



Rehabilitation, Recovery and Community Participation following Stroke

Part Two: Delivery of Stroke Rehabilitation to Optimize Functional Recovery

7th Edition, 2025

CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

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Rehabilitation, Recovery and Community Participation Following Stroke
Delivery of Stroke Rehabilitation to Optimize Functional Recovery 7th Edition
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INTRODUCTION AND OVERVIEW

Introduction to the Canadian Stroke Best Practice Recommendations

The Canadian Stroke Best Practice Recommendations (CSBPR) provide up-to-date, evidence-based guidelines for the prevention and management of stroke, to promote optimal recovery and reintegration for individuals with stroke and support their families and informal caregivers. The CSBPR are under the leadership of the Heart and Stroke Foundation of Canada (HSF).

The theme of the 7th Edition of the CSBPR is **building connections to optimize individual outcomes**. Individuals with stroke often present to the healthcare system with multiple co-morbid conditions – some of which may have contributed to their stroke, some of which may be consequences of it, and some of which may be unrelated. Nelson et al. ¹ found that approximately 80% of individuals who survive a stroke have on average five other conditions and a range of psychosocial issues. The interactions among complex co-morbid conditions must be considered to ensure treatment and ongoing care planning is personalized and person-centred.

The healthcare system is often designed to operate in silos, with planning and organization for different conditions being done separately rather than being integrated across conditions, even related vascular conditions. Even within stroke systems of care, locally and regionally, siloes can exist and continuity of care can be fractured. As individuals move through different settings and phases of care after a stroke, they often report feeling anxious and overwhelmed. Providing individualized care and ensuring connections are made within the community have a significant impact on a person's short- and long-term outcomes.

The 7th Edition of the CSBPR takes a broad, wholistic focus and takes into consideration issues of multimorbidity and increasing complexity of individuals with stroke. In addition, a more purposeful review of sex and gender representation in the seminal clinical trials upon which the recommendations are based has been undertaken to determine the extent to which available evidence has included both male and female subjects in sufficient proportions to be able to detect outcomes and generalize to a broader population. These findings are presented in the discussion sections of the module and integrated into the actual recommendations where appropriate to do so. Accompanying performance measures have been expanded to include system indicators, clinical indicators and new patient reported outcome measures, supporting our wholistic focus.

The goal of disseminating and implementing these recommendations is to optimize evidence-based stroke care across Canada, reduce practice variations in the care of individuals with stroke, and narrow the gap between current knowledge and clinical practice.

These recommendations have been developed in collaboration with the Canadian Stroke Consortium, CanStroke Recovery Trials Platform, StrokeCog, and the Canadian Neurological Sciences Federation. We work closely to ensure alignment of recommendations across guidelines where possible and appropriate.

Disclaimer: The Canadian Stroke Best Practice Recommendations (CSBPR) are designed to support implementation of best practices in stroke care across Canada. Healthcare systems, health organizations and professional organizations, as well as legislation and standards, vary provincially. The CSBPR provide guidance on a national level; they do not, overall, account for provincial variations in legislation or standards. The CSBPR are not intended to supersede any provincial or local law or organizational or professional standard. In considering and implementing the CSBPR, users are encouraged to consult and follow all appropriate legislation or standards.

Overview of the Rehabilitation, Recovery and Community Participation following Stroke Module

Stroke is on the rise in Canada with over 108,000 strokes occur in Canada every year. ²Stroke is a leading cause of adult disability, with 947,895 people 20 years of age and older estimated to be living

with the effects of stroke in Canada.³ In Canada, one-third of individuals with stroke, usually with transient ischemic attack (TIA) and milder strokes, are discharged back to the community directly from the emergency department.⁴ Of those individuals admitted to acute inpatient care, 39% will be discharged to their homes without support services, and an additional 19% will be discharged to their home setting with some support service referrals, 15% will be transferred to an inpatient rehabilitation service, 8% will be transferred to long-term care or complex continuing care.⁵ For those who had access to inpatient rehabilitation, the median length of stay was 29 days, 74% were discharged home, with a median Functional Independence Measure [FIM] efficiency of 0.84 FIM points gained per day.⁵

Ultimately, most individuals who experience a stroke will return to the community, to live independently or with some degree of support. The complexity and needs of individuals living in the community following stroke and their families has been increasing with shorter lengths of hospital stay and longer waits for community services. Several interdisciplinary team members and services are often required by individuals recovering from stroke. These individuals and their families have reported that coordination and integration of services are often major challenges as they try to navigate community healthcare services. They report at times falling through the cracks and not being able to meet their rehabilitation goals as a result (Community Consultation and Review Panel 2024). In addition, social determinant factors such as socio-economic status, education, and geographic location can also pose additional barriers to accessing care.

The 7th update of the Canadian Stroke Best Practice Recommendations (CSBPR) *Rehabilitation, Recovery and Community Participation following Stroke* module has been reorganized to better align with the International Classification of Functioning, Disability and Health (ICF) Framework.⁶ Further, due to the broad scope of topics covered in this module, this updated 7th edition has been divided into three parts:

- *Part One: Stroke Rehabilitation Planning for Optimal Care Delivery;*
- *Part Two: Delivery of Stroke Rehabilitation to Optimize Functional Recovery;*
- *Part Three: Optimizing Activity and Community Participation following Stroke, Update 2025.*

This module, Part Two: Delivery of Stroke Rehabilitation to Optimize Functional Recovery reflects the growing and changing body of research evidence available to guide direct rehabilitation therapies, screening, assessment, interventions, medical issues, and strategies for individuals who have experienced a stroke. Topics addressed in this module include therapy targeting upper and lower extremity function, aerobic function, balance, mobility and activities of daily living, spasticity, fall risk, communication, dysphagia, nutrition, central pain, visual and visual-perceptual issues, and bladder and bowel function.

This module provides guidance in the delivery of coordinated and seamless systems of care that supports early access to rehabilitation therapies, build on progress achieved during the initial recovery stages, and enabling people to achieve as much independence as possible to optimize their ability to resume life roles and leisure activities (addressed in Part Three). The physical, emotional, psychological, social and environmental needs of individuals with stroke are considered throughout this set of CSBPR. Successful planning, recovery, transitions and community participation following stroke requires integrated and coordinated people-centred efforts by all members of care teams involved with individuals who have had a stroke, their families and caregivers, and the broader community.

There is an urgent imperative for health systems of care to address the recovery needs of individuals with stroke, and ensure services and resources are in place and accessible to reduce complications and provide equitable opportunities for all individuals recovering from stroke to achieve optimal health outcomes. The physical, emotional, psychological, social and environmental needs of individuals with stroke are considered throughout this set of CSBP recommendations. Considerations for equity in accessing and receiving needed services and facilitating linkages to resources must be addressed at all stages of recovery.

CSBPR Definitions and Descriptions

Stroke Rehabilitation is a progressive, dynamic, goal orientated process that addresses stroke-related impairments, activity limitations and participation restrictions to optimize individuals' physical, cognitive, emotional, communicative, and social functional levels. In the chronic stage of stroke, rehabilitation may also focus on maintaining current functional abilities and preventing or slowing future functional decline and secondary health conditions (such as depression).

Rehabilitation is NOT a setting, rather, it is a process that includes a set of activities that begins soon after the initial event, once the individual with stroke is medically stable to participate and goals for rehabilitation, recovery and participation can be identified.

Rehabilitation occurs across the continuum of stroke care in a variety of formal and informal settings such as acute care or sub-acute care; rehabilitation units, on general or mixed rehabilitation units; palliative care units; in ambulatory or community settings, such as outpatient or day clinics, home-based services (includes early supported discharge and long-term care services), recreation centres, and outreach teams. Rehabilitation considers the individual's goals of care, including integration of appropriate palliative care principles as part of the care continuum.

Palliative Rehabilitation is an integral part of this continuum by focusing on improving quality of life, helping to manage symptoms, maintain functional abilities and support independence (Refer to CSBPR Stroke Systems of Care, Section 9 Palliative Care)

Stroke Systems of Care are defined as a comprehensive, diverse and longitudinal system that addresses all aspects of stroke care within an integrated, organized and coordinated approach. A stroke system spans the continuum of care from primary prevention to end of life. A stroke system ensures access to evidence-based therapies which optimize their survival and recovery.

Integrated Stroke Systems consider all aspects of planning and delivering care, such as access, assessment, treatment, clinical evidence, data, outcomes, benchmarking, guidelines, planning, organization of services, funding, and education.

Spasticity *Spasticity is manifested as velocity- and muscle length-dependent increase in resistance to externally imposed muscle stretch. It results from hyperexcitable descending excitatory brainstem pathways and from the resultant exaggerated stretch reflex responses. Other related motor impairments, including abnormal synergies, inappropriate muscle activation, and anomalous muscle coactivation, coexist with spasticity and share similar pathophysiological origins.*⁷

Refer to CSBPR Rehabilitation, Recovery and Community Participation following Stroke Parts [One](#) and [Three](#): for additional definitions and descriptions.

Considerations Regarding Stroke Rehabilitation

Screening is a process for evaluating the possible presence of a particular problem. Screening is a purposeful action or query for early identification of individuals who may be at risk of developing a specific condition or disorder or problem. Screening may suggest that an issue may exist. Findings from screens can indicate the need for more comprehensive assessment. Screening is usually brief and used to identify possible concerns, not typically to diagnose. Healthcare providers may use preliminary screening measures to support clinical decision making.

Assessment is a process for defining and measuring the nature of a stroke-related health problem, informing a diagnosis, formulating a prognosis, and contributing to developing specific treatment recommendations for addressing the problem or diagnosis. Assessment may also include monitoring response to therapeutic intervention. The purpose of assessment is to gather more specific and detailed information to provide a comprehensive understanding of a potential issue. Assessments will include other information to help provide a broader context of results.

Note: Screening and assessment of individuals following stroke must take into consideration multiple factors. Ideally, both screening and assessment tools should be validated for their specific use and target population to provide the most accurate interpretation of results.

Settings: Settings for stroke rehabilitation care refers to the physical locations where rehabilitation care and services are delivered to, and received by, individuals who have experienced a stroke, their families and caregivers. Rehabilitation assessments and interventions, key components of comprehensive stroke care, are provided in a range of settings such as: acute inpatient care centres, sub-acute care settings; inpatient rehabilitation units: on stroke-specific, general or mixed rehabilitation units; in outpatient clinics, ambulatory or community settings, such as outpatient, day clinics and recreation centres; long-term care, complex care, and an individual's home and place of residence (receiving services such as early supported discharge services and homecare rehabilitation or outreach teams). Care may be provided in person or virtually.

Duration: Length of service or stay for stroke rehabilitation varies depending upon factors such as the types of services required, accessibility of those services and the goals and needs of the individual with stroke, their families and caregivers. In some regions and local areas, the availability of staff and resources may impact duration, and all providers should strive to achieve guideline-directed therapy recommendations.

Timeframe: Stroke rehabilitation requirements often continue for many months and even years after an index stroke. Currently in Canada, publicly funded healthcare systems tend to allow for stroke rehabilitation within the first six months following stroke onset, even though many individuals with stroke will require some of these services beyond that arbitrary time frame. Rehabilitation is an ongoing process and rehabilitation needs and goals should be re-assessed periodically and plans updated as needed.

Stroke Rehabilitation Delivery: Stroke rehabilitation can be delivered in person or virtually, as both individual sessions and group activities. Decisions regarding mode of delivery of stroke rehabilitation therapies and interventions should be based on the individual with stroke's personal factors, goals of the encounter, type of services to be provided, and the appropriateness and feasibility of each modality.

WHO International Classification of Functioning, Disability and Health ⁶

Impairment: Problems in body function or structure such as a significant deviation or loss

Activity limitation: Difficulties an individual may have in executing activities

Participation restrictions: Problems an individual may experience in involvement in life situations

Notable Updates in Rehabilitation, Recovery and Community Participation following Stroke, Part Two Delivery of Stroke Rehabilitation To Optimize Functional Recovery, Module, Update 2025

- **Reorganization of the Rehabilitation Module:** The Stroke Rehabilitation, Recovery and Community Participation module has been divided into three parts, and the topics have been restructured to align with the International Classification of Functioning (ICF) framework for improved clarity and flow.
- **Conversion to GRADE ratings:** In moving to GRADE ratings, some consensus-based recommendations from the 6th Edition have now been moved to Clinical Considerations
- **Increased Evidence:** The evidence supporting multiple recommendations throughout this module was upgraded to a High Level of Evidence coupled with a Strong Recommendation. Examples include screening for swallowing impairment and referral to a trained dysphagia professional once an individual with stroke fails screening; and a trial of low-dose centrally acting analgesics for persistent Central Post-Stroke Pain.
- **New Outcomes Added:** A Strong Recommendation and a High Level of Evidence was assigned to new outcomes of physical rehabilitation treatment approaches. For example, aquatic exercise

is now considered effective for improving not only balance and also walking speed and mobility; and aerobic training is now considered effective for improving not only cardiovascular endurance and cognition, as well as balance and walking.

- **New section (Section 10) on Bladder and Bowel Function** has been added that includes recommendations for screening, assessment, and management.
- **Expanded Inclusion of Healthcare Professionals:** A broader scope of healthcare professionals have been engaged who have expertise to support the ongoing management of medical co-morbidities and other medical needs as part of inpatient and community rehabilitation programs.
- **Utilization of validated tools:** Further emphasis on the use of validated assessment tools across rehabilitation care, including recreation, leisure and social assessments.

Guideline Development Methodology

The CSBPR present high-quality, evidence-based stroke care guidelines in a standardized framework. As healthcare providers across all disciplines implement these recommendations, it is expected that practice variations will be reduced and gaps between evidence and practice will start to close, leading to improved outcomes for individuals with stroke.

The methodology used to develop this module has followed a thorough and rigorous process. [Refer to CSBPR Overview of Methodology for additional detail.](#) ⁸ Key steps in our development process have included:

1. Establish an expert interprofessional writing group representing relevant disciplines across the continuum of care and a range of settings and striving for balance regarding geography, gender and overall diversity. [Refer to Appendix One for a list of writing group members and affiliations.](#)
2. Consult with the Stroke Rehabilitation Community Consultation and Review Panels, comprising individuals with stroke, informal caregivers, and family members.
3. Select clinical questions to address in the module using the population/problem, intervention or exposure, comparison, and outcome (PICO) format, where appropriate and applicable.
4. Conduct a systematic search and appraisal of research literature to March 2025 and update evidence summary. Refer to the [assigning evidence levels](#) section of this module for more information on the GRADE approach.
5. Conduct a systematic search and appraisal of external reference guideline recommendations.
6. Scientific writing group and the community consultation panels develop, review and finalize a set of recommendations, address clinical questions, review and discuss benefits, risks, and harms of proposed recommendations, and adhere to the elements of the Agree II criteria where appropriate. ⁹ This includes consideration of individual values and preferences, informed by the community consultation panels and available evidence.
7. Scientific Writing Group rates the strength of the recommendations and the quality of evidence following GRADE criteria.¹⁰⁻¹²
8. Review of the proposed module by the Canadian Stroke Best Practices Advisory Committee, and incorporation of edits as required, with further consideration of benefits, risks, and harms.
9. Review of the proposed module by external leading experts in Canada and internationally, and incorporation of edits as required. [Refer to Appendix Two for a list of External expert reviewers](#)
10. Obtain final approval and endorsement and undertake French translation.
11. Update educational materials and implementation resources.
12. Disseminate through publication and public release knowledge translation activities.

13. Continue with ongoing review and update process.

More detail for each of these steps is available in the [CSBPR Overview, Methods and Knowledge Translation](#) manual on the Canadian Stroke Best Practices website. www.strokebestpractices.ca⁸

Assigning Evidence Levels

The [Grading of Recommendations, Assessment, Development and Evaluation](#) (GRADE)¹³ methodology and terminology has been applied throughout these guidelines. With GRADE, each recommendation was assessed for:

1. The **strength of the guidance** (strong or conditional), based on the balance of desirable and undesirable consequences, quality of evidence, values and preferences of those affected, and resource use.
 - A strong recommendation is one for which the guideline panel is confident that the desirable effects of an intervention outweigh its undesirable effects.
 - A conditional recommendation is one for which the guideline panel finds that the desirable effects probably outweigh the undesirable effects, but appreciable uncertainty exists.and
2. The **quality of the evidence** (high, moderate, low) upon which the recommendations are formulated: risk of bias, directness of evidence, consistency and precision of results, risk of publication bias, magnitude of the effect, dose-response gradient, and influence of residual plausible confounding.¹²

The writing group was provided with comprehensive evidence tables that included summaries of high-quality evidence identified through the structured literature searches. The group discussed and debated the quality of the evidence and through consensus developed a final set of proposed recommendations. Each recommendation was assigned a rating as to the strength of the recommendation and the quality of the evidence. Where appropriate and feasible, full GRADE review and analysis using relevant GRADE tables has been conducted ([GRADE Handbook](#)).¹³

Special Note about Assigning Levels of Evidence for Stroke Rehabilitation: The research literature in this area is rapidly evolving, with new evidence emerging for innovative therapies applicable at different stages of care. Some therapies and management strategies included in this rehabilitation module of the *CSBPR* have evidence only for specific time periods. The writing group has carefully and thoughtfully examined all therapies with respect to the evidence regarding timing of the interventions and have clearly stated where the evidence differs between early and later stages of rehabilitation and recovery. In consideration of these realities, some of the recommendations provided in this module may have two different levels of evidence accompanying them.

The evidence has been grouped into two categories for certain recommendations where the evidence differs, to better reflect what is known at this time and provide more specific guidance to clinicians:

- **‘Early’ stages** of rehabilitation describe the strength of research evidence for a given therapy tested in individuals with stroke from stroke occurrence through the first six months post-stroke (i.e. acute or subacute phase of stroke recovery);
- **‘Late’ stages** of rehabilitation describe the strength of research evidence for a given therapy tested in individuals with stroke beyond the first six months following an index stroke (i.e., chronic phase of stroke recovery).

Clinical Considerations

The CSBPR uses the additional category of clinical considerations, consisting of expert opinion statements. These are included when it is determined that guidance related to common clinical issues would be helpful, but the topic lacked sufficient evidence to form an actual recommendation.

Conflicts of Interest

All potential participants in the recommendation development and review process were required to complete confidentiality agreements and declare all actual and potential conflicts of interest prior to participation. Declared conflicts of interest were reviewed by the co-chairs of the CSBPR Advisory Committee and Heart & Stroke staff to assess the potential impact. Those with significant conflicts with respect to the module topic were not selected for writing group or reviewer roles.

Participants who have conflicts for a particular topic area were identified at the beginning of discussions for that topic and were recused from voting. If a co-chair is in conflict, they were recused from their responsibilities for that discussion and another non-conflicted participant assumes the role for that discussion and vote. Heart & Stroke senior staff members participated in all writing group discussions and intervene if they perceived an untoward bias by a writing group member.

Conflict of interest declarations for the Rehabilitation, Recovery and Community Participation following Stroke, *Part Two: Delivery of Stroke Rehabilitation to Optimize Functional Recovery* module writing group members can be found in [Appendix One](#).

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Community Consultation and Review Panel

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English link:

https://journals.lww.com/ajpmr/fulltext/9900/canadian_stroke_best_practice_recommendations.785.aspx

French link:

https://journals.lww.com/ajpmr/fulltext/9900/canadian_stroke_best_practice_recommendations.785.aspx (online supplement)

Comments

The Heart and Stroke Foundation of Canada's stroke team invites your comments, suggestions, and inquiries about the development and application of the CSBPR at strokebestpractices@heartandstroke.ca.

REHABILITATION, RECOVERY AND COMMUNITY PARTICIPATION FOLLOWING STROKE MODULE

Part Two: Delivery of Stroke Rehabilitation to Optimize Functional Recovery, 7th edition update, 2025

Section 1 Upper Extremity Function - General Principles and Therapies

1. Upper Extremity Function– General Principles and Therapies, Recommendations 2025
<p>Notes:</p> <ul style="list-style-type: none">• <i>Many therapy approaches can be used together and may provide some synergistic benefits. Research supporting these recommendations often combines multiple interventions, applying them simultaneously in both studies and practice.</i>• <i>When using specific therapeutic interventions, appropriately trained health professionals should follow established protocols whenever they are available.</i>• <i>The choice of therapy will vary depending on the severity of impairments in each individual with stroke. This should be considered when creating a personalized rehabilitation plan.</i>• <i>Interventions should be tailored to each individual with stroke, and often, multiple therapies can be considered for a single person.</i>• Evidence Grading System: <i>For some areas of stroke rehabilitation, the same topic area may have different evidence for early and later stages of rehabilitation and recovery. In these instances, the levels of evidence will be stated separately for each time interval. For the purposes of these recommendations 'early' refers to strength of evidence for therapies applicable to individuals with stroke who are less than 6 months post stroke, and 'late' refers to strength of evidence for therapies applicable to individuals with stroke who are more than 6 months from index stroke event.</i>
<p>1.1 General Principles</p> <ol style="list-style-type: none">Individuals should engage in training that is meaningful, engaging, repetitive, progressively adapted, task-specific and goal-oriented to enhance motor control and restore sensorimotor function [Strong recommendation; High quality of evidence].Training should encourage the use of the individuals' affected extremity during functional tasks and be designed to simulate partial or whole skills required in activities of daily living (ADLs) (e.g. folding, buttoning, pouring, and lifting) [Strong recommendation; High quality of evidence].
<p>1.2 Specific Therapies</p> <ol style="list-style-type: none">Range of motion exercises (passive and active assisted) that include placement of the upper extremity in a variety of appropriate and safe positions should be considered [Strong recommendation; Low quality of evidence].Functional Electrical Stimulation (FES) involving electrical stimulation in combination with task-oriented training of the upper extremity is recommended to improve motor function [Strong recommendation; Moderate quality of evidence].High intensity Constraint-Induced Movement Therapy (CIMT) (i.e., immobilization of the non-paretic upper extremity during 90% of waking hours and 3-6 hours of task-oriented training per day is recommended for a select group of individuals with stroke who demonstrate at least 20 degrees of active wrist extension and 10 degrees of active finger extension, with minimal

- sensory deficits and normal cognition [Early - Strong recommendation; High quality of evidence; Late - Strong recommendation; High quality of evidence].
- iv. **Mirror therapy** may be considered to improve motor and ADL function [Strong recommendation; Moderate quality of evidence].
 - v. **Sensory stimulation** modalities (e.g., transcutaneous electrical nerve stimulation [TENS], and acupuncture) may be considered to improve upper extremity function [**Conditional recommendation**; Low quality of evidence].
 - vi. **Biofeedback** in the form of visual and/or auditory signals during exercises of the upper extremity is recommended to improve motor function [Strong recommendation; High quality of evidence].
 - vii. Individuals with stroke should be encouraged to engage in **mental imagery practice** to enhance upper extremity sensorimotor recovery as an adjunct to upper extremity rehabilitation [Strong recommendation; Moderate quality of evidence].
 - viii. **Virtual reality**, including both immersive technologies such as head mounted or robotic interfaces and non-immersive technologies such as gaming devices, may be considered as adjunct tools to other rehabilitation therapies, to provide additional opportunities for engagement, feedback, repetition, intensity and task-oriented training [Strong recommendation; Moderate quality of evidence].
 - ix. Therapists should consider **supplementary training programs** aimed at increasing the active movement and functional use of the affected upper extremity between therapy sessions, such as Graded Repetitive Arm Supplementary Program (GRASP), suitable for use during hospitalization and at home [Early - Strong recommendation; Moderate quality of evidence; Late- Strong recommendation; Low quality of evidence].
 - x. **Strength training** is recommended for individuals with mild to moderate upper extremity impairment for improvement in upper extremity motor function [Strong recommendation; High quality of evidence].
 - xi. **Bilateral upper extremity training** should be considered for individuals with some active movement in the affected upper extremity to improve upper extremity motor function [Early – Strong recommendation; Moderate quality of evidence; Late – Strong recommendation; High quality of evidence].
 - xii. **Training in compensatory techniques** and provision of adaptive equipment may be considered for individuals with stroke who are unable to produce any voluntary muscle activity in the affected upper extremity to optimize independence with ADLs [Strong recommendation; Low quality of evidence].
 - xiii. **Retraining trunk control** should be considered to improve function of the affected arm and hand [Strong recommendation; Moderate quality of evidence].
 - xiv. **Trunk restraint** (i.e., physical restraint) is recommended to decrease compensatory movements during reaching tasks to improve upper extremity function [Strong recommendation; High quality of evidence].

1.3 Adaptive Equipment

- i. Adaptive equipment (e.g., long-handled shoehorn, adaptive cutting board for one-handed use, adapted guitar foot strummer) designed to improve safety and upper extremity function may be considered if other methods of performing specific functional tasks are not available or alternative methods of performing tasks cannot be learned [Strong recommendation; Low quality of evidence].

Section 1 Clinical Considerations

1. Functional dynamic orthoses for the upper extremity may be offered to individuals with stroke to facilitate repetitive task-specific training.
2. **Non-invasive brain stimulation**, including repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) could be considered as an adjunct to upper extremity rehabilitation. *Note while these interventions are not yet available/approved for use in stroke in Canada the evidence for their use continues to be strengthened.*

Rationale

Upper extremity function is frequently reduced following stroke, limiting the individual with stroke's ability to perform basic ADLs, such as dressing and bathing. While many individuals with stroke will regain their pre-stroke upper extremity function, a portion of those with initial weakness, will not. To address the needs of these individuals, several therapeutic techniques have been developed for those whose upper extremity movement had been impacted by stroke.

Individuals with stroke have faced challenges in receiving equitable access to individualized rehabilitation for upper extremity function, especially in the community following hospital discharge. Individuals with stroke highlight the importance of education on upper extremity rehabilitation, home exercises, adaptive devices, and the potential cost of devices and funding options. Including family members and caregivers in this education is also valuable and helpful.

System Implications

To achieve timely and appropriate assessment and management of upper extremity function, organizations should optimize the following system components:

1. Access to healthcare providers experienced in arm and hand assessment, treatment and management following stroke, with ongoing training available.
2. Timely access to specialized, interdisciplinary stroke rehabilitation services where therapies of appropriate type and intensity are provided.
3. Access to appropriate equipment and training for equipment use (such as functional electrical stimulation).
4. Long-term rehabilitation services accessible and available in long-term care and complex continuing care facilities, and in outpatient and community programs.
5. Virtual reality, including immersive technologies and non-immersive technologies, are evolving, 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

System Indicators

1. Access to stroke rehabilitation services 7 days per week for inpatient care.
2. Proportion of individuals within a stroke region who access an inpatient and community-based stroke rehabilitation as part of their episode of care for a stroke event.

Process Indicators

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 dedicated stroke rehabilitation unit during inpatient rehabilitation.
5. Median hours per day of direct task-specific therapy provided by the interdisciplinary stroke team.
6. Average days per week of direct task specific therapy provided by the interdisciplinary stroke team (target is a minimum of five days).

Patient-Oriented Indicators

7. 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.
8. 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.
9. Modified Rankin Score at 3 months, 6 months and one year following stroke.

Implementation Resources and Knowledge Transfer Tools

Resources and tools listed below that are external to Heart & Stroke and the Canadian Stroke Best Practice Recommendations may be useful resources for stroke care. However, their inclusion is not an actual or implied endorsement by the Canadian Stroke Best Practices team or Heart & Stroke. The reader is encouraged to review these resources and tools critically and implement them into practice at their discretion.

Health Care Provider Information

- Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery and Community Participation following Stroke, [Part One: Stroke Rehabilitation Planning for Optimal Care Delivery](#) module; and, [Part Three: Optimizing Activity and Community Participation following Stroke, Update 2025](#)
- Heart & Stroke: Taking Action for Optimal Community and Long-Term Stroke Care: A resource for healthcare providers: <https://www.strokebestpractices.ca/resources/professional-resources/tacls>
- Stroke Engine: FIM® Instrument: <https://strokengine.ca/en/assessments/functional-independence-measure-fim/>
- UDS: AlphaFIM® Instrument: <https://www.udsmr.org/>
- Stroke Engine: Chedoke-McMaster Stroke Assessment Scale: <https://strokengine.ca/en/assessments/chedoke-mcmaster-stroke-assessment/>
- Chedoke-McMaster Arm and Hand Activity Inventory (CAHAI): <https://www.cahai.ca/>
- Stroke Engine: Modified Ashworth Scale: <https://strokengine.ca/en/assessments/modified-ashworth-scale/>
- Stroke Engine: Box and Block Test: <https://strokengine.ca/en/assessments/box-and-block-test-bbt/>
- Stroke Engine: Nine Hole Peg Test: <https://strokengine.ca/en/assessments/nine-hole-peg-test-nhpt/>
- Stroke Engine: Fugl-Meyer Assessment of Sensorimotor Recovery after Stroke (FMA): <https://strokengine.ca/en/assessments/fugl-meyer-assessment-of-sensorimotor-recovery-after-stroke-fma/>

- Stroke Engine: Action Research Arm Test: <https://strokengine.ca/en/assessments/action-research-arm-test-arat/>
- Stroke Engine: Wolf Motor Function Test: <https://strokengine.ca/en/assessments/wmft/>
- EBRSR: Evidence-Based Review of Stroke Rehabilitation (Triage Module): <http://www.ebrsr.com/evidence-review/4-managing-stroke-rehabilitation-triage-process>
- Aphasia Institute: <https://www.aphasia.ca/>
- Stroke Engine: <http://www.strokengine.ca/>

Resources for Individuals with Stroke, Families and Caregivers

- Heart & Stroke: Signs of Stroke: <http://www.heartandstroke.ca/stroke/signs-of-stroke>
- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>
- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1
- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>
- Heart & Stroke Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbpr-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031>
- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbfc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Arms and Legs: <https://www.heartandstroke.ca/stroke/recovery-and-support/physical-changes/arms-and-legs>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>
- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- CanStroke Recovery Trials: Tools and Resources: <https://canadianstroke.ca/tools/>
- Stroke Engine: <http://www.strokengine.ca/>

Summary of the Evidence

Task-Specific Training

Task-specific training involves the repeated practice of functional tasks, which combines the elements of intensity of practice and functional relevance. The tasks should be challenging and progressively adapted and should involve active participation. French et al.¹⁴ included the results from 11 randomized controlled trials (RCTs) in a Cochrane review that included an upper extremity rehabilitation component. Repetitive task-specific training was associated with a small treatment effect on arm and hand function, assessed post intervention. (standardized mean difference [SMD]=0.25, 95% CI 0.01 to 0.49, $p=0.045$ and SMD=0.25, 95% CI 0.00 to 0.51, $p=0.05$, respectively). The benefits appeared to persist up to 6 months follow-up. Patients treated from 16 days to 6 months post stroke derived the greatest value. In contrast to these findings, in an earlier systematic review of motor recovery following stroke, Langhorne et al.¹⁵ identified 8 RCTs of repetitive task training, specific to the upper extremity. 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. In a crossover RCT, Shimodzone et al.¹⁶ randomized 49 participants in the sub-acute phase of stroke 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. Action Research Arm Test (ARAT) and the Fugl-Meyer Assessment (FMA) were assessed at baseline, and at week 2 and 4. After 4 weeks of treatment, significantly greater improvements on the ARAT ($p=0.009$) and FMA ($p=0.019$) were demonstrated by the RFE group compared to the control group.

Functional Electrical Stimulation

While functional electrical stimulation (FES) has been investigated extensively in the rehabilitation of the lower extremity and for preventing/treating shoulder subluxation, there is a smaller literature base for its use as a modality to improve upper extremity function. In a network meta-analysis, Tenberg et al.¹⁷ included 5 trials that examined active electrical stimulation and reported the treatment was not associated with a significant improvement in motor function (SMD=0.63, 95% CI -0.01 to 1.27); however, when combined with task-specific training, the effect was enhanced (SMD=1.03, 95% CI 0.51 to 1.55, $n=12$ trials). Khan et al.¹⁸ included 25 studies examining FES-based interventions for the upper extremity including both open and closed loop systems. There was significantly greater improvement in upper motor function using electromyography (EMG)-controlled FES compared with brain-computer interface (BCI)-controlled and manually controlled FES systems. Mean difference for the FMA was 14.14, (95% CI 11.72 to 16.6) vs. 5.6 (95% CI 3.77 to 7.5) for manually controlled FES and 5.37 (95% CI 4.2 to 6.6) for BCI-controlled FES. However, only data from between 3 and 5 trials were available for pooled analyses. A similar pattern was evident for mean difference in ARAT scores with a mean difference of 11.9 (95% CI 8.8 to 14.9) for EMG-controlled FES.

Eraifej et al.¹⁹ included the results of 20 RCTs in a systematic review that evaluated the ability of FES to improve ADL and motor function. Pooling data from 8 trials, there was no significant difference between groups (FES and usual care) in ADL performance (SMD=0.64, 95% CI -0.02 to 1.30, $p=0.06$); however, in sub group analysis including 5 trials, persons who received FES during the acute phase of stroke (within 2 months) did improve their ADL performance with FES (SMD=1.24, 95% CI 0.46 to 2.03, $p=0.002$). FES was associated with significant improvement in FMA scores (MD=6.72, 95% CI 1.76, 11.68, $p=0.008$). Vafadar et al.²⁰ pooled the results from 10 trials evaluating the use of FES for the rehabilitation of shoulder subluxation, pain, and upper arm motor function. Pooling the results from 5 trials, FES was not associated with significant improvements in arm motor function when initiated early post stroke, compared with conventional therapy (SMD=0.36, 95% CI -0.27 to 0.99, $p=0.26$). Pooling of results was not possible for an evaluation of FES in the chronic stage of stroke.

Constraint Induced Movement Therapy

Traditional constraint induced movement therapy (CIMT) involves restraint of the unaffected arm for at least 90 percent of waking hours, in addition to a minimum of 6 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 trial²¹ suggests that traditional (intensive) CIMT should not be used for individuals in the first month post stroke, and in fact may be associated with worse outcomes. Patients who were randomized to receive 3 hours of intensive therapy in addition to wearing a constraint for 6 hours/day had lower ARAT scores at 3 months compared with patients who had received conventional occupational therapy or standard CIMT for two hours each day. In the largest RCT of conventional CIMT²² which included 222 patients, recruited 3-9 months post stroke, patients in the CIMT group had significantly greater improvement in Wolf Motor Function Tests (WMFT) scores and Motor Activity Log (MAL) (Amount of Use [AOU] and Quality of Movement [QOM] subscores) at 12 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 (mCIMT) 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 5 hours a day, and with half-hour blocks of 1:1 therapy provided for up to 10 weeks.²³ 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. In the EXPLICIT trial²⁴ 58 participants in the acute phase of stroke were randomized to a usual care group or a modified CIMT (mCIMT), which involved restraint for 3 hours, 5 days a week for 3 weeks in addition to 60 minutes of supervised intensive graded practice focused on improving task-specific use of the paretic arm and hand. There was significantly greater improvement in the mCIMT group on ARAT scores, the primary outcome, from baseline to 5, 8- and 12-weeks following treatment, but not at 26 weeks. There were no significant differences between groups on impairment measures, such as the FMA of the arm, or Motricity Index scores.

Liu et al.²⁵ included the results of 16 RCTs examining mCIMT or CIMT in the acute or subacute stage of stroke and reported significantly greater gains in ARAT, Barthel Index, FMA, and MAL Log scores (AOU, QOM) compared with the control condition. A Cochrane review²⁶ included the results from 42 RCTs examining both CIMT and mCIMT, across the spectrum of the stroke recovery continuum. Overall, neither form of CIMT (traditional nor modified) was associated with a significant improvement in standardized measures of disability (SMD=0.24, 95% CI -0.05 to 0.52) at the end of treatment, or at 6 to 12 months follow-up (SMD=-0.21, 95% CI -0.57 to 0.16), compared with usual care. CIMT was associated with significant improvements in arm motor function, dexterity and measures of arm motor impairment. 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. Another recent systematic review, Gao et al.²⁷ included the results of 44 RCTs including 1,779 individuals and examined the benefits of 4 categories of CIMT, which varied by time of constraint (≤ 4 hours to >10 hours/day). Compared with conventional therapy alone, CIMT provided for between 4 and 6 hours daily was associated with the most improvements in motor and ADL performance. In contrast, Tenberg et al.¹⁷ reported that high-intensity CIMT was associated with significantly greater improvement in motor function assessed at the end of the treatment period compared to other active interventions (SMD=0.86, 95% CI 0.40-1.32).

