CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Stroke Systems of Care

7th Edition, Update 2026

Evidence Tables

Core Elements

Sacha Arsenault and Gary Hunter (Writing Group Co-Chairs)
on Behalf of the Canadian Stroke Best Practice Recommendations
Stroke Systems of Care Writing Group

Table of Contents

Published Guidelines

Guideline	Recommendations
Nguyen TN, Castonguay AC, Siegler JE, Nagel S, Lansberg MG, de Havenon A et al; SVIN GAPS Committee. **Mechanical Thrombectomy in the Late Presentation of Anterior Circulation Large Vessel Occlusion Stroke: A Guideline from the Society of Vascular and Interventional Neurology Guidelines and Practice Standards Committee.** ***Stroke Vasc Interv Neurol.* 2023 Jan;3(1):e000512.**	*Systems of Care* Transfers Versus Mothership Paradigms In patients with a suspected LVO presenting within the 6 to 24 hours of last known well, it may be reasonable to transport the patient directly to an EVT-performing center if transport time would not be delayed by >15 minutes relative to the nearest stroke center. Class of recommendation: 2b; Level of Evidence: Expert opinion Consensus
Feigin VL, Owolabi MO; World Stroke Organization–Lancet Neurology Commission Stroke Collaboration Group. **Pragmatic solutions to reduce the global burden of stroke: A World Stroke Organization-Lancet Neurology Commission.** ***Lancet Neurol*. 2023 Dec;22(12):1160-1206.** **(selected)**	*Surveillance* Establish low-cost surveillance systems, ideally within existing systems for non-communicable diseases, to adequately guide prevention and treatment. *Prevention* Raise public awareness and take action to encourage a healthy lifestyle and prevent stroke via population-wide deployment of digital technologies (a so-called motivational mass individual strategy for stroke prevention) with simple, inexpensive screening for cardiovascular disease and modifiable risk factors. *Acute care* Prioritise effective planning of acute stroke care services; capacity building, training, and certification of a multidisciplinary workforce; provision of evidence-based equipment and affordable medicines; and adequate resource allocation at national and regional levels. Establish regional networks and protocol-driven services, including community-wide awareness campaigns for early recognition of a stroke, regionally coordinated pre-hospital services, telemedicine networks, and stroke centres that can triage and treat all cases of acute stroke, and facilitate timely access to reperfusion therapy, including intravenous thrombolysis or mechanical thrombectomy for ischaemic stroke. *Rehabilitation* Establish multidisciplinary rehabilitation services and adapt evidence-based recommendations to the local context, including the training, support, and supervision of community health-care workers and caregivers to assist in long-term care.

Guideline	Recommendations
	Stroke surveillance Governments need to establish nationwide systems for monitoring the burden of stroke, through registries, electronic health records, and vital statistics systems. These systems must achieve near-universal surveillance of indicators of stroke burden and risk factors, to reliably inform the development of programmes for stroke prevention, acute care, and rehabilitation. Surveillance systems must become part of national stroke plans and monitoring systems for non-communicable diseases, which should be able to identify stroke cases in the community.
National Clinical Guideline for Stroke for the UK and Ireland. London: Intercollegiate Stroke Working Party; 2023 May 4. **Available at:** www.strokeguideline.org. **(selected)**	**Overall Structure of Stroke Services** 6.1 Recommendations A. Comprehensive stroke services should include the whole stroke pathway from prevention (including neurovascular services) through pre-hospital and acute care, early rehabilitation, secondary prevention, early supported discharge, community rehabilitation, systematic follow-up, palliative care and long-term support. B. Comprehensive stroke services should be provided based on an estimate of the needs of the population served, and derived from the best available evidence locally and nationally. C. Comprehensive stroke services should ensure that: • people with suspected stroke or TIA are diagnosed and treated urgently, using evidence-based treatments; • sufficient provision is made for people with stroke with long-term disability covering the full range of their needs (e.g. nursing, therapy, emotional support, practical support, family/carer support); • people with stroke who live in care homes or are unable to leave their own home have equivalent access to specialist stroke services; • people with stroke can re-access specialist stroke services when necessary • people dying with stroke receive end-of-life (palliative) care from the acute stroke service and whenever possible in their own homes. D. A public education and professional training strategy should be developed and implemented to ensure that the public and emergency personnel (e.g. staff in emergency call centres) can recognise when a person has a suspected stroke or TIA and respond appropriately. This should be implemented in such a way that it can be formally evaluated. E. All those caring for people with stroke should have the knowledge, skills and attitudes to provide safe, compassionate and effective care, especially for vulnerable people with restricted mobility, sensory loss, impaired communication and cognition and neuropsychological problems. F. People with stroke and their family/carers should be provided with sufficient information about which services are available and how to access them at all stages of the pathway of care. All information should be provided in a format accessible to those with communication disability. G. Along the pathway of stroke care, there should be: • protocols between healthcare providers and social services that enable seamless and safe transfers of care without delay;

Guideline	Recommendations
	• protocols in place that enable rapid assessment and provision of all equipment, aids (including communication aids) and structural adaptations needed by people with disabilities after stroke. H. The process of care, the patient experience and person-centred outcomes of hospital and community-based stroke services should be monitored and evaluated regularly through participation in national comparative audit. I. All stroke services should regularly seek the views of those who use their services, and use the findings to design services around the needs of the person with stroke. Specific recommendations are provided in the areas of acute stroke services, secondary prevention services, stroke rehabilitation services and long-term care services.
Stroke Foundation. National Acute Stroke Services Framework 2023. Melbourne, Australia **Available at:** www.strokefoundation.org.au	**Section 1: Recommended pre-hospital services and statewide systems** Organised pre-hospital services specific to stroke should be developed and coordinated across and (where appropriate) between each jurisdiction. This should include agreed mapping of stroke-capable services and hospitals to bypass, validated stroke screening protocols and pre-notification systems. Health Departments should develop agreed statewide service plans and associated policies governing rapid assessment and transfers. Each hospital should be categorised using this Framework. Where no on-site stroke medical specialists are available and there is agreement not to bypass the hospital, telestroke consultation should be used to assess eligibility for acute stroke therapies and/or transfer to stroke specialist centres. Telehealth should be used to improve ongoing management including acute medical care and assessment of rehabilitation where there is limited access to on-site acute stroke and rehabilitation expertise. **Section 2: Recommended hospital stroke services** The following categories of hospitals are capable of caring for patients with acute stroke: Comprehensive Stroke Centres (CSC), Primary Stroke Centres (PSC), Stroke Capable Regional General Hospitals (SCRGH), and Telestroke Thrombolysis Centres. General hospitals should not admit patients with acute stroke. **Section 3: Stroke unit care definition** Minimum criteria: 1. Co-located beds within a geographically defined unit. This includes where beds are grouped together in the one room/bay OR beds are in rooms that are side-by-side OR as a minimum, beds are within the same ward, provided the same interprofessional team manage their care. 2. Dedicated, interprofessional team with members who have expertise in stroke and/or rehabilitation. The minimum team would consist of medical (stroke) lead, nursing and allied health (including occupational therapy, physiotherapy, speech pathology, social work and dietitian) and stroke coordinator, all with dedicated full time equivalent hours for these roles.

