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Acute Stroke Management Online Supplemental Material:

The following content are included here as supplemental material to the Canadian Stroke Best Practice Recommendations: *Acute Stroke Management,* 7th Edition Practice Guidelines Update, 2022, published in the Canadian Journal of Neurological Sciences (CJNS) in December 2022. This content includes definitions, laboratory tables and boxes for criteria applicable to several recommendations, and further implementation guidance.

Note, this material has been translated into French, and the French version is also available at CJNS as online Supplemental Materials.

Contents:

Overview Section:

Criteria for Stroke Centres Providing Acute Ischemic Stroke Treatment

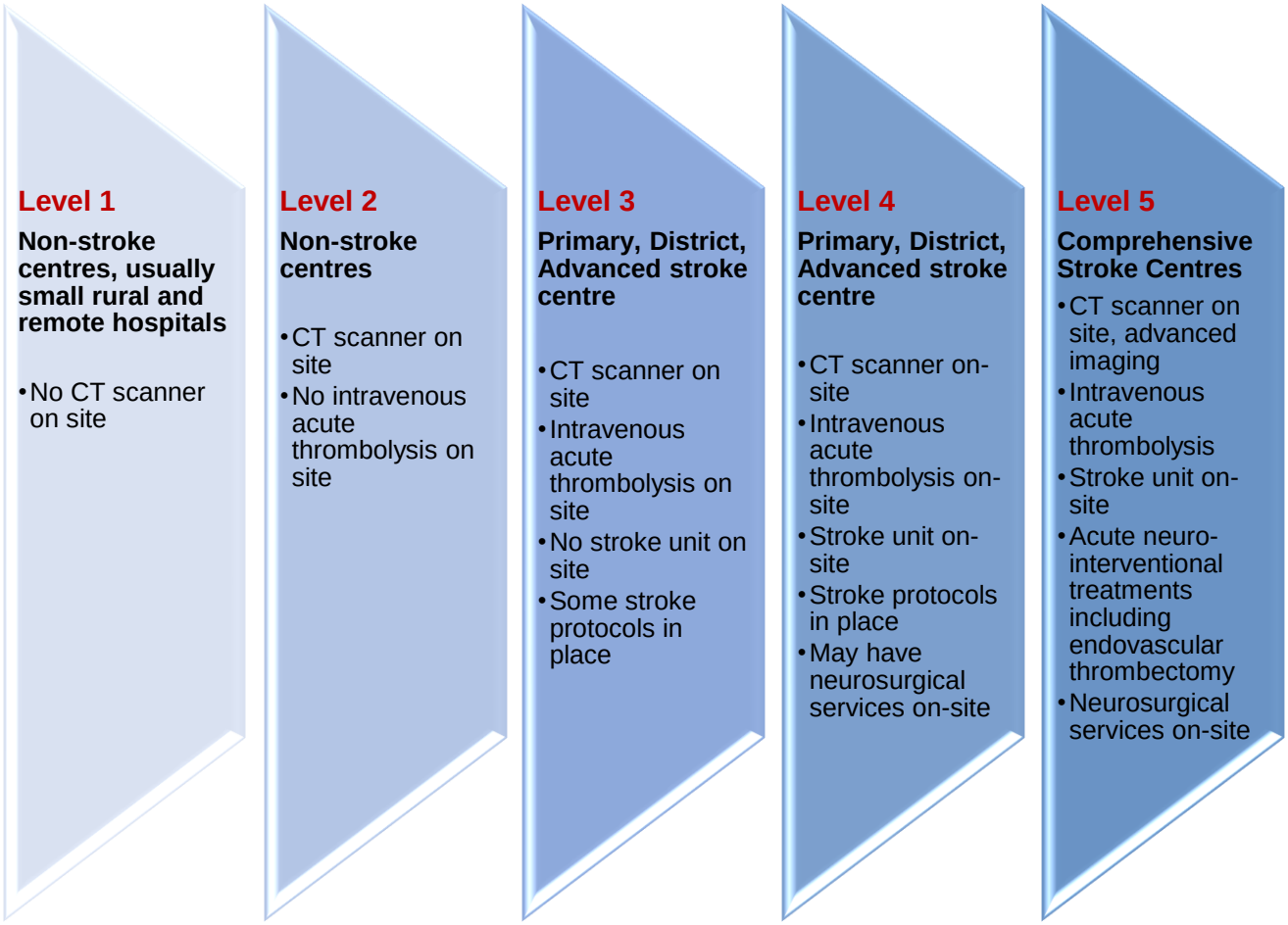
Within the Canadian Stroke Best Practices *Optimal Acute Stroke Services Framework,* all hospitals in Canada have been assessed based on their capacity to provide guideline-directed stroke care. Each acute care hospital in Canada has been classified as belonging to one of five stroke service levels (refer to Figure 2).

- Level 1 and 2 hospitals do not provide emergent acute stroke services. Level 3, 4, and 5 hospitals have increasing levels of coordinated stroke care services, including on-site CT imaging and acute thrombolysis.
- Level 3 hospitals are primary stroke centres that provide intravenous thrombolysis, with or without virtual telestroke support, but they do not have acute stroke units.
- Level 4 hospitals are primary or district or advanced stroke centres that offer on-site intravenous thrombolysis and have acute inpatient stroke units. Neurosurgical services are available at some Level 4 centres.
- Level 5 hospitals are comprehensive stroke centres that provide advanced stroke care including endovascular interventions, and neurosurgical and advanced interventional radiology services.
- Level 4 and 5 centres accept transfers from less resourced centres to provide advanced treatment and access to rehabilitation.
- Level 5 comprehensive stroke centres must meet the following criteria to provide endovascular thrombectomy (EVT):

    1. A designated stroke team that includes physicians with stroke expertise (e.g., stroke neurologist or other physicians with advanced stroke training); stroke nurses and advanced practice nurses and/or nurse practitioners; neurosurgeons; (neuro)-radiologists, emergency physicians; critical care physicians; rehabilitation therapists (i.e., physical therapists, occupational therapists, speech-language pathologists), dieticians, pharmacists, and social workers.
    2. On-site neurointerventional expertise with 24-hour access, seven days a week.
    3. On-site neurosurgery support and neurocritical care services.
    4. On-site stroke imaging with 24-hour access to a scanner and rapid interpretation of images, seven days a week, including a computed tomography (CT) scanner (i.e., third-generation or higher helical scanner) with programming for CT angiography (CTA). Multiphase or dynamic CTA or CT perfusion (CTP) imaging can also be used if available on-site. Magnetic resonance imaging, angiography, or perfusion (MRI, MRA, MRP) may be considered if available on site and will not delay acute stroke treatments.
    5. Capability to administer intravenous thrombolysis.
    6. On-site designated acute or comprehensive stroke unit, which is a specialized, geographically defined hospital unit dedicated to the management of patients with stroke, staffed by an experienced interdisciplinary stroke team, and providing a complex package of evidence-based care (e.g., protocols, care pathways) for acute stroke management, early rehabilitation, and education to people with stroke in hospital.