Mirror Therapy

Mirror therapy is a technique that uses visual feedback about motor performance to enhance upper extremity function following stroke and reduce pain. Evidence from a Cochrane review,²⁸ which included the results from 62 RCTs, including mirror therapy for both the upper and lower extremity indicated a modest improvement in upper extremity motor function compared with the control group at the end of the intervention (SMD=0.46, 95% CI 0.23-0.69, 31 trials). A systematic review and network meta-

analysis²⁹ included the results of 37 RCTs assessing mirror therapy, alone or in combination with electrical stimulation. Overall, mirror therapy was associated with significantly greater improvement in the FMA and Functional Independence Measure (FIM) scores compared with conventional therapy, while mirror therapy + electrical stimulation + conventional therapy provided for ≤ 4 weeks was more effective than conventional therapy only for improving FMA scores (SMD=0.38, 95% CI 0.22–0.55). In a meta-analysis³⁰ including the results from 11 RCTs, mirror therapy was associated with significantly increased motor function compared with the control condition (SMD=0.51, 95%CI 0.29-0.73).

Biofeedback

In a systematic review & network meta-analysis,¹⁷ which included 37 treatment classes comparing a variety of interventions compared with nonspecific/multimodal active upper extremity therapy, 5 interventions were found to be superior when assessment was conducted at the end of the intervention period. Among them was biofeedback (SMD=0.45, 95% CI 0.16-1.74), although it was used without a co-intervention in only a single trial.

Mental Practice

Mental practice is the process whereby an individual repeatedly rehearses tasks mentally without physically performing them, with the goal of improving actual performance. In a Cochrane review which included the results of 25 RCTs, Barclay-Goddard et al.³¹ reported when used in addition to other therapies, mental practice was associated with a significant improvement in measures of upper extremity activity and impairment (SMD=0.66, 95% CI 0.39-0.94 and SMD=0.59, 95% CI 0.3-0.87, respectively), compared with conventional therapy, but not when used by itself, compared with conventional therapy.

Virtual Reality

A systematic review³² included the results from 43 RCTs evaluating the effectiveness of virtual reality (VR)-supported exercise therapy for upper extremity motor rehabilitation in stroke. In 16 RCT's, commercial games were used and in 27 RCT's, programs designed for rehabilitation were used. VR interventions were associated with significantly higher upper-extremity motor function scores (SMD=0.45, 95% CI 0.21 to 0.68). The effect size was significantly greater in trials that provided therapy for >15 hours (SMD=0.92, 95% CI 0.35 to 1.49) vs. ≤ 15 hours (SMD= -0.10, 95% CI -0.35 to 0.15). VR interventions were also associated with significantly higher FIM scores (SMD=0.23, 95% CI 0.06-0.40), but not Barthel Index scores (SMD=0.20, 95% CI -0.16 to 0.55), Box & Block test scores, Action Research Arm Test scores, or Wolf Motor Function Test scores.

Laver et al.³³ included the results of 22 RCTs in a Cochrane review examining the effectiveness of virtual reality, mainly using commercially available gaming consoles. Compared with conventional treatment, virtual reality interventions were not associated with significant improvements in measures of upper extremity function, at either the end of treatment, or at 3 months, (SMD=0.07, 95% CI -0.05 to 0.20 and SMD=0.11, 95% CI -0.10 to 0.32, respectively). However, when virtual reality was used in addition to usual care (providing a higher dose of therapy for those in the intervention group) there was a statistically significant difference between groups (SMD= 0.49, 0.21 to 0.77, 10 studies). When assessments were conducted using the FMA (upper extremity) at the end of treatment, there was a significant treatment effect of virtual reality. The results from several recent RCTs³⁴⁻³⁷ indicated that virtual reality was not associated with significant improvements in ARAT scores, or a variety of other outcomes, including Canadian Occupational Performance Measure, Stroke Impact Scale, FIM, or FMA.

GRASP

Evidence from a single trial evaluating the Graded Repetitive Arm Supplementary Program (GRASP) program suggests that additional therapy, performed outside of regular therapy can improve upper

extremity function.³⁸ In this multi-site RCT, 103 patients recruited an average of 21 days following stroke with upper-extremity FMA scores between 10 and 57, were randomized to participate in a 4 week (one hour/day x 6 days/week) homework-based, self-administered program designed to improve ADL skills through strengthening, range of motion (ROM) and gross and fine motor exercises or to a non-therapeutic education control group. At the end of the treatment period, participants in the GRASP group had significantly higher mean Chedoke Arm & Hand Activity Inventory, ARAT and MAL scores compared with the control group. The improvement was maintained at 3 months follow-up.

Strength Training

Strength training has not been well studied in the context of upper extremity rehabilitation. Hunter et al.³⁹ included 288 participants who had sustained a stroke in the anterior cerebral circulation territory within the previous 2-60 days, with some voluntary muscle contraction in the paretic upper extremity and without full dexterity in the FAST-INdiCATE Trial. Participants were randomized to receive functional strength training (FST) or movement performance therapy (MPT) in addition to conventional rehabilitation for 6 weeks. There was significant improvement in mean ARAT scores at 6 weeks within each group with no significant differences between groups (FST: 24.4 to 34.1 vs. MPT: 26.5 to 34.4, $p=0.29$). There was no significant difference between groups in mean ARAT scores or mean change scores from baseline, nor were there significant differences between groups in mean WMFT scores or mean change scores at 6 weeks or 6 months. In an older systematic review, including 13 RCTs, Harris & Eng⁴⁰ reported that therapy programs including a strength training or resistance training component were associated with significant improvements in motor function (SMD=0.21, 95%CI 0.03–0.39, $p=0.03$), 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, $p=0.16$). Improvements were noted in both the acute and chronic stages of stroke.

Bilateral Arm Training

The results from several systematic reviews and meta-analyses indicate that bilateral arm training is associated with significantly greater improvements in measures of impairment,⁴¹⁻⁴³ but not necessarily for measures of activity. The greatest benefit was found in patients with mild paresis, in the chronic stage of stroke and when bilateral training was provided as bilateral functional task training, and at high doses. An older Cochrane review,⁴⁴ which has not been updated since 2010, included the results from 18 RCTs, and reported that compared with conventional care, bilateral training was not associated with significantly better scores on measures of arm function, ADL performance or extended ADL, but did improve motor impairment. However, the treatment effect was very much dependent on the outcome used for assessment, the type of bilateral arm training that was provided (e.g., bilateral functional task training, bilateral robot-assisted training, mirror therapy and bilateral training with rhythmic auditory cueing) and the therapy the control group received (unimanual vs. conventional therapy).

Trunk Retraining

Trunk retraining is a type of physical therapy that focuses on exercises designed to improve the control and stability of the torso (trunk) muscles, which are often weakened after a stroke, leading to impaired balance, mobility, and difficulty with daily activities. A Cochrane review⁴⁵ included the results from 68 RCTs. Trunk training interventions included core-stability training (isometric strengthening of the trunk muscles), electrical stimulation that targeted ≥ 1 core trunk muscles, selective-trunk training aimed at improving selective movements of the upper and lower part of the trunk, sitting-reaching therapy, 10° steady-tilted platform and weight-shift training. The median duration of therapy was 4 weeks, providing a median of 600 minutes of total training. The intensity of training ranged from 30 minutes to 2,700 minutes (45 hours). Overall, trunk training was associated with a significant improvement in trunk function compared with both dose matched and non-dose matched therapy. Compared with non dose-matched therapy, trunk training was associated with a significant improvement in arm-hand activity, trunk function and ADL performance, while compared with dose-matched therapy, trunk training was not associated with a significant improvement in arm-hand activity or improvement in performance in ADL.

Trunk Restraint

Trunk restraint therapy is a rehabilitation technique in which the patient wears a harness or device to stabilize their trunk, preventing excessive compensatory movements, thus forcing them to use their affected upper extremity more effectively. A systematic review authored by Zhang et al.⁴⁶ included the results from 10 RCTs including 255 patients with upper extremity impairment following stroke. Patients received trunk restraint as part of a task-oriented training program or task-oriented training alone for two to 5 days per week, for two to 10 weeks. Trunk restraint was associated with significantly greater improvement in MAL-AOU and MAL-QOM (MD=0.34, 95% CI 0.20-0.47 and MD=0.34, 95% CI 0.18-0.50, respectively), FMA-UL (MD=0.68, 95% CI 0.39-0.98), ARAT (MD=4.3, 95% CI 2.33-6.27) and ADL performance (SMD=0.98, 95% CI 0.07 -1.89). The benefits were greatest for patients in the subacute stage of stroke.

Functional Dynamic Orthoses

This hand orthosis is designed to support, stabilize, or assist the movement of a specific joint or body part while also allowing for dynamic movement, such as executing a grasp. Dynamic hand orthoses were associated with significant improvement in ARAT scores (MD= 6.23 points, 95% CI 0.28 to 12.19; 2 trials included) and Box and Block Test (MD=2.99, 95% CI 0.39 to 5.60; 4 trials included) in a systematic review including 4 RCTs (56 patients) with upper extremity impairment following stroke, with no significant improvement in quality of life scores, motor function or grip strength.⁴⁷

Non-invasive Brain Stimulation

Non-invasive brain stimulation using either transcranial direct-current stimulation (tDCS) or repetitive transcranial magnetic stimulation (rTMS) have been shown to be beneficial forms of treatment for upper-extremity rehabilitation.

A large Cochrane review including the results of 67 RCTs including 1,729 participants with stroke compared active anodal or cathodal tDCS vs. sham treatment + an active or passive control treatment comparator.⁴⁸ tDCS was associated with significant improvement in ADL performance, measured at the end of the intervention, compared with placebo or passive control interventions (SMD=0.28, 95% CI 0.13 to 0.44, n=19 trials) and at follow-up (SMD=0.31, 95% CI 0.01 to 0.62; 6 trials). tDCS was also associated with a significant improvement in ADL performance, measured after the intervention, compared with an active intervention control (Barthel Index MD=6.59, 95% CI 1.26 to 11.9, 3 trials). Chhatbar et al.⁴⁹ included the results from 8 RCTs (213 participants) investigating the role of tDCS (≥5 sessions) in post-stroke recovery of upper extremity, compared with a sham condition. tDCS was associated with significantly greater improvements in FMA (upper extremity scores) compared with sham treatment (SMD=0.61, 95% CI 0.08 to 1.13, p=0.02). Treatment effects were more pronounced in the chronic vs. acute stage of stroke (SMD=1.23 vs. SMD=0.18).

In the Navigated Inhibitory rTMS to Contralesional Hemisphere Trial (NICHE), Harvey et al.⁵⁰ randomized 199 patients with a unilateral ischemic or hemorrhagic stroke occurring within three to 12 months of enrollment, with a Chedoke–McMaster assessment stage of 3-6 for both arm and hand, to receive low-frequency (1 Hz) active or sham rTMS to the non-injured motor cortex before each 60-minute therapy sessions, delivered over 6-weeks. At the end of 6 months, 67% of the experimental group and 65% of sham group improved ≥5 points on FMA-upper extremity (the primary outcome). The difference was not statistically significant (p=0.76). There was also no difference between experimental and sham groups in the ARAT (p=0.80) or WMFT (p=0.55) scores. In an extension of the NICHE trial, the Electric Field Navigated 1hz rTMS for Post-stroke Motor Recovery Trial (E-FIT), Edwards et al.⁵¹ used the same inclusion criteria and trial protocol (albeit a different sham coil) and randomized an additional 60 patients. Even with the larger sample size, when combining the results from both trials, the combined mean odds of achieving the primary outcome were not significantly higher in the active rTMS group (posterior mean odds ratio [OR]=0.94, 96% credible interval of 0.61–4.80). When including only participants from the E-FIT trial, the percentage of patients in the active rTMS group who achieved the

primary outcome was 60% vs. 50% in the sham group (OR=1.49, 95% CI 0.53 to 4.22). A systematic review that included the results from 45 RCTs reported that overall rTMS was associated with significantly greater improvement in upper arm function, assessed using the FMA-UE (SMD=1.12, 95% CI 0.56-1.68, 17 trials), with the benefit persisted up to 5 months following the intervention.⁵²

Pharmacotherapy & Functional Recovery

Selective serotonin reuptake inhibitors (SSRIs) have been investigated as a potential modulator of functional recovery post stroke, in patients both with and without mood disorders. Unfortunately, there appears to be increasing evidence that SSRIs do not help to reduce disability or improve independence and may, in fact, be associated with harm. Mead et al.⁵³ included the results from three large RCTs in a patient-level meta-analysis, which recruited 5,907 patients with persisting focal neurological deficit following acute stroke. All participants were randomized to receive 20 mg fluoxetine daily or placebo for 6 months. Trials included in the review were The Efficacy of Fluoxetine-a randomisEd Controlled Trial in Stroke (EFFECTS⁵⁴), the Assessment of Fluoxetine In sTroke recovery trial (AFFINITY,⁵⁵) and the Fluoxetine Or Control Under Supervision (FOCUS) trial.⁵⁶ At 6 months, the distribution of modified Rankin Scale (mRS) scores did not differ significantly between groups (common OR=0.96, 95% CI 0.87 to 1.05; GRADE: high quality). Neither was the distribution of scores significantly different between groups at 12 months (common OR=0.98, 95% CI 0.89 to 1.07). Fluoxetine was associated with a significantly increased frequency of seizures (2.64% vs. 1.8%, p=0.03), falls with injury (6.26% vs 4.51%, p=0.03), and fractures (3.15% vs 1.39%, p=0.01). In a Cochrane review, Legg et al.⁵⁷ included 76 RCTs including 13,029 participants who had suffered a stroke within the previous 12 months. Trials compared a variety of SSRIs vs. placebo. In most trials, patients were recruited in the early stages of stroke. There was no significant difference between groups in measures of disability (SMD=0.0, 95% CI -0.5 to 0.5, 5 trials; GRADE: high), nor was there a better chance of being independent at the end of treatment (RR=0.98, 95% CI 0.93 to 1.03, 5 trials; GRADE: high). SSRIs were associated with significantly higher risks of seizures and bone fractures.

Sex & Gender Considerations

While women are more likely to survive strokes than men, they tend to experience greater disability. Potential reasons for this imbalance may include greater initial stroke severity, higher pre-stroke disability and older age at stroke onset.⁵⁸ Women are also historically underrepresented in research studies. Data are limited with respect to rehabilitation outcomes with respect to sex. MacDonald et al.⁵⁹ used administrative data sets including 20,143 patients and compared sex differences in discharge Functional Independence Measure (FIM) scores from inpatient rehabilitation units in Ontario over a 5-year period. While in unadjusted analysis, women had a lower mean FIM score (94.1 vs. 97.8, p < 0.001), after adjusting for baseline characteristics, the difference was no longer significant. There is some evidence that women are under-represented in stroke rehabilitation clinical trials. In a recent systematic review,⁶⁰ examining female recruitment in 1,276 randomized trials investigating upper extremity rehabilitation interventions, the overall percentage of women included across all trials was 38.8%. The trials included participants across all stages of stroke chronicity, all rehabilitation settings, and intervention types (pharmacological, traditional and nontraditional rehabilitation therapies, and complementary interventions).

[Evidence Tables and Reference List 1](#)

Section 2 Shoulder Pain & Complex Regional Pain Syndrome (CRPS) following Stroke

2. Shoulder Pain & Complex Regional Pain Syndrome (CRPS) following Stroke, Recommendations 2025

Note: Shoulder pain after stroke is often multifactorial and may result from stroke-related hemiplegia, spasticity, injury or acquired musculoskeletal conditions stemming from impaired joint and soft tissue integrity. Pain may be from a combination of neuropathic, nociceptive or nociplastic causes. Accurate diagnosis of etiology is crucial for optimal management.

Refer to [Section 3](#) for additional information on Spasticity.

For these recommendations, 'Flaccid' is defined as the state of low muscle tone (hypotonia) with the absence of voluntary muscle movement and diminished resistance to passive stretch.

2.1 Prevention of Hemiplegic Shoulder Pain and Subluxation

- i. Joint protection strategies should be applied during the flaccid stage of recovery to prevent or minimize shoulder pain and injury. Strategies include:
 - a. Positioning and supporting the upper extremity when the individual is at rest [Strong recommendation; Moderate quality of evidence].
 - b. Protecting and supporting the shoulder in neutral rotation and forearm in neutral supination/pronation using a modified lap tray designed for this purpose during wheelchair use [Strong recommendation; Moderate quality of evidence].
- ii. Overhead pulleys should not be used [Strong recommendation; Low quality of evidence].
- iii. The upper extremity should not be moved passively beyond 90 degrees of shoulder flexion or abduction, unless the scapula is upwardly rotated, and the humerus is laterally rotated [Strong recommendation; Moderate quality of evidence].
- iv. Healthcare staff, individuals with stroke, family and caregivers should be educated to correctly protect, position, and move the affected upper extremity [Strong recommendation; Low quality of evidence].

Section 2.1 Clinical Considerations

1. Healthcare staff, individuals with stroke, family, and caregivers should avoid pulling on the affected upper extremity.
2. The affected upper extremity should be protected and supported during functional mobility such as transfers.
3. Shoulder slings should only be considered in the flaccid stage when no other upper extremity support is possible. After the flaccid stage, use of slings should be discouraged, given they may reduce upper extremity use, inhibit arm swing, contribute to contracture formation, and decrease body image.

2.2 Assessment of Hemiplegic Shoulder Pain

- i. The assessment of the painful hemiplegic shoulder should focus on determining the cause and include evaluation of tone, active movement, changes in length of soft tissues, alignment of joints of the shoulder girdle, trunk posture, levels of pain, musculoskeletal changes in the shoulder, and impact of pain on physical and emotional health [Strong recommendation; Low quality of evidence].

Section 2.2 Clinical Considerations

1. The diagnosis of post-stroke CRPS should be considered when typical causes of shoulder or hand pain, such as acute trauma or bony fracture have been ruled out. Clinicians should be aware of post-stroke CRPS and its clinical presentation to facilitate early diagnosis and treatment. When available, if post-stroke CRPS is suspected, referral to physiatry or other physician with experience in stroke rehabilitation or pain should be considered.

2.3 Management of Hemiplegic Shoulder Pain

- i. Treatments for hemiplegic shoulder pain related to limitations in range of motion may include gentle stretching and mobilization techniques within pain-free range and increasing external rotation and abduction [Strong recommendation; Low quality of evidence].
- ii. Taping of the affected shoulder is recommended to reduce shoulder pain in the acute phase of recovery [Strong recommendation; High quality of evidence].
- iii. For patients with a flaccid upper extremity, electrical stimulation should be considered [Strong recommendation; Moderate quality of evidence].
- iv. The use of shoulder orthoses may be considered to reduce shoulder subluxation in the flaccid stage [Strong recommendation; Moderate quality of evidence].
- v. If there are no contraindications, non-steroidal anti-inflammatory (NSAID) analgesics (oral or topical) could be considered for pain relief on an individual basis [Conditional recommendation; Low quality of evidence].
- vi. Chemo-denervation botulinum toxin is recommended for the treatment of hemiplegic shoulder pain thought to be related to spasticity [Strong recommendation; High quality of evidence].
- vii. Subacromial corticosteroid injections may 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 [Conditional recommendation; Moderate quality of evidence].
- viii. Acupuncture should be considered, in addition to conventional rehabilitation, in the treatment of hemiplegic shoulder pain [Conditional recommendation; High quality of evidence].
- ix. Extracorporeal shock wave therapy (ESWT) may be considered in the treatment of hemiplegic shoulder pain [Strong recommendation; Moderate quality of evidence].

Section 2.3 Clinical Considerations

1. Active range of motion should be increased gradually in conjunction with restoring alignment and strengthening weak muscles in the shoulder girdle.

Note: For additional information on pain management, refer to [Section 9 on Central Pain](#).

2.4 Hand Edema

Recommendations

Note, no evidence-based recommendations are included for this section.

Section 2.4 Clinical Considerations

1. For Individuals with stroke who experience hand edema, the following have been shown to have some benefit:
 - a. Active, active-assisted, or passive range of motion exercises.
 - b. Elevating the arm when at rest if possible.

- c. Retrograde massage.
- d. Gentle joint mobilization for the hand and fingers.
- e. Compression, including use of compression garments with appropriate monitoring by health professionals with expertise in use and fit.

2.5 Complex Regional Pain Syndrome (CRPS) Management

- i. Early assessment by a physiatrist or other physician with expertise in management in stroke for consideration of an early course of oral corticosteroids, on a tapering regimen, should be considered to reduce swelling and pain among patients with no contraindications [Early – Strong Recommendation; High quality of evidence].
- ii. Acupuncture may be considered as an adjunct therapy to reduce pain in individuals with CRPS [Conditional recommendation; Moderate quality of evidence].
- iii. Extracorporeal shock wave therapy (ESWT) may be considered as an adjunct therapy to reduce pain in individuals with CRPS [Strong recommendation; High quality of evidence].

Section 2.5 Clinical Considerations

1. Clinicians should be aware of CRPS and its clinical presentation to facilitate early diagnosis and treatment. When CRPS is suspected, early assessment by a physiatrist or other physician with expertise in stroke is essential for consideration of treatment with oral corticosteroids. Diagnosis of CRPS clinical and is based on the presence of pain accompanied by other supportive sensory, vasomotor, pseudomotor/edema and motor/trophic signs and symptoms, as detailed in the revised International Association for the Study of Pain (IASP) (or Budapest) criteria. This includes hyperalgesia/allodynia, temperature asymmetry, skin color changes or asymmetry, edema, sweating changes or asymmetry, decreased range of motion, motor dysfunction, and trophic (hair, nail, skin) change.
2. There is currently no established protocol for corticosteroids. A reasonable early course of corticosteroids could include starting at 30 – 50 mg daily of 3-5 days and then tapering doses over 2-3 weeks.

Rationale

The incidence of shoulder pain following stroke varies widely from 22% to 47%.⁶¹ Typically developing within two weeks to two months post-stroke, shoulder pain can inhibit participation in rehabilitation activities, and contribute to poor functional recovery, longer hospital stays, reduced limb movement, depression, sleeplessness, and reduced quality of life. Shoulder pain results from muscle weakness, spasticity, and the positioning of the arm during recovery.

Individuals with stroke express that it can be difficult to perceive pain, fatigue and other sensations on the affected side following stroke. Individuals with stroke advocate for access to rehabilitation services for shoulder pain and Complex Regional Pain Syndrome across the continuum of stroke recovery. They highlight the importance of receiving education on upper extremity positioning, appropriate use of the affected arm (including how much to use arm, when to rest, and signs of fatigue) and how to safely return to ADL and leisure activities.

System Implications

To achieve timely and appropriate assessment and management of shoulder pain, organizations should optimize the following system components:

1. Organized stroke care, including access to early rehabilitation therapies, access to stroke rehabilitation units, and a critical mass of trained interdisciplinary staff during the rehabilitation period following stroke.

2. Affordable access to equipment for proper limb positioning (e.g., pillows, arm troughs) and for management of shoulder pain (e.g., slings, supports, taping).
3. Healthcare providers with appropriate training and experience in upper extremity assessment, treatment and management, including inter-articular joint injections and botulinum toxin injections.
4. Processes in place to enable timely access to specialized, interdisciplinary stroke rehabilitation services for the management of shoulder pain.
5. Timely access to appropriate rehabilitation therapy intensity/ treatment modalities for management or reduction of shoulder pain in stroke survivors.
6. Processes in place to provide education for all healthcare providers, that will be providing care and working with individuals with stroke, about shoulder protection, positioning and movement following stroke.
7. Processes in place to provide education to the individual with stroke, family and caregivers regarding shoulder positioning, protection and movement following stroke.
8. Process in place to assess, treat and manage pain related to the upper extremity experienced by an individual with stroke.
9. Long-term rehabilitation services available at all stages across the continuum of care, and including in long-term care, and complex continuing care facilities, and in outpatient and community programs.
10. The development and implementation of an equitable and universal pharmacare program, implemented in partnership with the provinces and territories, designed to improve access to cost-effective medications for all people in Canada regardless of geography, age, or ability to pay. This program should include a robust common formulary for which the public payer is the first payer.

Performance Measures

System Indicators

1. Access to stroke rehabilitation services 7 days per week for inpatient care.
2. Proportion of individuals within a stroke region who access an inpatient and community-based stroke rehabilitation as part of their episode of care for a stroke event.

Process Indicators

3. Proportion of individuals with stroke 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).
4. Length of stay during acute care hospitalization and inpatient rehabilitation for individuals with stroke experiencing shoulder pain (versus individuals with stroke not experiencing shoulder pain).

Patient-Oriented Indicators

5. Proportion of individuals with stroke with restricted range of motion related to shoulder pain.
6. Proportion of individuals with stroke who report shoulder pain at three-month and six-month follow-up.
7. Pain intensity rating change, from baseline to defined measurement periods.
8. Motor score change, from baseline to defined measurement periods.
9. Range of shoulder external rotation before and after treatment for shoulder pain.

Implementation Resources and Knowledge Transfer Tools

Resources and tools listed below that are external to Heart & Stroke and the Canadian Stroke Best Practice Recommendations may be useful resources for stroke care. However, their inclusion is not an actual or implied endorsement by the Canadian Stroke Best Practices team or Heart & Stroke. The reader is encouraged to review these resources and tools critically and implement them into practice at their discretion.

Health Care Provider Information

- Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery and Community Participation following Stroke, [Part One: Stroke Rehabilitation Planning for Optimal Care Delivery](#) module; and, [Part Three: Optimizing Activity and Community Participation following Stroke, Update 2025](#)
- Heart & Stroke: Taking Action for Optimal Community and Long-Term Stroke Care: A resource for healthcare providers: <https://www.strokebestpractices.ca/resources/professional-resources/tacls>
- UF Health: Pain scales: <https://pami.emergency.med.jax.ufl.edu/resources/provider-resources/pain-assessment-scales/>
- Stroke Engine: Fugl-Meyer Assessment of Sensorimotor Recovery after Stroke (FMA): <https://strokengine.ca/en/assessments/fugl-meyer-assessment-of-sensorimotor-recovery-after-stroke-fma/>
- Stroke Engine: <http://www.strokengine.ca/>

Resources for Individuals with Stroke, Families and Caregivers

- Heart & Stroke: Signs of Stroke: <http://www.heartandstroke.ca/stroke/signs-of-stroke>
- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>
- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1
- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>
- Heart & Stroke: Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbpr-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031>

- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbfc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>
- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- CanStroke Recovery Trials: Tools and Resources: <https://canadianstroke.ca/tools/>
- Stroke Engine: <http://www.strokeengine.ca/>

Summary of the Evidence

Hemiplegic Shoulder Pain

The use of supportive slings, supports and other modalities may help to prevent and reduce the risk of subluxation and hemiplegic shoulder pain. Ada et al.⁶² randomized 46 persons who were at risk of developing shoulder subluxation following a recent stroke to use a modified lap-tray while sitting and a triangular sling while standing to support the affected arm for four weeks, while those in a control group used a hemi-sling while sitting and standing. At the end of the treatment period there were no significant difference between groups in terms of shoulder subluxation (mean difference [MD] -3 mm, 95% CI -8 to 3), pain at rest (MD -0.7 out of 10, 95% CI -2.2 to 0.8), shoulder external rotation (MD -1.7 out of 10, 95% CI -3.7 to 0.3) or having less contracture of shoulder external rotation (MD -10 deg, 95% CI -22 to 2). Pan et al.⁶³ randomized 120 inpatients recruited from a rehabilitation hospital with upper extremity dysfunction, an average of two months post stroke, with/without shoulder pain to receive modified wheelchair arm-support used for at least 60 minutes a day, for 4 weeks, or passive rehabilitation exercises. Among patients without shoulder pain at baseline, a significantly lower percentage of those in the intervention group developed shoulder pain at the end of follow-up (1/25 vs. 6/20, $p=0.034$). Among all patients, at 12 weeks, there was significantly greater improvement in median pain scores, modified Barthel Index and Quality of Life Index scores in the intervention group.

Several systematic reviews have been published on the topic of hemiplegic shoulder pain. Deng et al.⁶⁴ included the results of 9 RCT of 424 persons with shoulder pain following stroke to examine the potential benefit of kinesio taping in addition to conventional therapy. Kinesio taping was associated with a significant reduction in pain (MD = -1.45, 95% CI -1.98 to -0.92 cm), shoulder subluxation (SMD= -0.65, 95% CI -0.95 to -0.35), and a significant improvement in motor function (MD=4.22, 95% CI 3.49 to 4.95) and performance of ADLs (MD = 6.86, 95% CI 3.99 to 9.73). In a systematic review that evaluated the use of strapping,⁶⁵ pooling of results was possible for only a single outcome. Strapping was not associated with significant improvement in upper extremity component of the Motor Assessment Scale (MD=0.87, 95% CI -0.7 to 1.81). The results for the other outcomes (pain, subluxation, range of movement) including results from individual trials were mixed, with some studies reporting a benefit, while others did not. The authors concluded the efficacy of shoulder strapping to alleviate upper extremity dysfunction and shoulder impairments caused by stroke remains unknown, while acknowledging that shoulder strapping may delay the onset of pain in those with severe weakness or paralysis. Therapies to prevent the risk of developing a painful hemiplegic shoulder in the acute stage of stroke, were explored by Ada et al.⁶⁶ in a Cochrane review that included the results from 4 RCTs including 142 participants with a flaccid arm with no history of shoulder pain. Treatments included shoulder strapping (n=3) and hemisling (n=1) to reduce upper extremity and shoulder impairments and dysfunction, compared with no strapping or sling. The duration of treatment ranged from 5 days to 6 weeks. Shoulder strapping significantly delayed the onset of shoulder pain by a mean of 13.6 days (95% CI 9.7 to 17.8), compared with no strapping, with no difference between groups in improvement of motor function or prevention of contracture.

Electrical stimulation can be used for the prevention and management of shoulder subluxation. A systematic review⁶⁷ examined the use of a variety of techniques including transcutaneous electrical nerve stimulation (TENS), percutaneous nerve stimulation, functional electrical stimulation (FES), and electric acupuncture for the treatment of hemiplegic shoulder. The results from 6 RCTs were included. Compared with electrical stimulation +/- sham treatment, other active treatments and conventional treatment, overall electrical stimulation was associated with a significant reduction in pain following treatment (SMD= -1.89, 95% CI -3.05 to -0.74), significant improvement in pain-free external rotation (WMD=18.9 degrees, 95% CI 7.00-30.8) and improvement in ADL, assessed using the Barthel Index (WMD=8.96, 95% CI 5.26-12.66). Lee et al.⁶⁸ included the results of 11 trials evaluating the effectiveness of NMES for the management of shoulder subluxation in both the acute and chronic stages of stroke. NMES was effective in reducing subluxation in the acute stage of stroke (SMD= -1.1, 95% CI -1.53 to -0.68, $p < 0.001$) but not in the chronic stage (SMD= -1.25, 95% CI -1.61 to 0.11, $p = 0.07$) but did not significantly reduce pain in either the acute or chronic stages. Vafadar et al.²⁰ included 10 trials evaluating the evidence for the effect of FES on shoulder subluxation, pain and upper extremity motor function when added to conventional therapy. Pooling data from 6 trials showed that electrical stimulation was more effective than the conventional therapy alone in improving shoulder subluxation, when applied within the first 6 months of stroke (SMD= -0.70, 95% CI -0.98 to -0.42). Only data from two trials were available for the effect of electrical stimulation when applied 6 months after stroke. Ada & Foongchomcheay⁶⁶ included participants with subluxation or shoulder muscle paralysis in both the acute and chronic stages of stroke, from seven RCTs. 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. In one of the largest RCTs, Church et al.⁶⁹ randomized 176 patients to receive active or sham surface NMES treatments in addition to conventional therapy, for four weeks following acute stroke. There was no significant difference between groups in measures of upper extremity function, or the prevalence of pain post intervention, at 3 months.

Treatment with botulinum toxin type a (BTX-A) may help to improve hemiplegic shoulder pain. A Cochrane review,⁷⁰ which included the results of 6 RCTs examined the efficacy of the use of BTX-A in the treatment of 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.⁷¹ 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 to 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. In a more recent RCT, Tan et al.⁷² randomized 36 patients with spastic hemiparesis due to a stroke occurring ≥ 2 months previously to receive either ultrasound-guided BTX-A (100 U) or 2.0-mL saline (placebo). At the end of 4 weeks the mean pain score had improved in both groups, but the change from baseline was significantly greater in the BTX-A group (7.1 to 2.8 vs. 7.3 to 4.2, mean change= -1.39, 95% CI -2.41 to -0.36), while at week 24, there was no longer a significant difference between groups. At 4 weeks, there was significantly greater improvement in the BTX-A group in mean Fugl Meyer Assessment (FMA) change scores from baseline.

Intra-articular corticosteroids injections may also help to improve symptoms of shoulder pain. Rah et al.⁷³ 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), in addition to a standardized exercise program. There was significantly greater reduction in the average shoulder pain level, both and night, at 8 weeks associated with steroid injection. In contrast, Snels et al.⁷⁴ reported that in 37 patients with hemiplegic shoulder pain (≥ 4 , VAS 0 to 10) 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.

Acupuncture can be beneficial for patients with hemiplegic shoulder pain, improving both pain levels and functional outcomes, although it is generally considered a complementary therapy. Typically, it is combined with other rehabilitation strategies. For example, a systematic review by Zhan et al.⁷⁵ included the results of 40 RCTs of persons with hemiplegic shoulder pain following stroke. Trials

compared many different types of acupuncture + rehabilitation therapies vs. therapy only, provided for 5 to 60 sessions, over 7 days to 4 months. Acupuncture + therapy was associated with a significantly greater reduction in pain scores (MD= -1.32, 95% CI -1.58 to -1.07), significantly greater improvement in motor function, assessed using the FMA (MD=6.81, 95% CI 4.95 to 8.67), and ADL performance (MD=11.17, 95% CI 9.44 to 12.91).

Extracorporeal shock wave therapy (ESWT) has been suggested as a non-invasive and alternative treatment for shoulder pain. Zhang & Zhang⁷⁶ reported that ESWT was associated with a significant reduction in pain scores (MD= -1.19, 95% CI -1.43 to -0.95) and improvement in motor function (MD = 6.25, 95% CI 4.64 to 7.87) in a systematic review including 18 RCT of 1,248 participants with shoulder pain following stroke, or with shoulder hand syndrome. Trials compared ESWT +/- cointerventions vs. conventional rehabilitation +/- other modalities. The duration of the intervention ranged from 14 to 30 days.

Topical non-steroidal anti-inflammatory ointments may also be helpful for relief of shoulder pain.⁷⁷

Hand Edema

For patients with hand edema, results from a systematic review suggest that mobilization exercises (i.e. range of motion exercises) may be effective in reducing hand edema in patients with acute stroke.⁷⁸ Bandaging, intermittent compression, kinesio tape, neutral functional realignment orthosis, and hand realignment orthosis were not found to be effective treatments.

Complex Regional Pain Syndrome (CRPS)

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. A Cochrane overview of reviews conducted by O'Connell et al.⁷⁹ evaluated 19 studies that used a variety of interventions to treat pain and/or disability associated with CRPS. The authors found moderate quality evidence that intravenous regional blockade with guanethidine was not effective in treating CRPS and is associated with adverse events, and low-quality evidence 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 was low-quality evidence that local anaesthetic sympathetic blockade, physiotherapy, and occupational therapy are not effective for CRPS. Acupuncture has been shown to reduce pain, improve motor performance and improve performance of ADLs when added to conventional therapy.^{80,81}

Sex & Gender Considerations

The research on sex and gender differences related to the frequencies of shoulder pain and CRPS is limited. No studies were reviewed that addressed incidence, prevalence or response to treatment of these conditions.

[Evidence Tables and Reference List 2](#)

Section 3 Range of Motion and Post-Stroke Spasticity

3. Range of Motion and Post-Stroke Spasticity, Recommendations 2025

Note: Spasticity is a common consequence of stroke and can negatively affect function, range of motion, pain, skin integrity, care needs, and engagement in rehabilitation. Routine assessment is essential to identify and manage these potential impacts effectively.

Section 3.0 Clinical Considerations for Assessment of Post-Stroke Spasticity

1. Spasticity assessment should be a component of neurological assessments for an individual with stroke. *Refer to [Section 2 on Shoulder Pain](#) for additional information.*
2. Assessment for spasticity and its potential complications should be conducted regularly, throughout the continuum of stroke care, to ensure timely identification and management.
3. Assessment and management of complicated post-stroke spasticity should be carried out by a healthcare professional with expertise in spasticity management and an interprofessional team with specialized expertise in spasticity care whenever possible and using validated assessment and outcome measures.
4. Assessment of spasticity should include identification and consideration of factors that can increase post-stroke spasticity (e.g., noxious stimuli such as infections, pain or constipation).