Guideline	Recommendations
	3. Interprofessional team meet at least once per week to discuss patient care. 4. Regular programs of staff education and training relating to stroke. (e.g., stroke induction program, dedicated stroke inservice program, and access to annual national or regional stroke conferences/ educational webinars). **Section 4: Regional coordination responsibility for acute stroke** Features of a regional or hub service in rural areas without Comprehensive Stroke Centres: • Responsibility for regional stroke planning and local stroke network (this may be coordination across a local health district) • Collaboration with ambulance services to plan and monitor adherence to protocols and policies for emergency transfers along with back transfers across a local health district • Extra capacity for specialist clinical support (outreach or via telemedicine) • Extra capacity for educational outreach (including medical, nursing [educator or consultant], allied health and research). • Extra capacity to respond to/accept additional transfers • Stroke coordinator position and stroke medical lead to coordinate care between sites • Regional coordination of hyperacute therapy • Use of telemedicine links to comprehensive stroke centres (for primary stroke centres) **Section 5: Workforce requirements** As a minimum, CSC and PSC stroke services should have dedicated full-time equivalents (FTE) for stroke nursing, allied health and medical involvement. A stroke care coordinator role should also exist in all hospital services with more than 100 stroke admissions per year. In SCRGHs, there should be a stroke coordinator with stroke expertise, with FTE dedicated to stroke, and an identifiable medical lead (even if FTE is not specifically allocated for this role). **Section 6: Quality improvement** Acute stroke care requires the translation of research evidence into clinical practice and acute stroke services must continually strive to improve their performance. The Learning Health System represents one such example, incorporating i) evidence from stakeholder engagement and priority setting; ii) evidence from knowledge generation (research) and synthesis (guidelines); iii) evidence from data and information systems (real world data) and benchmarking (informatics); and iv) evidence from implementation science and healthcare improvement.
Kleindorfer DO, Towfighi A, Chaturvedi S, Cockroft KM, Gutierrez J, Lombardi-Hill D et al. **2021 Guideline for the Prevention of Stroke in Patients with Stroke and**	*Secondary prevention* 1. In patients with ischemic stroke or TIA, voluntary hospital-based or outpatient-focused quality monitoring and improvement programs are recommended to improve short-term and long-term adherence to nationally accepted, evidence-based guidelines for secondary stroke prevention. 2. In patients with ischemic stroke or TIA, a multidisciplinary outpatient team-based approach (ie, care provision with active medication adjustment from advanced practice providers, nurses, or pharmacists) can be effective to control BP, lipids, and

Guideline	Recommendations
Transient Ischemic Attack: A Guideline from the American Heart Association/American Stroke Association. ***Stroke* 2021; 52: e364-e467.**	other vascular risk factors. 3. In patients presenting to their primary care provider as the first contact after TIA or minor stroke, it is reasonable to use a decision support tool that improves diagnostic accuracy, stratifies patients in risk categories to support appropriate triage, and prompts the initiation of medications and counseling for lifestyle modification for secondary stroke prevention to reduce the 90-day risk of recurrent stroke or TIA.
Langhorne P, Audebert HJ, Cadilhac DA, Kim J, Lindsay P. **Stroke systems of care in high-income countries: what is optimal?** ***Lancet*. 2020 Oct 31;396(10260):1433-1442** **(Series review)**	Interventions currently available within high-income health systems to facilitate the delivery of timely access to stroke care are summarized. *Education and training campaigns* • 4 factors responsible for delays for reperfusion therapies include i) patient-related factors; ii) training and related health system factors; iii) resources; and iv) inadequate coordination between different parts of the service • Strategies directed at the public and emergency medical services appear to improve stroke recognition, time to presentation, and treatment • Public awareness campaigns do not appear effective for improving response times after stroke onset. • Educational interventions for emergency medical services can improve access to thrombolysis. • The use of validated prehospital stroke screening tools used by paramedics can improve the accuracy of paramedic diagnosis. *Mobile stroke units* • MSUs can expedite the diagnosis, triage, and treatment of stroke. • MSUs can also provide other prehospital treatments, including early reversal of warfarin, dabigatran, or other anticoagulants after intracerebral haemorrhage or before thrombolysis. *Stroke centres* • Both comprehensive stroke centres (CSCs) and primary stroke centres (PSCs) approaches have been associated with improvements in the quality and outcome of care, compared with non-specialist care in general hospitals, although CSCs are required for the most complex stroke interventions. • In regions without PSCs or CSCs, thrombolysis can be started before transportation to specialized facilities, to avoid critical delays. • In some cases, when hospitals provide thrombectomy and do not have neurosurgery or neurointensive care services, transfer to the appropriate specialized service may be required. *Stroke Units* • Compared with care in general medical or neurology wards, admission to a stroke unit can result in more patients surviving, returning home, and regaining independence. • The core features of stroke unit care include: a discrete ward area; specialist medical, nursing, and therapy staff with stroke expertise; a multidisciplinary team working together through regular meetings; and standard protocols to address common challenges and reduce the risk of complications.