Figure 2 Acute Stroke Service Capability

Service levels determined through an Acute Stroke Resource and Services Inventory conducted and validated by Heart & Stroke in 2019 and updated in 2022.



CSBPR 7 Acute Stroke Management Module Definitions

Acute stroke: An episode of symptomatic neurological dysfunction caused by focal brain, retinal or spinal cord ischemia or hemorrhage with evidence of acute infarction or hemorrhage on imaging (MR, CT, retinal photomicrographs), and regardless of symptomatic duration.

Ischemic stroke: An episode of neurological dysfunction caused by focal cerebral, spinal, or retinal cell death attributable to ischemia (blockage of an artery or vein), based on pathological, imaging, or other objective (clinical) evidence of cerebral, spinal cord, or retinal focal ischemic injury or until other etiologies have been excluded. Traditional definitions suggested that symptoms of stroke must last > 24 hours, but time-based definitions are now often reconsidered based on more advanced neuroimaging.

Transient ischemic attack (TIA, sometimes referred to as a “mini-stroke”): A clinical diagnosis that refers to a brief episode of neurological dysfunction caused by focal brain, spinal cord, or retinal ischemia, with clinical symptoms, and without imaging evidence of infarction (Easton, 2009; Sacco

et al., 2013). TIA and minor acute ischemic stroke fall along a continuum. TIA symptoms fully resolve within 24 hours and usually within one hour. If any symptoms persist beyond 24 hours, this is considered a stroke, although this continuum cannot be differentiated by symptom duration alone. A TIA is significant as it can be a warning of a future stroke event. Patients and healthcare professionals should respond to an acute TIA as a medical emergency.

Minor non-disabling ischemic stroke (sometimes referred to as mild or non-disabling stroke): A brain, spinal, or retinal infarct that is typically small and associated with a mild severity of clinical deficits or disability. It may not require hospitalization. Practically speaking, deficits that if unchanged, would not impair the patient's ability to perform their ADLS, work and/or walk independently (based on PRISMS trial, 2018).

Note: For practical purposes, assessment, diagnosis, and management of individuals presenting with symptoms of TIA or minor ischemic stroke should follow similar processes as those throughout this module. Differentiating between TIA and minor stroke is less relevant and condition management should be informed by clinical history, presentation, and diagnostic imaging. Evidence shows that at least 20% of individuals presenting with TIA will experience a subsequent and more involved stroke, highlighting the need for aggressive secondary prevention for this group (OSVASC, NEJM, 2016).

Cerebral venous thrombosis (CVT): Thrombosis of the veins in the brain, either the dural venous sinuses or the more upstream cortical or deep veins. CVT may be present with neurological deficits due to venous congestion (sometimes called venous infarction) or due to hemorrhage. In the mildest circumstance CVT will present with headache only and sometimes with retinal edema (papilledema) and associated visual changes. CVT is an uncommon cerebrovascular disorder, accounting for <1% of all stroke syndromes.

Cryptogenic stroke: Cryptogenic stroke is defined as a brain infarction not clearly attributable to a definite cardioembolism, large artery atherosclerosis, small artery disease, or other identifiable cause despite extensive investigation. This group accounts for 25 to 40% of all strokes (Saver, 2016; [1]Yaghi et al., 2017[2]).

Embolic stroke of undetermined source (ESUS): A subset of cryptogenic strokes that represent approximately 9 to 25% of ischemic strokes, that meet the following criteria (Tsivgoulis et al., 2019[3]; Ntaios, 2020)[4]:

- Acute brain infarct visualized on neuroimaging; not a subcortical lacune <1.5 cm.
- Absence of proximal atherosclerotic arterial stenosis >50%
- No atrial fibrillation or other major-risk cardioembolic source
- No other likely cause of stroke (e.g., dissection, arteritis, cancer)

[1] Saver JL. Cryptogenic Stroke. *N Engl J Med*. 2016;374(21):2065-2074. doi:10.1056/NEJMcp1503946

[2] Yaghi S, Kamel H, Elkind MSV. Atrial cardiopathy: a mechanism of cryptogenic stroke. Expert Rev Cardiovasc Ther. 2017 Aug;15(8):591-599. doi: 10.1080/14779072.2017.1355238. Epub 2017 Jul 27. PMID: 28718666; PMCID: PMC6092961.

[3] Tsivgoulis G, Kargiotis O, Katsanos AH, et al. Incidence, characteristics and outcomes in patients with embolic stroke of undetermined source: A population-based study. *J Neurol Sci*. Jun 15 2019;401:5-11. doi:10.1016/j.jns.2019.04.008

[4] Ntaios G. Embolic Stroke of Undetermined Source: JACC Review Topic of the Week. *J Am Coll Cardiol*. Jan 28 2020;75(3):333-340. doi:10.1016/j.jacc.2019.11.024

Mobile stroke unit: A mobile stroke unit has both the medical expertise and imaging technology to evaluate and treat patients with suspected stroke rapidly and accurately. The most important benefit of the mobile stroke unit is rapid diagnosis of the stroke type, allowing hemorrhage to be ruled out and treatment with intravenous thrombolysis to be started quickly if appropriate. Generally, these patients are referred to a hospital with CT imaging and a stroke (or telestroke) program (Shuaib & Jeerakathil, 2016).[5]

Hemorrhagic stroke: A stroke caused by the rupture of a blood vessel within the brain tissue, subarachnoid space or intraventricular space.

Intracranial hemorrhage includes bleeding within the cranial vault and encompasses intraventricular, intraparenchymal, subarachnoid, subdural and epidural hemorrhage.

Spontaneous, nontraumatic intracerebral hemorrhage is bleeding within the brain parenchyma without obvious systemic, neoplastic, traumatic, or macrovascular etiology. This stroke subtype accounts for about 10-15% of all strokes and a disproportionately higher number of stroke related deaths. ICH are often categorized according to their location within the brain: lobar, deep, cerebellar, and brainstem.