3.1 Upper Extremity

- i. Static stretching with positioning orthoses may be considered to treat wrist-flexor spasticity [**Conditional recommendation**; Moderate quality of evidence].
 - a. Routine use of splints alone for spasticity is not recommended [Strong recommendation; High quality of evidence].
 - b. The use of splints may be considered to prevent complications of spasticity on an individualized basis. If a splint is used, a plan for monitoring the splint for effectiveness should be followed [Strong Recommendation; Low quality of evidence].
- ii. Chemo-denervation using botulinum toxin should be considered to increase passive range of motion for patients with spasticity of the shoulder [Early: Strong recommendation; Moderate quality of evidence; Late: Strong recommendation; High quality of evidence].
- iii. Chemo-denervation using botulinum toxin should be considered over oral medications as first-line treatment of focal spasticity [Strong recommendation; High quality of evidence].

Section 3.1 Clinical Considerations

1. Oral medications (i.e., tizanidine and baclofen) can be considered as an adjunct for the treatment of disabling spasticity, but side effects of fatigue and drowsiness are common.
2. Adjunct treatments (i.e., electrical stimulation, CIMT, taping, dynamic splinting, extracorporeal shock wave therapy), in addition to chemo-denervation using botulinum toxin may be considered to treat spasticity.
3. Non-invasive brain stimulation may be considered in the treatment of spasticity. *Note these interventions are not yet available/approved for use in Canada.*
4. Follow-up assessments for spasticity should be included as part of the routine care plan during inpatient rehabilitation, and at the start and end of outpatient rehabilitation therapy.

3.2 Lower Extremity

- i. Active stretching and joint mobilization exercises is recommended in both the early and late stages to increase ankle joint range of motion and gait parameters, and to decrease spasticity [Strong recommendation; Moderate quality of evidence].
- ii. Chemo-denervation using botulinum toxin is recommended to reduce focal spasticity in individuals with stroke [Strong recommendation; High quality of evidence].
- iii. Intrathecal baclofen may be considered for cases of severe, chronic, and intractable spasticity that cannot be effectively managed with oral antispasmodic agents [Strong recommendation; Low quality of evidence].

Section 3.2 Clinical Considerations

1. Oral medications (i.e., tizanidine and baclofen) can be considered as an adjunct for the treatment of disabling spasticity, but side effects of fatigue and drowsiness are common.
2. Whole body vibration may be considered to decrease lower extremity spasticity in the early stage, but not in the late stage.
3. Extracorporeal shock wave therapy (ESWT) should be considered to decrease spasticity and pain associated with plantar flexor spasticity.

Rationale

Post-stroke spasticity is characterized by increased muscle tone and abnormal reflexes, which can significantly impact both upper and lower extremity function. When the upper extremity is affected, the ability to perform personal care tasks such as dressing, and eating, is reduced, which may lead to dependence on caregivers or family members. Individuals with lower extremity spasticity have difficulty standing, walking and maintaining balance. Management and treatment of post-stroke spasticity can facilitate the rehab process by decreasing the burden of care and improving comfort and engagement in activities.

While post-stroke spasticity can interfere with rehabilitation and lead to negative consequences, it may also offer functional benefits in certain cases—for example, increased finger flexor spasticity may aid grip, or knee extensor spasticity may assist with weight bearing. Assessing the functional impact of spasticity and clearly identifying treatment goals are essential components of effective spasticity management.

Individuals with stroke emphasize the importance of education on spasticity management for individuals with stroke, their family and caregivers and note that certain strategies may be helpful to provide relief and management. They emphasize the impact spasticity can have on ability to engage in exercise and ADL. Accordingly, strategies to manage spasticity should be discussed with individuals with stroke using a person-centred approach.

System Implications

To achieve timely and appropriate assessment and management of shoulder, arm and hand range and spasticity, organization should optimize the following system components:

1. Availability of and access to organized stroke care, including stroke rehabilitation units with critical mass of trained interdisciplinary staff during the rehabilitation period following stroke.
2. Processes in place to enable timely access to specialized, interdisciplinary stroke rehabilitation services, where assessments and therapies of appropriate type and intensity are provided.

3. Initial and ongoing assessments performed by healthcare providers experienced in stroke rehabilitation both in hospital and in the community.
4. Expertise within the interdisciplinary stroke team to prevent, manage and/or ameliorate post-stroke spasticity and remediate its complications and functionally related limitations.
5. Healthcare providers with appropriate training and experience in spasticity assessment, treatment and management, including inter-articular joint injections and botulinum toxin injections.
6. Processes in place to enable timely access to appropriate intensity of rehabilitation for individuals with stroke as defined within the best practice recommendations.
7. Process for timely assessment and affordable access to an orthotic/splint/brace should be considered to ensure safety.
8. Optimization of strategies to prevent or manage spasticity both initially post stroke and at follow-up assessments.
9. Funding for chemo-denervation and associated post injection rehabilitation services where necessary.
10. Long-term rehabilitation services widely available across the continuum of care, including in long-term care and complex continuing care facilities, and in outpatient and community programs.
11. The development and implementation of an equitable and universal pharmacare program, implemented in partnership with the provinces and territories, designed to improve access to cost-effective medicines for all people in Canada regardless of geography, age, or ability to pay. This program should include a robust common formulary for which the public payer is the first payer.

Performance Measures

System Indicators

1. Availability of expertise and programs in post-stroke spasticity.
2. Proportion of individuals with stroke who experience post-stroke spasticity.

Process Indicators

3. Time from stroke onset to first functional assessment including signs of spasticity.
4. Frequency and intensity of therapy for post-stroke spasticity.
5. Access to specialized services to support management of post-stroke spasticity.

Patient-Oriented Indicators

6. Change (improvement) in functional status scores using a standardized assessment tool following therapy for post-stroke spasticity – measures at 90 day, 6 months and one year following stroke.
7. Extent of change in upper and lower limb spasticity scores using a standardized assessment tool (e.g., Modified Ashworth Scale) from admission to an inpatient rehabilitation program to discharge.
8. Change in reported pain levels, based on validated pain rating scale measures from baseline to defined measurement periods (e.g., 30, 60, 90 days following stroke).
9. Changes in quality of life measured at regular intervals during recovery and participation, and reassessed when changes in health status or other life events occur (e.g., at 60, 90- and 180-days following stroke).

10. Levels of burden of care on family and caregivers supporting an individual with post-stroke spasticity.

Implementation Resources and Knowledge Transfer Tools

Resources and tools listed below that are external to Heart & Stroke and the Canadian Stroke Best Practice Recommendations may be useful resources for stroke care. However, their inclusion is not an actual or implied endorsement by the Canadian Stroke Best Practices team or Heart & Stroke. The reader is encouraged to review these resources and tools critically and implement them into practice at their discretion.

Health Care Provider Information

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- Heart & Stroke: Taking Action for Optimal Community and Long-Term Stroke Care: A resource for healthcare providers: <https://www.strokebestpractices.ca/resources/professional-resources/tacls>
- Stroke Engine: FIM® Instrument: <https://strokengine.ca/en/assessments/functional-independence-measure-fim/>
- UDS: AlphaFIM® Instrument: <https://www.udsmr.org/>
- Stroke Engine: Modified Ashworth Scale: <https://strokengine.ca/en/assessments/modified-ashworth-scale/>
- UF Health: Pain scales: <https://pami.emergency.med.jax.ufl.edu/resources/provider-resources/pain-assessment-scales/>
- Stroke Engine: <http://www.strokengine.ca/>

Resources for Individuals with Stroke, Families and Caregivers

- Heart & Stroke: Signs of Stroke: <http://www.heartandstroke.ca/stroke/signs-of-stroke>
- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>
- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1
- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>

- Heart & Stroke: Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbpr-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031>
- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbfc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>
- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- CanStroke Recovery Trials: Tools and Resources: <https://canadianstroke.ca/tools/>
- Stroke Engine: <http://www.strokingengine.ca/>

Summary of the Evidence

Upper Extremity Spasticity

Spasticity can be painful, interfere with functional recovery and hinder rehabilitation efforts. If not managed appropriately, patients 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. Harvey et al.⁸² included the results of 49 RCTs in a Cochrane review including participants with neurological condition, advanced age, those with a history of trauma and those with underlying joint or muscle pathology. Of these, 11 trials included stroke cohorts treated for upper extremity impairment. Trials evaluated the effect of stretching programs (casting, splinting, self-administered, positioning, and sustained passive stretch) on preventing contractures. Stretching programs did not significantly increase joint mobility, improve spasticity, activity limitations, or pain either after the intervention or at follow-up, when compared with usual care. Salazar et al.⁸³ included the results from three RCTs of patients post stroke with upper extremity spasticity and reported that static stretching with positioning orthoses was associated with significantly greater reduction in wrist-flexor spasticity compared with no therapy or conventional physiotherapy (mean difference [MD]= -1.89, 95% CI -2.44 to -1.34).

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 extremity function. In the BOTOX Economic Spasticity Trial (BEST), 273 persons with chronic post-stroke upper and lower extremity spasticity were randomized to receive a single dose of BTX-A with an optional second dose offered ≥ 12 weeks after the first injection, or placebo in addition to usual care. Dosing and site of injection was based on clinician judgement. In the publication of the trial that was dedicated to functional outcomes,⁸⁴ there were no significant differences between groups at weeks 12, 24 or 52 with respect to the percentage of patients who achieved their principal active functional goal (33.1% vs. 28.9%, 40.9% vs. 33.3% and 45.0% vs. 52.4%, respectively), although a higher number of persons in the BTX-A groups achieved their secondary passive functional goals at 24 weeks, (60.6% vs. 38.6%, $p=0.016$), but not at weeks 12 or 52. In another BEST publication, BTX-A was more effective than placebo in reducing pain from baseline to week 12.⁸⁵ Higher proportions of patients with pain in the BTX-A group achieved $\geq 30\%$ and $\geq 50\%$ reductions in pain. Shaw et al.⁸⁶ randomized 333 subjects < 1 month following stroke with spasticity of the elbow (modified Ashworth Score [MAS] > 2) and/or spasticity of the shoulder, wrist or hand with reduced arm function to receive 100 or 200 U Dysport[®] in addition to a standardized therapy program provided for one hour/day, 2x/week for 4 weeks) or therapy program only. Repeat injections were available to participants in the

intervention group at 3, 6 and 9 months. 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 extremity 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.⁸⁷ 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 in 102 patients with moderate to severe spasticity of the arm, who received 750-1,000 U Dysport or placebo an average of 6 years following stroke. In a systematic review, Sun et al.⁸⁸ pooled the results from 18 RCTs of adults with upper extremity spasticity following stroke in which a wide variety of outcomes were reported. Trials compared one-time injections of BTX-A formulation with placebo. At 4 to 16 weeks, treatment with BTX-A was associated with significant improvement in muscle tone (SMD=-0.76; 95% CI -0.97 to -0.55), physician global assessment ([SMD=0.51; 95% CI 0.35-0.67) and disability assessment scale (SMD=-0.30; 95% CI -0.40 to -0.20), with no significant improvement on active upper extremity function (SMD=0.49; 95% CI -0.08 to 1.07). BTX-A may also be used in addition with other treatment modalities to reduce spasticity. Other treatments include electrical stimulation,^{89,90} constraint-induced movement therapy,⁹¹ taping,⁹² and dynamic splinting.⁹³

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 well studied in the stroke population and is used more frequently in patients recovering from spinal cord injury; however, in one small RCT, Güntürk et al.⁹⁴ reported that in patients randomized to receive treatment with BTX-A (total dose 100-300 U) or oral baclofen (total dose 3-80 mg daily), median elbow, wrist and finger MAS scores and pain scores had improved significantly at 6 weeks in both groups, with no significant differences between groups. There was no significant improvement in median Barthel Index scores within, or between groups at 6 weeks. 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.⁹⁵ 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 MAS scores (9.3 vs. 6.5, $p=0.038$). There were also significant improvements in pain, quality of life, and physician assessment of disability.

Extracorporeal shockwave therapy (ESWT) is a non-invasive treatment that uses acoustic shock waves to reduce pain and heal tissue and has been used traditionally to treat injuries such as tendonitis, and other soft tissue injuries, but has also been used for the treatment of spasticity following stroke. Cabanas-Valdés et al.⁹⁶ included the results of 16 RCTs, including 764 participants who had sustained an ischemic or hemorrhagic stroke and had residual upper-extremity hemiparesis and spasticity. In most trials, ESWT plus conventional therapy was compared with conventional therapy only. A sham condition was used in two trials. ESWT was associated with a significant reduction in MAS and pain scores compared with therapy alone, and an improvement in Fugl-Meyer Assessment scores.

Non-invasive brain stimulation using either transcranial direct-current stimulation (tDCS) or repetitive transcranial magnetic stimulation (rTMS) has been shown to be beneficial for the treatment of upper-extremity spasticity. rTMS and tDCS were associated with significant reductions in mean MAS scores compared with the control condition (sham stimulation, +/- cointerventions) in a systematic review authored by Wang et al.⁹⁷ (MD= -0.40, 95% CI -0.56 to -0.25 and MD=-0.65, 95% CI -1.07 to -0.22, respectfully), including the results of 14 RCTs of 236 patients with upper extremity spasticity.

Lower Extremity Spasticity

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. Chen et al.⁹⁸ randomized 121 patients discharged from inpatient rehabilitation, an average of 3.3 months post stroke, with lower extremity spasticity to a nurse-guided home-based rehabilitation exercise program, aimed at reducing spasticity and improving mobility, which lasted for 12 months, or to receive conventional rehabilitation. At the end of 12 months, there was significantly greater improvement in mean lower extremity MAS scores, as well as motor function, gait speed and BI scores in the home-based rehabilitation exercise program group (from 3.32 to 1.07 vs. 3.27 to 1.69, p for group x time interaction =0.004). Kluding et al.⁹⁹ reported that 8 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 degrees in the control group ($p < 0.01$).

The use of BTX-A for treatment of lower extremity spasticity is not as well-studied compared with the upper extremity. In the REFLEX Study, Wein et al.¹⁰⁰, included 468 patients, recruited from 60 centres in the United States with spasticity of the ankle (MAS ≥ 3) following stroke of duration > 3 months. Participants were randomized to receive either BTX-A (Botox 300–400 U) or placebo and followed for 12 weeks during the double-blind phase of the trial. During this phase of the trial there was significantly greater improvement in mean MAS ankle scores from baseline to 4-6 weeks in the BTX-A group (-0.81 vs. -0.61, $\Delta = -0.20$). During the open-label phase of the trial, mean MAS scores were reduced by -1.2 points for patients in the BTX-A group and by -1.4 points for those in the group that initially received placebo. During the double-blind phase, the mean Physician-assessed Clinical Global Impression of Change (CGI) from baseline to 4-6 weeks was significantly greater in the BTX-A group (0.86 vs. 0.65; $\Delta = 0.22$). At the end of the open-label phase, patients in both groups had improved to an average of 1.6 points. Goal Attainment Scale (GAS) scores, reflecting individualized patient goals, showed incremental improvements with each subsequent treatment cycle.

A systematic review by Doan et al.¹⁰¹ included the results of 12 RCTs of patients with lower extremity spasticity. Duration of stroke was greater than three months in 8 trials. Patients were randomized to receive BTX-A injections or placebo. At four weeks, there was significantly greater improvement in measures of spasticity (Ashworth Scale [AS], MAS) in the BTX-A group (SMD = -0.61, 95% CI -0.92 to -0.3). Kaji et al.¹⁰² randomized 120 patients with lower extremity spasticity following a stroke of greater than 6 months post onset to receive a single treatment of 300 U Botox or placebo. There was a significantly greater reduction in mean MAS 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. Pittock et al.¹⁰³ 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, 8 and 12 weeks following treatment. Lower doses (500 and 1,000 U) resulted in significant reductions in spasticity by week four only.

Intrathecal baclofen (ITB) is not generally used in the treatment of post-stroke spasticity, but can be considered in certain cases, particularly if other treatment options are ineffective or if the spasticity is severe and disabling. It is used more commonly in spinal cord injury, multiple sclerosis and cerebral palsy. The Spasticity In Stroke—Randomized Study¹⁰⁴ (SISTERS) included 60 patients recruited from 11 rehabilitation centres in Europe and the US with chronic stroke with spasticity in ≥ 2 extremities and an AS score ≥ 3 in at least two affected muscle groups in the lower extremities. After a run-in period, patients were randomized to receive ITB or conventional medical management, using a combination of oral antispastic medications, comprising at least one of oral baclofen, tizanidine, diazepam (or other benzodiazepines), or dantrolene. At 6 months post treatment, the mean reduction in lower extremity AS scores was significantly greater in the ITB group (-0.99 vs. -0.43, $p = 0.0140$).

Less conventional treatments for the treatment of lower extremity spasticity include extracorporeal shock wave therapy (ESWT) and whole-body vibration (WBV), although both are considered a complementary therapy, and are used in addition to traditional rehabilitation therapies. In two small RCTs, ESWT was associated with significantly greater reductions in spasticity compared with

conventional therapy. ^{105,106} In a systematic review including 11 RCTs, Zhang et al. ⁷⁶ reported that WBV was associated with a significant reduction in lower extremity spasticity (SMD= -0.26, 95% CI -0.44 to -0.07). Treatment was most effective in the acute/subacute stage of stroke and in patients under 60 years.

Sex & Gender Considerations

Current research suggests there are no significant sex differences in the development of upper or lower extremity spasticity following a stroke. None of the studies we reviewed that examined any interventions for post-stroke spasticity included an analysis that explored sex or gender as a potential determinant of rehabilitation outcome.

[Evidence Tables and Reference List 3a](#)

[Evidence Tables and Reference List 3b](#)

Section 4 Lower Extremity, Balance, Mobility and Aerobic Training

4. Lower Extremity, Balance, Mobility and Aerobic Training, Recommendations 2025

4.0 General Considerations

- i. Patients should participate in training that is meaningful, engaging, progressively adaptive, intensive, task-specific and goal-oriented, in an effort to improve transfer skills and mobility [Strong recommendation; High quality of evidence].

4.1 Lower Extremity Function and Gait

- i. Task-specific and goal-oriented training that is repetitive and progressively adapted should be delivered to improve performance of selected mobility tasks such as sit to stand, walking distance and walking speed [Strong recommendation; High quality of evidence].
 - a. Both group and individual task-specific training are effective and may be considered [Strong recommendation; High quality of evidence].
- ii. Resistance training should be considered for individuals with mild to moderate impairment in the lower extremity to improve strength and motor function; however, its impact on functional mobility is limited [Strong recommendation; High quality of evidence].
- iii. Treadmill-based gait training (with or without body weight support) may be used to enhance walking speed, and distance walked as an adjunct to over-ground training or when over-ground training is not available or appropriate. [Strong recommendation; High quality of evidence].
- iv. Electromechanical (robotic) assisted gait training devices are not recommended over conventional gait training [Strong recommendation; High quality of evidence].
- v. Rhythmic auditory stimulation (RAS) should be used to improve gait (i.e., walking speed, cadence, stride length) and function [Strong recommendation; High quality of evidence].
- vi. Functional electrical stimulation (FES) should be used to improve balance, gait speed and mobility in selected individuals with stroke [Strong recommendation; High quality of evidence].
- vii. Ankle-foot orthoses should be used with selected individuals with foot drop following proper assessment and with follow-up to verify their effectiveness to improve gait speed and balance [Strong recommendation; High quality of evidence].
- viii. Aquatic exercise is recommended to improve walking speed and mobility [Strong recommendation; High quality of evidence].
- ix. Non-immersive virtual reality training may be considered to improve lower extremity function, balance and gait (i.e., walking speed, cadence, stride length) as an adjunct to conventional gait training [Strong recommendation; Moderate quality of evidence].
- x. Biofeedback, in the form of visual and/or auditory signals, may be used to improve lower extremity function [Strong recommendation; Moderate quality of evidence].
- xi. Mental imagery practice may be considered as an adjunct to gait training to improve gait speed [Strong recommendation; Low quality of evidence].

Section 4.1 Clinical Considerations

1. The need for gait aids, wheelchairs, and other assistive devices should be evaluated on an individual basis.

- a. Once equipment has been provided, individuals with stroke should be reassessed, as appropriate, to determine progress, if changes or adjustments are required, and, if and when the equipment is no longer needed.

4.2 Balance

- i. The following therapies should be considered to improve balance following stroke (in addition to recommendations 4.1 ix and vi):
 - a. Trunk training/seated balance training [Strong recommendation; High quality of evidence].
 - b. Aquatic balance training [Strong recommendation; High quality of evidence].
 - c. Tai Chi [Strong recommendation; High quality of evidence].
 - d. Balance training combined with visual feedback or motor imagery training may be considered as an adjunct therapy [Strong recommendation; Moderate quality of evidence].
 - e. The use of unstable surfaces and balance boards [Strong recommendation; Moderate quality of evidence].
 - f. Whole-body vibration training is recommended as an adjunct therapy [Conditional recommendation; High quality of evidence].
- ii. Force platform biofeedback is not recommended over conventional balance training [Strong recommendation; High quality of evidence].

Section 4.2 Clinical Considerations

1. Therapists should consider both anticipatory and reactive balance control within their assessment and treatment.

4.3 Sit-to-Stand Function

- i. Sit-to-stand practice should be considered to improve sit to stand capacity [Strong recommendation; Moderate quality of evidence].

4.4 Aerobic Training

Refer to AEROBICS guidelines for additional information.¹⁰⁷

- i. Once medically stable, individuals with stroke should be considered for their ability to participate in aerobic exercise training [Strong recommendation; Moderate quality of evidence].
- ii. Pre-participation evaluation should include assessment of physical activity behaviours and exercise history and a medical history and physical examination by appropriately qualified healthcare professionals with expertise in aerobic training to identify factors that require special consideration or constitute a contraindication to aerobic exercise [Strong recommendation; Moderate quality of evidence].
- iii. If the plan is to conduct aerobic training at light intensity (e.g., <40% of predicted heart rate reserve), a submaximal exercise test may be considered [Strong recommendation; Moderate quality of evidence].
- iv. Screening aerobic exercise tests should be conducted with monitoring of clinical signs and symptoms, heart rate, blood pressure, and rating of perceived exertion [Strong recommendation; Moderate quality of evidence].

- a. During a symptom-limited exercise stress test, an electrocardiogram should also be used to monitor electrocardiography [Strong recommendation; Moderate quality of evidence].
- v. Individually tailored aerobic training involving large muscle groups should be incorporated into a comprehensive stroke rehabilitation program to enhance cardiovascular endurance, balance and walking [Strong recommendation; High quality of evidence].
 - a. To achieve a training effect, patients should participate in aerobic exercise for a minimum of 8 weeks [Strong recommendation; High quality of evidence], at least 3 times weekly progressing as tolerated from 5 to 20 minutes or more per session, exclusive of warm-up and cool-down [Strong recommendation; Moderate quality of evidence].
 - b. Clinical signs and symptoms, heart rate, blood pressure, and rating of perceived exertion and other pertinent medical factors should be monitored during training to ensure safety and attainment of target exercise intensity [Strong recommendation; Moderate quality of evidence].
- vi. 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 [Strong recommendation; Moderate quality of evidence].
 - a. Strategies to address specific barriers to physical activity related to individuals with stroke, healthcare providers, family, and/or the environment should be employed [Strong recommendation; Moderate quality of evidence].

Rationale

Mobility and balance impairments are highly prevalent post-stroke, particularly among individuals with more severe strokes, and affect a person's safety, ability to perform daily activities and maintain independence. These issues often result from a combination of muscle weakness, reduced coordination, and sensory deficits, which can make movements such as standing and walking difficult. Loss of balance increases the risk of falls, further complicating recovery and rehabilitation efforts. Effective rehabilitation strategies, including physical therapy and balance training, are essential to help individuals regain their mobility, enhance their stability, and improve their overall quality of life after a stroke.

Individuals with stroke have highlighted the importance of repetition, progression and variation in stroke rehabilitation programs regarding gait, mobility and balance. Opportunities to practice skills in a variety of environments that mimic real life situations is also deemed helpful. Individuals with stroke emphasize the importance of the involvement of their family members and caregivers when receiving education and training regarding gait, mobility, and aerobic exercises. This includes how to safely and appropriately engage in aerobic exercise at home, as well as education and practice for safe and appropriate use of assistive devices.

System Implications

To achieve timely and appropriate assessment and management of basic mobility, postural control, lower extremity function, gait, and transfer skills, organizations should optimize the following system components:

1. Organized stroke care, including stroke rehabilitation units with a critical mass of trained staff and an interdisciplinary team during the rehabilitation period following stroke.
2. Initial and ongoing standardized assessment performed by healthcare providers trained and experienced in stroke rehabilitation.

3. Processes in place for timely access to specialized, interdisciplinary stroke rehabilitation teams and modalities.
4. Timely access to appropriate modality and appropriate intensity of rehabilitation for individuals with stroke.
5. Processes should be in place to ensure proper assessment of patients to meet equipment needs (e.g., seating assessments).
6. Access to required supportive devices and equipment to promote safety, participation in activities and independence. This equipment should be affordable and programs in place for those unable to afford equipment.
7. Access to appropriate devices for healthcare providers to complete exercise assessment to develop appropriate intensity aerobic exercise (e.g., ECG monitored exercise stress test).

Performance Measures

System Indicators

1. Access to stroke rehabilitation services 7 days per week for inpatient care.
2. Proportion of individuals within a stroke region who access an inpatient and community-based stroke rehabilitation as part of their episode of care for a stroke event.

Process Indicators

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 in active rehabilitation on a stroke rehabilitation unit during inpatient rehabilitation.
5. Median hours per day (minimum of three) of direct task-specific therapy provided by the interdisciplinary stroke team.
6. Median days per week (minimum of five) of direct task specific therapy provided by the interdisciplinary stroke team.

Patient-Oriented Indicators

7. Extent of change (improvement) in functional status on the 6-Minute Walk Test from admission to an inpatient rehabilitation program to discharge.
8. Change (improvement) in functional status scores (e.g., FIM® Instrument sub score locomotion) from admission to an inpatient rehabilitation program to discharge.
9. Extent of change (improvement) in functional status score (e.g., CMSA lower limb sub scale) from admission to an inpatient rehabilitation program to discharge.
10. 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).
11. 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.

Implementation Resources and Knowledge Transfer Tools

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reader is encouraged to review these resources and tools critically and implement them into practice at their discretion.

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- Stroke Engine: FIM® Instrument: <https://strokengine.ca/en/assessments/functional-independence-measure-fim/>
- UDS: AlphaFIM® Instrument: <https://www.udsmr.org/>
- Stroke Engine: Aerobic Exercise: <https://strokengine.ca/en/interventions/aerobic-exercise-subacute/>
- Aerobic Exercise Recommendations to Optimize Best Practices in Care After Stroke: Aerobics 2019 Update: <https://strokengine.ca/wp-content/uploads/2020/06/AEROBICS-2019-last-revised-March-1.pdf>
- Stroke Engine: Chedoke-McMaster Stroke Assessment: <https://strokengine.ca/en/assessments/chedoke-mcmaster-stroke-assessment/>
- Consensus-based core recommendations from the third Stroke Recovery and Rehabilitation Roundtable 2023. Agreed upon protocols for assessment tools listed below can be found in Supplementary file "sj-docx-2-wso-10.1177_17474930231205207.docx": <https://journals.sagepub.com/doi/10.1177/17474930231205207#supplementary-materials>:
 - Fugl-Meyer Motor Assessment - Lower extremity subscale (FMA-LE)
 - Trunk Impairment Scale (TIS)
 - Functional Ambulation Category (FAC)
 - Mini-Balance Evaluations Systems Test (Mini-BESTest)
 - Berg Balance Scale (BBS)
 - 10-meter walk test (10mWT)
 - 6-minute walk test (6MWT)
 - Dynamic Gait Index (DGI)
- Stroke Engine: Modified Ashworth Scale: <https://strokengine.ca/en/assessments/modified-ashworth-scale/>
- Stroke Engine: 6-minute walk test: <https://strokengine.ca/en/assessments/six-minute-walk-test-6mwt/>
- Stroke Engine: Fugl-Meyer Assessment: <https://strokengine.ca/en/assessments/fugl-meyer-assessment-of-sensorimotor-recovery-after-stroke-fma/>
- Stroke Engine: Functional Ambulation Categories: <https://strokengine.ca/en/assessments/fac/>
- Stroke Engine: Timed Up and Go Test: <https://strokengine.ca/en/assessments/timed-up-and-go-tug/>

- Stroke Engine: Berg Balance Scale: <https://strokengine.ca/en/assessments/berg-balance-scale-bbs/>
- Stroke Engine: <http://www.strokengine.ca/>

Resources for Individuals with Stroke, Families and Caregivers

- Heart & Stroke: Signs of Stroke: <http://www.heartandstroke.ca/stroke/signs-of-stroke>
- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>
- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1
- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>
- Heart & Stroke: Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbpr-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031>
- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbfc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Arms and Legs: <https://www.heartandstroke.ca/stroke/recovery-and-support/physical-changes/arms-and-legs>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>
- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- Aerobic Exercise Recommendations to Optimize Best Practices in Care After Stroke: Aerobics 2019 Update Participant Guide: https://www.canadianstroke.ca/sites/default/files/resources/CPSR_Guide_Patients-English_WEB3.pdf
- CanStroke Recovery Trials: Tools and Resources: <https://canadianstroke.ca/tools/>
- Stroke Engine: <http://www.strokengine.ca/>
- Stroke Toolkit for Aquatic Rehabilitation and Recreation Therapy (STARRT): <https://www.starrt.ca/en>

- Int J Stroke: Standardized measurement of balance and mobility post-stroke: Consensus-based core recommendations from the third Stroke Recovery and Rehabilitation Roundtable: <https://pubmed.ncbi.nlm.nih.gov/37824730/>¹⁰⁸

Summary of the Evidence

Lower Extremity Gait Training

Task Oriented Training (Task-Specific Training)

Task oriented training (also called task-specific training) involves active practice of task-specific motor activities. Repeated motor practice has been shown to improve walking speed and functional ambulation.

A Cochrane review by English et al.¹⁰⁹ pooled findings from 17 RCTs that compared circuit class training, provided for a minimum of once-weekly sessions for a minimum of 4 weeks, with no therapy, sham therapy, or another therapy modality. Only studies that reported interventions with a focus on repetitive practice of functional tasks arranged in a circuit, with the aim of improving mobility, were included. Pooling the results from 10 trials, compared with any other intervention, circuit class training was associated with a significantly greater increase in distanced walked (m) in the 6-minute walk test (6MWT) (MD=60.86, 95% CI 44.55 to 77), a distance which exceeded the minimal clinically important difference of 34.4 metres. The mean gait speed in the intervention groups was 0.15 metres/ second faster (95% CI 0.10 to 0.19 m/s) compared with the control group. Other outcomes with scores significantly higher in the intervention group included Timed-up-and Go (TUG) test, Stroke Impact Scale, Functional Ambulation Classification and the Rivermead Mobility Index. In another Cochrane review, French et al.¹⁴ examined task-specific training on upper and lower extremity functions compared with usual care, an alternative intervention, or no care. Lower extremity repetitive task-oriented training interventions were examined in 17 trials. Two trials focused on sit-to-stand practice, 6 trials focused on walking practice, while 4 trials investigated interventions that focused specifically on sitting balance trunk control, and balance. Repetitive task training was associated with significantly greater improvements in walking distance (MD= 34.80 metres, 95% CI 18.19 to 51.41 metres; 9 studies) and functional ambulation (SMD= 0.35, 95% CI 0.04 to 0.66; 8 studies), sit-to-stand post treatment (SMD=0.35, 95% CI 0.13 to 0.56, 7 studies) and standing balance or reach (SMD= 0.24, 95% CI 0.07 to 0.42; 9 studies).

Resistance Training

Many individuals experience muscle weakness as a consequence of stroke. Strength training may help to improve measures of gait and balance. Flansbjerg et al.^{110,111} randomized 24 persons living in the community a minimum of 6 months post stroke to a training group that participated in supervised progressive resistance training of the knee muscles twice weekly for 10 weeks, or to a control group in which participants continued their usual daily activities. The authors found that on the paretic side, the mean dynamic knee muscle strength extension and flexion in the intervention group had improved significantly more at the end of treatment and was maintained at 4-year follow-up compared to the control group. However, there were no significant differences between groups in mean improvement on the TUG test, gait speed or distance traveled on the 6MWT at four years. Cooke et al.¹¹² randomized participants with subacute stroke (mean 1 month) to one of three treatment groups for a duration of 6 weeks: 1) conventional physiotherapy (CPT) + Functional Strength training (FST); 2) extra intensity training (CPT + CPT); or 3) CPT alone. Following the 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.

Treadmill Training with and without Body Weight Support

In a Cochrane review, Mehrholz et al.¹¹³ included the result of 56 trials (n=3,105) and concluded that patients with stroke who received treadmill training (with or without body weight support) in combination with physiotherapy had significantly improved gait velocity (MD=0.06 m/s, 95% CI 0.03 to 0.09) and greater walking endurance (MD=14.19 metres, 95% CI 2.92 to 25.46), when assessed at the end of treatment. Among studies evaluating treadmill training with body weight support, patients were no more likely to achieve independent walking than patients receiving gait training without these devices (risk difference= -0.00, 95% CI -0.02 to 0.02), nor was gait velocity or walking endurance increased significantly at the end of scheduled follow-up (MD=0.03 m/s, 95% CI -0.05 to 0.10 and MD= 21.64 m, 95% CI -4.70 to 47.98). In the MOBILISE trial,^{114,115} 126 patients were randomized to an experimental or a control group within 28 days of stroke 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 extremity 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. In the Locomotor Experience Applied Post Stroke (LEAPS) trial, Nadeau et al.¹¹⁶ randomized 408 patients with residual paresis who were able to walk 10 feet with no more than one-person assistance and within 45 days of stroke onset to one of 3 programs: 1) Locomotor training program (LTP), 2) Home exercise program (HEP), or 3) Usual Care (UC). Both LTP and HEP programs were of similar duration and intensity (90-minute sessions, 3 times/week) for 12-16 weeks, for a total of 30 to 36 exercise sessions. At 6 months, 50.4% of LTP, 49.2% of HEP, and 32.2% of UC patients had improved to a higher functional walking level with no significant differences between the LTP and HEP groups.

Electromechanical/Robot-Assisted Gait Training Devices

In an updated Cochrane review, Mehrholz et al.¹¹⁷ included 62 trials including 2,440 participants with difficulty walking following a stroke and examined 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. Electromechanical-assisted gait training in combination with physiotherapy increased the odds of participants becoming independent in walking at the end of treatment (Odds ratio [OR]=2.01, 95% CI 1.51 to 2.69; 38 trials; GRADE: high certainty); however, the benefit was lost at the end of follow-up, which averaged 22.3 weeks (OR=1.93, 95% CI 0.72 to 5.13; 6 trials; GRADE: low certainty). At the end of the intervention, walking speed was also significantly faster in the experimental group (MD=0.06 m/s, 95% CI 0.02 to 0.1; 42 trials; GRADE: low certainty), with the benefit lost at the end of follow-up, which averaged 19 weeks (MD=0.07 m/s, 95% CI - 0.03 to 0.17; 13 trials; GRADE: low certainty). At neither the end of the intervention, nor at follow-up (mean of 18 weeks), was walking capacity (distance walked in 6 minutes) significantly improved in the experimental group (MD=10.86 meters, 95% CI -5.72 to 27.44; 24 trials and MD=7.76 meters, 95% CI -21.47 to 36.99; 11 trials. GRADE: moderate). Molteni et al.¹¹⁸ included 75 patients with first-ever stroke, with onset within the previous 35 days, and limited ambulation capacity in the Stroke Rehabilitation with Exoskeleton-assisted Gait. (EKSOGAIT) trial. In addition to conventional rehabilitation that all patients received for 120 minutes daily, 6 days a week, Patients were also randomized to an experimental group and received 15 sessions (60 minutes each, 5 days/week for 3 weeks) with the Ekso™ device (an exoskeleton) or the same amount of conventional gait training (control group). There was no significant difference in the primary outcome (6MWT) between groups at the end of the intervention. The mean distance walked from baseline to end of

treatment increased from 48.60 meters to 139.24 m in the experimental group and from 44.29 meters to 149.43 in the control group.

