.: Summary of Validated and Frequently Used Screening and Assessment Tools for Stroke Rehabilitation
- Comb and Razor Test: [http://strokengine.ca/assess/module\\_crt\\_intro-en.html](http://strokengine.ca/assess/module_crt_intro-en.html)
- Behavioral Inattention Test: [http://strokengine.ca/assess/module\\_bit\\_intro-en.html](http://strokengine.ca/assess/module_bit_intro-en.html)
- Line Bisection Test: [http://strokengine.ca/assess/module\\_lbt\\_intro-en.html](http://strokengine.ca/assess/module_lbt_intro-en.html)
- Rivermead Perceptual Assessment Battery: <http://www.gl-assessment.co.uk/products/rivermead-perceptual-assessment-battery>
- Ontario Society of Occupational Therapy Perceptual Evaluation: [http://strokengine.ca/assess/module\\_osot\\_intro-en.html](http://strokengine.ca/assess/module_osot_intro-en.html)
- Motor-Free Visual Perceptual Test: [http://strokengine.ca/assess/module\\_mvpt\\_intro-en.html](http://strokengine.ca/assess/module_mvpt_intro-en.html)
- Florida Apraxia Screening Tool (FAST-R) & Florida Apraxia Battery-Extended and Revised Sydney (FABERS): <http://books.google.com/books?id=BA4HbvzqcVcC&pg=PA62&lpg=PA62&dq=Florida+Apraxia+Screening+Tool&source=bl&ots=w1B9cCYsg9&sig=cK1uo9l1POOav3-1YLANLCqvgWA&hl=en&sa=X&ei=HU2-UbysDIX6yQGO0YHABQ&ved=0CEQQ6AEwAQ#v=onepage&q=Florida%20Apraxia%20Screening%20Tool&f=false>
- Apraxia Screen of TULIA (AST): <http://tulia.ch/wordpress/wp-content/uploads/2011/02/AST1.pdf>

### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/att/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/att/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery:

<http://www.canadianstroke.ca/en/resources/patients-and-carers/>

- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)
- Senses and Perception: [http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.8545497/k.5A22/Senses\\_and\\_Perception.htm](http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.8545497/k.5A22/Senses_and_Perception.htm)

## Summary of the Evidence

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 colour processing, among others (Bowen et al., 2011). The prevalence of post-stroke perceptual deficits has been estimated to be as high as 69% one-month post-stroke and 74% two-years post-stroke (Edmans et al., 2000).

Of the perceptual deficits that affect individuals post-stroke, visual perceptual disorders, including unilateral spatial neglect (USN), may be the most frequently selected for investigation. In the Copenhagen Stroke Study, the incidence rate of post-stroke USN was found to be 23%, with USN being more common among individuals with a right-sided, as compared to a left-sided lesion (42% vs. 8%) (Pedersen et al., 1997). Presence of neglect has been reported to have a negative impact on functional recovery, length of rehabilitation stay, and independence following discharge (Katz et al., 1999; Paolucci et al., 2001; Gillen et al., 2005; Wee & Hopman, 2008).

In terms of non-pharmacological treatment of perceptual disorders post stroke, a Cochrane review by Bowen and colleagues (2011) identified five studies (n=308), each of which examined forms of sensory stimulation including cueing or visual stimulation. Based on the results of three trials providing sufficient data for pooling, no significant between group differences were found in perceptual impairment at the end of treatment (SMD=0.07, 95% CI -0.29 to 0.43). In another Cochrane review, 12 trials (n=306) were identified examining cognitive rehabilitation for the treatment of spatial neglect (Bowen and Lincoln, 2007). Although cognitive rehabilitation was associated with significant improvement in standardized neglect outcomes, treatment was not found to have a significant effect on functional disability (end of treatment: SMD=0.26 95% CI -0.2 to 0.7; follow-up: SMD=0.61, 95% CI -0.4 to 1.6). In both of these reviews, the authors concluded that there is insufficient evidence to support or refute the effectiveness of the interventions examined (Bowen et al., 2011; Bowen and Lincoln, 2007).

In a third Cochrane review examining interventions for visual field defects, Pollock and colleagues identified 13 studies (n=344, 83% post-stroke) exploring vision restorative therapy, visual scanning, and prism therapy (Pollock et al. 2011). Of the three treatments, only prism therapy was associated with significant improvement in visual field outcomes (MD=8.40, 95% CI 4.0 to 12.8). While both prism therapy and visual scanning were associated with improvement in scanning outcomes, neither treatment was found to have a significant treatment effect on functional ADLs (Pollock et al. 2011). Recently conducted randomized controlled trials (RCTs) have revealed conflicting evidence regarding the effectiveness of visual scanning therapy on visual perception (Ferreira et al. 2011; Chan et al. 2013; Kerkhoff et al. 2013), and more recent evidence regarding prism therapy has not provided further support for its use (Mancuso et al. 2012).

Other forms of treatment for spatial neglect and visual field deficits include the use of virtual reality and transcranial magnetic stimulation. Kim et al. (2011) conducted a RCT which investigated the effect of virtual reality training compared to conventional therapy on post stroke unilateral neglect. Patients who received virtual reality training demonstrated significantly greater changes in score on both the star cancellation test and Catherine Bergego scale compared to patients who received conventional therapy. However, no differences after treatment were observed between the two groups with respect to scores on the line bisection test or the Korean version of the modified Barthel Index. Regarding the use of repetitive transcranial magnetic stimulation (rTMS), Kim et al. (2013) examined the effect of this therapy at high and low frequencies on spatial neglect in acute stroke patients. Participants were randomly assigned to



receive 1 Hz stimulation over the nonlesioned posterior parietal cortex (PPC), 10 Hz over the lesioned PPC, or sham stimulation. After 10 stimulation sessions over a two-week period, the improvement in the line bisection test score in the high frequency rTMS group was statistically significant compared to that in the sham stimulation group ( $p=0.03$ ). Additionally, the improvements in the Korean-Modified Barthel Index scores in both the high and low frequency groups were statistically significant compared to those in the sham stimulation group ( $p<0.01$  and  $p=0.02$ , respectively).

[Link to evidence tables and reference list for Section 8](#)

## 9. Rehabilitation to Improve Central Pain

Stroke Rehabilitation Update 2014	9. Rehabilitation to Improve Central Pain
<ul style="list-style-type: none"> <li>i. Patients with persistent Central Post Stroke Pain (CPSP) should receive a trial of low-dose, centrally acting analgesics [Evidence Level C]: <ul style="list-style-type: none"> <li>a. Patients should receive an anticonvulsant (such as gabapentin or pregabalin) as a first-line treatment [Evidence Level C].</li> <li>b. Patients should receive a tricyclic antidepressant (e.g., amitriptyline) or an SNRI (particularly duloxetine) as second-line treatment [Evidence Level C].</li> <li>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.</li> </ul> </li> <li>ii. An individualized patient-centred 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].</li> </ul>	
<b>Rationale</b>	
<p>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 not all damage to the STT produces CPSP. It reportedly affects 2% to 5% of stroke patients. With involvement of the STT, patients have loss of temperature and pain sensation in the involved area. It is most commonly associated with lesions to the ventrocaudal nucleus of the thalamus but has been reported in brainstem lesions where there is damage to the STT. 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 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.</p>	
<b>System Implications</b>	
<ul style="list-style-type: none"> <li>• Inclusion of central pain assessments as part of standard screening and assessment protocols for stroke rehabilitation</li> <li>• Access to specialized services for management of central pain</li> </ul>	
<b>Performance Measures</b>	
<ol style="list-style-type: none"> <li>1. Changes in pain ratings from initiation of treatment, measured weekly, using standardized pains scales.</li> <li>2. Changes in quality of life of stroke patients who experience central pain syndrome, measured using a standardized scale and at regular follow-up intervals.</li> </ol>	
<b>Implementation Resources and Knowledge Transfer Tools</b>	
<b>Health Care Provider Information</b>	
<ul style="list-style-type: none"> <li>• Canadian Stroke Best Practices Taking Action Towards Optimal Stroke Care: <a href="http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf">http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf</a></li> <li>• Table 1: Stroke Rehabilitation Screening and Assessment Tools.: Summary of Validated and</li> </ul>	

#### Frequently Used Screening and Assessment Tools for Stroke Rehabilitation

- Pharmacological management of chronic neuropathic pain: revised consensus statement from the Canadian Pain Society:  
<http://www.pulsus.com/journals/abstract.jsp?jnlKy=7&atlKy=13142&isuKy=1234&isArt=t>
- Visual Analogue Scale (VAS): [http://www.blackwellpublishing.com/specialarticles/jcn\\_10\\_706.pdf](http://www.blackwellpublishing.com/specialarticles/jcn_10_706.pdf)
- McGill Pain Questionnaire: <https://www.gem-beta.org/public/DownloadMeasure.aspx?mid=1348>
- Pain Rating Scales: [http://www.painedu.org/Downloads/NIPC/Pain\\_Assessment\\_Scales.pdf](http://www.painedu.org/Downloads/NIPC/Pain_Assessment_Scales.pdf)
- Revised Illness Perception Questionnaire (IPQ-R): <http://www.uib.no/ipq/>
- Beck Depression Inventory (BDI), PHQ-9 Depression Scale:  
[http://strokengine.ca/assess/module\\_bdi\\_intro-en.html](http://strokengine.ca/assess/module_bdi_intro-en.html)
- CSPBR Table 7.1A Summary of Select Screening Tools for Use in Post-Stroke Depression (PSD)

#### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery:  
[http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory:  
[http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery:  
<http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)
- Physical Changes (Pain):  
[http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8562095/k.9286/Physical\\_changes.htm#pain-tab](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.8562095/k.9286/Physical_changes.htm#pain-tab)

#### Summary of the Evidence

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 thalamus, the part of the brain that affects sensation. The condition is rare, occurring in an estimated 2% to 5% of all stroke cases. Antidepressants including tricyclic antidepressants, serotonin–norepinephrine reuptake inhibitors and selective serotonin reuptake inhibitors are used most frequently for the treatment of neuropathic pain, although there is little published evidence of their effectiveness in CPSP. Vranken et al. (2011) randomized 48 patients with severe neuropathic pain resulting from cerebrovascular lesions or spinal cord lesions to receive escalating doses of either duloxetine (60 and 120mg/day) or placebo for 8 weeks. There was a trend towards reduction in pain associated with duloxetine treatment. At the end of treatment, the mean pain scores, assessed using a 10-point visual analogue scale were reduced from 7.1 to 5.0 (duloxetine) vs. 7.2 to 6.1 (placebo),  $p=0.06$ . There were no differences between groups in Patient Disability Index or EQ-5D scores but patients in the duloxetine group reported better pain scores on the bodily pain sub section of the SF-36

( $p=0.035$ ).

Several RCTs have been published evaluating the effectiveness of the anticonvulsant drugs, pregabalin and gabapentin. The majority of these studies have included patients with neuropathic pain of varying etiology. A single RCT included patients who were suffering exclusively from CPSP. In this study (Kim et al. 2011) randomized 220 patients to receive either 150-600 mg of pregabalin or placebo over 13 weeks. At the end of treatment the mean pain scores were reduced from 6.5 to 4.9 in the pregabalin group and from 6.3 to 5.0 in the placebo group, although the difference was not statistically significant. ( $p=0.578$ ). Treatment with pregabalin resulted in significant improvements, compared with placebo, on secondary endpoints including some aspects of sleep, anxiety (Hospital Anxiety & Depression Scale-A), and clinician global impression of change ( $p<0.05$ ). Adverse events were more frequent with pregabalin than with placebo and caused discontinuation of treatment in 9 (8.2%) patients compared with 4 (3.7%) of placebo patients. Vranken et al. (2008) randomized 40 patients (19 with stroke) suffering from severe neuropathic pain, to receive a 4-week course of treatment with escalating doses of pregabalin (max 600 mg/day) or placebo. At the end of treatment, patients in the pregabalin group experienced significantly greater pain relief on a 10-point visual analogue scale (mean=7.6 to 5.1 vs. 7.4 to 7.3,  $p=0.01$ ) and had significant improvement in EQ-5D scores and in the bodily pain domain of the SF-36. There was no significant difference in Pain Disability Index scores between groups. Serpell et al. (2002) randomized 307 patients with a wide range of neuropathic pain syndromes (9 with post stroke pain) to receive either gabapentin or placebo for 8-weeks. Gabapentin was given in three divided doses to a maximum of 2400 mg/day. Patients in the treatment group experienced a significantly greater reduction in pain over the study period (mean reduction of 21% vs. 14%,  $p=0.048$ ). Significant differences were shown in favour of gabapentin for the clinician and patient Global Impression of Change Scale, and some domains of the Short Form-McGill Pain Questionnaire.

One RCT has been published evaluating levetiracetam (LEV) in a CPSP population. Jungehulsing et al. (2013) studied 42 patients with a diagnosis of CPSP of duration greater than 3 months from a stroke with a score of 4 or greater on a numeric Likert scale for pain intensity (range 0-10). Participants were randomized to either: an intervention group; LEV at a maximum dose of 3000 mg or a control (placebo) group for 24 weeks which consisted of a 4-week baseline period, followed by two 8-week treatment periods each followed by a 2-week washout period. Compared to controls, LEV did not show an improvement in spontaneous or evoked pain, or any of the secondary measures including McGill Pain Questionnaire, revised Beck Depression Inventory, Short Form-12 Health Survey ( $p>0.05$  for all). Side-effects in the first treatment period included tiredness, pain increased, dizziness, pruritus, nausea, and headache in the LEV group compared to controls ( $p<0.05$ ).

[Link to evidence tables and reference list for Section 9](#)

## 10. Rehabilitation to Improve Language and Communication

Stroke Rehabilitation	10. Rehabilitation to Improve Language and Communication
<i>Update 2015</i>	
<ul style="list-style-type: none"> <li>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].</li> <li>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].</li> <li>iii. All Stroke patients should be screened for communication disorders using a simple, reliable, validated tool [Evidence Level C]. <i>Refer to Table 5: Screening and Assessment Tools for Stroke Patients with Aphasia.</i></li> <li>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].</li> <li>v. Persons with aphasia should have early access to a combination of intensive language therapy and communication therapy according to their needs, goals and impairment severity [Evidence Level B].</li> <li>vi. Treatment to improve functional communication can include language therapy focusing on: <ul style="list-style-type: none"> <li>a. production and/or comprehension of words, sentences and discourse, (including reading and writing) [Evidence Level C];</li> <li>b. conversational treatment, and constraint induced language therapy [Evidence Level B];</li> <li>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].</li> <li>d. Use of computerized language therapy to enhance benefits other therapies [Evidence Level C].</li> </ul> </li> <li>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].</li> <li>viii. Treatment to improve functional communication should include Supported Conversation techniques for potential communication partners of the person with aphasia [Evidence Level A].</li> <li>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].</li> </ul>	

- 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]. *Refer to CSBPR Mood, Cognition and Fatigue module, Recommendation 1 for additional information on aphasia and depression.*
- 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]. *Refer to CSBPR Stroke Transitions of Care module, Recommendation 5 for additional information.*

## Rationale

Aphasia is defined as the loss of ability to communicate orally, through signs, or in writing, or the inability to understand such communications. Aphasia is one of the most common consequences of stroke in both the acute and chronic phases. Acutely, it is estimated that between 21 – 38% of stroke patients are aphasic. The presence of aphasia has been associated with general decreased response to stroke rehabilitation interventions and an increased risk for mortality. Aggressive management of aphasia helps to improve both language and broader recovery.