Hemorrhagic infarct: Hemorrhagic infarct is defined as a hemorrhagic transformation into an area of arterial ischemic infarction or venous thrombosis associated tissue congestion.

CSBPR 7 Acute Stroke Management Module Reference Timeframes:

- **Prehospital and emergency department stroke care:** The key interventions needed for the assessment, diagnosis, stabilization, and treatment in the first hours after stroke onset. This includes all prehospital and initial emergency care for TIA, ischemic stroke, intracerebral hemorrhage, subarachnoid hemorrhage, and acute cerebral venous thrombosis. This stage involves rapid triaging of patients based on time of symptom onset, stroke acuity, and brain imaging. Treatments may include acute intravenous thrombolysis or acute endovascular interventions for ischemic stroke, emergency neurosurgical procedures, and same-day TIA diagnostic and risk stratification evaluation.

  The principal aim of this phase of care is to diagnose the stroke type, and to coordinate and execute an individualized treatment plan as quickly as possible.

  Prehospital and emergency department care is time-sensitive by nature: minutes for disabling stroke and hours for TIA. In addition, specific interventions are associated with their own individual treatment windows. Generally, this "hyperacute" time-sensitive window refers to care offered in the first 24 hours after an acute stroke (ischemic and hemorrhagic) or TIA.

- **Acute stroke care:** The key interventions involved in the assessment, treatment or management, and early recovery in the first days to weeks after stroke onset. This encompasses all the initial diagnostic procedures undertaken to identify the nature and mechanism of the stroke, interdisciplinary care to prevent complications and promote early recovery, institution of an individualized secondary prevention plan, and engagement with the person with stroke and their family to assess and plan for transition to the next level of care, which includes a comprehensive assessment of the person's rehabilitation needs. New models of acute ambulatory care such as rapid assessment TIA and minor stroke clinics or day-units are also starting to emerge.

[5] Shuaib A, Jeerakathil T. The mobile stroke unit and management of acute stroke in rural settings. *Cmaj*. Jul 16 2018;190(28):E855-e858. doi:10.1503/cmaj.170999

The principal aims of this phase of care are to identify the nature and mechanism of stroke, prevent further stroke complications, promote early recovery, and, in the case of the most severe strokes, provide palliation and end-of-life care.

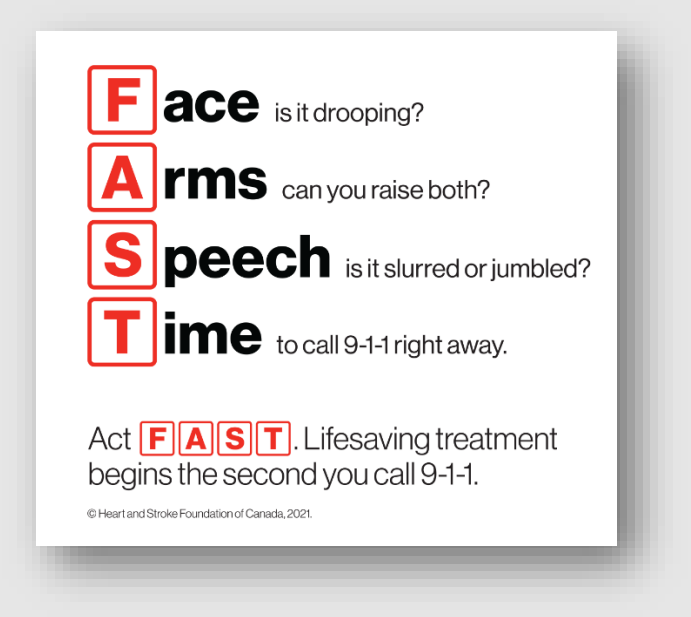
Generally, "acute care" refers to the first days to weeks of inpatient treatment. The person with stroke then transitions from acute care to inpatient or community-based rehabilitation; home, with or without support services; continuing care; or palliative care. This acute phase of care is usually considered to have ended either at the time of discharge from the acute stroke unit or 30 days after hospital admission.

CSBPR Acute Stroke Management Recommendations, 7th Edition, Update 2022

The content below provides additional information, definitions and implementation criteria to support several recommendations contained in the accompanying manuscript.

Section 1: Stroke Recognition and response

Box 1A FAST Signs of Stroke
Heart & Stroke, www.heartandstroke.ca/fast



Box 1B Core Information Generally Required by Emergency Medical Services Dispatch, Paramedics, and Receiving Healthcare Facility

1. Stroke symptom onset time if witnessed, and last known well time if not witnessed
2. Total symptom duration at anticipated arrival in the emergency department
3. Presenting signs of stroke and stroke severity score, based on standardized screening tools
4. Current condition of the patient having a stroke, including previous functional status and independence level, and changes in their condition since stroke symptom onset
5. Current medications (e.g., anticoagulants) if known
6. Advance care plans, if any
7. Expected time of arrival at the receiving hospital
8. Additional health problems, if known

Refer to Section 3 Emergency Medical Services Management of Acute Stroke for additional information.

Section 2: Triage and Initial Diagnostic Evaluation of Transient Ischemic Attack (TIA) and Non-Disabling Stroke

2. Triage and Initial Diagnostic Evaluation of Transient Ischemic Attack and Non-Disabling Stroke Recommendations 2022

Notes

- *Section 2 recommendations pertain to the initial management of patients with a suspected acute transient ischemic attack (TIA) or acute ischemic stroke **who are not candidates** for acute thrombolysis or endovascular intervention. For patients with suspected acute stroke that warrant hyperacute assessment to determine eligibility for intravenous thrombolysis and endovascular thrombectomy (EVT), refer to the current CSBPR Acute Stroke Management treatment recommendations, Sections 4 and 5.*
- *Some people experiencing acute stroke signs or symptoms may present to an outpatient setting such as a primary care physician or family health team office, community clinic, or urgent care centre. Processes should be in place to transport to emergency departments when indicated.*
- *The timing of symptom onset in patients who present to any healthcare facility with a suspected acute stroke or TIA should be carefully assessed.*
- *Individuals experiencing signs or symptoms of acute stroke require rapid assessment, diagnosis, and determination of risk for a recurrent stroke. Patients diagnosed with TIA or minor ischemic stroke who are not candidates for acute stroke treatment with intravenous thrombolysis or endovascular intervention may be prioritized for secondary prevention of stroke assessment and management.*
- *Ischemic stroke is a heterogenous condition with many different subtypes and causes, and it is beyond the scope of this guideline to address all of them. Section 2 focuses on the diagnostic studies that are relevant to the identification of common conditions (e.g., atherosclerosis, atrial fibrillation) or uncommon conditions requiring immediate treatment (e.g., bacterial endocarditis).*
- *Patients who present with onset of symptoms within 4.5 hours, regardless of whether the symptoms have resolved or not, should be sent for emergent assessment. Refer to Sections 3 and 4 for additional information.*
- *Patients with onset of symptoms within 4.5 to 48 hours, regardless of whether the symptoms have resolved or not, should be referred for urgent assessment. Refer to Section 2.0 and 2.1 for additional information.*