Guideline	Recommendations
	Transfer from hospital to community • To facilitate successful transfer, provision of adequate information and training, home assessments before discharge, and training and education for carers and family have been used commonly, but often fail to meet patients/carer needs. • Early supported discharge (ESD) programs have enabled patients to return home earlier with an increased chance of remaining at home and regaining independence in daily activities. *Continuing rehabilitation and reintegration into regular living* • There is much diversity in terms of both service delivery and research models. *Telemedicine networks* • The use of telemedicine has been used most commonly in the delivery of thrombolysis. • Telemedicine poses unique challenges in terms of technological and organizational quality standards, including remote control and broadband streaming for videoconferencing, data protection, standard operating procedures, accreditation for service providers, and clinical quality management and reviews. • Telestroke is used in different forms, ranging from exclusive remote consultation (eg, for indicating thrombolytic treatment) to comprehensive networks enabling smaller hospitals to run local stroke units, using telestroke as required. • The use of telemedicine for remote neurological assessment and imaging reading have been reported to be as reliable and valid as onsite examinations. The safety and efficacy of thrombolysis administration by telemedicine in smaller hospitals were equivalent to thrombolysis done in larger experienced stroke centres. • Telestroke networks are cost-effective. • Physical rehabilitation, speech and language therapy, and occupational therapy can be provided by telerehabilitation platforms, although the evidence base to support its widespread use is lacking. *Coordination and monitoring of services for stroke* • Agreements with emergency medical services should be in place to ensure that patients with symptoms suspicious of acute stroke are delivered to stroke-ready hospitals. • Concerns about both variation in practice among hospitals and inequity of access to best-practice management for acute stroke, highlight the need for monitoring the quality of care. • Regular stroke care quality monitoring should include the proportions of patients receiving (or experiencing delays in receiving) stroke unit care, intravenous thrombolysis, and mechanical thrombectomy. Continuity of care should also be evaluated, from prehospital emergency care and triage to the optimal facility, to in-hospital care management by a multidisciplinary team, and stroke aftercare tailored to individual patient needs. Standardized data collection via national audits or statewide registries is to be encouraged.
Adeoye O, Nyström KV, Yavagal DR, Luciano J, Nogueira RG, Zorowitz RD et al. **Recommendations for the**	**Primary/Primordial Prevention** 1. A stroke system should develop support mechanisms to assist communities and providers in initiating prevention regimens applicable to broader populations. 2. A stroke system should develop support mechanisms to assist communities as a whole, patients, and providers in long-term

Guideline	Recommendations
Establishment of Stroke Systems of Care: A 2019 Update. ***Stroke*. 2019 Jul;50(7):e187-e210** **Erratum in: *Stroke*. 2020 Apr;51(4):e70.** **(selected)**	adherence to primordial and primary preventive treatment regimens. **Community Education and Engagement** 1. A stroke system should support local and regional educational initiatives to increase stroke awareness (including stroke warning signs, risk factors, primary and secondary prevention, and recovery), aimed at the general population with enriched targeting of populations at increased risk for stroke and poor outcomes after stroke. 2. A stroke system should monitor the effectiveness of community education in improving behavioral responses to warning symptoms, stroke treatment rates, mortality, and other relevant outcomes. 3. Methods to systematically identify and treat risk factors in all patients at risk for stroke should be developed. 4. Innovative behavioral interventions addressing barriers to healthy behaviors, prevention adherence, and warning sign action with tools such as digital phenotype analysis, social network analysis, gamification, and machine learning offer opportunity for sustainable behavioral change, and research in these areas should be encouraged. **Emergency Medical Services** 1. Public health leaders along with medical professionals and others should design and implement public education programs focused on stroke systems and the need to seek emergency care (by calling 9-1-1) in a rapid manner. These programs should be repetitive and designed to reach diverse populations. Further research is needed to establish the most effective programs for diverse populations. 2. EMS leaders, in coordination with local, regional, and state agencies and in consultation with medical authorities and local experts, should develop triage paradigms and protocols that ensure that all patients with a known or suspected stroke are rapidly identified and assessed with a validated and standardized instrument for stroke screening such as FAST (Face, Arm, Speech, Time), Los Angeles Prehospital Stroke Screen, or CPSS. 3. When there are several intravenous alteplase–capable hospitals in a well-defined geographic region, extra transportation times to reach a facility capable of endovascular thrombectomy should be limited to no more than 15 minutes in patients with a prehospital stroke severity scale score suggestive of LVO. When several hospital options exist within similar travel times, EMS should seek care at the facility capable of offering the highest level of stroke care. Further research is needed to establish travel time parameters for hospital bypass in cases of prehospital suspicion of LVO. **Hospital-Based Acute Stroke Management** 1. The CSC, PCS, TSC, and ASRH framework provides an appropriate platform for the data-driven development of hospital-based processes of care and outcome metrics. All certification systems should meet or exceed these standards. All levels of stroke centers should work within their region in an integrated fashion, providing and sharing best practice. 2. Identification of candidates for thrombectomy requires the timely completion of parenchymal and arterial imaging (CT or magnetic resonance) to identify the subset of patients who may benefit from thrombectomy. All centers managing stroke patients should develop a plan for the definitive identification and treatment of these patients. Hospitals without thrombectomy capability should have transfer protocols to allow the rapid treatment of these patients at hospitals with the appropriate level of care. In some instances (eg, rural facilities without imaging and radiology capabilities 24 h/d and 7 d/wk), this may mean rapid transfer of patients with clinically suspected LVO to hospitals where their workup may be expedited.