Rhythmic Auditory Stimulation (RAS)

Rhythmic auditory cueing or stimulation, whereby walking is synchronized to a rhythmic auditory cue, may help to improve motor learning following a stroke. Ghai & Ghai¹¹⁹ examined music-based auditory cueing in addition to conventional physical therapy, including the results from 38 trials (11 RCTs). RAS was associated with significantly improved gait velocity (Hedges' $g=0.68$, 95% CI 0.42 to 0.93; 25 trials included), increased stride length (Hedges' $g=0.50$, 95% CI 0.26 to 0.73; 20 trials included), improved cadence (Hedges' $g=0.86$, 95% CI 0.50 to 1.22; 23 trials included) and improvement in TUG ($g=-0.76$, 95% CI -1.36 to -0.16; 6 trials included). Yoo & Kim¹²⁰ included the results of 8 RCTs ($n=242$) comparing intentional synchronization of target movement to externally generated rhythmic auditory cueing with traditional rehabilitative interventions or other controlled interventions in persons with hemiparesis following stroke. RAS was associated with large significant effect sizes for all lower extremity outcomes, including gait velocity (Hedges' $g=0.98$, 95% CI 0.69 to 1.28), cadence (Hedges' $g=0.84$, 95% CI 0.63 to 1.15) and stride length (Hedges' $g=0.76$, 95% CI 0.47 to 1.05).

Virtual Reality (VR)

Zhang et al.¹²¹ included 87 RCTs including 3,540 participants with stroke with upper and lower disability, with varying chronicity of stroke. In this systematic review, trials compared VR rehabilitation interventions, with many trials using commercially available devices such as Xbox Kinect™ vs. conventional rehabilitation or placebo therapy. At the end of treatment, VR interventions were associated with significantly higher Fugl-Meyer Assessment-lower extremity (FMA-LE) scores (MD=3.01, 95% CI 1.91–4.11; 16 trials, $n=732$), Functional Ambulation Categories (FAC) scores (MD=0.47, 95% CI = 0.14–0.79; 5 trials, $n=260$), and gait speed (MD=11.79 cm/sec, 95% CI 8.48–15.11; 9 trials, $n=310$), compared with conventional rehabilitation. A Cochrane review³³ included the results of 72 trials, which evaluated the effect of virtual reality and interactive video gaming. While most of the trials assessed upper intervention, a few assessed mobility outcomes. In these trials, virtual reality was not associated with significant improvements in gait speed, balance or TUG tests at the end of the intervention compared with conventional therapy. Iruthayarajah et al.¹²² included the results of 22 RCTs specifically examining the use of virtual reality in the chronic stage of stroke to improve balance. Interventions included the Wii Fit balance board, and treadmill training and postural training combined with virtual reality applications. Combining the results of 12 trials, VR interventions were associated with a significantly greater improvement in Berg Balance Scale (BBS) scores (MD=2.94, 95%CI 1.82–4.06, $p<0.001$). Gibbons et al.¹²³ included the results of 22 trials (552 participants) evaluating the effects of VR interventions on lower extremity outcomes post stroke. Pooled analyses were possible for studies including patients in the chronic stage of stroke. In the VR group, functional balance was improved significantly more following treatment (SMD=0.42, 95% CI 0.11 to 0.73), but not at follow-up (SMD=0.38, 95% CI -0.73 to 1.50). Gait velocity, cadence, stride length and step length were also significantly improved immediately following the intervention in the VR group.

Mental Practice (MP)

Mental practice can help facilitate motor recovery by activating the same neural circuits that are involved in performing the action. Silva et al.¹²⁴ conducted a Cochrane review including 20 RCTs of 762 participants recovering from stroke. Trials compared motor imagery +/- action observation, physical activity, or functional gait training. In most trials, the participants were asked to imagine isolated movements related to gait or to imagine rigorous sports movements. Each session was 30-60 minutes with a total dose of 100 to 1,200 minutes over 2-8 weeks. The control condition was physical therapy in most trials (total dose was 12 to 240 minutes). Mental practice was associated with an increase in gait speed compared with usual care (SMD=0.44, 95% CI 0.06 to 0.81, 6 trials, $n=191$;

GRADE: very low certainty) but not with motor function assessed using the FMA-LE or functional mobility assessed with Rivermead Mobility Index or TUG.

Functional Electrical Stimulation (FES)

FES can be used to improve gait quality in selected patients who are highly motivated and able to walk independently or with minimal assistance. A systematic review including the results of 14 trials examined the use of FES applied to the paretic peroneal nerve +/- cointerventions vs. conventional treatment.¹²⁵ Peroneal nerve devices were used in 12 trials, with conventional FES devices used in two trials. The stimulation sessions ranged from 20-60 minutes, 1-7x/week, for one day to 30 weeks. FES + supervised exercises was associated with a significant improvement on the 10 Meter Walk Test (10MWT) compared with supervised exercise alone (SMD=0.51, 95% CI 0.16 to 0.86; 5 studies, n=133) and in TUG (MD = -3.19 sec, 95% CI -5.76 to -0.62; 5 studies, n=780) compared with conventional therapy. A systematic review by Howlett et al.¹²⁶ included 18 trials of FES for improving upper or lower extremity activity compared to placebo, no treatment or training alone. FES was associated with significantly faster gait speed compared with training alone (MD= 0.08 m/s, 95% CI 0.02 to 0.15; results from 8 trials, 203 participants). However, an older Cochrane review¹²⁷ including the results from 24 RCTs, of which 12 evaluated interventions and outcomes associated with mobility. The results suggested that active FES was 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).

Biofeedback

Stanton et al.¹²⁸ included the results of 18 trials evaluating biofeedback. Active interventions included force platforms, EMG biofeedback, audio and visual feedback, provided for an average of 5 weeks. Overall, biofeedback improved lower extremity activities compared with usual therapy (SMD= 0.50, 95% CI 0.30 to 0.70).

Ankle-Foot Orthoses (AFO)

The use of ankle-foot orthoses is widespread. The results from several recent systematic reviews suggest that AFOs can be used to improve mobility and gait parameters. Their use has been associated with significant improvements in TUG, FAC, 6MWT and Motricity Index (MI), compared with no AFO use.¹²⁹ Choo & Chang¹³⁰ reported significant improvement in cadence, step length and stride length in a systematic review of 19 trials, including 434 participants in the subacute or chronic stage post stroke. An older Cochrane review conducted by Tyson & Kent¹³¹ included the results from 13 RCTs. During a single testing session, participants performed significantly better on measures of 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 the control condition where an AFO was not worn. There was no significant treatment effects associated with the outcomes of postural sway and timed mobility tests. 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.¹³²

Aquatic Exercise

Aquatic exercise was associated with a significant improvement in gait speed, (SMD=-0.45; 95% CI -0.71 to -0.19) and mobility (SMD= -0.43, 95% CI -0.7 to - 0.17) compared with conventional therapy, in a systematic review including the results of 17 RCTs.¹³³ In another systematic review including the results from 11 RCTs,¹³⁴ hydrotherapy was associated with significant improvements in Forward Reach Test (MD= 1.78, 95% C, TUGT (MD=-1.41, 95% CI -2.44 to -0.42), and knee extensor torque (MD= 6.14, 95% CI 0.59-11.7).

Balance Training

Trunk Training

Trunk training exercises can be added to standard physiotherapy to help improve balance. Thijs et al.⁴⁵ conducted a Cochrane review including the results from 68 RCTs including 2,585 participants recovering from stroke across the recovery continuum. Trunk training interventions assessed included core-stability training (isometric strengthening of the trunk muscles, n=18 trials) electrical stimulation that targeted ≥ 1 core trunk muscles (n=7 trials), selective-trunk training aimed at improving selective movements of the upper and lower part of the trunk (n=15 trials), sitting-reaching therapy (n=6 trials), 10° steady-tilted platform (n=2 trials) and weight-shift training (n=4 trials). The median duration of therapy was 4 weeks, providing a median of 600 minutes of total training. The intensity of training ranged from 30 minutes to 2,700 minutes (45 hours). Trials were classified as dose-dependent (n=44) or non-dose dependent (n=20), based on the amount of therapy provided in the control arms. Therapy provided in the control groups was diverse. Trunk training was associated with a significant improvement in standing balance (SMD=0.57, 95% CI 0.35 to 0.79; 11 trials included; GRADE: very low certainty); and walking ability (SMD=0.73, 95% CI 0.52 to 0.94; 11 trials included; GRADE: very low certainty), compared with non-dose-matched therapy. Compared with dose-matched therapy, trunk training was associated with a significant improvement in standing balance (SMD=1.00, 95% CI 0.86 to 1.15; 22 trials included; GRADE: very low certainty) and walking ability (SMD=0.69, 95% CI 0.51 to 0.87; 19 trials included; GRADE: low certainty). Bank et al.¹³⁵ included the results of 11 RCTs in a systematic review that investigated physiotherapy plus additional therapy (targeted mainly at improving sitting and standing balance). Compared with conventional physiotherapy alone, additional trunk training exercises did not result in significant differences between groups on the Trunk Control test (MD=-1.53, 95%CI -9.37-6.32, p=0.70; 5 studies, n=263), but was associated with significantly higher Trunk Impairment Scale scores (MD=1.70, 0.62-2.78, p=0.007; 4 studies, n=106).

Force Platform with Feedback

A 2004 Cochrane review¹³⁶ included 7 RCTs of 246 participants with abnormal weight bearing in the standing position or impaired standing balance following stroke. Trials compared force platform balance training with visual or auditory feedback vs. conventional treatment or other balance training or placebo balance training. Treatment duration ranged from two to 8 weeks. Intensity and frequency of treatment ranged from 20-60 minutes/session and 2-5 days/week. Visual feedback force platform feedback was not associated with significant improvement in either of the primary outcomes, pooling the results from two to three trials (BBS: MD=-1.98, 95% CI -5.55 to 1.59; and TUG: MD=7.31, 95% CI -1.32 to 15.94). Another systematic review¹³⁷ included the results from 8 trials of 214 participants recovering from stroke in the subacute and chronic stages. Trials compared visual feedback balance training using commercially available force platforms devices vs. conventional balance training. Treatment duration was two to 8 weeks. In pooled analyses, visual feedback balance training was not associated with significant differences between groups for any of the balance outcomes of interest (postural sway, weight distribution, BBS and TUG).

Aquatic Exercises

The benefit of aquatic exercises or hydrotherapy compared with land-based training for improving measures of balance was assessed in three recent systematic reviews, each including 11, 15 and 17 RCTs. Sessions in all included trials were typically provided for 30 to 60 minutes, two to 5 times per week and lasted for two to 12 weeks. Significantly greater improvements in BBS scores were reported in pooled analyses in two reviews with mean between group differences at the end of treatment of 1.55 and 1.60 points.^{134,138} In the third review,¹³³ the standardized mean difference in balance scores was 0.72 (95% CI 0.50-0.94).

Tai-Chi

In three recent systematic reviews, improved balance was reported following a course of traditional Chinese exercises or Tai Chi +/- additional rehabilitation therapies, compared with rehabilitation therapies only. The duration of therapy ranged widely from two to 52 weeks. Tai Chi or traditional Chinese exercises were associated with significantly greater improvement in BBS scores with mean differences of 4.87 (95% CI 4.46–5.28),¹³⁹ 7.67 (95% CI 3.44 -11.90),¹⁴⁰ and 2.07 (95% CI 1.52-2.62).¹⁴¹

Balance Training + Motor Imagery

When added to a program of traditional balance training, motor imagery has been shown to improve balance compared with balance training only. Zhao et al.¹⁴² included the results of 23 RCTs including 1,109 participants with motor dysfunction of the lower extremity. In most trials, kinesthetic motor imagery was used, whereby patients perceive their proprioception with the first-person view performing the movement. Motor imagery + conventional rehabilitation was associated with significantly greater improvement in BBS scores, a secondary outcome (MD=6.29, 95% CI 2.82-9.79).

Whole Body Vibration

In two systematic reviews that compared whole-body vibration training (WBVT) + conventional rehabilitation vs. conventional rehabilitation only, the addition of WBVT was associated with significantly greater improvements in BBS scores with between group mean differences of 4.08 (95% CI 2.39-5.76)¹⁴³ and 4.23 (95% CI 2.21-6.26)¹⁴⁴ after four to 12 weeks of treatment.

Sit-to-Stand

A Cochrane review¹⁴⁵ included the results of 13 RCTs that examined repetitive sit-to-stand training, exercise training programs that included sit-to-stand training, sitting training and augmented feedback. Compared with usual care/ or no treatment, repetitive sit-to-stand was associated with increased odds of independence in sit-to-stand (OR=4.86, 95% CI 1.43–16.50), although the results from only one trial were included. Active intervention reduced the time needed for sit-to-stand (SMD=-0.34, 95% CI -0.62 to -0.06, n=7 trials), and improved lateral symmetry (SMD=0.85, 95%CI 0.38–1.33, n=5 trials), but did not reduce the risk of falling (OR=0.75, 95% CI 0.46 to 1.22, n=5 trials).

Aerobic Training

An updated Cochrane review¹⁴⁶ included the results from 75 RCTs trials of patients in both the acute and chronic stages of stroke. Interventions were classified as 1) cardiorespiratory training (circuit training, aquatic training, ergometry, and treadmill training, 2) resistance training (using weights, exercise machines, or elastic devices) and 3) mixed training interventions using various combinations of walking, treadmill training, and resistance training, which included combinations of cardiorespiratory and resistance training methods. The control conditions included usual care, no intervention, or a non-exercise intervention. At the end of the intervention, cardiorespiratory training was associated with significant increases in physical fitness, preferred walking speed and walking capacity, and reductions in disability. Increases in muscle strength, preferred walking speed, and improved walking capacity and balance were also associated with resistance training interventions. Both Sandberg et al.¹⁴⁷ and Hornby et al.¹⁴⁸ reported significantly greater improvements in the 6MWT in RCTs associated with aerobic training, compared with conventional rehabilitation in persons with acute and chronic stroke. Gait speed and fastest possible walking speed were also significantly higher in the aerobic training group.^{148,149} Globas et al.¹⁵⁰ 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.

Pharmacotherapy & Functional Recovery

Selective serotonin reuptake inhibitors (SSRIs) have been investigated as a potential modulator of functional recovery post stroke, in patients both with and without mood disorders post-stroke. Unfortunately, there appears to be increasing evidence that SSRIs do not help to reduce disability or improve independence and may, in fact, be associated with harm. Mead et al.⁵³ included the results from three large RCTs in a patient-level meta-analysis, which recruited 5,907 patients with persisting focal neurological deficit following acute stroke. All participants were randomized to receive 20 mg fluoxetine daily or placebo for 6 months. Trials included were The Efficacy of Fluoxetine—a Randomized Controlled Trial in Stroke (EFFECTS⁵⁴), the Assessment of Fluoxetine in Stroke Recovery Trial (AFFINITY,⁵⁵) and the Fluoxetine or Control Under Supervision (FOCUS) trial.⁵⁶ At 6 months, the distribution of modified Rankin Scale (mRS) scores did not differ significantly between groups (common OR=0.96, 95% CI 0.87 to 1.05; GRADE: high quality). Neither was the distribution of scores significantly different between groups at 12 months (common OR=0.98, 95% CI 0.89 to 1.07). Fluoxetine was associated with a significantly increased frequency of seizures (2.64% vs. 1.8%, $p=0.03$), falls with injury (6.26% vs 4.51%, $p=0.03$), and fractures (3.15% vs 1.39%, $p=0.01$). In a Cochrane review, Legg et al.⁵⁷ included 76 RCTs including 13,029 participants who had suffered a stroke within the previous 12 months. Trials compared a variety of SSRIs vs. placebo. In most trials, patients were recruited in the early stages of stroke. There was no significant difference between groups in measures of disability (SMD=0.0, 95% CI -0.5 to 0.5, 5 trials; GRADE: high), nor was there a better chance of being independent at the end of treatment (RR=0.98, 95% CI 0.93 to 1.03, 5 trials; GRADE: high). SSRIs were associated with significantly higher risks of seizures and bone fractures.

Sex & Gender Considerations

While women are more likely to survive strokes than men, they tend to experience greater disability. Potential reasons for this imbalance may include greater initial stroke severity, higher pre-stroke disability and older age at stroke onset.⁵⁸ Data are limited with respect to rehabilitation outcomes with respect to sex. MacDonald et al.⁵⁹ used administrative data sets including 20,143 patients and compared sex differences in discharge Functional Independence Measure (FIM) scores from inpatient rehabilitation units in Ontario over a 5-year period. While in unadjusted analysis, women had a lower mean FIM score (94.1 vs. 97.8, $p < 0.001$), after adjusting for baseline characteristics, the difference was no longer significant. There is some evidence that women are under-represented in stroke rehabilitation clinical trials. In a recent systematic review,¹⁵¹ examining female recruitment in 1,285 randomized trials investigating lower-extremity rehabilitation interventions, the overall percentage of women included across all trials was 39.4%. The trials included participants across all stages of stroke chronicity, all rehabilitation settings, and intervention types (pharmacological, traditional and nontraditional rehabilitation therapies, and complementary interventions).

[Evidence Tables and Reference List 4](#)

Section 5 Falls Prevention and Management

5. Falls Prevention and Management, Recommendations 2025

- i. All individuals with stroke should be screened for fall risk, including fall history at admission, at all transition points, after a fall, and whenever there is a change in health status, using validated tools [Strong recommendation; High quality of evidence].
 - a. Screening should include identification of medical, physical, cognitive, medication related, and environmental factors associated with risk of falling, fear of falling, and fall injuries [Strong Recommendation; Moderate quality of evidence].
- ii. Individuals identified as being at risk for falls should undergo a comprehensive interdisciplinary assessment using validated tools [Strong Recommendation; Moderate quality of evidence].
 - a. Comprehensive falls assessment should include medical and functional history, evaluation of mobility, vision, perception, cognition, cardiovascular status, medications, and environment [Strong Recommendation; Moderate quality of evidence].
- iii. Based on assessment findings, an individualized falls prevention plan and fall prevention strategies should be implemented [Strong Recommendation; Moderate quality of evidence].
Refer to appropriate topics within this module for strategies to mitigate falls risk, (e.g. leg weakness, impaired balance, visual disturbances, cognitive impairment, sensory loss).
 - a. The individual with stroke, family, and caregiver should be made aware of the individual's increased risk for falls and provided education on precautions and strategies to reduce their risk of falling [Strong Recommendation; Moderate quality of evidence].
 - b. The individual with stroke, their family and caregivers should receive skills training to enable them to safely transfer and mobilize, including what to do if a fall occurs and how to get up from a fall [Strong Recommendation; Low quality of evidence].
 - c. For individuals with stroke who are at risk of falling, an individualized exercise program should be provided including balance training and advice on safety [Strong Recommendation; Moderate quality of evidence].
 - d. The individual with stroke their family, and caregivers should receive education regarding recommended and appropriate mobility aids, footwear, and transfer devices, with consideration of the healthcare, home and community environments [Strong Recommendation; Low quality of evidence].
- iv. Where applicable, bed and chair alarms should be provided for individuals with stroke at high risk for falls in accordance with local organizational fall prevention protocols [Strong Recommendation; Low quality of evidence].
- v. If an individual with stroke experiences a fall, they should be assessed for possible injury and the circumstances surrounding the fall to identify precipitating factors. Pre-existing falls prevention plans should be reviewed and modified to reduce the risk of further falls [Strong Recommendation; Low quality of evidence].

Rationale

Individuals with stroke are at higher risk for falls than many other hospitalized individuals. The reported incidence ranges from 14 to 65 percent.¹⁵² Falls occur often within the first week following stroke during the acute phase, and then again as an individual with stroke's mobility increases. The interdisciplinary care team must be cognizant of the risk for falls and ensure appropriate assessments and interventions take place.

Falls are a significant concern for individuals with stroke, occurring frequently due to impaired balance, mobility, and strength. The risk of falling is heightened by factors such as spasticity, sensory deficits, and cognitive impairments, which can lead to a lack of awareness of one's surroundings and poor coordination. These falls can result in serious injuries, such as fractures or head trauma, further complicating recovery and rehabilitation efforts. The fear of falling can be overwhelming, impact mental health, deter individuals from engaging in physical activities, and may cause an individual to retreat to 'safe' environments, leading to decreased mobility and social isolation. Individuals with stroke and their families spoke to the challenges of navigating new environments, which can be more require greater amount of concentration to prevent falls, and of asking for and accepting assistance for activities they were previously able to do safely independently. They encouraged speaking to others about a fear of falling and seeking mental health support where available.

Individuals with stroke emphasized the importance of individualized early and ongoing education and strategies for the individual with stroke, family and caregivers about fall prevention and management that is unique to the individual's abilities and situation. They valued information about how stroke impairments can impact falls risk, and environmental strategies for reducing falls risk, such as decluttering the home environment and home safety alarm devices. They also stressed the importance of learning how to strengthen their balance and attention to safety, and how to reduce injury and get up from a fall.

In addition, individuals with stroke expressed the importance of neck/wrist fall alarms/emergency button systems, especially for individuals experiencing aphasia and/or apraxia and the importance of being provided information about availability and usability. Balance is a concerning issue discussed by individuals with stroke and should be evaluated even if the individual is not presenting with any obvious balance difficulties, as there may be 'invisible' impairments that increase risk of falls (e.g., vision or cognitive changes).

System Implications

Organizations should provide a falls prevention and management strategy that includes:

1. Regular and ongoing education for staff in all hospital settings about risk assessment and prevention strategies related to falls, including transfer and mobilization training.
2. Use of a falls screening tool in all organizations for early recognition of fall risk.
3. Instructions for transferring and mobilization for individuals with stroke provided to all staff by physiotherapists and occupational therapists and provided to individuals with stroke and families by trained staff members.
4. Delivery of all therapies by trained professionals capable of interacting with people with communication limitations such as aphasia, by using supported conversation techniques.
5. Standardized falls risk assessment process within each organization that addresses timing of fall assessments, components, and the need for documentation.
6. Universal falls precautions in all environments where individuals with stroke receive care.

Performance Measures

System Indicators:

1. Fall incidence rate for individuals with stroke admitted to hospital (acute care or rehabilitation).
2. Proportion of stroke programs with a defined falls prevention program in place.
3. Availability of education and training for all staff on falls prevention and management.
4. Proportion of individuals with stroke who experience a fall during inpatient rehabilitation or in the community.

Process Indicators:

5. Proportion of individuals with stroke admitted to inpatient rehabilitation assessed for falls risk with standardized tool within 2 days of hospital admission (aligns to Accreditation Canada).

Patient-Oriented Indicators:

6. Proportion of individuals with stroke with falls who experience injuries during a fall incident.
7. Proportion of individuals with stroke with falls who experience a prolonged length of stay as a result of the fall.

Implementation Resources and Knowledge Transfer Tools

Resources and tools listed below that are external to Heart & Stroke and the Canadian Stroke Best Practice Recommendations may be useful resources for stroke care. However, their inclusion is not an actual or implied endorsement by the Canadian Stroke Best Practices team or Heart & Stroke. The reader is encouraged to review these resources and tools critically and implement them into practice at their discretion.

Health Care Provider Information

- Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery and Community Participation following Stroke, [Part One: Stroke Rehabilitation Planning for Optimal Care Delivery](#) module; and, [Part Three: Optimizing Activity and Community Participation following Stroke, Update 2025](#)
- Registered Nurses' Association of Ontario (RNAO): Preventing Falls and Reducing Injury from Falls Best Practice Guideline: <https://rnao.ca/bpg/guidelines/prevention-falls-and-fall-injuries>
- Stroke Engine: Berg Balance Scale: <https://strokengine.ca/en/assessments/berg-balance-scale-bbs/>
- Stroke Engine: <https://strokengine.ca/en/>

Resources for Individuals with Stroke, Families and Caregivers

- Heart & Stroke: Signs of Stroke: <http://www.heartandstroke.ca/stroke/signs-of-stroke>
- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>
- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1

- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>
- Heart & Stroke: Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbpr-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031>
- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>
- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- Aphasia Institute: <https://www.aphasia.ca/>
- RNAO: Health Education Fact Sheet: Stay active, stay independent: https://rnao.ca/sites/rnao-ca/files/Stay_active_stay_independent_FALLs_Fact_Sheet.pdf
- Stroke Engine: <https://strokengine.ca/en/>

Summary of the Evidence

The risk of falling is increased following stroke due to leg weakness, impaired balance, visual disturbances, functional dependence, cognitive impairment and sensory loss. The reported frequency of falls is difficult to estimate, and will vary across the time since stroke, the severity of stroke and associated comorbidities. Czernuszenko & Czlonkowska¹⁵³ reported that during stroke rehabilitation, there were 252 falls that occurred in 189 (16.3%) patients. The incidence rate for any fall was 7.6 per 1,000 patient-days (95% CI 6.6–8.5). Almost two-thirds of falls occurred during the first two weeks after admission. Patients fell most often during transfers (34%), while sitting (21%) and during position changes such as going from a sitting to standing (13%). Most falls did not result in injury (72%), while minor injuries occurred in 27% of cases, with 1.2% resulting in serious injury (fracture). In a systematic review that included 21 studies examining risk factors for falling post stroke, Xu et al.¹⁵⁴ reported the strongest predictors of falling (odds ratio [OR] >2) were reduced balance (OR=3.87, 95% CI 2.39 to 6.26), use of sedative & psychotropic medications (OR=3.19, 95% CI 1.36 to 7.48) disability in self-care (OR=2.30, 95% CI 1.51 to 3.49), and depression (OR=2.11, 95% CI 1.18 to 3.75). Non-significant factors included age, sex, duration of stroke, visual impairment, multiple strokes, motor impairment, and urinary incontinence.

Patients at highest risk of stroke need to be identified as soon as possible so that appropriate preventative measures can be taken. In a systematic review that sought to identify all fall risk assessment tools, regardless of patient population or setting, 38 tools were identified among 115 publications.¹⁵⁵ Two screening tools were developed for use in the hospital setting for patients following stroke: The Stroke Assessment of Fall Risk (SAFR), and The Royal Melbourne Hospital Falls Risk Assessment Tool (RMH FRAT). Breisinger et al.¹⁵⁶ developed the Stroke Assessment of Fall Risk (SAFR) to identify patients at risk of falling during inpatient rehabilitation. SAFR is composed of 4

impairment items (impulsivity, hemi-neglect, static, and dynamic sitting balance) and 3 functional limitations items (lowest score on three Functional Independence Measure items: transfers, problem solving, and memory), with possible scores ranging from 0 (low risk) to 49 (high risk). The area under the curve of the receiver operator curve was 0.73, which was significantly more accurate compared with a locally developed, 3-item, non-stroke specific tool, which could identify the risk of fallers no better than chance. Nystrom & Hellstrom¹⁵⁷ reported that higher scores on the Prediction of Falls in Rehabilitation Settings Tool (Predict FIRST), assessed during the first and fourth day of admission to an acute stroke unit helped to predict falls that occurred during the next 6 weeks (OR=5.21, 95% CI 1.10 to 24.78, p=0.038). Predict FIRST is composed of 5 fall risk factors, each giving one point: male, central nervous system medications, a fall in the past year, frequent toileting, and inability to do tandem stance. The scale is cumulative (i.e. more risk factors give a higher risk of falling). Patients with a score of zero have a 2% chance of falling, while those with all 5 points have a 52% risk of falling during the inpatient rehabilitation period. Pinto et al.¹⁵⁸ reported that longer time to complete the Timed Up and Go (TUG) test was predictive of falls among persons living in the community following a median of 13 months post stroke (OR=1.035, 95% CI 1.196 to 5.740, p=0.016). Fallers (n=56) took a median time of 18 seconds to complete the test compared with non-fallers (n=94) at 14 seconds.

There have been very few RCTs conducted evaluating therapies to specifically designed to reduce the occurrence of falls following stroke, and of those, the evidence suggests that such interventions are not effective. Mansfield et al.¹⁵⁹ found that an individualized perturbation balance training (PBT) program delivered for 6 weeks to 83 participants recruited from the community in the chronic stage of stroke did not reduce the rate of falls during 12 months (1.45 falls/ person-year in the PBT group vs. 1.72 falls/person-year in the control group; rate ratio=0.85, 95% CI 0.42 to 1.69), although participants in the PBT group had greater improvement in reactive balance. Dean et al.¹⁶⁰ 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. Batchelor et al.¹⁶¹ randomized 156 patients at high risk of falls into a tailored multifaceted 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. There was no difference in the frequency of falls 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 risk of injury (incidence rate ratio=1.57, p=0.25).

A Cochrane review¹⁶² included 14 RCTs (n=1,358) examining the effectiveness of interventions for preventing falls post stroke. In most trials, an “exercise” intervention was examined. Under this broad umbrella term, interventions included a combination of treadmill +/- overground walking, task-related training with progressive balance and strengthening exercises, community physiotherapy, whole-body vibration, agility training with stretching and weight-shifting exercises, perturbation training and Tai Chi. In some of these trials, falling was a secondary outcome. Other interventions included non-invasive brain stimulation, pre-discharge home visits, distance glasses, and a servo-assistive rollator. Combined exercise interventions were associated with a significantly reduced risk of falling (relative risk [RR]=0.72, 95% CI 0.54 to 0.94; 765 participants), although the certainty of evidence was low, while exercise was not associated with a significantly reduced risk of falling (RR=1.03, 95% CI 0.90 to 1.19; 10 trials, 969 participants). In a more recent systematic review, Yang et al.¹⁶³ reported that overall, falls prevention interventions were not associated with a significant reduction in falls (OR=0.88, 95% CI 0.64 to 1.21, n=15 interventions). In subgroups analysis, no category of intervention was associated with a reduction in falls (walking-based training, physical therapy-based interventions, or exercise-based interventions).

Sex & Gender Considerations

Women are often at a higher risk of falling after a stroke due to factors such as osteoporosis, frailty and an older age at stroke onset, which can contribute to balance issues and reduced motivation to engage in rehabilitation. Women may also be more likely to experience muscle weakness or joint stiffness, especially in the lower extremities, which can impair mobility and increase the risk of falls. Men often have higher risk of physical impairments related to stroke which can also elevate their risk of falling; however, they may be less likely to acknowledge these difficulties or seek out help, due to societal expectations around masculinity and independence, which can result in delayed intervention and increased fall risk.

Currently, there is a lack of specific research examining sex differences associated with falls prevention interventions following a stroke. While some studies have explored sex differences for broader stroke outcomes, such as long-term mortality and functional recovery, these do not specifically address falls prevention. The Cochrane review that evaluated various interventions aimed at preventing falls following stroke did not include sex in subgroup analysis.¹⁶²

[Evidence Tables and Reference List 5](#)

Section 6 Swallowing (Dysphagia), Nutrition and Oral Care

6. Swallowing (Dysphagia), Nutrition and Oral Care, Recommendations 2025

6.1 Swallowing (Dysphagia) and Feeding

- i. Screening for swallowing impairment in individuals with stroke is recommended before any oral intake (e.g. medications, food, liquid) by an appropriately trained health professional, using a valid screening tool [Strong recommendation; High quality of evidence].
- ii. Referral to a trained dysphagia professional is recommended when the initial swallowing screen has failed to prompt further comprehensive assessments and a plan for interventions to address swallowing, feeding, nutrition and hydration [Strong recommendation; High quality of evidence].
 - a. An individualized management plan should be developed to address therapy for dysphagia, dietary needs, and specialized nutrition plans [Strong recommendation; Low quality of evidence].
- iii. Instrumental swallowing assessments including video fluoroscopic swallow study (VFSS) or fiberoptic endoscopic examination of swallowing (FEES), should be considered for individuals with stroke who have (oro)pharyngeal dysphagia or suspected poor airway protection, identified during the bedside swallowing assessment, to guide therapeutic intervention [Strong recommendation; Low quality of evidence].
- iv. Dysphagia therapy to optimize the efficiency and safety of the oropharyngeal swallow should be implemented with monitoring and reassessment as required [Strong recommendation; Low quality of evidence].
 - a. Behavioural interventions (such as oropharyngeal exercises) are recommended [Strong recommendation; Moderate quality of evidence].
 - b. Modified food and/or fluid consistency to address swallowing difficulty and feeding efficiency should be provided [Strong recommendation; Moderate quality of evidence].
 - c. Electrical stimulation (particularly pharyngeal placement) may be considered as an adjunct to improve dysphagia [Strong recommendation; Low quality of evidence].
- v. Enteral nutrition support (i.e., tube feeding) is recommended for individuals with stroke who cannot safely swallow or meet their nutrient and fluid needs orally [Strong recommendation; High quality of evidence].
 - a. The decision to proceed with enteral nutrition support should be made as early as possible after admission, usually within the first three to seven days after admission in collaboration with the individual with stroke, family (or substitute decision maker), and the interdisciplinary team [Strong recommendation; Low quality of evidence].
 - b. A Percutaneous Endoscopic Gastrostomy (PEG) tube is recommended for enteral feeding if the individual with stroke requires a prolonged period of enteral nutrition (i.e. 4 weeks or longer) to reduce the risk of treatment failure and feeding interruption [Strong recommendation; High quality of evidence].
- vi. Individuals with stroke, their family and caregivers should receive interdisciplinary education on swallowing, prevention of aspiration, and feeding recommendations [Strong recommendation; Moderate quality of evidence].

Section 6.1 Clinical Considerations

1. To reduce the risk of aspiration pneumonia, individuals with stroke should be permitted and encouraged to contribute to feeding themselves whenever possible (e.g., hand-over-hand assistance).

2. To reduce the risk of choking and aspiration pneumonia, individuals with stroke should be appropriately positioned while eating or receiving enteral nutrition.
3. Non-invasive brain stimulation may be considered as an adjunct treatment to train muscles for post-stroke dysphagia. *Note these interventions are not yet available/approved for use in Canada.*

6.2 Nutrition and Hydration

- i. Individuals with stroke should be screened for malnutrition and dehydration within 24-48 hours of inpatient admission using a valid screening tool [Strong recommendation; Low quality of evidence].
 - a. Routine and repeated screening for nutritional and hydration status is recommended while supporting individuals with stroke during inpatient admission and after discharge to the community [Strong recommendation; Low quality of evidence].
- ii. Referral to a dietitian is recommended for individuals with stroke who fail screening or have nutritional concerns, hydration deficits, or other co-morbidities that may require nutritional intervention [Strong recommendation; High quality of evidence].
 - a. Meet nutritional and fluid needs through enteral and/or oral routes while supporting recommendations for food texture and fluid consistency [Strong recommendation, Moderate quality of evidence].
- iii. Nutritional supplementation should be considered in individuals with stroke who are experiencing malnutrition [Strong recommendation; Moderate quality of evidence].

6.3 Oral Health

- i. Active oral hygiene interventions (e.g., brushing, oral rinse) are recommended at least twice daily to maintain oral health in individuals with stroke, especially if dysphagia is present [Strong recommendation; Moderate quality of evidence].
- ii. Individuals with stroke, their family and caregivers should receive interdisciplinary education and training in safe and proper oral care [Strong recommendation; Low quality of evidence].
- iii. Referrals should be made to appropriate healthcare professionals with expertise in oral health as needed [Strong recommendation; Low quality of evidence].

Rationale

Dysphagia is a common complication following a stroke that can significantly impact an individual's quality of life and nutritional intake. This condition arises due to impaired muscle control in the throat and mouth, leading to difficulties with swallowing food, liquids, or medications. As a result, individuals with dysphagia face an increased risk of aspiration pneumonia, malnutrition, and dehydration. The challenges posed by dysphagia can also lead to social isolation and psychological distress, as mealtime often becomes a stressful experience. 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.¹⁶⁴

Individuals with stroke emphasize the importance of education and training for individuals with stroke and caregivers relating to the potential risks of dysphagia, such as aspiration, as well as information on dysphagia management. They highlight the importance of screening and assessment for dysphagia following stroke and advocate that screening for dysphagia should occur across the continuum of stroke care. Individuals with stroke also value education on topics such as healthy eating as well as oral health, to support their stroke recovery.

System Implications

In order to manage dysphagia and malnutrition post stroke, organizations should optimize the following system components:

1. Processes to ensure screening for swallowing impairment occurs prior to any oral intake, by an appropriately trained professional.
2. Development and delivery of educational programs to train appropriate staff to perform an initial swallowing screen for individuals with stroke. This may include staff across the continuum, such as in emergency departments, acute inpatient units, rehabilitation facilities, and community and long-term care settings.
3. Processes in place to ensure clear communication between staff, and between staff and individuals with stroke and their families regarding the patients' swallowing status so that all team members are aware.
4. 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.
5. Development and delivery of educational programs to ensure healthcare providers are adequately trained in oral health prevention and management strategies following stroke.
6. Processes to ensure education about dysphagia (e.g., meal preparation and management strategies) for the individual with stroke, family and caregivers is delivered in a timely way.