TABLE 2A Recommended Laboratory Investigations for Patients with Acute Stroke or Transient Ischemic Attack

Recommended Laboratory Investigations for Patients with Stroke and Transient Ischemic Attack		
*Note: This list presents the recommended **initial** laboratory tests for patients with stroke and TIA. Patient presentation, clinical judgment, and local stroke protocols should be considered in selecting appropriate laboratory investigations and the timing of completion.*		
Complete blood count (CBC)	International Normalized Ratio (INR)	Partial thromboplastin time (PTT)
Electrolytes	Creatinine and glomerular filtration rate (eGFR)	Liver enzymes (e.g., AST, ALT)
Random glucose or hemoglobin A1c	**Fasting** plasma glucose, or 2-hour plasma glucose, or glycated hemoglobin (A1c), or 75 g oral glucose tolerance test	Lipid profile (Fasting optional and decision should be based on individual patient factors)
Additional Laboratory Investigations for Consideration in Specific Circumstances		
*Note: All patients are individuals, and some may require additional investigations to fully understand their clinical situation. The investigations noted below may not be indicated for many patients with stroke and should be considered in **selected** patients with stroke based on clinical presentation and medical history.*		
Calcium, Magnesium, Phosphate	If female <50 years of age, consider pregnancy test	Blood cultures if infection suspected (per individual institutional protocol)
ESR	CRP	Troponin, where indicated
Blood and/or urine drug screen	HIV and syphilis serology, where indicated	
Arterial hypercoagulability screen: For consideration in selected patients *only if clinically indicated* *Consultation with a specialist in thrombosis to evaluate for hypercoagulable state is recommended.*		
Anticardiolipin antibodies, Beta-2-glycoprotein	Lupus anticoagulant	Sickle cell screen	Serum homocysteine and vitamin B12
Venous hypercoagulability screen: For consideration in selected patients *only if clinically indicated (e.g., a young person with a PFO)* *Consultation with a specialist in thrombosis to evaluate for hypercoagulable state is recommended.*		
Protein S	Protein C	Factor V Leiden
Prothrombin gene mutation	Antithrombin III	
Special considerations especially in young adults and children with stroke in absence of identified etiology *(Note: There is not strong evidence for the investigations listed below, and they should be considered only in selected patients with stroke based on clinical presentation and medical history.)* ***Consultation with a hematologist or neurologist is recommended.***		
Lumbar puncture for CSF analysis (cell count and differential, protein, glucose, bacterial and viral studies; possibly cytology/flow cytometry if CNS lymphoma is a consideration)	Brain biopsy (if vasculitis of the central nervous system or angiocentric lymphoma is a consideration)	
Advanced neuroimaging (i.e., diagnostic catheter cerebral angiography and or MRI vessel wall imaging)	Further genetic tests – CADASIL, Fabry's, MELAS	

Section 3: Emergency Medical Services

3. Emergency Medical Services Management of Acute Stroke Recommendations 2022

Notes:

- *The recommendations in Section 3 cover the management of potential patients with stroke from the time of first contact with the local emergency medical services (EMS) to transfer of care to the hospital and transfer between healthcare facilities by EMS.*
- *These recommendations are **directed to EMS personnel and those individuals who support EMS**, including communications officers and dispatchers. They also apply to other first responders such as emergency medical responders and primary care paramedics who have been trained to screen for stroke and manage potential patients with stroke during transfer. These recommendations are intended to be **translated into practice by the entire breadth of out-of-hospital healthcare providers** within the defined scope of practice of each.*

Context and Definitions

Approximately two-thirds of all patients who seek acute care for stroke arrive at the emergency department by ambulance. Local variations should be taken into consideration for prehospital time (e.g., remote locations with poor road access).

The three timelines below have been established to describe EMS in Canada for patients with stroke who may be eligible for acute ischemic stroke therapy, including intravenous thrombolysis and endovascular thrombectomy (EVT). ***The probability of disability-free survival decreases as the time from symptom onset to treatment increases. Therefore, all phases of patient care should aim for the shortest possible process and treatment times.***

Prehospital phase (**Timeline 1):** Starts with symptom onset and ends with hospital arrival and includes on-scene management and transport time. Patients with ischemic stroke who can arrive at hospital within a **4.5 hour** time window from witnessed stroke symptom onset or last known well and be treated as soon as possible may be eligible to receive medical treatment with intravenous thrombolysis; thrombolysis may be offered alone or in combination with endovascular intervention (e.g., thrombectomy, other endovascular procedures such as stenting) which has a **6-hour** time window for most patients. Highly selected patients may be eligible for EVT **up to 24 hours** from stroke symptom onset or last known well. *Refer to Section 4 Emergency Department Evaluation and Management of Patients with Transient Ischemic Attack and Acute Stroke for more information.*

Emergency department phase (**Timeline 2):** Starts with hospital arrival and ends with disposition time from the emergency department. People with stroke may transition from the emergency department to various settings: admission (ideally to a stroke unit) for inpatient care, transfer to another healthcare facility, or discharge to the community (usually place of residence). *Refer to Section 4 Emergency Department Evaluation and Management of Patients with Transient Ischemic Attack and Acute Stroke for more information.*

Interhospital transfer time (Timeline 3): Applies to patients with stroke who require ***transfer from one hospital to another*** to receive more advanced stroke care. The delay for patients who first arrive at an emergency department that has limited acute stroke services and who then requires transfer can be an important factor in determining outcomes. The recommendations in this section suggest that this time be as short as possible, and EMS plays a key role in timing and the transfer process.