Guideline	Recommendations
	3. Centers providing thrombectomy should rigorously track patient flow at all time points from presentation to imaging to intervention to allow iterative process improvement. Technical outcomes (reperfusion rates), procedural complications, and patient clinical outcomes must be tracked and reported. **Secondary Prevention/Postacute Care** 1. Stroke centers should use organized approaches (eg, stroke teams, stroke units, and written protocols) to ensure that all patients receive appropriate subacute care. 2. Stroke centers should adopt approaches to secondary prevention that address all major modifiable risk factors and that are consistent with the national guidelines for all patients with a history or a suspected history of stroke or TIA. The focus of postacute care should be on reducing mortality, maximizing recovery, and preventing recurrent stroke and cardiovascular events. 3. A stroke system should establish support systems to ensure that all patients discharged from hospitals and other facilities to their homes have appropriate follow-up with specialized stroke services when needed and primary care arranged on discharge. These efforts should include education and training for the patient and his or her family members. Clear, comprehensive, and timely communication across the inpatient and outpatient poststroke continuum of care is essential to ensure appropriate medical and rehabilitation care. **Rehabilitation and Recovery of Stroke Survivors** 1. A stroke system should ensure that all stroke survivors receive a standardized screening evaluation during the initial hospitalization to determine whether rehabilitation services are needed and the type, timing, location, and duration of such therapy. Long-term primary care and specialist (physiatrist or neurology) follow-up should be arranged to identify patients with residual impairments so that these patients receive appropriate continued rehabilitation. 2. A stroke system should periodically assess its level of available rehabilitation services and community resources. **Palliative and End-of-Life Care** 1.Efforts should be made to advance the use of technology and patient-reported outcomes and to facilitate improved care transitions in stroke care. These interventions should be refined on the basis of continuous quality improvement measurement and methods. Such efforts not only will bolster overall stroke prevention, treatment, and recovery but also may reduce the persistent disparities observed in stroke care. Before implementation, new policies should be evaluated for potential adverse impacts on access to care and disparities in care. 2. Federal or other governmental institutions should enact policies that standardize the organization of stroke care throughout the continuum. Such policies should aim to lower barriers to seeking emergency care for stroke, to ensure that stroke patients receive care at appropriate hospitals in a timely manner, and to facilitate access to secondary prevention and rehabilitation and recovery resources after stroke.
Lindsay P, Furie KL, Davis SM, Donnan GA, Norrving B. **World Stroke Organization global stroke**	A framework is provided detailing 3 levels of universal stroke services and resource availability for all core elements of stroke care across the continuum of care and across health models.

Guideline	Recommendations
services guidelines and action plan. ***Int J Stroke.* 2014 Oct;9 Suppl A100:4-13.**	• Minimal (eg, Care provided in local communities without coordination across defined geographic regions). In this environment, laboratory tests and diagnostic studies are scarce, and much of the emphasis is placed on bedside clinical skills, teaching, and prevention. • Essential (eg, Limited coordinated stroke care provided across geographically discrete regions). In this environment, essential services level offers access to a CT scan, physicians, and the potential for acute thrombolytic therapy, however stroke expertise may still be difficult to access. • Advanced (eg, Fully coordinated stroke care provided across geographically discrete regions). In this environment advanced stroke services are available, including multidisciplinary stroke expertise, multimodal imaging, and comprehensive therapies, a coordinated referral system, and telestroke consultations are available. Using the framework above, key evidence-based recommendations and key performance measures are provided for: A. Systems for stroke recognition and response B. Hyperacute stroke care (first hours after stroke) C. Acute inpatient care (first days after stroke) D. Stroke rehabilitation E. Secondary stroke prevention F. Longer-term stroke recovery 10 Health system monitoring indicators are also described (eg, Stroke incidence rates adjusted for age and sex in the population).
Ringelstein EB, Chamorro A, Kaste M, Langhorne P, Leys D, Lyrer P et al; ESO Stroke Unit Certification Committee. **European Stroke Organisation recommendations to establish a stroke unit and stroke center.** ***Stroke.* 2013 Mar;44(3):828-40.**	A consensus statement was developed based on a review of the literature and a survey of European stroke experts (the Stroke Unit Committee) to describe the essential components and infrastructure of a stroke unit and stroke centre. Elements for both include: • Infrastructure of the Stroke Unit includes an acute monitoring period providing 24-hour continuous monitoring of vital parameters (ECG, blood pressure, O2 -saturation, and temperature), composed of a minimum of 4 beds and a post acute step-down stroke unit. • Urgent access to a neurological evaluation and to the expertise of a neurologist or internist experienced in stroke medicine. • Diagnostic and Therapeutic Infrastructure (CT/MRI, Permanent access to ECG, availability of Doppler, access to a transesophageal echocardiography and transthoracic echocardiography, access to ICU, and quick turnaround of laboratory results). • Access to early rehabilitation, including early mobilization, and an interdisciplinary team. • Hospital characteristics necessary to run the ESO Stroke Unit are also described including required expertise of the medical and nursing staff. Additional requirements for an ESO stroke centre and quality indicators are also described are also described.
Higashida R, Alberts MJ, Alexander DN, Crocco TJ, Demaerschalk BM, Derdeyn CP et al; on behalf of the American	1. Public health leaders along with medical professionals and others should design and implement public education programs focused on stroke symptoms and the need to seek emergency care (by calling 9–1–1) in a rapid manner. These programs should be repetitive and designed to reach diverse populations.

Guideline	Recommendations
Heart Association Advocacy Coordinating Committee. **Interactions within stroke systems of care: A policy statement from the American Heart Association/ American Stroke Association.** ***Stroke*. 2013;44:2961–2984.**	a. EMS leaders in coordination with local, regional, and state agencies and in consultation with medical authorities and local experts should develop triage paradigms and protocols that ensure that all patients with a known or suspected stroke are rapidly identified and assessed by use of a validated and standardized instrument for stroke screening, such as the FAST (face, arm, speech test) scale, LAPSS, or the Cincinnati Prehospital Stroke Scale (CPSS). 2. Unless there are compelling mitigating circumstances, when there are several acceptable hospitals (ASRH, PSC, CSC) in a well-defined geographic region, extra transportation times to reach another facility should be limited to no more than 15 to 20 minutes. a. Protocols that include prehospital EMS notification that a stroke patient is enroute should be used routinely. 3. Healthcare authorities, medical leaders, and government agencies should support the formation, operations, and certification of stroke centers as one proven means to improve patient care and outcomes. 4. Different services within a hospital that may be transferring patients through a continuum of care, as well as different hospitals that may be transferring patients to other facilities, should establish hand-off and transfer protocols and procedures that ensure safe and efficient patient care within and between facilities. a. Protocols for interhospital transfer of patients should be established and approved beforehand so that efficient patient transfers can be accomplished at all hours of the day and night. 5. All hospitals caring for stroke patients within a stroke system of care should develop, adopt, and adhere to care protocols that reflect current care guidelines as established by national and international professional organizations and state and federal agencies and laws. 6. Because of the limited distribution and availability of neurological, neurosurgical, and radiological expertise, the use of telemedicine/telestroke resources and systems should be supported by healthcare institutions, governments, payers, and vendors as one method to ensure adequate 24/7 coverage and care of stroke patients in a variety of settings. 7. Government agencies and third-party payers are urged to develop and implement reimbursement schedules for patients with acute stroke that reflect the demanding care and expertise that such patients require to achieve an optimal outcome, regardless of whether they receive a specific medication or procedure. 8. Cities, counties, regions, and states are urged to develop an organizational infrastructure and decision making body to assist in addressing care issues, decision making, implementation, and problem solving. This is typically in the form of a stroke committee defined by a region or other overseeing body. a. All of the elements of a stroke system of care will operate in a highly complex and multidisciplinary environment with many elements and stakeholders, each with their own rules and regulations. In terms of the many controlling authorities, it is paramount that the “best interests of the patient” be the primary concern and driving factor when any rules and regulations are made and implemented. 9. Each major element of a stroke system of care, as well as the entire system as defined by local or regional factors, should develop and implement at least 2 meaningful quality improvement projects that will result in improved patient care or outcomes.