## System Implications

Patients with communication deficits, and their family members and caregivers, require access to specialized inpatient and community-based communication services following their stroke:

- Programs and services should be in place in all organizations and communities with easy access and appropriate support for stroke patients with communication impairments, including access to speech-language pathologists
- Telemedicine technology should be strongly considered and actively utilized, particularly in areas with limited in-person access to speech-language pathologists, to ensure equity in rehabilitation opportunities for people with post-stroke aphasia
- Community support programs and peer-support groups should be established and information should be readily available in acute care and the rehabilitation settings for patients to access these groups

## Performance Measures

1. Percentage of patients screened for aphasia during acute inpatient admission; and during initial assessment in a rehabilitation setting.
2. Percentage of patients with aphasia who receive a detailed assessment by a speech-language pathologist prior to leaving acute care.
3. Median time from hospital discharge to initiation of aphasia therapy in the community.
4. Number of staff members in each rehabilitation setting trained on supportive communication techniques.
5. Percentage of time each patient with stroke and communication issues spends in therapy with communication specialist (speech language pathologist or other trainer professional when SLP not available).

## Implementation Resources and Knowledge Transfer Tools

### Health Care Provider Information

- Canadian Stroke Best Practices Taking Action Towards Optimal Stroke Care: [http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.: Summary of validated and



frequently used screening and assessment tools for stroke rehabilitation

- Table 10, Screening and Assessment Tools for Stroke Patients with Aphasia
- Aphasia Institute: <http://www.aphasia.ca/health-care-professionals>
- Frenchay Aphasia Screening Tools: [http://strokengine.ca/assess/module\\_fast\\_intro-en.html](http://strokengine.ca/assess/module_fast_intro-en.html)
- American Speech-Language-Hearing Association Functional Assessment of Communication Skills in Adults (ASHA-FACS): [http://strokengine.ca/assess/module\\_asha\\_2d\\_facs\\_intro-en.html](http://strokengine.ca/assess/module_asha_2d_facs_intro-en.html)
- Mississippi Aphasia Screening Test: [http://www.strokengine.ca/family/fast\\_family/](http://www.strokengine.ca/family/fast_family/)
- AphasiaAccess: <http://www.aphasiaaccess.org/>
- Aphasia United Best Practice Recommendations: <http://www.shrs.uq.edu.au/best-practice-recommendations>
- Australian Aphasia Rehabilitation Pathway: <http://www.aphasiapathway.com.au/?name=About-the-statements>
- Aphasia Institute: <http://www.aphasia.ca/home-page/health-care-professionals/>
- Stroke Engine: <http://www.strokengine.ca/>
- Stroke Engine: <http://www.strokengine.ca/>

#### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)
- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery: <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)
- Communication: <http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.8559457/k.9164/Communication.htm>
- Aphasia Institute: <http://www.aphasia.ca/people-with-aphasia-and-families/>

#### Summary of the Evidence

A report based on data from the Ontario Stroke Audit estimated that 35% of individuals with stroke have symptoms of aphasia at the time of discharge from acute care (Dickey et al., 2010). Risk factors for

aphasia following stroke include older age and greater severity of stroke and stroke-related disability (Dickey et al., 2010; Bersano et al., 2009; Gialanella & Prometti, 2009; Pedersen et al., 2004; Ferro et al., 1999). Presence of post-stroke aphasia is associated with longer lengths of hospital stay (Gialanella & Prometti, 2009), poorer outcomes in terms of activities of daily living and mobility (Gialanella & Prometti, 2009; Paolucci et al., 2005), discharge to long-term care (Gialanella & Prometti, 2009; Dickey et al., 2010), and higher rates of mortality over both the short and long-term following stroke (Bersano et al., 2009). Additionally, aphasia has been demonstrated to have a negative impact on quality of life, mood, and social outcomes (Davidson et al., 2008; Ferro et al., 1999; Wade et al., 1986).

In general, there is a large literature base examining the effectiveness of speech and language therapy (SLT) for the treatment of aphasia following stroke. In an updated Cochrane review, Brady and colleagues identified 39 RCTs (n=2518) investigating SLT for post-stroke aphasia, 19 (n=1414) of which compared SLT to no treatment (Brady et al., 2012). Patients who received SLT experienced significantly more improvement in functional communication ( $p<0.01$ ), reading comprehension ( $p<0.05$ ), and expressive language ( $p<0.05$ ), as compared to patients randomized to a no treatment control group. An additional 7 trials (n=279) compared SLT to social support/stimulation. Although pooled analysis revealed mixed findings, results from a large (n=170) trial suggests that, as compared to unstructured social contact, SLT may not be associated with significantly greater improvement in functional language ability (Bowen et al. 2012). Additional research from Rose et al. (2013) reports that gesture training combining symbolic gestures with verbal training has led to positive improvements in verbal production; however, the authors emphasize the importance of trained gestures that follow gesture training protocols. Blake et al. (2013) add that context is key to language recovery in order for the patient to understand ambiguous words, determine a speaker's intentions, and determine non-literal communication such as metaphors and idioms.

Brady et al. also identified 25 studies (n=910) comparing one type of SLT with another (Brady et al. 2012). Across the 11 different treatment comparisons, few significant between group differences were identified. The authors concluded that although the results of the review generally favour SLT over no treatment/communication stimulation, there is insufficient evidence to support any specific types of therapy (Brady et al. 2012). However, when interpreting these results, it is important to note that the aphasia literature presents several potential sources of bias, including lack of sample size calculations, use of non-standardized outcome assessments, lack of clarity regarding aphasia types and levels of severity, and undocumented details of therapy (Kelly et al., 2010). Moreover, potential benefits of intensive SLT over conventional SLT may be confounded by significantly higher dropout from intensive SLT (Brady et al., 2012).

In a review examining the association between SLT intensity and treatment effect, Bhogal et al. identified 10 controlled trials examining SLT post-stroke and found that studies with more intensive therapy provision were more likely to report significant positive treatment effects whereas studies with less intensive therapy provision were more likely to report non-significant treatment effects (Bhogal et al., 2003). Bhogal and colleagues concluded that intense SLT over a short period of time is associated with improved outcomes of speech and language for patients with post-stroke aphasia. Likewise, in their Cochrane review, Brady et al. concluded that intensive speech and language therapy appears to have some benefit in terms of functional communication, writing, and severity of impairment (Brady et al., 2012). However, an RCT conducted by Martins et al. (2013) compared intensive and regular speech and language therapy and found that although intensive therapy demonstrates a trend towards greater improvement than regular therapy, no statistically significant differences between the two interventions were found on any of the outcome measures. It should be noted that the authors state that the lack of statistical significance may have been due to the small sample size (Martins et al. 2013). Similarly, an RCT conducted by van der Meulen et al. (2014) compared two groups over two study periods with the experimental group receiving Melodic Intonation Therapy (MIT) during the first period followed by regular treatment during the second period whilst the control group were delayed and received MIT during the second study period only. Van der Meulen et al. (2014) found no significant difference in levels of treatment intensity ( $p=0.49$ ) but did find that treatment intensity was significantly predictive of outcome on the repetition of trained items in MIT ( $p=0.02$ ). It was also reported that receiving MIT later after being delayed was associated with less improvement thus indicating that timing of rehabilitation is crucial for

language recovery.

Further research has advocated for therapy early post-stroke to reduce the long-term effects of aphasia. Godecke et al. (2013) report that the amount of therapy in early post-stroke recovery was a significant predictor of recovering from aphasia ( $p=0.030$ ); however, frequency of therapy sessions was not a significant predictor. Thus, it can be concluded that timing of interventions may be as important as frequency of participation. These findings were replicated by Godecke et al. (2014) who compared early rehabilitation with a usual care group and found patients in the early rehabilitation group demonstrated a greater level of recovery with an 18% higher score on the Western Aphasia Battery Quotient than usual care patients. These improvements were maintained up to 6 months post-stroke with early rehabilitation patients exhibiting a 16% advantage over usual care patients (Godecke et al. 2014).

There is some evidence that group SLT and/or volunteer-facilitated SLT may represent effective means of supplementing available speech language resources and/or to increase the intensity of SLT, where appropriate. Brady and colleagues identified three trials comparing group SLT to conventional SLT and four trials comparing volunteer-facilitated SLT to professional SLT: with respect to both comparisons, outcomes obtained in group and volunteer-facilitated SLT were similar to those obtained in conventional therapy delivered by trained professionals (Brady et al. 2012).

A review by Hilton et al. (2014) revealed a number of recommendations for clinicians and relatives in order to further improve care for stroke patients. Recommendations include providing greater amounts of information to patients to reduce anxiety, informing and warning relatives of potential difficulties in the transitions from hospital to home and providing coping strategies that can be utilized by patient and relative, and for clinicians to be aware of the need for psychosocial support. Research from Nykanen et al. (2013) investigated the efficacy of the Communication Therapy for People with Aphasia and their Partners (APPUTE) intervention, a program designed to improve communication between patients and relatives, and found that patients improved significantly from baseline to the end of rehabilitation in communication efficiency ( $MD = -1.053$ ,  $SE = .352$ ,  $p=0.016$ , 95% CI  $[-1.940, -.167]$ ) and on the Western Aphasia Battery ( $MD = -3.471$ ,  $SE = .708$ ,  $p<0.001$ , 95% CI  $[-4.911, -2.030]$ ). Partners of patients also demonstrated consistent improvement with significant changes in communication skills found between baseline and the end of the first rehabilitation period ( $MD = -1.667$ ,  $SE = .165$ ,  $p<0.001$ , 95% CI  $[-2.128, -1.206]$ ) and between the first and end of the second rehabilitation period ( $MD = -3.951$ ,  $SE = .245$ ,  $p<0.001$ , 95% CI  $[-4.635, -3.266]$ ) (Nykanen et al. 2013).

[Link to evidence tables and reference list for Section 10](#)

## 11. Life Roles and Activities (Driving, Vocation, Sexuality and Relationships, and Leisure)

### Stroke Rehabilitation Update 2015

### 11. Life Roles and Activities

#### 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].

*\*Refer to individual provincial and territorial laws for requirements for reporting a patient's fitness to drive to driving authorities.*

- 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

*Refer to Appendix Table 5 for suggestions of tools for pre-driving screening*

- 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].

*Refer to CSBPR Managing Stroke Transitions of Care Module, recommendation 5 for additional information on community reintegration; and CSBPR Mood, Cognition & Fatigue Module for information on Mood and Cognition issues following stroke.*

### **Rationale**

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 (Gabriele & Renate, 2009; Finestone et al., 2010; Carlsson et al., 2007; Boosman et al., 2011). Furthermore, given increases in the number of individuals working past traditional retirement age and in the incidence of stroke amongst younger individuals (George et al., 2011), issues related to the resumption of these life roles and activities may be increasingly relevant to a growing proportion of stroke survivors.

### **System Implications**

There is a need for:

- open discussions between primary care providers and patients regarding the resumption of pre

- stroke roles, responsibilities and leisure activities;
- coordination between primary care provider and community agencies for referral to appropriate programs and services;
- active communication between the patient's vocational lead (i.e. supervisor/employer/educator), where applicable, to ensure an appropriate and flexible transition back to the workforce.
- For patients with aphasia, all discussions should be conducted with proper support ensuring effective communication.

### Performance Measures

1. Percentage of patients screened for concerns regarding life roles and leisure activity issues during inpatient/outpatient rehabilitation and in the community within 3-months post stroke.
2. Change in outcome measurement tool scores from prior to therapy until completion of therapy for each issue addressed (*to be customized to appropriate issue and tool used*).
3. Percentage of patients who are able to return to work/vocation following stroke rehabilitation, among those who were working prior to their stroke and have set a goal to return to work.

### Implementation Resources and Knowledge Transfer Tools

#### Health Care Provider Information

- Canadian Stroke Best Practices Taking Action Towards Optimal Stroke Care: [http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW\\_EN\\_22May13F.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2013/05/CSBP-Taking-Action-Resource-OVERVIEW_EN_22May13F.pdf)
- Table 1: Stroke Rehabilitation Screening and Assessment Tools.: Summary of Validated and Frequently Used Screening and Assessment Tools for Stroke Rehabilitation
- Canadian Council of Motor Transport Administrators (CCMTA) medical standards for drivers - <http://ccmta.ca/en/publications/resources-home/category/medical-standards-for-drivers>
- Older Drivers in Canada: <http://www.olderdriversafety.ca/professional/index.html>
- Strategies for successful return to work: <http://www.iwh.on.ca/working-together>
- Assessment of Life Habits Scale (LIFE-H): [http://strokingengine.ca/assess/module\\_lifeh\\_intro-en.html](http://strokingengine.ca/assess/module_lifeh_intro-en.html)
- Reintegration to Normal Living Index (RNLI): [http://strokingengine.ca/assess/module\\_rnli\\_intro-en.html](http://strokingengine.ca/assess/module_rnli_intro-en.html)
- Stroke Impact Scale: [http://strokingengine.ca/assess/module\\_sis\\_intro-en.html](http://strokingengine.ca/assess/module_sis_intro-en.html)
- Stroke Specific Quality of Life Scale: [http://strokingengine.ca/assess/module\\_ssqli\\_intro-en.html](http://strokingengine.ca/assess/module_ssqli_intro-en.html)
- Medical Outcomes Study Short Form (SF-36): [http://strokingengine.ca/assess/module\\_sf36\\_intro-en.html](http://strokingengine.ca/assess/module_sf36_intro-en.html)

#### Patient Information

- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Living with Stroke Program: [www.heartandstroke.ca/livingwithstroke](http://www.heartandstroke.ca/livingwithstroke)
- Stroke Resources Directory: [http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.8598311/k.97BA/Stroke\\_Resources\\_Directory/apps/kb/cs/contactsearch.asp](http://www.heartandstroke.com/site/c.ikiQLcMWJtE/b.8598311/k.97BA/Stroke_Resources_Directory/apps/kb/cs/contactsearch.asp)



- Your Stroke Journey: [http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY\\_FINAL\\_ENGLISH.PDF?\\_ga=1.159598453.972946853.1415208838](http://www.heartandstroke.com/atf/cf/%7B99452d8b-e7f1-4bd6-a57d-b136ce6c95bf%7D/YOURSTROKEJOURNEY_FINAL_ENGLISH.PDF?_ga=1.159598453.972946853.1415208838)
- Stroke Engine: <http://strokengine.ca/>
- Heart and Stroke Foundation Canadian Partnership for Stroke Recovery: <http://www.canadianstroke.ca/en/resources/patients-and-carers/>
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf)
- South-Western Ontario Stroke Network Return to Work Website: <http://swostroke.ca/rtw-introduction/>
- Older Drivers in Canada: <http://www.olderdriversafety.ca/consumer/index.html>
- Resource guides for community based stroke support groups, and patients and families <http://www.canadianstroke.ca/wp-content/uploads/2013/09/SupportGroupToolkit-EN1.pdf>
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Life after Stroke: <http://www.lifeafterstroke.ca/>
- Intimacy and Relationships (pictographic booklet): <http://www.aphasia.ca/shop/intimacy-and-relationships-talking-to-your-doctor>

## Summary of the Evidence

### Return to Driving

Return to driving is a common patient inquiry during rehabilitation from stroke. Inability to drive has an impact on a patient's lifestyle and emotional well-being and leads to a strong feeling of loss for the patient (White et al., 2012). However, driving requires a minimum level of sensory, motor and cognitive functioning that is often compromised following a stroke. Common residual deficits preventing the resumption of driving include visual disturbances, hemiparesis and spasticity (White et al., 2012). Deficits found to be predictive of returning to driving include walking ability ( $p=0.001$ ), upper extremity dressing scores ( $p<0.001$ ), Berg Balance Scale scores ( $p<0.001$ ), lower extremity Motricity Index scores ( $p<0.001$ ) and FIM® cognitive scores ( $p<0.001$ ) with the latter two items included in a predictive model (OR=1.03, 95% CI 1.01-1.05) with a 74.8% accuracy rating (Aufman et al. 2013).