Box 3A Core Information That May Be Required by Dispatch, Emergency Medical Services, and Receiving Healthcare Facility

1. Where permitted, patient name, date of birth, and health card number *Note: In general, this confidential personal health information is not allowed to be transmitted by radio; however, some*

provinces have received a waiver and had this restriction lifted for emergency cases such as stroke.

2. Location of patient
3. Stroke symptom onset time if witnessed, and last known well time if not witnessed
4. Total symptom duration at anticipated arrival in the emergency department
5. Presenting signs of stroke and stroke severity score, based on standardized screening tools
6. Current condition of the patient having a stroke, including medical stability, previous functional status and independence level, and changes in their condition since stroke symptom onset
7. Current medications (e.g., anticoagulants) if known, and time taken
8. Advance care plans, if any
9. Expected time of arrival at the receiving hospital, including in scene time
10. Additional health problems, if known

Box 3B Considerations in EMS Transport Decisions

The following elements should be considered when making transport decisions for patients with suspected acute stroke:

1. An EMS system should be set up to triage patients exhibiting signs and symptoms of an acute stroke as a high priority for evaluation, response, and transport.
2. The patient's presenting signs and symptoms.
3. Anticipated transport time, including bypass time.
4. The probability that the patient is acutely treatable with either intravenous thrombolysis and/or EVT:
    a. Patients are eligible for intravenous thrombolysis within 4.5-hours of known or presumed symptom onset or last known well
    b. Some patients may be eligible for endovascular thrombectomy when highly selected by neurovascular imaging up to 24 hours from known or presumed symptom onset or last known well. Transport time and receiving hospital projected treatment time must be considered when making transport and triage decisions.
5. The emergency department's ability to provide acute intravenous thrombolysis within a target 90th percentile for door-to-needle (i.e., arrival to treatment) time of ≤60 minutes (upper limit) and a target ***median*** door-to-needle time of ≤30 minutes.
6. Other acute care needs of the patient, including stabilization or advanced airway control that is beyond the capabilities of the responding EMS personnel.
7. **(NEW for 2022)** A system of rapid transport should be available to facilitate the movement of patients from one emergency department to another when time-sensitive stroke-specific care cannot be provided in the emergency department where the patient is first assessed**.**

Section 4: Emergency Department Evaluation

4. Emergency Department Evaluation and Management of Patients with Transient Ischemic Attack and Acute Stroke Recommendations 2022

Box 4A Exclusion Criteria for IV Thrombolysis Selection Imaging: CT Findings

1. Signs of hemorrhagic stroke on CT.
2. CT showing early signs of extensive loss of grey/white matter differentiation and/or low attenuation changes in the affected territory such that the majority of the territory has already infarcted. For the middle cerebral artery (MCA) territory, this would correspond with an ASPECTS of <6.

Refer to Section 5 Acute Ischemic Stroke Treatment for additional intravenous thrombolysis clinical inclusion and exclusion criteria.

Box 4B Imaging Criteria for Consideration of Endovascular Thrombectomy in Patients Arriving Within 6 Hours of Stroke Onset

4B.1. For anterior circulation: Imaging Criteria for Endovascular Thrombectomy in Patients Arriving Within 6 Hours of Stroke Onset

1. Presence of an intracranial artery occlusion in the anterior circulation on CTA or MRA, including occlusion of the terminal internal carotid artery or proximal MCA

AND

2. Presence of a small to moderate ischemic core on non-contrast CT or MRI, usually consistent with an ASPECTS score of ≥6 for the anterior circulation.
    a. Patients presenting with an intracranial artery occlusion and large core, such as those with an ASPECT score <6, may be considered for EVT based on expected risks and benefits, after consultation with a physician with stroke expertise and with the treating neurointerventionalist, along with the patient and/or family and/or substitute decision-makers.

4B.2 For posterior circulation: Imaging Criteria for Consideration of Endovascular Thrombectomy for Patients Arriving Within 6 Hours of Stroke Onset

1. Patients presenting with an intracranial occlusion of the posterior circulation (e.g., the basilar artery) may be considered for EVT based on expected risks and benefits, after consultation with a physician with stroke expertise and with the treating neurointerventionalist, along with the patient and family or substitute decision-maker.
Note: Randomized trials are ongoing, and this recommendation will be reviewed once the results become available.

Box 4C Imaging Selection Criteria for Endovascular Therapy for Patients Arriving 6-24 Hours After Symptom Onset or Last Known Well Time

System Access

1. On-site stroke imaging with 24-hour access, seven days a week, including a CT scanner (i.e., third generation or higher helical scanner) with programming for CTA; and ability to perform multiphase CTA or CTP imaging.
2. Sites using CTP perfusion imaging should use software that provides quantifiable measurements of ischemic core and penumbra.

3. The location of occlusion is defined by CTA performed from aortic arch to the vertex of the head. Inclusion of the aortic structures allows planning and assessment of the technical feasibility of an endovascular approach to the occluded intracranial artery.

Anterior Circulation

1. Presence of an intracranial artery occlusion in the anterior circulation on CTA including occlusion of the terminal internal carotid artery or proximal MCA)

   AND

2. Presence of a small to moderate ischemic core on unenhanced CT, usually consistent with an ASPECTS score of ≥6 for the anterior circulation

   AND (one of the following 3, 4, or 5)

3. Presence of moderate to good pial collateral filling on CTA (ESCAPE Trial criteria, as defined by multiphase CTA or assessment of the raw data set acquired from CTP), or evidence of CTP mismatch.

   OR

4. Presence of small to moderate ischemic core on CTP as measured by ischemic core volume <70 ml, mismatch ratio >/= 1.8 and mismatch volume >/= 15 ml (DEFUSE3 trial criteria).

   OR

5. Ischemic core volume <51 mL in patients <80 years old or ischemic core volume <31 mL in patients ≥80 years old (DAWN trial criteria).

Posterior circulation

1. Patients presenting with an intracranial occlusion of the posterior circulation (e.g., the basilar artery) may be considered for EVT based on expected risks and benefits, after consultation with a physician with stroke expertise and with the treating neurointerventionalist, along with the patient and family, or substitute decision-makers.

   a. Decisions should be based on expert opinion after considering multiple factors, including initial imaging features including quality, clinical presentation, medical therapies including thrombolysis, health status, delay in expected time of arrival at EVT centre, and patient goals of care.