Guideline	Recommendations
	a. Stroke outcome measures must include adjustments for baseline stroke severity. 10. A stroke system of care should ensure that all patients have access to poststroke care (ie, discharge planning services, rehabilitation, nursing facilities, medical follow-up) regardless of their financial status or socioeconomic background. Such availability will ensure that each patient has the opportunity to achieve a maximum recovery from stroke, which will ultimately reduce the societal and economic impact of stroke.

Evidence Tables

Learning Health System (LHS) Models

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Cadilhac et al. 2023 **Australia** **Review**	NA	NA	A literature search was conducted to identify learning health system (LHS) models applicable to stroke, TIA, from which the core elements were extracted. Secondly, a case study survey template was designed including 54 closed or open-ended questions/subquestions to be completed in a Qualtrics survey that mapped onto the framework, including LHS model case studies provided by senior stroke clinical and policy leaders, involved in World Stroke Organization committees and programs, from different regions of the world. An author from the United States Department of Veterans Affairs was also invited to describe a recent quality improvement (QI) project for TIA. The survey was completed by 11 individuals who were requested to describe the LHS approach used in their country, which LHS elements were included, and what component of the stroke continuum of care was the focus	**Primary Outcome:** NA	Commonly reported components of an LHS model include a continuous learning culture (adaptability and equity), structure and governance (cooperative and participatory leadership), inclusiveness, shared accountability and solidarity), science and informatics (privacy, scientific integrity and open innovation), patient-client partnership (person focused), and incentives (value and transparency) *Literature search results* The focus of LHSs for stroke ranged from targeting prevention, acute treatment of ischemic stroke, TIA, oral care to prevention of complications after intracerebral hemorrhage, and systems-level adoption to improve the whole patient journey from symptom onset to life back in the community. Few articles included all core aspects of the LHS model. Published reports from high income countries included examples from 6 Canadian provinces that established comprehensive stroke centres, with regional strategies to ensure access to acute stroke interventions, an acute stroke pathway, and other initiatives. Several examples were provided from the US including the IMPROVE initiative to reduce door-to-needle time), and an LHS systems approach to support clinical teams to improve the quality of care for patients with TIA (the PREVENT program), among others. Published reports from middle- and low-income countries are also provided (China, and the Philippines). 7 case examples of LMS models were included from: Nigeria, Africa, Australia (n=2), the Czech

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					Republic, New Zealand, Sweden, and the United States (US), representing a national (n=3) or regional approach (n=4). Fidelity to the core elements ranged across the models. Lessons learned from implementation of a stroke LHS from each case example, are provided.