Performance Measures

System Indicators

1. Presence of a dysphagia program for all inpatient stroke rehabilitation units.
2. Access to dysphagia education programs for staff, individuals with stroke and their families.
3. Proportion of individuals experiencing dysphagia following an acute stroke.

Process Indicators

4. Proportion of individuals with acute stroke screened with a standardized screening tool for dysphagia on same day of hospital arrival (Accreditation Canada).
5. Proportion of individuals with stroke 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.
6. Median time in minutes from patient arrival in the emergency department to initial swallowing screening by a trained clinician.
7. Proportion of individuals with stroke who have their dysphagia status reassessed during stroke rehabilitation.

Patient-Oriented Indicators

8. Incidence of malnutrition among individuals with stroke admitted to inpatient care for stroke which leads to delays in discharge.
9. Proportion of individuals with acute stroke and dysphagia who experience post stroke complications such as pneumonia.
10. Changes in quality of life for individuals with stroke and dysphagia measured at regular intervals during recovery and participation, and reassessed when changes in health status or other life events occur (e.g., at 60, 90- and 180-days following stroke).

Implementation Resources and Knowledge Transfer Tools

Resources and tools listed below that are external to Heart & Stroke and the Canadian Stroke Best Practice Recommendations may be useful resources for stroke care. However, their inclusion is not an actual or implied endorsement by the Canadian Stroke Best Practices team or Heart & Stroke. The reader is encouraged to review these resources and tools critically and implement them into practice at their discretion.

Health Care Provider Information

- Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery and Community Participation following Stroke, [Part One: Stroke Rehabilitation Planning for Optimal Care Delivery module](#); and, [Part Three: Optimizing Activity and Community Participation following Stroke, Update 2025](#)
- Heart & Stroke: Taking Action for Optimal Community and Long-Term Stroke Care: A resource for healthcare providers: <https://www.strokebestpractices.ca/resources/professional-resources/tacls>
- MNA: Mini Nutritional Assessment: https://www.mna-elderly.com/forms/mini/mna_mini_english.pdf
- BAPEN: Malnutrition Universal Screening Tool (MUST): <http://www.bapen.org.uk/screening-for-malnutrition/must/introducing-must>
- Canadian Malnutrition Task Force: Canadian Nutrition Screening Tool: <https://nutritioncareinCanada.ca/resource-library/hospital-care-adults/screening>
- Stroke Engine: <http://www.strokingengine.ca/>
- International Dysphagia Diet Standardization Initiative: <https://www.iddsi.org/home>

Resources for Individuals with Stroke, Families and Caregivers

- Heart & Stroke: Signs of Stroke: <http://www.heartandstroke.ca/stroke/signs-of-stroke>
- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>
- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1
- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>
- Heart & Stroke: Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient->

[resources/csbpr-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031](https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community)

- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbfc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>
- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- Heart & Stroke: Problems Swallowing: <https://www.heartandstroke.ca/stroke/recovery-and-support/physical-changes/swallowing>
- CanStroke Recovery Trials: Tools and Resources: <https://canadianstroke.ca/tools/>
- Stroke Engine: <http://www.strokengine.ca/>

Summary of the Evidence

Dysphagia

The implementation of a standardized program for bedside screening is thought to decrease the incidence of dysphagia-related pneumonia. Components may include those related to a patient's level of consciousness, an evaluation of oral motor function and oral sensation, as well as the presence of a cough. It may also include trials of small sips of water, whereby a "wet" or hoarse voice are suggestive of an abnormal swallow. While a variety of dysphagia screening tools are currently in use, it is unclear which one performs best. To further knowledge in this area, in a Cochrane review, Boaden et al.¹⁶⁵ evaluated the test characteristics of 37 different screening tools of which 24 used only a water test, 6 used a combination of water and other liquid consistencies, and 7 used other methods. When compared against gold standards (which varied across studies), the best performing swallow screening tools were, the combined water swallow tests and Oxygen Saturation Test, Gugging Swallowing Screen (GUSS),¹⁶⁶ and Toronto Bedside Swallowing Screening Test (TOR-BSST).¹⁶⁷ Screening tools that used a combination of water and other consistencies as testing materials were more accurate than screening tests that used only water. Nevertheless, the authors concluded that they were unable to identify a single screening tool with high, and precisely estimated sensitivity and specificity due to lack of high-quality studies.

Sherman et al.¹⁶⁸ included the results from 30 studies, of which 6 were RCTs, including patients with swallowing problems following stroke. The outcomes of patients who received no screening vs. screening, were compared. Among the studies in which a previously validated screening tool was used, the Acute Screening of Swallow in Stroke/TIA¹⁶⁹ was used most frequently (n=6), followed by the GUSS¹⁶⁶ (n=4), and the Three-Step Swallowing Screen protocol^{170,171} and the MetroHealth Dysphagia Screen,¹⁷² which were used in one study each. Overall, dysphagia screening was associated with reduced odds of pneumonia (OR=0.57, 95% CI, 0.45–0.72), mortality (OR=0.52, 95% CI 0.35–0.77), dependency (OR=0.54, 95% CI, 0.35–0.85) and reduced length of hospital length of stay (SMD= –0.62 days, 95% CI, –1.05 to –0.20).

While texture-modified diets, 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, there is little direct evidence of their benefit. The effectiveness of a variety of treatments for dysphagia and nutritional management was evaluated in a Cochrane review.¹⁷³ Dysphagia treatments examined in 41 RCTs included acupuncture, behavioural interventions, drug therapy, neuromuscular electrical stimulation, pharyngeal electrical stimulation, physical stimulation

(thermal, tactile), transcranial direct current stimulation, and transcranial magnetic stimulation. Overall, there was no reduction in the odds of death or disability or case fatality at the end of the trial associated with dysphagia therapies. While swallowing therapy significantly reduced the proportion of participants with dysphagia at the end of the trial, reduced the risk of chest infections or pneumonia, and was associated with a mean reduction in hospital length of stay of almost 3 days, the authors cautioned that *further high-quality trials are required before clinical decisions can be made about what treatments are effective*. Another systematic review including the results of 22 RCTs of patients in acute or critical care settings with dysphagia.¹⁷⁴ Interventions included non-invasive electrical brain stimulation (transcranial electrical stimulation or transcranial magnetic stimulation), pharyngeal electrical stimulation, neuromuscular electrical stimulation, acupuncture, behavioral therapy, chin tuck, respiratory muscle strength training, tongue palate resistance training, and effortful swallow training and traditional swallowing exercises. While swallowing therapy was not associated with a significantly decreased risk of aspiration (RR=0.79, 95% CI 0.44 to 1.45), it was associated with a decreased risk of pneumonia (RR=0.71, 95% CI 0.56 to 0.89).

Surface Neuromuscular electrical stimulation (NMES) using devices such as VitalStim has been used in the rehabilitation of swallowing function in patients with stroke-associated dysphagia. While this treatment is popular in the United States and other countries, it is not widely used in Canada, and the evidence supporting its use is conflicting. Tarihci Cakmak et al.¹⁷⁵ randomized 34 patients with dysphagia an average of 50 weeks post stroke to receive traditional dysphagia therapy + NMES with the VitalStim device (45 minutes/session x 5 days/week x 3 weeks) or dysphagia therapy only. The stimulation intensity level started at 2 mA, increased by 0.5 mA intervals, and stabilized when the patient felt vibration in the patient's neck. From baseline to end of follow-up at three months, there were significant improvements within both groups in mean scores for all outcomes (Functional Oral Intake Scale [FOIS], Eating Assessment Tool (EAT-10), the Swallowing Quality of Life Questionnaire (SWAL-QOL), and voice-related quality of life questionnaire, with no between group differences. Carnaby et al.¹⁷⁶ recruited 57 patients with post-stroke dysphagia from a stroke rehabilitation unit. Patients were randomized to receive usual care, which included behavioral swallowing therapy for 1 hour/day for 3 weeks, or until hospital discharge, or McNeill Dysphagia Therapy (MDTP) swallowing therapy in addition to active NMES with the VitalStim device or MDTP + sham NMES. Post intervention, there was significantly greater improvement in mean Mann Assessment of Swallowing Ability (MASA) and (FOIS) scores in the MDTP group + sham stimulation compared with the other two groups. At 3 months, in adjusted analysis, compared with usual care, MDTP + sham NMES was associated with a significantly greater likelihood of return to normal diet (hazard ratio [HR]=4.32, 95% CI 1.08-17.2). Park et al.¹⁷⁷ reported significantly greater improvement in swallowing ability following 6 weeks of active treatment with the VitalStim device among 61 stroke rehabilitation patients. At the end of treatment, patients who received active NMES had greater improvement in Videofluoroscopy Dysphagia Scale and Penetration–Aspiration Scale scores, compared with those who received sham treatment. A systematic review authored by Chen et al.¹⁷⁸ included the results for 8 RCTs examining NMES and reported that active treatment was associated with significantly better swallowing function scores at the end of the treatment period (SMD=1.27 (95% CI 0.51-2.02).

For patients who cannot obtain their nutrient and fluid needs orally, enteral nutrition may be required. Results from the largest trial of its kind indicate that there is little difference in outcome between routes of enteral feeding. The Feed or Ordinary Diet (FOOD) trial¹⁷⁹ also addressed the issues of timing of initiation of enteral feeding. The FOOD trial included 1,210 patients admitted within 7 days of stroke from 47 hospitals in 11 countries. In one arm of the trial, 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 a non-significant absolute increase in risk of death of 1.0% (–10.0 to 11.9, p=0.9) and a borderline increased risk of death or poor outcome of 7.8% (0.0 to 15.5, p=0.05) at 6 months. In the second part of the trial, patients were randomized to receive enteral feeds as early as possible or to avoid feeding for 7 days. Early tube feeding was associated with non-significant absolute reductions in the risk of death or poor outcome (1.2%, 95% CI -4.2 to 6.6, p=0.7) and death (15.8%, 95% CI -0.8 to 12.5, p=0.09) at 6 months. A Cochrane review¹⁸⁰ comparing NG and PEG feeding tubes also reported few differences between feeding tube types. The review was composed of 11 RCTs including 735 adults with dysphagia, of whom 462 were recovering from stroke. PEG tubes

were associated with significantly reduced odds of treatment failures (blocked tubes or disruptions in feeding schedule), but there was no significant difference between groups in mortality, aspiration-related pneumonia or adverse events.

Nutrition

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 pre-morbid malnutrition. This topic has been explored more extensively in the geriatric population of individuals hospitalized for medical issues. In the Nutrition effect On Unplanned Readmissions and Survival in Hospitalized patients (NOURISH) trial, Deutz et al.¹⁸¹ randomized 652 malnourished patients, recruited from 78 sites in the United States who were recently hospitalized to receive standard nutritional care + an oral supplement providing an 350 kcal, 20 g protein, 11 g fat, 44 g carbohydrate, and 1.5 g calcium-beta-hydroxy-methylbutyrate (HMB) twice daily or a placebo drink that contained 48 kcal, 12 g carbohydrate, and 10 mg vitamin C during their hospital stay and continuing up to 90 days following discharge. A significantly higher percentage of patients were classified as well-nourished at 90 days (category A, using Subjective Global Assessment) in the oral supplementation group (45.5% vs. 30.0%). For the primary outcome, a composite of death or non-elective readmission within 90 days post discharge, there was no significant difference between the groups (26.8% vs. 31.1%), nor was there a difference in the proportion of patients readmitted after 90 days (25.2% vs. 25.6%); however, mortality was lower in the oral supplementation group (4.8% vs. 9.7%, $p=0.018$). In a larger RCT, a similar finding was reported. The Effect of early nutritional support on Frailty, Functional Outcomes, and Recovery of malnourished medical inpatients Trial (EFFORT), recruited 2,088 patients from 8 hospitals in Switzerland with a medical condition, a Nutrition Risk Score-2002 ≥ 3 , who were able to consume food orally, and had an anticipated hospital stay of >4 days.¹⁸² Patients were randomized to receive either individualized nutritional support (intervention group), or standard hospital food (control group). Patients in the intervention group received supplements and enteral feeding, as well as a prescription for oral nutritional supplements at discharge, as required. The primary (composite) outcome was all-cause mortality, admission to the intensive care unit from the medical ward, non-elective hospital readmission after discharge, major complications as a new occurrence or a decline in functional status of $\geq 10\%$ from admission to day 30, measured by the Barthel Index. At 30 days, the risk of primary outcome was significantly lower in the intervention group (23% vs. 27%, adjusted odds ratio [OR]=0.79, 95% CI 0.64 to 0.97). Among the components of the primary outcome, mortality was significantly lower in the intervention group (7% vs. 10%, OR=0.65, 95% CI 0.47 to 0.91) as were the odds of functional decline (4% vs. 6%, OR=0.62, 95% CI 0.40 to 0.96).

The results of trials focused on stroke exclusively are less impressive. In the largest trial of its kind, the FOOD trial, reported that routine supplementation with an additional 540 Kcal/day for all patients, regardless of pre-morbid nutritional status, did not help to improve global outcomes.¹⁸³ In this trial, 4,023 patients were randomized to receive or not receive an oral nutritional supplement in addition to a regular hospital diet, provided for the duration of their entire hospital stay. At 6-month follow-up, there was no significant difference between groups on the primary outcome, death or poor outcome (OR=1.03, 95% CI 0.91 to 1.17), which was comparable with a 1% to 2% absolute benefit or harm from oral supplements. However, in this trial, only 8% of patients were malnourished at baseline, which may have contributed to the null finding. In a recent Cochrane review,¹⁸⁴ the focus was protein and energy supplementation. Although 52 RCTs were included, evaluating a broad range of interventions (protein and energy supplementation, enteral feeding, parenteral supplements, parenteral or enteral supplements, and oral and parenteral supplements) under the umbrella term of nutritional therapies, only data from one to two trials were available for the primary outcomes. Oral supplementation was not associated with a reduction in the odds of disability, defined as an mRS score of 0-2, at 6 months (OR=0.97, 95% CI 0.86 to 1.10; 1 trial [FOOD trial]: GRADE: low), or in the performance of activities of daily living, assessed using the Functional Independence Measure motor subscale, at 3.5 to 8 weeks follow-up (MD= 8.74, 95% CI 5.93 to 11.54, 2 studies; GRADE: very low).

Oral Care

Physical weakness following stroke may prevent patients from independently completing their ADLs, including oral care. Poor oral care, combined with potential side effects of medication (e.g., dry mouth, oral ulcers, stomatitis), may contribute to greater amounts of bacteria in the mouth, leading to an increased risk of pneumonia. Therefore, on admission to hospital, all patients should have an oral/dental assessment to examine mastication, tooth wear, oral disease, and use of appliances following stroke. However, few studies have examined interventions to improve oral hygiene in patients following stroke. A Cochrane review conducted by Campbell et al.¹⁸⁵ included the results of 15 RCTs (n=1,546) that included patients receiving some form of assisted oral healthcare in a healthcare facility following stroke. Trials evaluated interventions designed to improve the cleanliness and health of the mouth, tongue and teeth (e.g., toothbrush, toothpaste, mouth gel, mouthwash, tongue cleaners, lip balm), care protocols led by healthcare staff or informal carers, combinations of education and training, selective decontamination of the digestive tract, and povidone-iodine rinses. Pooling of results was difficult due to the wide variation in treatment contrasts. Oral health care (OHC) interventions were associated with a significant reduction in denture plaque (MD=-1.31, 95% CI -1.96 to -0.66), and improvement in staff/patient OHC knowledge one month after the intervention was delivered (MD=0.70, 95% CI 0.06 to 1.35), when compared with usual care although the results from only a single small trial were included.

Sex & Gender Considerations

No literature was identified that discussed potential sex or gender differences on the topics of screening or treatment for dysphagia, nutrition or oral health, post stroke.

[Evidence Tables and Reference List 6a](#)

[Evidence Tables and Reference List 6b](#)

Section 7 Language and Communication

7. Language and Communication, Recommendations 2025

- i. Healthcare providers working across the continuum of care should undergo training about aphasia and other communication disorders, including recognition of the impact of aphasia and methods to support communication [Strong recommendation; Low quality of evidence].
Note: Other communication disorders may include dysarthria, apraxia of speech and cognitive communication deficits.
- ii. All individuals with stroke should be screened for communication impairments, ideally by a healthcare professional with expertise in communication, using a validated screening tool [Strong recommendation; Low quality of evidence].
- iii. Individuals with stroke with suspected communication impairments should be assessed by a Speech-Language Pathologist (SLP) or other healthcare provider with expertise in communication impairments, using standardized, valid assessment to identify impairments, activity limitations, participation restrictions, and the impact on relationships related to communication deficits, across the rehabilitation care continuum [Strong recommendation; Low quality of evidence].
- iv. Individuals with aphasia and other communication disorders (e.g., speech apraxia) should have early access to a combination of intensive speech, language, and communication therapy according to their needs, goals and impairment severity to improve functioning [Strong recommendation; High quality of evidence].
- v. Training in supported conversation techniques for potential communication partners of individuals with aphasia should be offered [Strong recommendation; High quality of evidence].
- vi. All information intended for the use of individuals with aphasia should be available in aphasia-friendly formats [Strong recommendation; Low quality of evidence].
- vii. Families of individuals with aphasia should be engaged in the entire process from screening through intervention, including family education and training in supported communication [Strong recommendation; Low quality of evidence].

Section 7 Clinical Considerations:

1. Treatment to improve functional communication may include interventions such as language therapy focusing on impairments-based approaches, conversational treatment, training on use of assistive devices, computer therapy.
 - a. Production and/or comprehension of words, sentences and discourse, (including reading and writing), is recommended to improve functional communication.
 - b. Use of non-verbal strategies, assistive devices and technology (e.g., iPads, Tablets, other computer-guided therapies), which can be incorporated to improve communication.
 - c. Use of computerized language therapy for reading practice and word finding and to enhance benefits of other therapies.
2. Treatment for aphasia may include group therapy and conversation groups. Groups can be used to supplement the intensity of therapy during hospitalization and/or as continuing therapy following discharge.
3. Individuals with aphasia should be assessed for their potential to benefit from using augmentative alternative communication modalities (e.g. iPad, tablet, electronic devices, alphabet board) or other communication support tools, ideally that are culturally relevant.

Rationale
<p>Aphasia, which is a common consequence of stroke, is associated with challenges in speaking, reading, writing, and comprehension. Acutely, it is estimated that between 21% and 38% of stroke patients are aphasic. ^{186,187} This condition significantly impacts an individual's ability to express themselves and understand others. Individuals with aphasia may struggle to find the right words, form coherent sentences, or follow conversations, which can lead to frustration, social withdrawal, and decreased quality of life. Other communication impairments following stroke include dysarthria, apraxia of speech and cognitive-communication disorders. Communication barriers not only affect personal interactions but can also hinder participation in rehabilitation, access to essential services, community participation and an increased risk for mortality. Aggressive management of aphasia helps to improve both language and broader recovery.</p> <p>Individuals with stroke have emphasized the necessity of early screening and assessment for language and communication changes following stroke and the importance of access to rehabilitation to improve communication and language. Aphasia challenges can have a significant impact for the individual with stroke, their family members, and caregivers. Individuals with stroke express that difficulties in these areas can have a profound impact on their self-esteem and relationships. Availability and accessibility of individualized therapy, specialists and virtual rehabilitation regardless of financial limitations and geography, that help with communication and language are recognized as important elements of recovery.</p>
System Implications
<p>To achieve timely and appropriate access to specialized inpatient and community-based communication services following their stroke, organizations should optimize the following system components:</p> <ol style="list-style-type: none"> 1. Processes in place to access Speech-Language Pathologists and other appropriate professionals, communication programs and services, and appropriate support for individuals with stroke with communication impairments, available in all organizations and communities, and that is affordable. 2. Access to virtual care technology that should be actively utilized, particularly in areas with limited in-person access to Speech-Language Pathologists, to ensure equity in rehabilitation opportunities for individuals with post-stroke aphasia or other language and communication impairments. 3. Community aphasia-friendly support programs and peer-support groups established, with information about how to access these programs and groups readily available in acute care and the rehabilitation settings. 4. Processes to provide education to all healthcare providers who will be working with individuals with stroke who may have language and communication impairment.
Performance Measures
<p>System Indicators</p> <ol style="list-style-type: none"> 1. Proportion of staff members in each rehabilitation setting trained on supportive communication techniques. 2. Access to speech-language and specialized aphasia services in each region. 3. Proportion of individuals experiencing aphasia or other communication issues following an acute stroke. <p>Process Indicators</p> <ol style="list-style-type: none"> 4. Proportion of individuals with stroke screened for aphasia during acute inpatient admission; and during initial assessment in a rehabilitation setting.

5. Proportion of individuals with stroke with aphasia who receive a detailed assessment by a speech-language pathologist prior to leaving acute care.
6. Median time from hospital discharge to initiation of aphasia therapy in the community.
7. Proportion 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).

Patient-Oriented Indicators

8. Changes in quality of life for individuals with stroke and aphasia measured at regular intervals during recovery and participation, and reassessed when changes in health status or other life events occur (e.g., at 60, 90- and 180-days following stroke).

Implementation Resources and Knowledge Transfer Tools

Resources and tools listed below that are external to Heart & Stroke and the Canadian Stroke Best Practice Recommendations may be useful resources for stroke care. However, their inclusion is not an actual or implied endorsement by the Canadian Stroke Best Practices team or Heart & Stroke. The reader is encouraged to review these resources and tools critically and implement them into practice at their discretion.

Health Care Provider Information

- Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery and Community Participation following Stroke, [Part One: Stroke Rehabilitation Planning for Optimal Care Delivery](#) module; and, [Part Three: Optimizing Activity and Community Participation following Stroke, Update 2025](#)
- Heart & Stroke: Taking Action for Optimal Community and Long-Term Stroke Care: A resource for healthcare providers: <https://www.strokebestpractices.ca/resources/professional-resources/tacls>
- Aphasia Institute: <https://www.aphasia.ca/>
- Stroke Engine: Frenchay Aphasia Screening Tools: <https://strokenine.ca/en/assessments/frenchay-aphasia-screen-test-fast/>
- Stroke Engine: American Speech-Language-Hearing Association Functional Assessment of Communication Skills in Adults (ASHA-FACS): <https://strokenine.ca/en/assessments/american-speech-language-hearing-association-functional-assessment-of-communication-skills-for-adults-asha-facs/>
- COMBI: Mississippi Aphasia Screening Test: <http://www.tbims.org/mast/index.html>
- Aphasia Access: <http://www.aphasiaaccess.org/>
- Australian Aphasia Rehabilitation Pathway: <http://www.aphasiapathway.com.au/?name=About-the-statements>
- Stroke Engine: <http://www.strokenine.ca/>

Resources for Individuals with Stroke, Families and Caregivers

- Heart & Stroke: Signs of Stroke: <http://www.heartandstroke.ca/stroke/signs-of-stroke>
- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>

- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1
- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>
- Heart & Stroke: Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbpr-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031>
- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbfc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>
- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- Heart & Stroke: Communication: <https://www.heartandstroke.ca/stroke/recovery-and-support/physical-changes/communication>
- Aphasia Institute: <https://www.aphasia.ca/>
- Stroke Engine: <http://www.strokeengine.ca/>

Summary of the Evidence

Aphasia, an acquired communication disorder that impairs the ability to process language, speak and understand others, affects 21% to 38% of stroke survivors.^{186,187} Aphasia is associated with increased length of hospital stay, inpatient complications, overall neurological disability, mortality and discharge disposition.¹⁸⁸ A Cochrane review¹⁸⁹ included 57 RCTs comparing speech-language therapy (SLT) for aphasia after stroke with no SLT, social support or stimulation, or another form of SLT. In total, 74 randomized comparisons, consisting of over 3,000 participants were included in the review. Among the trials comparing SLT vs. no SLT, the interventions described were conventional SLT, (n=12), constraint-induced aphasia therapy (n=1), melodic intonation therapy (n=1), intensive SLT (n=5), group SLT (n=1), volunteer-facilitated SLT (n=2), computer-mediated SLT (n=6), and functionally based SLT involving a communicative partner (n=1). Acupuncture was a co-intervention in 3 trials. Compared with no SLT, speech language therapy was associated with a significant improvement in functional communication (SMD=0.28, 95% CI 0.06 to 0.49), compared with no SLT, along with significant improvements in reading comprehension (SMD= 0.29; 95% CI 0.03 to 0.55), general expressive language (SMD=1.28; 95% CI: 0.38 to 2.19) and written expressive language (SMD=0.41, 95% CI 0.14 to 0.67) immediately after SLT. However, the positive effects were no longer evident at 6 months. No significant differences in outcomes were found between group vs. individual SLT, computer-mediated vs. professional SLT or constraint-induced aphasia vs. other forms of SLT.

The impact SLT has on communication outcome appears to be mediated by the intensity and duration of the therapy. Brady et al.¹⁹⁰ included the results of 25 RCTs and examined the effects of total dose of SLT (hours), intensity (hours/week), frequency (days/week) and duration (total weeks) on communication outcomes post stroke. Mean gains in overall language ability, assessed using the

Western Aphasia Battery–Aphasia Quotient, were greatest when total amount of therapy was provided for >20 to < 50 hours (18.37 points, 95% CI 10.58 to 16.16). For functional communication, assessed using the Aachen Aphasia Test–Spontaneous Speech Communication, mean gains were greatest after >14 to 20 hours of therapy (0.94 points, 95% CI 0.34 to 1.55). In terms of intensity of therapy, mean gains from baseline for overall language ability were similar when SLT was provided for up to 2 hours per week (15.85 points, 95% CI 8.06–23.64), 3 to 4 hours per week (15.80 points, 95% CI 8.85 to 22.74) and for 9 or more hours per week (15.64 points, 95% CI 9.14 to 22.13). The pattern was similar for functional communication with the greatest gains for therapy provided for up to 2 hours/week (0.77 points, 95% CI 0.36–1.19) with equivalent gains for 2 to 3 hours/week (0.76 points, 95% CI 0.34–1.18) and 3-4 hours/week (0.70 points, 95% CI 0.35–1.06). The greatest gains in overall language ability and functional communication were achieved when SLT was provided for 5 days per week (14.95 points, 95% CI 8.67–21.23 and 0.78 points, 95% CI 0.48–1.09, respectively). Finally, the greatest gains in overall language ability were associated with SLT that was provided for 11 to 20 weeks (17.27, 95% CI 9.71-24.82), followed by therapy provided for >20 weeks (16.93, 95% CI 8.57-25.29), while therapy provided for <3 weeks was not associated with significant improvement.

A 2016 systematic review, authored by Simmons-Mackie,¹⁹¹ updated with an additional 25 studies from their previous review in 2010¹⁹² included the results of 56 studies evaluated the effect of education and communication interventions focusing on partner training of individuals with aphasia (mainly stroke and mainly chronic aphasia) and their communication partners. A variety of types of partner training were studied and included studies involving both partners and individuals with aphasia, and partners alone. In most studies, there was an increase in communication activities and participation between the participant and communication partner. The authors concluded that communication partner training should be conducted to improve partner skills in facilitating the communication of people with chronic aphasia, and additional research is needed to strengthen and expand recommendations related to acute aphasia.

Sex & Gender Considerations

Evidence from two recent systematic reviews and meta-analyses suggest that the risk of aphasia following stroke is higher in women. Li et al.¹⁹³ included the results from 36 papers (n= 31,058) and reported the odds of post-stroke aphasia were higher in women (36% vs. 31%, OR= 1.23, 95% CI 1.19 to 1.29). A similar result was found by Wallentin¹⁹⁴ who included the results from 25 studies (29.6% vs. 26.0%, RR= 1.139, 95% CI 1.100 to 1.180).

In a companion study examining the association between SLT outcomes and therapy provision, Brady et al.¹⁹⁵ reported sex-related differences in response to SLT. For women, the greatest gains in functional communication were associated with lower levels of SLT (provided for 4 days/week, <2 hours/week for a total of 14-20 hours), compared with men where higher intensity therapy was associated with higher gains (SLT provided for >5 days/week, 3-4 hours/week for a total of ≥50 hours).

[Evidence Tables and Reference List 7](#)

Section 8 Visual and Visual-Perceptual Impairment

8. Visual and Visual-Perceptual Impairment, Recommendations 2025

8.0 Visual and Visual-Perceptual Impairments

- i. All individuals with stroke should be screened for central vision impairment, ocular motility disorders, visual field deficits, and visual perceptual disorders early after stroke as a routine part of the broader rehabilitation assessment process [Strong recommendation; Moderate quality of evidence].
- ii. Individuals with stroke with suspected perceptual impairments (e.g., visuo-spatial impairment, agnosia, body schema disorders and apraxia) should be assessed using validated tools [Strong recommendation; Low quality of evidence].
- iii. Individuals with stroke who have vision or visual-perceptual impairment, their family and caregivers, should receive education on visual-spatial impairment and other perceptual deficits as well as treatment recommendations and safety considerations [Strong recommendation; Low quality of evidence].

8.1 Vision Impairments

- i. Individuals with visual impairment impacting their ability to locate themselves and travel safely and independently either indoors or outdoors should receive training in compensatory techniques, including sighted guide, orientation to space, and mobility training in familiar and unfamiliar spaces [Strong recommendation; Moderate quality of evidence].
- ii. Individuals with difficulties completing ADL and instrumental activities of daily living (IADL) activities related to visual impairments post-stroke should receive assessment and training from appropriate vision rehabilitation specialists when feasible [Strong recommendation; Moderate quality of evidence].
 - a. Intervention should focus on the use of specialized compensatory techniques (such as scanning) and modifications to the task or environment such as increase of luminance/lighting or contrast [Strong recommendation; Moderate quality of evidence].

8.2 Visual-Perceptual Impairments

- i. Visual scanning training may be considered to improve spatial neglect [Strong recommendation; Moderate quality of evidence].
- ii. Mirror therapy should be used to improve visual spatial neglect in the early-stage post stroke [Strong recommendation; Moderate quality of evidence].
- iii. Eye patching of the non-affected hemi field (ipsilateral to the lesion) may be considered to improve visual spatial neglect reading and neglect symptoms [Strong recommendation; Low quality of evidence].
- iv. Virtual reality may be considered to improve visual spatial neglect [Strong recommendation; Low quality of evidence].
- v. Limb activation may be considered to improve visual spatial neglect [Strong recommendation; Moderate quality of evidence].
- vi. The use of prisms may be considered to expand the visual field and increase scanning abilities; however, there is no evidence of impact on functional performance [Strong recommendation; Moderate quality of evidence].

Refer to Rehabilitation, Recovery and Community Participation Following Stroke

[Part Three: Optimizing Activity and Community Participation following Stroke, Section 4 for information on return to driving.](#)

Section 8 Clinical Considerations

1. Body awareness training and movement interventions may be used to improve visual spatial neglect symptoms and activities of daily living.
2. Non-invasive brain stimulation may be considered to improve visual spatial neglect. *Note these interventions are not yet available/approved for use in Canada.*
3. Consider education on compensatory strategies to improve functional performance or comfort, such as unilateral translucent patching for double vision, binasal occlusion for spatial vision, environmental modifications or cues for neglect.
4. For individuals with vision impairment following stroke, referral to a neuro-ophthalmologist or an optometrist experienced in post-stroke vision rehabilitation may be considered.

Rationale

Visual perceptual disorders are common following stroke, affecting an average of 65% of individuals with stroke in the acute stage of stroke.¹⁹⁶ These impairments can negatively affect an individual's ability to process and interpret visual information, and may manifest as problems with depth perception, spatial awareness, and the ability to recognize objects or faces, which can hinder daily activities such as reading, driving, and navigating environments. As a result, individuals may experience increased frustration and anxiety, leading to reduced independence and social participation. The presence of neglect has been associated with both severity of stroke and age of the individual and the challenges posed by visual perceptual impairments have also been associated with longer lengths of hospital stay and slower recovery during inpatient rehabilitation.

Post-stroke visual impairment (VI) is a common but often under-recognized concern. It can manifest as decreased vision, diplopia, visual field deficits, eye movement disorders, and visual inattention or neglect or visual perception disorders. More than half of stroke survivors will experience vision impairment.¹⁹⁶ Individuals with post-stroke vision impairment often face a decline in their quality of life, reduced independence, increased depression, and higher chance of social isolation.¹⁹⁷ Additional challenges recognizing vision impairment can arise when patients have neurological or cognitive deficits, such as visual-spatial inattention and communication impairment, which can obscure the symptoms. Standardized screening has been shown to be feasible and to improve the detection of vision loss after stroke.^{198,199}

Limb apraxia is more common in those with left hemisphere involvement (28 – 57%) but can also be seen in right hemisphere damage (0 – 34%).²⁰⁰ 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.

Individuals with stroke have emphasized the importance of awareness that visual perceptual deficits can occur following stroke. They express that it can be difficult for an individual with stroke to notice or communicate visual or perceptual changes following stroke and thus highlight the importance of access to appropriate screening, assessment, management and education. Individuals with stroke also advocate for improved access to vision rehabilitation services. They note that these changes can greatly impact activities of daily living and participation in rehabilitation. For example, it can be difficult for individuals with stroke to fully participate in rehabilitation when experiencing diplopia.

System Implications

To achieve timely and appropriate assessment and management of perceptual deficits, organizations should optimize the following system components:

1. Inclusion of initial standardized screening and assessment of visual perceptual deficits (e.g., inattention and apraxia).
2. Access to appropriate healthcare providers experienced in the field of stroke and visual perception.
3. Timely access to specialized, interdisciplinary stroke rehabilitation services where therapies of appropriate type and intensity are provided, and staff are trained to assess and manage visual-perceptual issues.
4. Access to appropriate equipment to aid in recovery, when necessary, without financial barriers.
5. Long-term rehabilitation services widely available in long-term care and complex continuing care facilities, and in outpatient and community programs and settings.

Performance Measures

System Indicators

1. Availability of inpatient and community-based education and resources for individuals with stroke experiencing visual perceptual deficits.
2. Proportion of individuals experiencing visual-perceptual deficits following an acute stroke.

Process Indicators

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

Patient-Oriented Indicators

5. Changes in quality of life for individuals with stroke and visual perceptual deficits measured at regular intervals during recovery and participation, and reassessed when changes in health status or other life events occur (e.g., at 60, 90- and 180-days following stroke).

Implementation Resources and Knowledge Transfer Tools

Resources and tools listed below that are external to Heart & Stroke and the Canadian Stroke Best Practice Recommendations may be useful resources for stroke care. However, their inclusion is not an actual or implied endorsement by the Canadian Stroke Best Practices team or Heart & Stroke. The reader is encouraged to review these resources and tools critically and implement them into practice at their discretion.

Health Care Provider Information

- Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery and Community Participation following Stroke, [Part One: Stroke Rehabilitation Planning for Optimal Care Delivery](#) module; and, [Part Three: Optimizing Activity and Community Participation following Stroke](#), Update 2025
- Heart & Stroke: Taking Action for Optimal Community and Long-Term Stroke Care: A resource for healthcare providers: <https://www.strokebestpractices.ca/resources/professional-resources/tacls>
- Stroke Engine: Comb and Razor Test: <https://strokengine.ca/en/assessments/comb-and-razor-test/>

- Stroke Engine: Behavioral Inattention Test: <https://strokengine.ca/en/assessments/behavioral-inattention-test-bit/>
- Stroke Engine: Line Bisection Test: <https://strokengine.ca/en/assessments/line-bisection-test/>
- GL Assessment: Perceptual Assessment Battery: <http://www.gl-assessment.co.uk/products/rivermead-perceptual-assessment-battery>
- Stroke Engine: Ontario Society of Occupational Therapy Perceptual Evaluation: <https://strokengine.ca/en/assessments/ontario-society-of-occupational-therapists-osot-perceptual-evaluation/>
- Stroke Engine: Motor-Free Visual Perception Test: <https://strokengine.ca/en/assessments/motor-free-visual-perception-test-mvpt/>
- Ability Lab: Apraxia Screen of TULIA (AST): <https://www.sralab.org/rehabilitation-measures/apraxia-screen-tulia>
- Stroke Engine: Visual Impairment Screening Assessment (VISA): <https://strokengine.ca/en/assessments/visual-impairment-screening-assessment-visa/>
- Stroke Engine: <http://www.strokengine.ca/>

Resources for Individuals with Stroke, Families and Caregivers

- Heart & Stroke: Signs of Stroke: <http://www.heartandstroke.ca/stroke/signs-of-stroke>
- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>
- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1
- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>
- Heart & Stroke Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031>
- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>

- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- CanStroke Recovery Trials: Tools and Resources: <https://canadianstroke.ca/tools/>
- Heart & Stroke: Changes in Perception: <https://www.heartandstroke.ca/stroke/recovery-and-support/emotions/changes-in-perception>
- Stroke Engine: <http://www.strokeengine.ca/>

Summary of the Evidence

Visual perceptual disorders are common following stroke, affecting an average of 65% of patients in the acute stage of stroke. The most common type of visual perception disorder following stroke is visual neglect or inattention, affecting 14% to 82% of patients. Visual field loss is also common, affecting 5.5% to 57% of patients.²⁰¹

In a Cochrane review examining a wide-range of interventions for all forms of impaired perception following stroke (hearing, smell, somatosensation, touch, taste and/or vision post stroke), Hazelton et al.²⁰² included 18 RCTs (541 participants). Among the 7 RCTs specifically examining 12 rehabilitation interventions for visual perception disorders, interventions assessed included repeated figure drawing, computer-based games, and therapist-led functional activities. In 2 trials, a single 90-minute session was provided. In the remaining trials, sessions lasted 30 minutes and were provided 3-5 days/week for 4-6 weeks. Overall, rehabilitation interventions were not associated with significantly higher extended activities of daily living (EADL) scores compared with a control condition (Rivermead ADL: MD=0.94, 95% CI -1.60 to 3.48; 1 trial, n=33), nor were perception scores higher (Motor-Free Visual Perception Test: MD= -1.75, 95% CI -5.39 to 1.89; 1 trial, n=27). The certainty of the evidence associated with both outcomes was very low.