Note: ASPECTS is one tool to estimate core: A small-to-moderate ischemic core can be defined by ASPECTS of 6 or higher on NCCT or areas of low cerebral blood volume or cerebral blood flow maps on CTP imaging.

Section 5: Acute Ischemic Stroke Treatments

5. Acute Ischemic Stroke Treatment Recommendations 2022

Box 5A Time Windows for Reperfusion in Acute Ischemic Stroke

Available treatments	Time from stroke onset or last known well	Population	Notes and criteria
Screening for stroke signs and symptoms	Within 24 hours	All patients showing signs of acute disabling stroke	
Intravenous thrombolysis	0 to 4.5 hours	All patients showing signs of acute disabling stroke	Based on CT/CTA
	4.5 to 6 hours	Select patients showing signs of acute disabling stroke	Requires advanced imaging for tissue-based decision-making
	6 to 9 hours	Select patients - in discussion with a stroke expert	Requires advanced imaging for tissue-based decision-making
Endovascular thrombectomy	0 to 6 hours	All patients showing signs of acute disabling stroke with LVO	Based on CT/CTA
	6 to 24 hours	All persons showing signs of acute disabling stroke with LVO	Requires advanced imaging for tissue-based decision-making

Box 5B Criteria for Intravenous Thrombolysis Treatment

Refer to Section 4.2 and Box 4A for detailed recommendations on neuroimaging-based selection criteria

While these criteria are designed to guide clinical decision-making, the decision to use thrombolysis should be based on the clinical judgment of the treating physician. The relative benefits of thrombolysis versus potential risks or contraindications should be weighed on an individual basis.

Inclusion Criteria

Patients should be considered eligible for intravenous thrombolysis and/or EVT if they fulfill the following clinical criteria:

- Diagnosed with an acute ischemic stroke.
- The stroke is disabling (i.e., significantly impacting function), usually defined as National Institutes of Health Stroke Scale (NIHSS)>4.
- The risks and benefits of thrombolysis are within the patient's goals of care and take into consideration their functional status prior to stroke.
- Life expectancy of 3 months or more.
- Age ≥18 years. (Refer to pediatric guidelines for treatment <18 years of age).

- For adolescents, a decision to administer intravenous thrombolysis should be based on clinical judgment; presenting symptoms; patient age; and, if possible, consultation with a pediatric stroke specialist.

- Time from last known well (onset of stroke symptoms) is <4.5 hours before thrombolysis administration. **For patients >4.5 hours refer to Section 5.1 for additional information.*

Absolute Exclusion Criteria

- Any source of active hemorrhage or any condition that could increase the risk of major hemorrhage after intravenous thrombolysis administration.
- Any hemorrhage on brain imaging.

Relative Exclusion Criteria (requiring clinical judgement based upon the specific situation. Consult Stroke Specialist at Comprehensive Stroke Centre if there are any questions or concerns about these criteria).

Historical

- History of intracranial hemorrhage.
- Stroke or serious head or spinal trauma in the preceding 3 months.
- Major surgery (e.g., cardiac, thoracic, abdominal, or orthopedic) in the preceding 14 days. Risk varies according to the procedure.
- Arterial puncture at a non-compressible site in the previous 7 days.

Clinical

- Stroke symptoms due to another non-ischemic acute neurological condition such as seizure with post-ictal Todd's paralysis or focal neurological signs due to severe hypo- or hyperglycemia.
- Hypertension refractory to aggressive hyperacute antihypertensive treatment such that target blood pressure <180/105 cannot be both achieved and maintained.
- Currently prescribed and taking a direct non-vitamin K oral anticoagulant. *Refer to Section 5.2 Clinical Considerations for additional information.*

CT or MRI Findings

- CT showing early signs of extensive infarction (e.g., >1/3 of middle cerebral artery [MCA] territory, or ASPECTS score <6).

Laboratory

- Blood glucose concentration <2.7 mmol/L or >22.2 mmol/L.
- Elevated activated partial-thromboplastin time.
- International Normalized Ratio >1.7.
- Platelet count <100,000 per cubic millimetre.

Box 5C Inclusion Criteria for Endovascular Thrombectomy

Refer to Section 4.2 and Boxes 4B and 4C for detailed recommendations on neuroimaging-based selection criteria.

Patients should be considered eligible for endovascular thrombectomy if they fulfill the following clinical criteria:

1. Diagnosed with an acute ischemic stroke.
2. The stroke is disabling (i.e., significantly impacting function), usually defined as National

Institutes of Health Stroke Scale (NIHSS)>4.

3. There is a proven, clinically relevant (symptomatic), intra- or extracranial acute arterial occlusion that is amenable to endovascular intervention.
4. The risks and benefits of endovascular thrombectomy are within the patient's goals of care and take into consideration their functional status prior to stroke.
5. Age ≥18 years. (Refer to pediatric guidelines for treatment <18 years of age).
    a. Currently, there is no evidence for EVT in pediatric populations and the decision to treat should be based on the potential benefits and risks of the therapy, made by a physician with pediatric stroke expertise in consultation with the EVT provider and the patient and/or family or substitute decision-makers.
6. **Intravenous thrombolysis:** If intravenous thrombolysis is given in conjunction with endovascular thrombectomy, refer to Box 5B for additional inclusion criteria.
7. **Premorbid condition criteria**: In general, individuals considered eligible for EVT are those who were deemed functionally independent before their index stroke (i.e., mRS <3) and have a life expectancy >3 months. *Note: These criteria are based on major clinical trial inclusion criteria. Decisions should be based on these factors, clinical judgement, and the patient's goals of care.*
8. **Imaging:** Patients must qualify for imaging criteria in early and late windows as described in Boxes 4B and 4C.
9. **Time to treatment:** The decision to proceed with EVT should be shared by the physician with clinical stroke expertise and the neuro-interventionalist, who will use the available imaging information as is indicated.
    a. Specifically:
        i. Patients should have immediate neurovascular imaging (see above) to determine eligibility). Patients can be considered for imaging within a 24-hour window from stroke symptom onset or last known well.
        ii. For patients presenting <6 hours from stroke symptom onset or last known well to initiation of treatment (i.e., arterial puncture), all patients who meet eligibility criteria should be treated.
        iii. For patients presenting between 6 and 24 hours from last known well, selected patients may be treated if they meet clinical and imaging criteria and based on local protocols and available expertise in EVT.