Integrated Care Models

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Liu et al. 2025 **China** **Systematic review & meta-analysis**	One trial was assessed at a high risk of bias, 7 were at some risk of bias.	19 RCTs including patients with stroke of any type, stage, or severity.	Trials examined the effectiveness of stroke-specific integrated care (IC) models compared with conventional care. IC interventions were those that emphasized adherence to 10 principles: comprehensive services across the continuum of care, patient focus, standardized care delivery through interprofessional teams, close geographic access to care, performance monitoring, development and implementation of information systems, a patient-centered, team-based healthcare service culture, guided by clear leadership and management, physician integration, a multi-level, multi-stakeholder health service governance structure and fiscal accountability. IC interventions focused on the process of coordination between	**Primary Outcome:** Health-related quality of life, (HR-QoL) activities of daily living (ADL), and depression	Examples of interventions included very early supported discharge programs, a virtual multidisciplinary stroke care clinic, integrated palliative care, an integrated multidisciplinary geriatric rehabilitation programme, stroke secondary prevention, combining hospital and community resources, an integrated primary care management programme, and a transitional care program for stroke survivors. IC was associated with significant improvements in HR QoL (SMD= 0.69, 95% CI 0.35 to 1.02), ADL performance (SMD=0.95, 95% CI 0.48 to 1.43) and depression (SMD=-1.02, 95% CI -1.77 to -0.26). Adherence to each of the 10 principles was 100% (Comprehensive services across the continuum of care, patient focus, and standardized care delivery through interprofessional teams), 95% (physician integration), 90% (performance management), 74% (organizational culture and leadership), 63% (information systems), 58% (close geographic access to care), 42% (governance structure), and 5% (financial accountability).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			clinical providers, home healthcare agencies, community agencies, and allied primary healthcare.		
Eustace et al. 2025 **UK** **Systematic review & meta-analysis**	Of the RCTS, 10 were at low risk of bias, 33 were moderate risk and 21 studies were at high risk of bias, using the Cochrane Risk of Bias v.2 (RoB2) tool. Of the non RCTs, 20 were considered at moderate risk of bias and 15 studies were at high risk of bias using the Risk Of Bias In Non-randomized Studies—of Interventions (ROBINS-I) instrument	99 studies (64 RCTs, 35 non RCTs), published from January 2012 to January 2024 that included 88,435 patients with any type of stroke or TIA and evaluated interventions as part of integrated care.	Interventions assessed were wide ranging. Examples included screening for complications, QoL, and depression, counselling for lifestyle changes, secondary prevention counselling, medication adherence, interviews and education (web-based training) for caregivers and patients, standardised care pathway, very early mobilisation, early supported discharge, tele-rehab, exercise, post acute care program, individualised transitional care model based at home, patient/family education, and a multidisciplinary poststroke consultation team, among others.	**Primary outcomes:** Mortality, recurrent stroke and major bleeding **Secondary outcomes:** Quality of life (QoL), unplanned readmission, anxiety and depression, lifestyle and cardiovascular risk factors, and adherence to intervention	There were no significant reductions in mortality (at 90 days, one year or >one year), major bleeding (RR=1.35, 95% CI 0.56–3.22, 4 studies), or unplanned readmissions (RR=0.88, 95% CI 0.73–1.05, 9 RCTs) associated with integrated care In pooled analysis including the results from RCTs, the risk of recurrent stroke was reduced significantly in patients that received integrated stroke (RR=0.79, 95% CI 0.63–1.00, n=9 trials) and incidence of depression (RR=0.95, 95% CI 0.92–0.99). There was significant improvement in QoL associated with integrated care (SMD= 0.41, 95% CI 0.26–0.56, 21 studies). Overall, integrated care was associated with a significant improvement in cardiovascular risk factors (systolic blood pressure and LDL-cholesterol).
Ganesh et al. 2016	NA	319,972 patients hospitalized for stroke/TIA in Canada (excluding	The primary outcome of provinces with stroke systems were compared to those without,	**Primary outcome:** Change in 30-day mortality over the	Provinces with stroke care systems were British Columbia, Alberta, Ontario, Quebec, Nova Scotia, and Prince Edward Island.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Canada **Retrospective study**		Quebec) during fiscal years 2003/2004 through 2013/2014. Mean age was 73 years, 50% were men. 67.5% of strokes were ischemic.	after adjustment for potential confounders. In addition, surveys of Canadian hospitals were conducted in 2009 in 306 hospitals and 2013 in 601 hospitals to identify key aspects of acute stroke care delivery in their institution (the provision of care on a stroke unit, the availability of CT or MRI and carotid doppler imaging for stroke patients, and access to neurosurgical services, stroke rehabilitation services, stroke prevention clinics, and telestroke services). Resources in provinces with integrated systems were compared to those without.	study period	226 hospitals participated in both surveys, of which 180 had an integrated system of care and 46 did not. In 2009, hospitals with a stroke system were significantly more likely to have carotid doppler available within 24 hours of presentation (78.9% vs. 54.3%), provide access to stroke prevention clinic within 48–72 hours (38.3% vs. 21.7%), and provide telestroke services (36.1% vs. 10.9%). In 2013, hospitals with a stroke system were significantly more likely to provide access to stroke prevention clinic within 48–72 hours (77.8% vs. 45.7%) and provide telestroke services (55.0% vs. 23.9%). The crude 30-day mortality was 14.5% in non system hospitals in 2003/04, which remained stable until 2013/14 (14.2%). In contrast, mortality dropped from 15.8% to 12.7% in hospitals with stroke systems during the same period. In 2003/04, the adjusted incidence rate ratio (IRR) for 30-day mortality was 0.96 (95% CI 0.89–1.04) for provinces with integrated systems of stroke care vs those without such systems. From 2010/2011 to 2013/2014 the IRR was significantly lower in hospitals with stroke systems in place. 2010/2011 IRR=0.90 (95% CI 0.84–0.97) 2011/2012 IRR=0.85 (95% CI 0.79–0.92) 2012/13 IRR=0.85 (95% CI 0.79–0.92) 2013/2014 IRR=0.85 (95% CI 0.79–0.92)