As such, screening for potential deficits in driving ability may be needed to ascertain whether returning to driving is a viable option. Research from Akinwuntan et al. (2013) revealed that stroke patients and healthy participants differ significantly in driving ability with only 46.67% of stroke patients passing a driver simulation test compared to 93.75% of healthy participants. Barco et al. (2013) reported that older age ( $p=0.005$ ), lower grip strength ( $p=0.018$ ), higher visual acuity scores ( $p=0.029$ ), slower brake reaction time ( $p=0.04$ ), and higher scores on the nine-hole peg test (left hand  $p=0.027$ , right hand  $p=0.038$ ), with Trail-Making Test A (TMT-A) being found to be predictive for on-road driving performance (AUC = 0.87). Similarly, Aslaken et al. (2013) also found that TMT-A scores were predictive of on-road performance (AUC = 0.81, sensitivity = 0.85, specificity = 0.72) along with simple reaction time (AUC = 0.78, sensitivity = 0.77, specificity = 0.77) and Grooved Pegboard task scores (AUC = 0.73, sensitivity = 0.82, specificity = 0.18).

Patients often overestimate their ability to drive after stroke (Heikkila et al., 1999). A population based case-control study from the United States found that a higher percentage of drivers diagnosed with stroke who had been involved in accidents (7.3%) compared to the percentage of drivers diagnosed with stroke who were not involved in accidents (4.1%). After adjusting for age, sex, race, and driving frequency, these findings were statistically significant (OR 1.9, 95% CI 1.0-3.9) (McGwin et al., 2000). The 2009 Canadian Medical Standards for Drivers state that patients who have had a stroke *"should not drive for at least one month. They may be allowed to operate any motor vehicle after the one month waiting period provided*

*there has been a good recovery, the condition has stabilized and there are no signs of impending recurrence and a neurological assessment indicates that they are functionally able.*" The medical standards also recommend that a neurological report be filed prior to resuming driving and a road-test is recommended for any individual with residual motor deficits. Facilitating a patient's return to driving, where applicable, is an important part of rehabilitation. Return to driving was found to be significantly associated with an increase in community reintegration at one year post-stroke (Finestone et al., 2010).

There is limited information available regarding the sensitivity and specificity of office-based driver performance screening tools. Two systematic reviews (Devos et al., 2011; Marshall et al., 2007) outlining the screening tools that are most predictive of a pass or fail during on-road testing have been completed. The Road Sign Recognition test and Compass, which are both part of the Stroke Drivers Screening Assessment (SDSA), the Trail Making Test part A and part B, the Rey-Osterreith Complex Figure Test, and the Useful Field of View (UFOV) test have been identified as useful tools. These reviews, however, were not stroke specific. Cognitive screening tools were found to be the most predictive of outcome (pass/fail) on an on-road test.

Similarly, there have been very few randomized controlled trials to evaluate interventions that may support a successful return to driving for patients post stroke. A literature review conducted by Classen et al. (2014) of 6 studies (including 5 RCTs) revealed that whilst there was a lack of evidence for cognitive and visual training interventions, driving simulator interventions were highly recommended and traffic theory knowledge tests were moderately recommended. Visual information processing training and simulator based training interventions have been assessed (Mazer et al., 2003; Crotty & George, 2009; Akinwuntan et al., 2005). No statistically significant differences were found between intervention and control groups for on-road driving performance with the use of the UFOV or Dynavision training. Visuoperceptual scores (Mazer et al., 2003), response time, visual scanning abilities and driving self-efficacy (Crotty & George, 2009) also remained comparable between groups. The simulator based intervention assessed by Akinwuntan and colleagues found statistically significant improvements in neuropsychological test results ( $P < 0.05$ ) and on-road driving assessments ( $P = 0.03$ ) for patients receiving the intervention compared to controls (Akinwuntan et al., 2005).

### **Return to Vocation**

A patient's pre-stroke vocation may have included work, school and/or volunteering and is particularly important to address in younger stroke survivors. Return to work is the most common vocation addressed in the literature, and has been found to improve the quality of life for both the patient and their spouse (Gabriele & Renate, 2009). A review by Morris and colleagues (Morris, 2011), found that psychological disorders, fatigue, and effects from the stroke that impair a patient's ability to perform specific work tasks have been reported in the literature as barriers for a patients potential return to work (Morris, 2011).

A wide range of estimates for the proportion of patients who return to work after stroke have been found. A mean of 44% of patients returning to work was found across a set of studies included in a review by Daniel et al. 2009 (Daniel et al., 2009). Patients more likely to return to work include those who worked in white collar jobs as opposed to blue collar (Tanaka et al., 2011; Tanaka et al. 2014), who had a higher income and who had a higher level of education (Trygged et al., 2011). Modifications to previous working conditions (Wozniak & Kittner, 2002) and a supportive employer (Morris, 2011) have been found to help facilitate a patients return to work. A systematic review of vocational rehabilitation interventions for patients post stroke was inconclusive in drawing conclusions regarding their effectiveness (Baldwin & Brusco, 2011). The study included six retrospective cohort studies of varying intervention types and a high level of heterogeneity; no randomized controlled trials were identified.

Although pediatric stroke is relatively rare, school aged stroke survivors are likely to have educational needs that are not typically addressed in older patients. Parent reported outcomes of school aged children in a study by Ganesan and colleagues found that 53% of patients needed school related assistance (Ganesan et al., 2000) based on a population of 90 stroke survivors between the ages of three months and 15 years (Ganesan et al., 2000). The same study reported that 62% of participants experienced at least some neurological deficits when assessed at a mean of 2.07 years post stroke. Another study,

although small (n=23), found similar results, with 65% of participants aged 0 to 12 at stroke onset having at least some cognitive deficits (Rodrigues et al., 2011). Participants with a history of stroke also performed worse on arithmetic, reading and writing school performance tests compared to a control group of students (Rodrigues et al., 2011).

### **Sexuality**

Evidence suggests that there are significant changes in sexuality and sexual functioning for patients post-stroke. A study assessing the impact of stroke on a patient's sexual functioning found that 64% of patients experienced difficulties (Kersten et al., 2002). Another study found that stroke survivors are significantly less satisfied with their sex life one year after stroke compared to a control group of individuals not having experienced a stroke ( $p=0.001$ ) (Carlsson et al., 2007). Difficulties may include changes in libido, coital frequency, sexual arousal and sexual satisfaction (Korpelainen et al., 1999). These changes may be a result of physical or psychosocial reasons or because of the presence of co-morbidities and medication use. Further research by Bugnicourt et al. (2014) revealed that 30 of 104 patients experiencing sexual dysfunction with impairments in sexual activity significantly predicted by depression (OR 9.1, 95% CI 2.45-33.46,  $p=0.001$ ) and the use of ACE inhibitors (OR 6.0, 95% CI 2.11-17.27,  $p=0.001$ ). The fears and concerns of a patient's partner have also been suggested to contribute to a patient's decline in sexuality after stroke (Giaquinto et al., 2003).

Patients prefer to address sexuality with their physicians as opposed to other health care providers, to receive written material, and to initiate discussion early in the rehabilitation process (Stein et al., 2013). A study assessing a sexuality education intervention found that patients who received a short (40-50 minute) education session that outlined the changes that they can expect in their sexuality post-stroke, frequently asked questions and tips to avoid sexual dysfunction were more sexually active and experienced greater sexual satisfaction than patients who did not. Interventions addressing post stroke sexuality are limited. Only one intervention was identified, consisting of patient education sessions following discharge from hospital (Song et al., 2011). Patients who received this intervention reported being more sexually active and satisfied one month post-stroke compared to control patients (Song et al., 2011).

### **Leisure Activity**

Leisure activity has been found to be markedly reduced for individuals post-stroke (Drummond, 1990). Eighty-seven percent of individuals in a study assessing participation one year after stroke reported at least one gap or incongruence between an activity they wanted to do but were not currently doing (Eriksson et al., 2012). The same study found that the most frequently cited occupational gaps were in leisure and social activities (Eriksson et al., 2012).

The definition of leisure activities can vary quite widely among individuals. However, established tools such as the Nottingham Leisure Questionnaire (NLQ) and the Occupational Gaps Questionnaire contain a list of possible activities. For example, leisure activities on the NLQ are defined as activities that "individuals do during their free time" and can include watching TV, gardening, cooking, dancing, photography, sports etc. (Drummond et al., 2001).

Decreased participation (defined as instrumental activities of daily living and leisure activities) was found to explain 50% of the variance in life satisfaction scores in a sample of 56 patients living in the community one year after stroke (Hartman-Maeir et al., 2007). A review by Nicholson et al. (2013) revealed that personal barriers such as physical difficulties and motivation, and environmental barriers including transportation and affordability were frequently cited by stroke patients as reasons for decreased participation. However, socializing, returning to driving, and ability to perform activities of daily living were cited as motivational factors (Nicholson et al., 2013). Another study assessing the effects of social activity in particular (one dimension of leisure activity) on life satisfaction post-stroke found that 6.9% of the variance in a participant's level of life satisfaction was explained by level of social activity (Boosman et al., 2011). Individuals at risk of decreased social activity are typically younger, female, not living with a partner and have a lower functioning at one year post-stroke (Schepers et al., 2005).

Results from a meta-analysis assessing community occupational therapy interventions found that interventions were effective in improving patient outcomes (Walker et al., 2004). Type of intervention, be it leisure or activities of daily living (ADL) specific, generated positive results in the corresponding outcome measure (i.e. leisure specific interventions result in positive leisure activity outcomes but do not show a similar response in general ADL outcomes. Likewise, ADL specific interventions resulted in positive ADL outcomes but did not appear to influence leisure activity outcomes). Educational sessions alone have also demonstrated effectiveness in improving leisure outcomes for patients following a stroke (Desrosiers et al., 2007).

[Link to evidence tables and reference list for Section 11](#)

## Section 12. Pediatric Stroke Rehabilitation

*About these recommendations: 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.*

### Introduction

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. Stroke in infants and children has become increasingly recognized and their care specialized in some areas of Canada. The primary cause of stroke in children, unlike in adults, is not cardiovascular disease or atherosclerosis, and outside of the neonatal period is less likely to be embolic in origin than in the adult population. 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. This means that the outcomes of individual strokes in children cannot simply be determined by location of damage and the initial physical manifestations of the damage, but also must be evaluated with a developmental lens in mind. The long-term outcomes of children who have had a stroke must be monitored for many years, as infants and toddlers may not have the full impact of the stroke realized until their adolescence or young adult years.

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. There are limited studies on such things as functional electrical stimulation, botulinum toxin Type A treatment for dystonia and spasticity, and the necessity for constraint induced movement therapy and its appropriate dosing. There is a lack of clarity regarding timing of rehabilitation interventions, intensity of interventions and duration of therapy in children. While the limitations in the literature are clear, it is also encouraging to see that quality research is beginning to surface in these key areas of therapeutic intervention and long-term outcomes. There is a larger body of evidence that has emerged in the pediatric cerebral palsy literature addressing some of the same issues around rehabilitation, and some of this evidence may be applicable to children with stroke. As part of future editions of these stroke best practice recommendations, an in-depth review will be conducted of the cerebral palsy literature to determine applicability and generalizability to pediatric stroke.

***A key message emerging from the current literature is that it is now increasingly clear 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.***

In addition, the psychological well being of the entire family is an important component of pediatric stroke rehabilitation. In perinatal stroke, and many childhood strokes, a definitive cause can usually not be identified and diagnosis is often delayed. Mothers are also bombarded with information (and misinformation) during pregnancy on what they should and should not do. This combination leads many mothers of children with perinatal stroke to assume that they are somehow responsible for their child's brain injury and its consequences. Such misplaced guilt is very common and can be extremely disabling. Misplaced blame on doctors and others is also common. Such psychological complications in the parents add to the overall morbidity incurred by the family. Therefore, parents and family members should be included in goal-setting and developing individualized rehabilitation plans for each child who has had a stroke, and offered appropriate support throughout this journey.

This pediatric stroke section of the Canadian Stroke Best Practice Recommendations Stroke Rehabilitation module provides a description of the current state of evidence for pediatric stroke rehabilitation, to assist in treatment planning and goal setting, and also to raise awareness of the gaps in knowledge that should drive ongoing research efforts in this area. The goal of stroke research in children is to build upon the key studies that have already begun in the field of pediatric stroke rehabilitation, and to generate evidence to guide best practice for efficacious stroke treatment and recovery. This section also highlights the need for stroke systems of care to be built to support children with stroke, support families, and to address issues of initial and ongoing access to rehabilitation services to meet the changing needs of children with stroke as they grow and develop.

## Pediatric Definition

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).

## Canadian Stroke Best Practice Recommendations

### PEDIATRIC STROKE REHABILITATION

#### 1. Organization and Assessment for Stroke Rehabilitation

Stroke Rehabilitation	12.1. Organization and Assessment for Stroke Rehabilitation
<b>Update 2015</b>	
<b>1.1 Assessment for Rehabilitation</b>	
<ul style="list-style-type: none"> <li>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].</li> <li>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].</li> <li>iii. Clinicians should consider standardized, valid assessment tools to evaluate the patient's stroke-related impairments, functional activity limitations, role participation restrictions, mood and behaviour changes, and environmental restrictions [Evidence Level C].</li> <li>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.</li> <li>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].</li> <li>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].</li> </ul>	
<b>1.2 Pediatric Stroke Rehabilitation Team</b>	
<p><i>Note: Applicable for all stroke rehabilitation settings (acute care hospital, ambulatory clinic, community-based services and programs)</i></p> <ul style="list-style-type: none"> <li>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]. <ul style="list-style-type: none"> <li>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].</li> <li>b. The parent(s) and other family members are also included as part of the core team [Evidence Level C].</li> <li>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].</li> </ul> </li> </ul>	

## 2. Stroke Rehabilitation Therapy for Children

Stroke Rehabilitation Update 2015	12.2. Stroke Rehabilitation Therapy for Children
<p><b>2.1 General Principles</b></p> <ul style="list-style-type: none"> <li>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].</li> <li>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].</li> <li>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].</li> <li>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].</li> </ul> <p><b>2.2 Specific Therapies for Arm and Hand</b></p> <ul style="list-style-type: none"> <li>i. <b>Range of motion</b> 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].</li> <li>ii. <b>Hand and wrist splints</b> 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.</li> <li>iii. <b>Traditional or modified constraint-induced movement therapy (CIMT)</b> 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].</li> <li>iv. <b>Functional Electrical Stimulation (FES)</b> may be considered to increase awareness of extremity, reduce motor impairment and improve upper extremity function [Evidence Level C].</li> <li>v. <b>Mirror Therapy</b> should be considered as an adjunct to motor therapy for select patients. It may help to improve grasp and pinch strength. [Evidence Level C].</li> <li>vi. Chemodenervation using <b>Botulinum Toxin Type A</b> may be considered to increase range of motion for patients with focal and/or symptomatically distressing upper limb spasticity or dystonia [Evidence Levels C].</li> <li>v. <b>Repetitive Transcranial Magnetic Stimulation (rTMS)</b> may be considered as an experimental adjunct to upper extremity therapy within a clinical trial [Evidence Level C].</li> <li>vi. <b>Surgical interventions</b> such as tendon repositioning to promote more functional joint mechanics should be considered in select patients [Level C].</li> </ul> <p><b>2.3 Lower Limb Mobility</b></p> <ul style="list-style-type: none"> <li>i. <b>Range of motion</b> exercises (passive and active assisted) should be provided as well as physical activity and gait training to promote ambulation [Level C].</li> <li>ii. <b>Ankle-foot orthoses</b> and other splints should be considered in appropriate patients, and be customized to individual patients [Evidence Level C].</li> <li>iii. Chemodenervation using <b>Botulinum Toxin Type A</b> may be considered to increase range of</li> </ul>	

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].