Box 5D (NEW FOR 2022) Pre- and Post-Management of Patients Undergoing Endovascular Thrombectomy

Note: The following information is provided as general management considerations for patients with stroke undergoing EVT. All EVT-enabled sites should follow local post-procedural protocols and assessment algorithms for neuro vitals, puncture site and extremity perfusion assessments, and patient mobilization restrictions.

5D.1 General Management Before and During Endovascular Thrombectomy

1. **Team Communication**: Maintain ongoing open communication between the stroke physician and the interventionalist for treatment decision-making; and before, during and after the EVT procedure.
2. **Airway:** Adequate airway control and oxygenation should be ensured, with a goal of maintaining oxygen saturation at >92%.
3. **Intubation:** Intubation may be necessary for patients with reduced oxygenation, those who are vomiting, or those who require significant sedation to remain calm for the procedure.

4. **Anesthesia:** Some EVT providers may be comfortable administering their own procedural sedation for EVT. Consultation with anesthesiology may be considered for patients who are anticipated to have airway difficulties or marked difficulties cooperating with the procedure.
5. **Contrast allergy:** A contrast allergy is not an absolute contraindication to EVT. If the patient has a known or suspected contrast allergy:
    a. Pre-treat with:
        1. H1 antagonist 50 mg IV diphenhydramine
        2. Steroid 40 mg IV methylprednisolone or 200mg IV hydrocortisone
        3. H2 blockers: ranitidine 50mg IV or famotidine 20mg IV;

    b. Consider:
        1. Supplemental oxygen
        2. Epinephrine
        3. Intubation (if severe laryngeal edema)
6. **Cardiac monitoring:** Blood pressure should be maintained according to targets for patients who receive thrombolysis; however, aggressive blood pressure lowering should be avoided, especially before reperfusion is achieved. Patients should be monitored for arrhythmias.
7. **Temperature regulation:** The goal is to aim for euthermia. There is no known benefit to hypothermia.
8. **Hyperglycemia:** The goal is to aim for normoglycemia. Hyperglycemia is associated with harm in acute ischemic stroke.
9. **Catheter:** Insertion of a foley catheter could be considered only if necessary to reduce patient distress and movement during the procedure and should not delay reperfusion.

5D.2 General Management After Endovascular Thrombectomy

1. Patient should remain supine for the first 2 to 6 hours, with the head of the bed at not >30 degrees.
2. The puncture site (groin or wrist) should be closed by manual compression, sandbag, or other device.
3. The puncture site should be assessed for swelling or hematoma Q15 minutes for the first hour, then Q30 minutes for the next hour, then Q1 hourly for the next 1 to 5 hours depending whether a vascular closure device was used and on the access location.
4. Pulses at the puncture site and distal to it should be assessed along with vital signs as per local protocols.
5. Puncture site hematoma should be suspected if there is local bleeding, groin swelling, bruising, pain or unexplained reduction in hemoglobin or hematocrit.
6. If puncture site hematoma is suspected, on-call physician should be called, and prolonged manual compression applied. A stat CBC should be obtained and repeated Q4 to 6 hours.
7. If puncture site hematoma persists despite manual compression, a CT angiogram, or ultrasound if CT not available, should be obtained to assess for pseudoaneurysm or other abnormality, and consultation with vascular surgery for thrombin injection or other intervention should be considered.
8. Retroperitoneal hemorrhage should be suspected if the patient has back pain, flank bruising (Grey Turner sign), abdominal distention with periumbilical ecchymosis (Cullen sign),

hypotension and tachycardia, or unexplained anemia. This is most often seen in the first 24 hours.

9. If retroperitoneal hemorrhage is suspected, a three-phase CT of the abdomen should be obtained as soon as possible, and fluid resuscitation, blood transfusion or surgical consultation should be considered.
10. If there is neurologic deterioration, stat CT and CTA should be obtained, to assess for hemorrhagic conversion, reperfusion injury, extracranial occlusion, or intracranial occlusion.
11. If extracranial occlusion is detected, particularly after stenting, urgent endovascular intervention should be considered, in consultation with a stroke specialist and interventional radiology specialist.
12. If intracranial reocclusion is detected, urgent EVT should be considered, in consultation with a stroke specialist and interventional radiology specialist.
13. Creatinine should be obtained and assessment for contrast-induced nephropathy conducted.
14. If contrast-induced nephropathy is identified, local protocols should be followed and consultation with nephrology considered.
15. The ideal blood pressure target after EVT is unknown. Blood pressure targets should be individualized based on clinical factors, such as the degree of recanalization achieved, whether there was an intraprocedural complication, whether intravenous thrombolysis was given, and the patient's baseline blood pressure. *Refer to Section 4 Emergency Department Evaluation and Management of Patients with Transient Ischemic Attack and Acute Stroke for additional information on managing blood pressure in acute stroke.*

Section 8: Acute Stroke Unit Care

Box 8A Optimal Acute Inpatient Stroke Care

Definitions

Acute stroke unit: A specialized, geographically defined hospital unit dedicated to the management of patients with stroke, staffed by an experienced interdisciplinary stroke team, and providing a complex package of evidence-based care (e.g., protocols, care pathways) for acute stroke management, early rehabilitation, and education to patients with stroke in hospital.

Rehabilitation stroke unit: A specialized, geographically defined hospital rehabilitation unit dedicated to the management and recovery of people following stroke. These units accept patients for intensive rehabilitation provided by an interdisciplinary team, once patients are medically stable, usually within five to seven days after an acute stroke event. *Refer to CSBPR Rehabilitation and Recovery Following Stroke, Section 2 for additional information.*[6]

Comprehensive stroke unit: A comprehensive stroke unit is a specialized, geographically defined hospital unit that combines acute stroke care and stroke rehabilitation. It accepts patients with acute stroke and also provides them with rehabilitation services all in one place, usually for up to several weeks. Both the rehabilitation unit model and the comprehensive unit model offer prolonged periods of rehabilitation (Langhorne, 2020).[7]

Alternate stroke care delivery models: Many models of acute stroke care exist across Canada. Although many organizations do not have an official administrative designation as an acute stroke centre, they meet most or all of the stroke unit criteria listed as core elements below, and should be recognized as attempting to provide optimal, evidence-based stroke care despite administrative and structural resource challenges. These models are sometimes referred to as clustered acute stroke care, or purposeful grouping of patients with stroke.