Acute Stroke Care

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Ibsen et al. 2025 **Norway** **Prospective study**	NA	155 patients undergoing CT examination within the first 24 hours after onset of stroke symptoms. Mean age was 72 years, 42% were men.	The outcomes of patients at a rural hospital with a CT scanner (with off hours access through telestroke) were compared with those of patients at 2 reference hospitals from two other rural regions in Norway with similar distances to their local hospital but without access to a rural CT scanner.	**Primary outcomes:** Time components, mRS scores at 3 months, percentage of patients receiving intravenous thrombolysis	Median time from onset of symptoms to completed CT examination was significantly shorter in the rural group (93 vs 240 minutes, p<0.05). In patients receiving intravenous thrombolysis, median time from onset of symptoms to treatment was significantly shorter in the rural group (124 vs. 213 minutes, p<0.05). 12 patients with ischemic stroke in the rural group were given intravenous thrombolysis vs. 8 in the reference group (p=0.24). The percentage of patients with mRS 0–2 at 3 months follow-up was 54.7% in the rural group vs. 60.6% in the reference group (p=0.61).
Zhao et al. 2021 **China** **Systematic review & meta-analysis**	14 studies were considered to be of good quality (≥7 Newcastle–Ottawa Scale score)	19 studies (1 RCT, 18 retrospective studies) including patients with acute ischemic stroke eligible for treatment with endovascular thrombectomy (EVT). Mean/median age ranged from 66 to 79 years. Mean/median NIHSS score ranged from 12 to 22. (% of men not reported)	The outcomes of patients admitted directly to a comprehensive stroke centre (CSC) for EVT (n=4,205) were compared with patients initially transferred to a primary stroke centre (PSC) with secondary transfer to a CSC (n=4,546) were compared.	**Primary outcomes:** Symptomatic intracerebral hemorrhage (sICH) within 7 days, favorable outcome (mRS 0-2) at 3 months, mortality in hospital, mortality at 3 months; and successful recanalization rate	The odds of a sICH were not significantly lower in the direct transfer to CSC group (OR=0.86, 95% CI 0.62-1.18; 13 studies, n=3,857). The odds of a favourable outcome were significantly higher in the direct transfer to CSC group (OR=1.26, 95% CI 1.12–1.42; 16 studies, n= 5,258). The odds of in-hospital mortality were not significantly lower in the direct transfer to CSC group (OR=0.84, 95% CI 0.51–1.39), or at 3 months (OR=1.01, 95% CI 0.85-1.21). The odds of successful recanalization were not significantly higher in the direct transfer to CSC group (OR=1.03, 95% CI 0.88-1.20).
Langhorne et al. 2020 **Stroke Unit**	The most common source of bias was	29 RCTs (n= 5,902), including participants admitted to hospital	Comparisons between organized stroke unit care with alternative services.	**Primary Outcomes:** Poor outcome, defined as death, dependency (e.g., mRS>3 or BI <18), and	**Organized stroke unit vs. alternative service** Stroke units significantly reduced the odds of a poor outcome OR=0.77, 95% CI 0.69 to 0.87.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Trialists' Collaboration **UK** **Cochrane Review**	failure to mask the patient and/or outcome assessor	following acute stroke.	Treatment comparisons included acute stroke units that accept patients acutely but discharge early (usually within seven days) and were classified according to intensity of care: i) intensive care with intensive monitoring, ii) semi-intensive care, but with no life support facilities and iii) non-intensive care, and other forms of more organized care such as combined acute and rehabilitation stroke units, mixed rehabilitation ward and mobile stroke teams.	institutionalization at the end of scheduled follow-up. **Secondary Outcomes**: Quality of life, patient and carer satisfaction, and length of hospital stay (LOS).	Results from 26 studies included. Stroke units significantly reduced the odds of death at the end of scheduled follow-up. OR=0.76, 95% CI 0.66 to 0.88. Results from 29 studies included. Stroke units significantly reduced the odds of death or institutional care by the end of scheduled follow-up. OR=0.76, 95% CI 0.67 to 0.85. Results from 25 studies included. Stroke units significantly reduced the odds of death or dependency by the end of scheduled follow-up. OR=0.75, 95% CI 0.66 to 0.85. Results from 24 studies included. Hospital LOS was not significantly shorter for stroke unit patients SMD=0.16, 95% CI -0.33 to 0.01. Results from 19 studies included. Quality of evidence was moderate. **Stroke Unit vs. General Medical Ward** Stroke units significantly reduced the odds of a poor outcome OR=0.78, 95% CI 0.68 to 0.91. Results from 14 studies included. Stroke units significantly reduced the odds of death at the end of scheduled follow-up. OR=0.75, 95% CI 0.63 to 0.91. Results from 15 studies included. Stroke units significantly reduced the odds of death or institutional care by the end of scheduled follow-up. OR=0.74, 95% CI 0.63 to 0.87). Results from 13 studies included. Stroke units significantly reduced the odds of death or dependency by the end of scheduled follow-up. OR=0.75, 95% CI 0.64 to 0.88). Results from 12 studies included.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					Hospital LOS was not significantly shorter for stroke unit patients SMD=0.13, 95% CI -0.29 to 0.04. Results from 10 studies included. **Mobile Stroke Team vs General Medical Ward** Only 2 studies were included in pooled analysis. Mobile stroke teams were not associated with significantly better outcomes. **Mixed Rehabilitation Ward vs. GMW** MRWs significantly reduced the odds of a poor outcome OR=0.65, 95% CI 0.47 to 0.90. Results from 6 studies included. MRW did not reduce the odds of death at the end of scheduled follow-up. OR=0.91, 95% CI 0.58 to 1.42. Results from 6 studies included. MRW significantly reduced the odds of death or institutional care by the end of scheduled follow-up. OR=0.71, 95% CI 0.51 to 0.99. Results from 5 studies included. MRW significantly reduced the odds of death or dependency by the end of scheduled follow-up. OR=0.65, 95% CI 0.47 to 0.90. Results from 6 studies included. Hospital LOS was not significantly shorter for MSU patients SMD=0.08, 95% CI -0.21 to 0.37. Results from 3 studies included.
Langhorne et al. 2002 **UK** **Systematic review**	NA	11 trials examining the structure and care processes of comprehensive stroke units (combining acute and rehabilitation) and stroke rehabilitation	In addition to data abstraction, a survey was used where trialists were asked to describe the process of care for two hypothetical patients. Elements of interest included: structure and	**Primary outcome:** Not applicable	**Structure and organization of acute stroke units** Bed numbers ranged from 6-12. All units described staffing levels for a core multidisciplinary team of medical, nursing, physiotherapy, occupational therapy and speech and language therapy staff. Patients and family were routinely provided with

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			organization, processes of care and discharge planning and follow up		information on stroke disease, rehabilitation, and recovery. All units described educational and training programmes for staff. **Processes of Care** Most units reported providing routine assessments (history and clinical examination) and investigations (biochemistry and hematology), ECG and CT and carotid Doppler ultrasound in select patients. Early medical management strategies and prevention and management of complications are described. General management strategies are described with a focus on early rehabilitation strategies. **Discharge planning** Most units (9/11) made early contact with patients and carers to make appropriate comprehensive assessments for hospital discharge. A minority (4/11) reported a pre-discharge home visit or follow up from a stroke liaison nurse.
Man et al. 2018 **USA** **Retrospective study (GWTG)**	NA	722, 941 patients admitted to 134 comprehensive stroke centers (CSCs) and 1,047 primary stroke centers (PSCs) from 2013-2015, with acute ischemic stroke. Mean age was 70 years, 50% were men. Median baseline NIHSS score was 4.	The outcomes and process indicators of patients admitted to CSC and PSC, were compared. There were 110,624 patients presenting to an emergency department (ED) at a CSC vs. 494,512 at a PSC. There were 48,376 patients who transferred to a CSC vs. 69,429 to a PSC.	**Primary outcomes:** Conformity to 7 performance measures and the summary defect-free care measure and 8 performance measures	*ED admissions* i) Performance measures There were no significant differences between groups with respect to the odds of: receiving i.v. t-PA within 3 hours of stroke onset, receiving early antithrombotics, DVT prophylaxis, anticoagulation for AF, statin therapy, smoking cessation counselling, or defect free care (94.2% vs. 93.8%). The odds of receiving antithrombotics at discharge were significantly lower in the PSC group (OR=0.59, 95% CI 0.36-0.97). ii) Quality measures There were no significant differences between groups with respect to the odds of: receiving i.v. t-PA within 4.5hours of stroke onset, LDL measured,