In a Cochrane review, specifically examining interventions to improve spatial neglect post stroke, Longley et al.²⁰³ included 65 RCTs (1,951 participants). A wide range of interventions were examined including visual interventions (e.g., visual scanning training, half-field eye patching), prism adaptation, body awareness interventions (e.g., limb activation, trunk rotation, mirror therapy), mental function interventions (mental imagery, virtual reality training, and general cognitive rehabilitation), movement interventions (e.g., robotic upper extremity treatment, constraint-induced movement therapy, and visuomotor feedback training), non-invasive brain stimulation (NIBS), electrical stimulation (e.g., transcutaneous electrical nerve stimulation [TENS], functional electrical stimulation [FES] and EMG-triggered electrical stimulation), and acupuncture. The primary outcome was performance of ADL. Visual interventions were not associated with significantly better ADL scores at one month post intervention compared with a control condition (SMD= -0.04, 95% CI -0.57 to 0.49; 2 trials, n=55), or immediately post intervention (SMD=-0.15, 95% CI -0.6 to 0.3; 3 trials, n=75), nor were they associated with significantly greater improvement in measures of neglect at either one month or immediately post intervention. Similarly, prism adaptation, and NIBS were not associated with significant improvement in performance in ADL or measures of neglect. Interventions that were associated with significant improvement in ADL performance and neglect were body awareness interventions, and electrical stimulation with devices, while no data were available for the primary outcome for mental function interventions, movement interventions, or acupuncture.

A Cochrane review²⁰⁴ examining interventions associated with the rehabilitation of visual field deficits post-stroke to improve ADL performance, was unable to draw firm conclusions as limited data were available for pooled analysis. Among the 20 RCTs, data were available for one small trial indicating that visual restitution therapy had no effect on functional outcome, the primary outcome. Data were available from two trials of compensation (scanning), which also suggesting that therapy had no effect on extended activities of daily living. However, there was limited low-quality evidence that compensatory scanning training improved quality of life. Similarly, data from single trials of compensative interventions (prims) and assessment by an orthoptist were not associated with significant improvements in ADL performance.

A systematic review included 238 inpatients from 5 RCTs with unilateral neglect associated with a stroke sustained within the previous month.²⁰⁵ Interventions were initiated during inpatient rehabilitation and examined the addition of mirror therapy to routine rehabilitation +/- other co-interventions with sham mirror therapy or no mirror therapy plus routine rehabilitation +/- other co-interventions. Mirror therapy was associated with significant improvement in standardized measures of spatial neglect (SMD=1.62, 95% CI 1.03–2.21) and ADL (SMD=2.09, 95% CI 0.63–3.56) at the end of treatment. There is limited evidence from a few small trials of the benefits of eye patching,^{206,207} virtual reality,^{208,209} and limb activation.²¹⁰

Non-invasive brain stimulation has been used successfully in the rehabilitation of visual impairment. Kim et al.²¹¹ randomized 27 patients admitted for inpatient rehabilitation, with visuospatial neglect to receive repetitive transcranial magnetic stimulation (rTMS). Patients were randomized to receive 10, 20-minute sessions over 2 weeks of 1) low-frequency (1Hz) rTMS over the non-lesioned posterior parietal cortex (PPC), 2) high-frequency (10Hz) rTMS over the lesioned PPC, or 3) sham stimulation. Although there were no significant differences between groups in mean changes in Motor-Free Visual Perception Test, Star Cancellation Test or Catherine Bergego Scale, there was a significant difference among groups in Line Bisection Test change scores ($p=0.049$). Post-hoc analysis indicated the improvement was significantly greater in the high-frequency rTMS group compared to sham-stimulation group (-36.9 vs. 8.3, $p=0.03$). Additionally, improvements in mean Korean-Modified Barthel Index scores in both the high and low frequency groups were significantly greater compared to those in the sham stimulation group ($p<0.01$ and $p=0.02$, respectively). Yang et al.²¹² reported improvements in mean Behavioural Inattention Test (BIT)-Conventional, following treatment with rTMS, when treatment was combined with a sensory cueing device worn on the left wrist.

Sex & Gender Considerations

There is limited research specifically addressing sex differences in vision rehabilitation outcomes following stroke.

[Evidence Tables and Reference List 8](#)

Section 9 Central Pain

9. Central Pain, Recommendations 2025

- i. An individualized approach for management of central pain syndrome should be implemented by an interdisciplinary team that includes healthcare professionals with expertise in mental health and central pain management [Strong recommendation; Low quality of evidence].
- ii. Individuals with stroke should be assessed for central pain. The diagnosis of central post-stroke pain should be based on established diagnostic criteria after other causes of pain have been excluded [Strong recommendation; Moderate quality of evidence].
- iii. Individuals with persistent Central Post-Stroke Pain (CPSP) should receive a trial of low-dose, centrally acting analgesics [Strong recommendation; High quality of evidence].
 - a. Individuals should receive a gabapentinoid class of anticonvulsant (e.g., gabapentin or pregabalin) as a first-line treatment for central nervous system pain [Strong recommendation; High quality of evidence].
 - b. Other pharmacological treatment options that may be considered in the treatment of central pain include tricyclic antidepressants (e.g., amitriptyline), or a serotonin and norepinephrine reuptake inhibitors (SNRI) (particularly duloxetine) [Strong recommendation; Moderate level of evidence].

Rationale

Post-stroke central pain is a complex condition that can arise from damage to the spinothalamic tract (STT) of the central nervous system, often resulting in chronic pain that is difficult to manage. It reportedly affects 2% to 5% of stroke patients and complete resolution of the pain is challenging to achieve.²¹³ This type of pain typically manifests as a burning, aching, or tingling sensation in the affected areas and can significantly interfere with an individual with stroke's daily activities, interfere with sleep, and reduce overall quality of life. Individuals may experience heightened sensitivity to touch or temperature, complicating their ability to perform rehabilitation exercises and engage in everyday tasks. The unpredictability and intensity of central pain can lead to emotional distress, contributing to depression and anxiety. Effective management often requires an interdisciplinary approach, including medication, physical therapy, and psychological support, to alleviate symptoms and improve the overall well-being of those affected.

Individuals with stroke stress the importance of education on central post-stroke pain, including information for family members and caregivers. This education may include information to self-monitor and recognize potential symptoms as well as the dosing, timing, and contraindications of medications. Individuals with stroke appreciate an individualized and person-centred approach for the management of central pain that values their choices and autonomy.

System Implications

To achieve timely and appropriate assessment and management of central pain, organizations should optimize the following system components:

1. Inclusion of central pain assessments as part of standard screening and assessment protocols for stroke rehabilitation across the continuum of stroke care.
2. Access to specialized services for management of central pain.
3. The development and implementation of an equitable and universal pharmacare program, implemented in partnership with the provinces, designed to improve access to cost-effective medicines for all people in Canada regardless of geography, age, or ability to pay. This program should include a robust common formulary for which the public payer is the first payer.

4. Develop standardized education for individuals with stroke and their families what to monitor for and what can be done.

Performance Measures

System Indicators

1. Availability of inpatient and community-based education and resources for individuals with stroke experiencing central pain.
2. Proportion of individuals central pain issues following an acute stroke.

Process Indicators

3. Proportion of individuals with stroke experiencing central pain who receive a comprehensive assessment by appropriately trained healthcare professionals.
4. Proportion of individuals with stroke experiencing central pain who receive comprehensive treatment and an ongoing management plan by appropriately trained healthcare professionals.

Patient-Oriented Indicators

5. Changes in pain ratings from initiation of treatment, measured weekly, using standardized pains scales.
6. Changes in quality of life of individuals with stroke who experience central pain syndrome, measured using a standardized scale and at regular follow-up intervals.

Implementation Resources and Knowledge Transfer Tools

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- Heart & Stroke: Taking Action for Optimal Community and Long-Term Stroke Care: A resource for healthcare providers: <https://www.strokebestpractices.ca/resources/professional-resources/tacls>
- NIH: Pharmacological management of chronic neuropathic pain: revised consensus statement from the Canadian Pain Society: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4273712/>
- Blackwell Publishing: Visual Analogue Scale (VAS): http://www.blackwellpublishing.com/specialarticles/jcn_10_706.pdf
- Physiopedia: McGill Pain Questionnaire: https://www.physio-pedia.com/McGill_Pain_Questionnaire
- Pain rating scales: <https://pami.emergency.med.jax.ufl.edu/resources/provider-resources/pain-assessment-scales/>
- Stroke Engine: Beck Depression Inventory (BDI), PHQ-9 Depression Scale: <https://strokengine.ca/en/assessments/patient-health-questionnaire-phq-9/>

- Stroke Engine: <http://www.strokingengine.ca/>

Resources for Individuals with Stroke, Families and Caregivers

- Heart & Stroke: Signs of Stroke: <http://www.heartandstroke.ca/stroke/signs-of-stroke>
- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>
- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1
- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>
- Heart & Stroke Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbpr-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031>
- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbfc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>
- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- Stroke Engine: <http://www.strokingengine.ca/>

Summary of the Evidence

Central post-stroke pain (CPSP) is a rare neurological disorder, in which the body becomes hypersensitive to pain, resulting from damage to the thalamus, the part of the brain that affects sensation. The condition occurs in an estimated 2% to 5% of all stroke cases.²¹³ The literature on the treatment of CPSP is sparse.

Anticonvulsants (gabapentin, pregabalin), anti-seizure medications (lamotrigine) and antidepressants including tricyclic antidepressants (TCA), serotonin–norepinephrine reuptake inhibitors and selective serotonin reuptake inhibitors are the most frequently used drugs for the treatment of neuropathic pain, although there is little published evidence of their effectiveness in CPSP. Most recently, Mahesh et al.²¹⁴ randomized 82 patients diagnosed with CPSP within the first 60 days post stroke to receive 30 mg duloxetine or placebo daily for 4 weeks. The dose was doubled if there was no response to treatment at two weeks. There were significantly greater reductions in the mean numeric pain intensity (NPI) score at the end of treatment in the duloxetine group (6.51 to 3.02 vs. 6.37 to 4.40, $p=0.02$),

Short-form McGill Pain Questionnaire-2 scores (19.5 to 8.85 vs. 20.3 to 13.3, $p=0.032$) and the Pain Disability Index (PDI) score (42.95 to 24.18 vs. 42.05 to 30.05, $p=0.005$). Adverse events including dizziness, somnolence, and nausea were reported more frequently in the duloxetine group. Vranken et al.²¹⁵ randomized 48 patients with severe neuropathic pain resulting from cerebrovascular lesions ($n=12$) or spinal cord lesions to receive escalating doses of either duloxetine (60 and 120 mg/day) or placebo for 8 weeks. At the end of treatment, the mean pain scores, assessed using a 10-point visual analogue scale (VAS) were reduced from 7.1 to 5.0 (duloxetine) vs. 7.2 to 6.1 (placebo), although the result was not statistically significant ($p=0.06$). 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 subsection of the 36-Item Short Form Survey ($p=0.035$). In an uncontrolled study, Kim et al.²¹⁶ reported that the addition of 30 to 60 mg duloxetine to concurrent pain medications helped to reduce Numeric Rating Scale pain scores by 30% in 70% of 37 patients with CPSP with chronic onset (mean 3.1 years)

Several RCTs have been published evaluating the effectiveness of the anticonvulsant drugs, pregabalin and gabapentin, most of which 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.²¹⁷ 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 on secondary endpoints including some aspects of sleep, anxiety and clinician global impression of change. Adverse events were more frequent with pregabalin causing the discontinuation of treatment in 8.2% of patients compared with 3.7% of placebo patients. Vranken et al.²¹⁸ 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 VAS (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 PDI scores between groups. Serpell et al.²¹⁹ 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 2,400 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 evaluated the potential benefit of the anti-epileptic agent, levetiracetam in patients with CPSP. Jungehulsing et al.²²⁰ included 42 patients with CPSP, of duration greater than 3 months and a score of 4 or greater on 10-point pain intensity scale. Participants were randomized to receive levetiracetam at a maximum dose of 3,000 mg or a placebo over a 24-week study period which included two, 8-week treatment periods. Treatment with levetiracetam was not associated with significantly greater improvement in spontaneous or evoked pain, or any of the secondary measures including the McGill Pain Questionnaire, revised Beck Depression Inventory, or the Short Form-12 Health Survey, with increased frequency of reported side-effects.

Sex & Gender Considerations

No evidence was reviewed suggestive of sex or gender differences in the frequency CPSP or response to treatment.

[Evidence Tables and Reference List 9](#)

Section 10 Bladder and Bowel Function

10. Bladder and Bowel Function, Recommendations 2025

10.1 Bladder Function

10.1.1 Screening of Bladder Function

- i. Individuals with stroke should be screened for urinary incontinence and retention [Strong recommendation; Moderate quality of evidence].

10.1.2 Assessment of Bladder Function

- i. Individuals with stroke experiencing persistent urinary incontinence should be assessed by trained personnel to determine the underlying cause and develop an individualized management plan [Strong recommendation; Moderate quality of evidence].
- ii. The use of a bladder scanner should be considered to assess post-void residual as the preferred least-invasive method [Strong recommendation; Low quality of evidence].

Section 10.1 Clinical Considerations:

1. A structured assessment for urinary incontinence may include:
 - a. Clinical history including location of stroke; past medical history of any previous incontinence or urinary symptoms and associated treatments; past gynecological or urological surgeries; history of vaginal birth; pre-stroke bladder habits and schedule; recent use of an indwelling catheter; current urinary symptoms and incontinence; daily liquid intakes.
 - b. Physical examination including cognitive status, abdominal, pelvic and sacral examination.
 - c. Review of medications for any potential contribution to the urinary symptoms of the individual.
 - d. Use of a bladder voiding calendar, including details such as frequency, urgency, time of voiding or incontinence, difficulties starting urine, and volumes (voided or catheterized).
 - e. Post-voiding residual volumes, measured with a portable ultrasound machine, to rule out incomplete voiding or retention.
 - f. Urinalysis and urine culture and sensitivity if there is suspicion of a urinary tract infection.
 - g. In case of urinary retention, presence of concomitant constipation/fecaloma should be evaluated and appropriately treated.
 - h. Referral to a urologist and/or urodynamic studies in selected cases, to further guide treatment.
2. Individuals with stroke experiencing incontinence should be assessed for environmental and functional factors (e.g. limited mobility, limited communication) that may contribute to urinary incontinence.

10.1.3 Management of Bladder Function

- i. Routine use of indwelling urinary catheters in individuals with stroke is not recommended due to the risk of adverse outcomes, such as urinary tract infections [Strong recommendation; High quality of evidence].

- a. If used, indwelling urinary catheters should be assessed daily and removed as soon as possible [Strong recommendation; High quality of evidence].
- b. Peri care and infection prevention strategies should be implemented to minimize risk of infection [Strong recommendation; Moderate quality of evidence].
- ii. Behavioral interventions, like timed voiding or a systematic voiding program, may be considered to reduce the number of urinary incontinence episodes and to improve quality of life [Strong recommendation; Moderate quality of evidence].
- iii. Pelvic floor muscle training may be used to improve voiding frequency and urinary symptoms (including incontinence) [Strong recommendation; Moderate quality of evidence].
- iv. Medication, such as anti-cholinergic or adrenergic agonists, should be considered for stress incontinence or urinary urgency, to improve urinary frequency and urgency, and decrease episodes of incontinence [Strong recommendation; Moderate quality of evidence].
- v. Transcutaneous electrical nerve stimulation (TENS) may be considered to reduce urinary incontinence after stroke [Strong recommendation; High quality of evidence].

10.2 Bowel Function

10.2.1 Screening of Bowel Function

- i. Individuals with stroke should be screened for fecal incontinence and constipation [Strong recommendation; Moderate quality of evidence].

10.2.2 Assessment of Bowel Function

- i. Individuals with stroke experiencing persistent constipation or bowel incontinence (for more than two weeks) should be assessed by trained personnel to determine the underlying cause and develop an individualized management plan [Strong recommendation; Moderate quality of evidence].

10.2.3 Management of Bowel Function

- i. An educational and behavioural program may be considered to reduce constipation/increase the frequency of bowel movements in individuals with stroke [Strong recommendation; Low quality of evidence].

Section 10.2.3 Clinical Considerations

1. Dietary choices, judicious use of pharmaceutical treatments (e.g. suppositories, stool softeners), abdominal massage, and trans-anal irrigation may be considered as part of a bowel management program.
2. Establish bowel routines, including sitting on toilet at the same time daily; sitting upright with feet supported; with minimum of 10-15 min each time to help evacuate bowel.

Section 10 Additional Clinical Considerations

1. Screening for bladder and bowel incontinence may also take place at various stages throughout the continuum of stroke care, especially at transition points or if there are changes in health status.
2. The use of assistive equipment, clothing design and augmented assistive communication may be considered to prevent and support individuals experiencing bladder and bowel incontinence.

Rationale
<p>Both bowel and bladder incontinence are common complications following a stroke, which negatively affect a person's daily functioning and may cause personal anxiety, leading to reductions in quality of life. These issues arise due to neurological damage that disrupts the control of the bladder and bowel muscles. Incontinence can result in social embarrassment, isolation, and decreased self-esteem, which can hinder recovery and rehabilitation efforts. Additionally, the fear of incontinence may restrict individuals from participating in physical activities or social events. Effective management strategies include bladder training, dietary adjustments, and medications. Individuals with stroke value a person-centred approach to care, including education and management strategies to improve bowel and bladder changes following stroke.</p>
System Implications
<p>To achieve timely and appropriate assessment and management of bladder and bowel function, organizations should optimize the following system components:</p> <ol style="list-style-type: none"> 1. Processes for standardized screening of bladder and bowel function, and subsequent assessment and management if needed. 2. Access to healthcare providers experienced in the field of stroke and bowel and bladder management. 3. Process in place to assess, monitor and document the use of routine indwelling urinary catheters.
Performance Measures
<p>System Indicators</p> <ol style="list-style-type: none"> 1. Availability of healthcare providers with expertise in bowel and bladder management as part of all stroke rehabilitation programs. 2. Availability of inpatient and community-based education and resources for individuals with bladder and bowel dysfunction following stroke. <p>Process Indicators</p> <ol style="list-style-type: none"> 3. Proportion of patients admitted to hospital with a diagnosis of acute stroke who undergo a bladder function assessment during inpatient stay. <p>Patient-Oriented Indicators</p> <ol style="list-style-type: none"> 4. Proportion of patients admitted to hospital with a diagnosis of acute stroke who experience issues with bowel and bladder function during inpatient stay. 5. Proportion of individuals with stroke who develop a urinary tract infection as a result of an indwelling catheter during inpatient stay. 6. Quality of life rating at 30 and 90 days for people who experience complications during acute inpatient admission following acute stroke, using a validated tool.
Implementation Resources and Knowledge Transfer Tools
<p><i>Resources and tools listed below that are external to Heart & Stroke and the Canadian Stroke Best Practice Recommendations may be useful resources for stroke care. However, their inclusion is not an actual or implied endorsement by the Canadian Stroke Best Practices team or Heart & Stroke. The reader is encouraged to review these resources and tools critically and implement them into practice at their discretion.</i></p>

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- Heart & Stroke: FAST Signs of Stroke...what are the other signs?: <https://www.heartandstroke.ca/stroke/signs-of-stroke/fast-signs-of-stroke-are-there-other-signs>
- Heart & Stroke: Your Stroke Journey: <https://www.heartandstroke.ca/-/media/pdf-files/canada/your-stroke-journey/en-your-stroke-journey-v20.pdf>
- Heart & Stroke: Post-Stroke Checklist: https://www.heartandstroke.ca/-/media/1-stroke-best-practices/resources/patient-resources/002-17_csbp_post_stroke_checklist_85x11_en_v1
- Heart & Stroke: Rehabilitation and Recovery Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/rehabilitation-nov2019/csbp-infographic-rehabilitation.pdf?rev=a2cff1fb27424c84bbd44b568d58d1b4>
- Heart & Stroke: Transitions and Community Participation Infographic: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/transition-of-care-nov2019/csbp-infographic-transitions-and-participation.pdf?rev=595e990a17e14232aa3b1c731d983ce3>
- Heart & Stroke Enabling Self-Management Following Stroke Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbpr-enabling-self-management-following-stroke-checklist-jan2021-final.pdf?rev=03b045c41df04abfb7f4cb652869f031>
- Heart & Stroke: Virtual Healthcare Checklist: <https://www.strokebestpractices.ca/-/media/1-stroke-best-practices/resources/patient-resources/csbp-infographic-virtual-healthcare-checklist.pdf?rev=bf2f5b0e9e4a49cfbfc251208b6a15e2>
- Heart & Stroke: Recovery and Support: <https://www.heartandstroke.ca/stroke/recovery-and-support>
- Heart & Stroke: Online and Peer Support: <https://www.heartandstroke.ca/heart-disease/recovery-and-support/the-power-of-community>
- Heart & Stroke: Services and Resources Directory: <https://www.heartandstroke.ca/services-and-resources>
- Heart & Stroke: Bowel and Bladder Problems: <https://www.heartandstroke.ca/stroke/recovery-and-support/physical-changes/bowels-and-bladder>
- The Canadian Continence Foundation: <https://www.canadiancontinence.ca/lived-experience-resources>

- Stroke Engine: <http://www.strokingengine.ca/>

Summary of the Evidence

Urinary Incontinence

Several strategies and interventions have been examined for the management of bladder incontinence post stroke. A Cochrane review ²²¹ included the results of 20 RCTs including 1,338 individuals at varying stages of recovery. Interventions examined included behavioral interventions (pelvic floor muscle training, and timed voiding), specialized professional nurse input, complementary medicine (acupuncture, electroacupuncture and moxibustion), and physical therapy (transcutaneous posterior tibial nerve stimulation [TPTNS], transcutaneous electrical nerve stimulation [TENS] and sensory-motor biofeedback). Compared with usual care or no intervention, based on the results from a single trial, behavioral interventions did not significantly reduce the number of incontinence episodes per 24-hour period (0.2 vs. 1.2; MD= -1.00, 95% CI -2.74 to 0.74), nor were they associated with improvements in quality-of-life (SMD= -0.99, 95% CI -2.83 to 0.86). In contrast, complimentary medicine increased the likelihood of achieving continence after treatment (RR=2.82, 95% CI 1.57 to 5.07) and TENS reduced the number of incontinent episodes in 24 hours (MD= -4.76, 95% CI -8.10 to -1.41). In two systematic reviews examining the benefit of single interventions, Özden et al. ²²² reported that pelvic floor muscle training was not associated with significantly better performance on the 3-day voiding diary (total) at 12 weeks (SMD=0.30, 95% CI -0.23 to 0.95), but was associated with significant improvement in daytime urination frequency and urinary incontinence, in pad tests. Cruz et al. ²²³ included 10 RCTS examining TENS and found that treatment was associated with significantly greater improvements in urinary incontinence measures (SMD=-1.99, 95% CI -3.48 to -0.49).

The effectiveness of bladder-training programs, which typically include timed/prompted voiding, bathroom training, pelvic floor exercises, and/or drug therapy, has been evaluated in a small number of studies. Thomas et al. ²²⁴ conducted a cluster feasibility trial, *Identifying Continence Options after Stroke (ICONS)*. Compared with usual care, the systematic voiding program was not associated with significantly increased odds of being continent at 6 or 12 weeks. In the largest RCT ever planned on the topic of post-stroke urinary incontinence, *ICONS II*, Watkins et al. ²²⁵ planned to randomize 1,024 patients, recruited from 10 stroke units in the UK, to participate in a systematic voiding programme group in which patients received an assessment, and behavioural interventions (bladder training or prompted voiding) or to receive usual care. Unfortunately, due to Covid-19, only 157 patients were recruited, and the trial was halted early. Tibaek et al. ²²⁶ randomized 31 men with lower urinary tract symptoms, one month following stroke, to a pelvic floor muscle training (PFMT) group, who received 12 weekly, 60 minutes sessions + at home exercise program or to a usual care group. There were no significant differences between groups on the primary outcomes (Danish Prostatic Symptom Score and voiding frequency). In an earlier trial Tibaek et al. ²²⁷ which also examined PFMT in 24 women with stress/urge urinary incontinence, the authors reported a significant decrease in voiding frequency in the intervention group, but not the control group.

Pharmacological agents can also be used for the management of urinary incontinence, although there are few trials evaluating their use following stroke. There is a larger evidence base for their use in multiple sclerosis, spinal cord injury and Parkinson's Disease. The use of anticholinergic medications was evaluated in a recent Cochrane review ²²⁸ which included 104 RCTs (n=47,106), mainly men with a symptomatic diagnosis of overactive bladder syndrome, detrusor overactivity, or both. Participants were randomized to receive darifenacin, fesoterodine, imidafenacin, oxybutynin, propiverine, solifenacin, or tolterodine or placebo. Anticholinergic drugs were associated with significantly greater improvements in condition-specific quality of life, and patient perception of cure or improvement, with a significant reduction in the mean number of urgency episodes per 24 hours. However, the risk of adverse events was significantly higher in the active interventions group (RR=3.50, 95% CI 3.26 to 3.75).

Fecal Incontinence

Management strategies for fecal incontinence have not been well studied in the stroke population. In the only RCT on the topic, Harari et al.²²⁹ randomized 146 stroke patients with constipation or fecal incontinence (an average of two years post stroke) to an intervention or control group. The intervention consisted of a one-time nursing assessment (history and rectal examination), followed by patient/carer education (booklet) and provision of diagnostic summary and treatment recommendations, which was sent to the patient's general practitioner. Persons in the intervention group had an average of 5 episodes of fecal incontinence episodes at one and 6 months, compared with 12 and 6 episodes, respectively among persons in the control group. In a recent Cochrane review, Todd et al.²³⁰ examined the use of a variety of conservative therapies and physical therapies in 1,598 participants with central neurological disease or injury, reported in 25 RCTs. Very few pooled analyses were conducted due to limited data availability. The authors concluded that some non-drug treatments, such as probiotics and abdominal massage, may improve self-reported symptoms of constipation, while others, such as holistic nursing assessment, may improve self-reported symptoms of fecal incontinence. The evidence supporting the use of probiotics and nursing assessment, is uncertain.

Sex & Gender Considerations

The incidence of urinary incontinence (UI) post stroke can vary widely from 28% to 79% and appears to be similar men and women.²³¹ Risk factors are also similar between the sexes and include age >70 years, intracranial hemorrhage, pre-stroke disability and stroke severity.²³² The incidence of post-stroke fecal incontinence is much lower than UI. Lucente et al.²³³ reported that 6.4% of 359 patients with acute stroke had fecal incontinence within the first 72 hours of stroke onset, decreasing to 1.9% at 90 days. In the same study, increased stroke severity and hemorrhagic stroke were independent risk factors for fecal incontinence in the acute stage of stroke, while female sex, was not (OR=2.31, 95% CI 0.88–6.08).

[Evidence Tables and Reference List 10](#)

APPENDIX ONE: REHABILITATION, RECOVERY AND COMMUNITY PARTICIPATION FOLLOWING STROKE SCIENTIFIC WRITING GROUP AND AUTHORS 2025

PART TWO: DELIVERY OF STROKE REHABILITATION TO OPTIMIZE FUNCTIONAL RECOVERY

NAME	PROFESSIONAL ROLE	LOCATION	DECLARED CONFLICTS OF INTEREST
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Jennifer K. Yao, MD, FRCPC Module Co-Chair	Medical Manager Acquired Brain Injury Program, G.F. Strong Rehab Centre, Vancouver Coastal Health Clinical Associate Professor, University of British Columbia, Division Head, Division of Physical Medicine and Rehabilitation Writing Group Co-Chair	Vancouver, BC	Support for attending meetings and/or travel from Heart and Stroke Foundation of Canada - reimbursement to self for conference travel Leadership or fiduciary role with Canadian Stroke Best Practice Review Advisory Committee member
Michelle LA Nelson, PhD Section One Co-Lead	Principal Investigator, Science of Care Institute, Lunenfeld-Tanenbaum Research Institute, Sinai Health Associate Professor, University of Toronto, Institute of Health Policy, Management and Evaluation Section One Co-Lead	Toronto, ON	All support for the present manuscript - March of Dimes Canada, World Stroke Organization, American Stroke Association, International Foundation of Integrated Care, small honoraria provided for talk at IFIC conference Grant funding paid from CIHR, Walton's Trust, AMS, paid to Sinai Health Payment or honoraria for speaking at IFIC (International Foundation of

			<p>Integrated Care) educational event</p> <p>Participation on the International Journal of Integrated Care Editorial Board</p> <p>Leadership or fiduciary role at World Stroke Organization, American Stroke Association, International Foundation for Integrated Care</p>
<p>Jing Shi, MD, FRCPC</p> <p>Section One Co-Lead</p>	<p>Director Stroke Rehabilitation, Saskatoon City Hospital</p> <p>Assistant Professor, University of Saskatchewan, Department of Physical Medicine and Rehabilitation</p> <p>Section One Co- Lead</p>	<p>Saskatoon, SK</p>	<p>Grants or contracts from the Saskatchewan Health Research Foundation, all funds directed to research activity costs</p> <p>Leadership or fiduciary role with the Saskatchewan Stroke Expert Panel Advisory Board and as medical director of stroke rehabilitation at Saskatoon City Hospital, as part of the academic clinical alternative payment (ACFP) physician contract</p>
<p>Patrice Lindsay RN, PhD</p>	<p>Previous Lead PWLE Engagement Strategy and Stroke, Heart and Stroke Foundation of Canada; Principal, MarcLind Health Systems and Engagement Consulting.</p>	<p>Toronto, ON</p>	<p>Consulting fees from Canadian Neurological Sciences Federation, payment to self</p> <p>Payment or honoraria from CHEP PLUS, honorarium payment to self</p> <p>Leadership or fiduciary role in other board, society, committee or advocacy group with Canadian Institutes of Health Research – ICRH IAB, unpaid</p>
<p>Ruth Barclay, PhD, MHSc, BMR(PT)</p>	<p>Professor, Department of Physical Therapy, University of Manitoba, Riverview Health Centre</p>	<p>Winnipeg, MB</p>	<p>Grant or contracts from CIHR, not related to manuscript</p> <p>Support for attending meetings and/or travel from CIHR – CIHR reviewer, not related to manuscript</p> <p>Leadership or fiduciary role on editorial board of the Journal of Aging and</p>

			Physical Activity until January 2025, unpaid
Diana Bastasi, B.Sc. (PT), MBA	Coordinator of Physiotherapy In-patient Services, The McGill University Health Centre, Montreal General Hospital Faculty (part-time) Lecturer, McGill University, School of Physical and Occupational Therapy	Montreal, QC	None to declare
Dylan Blacquiere, MD MSc	Medical Director, Champlain Regional Stroke Network Assistant Professor, University of Ottawa, Department of Medicine, Division of Neurology	Ottawa, ON	Payment or honoraria from Healthing (honorarium), Heart and Stroke Foundation of New Brunswick (Lecture honorarium), payment to self Payment for expert testimony from Burchells LLP, payment to self Participation on a Data Safety Monitoring Board or Advisory board with Abbevie – advisory board payment to self Leadership or fiduciary role with Heart and Stroke Foundation of Canada Stroke Best Practice Guidelines; Canadian Stroke Consortium – unpaid advisory/executive board
Mark I. Boulos, MD FRCPC, CSCN(EEG), MSc	Hurvitz Brain Sciences Research Program, Sunnybrook Research Institute, Sunnybrook Health Sciences Centre Department of Medicine, Division of Neurology, University of Toronto	Toronto, ON	Grants or contracts from Canadian Institutes of Health Research; Alternative Funding Plan from the Academic Health Sciences Centres of Ontario; Heart & Stroke Foundation of Canada; Division of Neurology at the University of Toronto; Sunnybrook Education Advisory Council and Education Research Unit; Ontario Genomics; Toronto Dementia Research Alliance, paid to my institution Consulting fees from Precision AQ, paid to self Payment or honoraria for lectures, presentations,

			<p>speakers bureaus, manuscript writing or educational events from Paladin Labs; Jazz Pharmaceuticals; Eisai, paid to self</p> <p>Receipt of equipment, materials, drugs, medical writing, gifts or other services from Braebon Medical Corporation, In-kind support to Dr. Boulos' research program</p>
Joy Boyce, OT Reg. (NS), BScOT and BA Hons	Occupational Therapist, Early Supported Stroke Discharge Coordinator, Nova Scotia Health Authority	Halifax, NS	Leadership or fiduciary role with the Atlantic Canada Stroke conference committee, co-chair and member
Geneviève Claveau, MD, FRCPC	<p>Staff Psychiatrist, Stroke and Non-Traumatic Brain Injury Program, Institut de réadaptation Gingras-Lindsay de Montréal</p> <p>Clinical Associate Professor, Division of Physical Medicine and Rehabilitation, Department of Medicine and Medical Specialties, Université de Montréal</p>	Montreal, QC	<p>Receipt of equipment, materials, drugs, medical writing, gifts or other services From Abbvie, Merz, Ipsen that included free lunches, educational material (handbooks) and participation in local conferences/educational sessions organized by them</p>
Norine Foley, MSc	Partner, workHORSE Consulting Group	London, ON	None to declare
Heather L. Flowers, PhD, SLP (C), Reg. CASLPO, CCC-SLP	Associate Professor, University of Ottawa, School of Rehabilitation Sciences, Faculty of Health Sciences,	Ottawa, ON	None to declare
Urvashy Gopaul, MSc, PhD, PT	Toronto Rehabilitation Institute-KITE Research	Toronto, ON	None to declare
Esther S. Kim, PhD, R.SLP, CCC-SLP	Professor, Chair, University of Alberta, Department of Communication Sciences and Disorders	Edmonton, AB	<p>Grants or contracts from SSHRC, CIHR - Unrelated to this manuscript, payment to institution</p> <p>Support for attending meetings and/or travel with University of Alberta and Canadian Stroke Congress, conference travel support (reimbursements)</p> <p>Leadership or fiduciary role as chair of the Council of Chairs of Canadian University Programs in</p>

			Speech-Language Pathology and Audiology (CCUP), unpaid Other financial or non-financial disclosures, salary from University of Alberta
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Rebecca Lund MSc (OT), OT Reg. (Ont.)	Manager, Stroke, Heart and Stroke Foundation of Canada	Toronto, ON	None to declare
Chelsy Martin PT, MScPT	Project Lead, Stroke Best Practices, Heart and Stroke Foundation of Canada	Ottawa, ON	None to declare
Alison M. McDonald, BScPT	Physiotherapist, Acquired Brain Injury Program, Nova Scotia Rehabilitation and Arthritis Centre Adjunct Professor (Clinical) Dalhousie University, School of Physiotherapy	Halifax, NS	None to declare
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Sarvenaz Mehrabi MD, MSc	Lawson Research Institute, St. Joseph's Health care London, Department of Physical Medicine and Rehabilitation	London, ON	All support for the present manuscript - helped in providing data through: 1) Database systematic searches & review, 2) updating evidence-based tables - paid by my employer, funded by St. Joseph healthcare London and Heart & Stroke foundation of Canada.
Anita Mountain, MD, FRCPC	Medical Lead, Acquired Brain Injury Program, Queen Elizabeth II Health Sciences Centre	Halifax, N.S	All support for the present manuscript, Heart and Stroke Foundation of Canada, no payments