#### **2.4 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].

### **3. Life Roles, Activities, and Family Wellness (School and Leisure)**

#### **Stroke Rehabilitation Update 2015** **12.3 Life Roles , Activities and Family Wellness**

##### **3.1 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].

##### **3.2 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].

##### **3.3 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].

## Rationale

Pediatric stroke affects >10,000 Canadian children. Stroke in children is a different disease process with different mechanisms, treatments, and outcomes as compared to adults. There are many developmental factors that are involved in the growing and maturing brain. This means that the outcomes of individual strokes in patients cannot simply be determined by location of the damage and the initial physical extent of damage, but also must be evaluated with a developmental lens in mind. The long-term outcomes of individuals who may have had a stroke must be monitored for many years prior as infants and toddlers may not have the full extent of the stroke impact realized until they are adolescents or young adults.

## System Implications

To ensure children who have experienced a stroke receive timely stroke rehabilitation assessment and treatments, the acute care, rehabilitation, and community organizations require:

- An adequate complement of clinicians experienced in pediatric stroke, developmental pediatrics, and stroke rehabilitation.
- A clear process for referral of patients to rehabilitation professionals and programs throughout childhood.
- Programs for children with stroke established in each province and partnerships to ensure access across regions. These programs should be appropriately resourced to meet the rehabilitation frequency and intensity needs of children affected by stroke.
- Standardized, validated, and expert consensus-based screening assessment tools and outcome measures specific to pediatric populations and training for professionals in using these tools.
- Development or expansion of stroke rehabilitation expertise in children's hospitals and children's treatment centres, as needed, and integration of stroke rehabilitation needs into school supports.
- Mechanisms to periodically re-evaluate children with stroke over their developing years to ensure that they have access to rehabilitation as appropriate, as they develop to ensure emerging or changing rehabilitation needs and goals are met.
- Coordination and development of strong partnerships in the community, and adequate resources to ensure access to comprehensive stroke rehabilitation. This is especially important in more rural and remote geographic locations where telehealth technologies should be optimized.
- Employers and education providers should be encouraged to provide school modifications and flexibility to allow patients to return to school.
- Financial assistance programs for families to ensure the child's rehabilitation and developmental needs are met after stroke.

## Performance Measures

Process and Outcome Performance Measures:

1. Rate of pediatric stroke cases in Canada diagnosed by year, stroke type, and by age group at onset (PPIS, neonatal stroke, childhood stroke).

2. Description of stroke functional levels pre and post rehabilitation based on validated measures of stroke functions and outcomes.
3. Distribution of stroke severity levels for all pediatric stroke patients admitted to inpatient and/or outpatient rehabilitation services following stroke.
4. Admission destination (facility type, service, location) for pediatric stroke and TIA patients in inpatient rehabilitation facilities.
5. Number and percentage of paediatric ischemic stroke or transient ischemic attack patients who received antithrombotic therapy prescriptions before or during rehabilitation.
6. Rates of readmission to acute care for children with stroke.
7. Number and rate of children with stroke who are admitted to inpatient and outpatient rehabilitation programs.
8. Degree of functional ability of paediatric stroke or transient ischemic attack patients at discharge from acute care and rehabilitation services, using modified Rankin score).
9. Pediatric Stroke Outcome Measure (PSOM) changes between neurology clinic follow-up visits. – Changes in scores from Recovery Recurrence Questionnaire between neurology clinic follow-up visits.
10. Discharge destination for pediatric stroke and TIA patients following inpatient rehabilitation stay.
11. Changes in neuropsychological evaluation outcomes between neurology clinic follow-up visits.

**System Performance Measures:**

1. Improved recognition and understanding of stroke-specific issues by rehabilitation professional caring for children.
2. Stroke-specific rehabilitation procedures and programs at tertiary care pediatric centres in all major Canadian centres.
3. Increased community-based rehabilitation options and patient participation for children and families affected by stroke.
4. Integrated neuropsychological testing and educational planning within the school system for children with stroke.
5. Access to experimental interventional therapies via a national integrated clinical trials network.

**Measurement Notes**

- Pediatric data could ideally be obtained from primary chart audit.
- Data may also be accessible from the Canadian Pediatric Ischemic Stroke Registry (CPISR) managed through the hospital for Sick Children in Toronto, and/or the International Pediatric Stroke Study registry, accessed through <https://app3.ccb.sickkids.ca/cstrokestudy/>.
- CIHI databases do contain information on children with stroke admitted to acute care facilities. This data is documented retrospectively and without validation studies so may be an underestimate of the total admissions for stroke in infants and children.

**Implementation Resources and Knowledge Transfer Tools**

**Health Care Provider Information**

- Management of Stroke in Infants and Children (American Heart Association Scientific Statement): <http://stroke.ahajournals.org/content/39/9/2644.full.pdf>
- Calgary Pediatric Stroke Program: <http://www.perinatalstroke.com/>



- International Paediatric Stroke Study: <https://app3.ccb.sickkids.ca/cstrokestudy/>
- Holland Bloorview Kids Rehabilitation Hospital: <http://www.hollandbloorview.ca/Home>
- Aphasia Institute: <http://www.aphasia.ca/home-page/health-care-professionals/>
- CSBPR Stroke Rehabilitation Module Table 6: Stroke Rehabilitation Screening and Assessment Tools commonly used in Pediatric Stroke Rehabilitation

### Patient Information

- A Family Guide to Pediatric Stroke: <http://www.strokebestpractices.ca/wp-content/uploads/2011/10/PEDSGuide-EN.pdf>
- Taking Charge of your Stroke Recovery [http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF\\_SBP\\_PatientsGuide\\_F14\\_EN\\_July2014-FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/08/HSF_SBP_PatientsGuide_F14_EN_July2014-FINAL.pdf)
- Post Stroke Checklist: [http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist\\_WEB.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF%20Post%20Stroke%20Checklist_WEB.pdf)
- IAPS Pediatric Stroke Fact Sheet and Family Guide (<http://iapediatricstroke.org/home.aspx> Heart and Stroke Foundation Healthy Kids: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3479025/k.9BB0/KidsTeens\\_Zone.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3479025/k.9BB0/KidsTeens_Zone.htm)
- Childhood Stroke: <http://www.aboutkidshealth.ca/En/HealthAZ/ConditionsandDiseases/BrainandNervousSystemDisorders/Pages/Stroke-Home.aspx>
- Canadian Paediatric Stroke Support Association: <http://www.cpssa.org/>
- International Alliance for Pediatric Stroke: <http://www.iapediatricstroke.org/home.aspx>
- Pediatric Stroke Network: <http://www.pediatricstrokenetwork.com/>
- Children's Hemiplegia and Stroke Association: <http://chasa.org/>
- Holland Bloorview Kids Rehabilitation Hospital: <http://www.hollandbloorview.ca/Home>
- Aphasia in Children: [http://www.rch.org.au/kidsinfo/fact\\_sheets/Language\\_disorders\\_Aphasia/](http://www.rch.org.au/kidsinfo/fact_sheets/Language_disorders_Aphasia/)
- Stroke Recovery: [http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke\\_Recovery.htm](http://www.heartandstroke.com/site/c.iklQLcMWJtE/b.3483945/k.A2C7/Stroke_Recovery.htm)
- Stroke in Young Adults: [http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke\\_Young\\_FINAL.pdf](http://www.strokebestpractices.ca/wp-content/uploads/2015/01/Stroke_Young_FINAL.pdf) The Internet Stroke Center: <http://www.strokecenter.org/patients/about-stroke/pediatric-stroke/introduction/>
- National Stroke Association: <http://www.stroke.org/understand-stroke/impact-stroke/pediatric-stroke>
- Jooay Community-based Activities for Children with Disabilities: <http://jooay.com/ChildhoodDisabilityLINK-LinktoConstraint-inducedmovementtherapy>: <http://www.childhooddisability.ca/cimt/>

### Summary of the Evidence

In general, there is a dearth of studies that evaluate rehabilitation interventions among the pediatric stroke population. This discussion will focus on the evidence for pediatric stroke specifically. Pediatric specific studies have been conducted in the following areas: functional electrical stimulation (FES), constraint induced movement therapy (CIMT), mirror therapy, botulinum toxin type A, and repetitive transcranial magnetic stimulation (rTMS).

Although CIMT is a widely studied therapeutic intervention in the adult stroke population, studies of its effect among pediatric stroke patients are just emerging. Taub et al. (2011) studied 20 children with

congenital hemiparesis to evaluate the effect of early (immediate) versus delayed (at 6 months post stroke) CIMT. Participants were randomized initially, and then crossed over to the other treatment arm at 6 months. The authors reported that compared to the delayed group, individuals who received early CIMT had large increases on the Pediatric Motor Activity Log ( $p < 0.0001$ ), and that at 6-month follow-up they continued to show larger gains on the Pediatric Motor Activity Log, Pediatric Arm Function Test, as well as passive and active range of motion (ROM). These findings are supported by an earlier study by Williw et al. (2002) which also compared early (immediate) versus delayed (6 months) CIMT in a cross-over RCT. Similarly, the authors reported that participants improved in the Peabody Development Motor Scale score one month post CIMT in both groups, but only after CIMT was completed. Previous pre-post studies have also demonstrated significant improvements in amount and quality of use of the affected extremity (Karmman et al. 2003), Pediatric Motor Activity Log-Revised (Rickards et al. 2014; Sterling et al. 2013), as well as the Pediatric Arm Function Test (Rickards et al. 2014). Challenges with CIMT include fatigue and compliance with the protocol.

Functional Electrical Stimulation (FES) is a commonly used therapeutic application for adult rehabilitation patients; there is little evidence for pediatric patients. One recent pre-post study has evaluated the use of 48 hours of FES in just four pediatric stroke participants (Kapadia et al. 2014). The authors reported significant improvement on the object manipulation sub-scale of the Rehabilitation Engineering Laboratory hand Function Test; all other measures revealed no significant improvements.

The effectiveness of mirror therapy in improving upper extremity function has been assessed in a single cross-over RCT (Gygax et al. 2011). Ten children were randomized to receive bimanual training with or without a mirror for three weeks; participants then crossed over to the other arm. Gygax et al. (2011) reported that grasp strength ( $p = 0.033$ ) and upper limb dynamic position ( $p = 0.044$ ) significantly improved with training with the mirror, whereas pinch strength improved without the use of a mirror.

Botulinum toxin type A is regularly used around the world to reduce excessive tone in the spastic affected extremity of individuals post stroke. Extensive evidence exists in the adult stroke population. With the exception of studies assessing a cerebral palsy population, there has not been a study which has examined the use of botulinum toxin specifically among pediatric stroke patients. Given the low prevalence of pediatric stroke, these patients are often combined with cerebral palsy patients in rehabilitation trials. Thus, the evidence for botulinum toxin for pediatric stroke is limited, despite extensive evidence in other populations (e.g., cerebral palsy, adult stroke).

Repetitive transcranial magnetic stimulation (rTMS) likely improves motor recovery in adult stroke and is now Health Canada approved for treating spasticity and major depression. In the pediatric stroke population, three RCTs have evaluated the effect of rTMS in improving upper extremity function. Gillick et al. (2014) reported a significant improvement among children with perinatal stroke in the rTMS group compared to the sham group on the Assisting Hand Assessment measure; however, no differences between groups were reported on the Canadian Occupational Performance Measure. Kirton et al. (2015, in press) performed a factorial trial of rTMS and CIMT in 45 children with perinatal stroke and hemiparesis, demonstrating additive effects lasting 6 months when combined with 2 weeks of intensive motor therapy. Kirton et al. (2008) also examined ten children with childhood stroke receiving either active or sham rTMS with possible modest improvements noted in grip strength and the Melbourne Assessment of Upper Extremity Function measure.

Overall, there has been limited research evaluating the use of specific rehabilitation interventions in the pediatric population, although multiple studies, some with small numbers, are increasingly being added. Studies from adult stroke populations have shown various treatments to be effective in improving outcomes. As a result, many of the therapies used among children have been derived from research study and clinical use in the older population. Future studies should recruit a greater number of pediatric stroke participants and evaluate a wide range of interventions. Adherence to strict methodological protocols would be beneficial in comparing between studies.

Finally, it is worth noting that the psychological well-being of the entire family is an important component of pediatric stroke rehabilitation. Often, the cause of perinatal stroke cannot be identified and, as such, parents, particularly mothers, place blame on themselves or doctors and health care professionals. This is largely the result of receiving a gross amount of medical information (or misinformation) during pregnancy. Important research has begun to be investigated in this area. Bemister et al. (2014) reported that when

compared to mothers of children without stroke, those who had a child that suffered a stroke were significantly more depressed. Further, there were significant differences in family functioning, parent health-related quality of life, and marital satisfaction. When specifically comparing mothers and fathers of children with pediatric stroke, mothers were found to have significantly higher anxiety and guilt regarding their child's condition. In a follow-up study, Bemister et al. (2015) reported that several factors including stroke severity, anxiety, social support, stress levels, marital quality, guilt, and blame significantly predicted a caregiver's depression. In addition to these variables, cognitive and behavioural impairments also predicted family functioning. These [psychological complications among parents add to the overall morbidity incurred by the family](#). Simple educational interventions are likely very effective at reducing or eliminating this complication; however, there are few studies which have assessed these therapeutic strategies and therefore, would be an important avenue for future research.