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					dysphagia screen, receiving stroke education or being assessed for rehabilitation. The odds of t-PA door-to-needle time ≤60 minutes, were significantly higher at a CSC (OR=1.48, 95% CI 1.25-1.75). The odds of receiving intensive statin therapy were significantly higher in the CSC group (58.9% vs. 44.7%, OR=1.29, 95% CI 1.04-1.59). The percentages of patients who received t-PA and EVT were significantly higher at CSC (14.3% vs. 10.3%, and 4.1% vs. 1.0%, respectively). Mean door-to needle times were significantly shorter at a CSC (52 vs. 61 minutes). The odds of in-hospital mortality were significantly higher in the CSC group (4.6% vs. 3.8%; OR=1.14, 95% CI 1.01-1.29). *Patients transferred in* i) Performance measures There were no significant differences between groups in the percentage of patients receiving early treatments. The percentages of patients receiving defect free were 95.5% (CSC) and 95.2% (PSC)). ii) Quality measures The odds of receiving intensive statin therapy were significantly higher in the CSC group (62.0% vs. 45.8%, OR=1.41, 95% CI 1.21-1.78). The percentages of patients who received t-PA and EVT were significantly higher at CSC (10.4% vs. 9.2%, and 5.5% vs. 1.4%, respectively). Mean door-to needle times were significantly shorter at a CSC (52 vs. 60 minutes). The odds of in-hospital mortality were significantly higher in the CSC group (5.5% vs. 4.2%; OR=1.17, 95% CI 1.05-1.32).
Purvis et al. 2018 **Australia**	NA	4,060 patients with stroke admitted to 109 hospitals that had a stroke unit. Median age was 75 years, 55% were men.	The outcomes of patients treated in hospitals that had a stroke coordinator (53 hospitals, n=2,072) were compared with	**Primary outcomes:** Death, independence on discharge (mRS 0–2), and severe complications (considered incapacitating,	Patients admitted to hospitals with a stroke coordinator were more likely to be admitted a stroke unit, to received rehabilitation within 48 hours, to be discharged on statin, antihypertensive, and antithrombotic medications, as appropriate, to

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Cross-sectional study			hospitals without a stroke coordinator (33 hospitals, n=1,333).	life threatening, and prolonging hospital stay.	receive risk prevention counselling prior to discharge, to have a support needs assessment, and have a written care plan. There were no significant differences between groups for any of the primary outcomes. The odds of a patient being discharged to a rehabilitation unit were higher in hospitals with a stroke coordinator (adjusted OR=1.8, 95% CI 1.1–2.8) and have a reduced length of acute stay (median -14 hours) if discharged.
NCT02795962 **Spain** **RCT** ***Direct Transfer to an Endovascular Center Compared to Transfer to the Closest Stroke Center in Acute Stroke Patients with Suspected Large Vessel Occlusion (RACECAT)***	Concealed Allocation: ☑ Blinding: Patient ☒ Assessor ☑ ITT: ☑	1,316 patients (planned) with suspected large vessel occlusion (LVO) identified by a RACE scale score >4 identified by EMS personnel in a pre-hospital setting.	Patient will be randomized to be transferred to the closest local stroke center (Local-SC) or to be transferred directly to an endovascular stroke center (EVT-SC).	**Primary outcome:** mRS score at 90 days **Secondary outcomes:** 90-day mortality, 90-day mortality on patients with sICH, clinical deterioration requiring intubation during primary or secondary transfers, clinical deterioration (≥4 points on the NIHSS) at 24 hours, proportion of patients receiving iv tPA and EVT within the first 8 hours from symptom onset	TBA

Abbreviations

CI: confidence interval	EVT: endovascular thrombectomy	ITT: intention-to-treat
MD: Mean difference	mRS: modified Rankin Scale	NA: Not assessed
RACE: Rapid Arterial oCclusion Evaluation	RCT: randomized controlled trial	OR: odds ratio
RR: relative risk	SMD: standardized mean difference	

References

Cadilhac DA, Bravata DM, Bettger JP, Mikulik R, Norrving B, Uvere EO et al. Stroke Learning Health Systems: A Topical Narrative Review With Case Examples. *Stroke*. 2023 Apr;54(4):1148-1159.

Eustace I, Buckley BJR, Kaya I, Hoad KL, France-Ratcliffe M, Hill AR, Lip GYH, Jones ID, Higginbotham K. Integrated care management for patients following acute stroke: a systematic review. *QJM.* 2025 Jan 24:hcaf029.

Ibsen J, Hov MR, Tokerud GE, Fuglum J, Linnerud Krogstad M, Stugaard M et al. Prehospital computed tomography in a rural district for rapid diagnosis and treatment of stroke. *Eur Stroke J*. 2024 Sep 28;10(1):23969873241267084.

Ganesh A, Lindsay P, Fang J, Kapral MK, Côté R, Joiner I, Hakim AM, Hill MD. Integrated systems of stroke care and reduction in 30-day mortality: A retrospective analysis. *Neurology*. 2016 Mar 8;86(10):898-904.

Langhorne P, Pollock A; Stroke Unit Trialists' Collaboration. What are the components of effective stroke unit care? *Age Ageing*. 2002 Sep;31(5):365-71.

Langhorne P, Ramachandra S; Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke: network meta-analysis. Cochrane Database Syst Rev. 2020 Apr 23;4(4):CD000197.

Liu B, Cai J, Zhou L. Effectiveness of integrated care models for stroke patients: A systematic review and meta-analysis. *J Nurs Scholarsh*. 2025 Mar;57(2):266-297.

Man S, Zhao X, Uchino K, Hussain MS, Smith EE, Bhatt DL et al. Comparison of Acute Ischemic Stroke Care and Outcomes Between Comprehensive StrokeCenters and Primary Stroke Centers in the United States. *Circ Cardiovasc Qual Outcomes*. 2018 Jun;11(6):e004512.

Manawadu D, Choyi J, Kalra L. The impact of early specialist management on outcomes of patients with in-hospital stroke. *PLoS One* 2014;9:e104758.

Purvis T, Kilkenny MF, Middleton S, Cadilhac DA. Influence of stroke coordinators on delivery of acute stroke care and hospital outcomes: An observational study. *Int J Stroke*. 2018 Aug;13(6):585-591.