	Assistant Professor Division of Physical Medicine & Rehabilitation, Department of Medicine, Dalhousie University		Grants or contracts from any entity - Qualified site investigator for research supported by Brain Canada, Heart and Stroke Foundation of Canada, Canadian Partnership for Stroke Recovery/CIHR/Governors of the University of Calgary. No payments to self. Support for research coordinator and research activities related to research grants from primary organization Leadership or fiduciary role as Rehabilitation co-chair for Canadian Stroke Best Practice Recommendations Advisory Committee, no payments.
Colleen O'Connell, MD, FRCPC	Medical and Research Director, Stan Cassidy Centre for Rehabilitation, Horizon Health Network Professor, Dalhousie University Faculty of Medicine, Dalhousie Medicine New Brunswick Clinical Research Director, Institute for Biomedical Engineering University of New Brunswick	Fredericton, N.B	Payments for lectures provided from MT Pharma Leadership or fiduciary role as Chair of Canadian Physiatry Research and Development Foundation, volunteer role
Colleen O'Connor, PhD, RD	Associate Professor and Undergraduate Program Chair, Brescia School of Food and Nutritional Sciences, Western University	London, ON	None to declare
Kara K. Patterson, PT, PhD	Senior Scientist, The KITE Research Institute, University Health Network Associate Professor University of Toronto, Department of Physical Therapy	Toronto, ON	Grants or contracts from Canadian Institutes of Health Research project grant; Heart and Stroke Grant in Aid; Rehabilitation Science Research Network for COVID catalyst grant, payments made to KITE Research Institute Support for attending meetings and/or travel, Heart and Stroke - Grant in Aid reviews, Stroke Cog Canadian Stroke Congress, travel expense reimbursement

			Leadership or fiduciary role as board member of the International Society for Posture and Gait Research
Tricia Shoniker, OT Reg. (Ont.), BSc OT, MOT	Occupational Therapist, Stroke, Neurological Program Parkwood Institute Professor, Fanshawe College, School of Health Sciences	London, ON	None to declare
Debbie Timpson, BSc(PT), MD, FRCPC	Physiatrist, Chief of Rehabilitation, Pembroke Regional Hospital	Pembroke, ON	Participation on a Data Safety Monitoring Board or Advisory board with Canadian Stroke Best Practice Recommendations Advisory Committee
Theodore Wein, MD, FRCPC, FAHA	Assistant Professor of Neurology and Neurosurgery, McGill University	Montreal, QC	Research grant, consulting fees, honoraria, honoraria for lectures, presentations, speaker's bureaus, manuscript writing or educational events, support for attending meetings and/or travel, plane ticket provided from Abbvie, Ipsen Participation on a Data Safety Monitoring Board or Advisory Board, Pharmazzz, Syneos, Artivion, payment to self
Janice Wright, MS, ACNP(c), RN-EC	Nurse Practitioner, Rehabilitation and Restorative Medicine, Hotel Dieu Shaver	St. Catharines, ON	None to declare
Brenda Yeates, MSW, RSW	Social Worker, Stroke Early Supported Discharge Team, Queen Elizabeth II Health Centre Ambulatory Care Centre	Grand Prairie, AB	Support for attending meetings and/or travel from Alberta Health Services, paid my wage to attend Writing Group Zoom Meetings as they took place during work time
Jeanne Yiu, OTR, BSc (OT), MSc (Rehab Sciences)	Regional Clinical Resource Educator, Occupational Therapy, Vancouver Coastal Health. Clinical Associate Professor, Department of Occupational Science & Occupational Therapy, Faculty of Medicine, University of British Columbia	Vancouver, BC	Support for attending meetings and/or travel from Vancouver Coastal Health, attended meetings during work hours

PART ONE: STROKE REHABILITATION PLANNING FOR OPTIMAL CARE DELIVERY

NAME	PROFESSIONAL ROLE	LOCATION	DECLARED CONFLICTS OF INTEREST
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<p>Jing Shi, MD, FRCPC Section Co-Lead</p>	<p>Director Stroke Rehabilitation, Saskatoon City Hospital</p> <p>Assistant Professor, University of Saskatchewan, Department of Physical Medicine and Rehabilitation</p> <p>Section Lead</p>	<p>Saskatoon, SK</p>	<p>Grants or contracts from the Saskatchewan Health Research Foundation, all funds directed to research activity costs</p> <p>Leadership or fiduciary role with the Saskatchewan Stroke Expert Panel Advisory Board and as medical director of stroke rehabilitation at Saskatoon City Hospital, as part of the academic clinical alternative payment (ACFP) physician contract</p>

<p>Nancy M. Salbach, PT, PhD Module Co-Chair</p>	<p>Professor, University of Toronto, Department of Physical Therapy The KITE Research Institute, Toronto Rehabilitation Institute- University Health Network Writing Group Co-Chair</p>	<p>Toronto, ON</p>	<p>All support for the present manuscript - Toronto Rehabilitation Institute Chair at the University of Toronto, payment to institution Grant or contracts with Canadian Institutes of Health Research, payment to institution Honorarium for a lecture with Canadian Institutes for Health Research, honorarium paid to self from research team</p>
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<p>Louis-Pierre Auger, OT, PhD</p>	<p>Postdoctoral Fellow, Institute of Health Sciences Education, Faculty of Medicine and Health Sciences, McGill University School of Physical and Occupational Therapy, Faculty of Medicine and Health Sciences, McGill University Center for Interdisciplinary Research in Rehabilitation of the Greater Montreal</p>	<p>Montreal, QC</p>	<p>All support for the present manuscript - Fonds de recherche du Québec, Santé, Doctoral scholarship and postdoctoral fellowship Grants or contracts from Fonds de recherche du Québec - Santé for postdoctoral fellowship</p>
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<p>Dylan Blacquiere, MD MSc</p>	<p>Medical Director, Champlain Regional Stroke Network Assistant Professor, University of Ottawa, Department of Medicine, Division of Neurology</p>	<p>Ottawa, ON</p>	<p>Payment or honoraria from Healthing (honorarium), Heart and Stroke Foundation of New Brunswick (Lecture honorarium), payment to self</p>

			<p>Payment for expert testimony from Burchells LLP, payment to self</p> <p>Participation on a Data Safety Monitoring Board or Advisory board with Abbevie – advisory board payment to self</p> <p>Leadership or fiduciary role with Heart and Stroke Foundation of Canada Stroke Best Practice Guidelines; Canadian Stroke Consortium – unpaid advisory/executive board</p>
Rebecca Bowes, HBA	Stroke Navigator, West GTA Stroke Network, Trillium Health Partners	Toronto, ON	<p>Support for attending meetings and/or travel from Trillium Health Partners, West GTA Stroke Network, paid by employer; participation paid as part of work role/duties</p> <p>Other financial or non-financial interests - Trillium Health Partners, West GTA Stroke Network, I was supported to participate as part of my regular salaried duties</p>
Imane Samah Chibane, MD	<p>Neurologist, Hôpital du Sacré-Cœur de Montréal, CIUSSS du Nord de l'Île de Montréal and Institut de réadaptation Gingras-Lindsay de Montréal (IRGLM)</p> <p>Assistant Professor Université de Montréal, Department of Neurosciences</p>	Montréal, QC	<p>Consulting fees from Merz, consultant as a moderator for an educational program</p>
Sarah J. Courtice MD, FRCPC	<p>Medical Manager ABI/Stroke and Transitional Rehabilitation Programs, GF Strong Rehabilitation Centre, Vancouver Coastal Health</p> <p>Clinical Instructor, University of British Columbia, Division of Physical Medicine and Rehabilitation</p>	Vancouver, BC	<p>Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid - Medical manager for the ABI and TRU programs at GF Strong Rehabilitation Centre - Physician leadership within health authority</p>

Rhina Delgado, BSc.OT	Stroke Service Coordinator, Stroke Program Edmonton Zone, Alberta Health Services	Edmonton, AB	None to declare
Melanie Dunlop, NP, BScN, MN, BA	Acquired Brain Injury Nurse Practitioner, Nova Scotia Rehabilitation & Arthritis Center	Halifax, NS	Support for attending meetings and/or travel - funding from NS Health to attend and present at ICN APN conference; not related to stroke practice
Norine Foley, MSc	Partner, workHORSE Consulting Group	London, ON	None to declare
Kimia Ghavami, MD FRCPC FCSCE	Neurologist, Vancouver Stroke Program, Vancouver General Hospital Clinical Assistant Professor, University of British Columbia, Division of Neurology	Vancouver, BC	Payment or honoraria for lectures provided to students and residents as part of teaching commitment with the University of British Columbia Leadership or fiduciary role with Stroke Services BC, Acute Medical Chair
Teresa Guolla, OT Reg.(Ont.), MHA., BSc.OT	National Lead, Program Development and Clinical Integration, Vision Loss Rehabilitation Canada, Inc.	Ottawa, ON	Consulting fees from the Canadian National Institute for the blind for consulting on visual accessibility of the environment, payments directly to self. Payment or honoraria from the Ontario stroke network (SE, NW, SW), Montfort Hospital, Ontario Society for Occupational Therapists, The Ottawa Hospital, Sunnybrook Hospital, Ottawa Home and Community Support, Queen's University Occupational Therapy Program, Ontario Regional Rehabilitation Coordinators, Sudbury General Hospital, small honoraria were paid either to my institution (Vision Loss Rehabilitation Canada) or to self. Leadership or fiduciary role in other board, society, committee or advocacy

			group, with the Academy for Certification of Vision Rehabilitation Specialists (ACVREP) committee on certification standards for occupational therapists - unpaid
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Patrice Lindsay RN, PhD	Previous Lead PWLE Engagement Strategy and Stroke, Heart and Stroke Foundation of Canada; Principal, MarcLind Health Systems and Engagement Consulting	Toronto, ON	Consulting fees from Canadian Neurological Sciences Federation, payment to self Payment or honoraria from CHEP PLUS, honorarium payment to self Leadership or fiduciary role in other board, society, committee or advocacy group with Canadian Institutes of Health Research – ICRH IAB, unpaid
Rebecca Lund MSc (OT), OT Reg. (Ont.)	Manager, Stroke, Heart and Stroke Foundation of Canada	Toronto, ON	None to declare
Sandra MacFayden, P.T.	PT, Provincial Ambulatory Stroke Clinic, Queen Elizabeth Hospital	Charlottetown, PE	None to declare
Chelsy Martin PT, MScPT	Project Lead, Stroke Best Practices, Heart and Stroke Foundation of Canada	Ottawa, ON	None to declare
Jasmine Masse, BSW, RSW	Social Worker, Community Stroke Care Service	Winnipeg, MB	Support for attending meetings and/or travel from Winnipeg Regional Health Authority, have been supported by my workplace but only through payment of regular wage during scheduled work hours when attending meetings for SBPR
Anita Mountain, MD, FRCPC	Medical Lead, Acquired Brain Injury Program, Queen Elizabeth II Health Sciences Centre Assistant Professor Division of Physical Medicine &	Hallifax, NS	All support for the present manuscript, Heart and Stroke Foundation of Canada, no payments Grants or contracts from any entity - Qualified site

	Rehabilitation, Department of Medicine, Dalhousie University;		investigator for research supported by Brain Canada, Heart and Stroke Foundation of Canada, Canadian Partnership for Stroke Recovery/CIHR/Governors of the University of Calgary. No payments to self. Support for research coordinator and research activities related to research grants from primary organization Leadership or fiduciary role as Rehabilitation co-chair for Canadian Stroke Best Practice Recommendations Advisory Committee, no payments.
Colleen O’Connell, MD, FRCPC	Medical and Research Director, Stan Cassidy Centre for Rehabilitation, Horizon Health Network Professor, Dalhousie University Faculty of Medicine, Dalhousie Medicine New Brunswick Clinical Research Director, Institute for Biomedical Engineering University of New Brunswick	Fredericton, N.B	Payments for lectures provided from MT Pharma Leadership or fiduciary role as Chair of Canadian Physiatry Research and Development Foundation, volunteer role
Phyllis G. Paterson, PhD	Professor Emerita, University of Saskatchewan, College of Pharmacy and Nutrition	Saskatoon, SK	Grant or contracts from CIHR; Saskatchewan Flax Development Commission – payments made to institution
Benjamin R. Ritsma, MD, FRCPC	Clinical Director – Rehabilitation, Providence Care Hospital Assistant Professor Queen’s University, Department of Physical Medicine and Rehabilitation	Kingston, ON	Grants or contracts from SEAMO (Southeastern Ontario Academic Medical Organization) Endowed Scholarship and Education Fund; University Hospitals Kingston Foundation (UHKF); Brain Canada - Platform Support Grants (PSG); Heart & Stroke – Grant-in-Aid (GIA) Program Grant; Canada Research Coordinating Committee (CRCC) – New Frontiers in

			<p>Research Fund (NFRF) - Exploration Grants. All funds directly to research activity costs.</p> <p>Leadership or fiduciary role with Stroke Rehabilitation Advisory Committee (Co-Chair) –Ontario Health - CorHealth; Stroke Network of Southeastern Ontario (Member) – Regional Stroke Steering Committee (RSSC); Community Stroke Rehabilitation (CSR) Initiative - Expert Panel – Ontario Health - CorHealth Ontario; Community Stroke Rehabilitation (CSR) Initiative - Executive Committee –Ontario Health - CorHealth Ontario; Stroke Leadership Council – Ontario Health - CorHealth Ontario. All unpaid.</p>
Elyse Shumway, SLP, M.A.	<p>Director, Clinical and Education Services, Aphasia Institute</p> <p>Adjunct Lecturer (Status Only), University of Toronto, Department of Rehabilitation Science</p>	Toronto, ON	None to declare
Ada Tang, PT PhD	Professor and Assistant Dean (Rehabilitation Science) McMaster University, School of Rehabilitation Science	Hamilton, ON	<p>Grants or contracts from Canadian Institutes of Health Research, Heart & Stroke, Physiotherapy Foundation of Canada. Paid to institution.</p> <p>Payment or honoraria for lectures, presentations, speakers' bureaus, manuscript writing or educational events from Canadian Society for Exercise Physiology, Canadian Physiotherapy Association Neurosciences Division. Paid to self.</p> <p>Support for attending meetings and/or travel for Work Congress for Neurorehabilitation, paid to self.</p>

			Participation on a Data Safety Monitoring or Advisory board with CanStim
Alda Tee, MHS., BSc.PT reg. PT	Regional Rehabilitation Coordinator, Central East Stroke Network Royal Victoria Regional Health Centre	Barrie, ON	None to declare
Debbie Timpson, BSc(PT), MD, FRCPC	Physiatrist, Chief of Rehabilitation, Pembroke Regional Hospital	Pembroke, ON	Participation on a Data Safety Monitoring Board or Advisory board with Canadian Stroke Best Practice Recommendations Advisory Committee
Clinton Yin Hang Tsang, MPH, MSc, RSLP	Regional Practice Initiatives Lead, Professional Practice Allied Health, Vancouver Coastal Health Clinical Assistant Professor, School of Audiology and Speech Sciences, University of British Columbia	Vancouver, BC	None to declare
Stacey Turnbull, RN CRN	Nurse Coordinator, Provincial Ambulatory Stroke Rehabilitation Services PEI	Charlottetown, PEI	None to declare
Katie White, B.Sc.PT, M.Sc	Director, Health Systems, Heart and Stroke Foundation of Canada Previous: Lead, Provincial Clinical Initiatives and Innovation, Stroke Services BC, Provincial Health Services Authority	Vancouver, BC	None to declare

APPENDIX TWO: DELIVERY OF STROKE REHABILITATION TO OPTIMIZE FUNCTIONAL RECOVERY, EXTERNAL REVIEWERS 2025

NAME	PROFESSIONAL ROLE	LOCATION	DECLARED CONFLICTS OF INTEREST
Zainab Al Lawati MD, MedEd, FRCPC, FAAPMR	Spasticity Director, Assistant Professor, University of Miami, Department of PM&R	USA	None to declare
Paula Barker MD, FRCPC	Clinical Assistant Professor, Memorial University	Corner Brook, NL	None to declare
Joyce L Chen BSc PT, PhD	Associate Professor, University of Toronto, Faculty of Kinesiology and Physical Education	Toronto, ON	None to declare
Jill Congram, RN, BN	Nurse Clinician, Tertiary Neuro Rehabilitation	Calgary, AB	None to declare
Kenneth Curtis OT(R)NL	OT Clinical Lead, NLHS-LG Zone	Lab City, NL	None to declare
Céline Ducroux MD, MSc	Stroke Physician Assistant Professor, University of Ottawa, Department of Medicine	Ottawa, ON	Currently participating, or have participated within the past two years, in a clinical trial as Co-investigator on Clinical Trial for Escape Mevo, EASI toc
Hillel M. Finestone MDCM, FRCPC	Physiatrist, Director of Stroke Rehabilitation Research, Bruyere Continuing Care, Elisabeth Bruyere Hospital Professor, University of Ottawa, Department of Medicine, Division of Physical Medicine and Rehabilitation	Ottawa, ON	None to declare

Margaret Grant MScOT(c), BScOT	Senior Consultant, Alberta Health Services	Calgary, AB	All support for the work reported in the manuscript – Alberta Health Services, employee Support for attending meetings and/or travel, congress fee for Canadian Stroke Congress in Calgary was covered through Canadian Stroke Congress, Congress EyeSee After Stroke Pre-Conference Workshop Planning Committee
Mary E. Halpine MD, FRCPC	Head of Neurorehabilitation program, Moncton City Hospital Associate Professor, Dalhousie University, Faculty of Medicine	Halifax, NS	None to declare
Anne Harris, MScPT	Physiotherapist, Acquired Brain Injury Unit, GF Strong Rehab Centre Vancouver Coastal Health	Vancouver, BC	Received/will be receiving a grant or honorarium CIHR Project Grant (2020-2024), co-applicant Currently participating, or have participated within the past two years in a clinical trial - University of British Columbia, clinical therapist
Sylvie Houde, MD, FRCP	Physiatre, neurologue, gestionnaire médical du programme AVC et autres lésions neurologiques acquises non-traumatiques Professeure adjointe de Clinique, Université de Montréal, département de médecine de réadaptation	Montréal QC	None to declare

Dorothy Kessler PhD, O.T. Reg. (Ont.)	Associate Professor, Queen's University, School of Rehabilitation Therapy	Kingston, ON	Received/will be receiving a grant or honorarium from Queen's University and Providence Care for Scientist in Rehabilitation fellowship
Jaylyn Leighton, PhD	Postdoctoral Fellow, Lunendeld-Tanenbaum Research Institute, Sinai Health	Toronto, ON	None to declare
Swati Mehta, PhD	Assistant Professor, Scientist, Western University, Schulich School of Medicine and Dentistry, Lawson Research Institute	London, ON	None to declare
Stuart Miller BScPT	Physiotherapist, Community Accessible Rehabilitation, Alberta Health Services	Calgary, AB	All support for the work reported in the manuscript – AHS, employee of Alberta Health Services Involved in other investment(s) or relationship(s) that could be seen by a reasonable, well-informed participant as having the potential to influence the content of the educational activity - participated in developing National FES Toolkit however I declined any honorarium or funding for this
Jennifer Milliken RD, HBSc	Clinical Neurological Sciences, Registered Dietitian, London Health Sciences Centre	London, ON	None to declare
Luciana de Oliveira Neves, MD, MSc	Former Head of Neurology and Head of Palliative Care, Hospital São Carlos University of Fortaleza, Department of Public Health	Brazil	All support for the work reported in the manuscript – UNIFOR, I am doing a postgraduate degree (doctorate)

Asha Shelton, Speech-Language Pathologist Reg. CASLPO	S-LP, North & East GTA Stroke Network, Regional Stroke Best Practice Team, Sunnybrook Health Science Centre Adjunct Lecturer, University of Toronto, Department of Speech-Language Pathology	Toronto, ON	None to declare
Shamala Thilarajah, PhD	Allied Health Research & Innovation Lead (Implementation Science), Snr Principal Physiotherapist Associate Professor, Singapore Institute of Technology	Singapore	None to declare
Ankur Wadhwa, MD, DM, FRCPC, Fellowship Canadian Stroke Consortium - scholar	Assistant Professor, University of Manitoba	Winnipeg, MB	None to declare

APPENDIX THREE: REFERENCES

1. Nelson MLA, Hanna E, Hall S, Calvert M. What makes stroke rehabilitation patients complex? Clinician perspectives and the role of discharge pressure. *J Comorb*. 2016;6:35-41.
2. Holodinsky JK, Lindsay P, Yu AYZ, Ganesh A, Joundi RA, Hill MD. Estimating the Number of Hospital or Emergency Department Presentations for Stroke in Canada. *Can J Neurol Sci*. 2023;50:820-825.
3. Government of Canada. Canadian Chronic Disease Surveillance System (CCDSS). 2023; <https://health-infobase.canada.ca/ccdss/data-tool/Index>. Accessed March 3, 2025.
4. Kapral MK, Hall R, Fang J, et al. Predictors of Hospitalization in Patients With Transient Ischemic Attack or Minor Ischemic Stroke. *Can J Neurol Sci*. 2016;43:523-528.
5. Canadian Institutes of Health Research. Transitions in Care: Overview. 2019; <http://www.cihr-irsc.gc.ca/e/50972.html> Accessed October 31, 2024.
6. World Health Organization. International Classification of Functioning, Disability and Health. 2001; <https://iris.who.int/bitstream/handle/10665/42407/9241545429-eng.pdf>. Accessed June 12, 2024.
7. Li S, Francisco GE, Rymer WZ. A New Definition of Poststroke Spasticity and the Interference of Spasticity With Motor Recovery From Acute to Chronic Stages. *Neurorehabil Neural Repair*. 2021;35:601-610.
8. Canadian Stroke Best Practices. Canadian Stroke Best Practice Recommendations. Overview of Methodology 7th Edition 2019-2023; <https://www.strokebestpractices.ca/recommendations/overview-methods-and-knowledge-translation>. Accessed March 3, 2025.
9. Brouwers MC, Kho ME, Browman GP, et al. AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ*. 2010;182:E839-842.
10. Guyatt G, Oxman AD, Akl EA, et al. GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables. *J Clin Epidemiol*. 2011;64:383-394.
11. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008;336:924-926.
12. Guyatt GH, Oxman AD, Kunz R, Vist GE, Falck-Ytter Y, Schünemann HJ. What is "quality of evidence" and why is it important to clinicians? *BMJ*. 2008;336:995-998.
13. Schünemann H B, Guyatt G, Oxman A, editors. GRADE handbook for grading quality of evidence and strength of recommendations. 2013; <https://guidelinedevelopment.org/handbook>. Accessed March 3, 2025.
14. French B, Thomas LH, Coupe J, et al. Repetitive task training for improving functional ability after stroke. *Cochrane Database Syst Rev*. 2016;11:Cd006073.

15. Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: a systematic review. *The Lancet Neurology*. 2009;8:741-754.
16. Shimodozono M, Noma T, Nomoto Y, et al. Benefits of a repetitive facilitative exercise program for the upper paretic extremity after subacute stroke: a randomized controlled trial. *Neurorehabil Neural Repair*. 2013;27:296-305.
17. Tenberg S, Mueller S, Vogt L, et al. Comparative Effectiveness of Upper Limb Exercise Interventions in Individuals With Stroke: A Network Meta-Analysis. *Stroke*. 2023;54:1839-1853.
18. Khan MA, Fares H, Ghayvat H, et al. A systematic review on functional electrical stimulation based rehabilitation systems for upper limb post-stroke recovery. *Front Neurol*. 2023;14:1272992.
19. Eraifej J, Clark W, France B, Desando S, Moore D. Effectiveness of upper limb functional electrical stimulation after stroke for the improvement of activities of daily living and motor function: a systematic review and meta-analysis. *Syst Rev*. 2017;6:40.
20. Vafadar AK, Côté JN, Archambault PS. Effectiveness of functional electrical stimulation in improving clinical outcomes in the upper arm following stroke: a systematic review and meta-analysis. *Biomed Res Int*. 2015;2015:729768.
21. Dromerick AW, Lang CE, Birkenmeier RL, et al. Very Early Constraint-Induced Movement during Stroke Rehabilitation (VECTORS): A single-center RCT. *Neurology*. 2009;73:195-201.
22. Wolf SL, Winstein CJ, Miller JP, et al. Effect of constraint-induced movement therapy on upper extremity function 3 to 9 months after stroke: the EXCITE randomized clinical trial. *JAMA*. 2006;296:2095-2104.
23. Page SJ, Boe S, Levine P. What are the "ingredients" of modified constraint-induced therapy? An evidence-based review, recipe, and recommendations. *Restor Neurol Neurosci*. 2013;31:299-309.
24. Kwakkel G, Winters C, van Wegen EE, et al. Effects of Unilateral Upper Limb Training in Two Distinct Prognostic Groups Early After Stroke: The EXPLICIT-Stroke Randomized Clinical Trial. *Neurorehabil Neural Repair*. 2016;30:804-816.
25. Liu XH, Huai J, Gao J, Zhang Y, Yue SW. Constraint-induced movement therapy in treatment of acute and sub-acute stroke: a meta-analysis of 16 randomized controlled trials. *Neural Regen Res*. 2017;12:1443-1450.
26. Corbetta D, Sirtori V, Castellini G, Moja L, Gatti R. Constraint-induced movement therapy for upper extremities in people with stroke. *Cochrane Database Syst Rev*. 2015;2015:Cd004433.
27. Gao Q, Zhang Y, Long J, Pan M, Wang J, Yang F. Effect of different constraint-induced movement therapy protocols on recovery of stroke survivors with upper extremity dysfunction: a systematic review and network meta-analysis. *Int J Rehabil Res*. 2023;46:133-150.
28. Thieme H, Morkisch N, Mehrholz J, et al. Mirror therapy for improving motor function after stroke. *Cochrane Database Syst Rev*. 2018;7:Cd008449.

29. Yang Y, Zhao Q, Zhang Y, Wu Q, Jiang X, Cheng G. Effect of Mirror Therapy on Recovery of Stroke Survivors: A Systematic Review and Network Meta-analysis. *Neuroscience*. 2018;390:318-336.
30. Zeng W, Guo Y, Wu G, Liu X, Fang Q. Mirror therapy for motor function of the upper extremity in patients with stroke: A meta-analysis. *J Rehabil Med*. 2018;50:8-15.
31. Barclay RE, Stevenson TJ, Poluha W, Semenko B, Schubert J. Mental practice for treating upper extremity deficits in individuals with hemiparesis after stroke. *Cochrane Database Syst Rev*. 2020;5:Cd005950.
32. Chen J, Or CK, Chen T. Effectiveness of Using Virtual Reality-Supported Exercise Therapy for Upper Extremity Motor Rehabilitation in Patients With Stroke: Systematic Review and Meta-analysis of Randomized Controlled Trials. *J Med Internet Res*. 2022;24:e24111.
33. Laver KE, Lange B, George S, Deutsch JE, Saposnik G, Crotty M. Virtual reality for stroke rehabilitation. *Cochrane Database Syst Rev*. 2017;11:Cd008349.
34. Adie K, Schofield C, Berrow M, et al. Does the use of Nintendo Wii Sports(TM) improve arm function? Trial of Wii(TM) in Stroke: a randomized controlled trial and economics analysis. *Clin Rehabil*. 2017;31:173-185.
35. Brunner I, Skouen JS, Hofstad H, et al. Virtual Reality Training for Upper Extremity in Subacute Stroke (VIRTUES): A multicenter RCT. *Neurology*. 2017;89:2413-2421.
36. Saposnik G, Cohen LG, Mamdani M, et al. Efficacy and safety of non-immersive virtual reality exercising in stroke rehabilitation (EVREST): a randomised, multicentre, single-blind, controlled trial. *The Lancet. Neurology*. 2016;15:1019-1027.
37. Kong KH, Loh YJ, Thia E, et al. Efficacy of a Virtual Reality Commercial Gaming Device in Upper Limb Recovery after Stroke: A Randomized, Controlled Study. *Top Stroke Rehabil*. 2016;23:333-340.
38. Harris JE, Eng JJ, Miller WC, Dawson AS. A self-administered Graded Repetitive Arm Supplementary Program (GRASP) improves arm function during inpatient stroke rehabilitation: a multi-site randomized controlled trial. *Stroke*. 2009;40:2123-2128.
39. Hunter SM, Johansen-Berg H, Ward N, et al. Functional Strength Training and Movement Performance Therapy for Upper Limb Recovery Early Poststroke-Efficacy, Neural Correlates, Predictive Markers, and Cost-Effectiveness: FAST-INdiCATE Trial. *Front Neurol*. 2017;8:733.
40. Harris JE, Eng JJ. Strength training improves upper-limb function in individuals with stroke: a meta-analysis. *Stroke*. 2010;41:136-140.
41. Gnanaprakasam A, Karthikbabu S, Ravishankar N, Solomon JM. Effect of task-based bilateral arm training on upper limb recovery after stroke: A systematic review and meta-analysis. *J Stroke Cerebrovasc Dis*. 2023;32:107131.
42. Chen S, Qiu Y, Bassile CC, Lee A, Chen R, Xu D. Effectiveness and Success Factors of Bilateral Arm Training After Stroke: A Systematic Review and Meta-Analysis. *Front Aging Neurosci*. 2022;14:875794.

43. van Delden AE, Peper CE, Beek PJ, Kwakkel G. Unilateral versus bilateral upper limb exercise therapy after stroke: a systematic review. *J Rehabil Med.* 2012;44:106-117.
44. Coupar F, Pollock A, van Wijck F, Morris J, Langhorne P. Simultaneous bilateral training for improving arm function after stroke. *Cochrane Database Syst Rev.* 2010;2010:Cd006432.
45. Thijs L, Voets E, Denissen S, et al. Trunk training following stroke. *Cochrane Database Syst Rev.* 2023;3:Cd013712.
46. Zhang Q, Fu C, Liang Z, et al. The effect of adding trunk restraint to task-oriented training in improving function in stroke patients: A systematic review and meta-analysis. *NeuroRehabilitation.* 2020;46:95-108.
47. Alexander J, Dawson J, Langhorne P. Dynamic hand orthoses for the recovery of hand and arm function in adults after stroke: A systematic review and meta-analysis of randomised controlled trials. *Top Stroke Rehabil.* 2022;29:114-124.
48. Elsner B, Kugler J, Pohl M, Mehrholz J. Transcranial direct current stimulation (tDCS) for improving activities of daily living, and physical and cognitive functioning, in people after stroke. *Cochrane Database Syst Rev.* 2020;11:Cd009645.
49. Chhatbar PY, Ramakrishnan V, Kautz S, George MS, Adams RJ, Feng W. Transcranial Direct Current Stimulation Post-Stroke Upper Extremity Motor Recovery Studies Exhibit a Dose-Response Relationship. *Brain Stimul.* 2016;9:16-26.
50. Harvey RL, Edwards D, Dunning K, et al. Randomized Sham-Controlled Trial of Navigated Repetitive Transcranial Magnetic Stimulation for Motor Recovery in Stroke. *Stroke.* 2018;49:2138-2146.
51. Edwards DJ, Liu CY, Dunning K, et al. Electric Field Navigated 1-Hz rTMS for Poststroke Motor Recovery: The E-FIT Randomized Controlled Trial. *Stroke.* 2023;54:2254-2264.
52. Chen G, Lin T, Wu M, et al. Effects of repetitive transcranial magnetic stimulation on upper-limb and finger function in stroke patients: A systematic review and meta-analysis of randomized controlled trials. *Front Neurol.* 2022;13:940467.
53. Mead G, Graham C, Lundström E, et al. Individual patient data meta-analysis of the effects of fluoxetine on functional outcomes after acute stroke. *Int J Stroke.* 2024;19:798-808.
54. Safety and efficacy of fluoxetine on functional recovery after acute stroke (EFFECTS): a randomised, double-blind, placebo-controlled trial. *The Lancet. Neurology.* 2020;19:661-669.
55. Safety and efficacy of fluoxetine on functional outcome after acute stroke (AFFINITY): a randomised, double-blind, placebo-controlled trial. *The Lancet. Neurology.* 2020;19:651-660.
56. Effects of fluoxetine on functional outcomes after acute stroke (FOCUS): a pragmatic, double-blind, randomised, controlled trial. *Lancet.* 2019;393:265-274.

57. Legg LA, Rudberg AS, Hua X, et al. Selective serotonin reuptake inhibitors (SSRIs) for stroke recovery. *Cochrane Database Syst Rev.* 2021;11:Cd009286.
58. Petrea RE, Beiser AS, Seshadri S, Kelly-Hayes M, Kase CS, Wolf PA. Stroke in women-Gender differences in stroke incidence and post-stroke disability in the Framingham Heart Study. *Stroke.* 2009;40:1032–1037.
59. MacDonald SL, Hall RE, Bell CM, Cronin S, Jaglal SB. Sex differences in the outcomes of adults admitted to inpatient rehabilitation after stroke. *PM R.* 2022;14:779-785.
60. Mehrabi S, Harnett A, Saikaley M, et al. Female Enrollment in Rehabilitation Trials: A Systematic Review of Reporting Sex and Female Participation in Randomized Controlled Trials of Poststroke Upper Extremity Rehabilitation Over 50 Years. *Arch Phys Med Rehabil.* 2024;105:1399-1406.
61. Anwer S, Alghadir A. Incidence, Prevalence, and Risk Factors of Hemiplegic Shoulder Pain: A Systematic Review. *Int J Environ Res Public Health.* 2020;17.
62. Ada L, Foongchomcheay A, Langhammer B, et al. Lap-tray and triangular sling are no more effective than a hemi-sling in preventing shoulder subluxation in those at risk early after stroke: a randomized trial. *Eur J Phys Rehabil Med.* 2017;53:41-48.
63. Pan R, Zhou M, Cai H, et al. A randomized controlled trial of a modified wheelchair arm-support to reduce shoulder pain in stroke patients. *Clin Rehabil.* 2018;32:37-47.
64. Deng P, Zhao Z, Zhang S, Xiao T, Li Y. Effect of kinesio taping on hemiplegic shoulder pain: A systematic review and meta-analysis of randomized controlled trials. *Clin Rehabil.* 2021;35:317-331.
65. Appel C, Perry L, Jones F. Shoulder strapping for stroke-related upper limb dysfunction and shoulder impairments: systematic review. *NeuroRehabilitation.* 2014;35:191-204.
66. Ada L, Foongchomcheay A, Canning C. Supportive devices for preventing and treating subluxation of the shoulder after stroke. *Cochrane Database Syst Rev.* 2005;2005:Cd003863.
67. Qiu H, Li J, Zhou T, Wang H, Li J. Electrical Stimulation in the Treatment of Hemiplegic Shoulder Pain: A Meta-Analysis of Randomized Controlled Trials. *Am J Phys Med Rehabil.* 2019;98:280-286.
68. Lee JH, Baker LL, Johnson RE, Tilson JK. Effectiveness of neuromuscular electrical stimulation for management of shoulder subluxation post-stroke: a systematic review with meta-analysis. *Clin Rehabil.* 2017;31:1431-1444.
69. Church C, Price C, Pandyan AD, Huntley S, Curless R, Rodgers H. Randomized controlled trial to evaluate the effect of surface neuromuscular electrical stimulation to the shoulder after acute stroke. *Stroke.* 2006;37:2995-3001.
70. Singh JA, Fitzgerald PM. Botulinum toxin for shoulder pain. *Cochrane Database Syst Rev.* 2010:Cd008271.