[Link to Pediatric Stroke Evidence Tables and Reference lists](#)

## APPENDIX

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**Table 1: Canadian Stroke Best Practice Recommendations  
Suggested Stroke Rehabilitation Screening and Assessment Tools**

**a. Tools to Assess Functional Capacity and Activities of Daily Living**

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Functional Independence Measure (FIM®)</b>  <b>Keith et al., 1987</b>	The FIM® is an <b>assessment</b> tool for physical and cognitive disability and is intended to measure burden of care.	18 items evaluating 6 areas of function: self-care, sphincter control, mobility, locomotion, communication and social cognition.  <u>Score Interpretation:</u> Maximum score is 126, with higher scores indicating greater levels of functional independence. Scores can also be calculated for motor and cognitive subscales.  <u>Administration:</u> Observation; approx. 30 minutes to complete.	The FIM® has been well-studied for its validity and reliability within stroke populations; however, it has been suggested that reliability is dependent on the individual administering the assessment (Salter et al. 2012).  <u>Specialized Training:</u> Required.	Available for purchase. <a href="http://www.udsmr.org/WebModules/FIM/Fim_About.aspx">www.udsmr.org/WebModules/FIM/Fim_About.aspx</a>
<b>AlphaFIM® Instrument</b>  <b>Stillman et al., 2009</b>	The AlphaFIM® Instrument is an assessment tool designed for use during acute care.	6 items assessing of motor (eating, grooming, bowel management and toilet transfers) and cognitive (expression and memory) function, which can be reliably collected in acute care. For patients who are able to walk 150 feet or more, eating and grooming items are replaced by items evaluating walking and bed transfer. <u>Score Interpretation:</u> Alpha-FIM® scores are transformed to a projected FIM® scores and an estimate of patient burden of care hours using an online proprietary algorithm (Lo et al. 2012). <u>Administration:</u> Approx. 5 minutes to complete.	Requires less time to complete than the original FIM®. <u>Specialized Training:</u> Required	Available for purchase. <a href="http://www.udsmr.org/WebModules/Alpha/Alp_About.aspx">www.udsmr.org/WebModules/Alpha/Alp_About.aspx</a>
<b>Modified Rankin Scale (mRS)</b>  <b>Rankin, 1957</b>	The mRS is an <b>assessment</b> tool for rating global outcome.	Individuals are assigned a subjective grade or rank ranging from 0 (no symptoms) to 5 (severe disability) based on level of independence with reference to pre-stroke activities rather than observation of task-based performance. <u>Administration:</u> Interview; 15 minutes to complete.	The scale's categorical options have been criticized as being broad and poorly defined (Wilson et al. 2002).  <u>Specialized Training:</u> Not required.	Free <a href="http://www.rankinscale.org/">www.rankinscale.org/</a>
<b>Barthel Index of Activities of Daily Living (BI)</b>	The BI is an <b>assessment</b> tool for evaluating independence	The BI consists of 10 common ADLs, 8 related to personal care and 2 related to mobility. <u>Score Interpretation:</u> The index yields a total score out of 100 with higher scores indicating greater functional independence.	Widespread familiarity of the BI contributes to its interpretability. The BI is relatively insensitive and a lack of comprehensiveness may result in problems with ceiling and floor effects	Free <a href="http://www.strokecenter.org/wp-content/uploads/2011/08">http://www.strokecenter.org/wp-content/uploads/2011/08</a>

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Mahoney et al., 1965</b>	in self-care activities.	<u>Administration:</u> Self-Report (less than 5 minutes) or direct observation (up to 20 minutes).	(Duncan et al. 1997). <u>Specialized Training:</u> Not required.	<a href="/barthel.pdf">/barthel.pdf</a>
<b>Modified Barthel Index of Activities of Daily Living (MBI)</b>  <b>Collin et al. 1988</b>	The MBI is a modified version of the BI.	The content of the BI and MBI are the same. It is only the scoring values that were changed in the MBI. Scoring: Functional categories may be scored from 0 to 1, 0 to 2 or 0 to 3, depending on the item. Total scores range from 0 to 20	The MBI has been reported to have excellent internal consistency, test-retest reliability and inter-rater reliability. Specialized training: Training required if administered by direct observation	<a href="http://www.strokecenter.org/trials/scales/barthel.pdf">http://www.strokecenter.org/trials/scales/barthel.pdf</a>
<b>Frenchay Activities Index (FAI)</b>  <b>Holbrook et al., 1983</b>	The FAI is an <b>assessment</b> tool for instrumental activities of daily living.	15 items representing activities in 3 domains: domestic chores, leisure and work, and outdoor activities.  <u>Score Interpretation:</u> Summed scores range from 15-60, with lower scores indicating less frequent activity.  <u>Administration:</u> Interview; approx. 5 minutes to complete.	The FAI provides complementary information to that obtained from the Barthel Index, with the FAI representing higher level ADLs (Pederson et al. 1997)  Age and Gender may influence scores (Holbrook & Skilbeck 1983; Appelros 2007).  <u>Specialized Training:</u> Not required.	Free  <a href="http://www.rehabmeasures.org/PDF%20Library/Frenchay%20Activities%20Index.pdf">www.rehabmeasures.org/PDF%20Library/Frenchay%20Activities%20Index.pdf</a>
<b>6 Minute Walk Test (6MWT)</b>  <b>Butland et al., 1982</b>	The 6MWT is an <b>assessment</b> tool for walking capacity and endurance.	The total distance (i.e., metres or feet) walked during the trial period is measured and recorded. The number and duration of rests can also be measured.  <u>Administration:</u> Observation; 6 minutes to complete.	Age, height, weight, and sex should each be considered when interpreting results. Encouragement may also impact test results: the published standardized protocol should be used (ATS, 2002; updated protocol Holland et al. 2014).  Reference equation developed for Canadians, which was based from the ATS protocol, uses only sex and age to determine the normative value for the 6-minute walk (Hill et al. 2011).  As a test of submaximal walking capacity, this test may be best suited to those with moderate-severe impairment (Salter et al. 2012). Variations of this test include the 2 minute and 12 minute walk tests. <u>Specialized Training:</u> Required reading.	Free  <a href="http://www.csc.unc.edu/spir/public/UNLICOMMSMW/SixMinuteWalkTestFormQxQ08252011.pdf">www.csc.unc.edu/spir/public/UNLICOMMSMW/SixMinuteWalkTestFormQxQ08252011.pdf</a>
<b>10 Meter Walk Test (10MWT)</b>	The 10MWT is an <b>assessment</b>	The total time required to walk 10 meters is measured and recorded.	Requires a 20 meter path that includes 5 meter for acceleration and deceleration.	Free



Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Sullivan et al., 2013</b>	tool for walking speed.	Administration: Time is measured while <u>individual walks 10-meters, after given space to accelerate to their preferred walking speed (this distance is not included when determining speed).</u>	Meta-analysis of age- and sex-specific normative speed found that the grand mean speed ranged from 94.3 cm/second (women aged 80 to 99 years) to 143.4 cm/second (men aged 40 to 49 years). The grand mean gait speed was relatively consistent for the decades 20 to 29 years to 60 to 69 years for men (133.9 to 143.3 cm/second) and women (124.1 to 139.0 cm/second). By the time subjects were aged 80 years or more, their mean gait speed declined to less than 100 cm/second. (Bohannon et al. 2011)	<a href="http://www.rehabmeasures.org/PDF%20Library/10%20Meter%20Walk%20Test%20Instructions.pdf">http://www.rehabmeasures.org/PDF%20Library/10%20Meter%20Walk%20Test%20Instructions.pdf</a>
<b>Life Habits (LIFE-H) Fougeyrollas et al. 1998</b>	The LIFE-H is an assessment tool for quality of social participation based on the ability to accomplish activities of daily living and social roles.	<p>LIFE-H assesses 12 domains of life habits. The first 6 domains are related to activities of daily living including: nutrition, fitness, personal care, communication, housing, mobility. The remaining are domains are related of social roles: responsibilities, interpersonal relationships, community life, education, employment and leisure.</p> <p>Score interpretation: LIFE-H is based on a continuous score ranging from 0 to 9, with 0 implying an optimal level of participation and 9 indicating total handicap. In the shortened version, the scale is reversed with 9 implying optimal level of participation and 0 indicating total handicap. The total LIFE-H score is obtained by summing the score of each item and then dividing by the number of items.</p> <p>Administration: The life-H is a self-administered questionnaire. Proxy respondents may be used for clients with low cognitive levels. (Poulin &amp; Desrosiers 2008).</p>	<p>The LIFE-H includes 240 items. The LIFE-H is also available to three shortened version: 1. LIFE-H 2.1 (58 items); 2. LIFE-H 3.0 (69 items); and 3. LIFE-H 3.1 (77 items). The International Network of Disability Creation Process encourages use of version 3.0. (Fougeyrollas et al. 1997; Fougeyrollas et al. 2001)</p> <p>The LIFE-H 3.0 (short form) may take 20 to 40 minutes to complete. The administration time for the long form can vary from 20 to 120 minutes. (Noreau et al. 2002)</p> <p>The LIFE-H is able to discriminate healthy individuals from clients with stroke.</p> <p>Training: None</p>	A copy of the LIFE-H can be ordered from the International Network on the Disability Creation Process (INDCP) by emailing the coordinator at <a href="mailto:francis.charrier@idrpq.qc.ca">francis.charrier@idrpq.qc.ca</a> .

## b. Tools to Assess Stroke Severity

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Canadian Neurological Scale (CNS)</b>  <b>Côté et al., 1986</b>	The CNS is an <b>assessment</b> tool for neurological impairment.	<p>Items include an assessment of mental activity (level of consciousness, orientation and speech) and motor activity (face, arms and legs) for patients with or without comprehension deficits in the acute stage.</p> <p><u>Score Interpretation:</u> Maximum score is 11.5; lower scores indicate higher severity.</p> <p><u>Administration:</u> Approximately 5-10 minutes or less to complete by an administrator.</p>	<p>Quick and simple tool completed by a trained health care practitioner. Used in the acute phase of stroke.</p> <p><u>Specialized Training:</u> Not Required.</p>	<p>Free</p> <p><a href="http://www.strokecenter.org/wp-content/uploads/2011/08/canadian.pdf">www.strokecenter.org/wp-content/uploads/2011/08/canadian.pdf</a></p>
<b>National Institutes of Health Stroke Scale (NIHSS)</b>  <b>Brott et al., 1989</b>	The NIHSS is an <b>assessment</b> tool for neurological status following a stroke.	<p>11 items which include an assessment of level of consciousness, facial palsy and the presence of neglect or visual, sensory, motor, language or speech deficits. Items are answered according to a 3 or 4 point ordinal scale.</p> <p><u>Score Interpretation:</u> Maximum score is 42; higher scores indicate a greater level of severity. (1-4=mild; 5-14=mild to moderate; 15-24=severe; &gt;25=very severe)</p> <p><u>Administration:</u> Approximately 5-10 minutes to complete by an administrator.</p>	<p>Can be completed by non-neurologists. Shortened versions are available. The suitability of the item assessing limb ataxia has been questioned, and several items cannot be assessed in patients with severe stroke.</p> <p><u>Specialized Training:</u> Required.</p>	<p>Free</p> <p><a href="http://www.strokecenter.org/wp-content/uploads/2011/08/NIH_Stroke_Scale.pdf">www.strokecenter.org/wp-content/uploads/2011/08/NIH_Stroke_Scale.pdf</a></p>
<b>Orpington Prognostic Scale (OPS)</b>  <b>Kalra &amp; Crome, 1993</b>	The OPS is an <b>assessment</b> tool for stroke severity and has been found to be beneficial in identifying a patient's suitability for rehabilitation.	<p>4 items which include an assessment of motor functioning in the arm, proprioception, balance and cognition.</p> <p><u>Score Interpretation:</u> Maximum score is 6.8; higher scores indicate a greater level of severity. (&lt;3.2=mild to moderate; 3.2 - 5.2 = moderate to moderately severe; &gt;5.2 = severe or major).</p> <p><u>Administration:</u> Approximately 5 minutes or less to complete by an administrator.</p>	<p>Quick and simple tool that does not require additional equipment for administration.</p> <p>Should not be used until the patient's medical condition has stabilized.</p> <p><u>Specialized Training:</u> Not Required.</p>	<p>Free</p> <p><a href="http://www.uwhealth.org/files/uwhealth/docs/pdf/spep_orpington_scale.pdf">www.uwhealth.org/files/uwhealth/docs/pdf/spep_orpington_scale.pdf</a></p>

## c. Tools to Assess Motor Function

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Chedoke-McMaster Stroke Assessment Scale (CMSA)</b>  <b>Gowland et al., 1993</b>	The CMSA is a <b>screening</b> and <b>assessment</b> tool for physical impairment and disability.	The CMSA consists of two inventories. The physical impairment inventory assesses 6 domains (should pain, postural control and arm, hand, leg, and foot movement), whereas the disability inventory assesses gross motor and walking function. <u>Score Interpretation:</u> The impairment and disability inventories yield total scores out of 42 and 100, respectively, with lower scores indicating greater impairment. <u>Administration:</u> Observation; up to 60 minutes to complete.	The CMSA is relatively comprehensive and has been well studied for reliability and validity (Poole and Whitney 2001). Taking approximately 1 hour to complete, the length and complexity of the CMSA may decrease the scales utility in clinical practice (Poole and Whitney 2001). <u>Specialized Training:</u> Required reading.	Free <a href="http://www.rehabmeasures.org/PDF%20Library/CMSA%20Manual%20and%20Score%20Form.pdf">http://www.rehabmeasures.org/PDF%20Library/CMSA%20Manual%20and%20Score%20Form.pdf</a>
<b>Fugl-Meyer Assessment of Motor Recovery after Stroke (FMA)</b>  <b>Fugl-Meyer et al., 1975</b>	The FMA is an <b>assessment</b> tool for motor functioning following a stroke.	155 items assessing motor function in the upper and lower extremity, balance, sensation, range of motion and pain. <u>Score Interpretation:</u> Maximum score is 226 (66 for upper extremity, 34 for lower extremity, 14 for balance, 24 for sensation, 44 for range of motion and 44 for pain); higher scores indicate greater functional performance. <u>Administration:</u> Approximately 30 minutes or more to complete by direct observation.	Widely used and validated. Shortened versions are available and the motor scale of the tool can be administered on its own. Requires additional equipment (e.g. tennis ball) and should be administered by a trained therapist (Occupational Therapist or Physiotherapist). <u>Specialized Training:</u> Required.	Free <a href="http://www.rehabmeasures.org/lists/rehabmeasures/dispform.aspx?ID=908">http://www.rehabmeasures.org/lists/rehabmeasures/dispform.aspx?ID=908</a>
<b>Rivermead Motor Assessment (RMA)</b>  <b>Lincoln and Leaditter, 1979</b>	The RMA is an <b>assessment</b> tool for motor performance.	38-items of increasing difficulty representing 3 domains: gross function, leg and trunk movement, and arm movement. <u>Score Interpretation:</u> Scores range from 0-38, with higher scores indicating better motor ability. <u>Administration:</u> Observation; up to 45 minutes to complete.	Although the RMA can be time consuming, administration is faster with high functioning individuals because of the progressing difficulty of the measure. Some concern has been reported regarding the validity of the RMA (Adams et al. 1997; Kurtais et al. 2009). The RMA should be administered by a physiotherapist. <u>Specialized Training:</u> Not required.	Free <a href="http://www.strokeengine.ca/assess/rma/">www.strokeengine.ca/assess/rma/</a>
<b>Stroke Rehabilitation Assessment of Movement (STREAM)</b>  <b>Daley et al., 1999</b>	The STREAM is an <b>assessment</b> tool for motor functioning following a stroke.	30 items assessing voluntary movement of the upper and lower limbs and basic mobility. Items are answered based on a 3 or 4 point ordinal scale. <u>Score Interpretation:</u> Maximum score is 70 (20 each for upper and lower limb and 30 for basic mobility); higher scores indicate greater	Quick and simple tool that does not require additional equipment for administration. A shortened version is available. Floor and ceiling effects have been noted for the STREAM raising concerns about the ability to capture change in patients	Free <a href="http://ptjournal.apta.org/content/79/1/8.full.pdf+html">http://ptjournal.apta.org/content/79/1/8.full.pdf+html</a>

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
		mobility. <u>Administration:</u> Approximately 15 minutes to complete by an administrator.	who are functioning at the higher or lower end of the scale. <u>Specialized Training:</u> Not required.	

