



I. GENERAL GOALS OF A STANDARDIZED NATIONAL STROKE MEDICINE FELLOWSHIP

One of the priorities Canadian stroke community is to develop a formal national fellowship curriculum in Stroke Medicine. The benefits of such a program are manifold and include, but are not limited to:

1. Standardization of advanced stroke training and evaluation of trainees across Canada to ensure proper application of best practises;
2. Sharing of resources and ideas between training sites;
3. National recognition of stroke medicine as a distinct subspecialty;
4. Creation of an internationally recognized and respected diploma.

This national curriculum is endorsed by the Canadian Stroke Consortium and supported by the CaSTOR initiative. Fellows trained in programs which adhere to this curriculum will graduate with the title of Fellow of the Canadian Stroke Consortium (FCSC).

II. DEFINITION

Stroke medicine (sometimes called vascular neurology) is a specialized field of medicine characterized by a clinical expertise in the diagnosis and medical management of ischemic and hemorrhagic vascular diseases of the central nervous system.

Expertise is defined as: sophisticated and interdisciplinary understanding, permitting assessment and teaching of complex referrals.

III. ELIGIBILITY REQUIREMENTS

All required clinical education for entry into a Stroke Medicine fellowship program must be completed in an RCPSC-accredited or CFPC-accredited residency program located in Canada or in an ACGME-accredited residency program in the United States. Trainees with training in accredited residency programs outside Canada and the United States are also eligible following verification of each entering fellow's level of competency in the required field using CanMEDS milestones or equivalent assessments from the core residency program. Fellows must have successfully completed an accredited program in neurology, pediatric neurology, internal medicine, geriatric medicine, neurosurgery, emergency medicine or family medicine.



Training Requirements and General Objectives

Applicants in established practice wishing to enter a fellowship program will also be required to demonstrate an adequate level of competency using CanMEDS milestones or their equivalent.

Depending on acquired competencies at time of entry, applicants may be offered adapted clinical exposure aimed at optimizing acquisition of required competencies during fellowship. For example, a trainee with less exposure to general neurology may be required to participate in general neurology activities.

IV. GOALS

The goals of training will depend on whether a fellow completes the **Stroke Certificate** (6 month), **Stroke Expert** (1 year) or **Stroke Scholar** (2 year) stream.

- a. **Upon completion of training in the Stroke Certificate stream, a fellow is expected to function as a physician competent in stroke medicine practicing principally in a primary care setting.**

The following areas of knowledge must be covered:

- Prevention (primary, secondary), risk factors, and epidemiology
- Clinical features of cerebrovascular diseases
- Clinical, paraclinical and radiological evaluation of the patient with cerebrovascular disease
- Causes of ischemic and hemorrhagic stroke
- Treatment of patients with ischemic and hemorrhagic stroke
- Recovery and rehabilitation

More specifically, the trainee must acquire and maintain clinical knowledge, skills and expertise in the following domains:

- Basic anatomy of cerebral and spinal vascular systems
- Basic physiology of cerebral and spinal blood flow
- Clinical epidemiology, risk factors (traditional and novel), prevention (primary/secondary), etiology, pathophysiology, clinical features, investigation and management of cerebral/spinal ischemia (ischemic stroke/TIA) and related disorders, including:
 - Atherothrombotic infarction and carotid stenosis
 - Embolic infarction and cardio-embolic disorders



Training Requirements and General Objectives

- Lacunar infarction
- Arterial dissection
- Prothrombotic states, vasculitis and other medical conditions associated with cerebrovascular diseases
- Thrombosis of cerebral veins and venous sinuses
- Management of hyperacute/acute ischemia including medical complications (hypertension, cardiac arrhythmias, raised intracranial pressure, seizures, sepsis and others)
- Clinical epidemiology, risk factors (traditional and novel), prevention (primary/secondary), etiology, pathophysiology, clinical features, investigation and management of cerebral/spinal hemorrhagic disorders including but not limited to:
 - Primary and secondary non-traumatic intracerebral hemorrhage
- Basic radiological (CT/CTA, MRI) interpretation skills of cerebral ischemic and hemorrhagic conditions
- Working knowledge of appropriate validated clinical tools (pre-hospital and acute stroke scales, functional/ADL scales and prognostic scores including but not limited to NIHSS, mRS, and CHADS2)
- Risk factors, prevention, etiology, pathophysiology, clinical features, investigation and management of vascular diseases of the spinal cord

b. Upon completion of training in the Stroke Expert stream, a fellow is expected to function as a physician with expertise in stroke medicine practicing principally in a primary or secondary care setting.