71. de Boer KS, Arwert HJ, de Groot JH, Meskers CG, Mishre AD, Arendzen JH. Shoulder pain and external rotation in spastic hemiplegia do not improve by injection of botulinum toxin A into the subscapular muscle. *J Neurol Neurosurg Psychiatry*. 2008;79:581-583.
72. Tan B, Jia L. Ultrasound-Guided BoNT-A (Botulinum Toxin A) Injection Into the Subscapularis for Hemiplegic Shoulder Pain: A Randomized, Double-Blind, Placebo-Controlled Trial. *Stroke*. 2021;52:3759-3767.
73. Rah UW, Yoon SH, Moon DJ, et al. Subacromial corticosteroid injection on poststroke hemiplegic shoulder pain: a randomized, triple-blind, placebo-controlled trial. *Arch Phys Med Rehabil*. 2012;93:949-956.
74. Snels IA, Beckerman H, Twisk JW, et al. Effect of triamcinolone acetonide injections on hemiplegic shoulder pain : A randomized clinical trial. *Stroke*. 2000;31:2396-2401.
75. Zhan J, Wei X, Tao C, et al. Effectiveness of acupuncture combined with rehabilitation training vs. rehabilitation training alone for post-stroke shoulder pain: A systematic review and meta-analysis of randomized controlled trials. *Front Med (Lausanne)*. 2022;9:947285.
76. Zhang T, Zhang C. Extracorporeal shock wave therapy for shoulder pain after stroke: A systematic review and meta-analysis. *Clin Rehabil*. 2023;37:774-790.
77. Bhat C, Rosenberg H, James D. Topical nonsteroidal anti-inflammatory drugs. *CMAJ*. 2023;195:E1231.
78. Giang TA, Ong AWG, Krishnamurthy K, Fong KNK. Rehabilitation Interventions for Poststroke Hand Oedema: A Systematic Review. *Hong Kong J Occup Ther*. 2016;27:7-17.
79. O'Connell NE, Wand BM, McAuley J, Marston L, Moseley GL. Interventions for treating pain and disability in adults with complex regional pain syndrome. *Cochrane Database Syst Rev*. 2013;2013:Cd009416.
80. Liu S, Zhang CS, Cai Y, et al. Acupuncture for Post-stroke Shoulder-Hand Syndrome: A Systematic Review and Meta-Analysis. *Front Neurol*. 2019;10:433.
81. Peng L, Zhang C, Zhou L, Zuo HX, He XK, Niu YM. Traditional manual acupuncture combined with rehabilitation therapy for shoulder hand syndrome after stroke within the Chinese healthcare system: a systematic review and meta-analysis. *Clin Rehabil*. 2018;32:429-439.
82. Harvey LA, Katalinic OM, Herbert RD, Moseley AM, Lannin NA, Schurr K. Stretch for the treatment and prevention of contracture: an abridged republication of a Cochrane Systematic Review. *J Physiother*. 2017;63:67-75.
83. Salazar AP, Pinto C, Ruschel Mossi JV, Figueiro B, Lukrafka JL, Pagnussat AS. Effectiveness of static stretching positioning on post-stroke upper-limb spasticity and mobility: Systematic review with meta-analysis. *Ann Phys Rehabil Med*. 2019;62:274-282.
84. Ward AB, Wissel J, Borg J, et al. Functional goal achievement in post-stroke spasticity patients: the BOTOX(R) Economic Spasticity Trial (BEST). *J Rehabil Med*. 2014;46:504-513.

85. Wissel J, Ganapathy V, Ward AB, et al. OnabotulinumtoxinA Improves Pain in Patients With Post-Stroke Spasticity: Findings From a Randomized, Double-Blind, Placebo-Controlled Trial. *J Pain Symptom Manage*. 2016;52:17-26.
86. Shaw LC, Price CI, van Wijck FM, et al. Botulinum Toxin for the Upper Limb after Stroke (BoTULS) Trial: effect on impairment, activity limitation, and pain. *Stroke*. 2011;42:1371-1379.
87. McCrory P, Turner-Stokes L, Baguley IJ, et al. Botulinum toxin A for treatment of upper limb spasticity following stroke: a multi-centre randomized placebo-controlled study of the effects on quality of life and other person-centred outcomes. *J Rehabil Med*. 2009;41:536-544.
88. Sun LC, Chen R, Fu C, et al. Efficacy and Safety of Botulinum Toxin Type A for Limb Spasticity after Stroke: A Meta-Analysis of Randomized Controlled Trials. *Biomed Res Int*. 2019;2019:8329306.
89. Lee JM, Gracies JM, Park SB, Lee KH, Lee JY, Shin JH. Botulinum Toxin Injections and Electrical Stimulation for Spastic Paresis Improve Active Hand Function Following Stroke. *Toxins (Basel)*. 2018;10.
90. Santamato A, Notarnicola A, Panza F, et al. SBOTE study: extracorporeal shock wave therapy versus electrical stimulation after botulinum toxin type a injection for post-stroke spasticity-a prospective randomized trial. *Ultrasound Med Biol*. 2013;39:283-291.
91. Nasb M, Li Z, A SAY, Dayoub L, Chen H. Comparison of the effects of modified constraint-induced movement therapy and intensive conventional therapy with a botulinum-a toxin injection on upper limb motor function recovery in patients with stroke. *Libyan J Med*. 2019;14:1609304.
92. Santamato A, Micello MF, Panza F, et al. Adhesive taping vs. daily manual muscle stretching and splinting after botulinum toxin type A injection for wrist and fingers spastic overactivity in stroke patients: a randomized controlled trial. *Clin Rehabil*. 2015;29:50-58.
93. Amini M, Shamili A, Frough B, Pashmdarfard M, Fallahzadeh Abarghouei A. Combined effect of botulinum toxin and splinting on motor components and function of people suffering a stroke. *Med J Islam Repub Iran*. 2016;30:373.
94. Güntürk E, Ögüt H, Güler H, Turhanoğlu AD. The effect of oral baclofen and botulinum toxin treatments in hemiplegic spasticity on the nociceptive flexor reflex: A randomized clinical trial. *Turk J Phys Med Rehabil*. 2022;68:524-531.
95. Gelber DA, Good DC, Dromerick A, Sergay S, Richardson M. Open-label dose-titration safety and efficacy study of tizanidine hydrochloride in the treatment of spasticity associated with chronic stroke. *Stroke*. 2001;32:1841-1846.
96. Cabanas-Valdés R, Serra-Llobet P, Rodriguez-Rubio PR, López-de-Celis C, Llauro-Fores M, Calvo-Sanz J. The effectiveness of extracorporeal shock wave therapy for improving upper limb spasticity and functionality in stroke patients: a systematic review and meta-analysis. *Clin Rehabil*. 2020;34:1141-1156.
97. Wang X, Ge L, Hu H, Yan L, Li L. Effects of Non-Invasive Brain Stimulation on Post-Stroke Spasticity: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Brain Sci*. 2022;12.

98. Chen S, Lv C, Wu J, Zhou C, Shui X, Wang Y. Effectiveness of a home-based exercise program among patients with lower limb spasticity post-stroke: A randomized controlled trial. *Asian Nurs Res (Korean Soc Nurs Sci)*. 2021;15:1-7.
99. Kluding PM, Santos M. Effects of ankle joint mobilizations in adults poststroke: a pilot study. *Arch Phys Med Rehabil*. 2008;89:449-456.
100. Wein T, Esquenazi A, Jost WH, Ward AB, Pan G, Dimitrova R. OnabotulinumtoxinA for the Treatment of Poststroke Distal Lower Limb Spasticity: A Randomized Trial. *PM R*. 2018;10:693-703.
101. Doan TN, Kuo MY, Chou LW. Efficacy and Optimal Dose of Botulinum Toxin A in Post-Stroke Lower Extremity Spasticity: A Systematic Review and Meta-Analysis. *Toxins (Basel)*. 2021;13.
102. Kaji R, Osako Y, Suyama K, Maeda T, Uechi Y, Iwasaki M. Botulinum toxin type A in post-stroke lower limb spasticity: a multicenter, double-blind, placebo-controlled trial. *J Neurol*. 2010;257:1330-1337.
103. Pittock SJ, Moore AP, Hardiman O, et al. A double-blind randomised placebo-controlled evaluation of three doses of botulinum toxin type A (Dysport) in the treatment of spastic equinovarus deformity after stroke. *Cerebrovasc Dis*. 2003;15:289-300.
104. Creamer M, Cloud G, Kossmehl P, et al. Effect of Intrathecal Baclofen on Pain and Quality of Life in Poststroke Spasticity. *Stroke*. 2018;49:2129-2137.
105. Yoldaş Aslan Ş, Kutlay S, Düsünceli Atman E, Elhan AH, Gök H, Küçükdeveci AA. Does extracorporeal shock wave therapy decrease spasticity of ankle plantar flexor muscles in patients with stroke: A randomized controlled trial. *Clin Rehabil*. 2021;35:1442-1453.
106. Lee CH, Lee SH, Yoo JI, Lee SU. Ultrasonographic Evaluation for the Effect of Extracorporeal Shock Wave Therapy on Gastrocnemius Muscle Spasticity in Patients With Chronic Stroke. *PM R*. 2019;11:363-371.
107. MacKay-Lyons M, Billinger SA, Eng JJ, et al. Aerobic Exercise Recommendations to Optimize Best Practices in Care After Stroke: AEROBICS 2019 Update. *Phys Ther*. 2020;100:149-156.
108. Van Crielinge T, Heremans C, Burridge J, et al. Standardized measurement of balance and mobility post-stroke: Consensus-based core recommendations from the third Stroke Recovery and Rehabilitation Roundtable. *Int J Stroke*. 2024;19:158-168.
109. English C, Hillier SL, Lynch EA. Circuit class therapy for improving mobility after stroke. *Cochrane Database Syst Rev*. 2017;6:Cd007513.
110. Flansbjerg UB, Miller M, Downham D, Lexell J. Progressive resistance training after stroke: effects on muscle strength, muscle tone, gait performance and perceived participation. *J Rehabil Med*. 2008;40:42-48.
111. Flansbjerg UB, Lexell J, Brogårdh C. Long-term benefits of progressive resistance training in chronic stroke: a 4-year follow-up. *J Rehabil Med*. 2012;44:218-221.

112. Cooke EV, Tallis RC, Clark A, Pomeroy VM. Efficacy of functional strength training on restoration of lower-limb motor function early after stroke: phase I randomized controlled trial. *Neurorehabil Neural Repair*. 2010;24:88-96.
113. Mehrholz J, Thomas S, Elsner B. Treadmill training and body weight support for walking after stroke. *Cochrane Database Syst Rev*. 2017;8:Cd002840.
114. Ada L, Dean CM, Morris ME, Simpson JM, Katrak P. Randomized trial of treadmill walking with body weight support to establish walking in subacute stroke: the MOBILISE trial. *Stroke*. 2010;41:1237-1242.
115. Dean CM, Ada L, Bampton J, Morris ME, Katrak PH, Potts S. Treadmill walking with body weight support in subacute non-ambulatory stroke improves walking capacity more than overground walking: a randomised trial. *J Physiother*. 2010;56:97-103.
116. Nadeau SE, Wu SS, Dobkin BH, et al. Effects of task-specific and impairment-based training compared with usual care on functional walking ability after inpatient stroke rehabilitation: LEAPS Trial. *Neurorehabil Neural Repair*. 2013;27:370-380.
117. Mehrholz J, Thomas S, Kugler J, Pohl M, Elsner B. Electromechanical-assisted training for walking after stroke. *Cochrane Database Syst Rev*. 2020;10:Cd006185.
118. Molteni F, Guanziroli E, Goffredo M, et al. Gait Recovery with an Overground Powered Exoskeleton: A Randomized Controlled Trial on Subacute Stroke Subjects. *Brain Sci*. 2021;11.
119. Ghai S, Ghai I. Effects of (music-based) rhythmic auditory cueing training on gait and posture post-stroke: A systematic review & dose-response meta-analysis. *Sci Rep*. 2019;9:2183.
120. Yoo GE, Kim SJ. Rhythmic Auditory Cueing in Motor Rehabilitation for Stroke Patients: Systematic Review and Meta-Analysis. *J Music Ther*. 2016;53:149-177.
121. Zhang B, Li D, Liu Y, Wang J, Xiao Q. Virtual reality for limb motor function, balance, gait, cognition and daily function of stroke patients: A systematic review and meta-analysis. *J Adv Nurs*. 2021;77:3255-3273.
122. Iruthayarajah J, McIntyre A, Cotoi A, Macaluso S, Teasell R. The use of virtual reality for balance among individuals with chronic stroke: a systematic review and meta-analysis. *Top Stroke Rehabil*. 2017;24:68-79.
123. Gibbons EM, Thomson AN, de Noronha M, Joseph S. Are virtual reality technologies effective in improving lower limb outcomes for patients following stroke - a systematic review with meta-analysis. *Top Stroke Rehabil*. 2016;23:440-457.
124. Silva S, Borges LR, Santiago L, Lucena L, Lindquist AR, Ribeiro T. Motor imagery for gait rehabilitation after stroke. *Cochrane Database Syst Rev*. 2020;9:Cd013019.
125. Jaqueline da Cunha M, Rech KD, Salazar AP, Pagnussat AS. Functional electrical stimulation of the peroneal nerve improves post-stroke gait speed when combined with physiotherapy. A systematic review and meta-analysis. *Ann Phys Rehabil Med*. 2021;64:101388.

126. Howlett OA, Lannin NA, Ada L, McKinstry C. Functional electrical stimulation improves activity after stroke: a systematic review with meta-analysis. *Arch Phys Med Rehabil.* 2015;96:934-943.
127. Pomeroy VM, King L, Pollock A, Baily-Hallam A, Langhorne P. Electrostimulation for promoting recovery of movement or functional ability after stroke. *Cochrane Database Syst Rev.* 2006;2006:Cd003241.
128. Stanton R, Ada L, Dean CM, Preston E. Biofeedback improves performance in lower limb activities more than usual therapy in people following stroke: a systematic review. *J Physiother.* 2017;63:11-16.
129. Daryabor A, Kobayashi T, Yamamoto S, Lyons SM, Orendurff M, Akbarzadeh Baghban A. Effect of ankle-foot orthoses on functional outcome measurements in individuals with stroke: a systematic review and meta-analysis. *Disabil Rehabil.* 2022;44:6566-6581.
130. Choo YJ, Chang MC. Effectiveness of an ankle-foot orthosis on walking in patients with stroke: a systematic review and meta-analysis. *Sci Rep.* 2021;11:15879.
131. Tyson SF, Kent RM. Effects of an ankle-foot orthosis on balance and walking after stroke: a systematic review and pooled meta-analysis. *Arch Phys Med Rehabil.* 2013;94:1377-1385.
132. Erel S, Uygur F, Engin Simsek I, Yakut Y. The effects of dynamic ankle-foot orthoses in chronic stroke patients at three-month follow-up: a randomized controlled trial. *Clin Rehabil.* 2011;25:515-523.
133. Ghayour Najafabadi M, Shariat A, Dommerholt J, et al. Aquatic Therapy for improving Lower Limbs Function in Post-stroke Survivors: A Systematic Review with Meta-Analysis. *Top Stroke Rehabil.* 2022;29:473-489.
134. Chae CS, Jun JH, Im S, Jang Y, Park GY. Effectiveness of Hydrotherapy on Balance and Paretic Knee Strength in Patients With Stroke: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Am J Phys Med Rehabil.* 2020;99:409-419.
135. Bank J, Charles K, Morgan P. What is the effect of additional physiotherapy on sitting balance following stroke compared to standard physiotherapy treatment: a systematic review. *Top Stroke Rehabil.* 2016;23:15-25.
136. Barclay-Goddard R, Stevenson T, Poluha W, Moffatt ME, Taback SP. Force platform feedback for standing balance training after stroke. *Cochrane Database Syst Rev.* 2004;2004:Cd004129.
137. Van Peppen RP, Kortsmid M, Lindeman E, Kwakkel G. Effects of visual feedback therapy on postural control in bilateral standing after stroke: a systematic review. *J Rehabil Med.* 2006;38:3-9.
138. Saquetteo MB, da Silva CM, Martinez BP, et al. Water-Based Exercise on Functioning and Quality of Life in Poststroke Persons: A Systematic Review and Meta-Analysis. *J Stroke Cerebrovasc Dis.* 2019;28:104341.

139. Zhang L, Zhang L, Yu X, Zhou H, Ding Y, Wang J. Effect of Tai Chi Yunshou training on the balance and motor functions of stroke patients: a systematic review and meta-analysis of randomized controlled trials. *Front Neurol.* 2023;14:1178234.
140. Zheng X, Wu X, Liu Z, et al. The Influences of Tai Chi on Balance Function and Exercise Capacity among Stroke Patients: A Meta-Analysis. *Evid Based Complement Alternat Med.* 2021;2021:6636847.
141. Ge L, Zheng QX, Liao YT, Tan JY, Xie QL, Rask M. Effects of traditional Chinese exercises on the rehabilitation of limb function among stroke patients: A systematic review and meta-analysis. *Complement Ther Clin Pract.* 2017;29:35-47.
142. Zhao LJ, Jiang LH, Zhang H, et al. Effects of Motor Imagery Training for Lower Limb Dysfunction in Patients With Stroke: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Am J Phys Med Rehabil.* 2023;102:409-418.
143. Yin Y, Wang J, Yu Z, et al. Does whole-body vibration training have a positive effect on balance and walking function in patients with stroke? A meta-analysis. *Front Hum Neurosci.* 2022;16:1076665.
144. Yang X, Xue X, Tu H, Li N. Effect of whole-body vibration training on the recovery of lower limb function in people with stroke: a systematic review and meta-analysis. *Disabil Rehabil.* 2023;45:3823-3832.
145. Pollock A, Gray C, Culham E, Durward BR, Langhorne P. Interventions for improving sit-to-stand ability following stroke. *Cochrane Database Syst Rev.* 2014;2014:Cd007232.
146. Saunders DH, Sanderson M, Hayes S, et al. Physical fitness training for stroke patients. *Cochrane Database Syst Rev.* 2020;3:Cd003316.
147. Sandberg K, Kleist M, Falk L, Enthoven P. Effects of Twice-Weekly Intense Aerobic Exercise in Early Subacute Stroke: A Randomized Controlled Trial. *Arch Phys Med Rehabil.* 2016;97:1244-1253.
148. Hornby TG, Holleran CL, Hennessy PW, et al. Variable Intensive Early Walking Poststroke (VIEWS): A Randomized Controlled Trial. *Neurorehabil Neural Repair.* 2016;30:440-450.
149. Jin H, Jiang Y, Wei Q, Wang B, Ma G. Intensive aerobic cycling training with lower limb weights in Chinese patients with chronic stroke: discordance between improved cardiovascular fitness and walking ability. *Disabil Rehabil.* 2012;34:1665-1671.
150. Globas C, Becker C, Cerny J, et al. Chronic stroke survivors benefit from high-intensity aerobic treadmill exercise: a randomized control trial. *Neurorehabil Neural Repair.* 2012;26:85-95.
151. Safaei-Qomi MR, Mehrabi S, Fleet JL, et al. A Systematic Review of Worldwide Female Enrollment in Randomized Controlled Trials of Post-Stroke Lower Extremity Rehabilitation. *Am J Phys Med Rehabil.* 2024.
152. Zhang L, Wang J, Dong X, et al. Injurious Falls before, during, and after Stroke Diagnosis: A Population-based Study. *Journal of the American Medical Directors Association.* 2025;26:105465.

153. Czernuszenko A, Czlonkowska A. Risk factors for falls in stroke patients during inpatient rehabilitation. *Clin Rehabil.* 2009;23:176-188.
154. Xu T, Clemson L, O'Loughlin K, Lannin NA, Dean C, Koh G. Risk Factors for Falls in Community Stroke Survivors: A Systematic Review and Meta-Analysis. *Arch Phys Med Rehabil.* 2018;99:563-573.e565.
155. Strini V, Schiavolin R, Prendin A. Fall Risk Assessment Scales: A Systematic Literature Review. *Nurs Rep.* 2021;11:430-443.
156. Breisinger TP, Skidmore ER, Niyonkuru C, Terhorst L, Campbell GB. The Stroke Assessment of Fall Risk (SAFR): predictive validity in inpatient stroke rehabilitation. *Clin Rehabil.* 2014;28:1218-1224.
157. Nyström A, Hellström K. Fall risk six weeks from onset of stroke and the ability of the Prediction of Falls in Rehabilitation Settings Tool and motor function to predict falls. *Clin Rehabil.* 2013;27:473-479.
158. Pinto EB, Nascimento C, Monteiro M, et al. Proposal for a New Predictive Scale for Recurrent Risk of Fall in a Cohort of Community-Dwelling Patients with Stroke. *J Stroke Cerebrovasc Dis.* 2016;25:2619-2626.
159. Mansfield A, Aqui A, Danells CJ, et al. Does perturbation-based balance training prevent falls among individuals with chronic stroke? A randomised controlled trial. *BMJ Open.* 2018;8:e021510.
160. Dean CM, Rissel C, Sherrington C, et al. Exercise to enhance mobility and prevent falls after stroke: the community stroke club randomized trial. *Neurorehabil Neural Repair.* 2012;26:1046-1057.
161. Batchelor FA, Hill KD, Mackintosh SF, Said CM, Whitehead CH. Effects of a multifactorial falls prevention program for people with stroke returning home after rehabilitation: a randomized controlled trial. *Arch Phys Med Rehabil.* 2012;93:1648-1655.
162. Denissen S, Staring W, Kunkel D, et al. Interventions for preventing falls in people after stroke. *Cochrane Database Syst Rev.* 2019;10:Cd008728.
163. Yang F, Lees J, Simpkins C, Butler A. Interventions for preventing falls in people post-stroke: A meta-analysis of randomized controlled trials. *Gait Posture.* 2021;84:377-388.
164. Martino R, Foley N, Bhogal S, Diamant N, Speechley M, Teasell R. Dysphagia after stroke: incidence, diagnosis, and pulmonary complications. *Stroke.* 2005;36:2756-2763.
165. Boaden E, Burnell J, Hives L, et al. Screening for aspiration risk associated with dysphagia in acute stroke. *Cochrane Database Syst Rev.* 2021;10:Cd012679.
166. Trapl M, Enderle P, Nowotny M, et al. Dysphagia bedside screening for acute-stroke patients: the Gugging Swallowing Screen. *Stroke.* 2007;38:2948-2952.

167. Martino R, Silver F, Teasell R, et al. The Toronto Bedside Swallowing Screening Test (TOR-BSST): development and validation of a dysphagia screening tool for patients with stroke. *Stroke*. 2009;40:555-561.
168. Sherman V, Greco E, Martino R. The Benefit of Dysphagia Screening in Adult Patients With Stroke: A Meta-Analysis. *J Am Heart Assoc*. 2021;10:e018753.
169. Middleton S, McElduff P, Ward J, et al. Implementation of evidence-based treatment protocols to manage fever, hyperglycaemia, and swallowing dysfunction in acute stroke (QASC): a cluster randomised controlled trial. *Lancet*. 2011;378:1699-1706.
170. Tohara H, Saitoh E, Mays KA, Kuhlemeier K, Palmer JB. Three tests for predicting aspiration without videofluorography. *Dysphagia*. 2003;18:126-134.
171. Wu MC, Chang YC, Wang TG, Lin LC. Evaluating swallowing dysfunction using a 100-ml water swallowing test. *Dysphagia*. 2004;19:43-47.
172. Schrock JW, Bernstein J, Glasenapp M, Drogell K, Hanna J. A novel emergency department dysphagia screen for patients presenting with acute stroke. *Acad Emerg Med*. 2011;18:584-589.
173. Bath PM, Lee HS, Everton LF. Swallowing therapy for dysphagia in acute and subacute stroke. *Cochrane Database Syst Rev*. 2018;10:Cd000323.
174. Duncan S, McAuley DF, Walshe M, et al. Interventions for oropharyngeal dysphagia in acute and critical care: a systematic review and meta-analysis. *Intensive Care Med*. 2020;46:1326-1338.
175. Tarihci Cakmak E, Sen EI, Doruk C, Sen C, Sezikli S, Yaliman A. The Effects of Neuromuscular Electrical Stimulation on Swallowing Functions in Post-stroke Dysphagia: A Randomized Controlled Trial. *Dysphagia*. 2023;38:874-885.
176. Carnaby GD, LaGorio L, Silliman S, Crary M. Exercise-based swallowing intervention (McNeill Dysphagia Therapy) with adjunctive NMES to treat dysphagia post-stroke: A double-blind placebo-controlled trial. *J Oral Rehabil*. 2020;47:501-510.
177. Park JS, Oh DH, Hwang NK, Lee JH. Effects of neuromuscular electrical stimulation combined with effortful swallowing on post-stroke oropharyngeal dysphagia: a randomised controlled trial. *J Oral Rehabil*. 2016;43:426-434.
178. Chen YW, Chang KH, Chen HC, Liang WM, Wang YH, Lin YN. The effects of surface neuromuscular electrical stimulation on post-stroke dysphagia: a systemic review and meta-analysis. *Clin Rehabil*. 2016;30:24-35.
179. Dennis MS, Lewis SC, Warlow C. Effect of timing and method of enteral tube feeding for dysphagic stroke patients (FOOD): a multicentre randomised controlled trial. *Lancet*. 2005;365:764-772.
180. Gomes CA, Jr., Andriolo RB, Bennett C, et al. Percutaneous endoscopic gastrostomy versus nasogastric tube feeding for adults with swallowing disturbances. *Cochrane Database Syst Rev*. 2015:Cd008096.

181. Deutz NE, Matheson EM, Matarese LE, et al. Readmission and mortality in malnourished, older, hospitalized adults treated with a specialized oral nutritional supplement: A randomized clinical trial. *Clin Nutr.* 2016;35:18-26.
182. Schuetz P, Fehr R, Baechli V, et al. Individualised nutritional support in medical inpatients at nutritional risk: a randomised clinical trial. *Lancet.* 2019;393:2312-2321.
183. Dennis MS, Lewis SC, Warlow C. Routine oral nutritional supplementation for stroke patients in hospital (FOOD): a multicentre randomised controlled trial. *Lancet.* 2005;365:755-763.
184. Sakai K, Niimi M, Momosaki R, et al. Nutritional therapy for reducing disability and improving activities of daily living in people after stroke. *Cochrane Database Syst Rev.* 2024;8:Cd014852.
185. Campbell P, Bain B, Furlanetto DL, Brady MC. Interventions for improving oral health in people after stroke. *Cochrane Database Syst Rev.* 2020;12:Cd003864.
186. Pedersen PM, Jørgensen HS, Nakayama H, Raaschou HO, Olsen TS. Aphasia in acute stroke: incidence, determinants, and recovery. *Ann Neurol.* 1995;38:659-666.
187. Brust JC, Shafer SQ, Richter RW, Bruun B. Aphasia in acute stroke. *Stroke.* 1976;7:167-174.
188. Lazar RM, Boehme AK. Aphasia As a Predictor of Stroke Outcome. *Curr Neurol Neurosci Rep.* 2017;17:83.
189. Brady MC, Kelly H, Godwin J, Enderby P, Campbell P. Speech and language therapy for aphasia following stroke. *Cochrane Database Syst Rev.* 2016:Cd000425.
190. Dosage, Intensity, and Frequency of Language Therapy for Aphasia: A Systematic Review-Based, Individual Participant Data Network Meta-Analysis. *Stroke.* 2022;53:956-967.
191. Simmons-Mackie N, Raymer A, Cherney LR. Communication Partner Training in Aphasia: An Updated Systematic Review. *Arch Phys Med Rehabil.* 2016;97:2202-2221.e2208.
192. Simmons-Mackie N, Raymer A, Armstrong E, Holland A, Cherney LR. Communication partner training in aphasia: a systematic review. *Arch Phys Med Rehabil.* 2010;91:1814-1837.
193. Li TT, Zhang PP, Zhang MC, et al. Meta-analysis and systematic review of the relationship between sex and the risk or incidence of poststroke aphasia and its types. *BMC Geriatr.* 2024;24:220.
194. Wallentin M. Sex differences in post-stroke aphasia rates are caused by age. A meta-analysis and database query. *PLoS One.* 2018;13:e0209571.
195. Brady MC, Ali M, VandenBerg K, et al. Precision rehabilitation for aphasia by patient age, sex, aphasia severity, and time since stroke? A prespecified, systematic review-based, individual participant data, network, subgroup meta-analysis. *Int J Stroke.* 2022;17:1067-1077.

196. Rowe FJ, Hepworth LR, Howard C, Hanna KL, Cheyne CP, Currie J. High incidence and prevalence of visual problems after acute stroke: An epidemiology study with implications for service delivery. *PLoS One*. 2019;14:e0213035.
197. Rowe FJ. Stroke survivors' views and experiences on impact of visual impairment. *Brain Behav*. 2017;7:e00778.
198. Hepworth LR, Howard C, Hanna KL, Currie J, Rowe FJ. "Eye" Don't See: An Analysis of Visual Symptom Reporting by Stroke Survivors from a Large Epidemiology Study. *J Stroke Cerebrovasc Dis*. 2021;30:105759.
199. Rowe FJ, Hepworth LR, Kirkham JJ. Development of core outcome sets for vision screening and assessment in stroke: a Delphi and consensus study. *BMJ Open*. 2019;9:e029578.
200. Donkervoort M, Dekker J, van den Ende E, Stehmann-Saris JC, Deelman BG. Prevalence of apraxia among patients with a first left hemisphere stroke in rehabilitation centres and nursing homes. *Clin Rehabil*. 2000;14:130-136.
201. Hepworth L, Rowe F, Walker M, et al. Post-stroke visual impairment: a systematic literature review of types and recovery of visual conditions. *Ophthalmol Res*. 2016;5:1-43.
202. Hazelton C, Thomson K, Todhunter-Brown A, et al. Interventions for perceptual disorders following stroke. *Cochrane Database Syst Rev*. 2022;11:Cd007039.
203. Longley V, Hazelton C, Heal C, et al. Non-pharmacological interventions for spatial neglect or inattention following stroke and other non-progressive brain injury. *Cochrane Database Syst Rev*. 2021;7:Cd003586.
204. Pollock A, Hazelton C, Rowe FJ, et al. Interventions for visual field defects in people with stroke. *Cochrane Database Syst Rev*. 2019;5:Cd008388.
205. Zhang Y, Xing Y, Li C, et al. Mirror therapy for unilateral neglect after stroke: A systematic review. *Eur J Neurol*. 2022;29:358-371.
206. Aparicio-López C, García-Molina A, García-Fernández J, et al. Cognitive rehabilitation with right hemifield eye-patching for patients with sub-acute stroke and visuo-spatial neglect: a randomized controlled trial. *Brain Inj*. 2015;29:501-507.
207. Tsang MH, Sze KH, Fong KN. Occupational therapy treatment with right half-field eye-patching for patients with subacute stroke and unilateral neglect: a randomised controlled trial. *Disabil Rehabil*. 2009;31:630-637.
208. Kim YM, Chun MH, Yun GJ, Song YJ, Young HE. The effect of virtual reality training on unilateral spatial neglect in stroke patients. *Ann Rehabil Med*. 2011;35:309-315.
209. Katz N, Ring H, Naveh Y, Kizony R, Feintuch U, Weiss PL. Interactive virtual environment training for safe street crossing of right hemisphere stroke patients with unilateral spatial neglect. *Disabil Rehabil*. 2005;27:1235-1243.

210. Luukkainen-Markkula R, Tarkka IM, Pitkänen K, Sivenius J, Hämäläinen H. Rehabilitation of hemispatial neglect: A randomized study using either arm activation or visual scanning training. *Restor Neurol Neurosci*. 2009;27:663-672.
211. Kim BR, Chun MH, Kim DY, Lee SJ. Effect of high- and low-frequency repetitive transcranial magnetic stimulation on visuospatial neglect in patients with acute stroke: a double-blind, sham-controlled trial. *Arch Phys Med Rehabil*. 2013;94:803-807.
212. Yang NY, Fong KN, Li-Tsang CW, Zhou D. Effects of repetitive transcranial magnetic stimulation combined with sensory cueing on unilateral neglect in subacute patients with right hemispheric stroke: a randomized controlled study. *Clin Rehabil*. 2017;31:1154-1163.
213. Andersen G, Vestergaard K, Ingeman-Nielsen M, Jensen TS. Incidence of central post-stroke pain. *Pain*. 1995;61:187-193.
214. Mahesh B, Singh VK, Pathak A, et al. Efficacy of Duloxetine in Patients with Central Post-stroke Pain: A Randomized Double Blind Placebo Controlled Trial. *Pain Med*. 2023;24:610-617.
215. Vranken JH, Hollmann MW, van der Vegt MH, et al. Duloxetine in patients with central neuropathic pain caused by spinal cord injury or stroke: a randomized, double-blind, placebo-controlled trial. *Pain*. 2011;152:267-273.
216. Kim NY, Lee SC, Kim YW. Effect of Duloxetine for the Treatment of Chronic Central Poststroke Pain. *Clin Neuropharmacol*. 2019;42:73-76.
217. Kim JS, Bashford G, Murphy KT, Martin A, Dror V, Cheung R. Safety and efficacy of pregabalin in patients with central post-stroke pain. *Pain*. 2011;152:1018-1023.
218. Vranken JH, Dijkgraaf MG, Kruis MR, van der Vegt MH, Hollmann MW, Heesen M. Pregabalin in patients with central neuropathic pain: a randomized, double-blind, placebo-controlled trial of a flexible-dose regimen. *Pain*. 2008;136:150-157.
219. Serpell MG. Gabapentin in neuropathic pain syndromes: a randomised, double-blind, placebo-controlled trial. *Pain*. 2002;99:557-566.
220. Jungehulsing GJ, Israel H, Safar N, et al. Levetiracetam in patients with central neuropathic post-stroke pain--a randomized, double-blind, placebo-controlled trial. *Eur J Neurol*. 2013;20:331-337.
221. Thomas LH, Coupe J, Cross LD, Tan AL, Watkins CL. Interventions for treating urinary incontinence after stroke in adults. *Cochrane Database Syst Rev*. 2019;2:Cd004462.
222. Özden F, Tümtürk İ, Özkeskin M, Bakırhan S. The effect of pelvic floor muscle training on urinary incontinence in patients with stroke: a systematic review and meta-analysis. *Ir J Med Sci*. 2023;192:1481-1495.
223. Cruz E, Miller C, Zhang W, et al. Does non-implanted electrical stimulation reduce post-stroke urinary or fecal incontinence? A systematic review with meta-analysis. *Int J Stroke*. 2022;17:378-388.

224. Thomas LH, Watkins CL, Sutton CJ, et al. Identifying continence options after stroke (ICONS): a cluster randomised controlled feasibility trial. *Trials*. 2014;15:509.
225. Watkins C, Tishkovskaya S, Brown C, et al. Systematic voiding programme in adults with urinary incontinence following acute stroke: the ICONS-II RCT. *Health Technol Assess*. 2022;26:1-88.
226. Tibaek S, Gard G, Dehlendorff C, Iversen HK, Biering-Soerensen F, Jensen R. Can pelvic floor muscle training improve quality of life in men with mild to moderate post-stroke and lower urinary tract symptoms? *Eur J Phys Rehabil Med*. 2017;53:416-425.
227. Tibaek S, Gard G, Jensen R. Pelvic floor muscle training is effective in women with urinary incontinence after stroke: a randomised, controlled and blinded study. *Neurourol Urodyn*. 2005;24:348-357.
228. Stoniute A, Madhuvrata P, Still M, Barron-Millar E, Nabi G, Omar MI. Oral anticholinergic drugs versus placebo or no treatment for managing overactive bladder syndrome in adults. *Cochrane Database Syst Rev*. 2023;5:Cd003781.
229. Harari D, Norton C, Lockwood L, Swift C. Treatment of constipation and fecal incontinence in stroke patients: randomized controlled trial. *Stroke*. 2004;35:2549-2555.
230. Todd CL, Johnson EE, Stewart F, et al. Conservative, physical and surgical interventions for managing faecal incontinence and constipation in adults with central neurological diseases. *Cochrane Database Syst Rev*. 2024;10:Cd002115.
231. Tuong NE, Klausner AP, Hampton LJ. A review of post-stroke urinary incontinence. *Can J Urol*. 2016;23:8265-8270.
232. Fluck A, Fry CH, Affley B, et al. Sex-specific independent risk factors of urinary incontinence in acute stroke patients: A multicentre registry-based cohort study. *Neurourol Urodyn*. 2024;43:818-825.
233. Lucente G, Corral J, Rodríguez-Esparragoza L, et al. Current Incidence and Risk Factors of Fecal Incontinence After Acute Stroke Affecting Functionally Independent People. *Front Neurol*. 2021;12:755432.

Additional References for Performance Measures

- Smith A, Hewitt J, Quinn TJ, Robling M. Patient-reported outcome measures (PROMs) use in post-stroke patient care and clinical practice: a realist synthesis protocol. *Syst Rev*. 2021 Apr 28;10(1):128. doi: 10.1186/s13643-021-01682-w. PMID: 33910631; PMCID: PMC8082773.
- Schmidt, R., Geisler, D., Urban, D. et al. Stroke survivors' preferences on assessing patient-reported outcome measures. *J Patient Rep Outcomes* 7, 124 (2023). <https://doi.org/10.1186/s41687-023-00660-1>
- Ibrahim S, Francis T, Sheehan KA, Kokorelias K, Stanimirovic A, Hashmi S, Kalocsai C, Ng S, Berkhout SG, Cameron JI, Rac V and Pikula A (2024) Exploring unmet needs and preferences of young adult stroke patients for post-stroke care through PROMs and gender differences. *Front. Stroke* 3:1386300. doi: 10.3389/fstro.2024.1386300