## d. Tools to Assess Mobility

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Berg Balance Scale (BBS)</b>  <b>Berg et al., 1989</b>	The BBS is an <b>assessment</b> tool for balance in older adults.	14-items in which patients are asked to maintain positions or complete movement tasks of varying levels of difficulty. All items are common to everyday life. <u>Score Interpretation:</u> Total scores range from 0-56, with scores of less than 45 generally accepted as being indicative of balance impairment. <u>Administration:</u> Observation; approx. 10 -15 minutes to complete.	The BBS requires little equipment or space to complete and has demonstrated high levels of reliability even when administered by an untrained assessor (Berg et al. 1995). Sensitivity may be reduced among severely affected patients as the BBS includes only one item relating to balance in a seated position (Mao et al. 2002). <u>Specialized Training:</u> Not required.	Free <a href="http://www.strokingengine.ca/assess/bbs/">http://www.strokingengine.ca/assess/bbs/</a>
<b>Clinical Outcome Variables (COVS)</b>  <b>Seaby and Torrance, 1989</b>	The COVS is an <b>assessment</b> tool for functional mobility.	13 items assessing mobility with respect to transfers, rolling, lying to sitting, sitting balance, ambulation, wheelchair mobility and arm function. <u>Score Interpretation:</u> Total scores range from 13 - 91, with lower scores indicating less functional mobility. <u>Administration:</u> Observation; 15 - 45 minutes to complete.	Provides detail in areas of mobility not assessed by global functional assessments such as the FIM® (Barclay-Goddard 2000). Although reliability of the COVS has been demonstrated, further evaluation of validity is required (Salter et al. 2012). Administration of the COVS requires a fairly lengthy list of equipment. <u>Specialized Training:</u> Required reading.	Available for purchase <a href="http://www.irrd.ca/covs/">http://www.irrd.ca/covs/</a>
<b>Functional Ambulation Categories (FAC)</b>  <b>Holden et al., 1984</b>	The FAC is an <b>assessment</b> tool for rating ambulation status.	Individuals are assigned a subjective grade based on 5 broad categories of walking ability, with scores ranging from 0 (cannot walk or needs help from more than 1 person) to 5 (can walk independently anywhere). <u>Administration:</u> Observation; approx. 5 minutes to complete.	The FAC may be subject to ceiling effects. Further research is needed to evaluate responsiveness in higher functioning populations (Salter et al. 2012). <u>Specialized Training:</u> Not required.	Free <a href="http://www.strokingengine.ca/?s=functional+ambulation+categories">http://www.strokingengine.ca/?s=functional+ambulation+categories</a>

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Mini BESTest</b> <b>Franchignoni et al. 2010.</b>	The MiniBEST is an assessment tool for balance control	The MiniBEST assesses balance control and dynamic balance through 14 items through the following domains: anticipatory postural adjustment, reactive postural control, sensory orientation, dynamic gait. Scoring: Each item is scored on a 3 level ordinal scale (0-2) for a total of 28 points. Two items have right and left assessment, where the lower score is used within the total score. Administration: 10 to 15 minutes to administer	Requires the following equipment: <ul style="list-style-type: none"> <li>60 cm x 60 cm block of 4" medium density Tempur foam (T41)</li> <li>Incline ramp of 10 degree slope (2 x 2 foot recommended)</li> <li>Standard chair without arm rests or wheels</li> <li>Firm chair with arms</li> <li>Box that is 9 inches (23 cm) in height (~2 stacked shoeboxes)</li> <li>Stopwatch</li> <li>Masking tape marked on floor at 3 meters from front of chair</li> </ul> Training: Specialized training is required: reading article/manual; training course/training DVD.	For free: <a href="http://www.bestest.us/">http://www.bestest.us/</a>
<b>Rivermead Mobility Index (RMI)</b> <b>Collen et al., 1991</b>	The RMI is an <b>assessment</b> tool for functional mobility.	15 items, 14 of which involve yes/no questions regarding performance of functional activities and 1 that involves unassisted standing for 10 seconds. <u>Score Interpretation:</u> Scores range from 0 - 15, with higher scores indicating better functional mobility. <u>Administration:</u> Self-report and observation; less than 5 minutes to complete.	Caution in the interpretation of the tests' hierarchical scaling has been advised as modifications (e.g., use of assistive devices) are not considered (Collen et al. 1991). <u>Specialized Training:</u> Not required.	Free <a href="http://www.strokingengine.ca/?s=rivermead">http://www.strokingengine.ca/?s=rivermead</a>
<b>Timed "Up and Go" Test (TUG)</b> <b>Podsiadlo and Richardson, 1991</b>	The TUG is a <b>screening</b> tool for basic mobility and balance.	Individuals are asked to stand from a seated position, walk 3 metres (using an aid if required), turn, walk back to the chair, and repeat themselves. <u>Score Interpretation:</u> The total time to complete the test is recoded with shorter intervals indicating better mobility and balance. <u>Administration:</u> Observation; approx. 3 minutes to complete.	The TUG addresses relatively few aspects of balance and yields a narrower assessment than more comprehensive balance measures, such as the Berg Balance Scale (Whitney et al. 1998). <u>Specialized Training:</u> Not required.	Free <a href="http://www.strokingengine.ca/?s=timed+up+and+go">http://www.strokingengine.ca/?s=timed+up+and+go</a>

## e. Tools to Assess the Upper Extremity

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Action Research Arm Test (ARAT)</b>  Lyle, 1981	The ARAT is an <b>assessment</b> tool for upper extremity function and dexterity.	19 items assessing four areas of function: grasp, rip, pinch, and gross movement. <u>Score Interpretation:</u> Scores range from 0 - 57, with lower scores indicating greater impairment. <u>Administration:</u> Observation; approx. 10 minutes to complete.	Significant floor and ceiling effects have been identified (Van der Lee et al.2002). <u>Specialized Training:</u> Not required.	Free <a href="http://www.strokingengine.ca/?s=action+research+arm+test">http://www.strokingengine.ca/?s=action+research+arm+test</a>
<b>Box and Block Test (BBT)</b>  Mathiowetz et al., 1985	The BBT is an <b>assessment</b> tool for unilateral gross manual dexterity.	Individuals are asked to move small blocks, one at time, from one compartment to another within 60 seconds. <u>Score Interpretation:</u> Scores are calculated by summing the number of blocks transported within the trial period. <u>Administration:</u> Observation; approx. 5 minutes to complete.	Established norms increase the interpretability of BBT results. Seated administration may increase the accessibility of the test. Because the BBS requires adequate strength and grip to transport blocks, it may be best suited for those with mild-moderate hemiparesis/weakness (Chanubol et al. 2012). <u>Specialized Training:</u> Not required.	Standardized equipment available for purchase  <a href="http://www.pattersonmedical.com/app.aspx?cmd=getProductDetail&amp;key=070_921018701">http://www.pattersonmedical.com/app.aspx?cmd=getProductDetail&amp;key=070_921018701</a>
<b>Chedoke Arm and Hand Activity Inventory (CAHAI)</b>  Barreca et al. 2004	The CAHAI is an <b>assessment</b> tool for arm and hand function.	13 bilateral functional tasks (e.g. do up five buttons, carry a bag up stairs, pour a glass of water). <u>Score Interpretation:</u> Total scores range from 13 to 91, with lower scores indicating greater impairment. <u>Administration:</u> Observation; approx. 25 minutes to complete.	The CAHAI has demonstrated good validity and reliability in stroke populations and evaluates a wide range of functions that are not considered in other measures of arm and hand function (Barreca et al. 2005). <u>Specialized Training:</u> Required.	Free <a href="http://www.cahai.ca/">http://www.cahai.ca/</a>
<b>Nine Hole Peg Test (NHPT)</b>  Mathiowetz et al., 1985	The NHPT is an <b>assessment</b> tool for fine manual dexterity.	Individuals are asked to, one at a time, insert 9 pegs from a container into a board with 9 empty holes and then to move the pegs back into the container while being timed. <u>Score Interpretation:</u> Two-trials are performed with each hand, with the final time being an average of the two trials. Lower scores indicate better dexterity. <u>Administration:</u> Observation; approx. 5 minutes to complete	The NHPT has demonstrated good reliability and validity (Salter et al. 2012). Norms for age, gender, and hand dominance have been established; however, norms produced from the original study may not transfer well commercial versions of the test (Davis et al. 1999). The NHPT is susceptible to practice effects. <u>Specialized Training:</u> Not required.	Standardized equipment available for purchase  <a href="http://www.pattersonmedical.com/app.aspx?cmd=getProduct&amp;key=IF_921029571">http://www.pattersonmedical.com/app.aspx?cmd=getProduct&amp;key=IF_921029571</a>
<b>Wolf Motor Function Test (WMFT)</b>	The WMFT is an <b>assessment</b> tool for upper extremity motor	17 items of increasing complexity and progressing from proximal to distal joint involvement. Tasks are performed as quickly as possible and are assessed in terms of	Provides assessment of both performance time and quality of movement. Floor effects have been reported for	Free <a href="http://www.strokingengine.ca/?s=wolf+motor+func">http://www.strokingengine.ca/?s=wolf+motor+func</a>



Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Wolf et al., 2001</b>	ability.	time, strength, and movement quality. <u>Score Interpretation:</u> Scores range from 0 - 75 with higher scores indicating greater motor ability. <u>Administration:</u> Observation; approx. 30 - 45 minutes to complete.	individuals with severe impairment (Salter et al. 2012). Further evidence regarding reliability and validity when used in clinical practice (i.e., real-time observation) is required. <u>Specialized Training:</u> Required.	<a href="#">ion+test</a>

## f. Tools to Assess Mood and Cognition

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Beck Depression Inventory (BDI)</b>  <b>Beck et al., 1961</b>	The BDI is a <b>screening</b> tool for depression and, if present, provides cut points for severity.	21 items relating to symptoms that have been found to be associated with the presence of depression. Items are presented in a multiple choice format ranging from 0 (no symptoms) to 3 (severe symptoms).  <u>Score Interpretation:</u> Maximum score is 63; higher scores indicate greater severity. Graded levels of severity; a score of 10 is considered the cut point for depression.  <u>Administration:</u> 5 - 10 minutes for self- report; 15 minutes with support.	Quick screening tool that does not require extra tools for completion.  Level of depression may be overestimated in women and when completed by a proxy. Rate of misdiagnosis was up to 34% in patients with stroke (Aben, Verhey, Lousberg, Lodder, & Honig, 2002).  <u>Specialized Training:</u> Not required.	Free  <a href="http://www.strokengine.ca/?s=beck+depression+inventory">http://www.strokengine.ca/?s=beck+depression+inventory</a>
<b>Geriatric Depression Scale (GDS)</b>  <b>Yesavage et al., 1982</b>	The GDS is a <b>screening</b> tool for depression and, if present, provides cut points for severity.	30 items relating to symptoms that have been found to be associated with the presence of depression. Items are presented in a yes/no response format.  <u>Score Interpretation:</u> Maximum score is 30 and indicates the highest level of depression. Graded levels of severity; a score of 10 is considered the cut point for depression.  <u>Administration:</u> 5 - 10 minutes for self- report.	Developed for use in the geriatric population. Short forms of the GDS are available.  The tool has been cited as being more accurate for diagnosing women compared to men, and there are concerns with its use for cognitively impaired individuals.  <u>Specialized Training:</u> Not required.	Free  <a href="http://www.strokengine.ca/?s=geriatric+depression+scale">http://www.strokengine.ca/?s=geriatric+depression+scale</a>
<b>Hospital Anxiety and Depression Scale</b>	The HADS is a <b>screening</b> tool	14 items (7 anxiety items and 7 depression items). Items are presented in a multiple	Simple screening tool that does not require extra tools for completion.	Available for purchase.

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>(HADS)</b>  <b>Zigmond &amp; Snaith, 1983</b>	for anxiety and depression and, if present, provides cut points for severity.	choice format ranging from 0 to 3. <u>Score Interpretation:</u> Maximum score is 21 for both anxiety and depression; higher scores indicate greater severity. (0-7=normal; 8-10=borderline abnormal; 11-21=abnormal) <u>Administration:</u> 2-6 minutes for self-report.	Does not contain questions related to the presence of somatic symptoms.  <u>Specialized Training:</u> Not required.	<a href="http://www.gla-assessment.co.uk/products/hospital-anxiety-and-depression-scale-0">http://www.gla-assessment.co.uk/products/hospital-anxiety-and-depression-scale-0</a>
<b>General Health Questionnaire (GHQ)</b>  <b>Goldberg &amp; Hillier, 1979</b>	The GHQ is a <b>screening</b> tool for psychiatric disorders.	28 items each addressing a particular symptom related to 4 domains of distress (depression, anxiety, worrying, and social distress). Items are in the form questions with yes/no responses. <u>Score Interpretation:</u> Multiple scoring methods exist. Conventional method is to score based on presence or absence of a symptom. <u>Administration:</u> Approximately 5 minutes to complete by self-report.	Quick and simple tool that does not require additional materials for completion. Cut-off scores have not been properly validated for diagnosis of psychiatric disorders. <u>Specialized Training:</u> Required reading.	Available for purchase. <a href="https://shop.psych.acer.edu.au/acer-shop/group/SD">https://shop.psych.acer.edu.au/acer-shop/group/SD</a>
<b>Mini-Mental State Examination (MMSE)</b>  <b>Folstein et al., 1975</b>	The MMSE is a <b>screening</b> tool for cognitive impairment.	11 items relating to 6 cognitive domains (orientation – in time and space, registration, attention and calculation, recall, language and read and obey). Items are in the form of questions or tasks. <u>Score Interpretation:</u> Maximum score is 30; higher scores indicate greater cognitive functioning. <u>Administration:</u> Approximately 10 minutes to administer.	Relatively quick and simple tool that requires no additional equipment.  Has been reported to have a low sensitivity, noted especially for those individuals with mild cognitive impairment as well and patients with stroke.  <u>Specialized Training:</u> Not required.	Available for purchase.  <a href="http://www4.parinc.com/Products/Product.aspx?ProductID=MMSE">http://www4.parinc.com/Products/Product.aspx?ProductID=MMSE</a>
<b>Montreal Cognitive Assessment (MoCA)</b>  <b>Nasreddine et al., 2005</b>	The MoCA is a <b>screening</b> tool for cognitive impairment.	11 items relating to 8 cognitive domains (visuospatial, executive, naming, memory, language, abstraction, delayed recall and orientation). Items are in the form of questions or tasks.  <u>Score Interpretation:</u> Maximum score is 30; higher scores indicate greater cognitive functioning. Total score $\geq 26$ is considered normal.  <u>Administration:</u> Approximately 10 minutes to administer.	Relatively quick tool and is suitable for patients with mild cognitive impairment.  Requires extra equipment (stopwatch and score sheet) and some training.  <u>Specialized Training:</u> Required reading.	Free  <a href="http://www.mocatest.org/">http://www.mocatest.org/</a>
<b>Clock Drawing Test (CDT)</b>	The CDT is a <b>screening</b> tool for cognitive	Involves a command to draw a clock or to copy a clock.	Quick and simple tool that does not require additional equipment for administration.	Free  <a href="http://www.strokingengine">http://www.strokingengine</a>

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Sunderland et al., 1989</b>	impairment.	<p><u>Score Interpretation:</u> No universal system for scoring exists. Individual scoring systems are based on the number of deviations from what is expected from the drawing.</p> <p><u>Administration:</u> Approximately 1-2 minutes to complete by the patient.</p>	<p>Often used as a supplement to other cognitive assessment tools. The CDT is one component of the MoCA.</p> <p><u>Specialized Training:</u> Not required.</p>	<a href="#">.ca/?s=clock+drawing</a>