Core Elements of Comprehensive Stroke and Neurovascular Care

(Adapted from the Stroke Unit Trialists Collaboration, 2020)

Efforts should be made to provide all the elements of stroke unit care or have processes in place to transfer patients to the closest acute or comprehensive stroke unit to meet their care needs.

a. **Ensures the person with stroke and their family and informal caregivers are at the centre of all stroke care planning and delivery**.
b. Has processes and mechanisms to prioritize access to stroke unit beds for patients with acute stroke within 24 hours of hospital arrival or in-hospital stroke (when medically appropriate, in consultation with other care team members).
c. Accepts patients with acute stroke for comprehensive stroke management within hours of the patient's arrival at hospital.
d. Has established protocols and processes of care in place to implement as many elements as possible to achieve optimal stroke care delivery within the geographic location, hospital volumes and resource availability (human, equipment, funding).

[6] Teasell R, Salbach NM, Foley N, et al. Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery, and Community Participation following Stroke. Part One: Rehabilitation and Recovery Following Stroke; 6th Edition Update 2019. *Int J Stroke*. Oct 2020;15(7):763-788.

[7] Langhorne P, Ramachandra S. Organised inpatient (stroke unit) care for stroke: network meta-analysis. *Cochrane Database Syst Rev*. Apr 23 2020;4(4):Cd000197. doi:10.1002/14651858.CD000197.pub4

e. Provides advanced diagnostic capability, specialized care, and close monitoring for patients with ischemic stroke, intracerebral hemorrhage, and TIA. Care may be expanded in some institutions to include patients with subarachnoid hemorrhage and other neurovascular conditions.

f. Includes a dedicated interdisciplinary stroke team with broad range of expertise, including neurology, nursing, neurosurgery, physiatry, rehabilitation professionals, pharmacists, and others (on-site or rapid access off-site).

g. Has access to 24/7 imaging and interventional neuroradiology expertise.

h. Has access to emergent neurovascular surgery.

i. Has protocols for emergent and acute stroke management in place, and for seamless transitions between stages of care, including prehospital, emergency department, and inpatient care.

j. Has dysphagia screening protocols to assess all patients with stroke without prolonged time delays prior to commencing oral nutrition and oral medications.

k. Has access to post-acute rehabilitation services, including inpatient, outpatient, community-based, and/or early supported discharge therapy.

l. Initiates transition/discharge planning as soon as possible after admission, and anticipates discharge needs to facilitate smooth transitions.

m. Holds daily or bi-weekly patient care rounds with the interdisciplinary stroke team to conduct case reviews and discuss patient management issues, family concerns or needs, and discharge planning (e.g., discharge or transition to the next step in the patient's care, timing, transition requirements).

n. Provides patient and family education that is formal, coordinated, and addresses learning needs and responds to patient and family readiness.

o. Provides palliative and end-of-life care when required and ideally by health professionals with specialized expertise in a palliative approach to care.

p. Ensures ongoing professional development for all staff on stroke knowledge, evidence-based best practices, skill building, and orientation of trainees.

q. Participates in clinical research for stroke care.

r. Routinely collects process and patient-oriented outcome data on all patients with stroke, and regularly reviews data to inform quality improvement and address gaps in service delivery.

Section 10: Advance Care Planning

10. Advance Care Planning Recommendations 2022

Definitions

Advance Care Planning is a process of reflection and communication. It is a time for individuals to reflect on their values and wishes, and to communicate their preferences about future healthcare decisions if they were unable to speak for themselves. (Adapted from: https://www.advancecareplanning.ca/)

Goals of Care are the clinical and personal goals for a patent's episode of care that are determined through a shared decision-making process. They reflect a shared understanding between patients, family, caregivers, other support people and the clinical team. (adapted from: https://www.safetyandquality.gov.au/our-work/comprehensive-care/essential-elements-comprehensive-care/essential-element-2-identifying-goals-care)

Section 11: Palliative and End of Life Care

11. Palliative and End-of-Life Care Recommendations 2022

Definitions

Palliative care is an approach that aims to reduce suffering and improve the quality of life for people who are living with life-limiting illness through the provision of: pain and symptom management; psychological, social, emotional, spiritual, and practical support; and support for caregivers during the illness and after the death of the person they are caring for. Palliative care provides comprehensive care throughout a person's illness trajectory and is not solely limited to end of life care. (Adapted from: https://www.canada.ca/en/health-canada/services/health-care-system/reports-publications/palliative-care/framework-palliative-care-canada.html#p1.1/)

In a palliative approach to care, the health care team identifies patients early on who would benefit from a palliative approach and initiates appropriate discussions and care management. Healthcare providers (e.g., primary care providers, nurses, stroke neurologist, palliative care specialists) are central to facilitate care to all patients throughout the many transitions. Specialist palliative care teams provide care in an advisory-consultant-educational-coaching role and shared care with primary care clinicians and specialist stroke teams. (Adapted from **Staffing a Specialist Palliative Care Service, a Team-Based Approach: Expert Consensus White Paper, J Pal Med 2019).**[8]

End-of-life care: Part of the palliative approach that involves the management and treatment of dying patients, and support for their families and informal caregivers.

Goals of care for palliative care: In the event of a treatment decision needing to be made, the medical team may initiate a "goals of care" discussion with the patient and/or their substitute decision-maker. This conversation should establish or clarify the patient's advance care wishes (see Section 10) in the context of their prognosis. Potential topics of discussion may include preferred location of palliation, the cessation of certain medical interventions, and comfort care options and preferences (e.g., resuscitation) in the event of immanent death. The intent is to have a written communication plan for the healthcare team help the team provide individualized palliative care in a timely manner. The person with stroke's health status can change over time

[8] Henderson JD, Boyle A, Herx L, et al. Staffing a Specialist Palliative Care Service, a Team-Based Approach: Expert Consensus White Paper. *J Palliat Med*. Nov 2019;22(11):1318-1323. doi:10.1089/jpm.2019.0314.

and the written plan should be reviewed in conjunction with such changes in status or changes in the healthcare team. The goals of care plan can be amended or revised at any time by the individual and/or substitute decision-maker.

Medical Assistance in Dying (MAiD): A procedure in which a patient receives medications to intentionally and safely end their life. Canadian federal law defines very specific criteria for MAiD eligibility. Each province and territory have established procedures for patients and clinicians to assess information about MAiD, as well as detailed MAiD assessment and provision protocols. Some people who have experienced a stroke may be eligible for MAiD. Clinicians providing post-stroke care should be aware of this and understand what to do if they are asked about MAiD.