## g. Tools to Assess Visual Perception and Neglect

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Behavioral Inattention Test (BIT)</b>  <b>Wilson et al., 1987</b>	The BIT is a <b>screening</b> and <b>assessment</b> tool for visual neglect.	<p>Comprised of two sections: the BIT Conventional subtest (BITC) (6 tests) and the BIT Behavioral subtest (BITB) (9 tests). The BITC consists of tests such as Line Crossing, Letter Cancellation etc. and the BITB consists of tests such as Picture Scanning and Telephone Dialing.</p> <p><u>Score Interpretation:</u> Maximum score and cut point for diagnosis of visual neglect are: (cut point/maximum score)</p> <ol style="list-style-type: none"> <li>1. BITC: 129/146</li> <li>2. BITB: 67/81</li> <li>3. BIT: 196/227</li> </ol> <p><u>Administration:</u> Approximately 40 minutes to administer.</p>	<p>A shortened version of the BIT is available consisting of 3 tests from the BITC and 5 tests from the BITB.</p> <p>Lengthy test that requires additional equipment (e.g. photographs, clock, coins, cards etc.).</p> <p><u>Specialized Training:</u> Not required.</p>	<p>Available for purchase.</p> <p><a href="http://www.pearsonassess.ca/en/programs/00/51/95/p005195.html?CS_Category=%26CS_Catalog=TPC-CACatalog%26CS_ProductID=749129972">http://www.pearsonassess.ca/en/programs/00/51/95/p005195.html?CS_Category=%26CS_Catalog=TPC-CACatalog%26CS_ProductID=749129972</a></p>
<b>Line Bisection Test (LBT)</b>  <b>Schenkenberg et al., 1980</b>	The LBT is a <b>screening</b> tool for unilateral spatial neglect.	<p>Consists of a series of 18 lines for which patients are asked to mark the midpoint on each line. It is part of the BIT but can also be used as a stand-alone tool.</p> <p><u>Score Interpretation:</u> Scoring is completed by measuring the distance between the true midpoint of the line and the mark made by the patient. No cut point for the diagnosis of</p>	<p>Does not require extra tools for completion.</p> <p>The test is unable to differentiate between visual neglect and visual field deficits.</p> <p><u>Specialized Training:</u> Not required.</p>	<p>Available for purchase.</p> <p><a href="http://www.pearsonassess.ca/en/programs/00/51/95/p005195.html?CS_Category=%26CS_Catalog=TPC-CACatalog%26CS_ProductID=749129972">http://www.pearsonassess.ca/en/programs/00/51/95/p005195.html?CS_Category=%26CS_Catalog=TPC-CACatalog%26CS_ProductID=749129972</a></p>

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
		<p>unilateral spatial neglect has been established for this test.</p> <p><u>Administration:</u> Approximately 5 minutes to complete by the patient.</p>		
<p><b>Motor-free Visual Perception Test (MVPT)</b></p> <p><b>Colarusso &amp; Hammill, 1972</b></p>	<p>The MVPT is an <b>assessment</b> tool for visual perception.</p>	<p>36 items assessing 5 domains of visual perception (spatial relations, discrimination – visual and figure-ground, visual closure and visual memory). Items are in the form of multiple choice questions with 4 possible answers.</p> <p><u>Score Interpretation:</u> Maximum score is 36; higher scores indicate greater visual perception.</p>	<p>Quick and simple tool and widely used.</p> <p>Administration requires extra equipment (test plates).</p> <p><u>Specialized Training:</u> Required.</p>	<p>Available for purchase.</p> <p><a href="http://www.academichtherapy.com/detailATP.tpl?action=search&amp;cart=14301685755462655&amp;eqskudatarq=8962-9&amp;eqTitledatarq=Motor-Free%20Visual%20Perception%20Test-4%20%28MVPT-4%29&amp;eqvendordatarq=ATP&amp;bobby=%5Bboby%5D&amp;bob=%5Bbob%5D&amp;TBL=[tbl]">http://www.academichtherapy.com/detailATP.tpl?action=search&amp;cart=14301685755462655&amp;eqskudatarq=8962-9&amp;eqTitledatarq=Motor-Free%20Visual%20Perception%20Test-4%20%28MVPT-4%29&amp;eqvendordatarq=ATP&amp;bobby=%5Bboby%5D&amp;bob=%5Bbob%5D&amp;TBL=[tbl]</a></p>

## g. Tools to Assess Spasticity

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Modified Ashworth Scale (MAS)</b>  <b>Bohannon &amp; Smith, 1987</b>	The MAS is an <u>assessment</u> tool for spasticity.	<p>Number of items is dependent on the number of joints that are being assessed. Joint assessment involves the movement of a joint from either maximal extension or flexion to the opposite position over a one second count.</p> <p><u>Score Interpretation:</u> A score is reported for each joint assessed. Scores can range from 0-4 (0, 1, 1+, 2, 3, and 4); higher scores indicate greater rigidity or tone.</p> <p><u>Administration:</u> Variable depending on the number of joints being assessed; a single joint is assessed over a one second count.</p>	<p>Quick assessment with no extra equipment required.</p> <p>The joint movement may cause some patient discomfort.</p> <p><u>Specialized Training:</u> Required.</p>	<p>Free</p> <p><a href="http://www.strokingengine.ca/?s=modified+ashworth">http://www.strokingengine.ca/?s=modified+ashworth</a></p>
<b>Frenchay Aphasia Screening Test (FAST)</b>  <b>Enderby et al., 1987</b>	The FAST is a <b>screening</b> tool for aphasia.	<p>The items are related to 4 domains of language impairment (comprehension, speech, reading and writing).</p> <p><u>Score Interpretation:</u> Maximum score is 30; higher scores indicate greater language abilities.</p> <p><u>Administration:</u> Approximately 3-10 minutes to administer.</p>	<p>Quick and simple. An abbreviated version that only includes the comprehension and speech components is available.</p> <p>Extra equipment (a stimulus card) is required.</p> <p><u>Specialized Training:</u> Not required.</p>	<p>Available for purchase. <a href="http://www.stass.co.uk/publications/adults-with-slc/fast">http://www.stass.co.uk/publications/adults-with-slc/fast</a></p>

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**Table 2: Suggested Screening/Assessment Tools for Risk of Falling Post Stroke**

Assessment Tool	Time to Complete	Items and Scores	Required Equipment
Stroke Assessment of Fall Risk (SAFR)  Breisinger et al. 2014	Unknown	7 fall risk-factors comprised of 4 impairment-based measures (impulsivity, hemi-neglect, static, and dynamic sitting balance) and 3 Functional Independence Measures (transfers, problem-solving, and memory) are measured.  Total scores range from 0-49 with a higher score indicating a higher risk of falling.	Several commonly available objects.
Predict-FIRST  Sherrington et al. 2010	30 minutes for physical component.	Respondents are measured on 5 risk factors including frequent toileting, central nervous system medications, experiencing a fall in the past year, being male, and inability to perform a tandem stance.  Respondents are cumulatively scored across the five risk factors to assess the probability of falling. A score of 0=2% chance of falling, 1=4%, 2=9%, 3=18%, 4=33% and 5=52%.	Several commonly available objects.
STRATIFY  Oliver et al. 1997	Unknown	Patients are given five questions about the absence (score of 0) or presence (score of 1) of falls risk factors including previous falls, visual impairments, frequent toileting, agitation, and a mobility score of three or four. Mobility scores are obtained by combining the mobility and transfer scores on the Barthel Index.  STRATIFY scores are ranged from 0 (low risk) to 5 (high risk).	Several commonly available objects.
Timed Up & Go Test (TUG)  Podsiadlo & Richardson. 1991	1-2 minutes	The patient begins in a seated position, is asked to stand and walk 3 metres, turn, walk back to their chair sit back down.  Patient is timed with difficulties in mobility monitored by instructor. A time of $\geq 15$ seconds indicates an increased risk of falling.	Several commonly available objects.
Modified Motor Assessment Scale (M-MAS)  Carr et al. 1985	15-35 minutes	8 items pertaining to balance, mobility and motor function, the latter of which measuring upper arm function, walking, sitting to standing, supine to side-lying, supine to sitting, and hand movements.  Each item is scored 0 to 6 with a higher score indicating greater difficulty performing the equivalent item task.	Several commonly available objects along with a low plinth.

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**Table 3: Suggested Swallow Screening and Assessment Tools**

Author/ Name of test	Components of test Details of validation study	Results of original validation study
Daniels et al. 1997 <sup>1</sup>  "Any Two"	Items included: 6 clinical features-dysphonia, dysarthria, abnormal volitional cough (includes water-swallowing test), abnormal gag reflex, cough after swallow and voice change after swallow were assessed. Scoring: Presence of any 2 of the items distinguished patients with/without dysphagia Sample: 59 acute stroke survivors were studied within 5 days of hospital admission.	Diagnostic standard: VMBS exam Prevalence of dysphagia: 74.6% The sensitivities and specificities of individual items ranged from 31%-76.9% and 61%-88%, respectively. Overall: Sensitivity: 92% Specificity: 67%
Trapl et al. 2007 <sup>4</sup>  The Gugging Swallowing Screen (GUSS)	Preliminary Assessment (vigilance, throat clearing, saliva swallow) Direct swallow ( semisolid, liquid, solid swallow trials) Scoring: Total scores ranged from 0 (worst) - 20 (no dysphagia). A cut-off score of 14 was selected Sample: 50 first-ever acute stroke patients with suspected dysphagia	Diagnostic standard: fiberoptic endoscopic evaluation using the Penetration Aspiration Scale to interpret the results. Prevalence of dysphagia: 73% First group of 19 patients using the GUSS to identify participants at risk of aspiration: Sensitivity: 100%, Specificity: 50% Second group of 30 patients Sensitivity: 100% Specificity: 69% Interrater reliability: Kappa=0.835
Martino et al. 2009 <sup>5</sup>  The Toronto Bedside Swallowing Screening Test (TOR-BSST)	Items included: presence of dysphonia before/after water swallowing test, impaired pharyngeal sensation and abnormal tongue movement. Scoring: pass=4/4 items; fail ≥1/4 items Sample: 311 stroke patients (103 acute, 208 rehabilitation)	Diagnostic standard: VMBS exam. Prevalence of dysphagia: 39% Sensitivity: 96% Specificity: 64% Interrater reliability (based on observations from 50 participants) ICC =0.92 (95% CI: 0.85-0.96)
Edmiaston et al. 2009 USA <sup>6</sup>  Acute Stroke Dysphagia Screen	Items included: Glasgow Coma Scale score <13, presence of facial, tongue or palatal asymmetry/weakness. If no to all 3 items, then proceed to 3 oz. water swallowing test.  Scoring: If there is evidence of change in voice quality, cough or change in vocal quality 1 minute after water swallowing test = fail. Sample: 300 acute stroke patients screened by nurses within 8 to 32 hours following admission.	Diagnostic standard: Mann Assessment of Swallowing Ability (MASA), performed by a SPL.  Prevalence of dysphagia: 29% Sensitivity (Dysphagia): 91% Specificity: 74% Sensitivity (aspiration risk): 95% Specificity: 68%  Interrater reliability: Kappa=94%

Author/ Name of test	Components of test Details of validation study	Results of original validation study
Turner-Lawrence et al. 2009 <sup>7</sup>  Emergency Physician Dysphagia Screen	The two-tiered bedside tool was developed by SLPs. Tier 1 items included: voice quality, swallowing complaints, facial asymmetry, and aphasia. Tier 2 items included a water swallow test, with evaluation for swallowing difficulty, voice quality compromise, and pulse oximetry desaturation ( $\geq 2\%$ ). Patients failing tier 1 did not move forward to tier 2. Scoring: Patients who passed both tiers were considered to be low-risk. Sample: a convenience sample of 84 stroke patients (ischemic/hemorrhagic) screened by 45 ER MDs.	Diagnostic standard: formal assessment conducted by an SLP Prevalence of dysphagia: 57% Sensitivity: 96% Specificity: 56% Interrater reliability: Kappa=0.90
Antonios et al. 2010 <sup>8</sup>  Modified Mann Assessment of Swallowing Ability (MMASA)	12 of the 24 MASA items were retained including: alertness, co-operation, respiration, expressive dysphasia, auditory comprehension, dysarthria, saliva, tongue movement, tongue strength, gag, volitional cough and palate movement. Scoring: Maximum score is 100 (no dysphagia). A cut-off score of 94 was used to identify patients at risk of dysphagia Sample: 150 consecutive patients with acute ischemic stroke were assessed by 2 neurologists shortly after admission to hospital.	Diagnostic standard: MASA conducted by SLP Prevalence of dysphagia: 36.2% Sensitivity: 87% & 93% Specificity: 86% & 84% Interrater reliability: Kappa=0.76
Schrock et al. 2011 <sup>9</sup>  MetroHealth Dysphagia Screen	5 Items included: Alert and able to sit upright for 10 minutes, weak, wet or abnormal voice, drooling, slurred speech and weak, or inaudible cough.  Scoring: $\geq 1$ items answered yes=failed screen Sample: 283 patients admitted to the Emergency department with acute stroke and screened for the presence of dysphagia by nurses	Diagnostic standard: VMBS Prevalence of dysphagia at 30 days: 32% Sensitivity: 95% Specificity: 55% Interrater reliability: Kappa=0.69

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**Table 4: Suggested Screening and Assessment Tools for Aphasia**

Assessment Tool	Time to Complete	Items and Scores	Required Equipment
<b>Acute Aphasia Screening Protocol (AASP)</b> Crary et al., 1989	10 minutes	44 items representing 4 domains: Attention/orientation to communication, auditory comprehension, expressive ability, and conversational style. Total scores range from 0-50 and are expressed as a percentage.	Several commonly available objects.
<b>Communicative Effectiveness Index (CETI)</b> Lomas et al., 1989.	Unknown	16 items consisting of statements regarding communication abilities with each statement rated out of 10.  Scores are summed to yield a total score out of 160 with higher scores indicative of good communication ability.	No equipment is required.
<b>Frenchay Aphasia Screening Test (FAST)</b> Enderby et al., 1987	3-10 minutes	Respondents are presented with tasks representing 4 language domains: comprehension, speech, reading, and writing. Respondents are scored on the basis of completeness/correctness of responses, with total scores ranging from 0-30. Lower scores indicate greater language impairment.	A stimulus card and written instructions.
<b>Frenchay Dysarthria Assessment</b>  Enderby et al. 1983	20 minutes	Respondents are presented with task representing 9 domains of speech: Reflexes (cough, swallow, dribble/drool); Respiration (at rest, in speech); Lips (at rest, spread, seal, alternate, in speech); Palate (fluids, maintenance, in speech); Laryngeal (time, pitch, volume, in speech); Tongue (at rest, protrusion, elevation, lateral, alternate, in speech); and Intelligibility (word, sentences, conversation).  Respondents are rated on their ability to perform each parameter using a 9 point scale that includes 5 descriptors and ½ marks.	Required
<b>Mississippi Aphasia Screening Test (MAST)</b> Nakase-Thompson et al., 2005	5-10 minutes	46 items representing 9 subscales: Naming, automatic speech, repetition, yes and no accuracy, object recognition, verbal instructions, reading instructions, verbal fluency, and writing/spelling diction. Scores can be summed for each individual subscale, combined to form two index scores representing expressive and receptive language, or summed to provide a global score out of 100. Lower scores indicate greater language impairment.	A photo, several commonly available objects, and written instructions.
<b>Porch Index of Communicative Ability (PICA)</b> Porch, 1967.	60 minutes	10 items over 8 subtests including verbal, auditory, copying, reading, pantomime, writing, visual and completion time. Scores range from 1-16 with a higher score indicative of a high communicative ability and a low score indicative of communication impairment.	Several commonly available objects.

Assessment Tool	Time to Complete	Items and Scores	Required Equipment
<b>Reitan-Indiana Aphasia Screening Examination (ASE)</b> Reitan and Wolfson, 1985)	N/A	32 items assessing language reception, expression, and comprehension. Scores are summed to yield a total score out of 77, with higher scores indicating greater language impairment.	A single commonly available object and written instructions.
<b>ScreeLing</b> Doesborgh et al., 2003	15 minutes	72 items representing 3 subscales: Semantics, Phonology, and Syntax. Scores can be calculated for each subscale, yielding a score from 0-24, or can be summed to provide a global score ranging from 0-72. Lower scores indicate greater language impairment.	No equipment is required.
<b>Ullevall Aphasia Screening Test (UAS)</b> Thommessen et al., 1999	5-10 minutes	Respondents are shown a picture and asked to follow a set of standardized instructions.  Seven aspects of language are used to assess responses and individuals are rated based on overall performance as having normal language ability or mild, moderate, or severe language disorder.	The stimulus painting, reading cards, and several commonly available objects.
<b>Western Aphasia Battery (WAB)</b> Shewan & Kertesz, 1980	1-2 hours	10 subtests assessing spontaneous speech, auditory comprehension, naming and repetition. Total scores are added up and expressed as a percentage. A score less than 93.8% is considered to be indicative of aphasia.	Several commonly available objects and written instructions.

Note: adapted from Salter et al., 2006.

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**Table 5: Suggested Assessment Tools for Pre-Driving Screening**

*Developed by the Toronto Rehabilitation Institute, UHN Driving best Practice Group and updated by D. Hebert, 2015 (D. Hebert et al, 2015)*

Assessment/ Domain	Cut-Off Scores Correlated with Driving Risk/Return to Driving and Patient Populations	References
<b>Dynavision</b>  Domain: visual scanning, peripheral visual awareness, visual attention, visuomotor reaction time, execution of visuomotor response sequence, basic cognitive skills (short term memory), and physical and mental endurance	<ul style="list-style-type: none"> <li>There has been some evidence that visual-motor training using this tool can result in improvement of a client's on-road driving performance with the stroke population.</li> <li>Limited data results indicate that safe drivers achieve approximately 52 or more hits on a 1 minute self-paced button Mode A task; 42 or more hits on a 60-second apparatus paced task; 200 or more hits on the 4-minute self-paced endurance (continuous) task; and 35 or more hits on the 1-minute apparatus-paced with 1-digit task.</li> <li>A 4 minute endurance subtest with a cut off of 195 correct responses over the 4 minute period from the Dynavision was superior to the CDBI in predicting success/failure in the on-road driving test (75%).</li> </ul>	<p>Klavora P, Gaskovski P, Martin K et al. The Effects of Dynavision Rehabilitation on Behind-the-Wheel Driving Ability and Selected Psychomotor Abilities of Persons After Stroke. <i>American Journal of Occupational Therapy</i>. 1995;49(6):534-542.</p> <p>Klavora P, Gaskovsh P, Forsyth R. Test-Retest Reliability of Three Dynavision Tasks. <i>Perceptual and Motor Skills</i>. 1995;80(2):607-610.</p> <p>Klavora P, Heslegrave R, Young M. Driving skills in elderly persons with stroke: Comparison of two new assessment options. <i>Archives of Physical Medicine and Rehabilitation</i>. 2000;81(6):701-705.</p>
<b>Motor Free Visual Perceptual Test</b>  Domain: overall visual perceptual ability-spatial relationships, visual discrimination, figure ground, visual closure, and visual memory.	<p>The MVPT was designed and standardized for adults for the normal population and the brain-injured population.</p> <p>It has norms for people aged 18-80.</p> <p>This test provides a profile of basic visual perceptual skills needed to drive, as well as an indication of a client's speed of processing visual information, and has been correlated to driving performance for the stroke population.</p> <p>Mazer, Korner-Bitensky &amp; Sofer (1998)</p> <ul style="list-style-type: none"> <li>MVPT (cut off, 30), positive predictive value 86.1%, negative predictive value 53.3%</li> <li>MVPT and Trail Making B, poor performance on both tests 22 times more likely to fail on-road evaluation</li> <li>Predictive values varied by side of lesion, MVPT higher for right lesion, and Trail Making B higher for left lesion</li> </ul>	<p>Korner-Bitensky N, Mazer B, Sofer S et al. Visual Testing for Readiness to Drive After Stroke. <i>American Journal of Physical Medicine &amp; Rehabilitation</i>. 2000;79(3):253-259.</p> <p>Mazer B, Korner-Bitensky N, Sofer S. Predicting ability to drive after stroke. <i>Archives of Physical Medicine and Rehabilitation</i>. 1998;79(7):743-750.</p>

Assessment/ Domain	Cut-Off Scores Correlated with Driving Risk/Return to Driving and Patient Populations	References
	<p>Korner-Bitensky et al. (2000)</p> <ul style="list-style-type: none"> <li>Lower predictive values for MVPT in multi-centre site, concluding it should not be used on own</li> <li>Older, right hemisphere lesion and lower MVPT scores more likely to fail on-road test (regression analysis)</li> </ul>	
<p><b>Trail Making Test</b></p> <p>Domain: Tests of visual conceptual and visuomotor tracking.</p>	<p>This test has been highly correlated with driving performance. Norms are available for persons aged 18-89 years, and it has been noted that scores decrease for individuals with advanced age or lower education levels.</p> <p>Mazer, Korner-Bitensky &amp; Sofer (1998)</p> <ul style="list-style-type: none"> <li>Trail Making B (cut off, 3 errors or more), positive predictive value 85.2%, and negative value 48.1%</li> <li>MVPT and Trail Making B, poor performance on both tests 22 times more likely to fail on-road evaluation</li> <li>Predictive values varied by side of lesion, MVPT higher for right lesion, and Trail Making B higher for left lesion</li> </ul> <p>Barco et al (2014) found Trail Making Test Part A and the Snellgrove Maze Task could predict the on-road performance of stroke clients. Alsaksen et al. found that Trailmaking Test Part A, CalCap Simple Reaction tie and the Grooved Pegboard were predictors of on-road performance with an overall classification accuracy of 82.1%. Cut of scores were Trail Making Test A, 46 s; CalCap, 395 ms; Grooved Pegboard, 97.5 s.</p> <p>A U.S. government study suggested that a timed score of 100 seconds on the Trails B subtest would indicate a need for further testing of driving performance because it correlated with increased crash risk.</p>	<p>Hopewell C. Driving Assessment Issues for Practicing Clinicians. <i>Journal of Head Trauma Rehabilitation</i>. 2002;17(1):48-61.</p> <p>Tombaugh T. Trail Making Test A and B: Normative data stratified by age and education. <i>Archives of Clinical Neuropsychology</i>. 2004;19(2):203-214.</p> <p>Mazer B, Korner-Bitensky N, Sofer S. Predicting ability to drive after stroke. <i>Archives of Physical Medicine and Rehabilitation</i>. 1998;79(7):743-750. (Please see this article for details regarding administering the Trail Making Test for Driving Ax purposes.)</p> <p>Barco P, Wallendorf M, Snellgrove C, Ott B, Carr D. Predicting Road Test Performance in Drivers With Stroke. <i>American Journal of Occupational Therapy</i>. 2014;68(2):221-229.</p> <p>Aslaksen P, Ørbo M, Elvestad R, Schäfer C, Anke A. Prediction of on-road driving ability after traumatic brain injury and stroke. <i>European Journal of Neurology</i>. 2013;20(9):1227-1233.</p> <p>Pellerito J. <i>Driver Rehabilitation And Community Mobility</i>. St. Louis, Mo.: Elsevier Mosby; 2006.</p> <p>National Highway Traffic Safety Administration:</p>

Assessment/ Domain	Cut-Off Scores Correlated with Driving Risk/Return to Driving and Patient Populations	References
		model driver screening and evaluation program: final technical report. Volume 1: Project summary and model program recommendations (DOT HS 809 582), Washington, DC, 2003, U.S. Department of Transportation.
<b>Colour Trails Test</b>	Color Trails Test comparable to test above	Elkinfrankston S, Lebowitz B, Kapust L, Hollis A, Oconnor M. The use of the Color Trails Test in the assessment of driver competence: Preliminary report of a culture-fair instrument. <i>Archives of Clinical Neuropsychology</i> . 2007;22(5):631-635.
<b>Clock Drawing Test</b>  Domain: Executive Function (planning/organization), memory, visual perceptual skills, visuo- spatial skills	Methods of administration and scoring of Clock Drawing Test can vary. See <i>AMA Physician's Guide to Assessing and Counseling Older Drivers</i> found in the Candrive website for 1 method (Freund Clock Scoring) of administering and scoring The Clock Drawing Test: <a href="http://www.ama-assn.org/ama1/pub/upload/mm/433/phyguidechap3.pdf">http://www.ama-assn.org/ama1/pub/upload/mm/433/phyguidechap3.pdf</a>  Preliminary research indicates an association between specific scoring elements of the clock drawing test and poor driving performance.	American Medical Association. <i>AMA physician's guide to assessing and counseling older drivers</i> . <a href="http://www.ama-assn.org/ama/pub/physician-resources/public-health/promoting-healthy-lifestyles/geriatric-health/older-driver-safety/assessing-counseling-older-drivers.shtml">http://www.ama-assn.org/ama/pub/physician-resources/public-health/promoting-healthy-lifestyles/geriatric-health/older-driver-safety/assessing-counseling-older-drivers.shtml</a>
<b>Snellen Eye Chart BIVABA</b>  Domain: Visual Acuity, Visual Field, Visual Attention	<b><u>Ministry of Transportation of Ontario Standards</u></b>  <b>Visual Acuity</b> – Effective May 29/05  Class of License:  G and H – a vision acuity not poorer than 20/50 with both eyes open and examined together  Class of License: A,B,C,D,E, F – a visual acuity not poorer than 20/30 with both eyes open and examined together, with the worse eye no poorer than 20/100  <b>Horizontal Visual Field</b> - Effective May 29/05  Class of License: G and H – a horizontal visual field of 120	On May 29, 2005 Regulation 340/94 of the Highway Traffic Act relating to the vision standards for driver licensing was amended to reflect:  Changes to the vision standards for all classes of license <ul style="list-style-type: none"><li>Lower the visual acuity</li><li>Provide a specific definition for the horizontal visual field</li></ul> Vision waiver program was created for drivers of passenger vehicles (class G, G1 or G2) who do

Assessment/ Domain	Cut-Off Scores Correlated with Driving Risk/Return to Driving and Patient Populations	References
	<p>continuous degrees along the horizontal meridian and 15 continuous degrees above and below fixation with both eyes open and examined together</p> <p>Class of License: A,B,C,D,E, F – a horizontal visual field of 150 continuous degrees along the horizontal meridian and 20 continuous degrees above and below fixation with both eyes open and examined together</p> <p>Vision Waiver program only applies to the visual field of G1, G2, and G drivers. There is currently no waiver program for visual acuity.</p>	<p>not meet the horizontal visual field standards. Prior to applying to this program one must first meet the entry criteria: visual acuity of 20/50 with both eyes, and horizontal visual field loss which occurred more than 3 months ago.</p> <p>Driver Improvement Office, Medical Review Section of the MTO 1-800-268-1481 or 416-235-1773.</p>
<p><b>UFOV – Useful Field of View Test</b></p> <p>Domain: Tests visual memory, visual attention, and divided attention with structured and unstructured components. The concept of “useful field of view” refers to the brain’s ability to comprehend visual info with the head and eyes in a stationary position. This test is administered on a computer.</p> <p>UFOV also includes a training component.</p>	<p>The UFOV has been shown to be a strong predictor of crash risk in older drivers.</p> <p>It is recommended for people who are age 55 years old or older, who have suffered health problems that cause deficits in thinking skills, who are concerned about their driving ability, and who have had multiple vehicle crashes.</p> <p>In one study of 294 drivers aged 55-90 years, UFOV displayed high sensitivity (89%) and specificity (81%) for predicting which older drivers had a history of crash problems.</p>	<p>Owsley C. Visual Processing Impairment and Risk of Motor Vehicle Crash Among Older Adults. <i>JAMA</i>. 1998;279(14):1083.</p> <p>Ball K, Owsley C, Sloane M, Roenker D, Bruni J. Visual attention problems as a predictor of vehicle crashes in older drivers. <i>Investigative Ophthalmology And Visual Science</i>. 1993;34(11):3110-3123.</p> <p>Ball K, Owsley C. The useful field of view test: a new technique for evaluating age-related declines in visual function. <i>Journal Of The American Optometric Association</i>. 1993;64(1):71-79.</p> <p>Owsley C, Ball K. Assessing visual function in the older driver. <i>Clinics In Geriatric Medicine</i> [serial online]. May 1993;9(2):389-401.</p> <p>Ball K, Rebok G. Evaluating the Driving Ability of Older Adults. <i>Journal of Applied Gerontology</i>. 1994;13(1):20-38.</p>
<b>DriveABLE</b>	<p>Positive predictive validity of the DriveABLE in identifying those who would fail the Road Test was 97% (n= 32 of 33).</p>	<p>Korner-Bitensky N, Sofer S. The DriveABLE Competence Screen as a predictor of on-road driving in a clinical sample. <i>Australian</i></p>

Assessment/ Domain	Cut-Off Scores Correlated with Driving Risk/Return to Driving and Patient Populations	References
	Negative predictive validity was 47%.  Sensitivity was 76%  Corresponding specificity of 90%.	<i>Occupational Therapy Journal</i> . 2009;56(3):200-205.
<b>Executive Function</b>	Asimakopulos, et al. Most predictive executive function test depends on patient. Refer to reference.  Motta K; Lee H; Falkmer T. found association between the scores of the Trail Making Test Part B ( $Rho=0.34$ , $p=0.034$ ) and the Key Search Test of the BADS ( $Rho=-0.61$ , $p=0.005$ ), and the driving assessment scores on the STISM driving simulator.	Asimakopulos J, Boychuck Z, Sondergaard D, Poulin V, Ménard I, Korner-Bitensky N. Assessing executive function in relation to fitness to drive: A review of tools and their ability to predict safe driving. <i>Australian Occupational Therapy Journal</i> . 2011;59(6):402-427.  Motta K, Lee H, Falkmer T. Post-stroke driving: Examining the effect of executive dysfunction. <i>Journal of Safety Research</i> . 2014;49:33.e1-38.
<b>Fitness-to-Drive Screening Measure</b>  Measure utilizes caregiver or occupational therapist perspective on fitness to drive. The test examines 54 driving skills. The examinee is then classified into one of three categories – at-risk driver, routine driver or accomplished driver  Available online free: <a href="http://fitnesstodrive.phhp.ufl.edu/">http://fitnesstodrive.phhp.ufl.edu/</a>	Test has strong psychometric properties  Currently test is being examined in the Canadian Context.	Classen S, Wang Y, Winter S, Velozo C, Lanford D, Bedard M. Concurrent Criterion Validity of the Safe Driving Behavior Measure: A Predictor of On-Road Driving Outcomes. <i>American Journal of Occupational Therapy</i> . 2012;67(1):108-116.  Classen S, Wen P, Velozo C et al. Psychometrics of the Self-Report Safe Driving Behavior Measure for Older Adults. <i>American Journal of Occupational Therapy</i> . 2012;66(2):233-241.  Classen S, Wen P, Velozo C et al. Rater Reliability and Rater Effects of the Safe Driving Behavior Measure. <i>American Journal of Occupational Therapy</i> . 2011;66(1):69-77.  Classen S, Winter S, Velozo C, Hannold E, Rogers J. Stakeholder Recommendations to Refine the Fitness-to-Drive Screening Measure. <i>The Open Journal of Occupational Therapy</i> . 2013;1(4). doi:10.15453/2168-6408.1054.Classen

Assessment/ Domain	Cut-Off Scores Correlated with Driving Risk/Return to Driving and Patient Populations	References
		S, Winter S, Velozo C, Hannold E, Rogers J. Stakeholder Recommendations to Refine the Fitness-to-Drive Screening Measure. <i>The Open Journal of Occupational Therapy</i> . 2013;1(4).



**Table: Summary of Commonly used Pediatric Stroke Assessment and Outcome Tools**

Assessment Tool	Purpose	Items and Administration	Additional Considerations	Availability
<b>Gross Motor Function</b>				
<b>Gross Motor Function Measure</b>  <b>Reference:</b> Russell, D.J., Rosenbaum, P.L., Avery, M.A., Lane, M (2002) Gross Motor Function Measure (GMFM-66 & GMFM-88) User's Manual. London, England: Mac Keith Press.				