The following areas of knowledge must be covered:

- Basic science aspects of vascular neurology
- Prevention (primary, secondary), risk factors, and epidemiology
- Clinical features of cerebrovascular diseases
- Clinical, paraclinical and radiological evaluation of the patient with cerebrovascular disease
- Causes of ischemic and hemorrhagic stroke
- Treatment of patients with ischemic and hemorrhagic stroke
- Recovery, regenerative processes, and rehabilitation
- Stroke leadership (committees, guidelines, public awareness etc.)



Training Requirements and General Objectives

- Basic research methodology, clinical trial design, critical appraisal skills

More specifically, the trainee must acquire and maintain clinical knowledge, skills and expertise in the following domains:

- Anatomy of cerebral and spinal vascular systems
- Physiology of cerebral and spinal blood flow
- Clinical epidemiology (basic elements of methodology/biostatistics), risk factors (traditional and novel), prevention (primary/secondary), etiology, pathophysiology, clinical features, investigation and management of cerebral/spinal ischemia (ischemic stroke/TIA) and related disorders, including:
 - Atherothrombotic infarction and carotid stenosis
 - Embolic infarction and cardio-embolic disorders
 - Lacunar infarction
 - Arterial dissection
 - Prothrombotic states, vasculitis and other medical conditions associated with cerebrovascular diseases
 - Biomarkers for diagnostic/prognostic assessment of ischemic and hemorrhagic cerebral disorders
 - Thrombosis of cerebral veins and venous sinuses
 - Strokes in adolescents, children and neonates, or during pregnancy
 - Management of hyperacute/acute ischemia including medical complications (hypertension, cardiac arrhythmias, raised intracranial pressure, seizures, sepsis and others)
- Clinical epidemiology, risk factors (traditional and novel), prevention (primary/secondary), etiology, pathophysiology, clinical features, investigation and management of cerebral/spinal hemorrhagic disorders including but not limited to:
 - Primary and secondary non-traumatic intracerebral hemorrhage
 - Subarachnoid hemorrhage and cerebral aneurysms
 - Vascular malformations including arteriovenous fistulas, arteriovenous malformations and cavernous angiomas
 - Basic radiological (CT/CTA, MRI, cervical and possibly transcranial ultrasound) interpretation skills of cerebral ischemic and hemorrhagic conditions (including ischemic and hemorrhagic scores or rating scales including ASPECTS, volume measurements etc.)



Training Requirements and General Objectives

- Working knowledge of appropriate validated clinical tools (pre-hospital and acute stroke scales, functional/ADL scales, prognostic scores, QoL including but not limited to NIHSS, mRS, Barthel, CHADS2)
- Risk factors, prevention, etiology, pathophysiology, clinical features, investigation and management of vascular diseases of the spinal cord

c. Upon completion of training in Stroke Scholar stream, a fellow is expected to function as a physician with expertise in stroke medicine practicing principally in a tertiary care setting and engaged in academic activities (research, teaching).

The following areas of knowledge must be covered:

- Basic science aspects of vascular neurology
- Prevention (primary, secondary), risk factors, and epidemiology
- Clinical features of cerebrovascular diseases
- Clinical, paraclinical and radiological evaluation of the patient with cerebrovascular disease
- Causes of ischemic and hemorrhagic stroke
- Treatment of patients with ischemic and hemorrhagic stroke
- Recovery, regenerative processes, and rehabilitation
- Stroke systems of care across the continuum
- Stroke leadership (committees, guidelines, public awareness etc.)
- Research methodology, clinical trial design, critical appraisal skills

More specifically, the trainee must acquire and maintain clinical knowledge, skills and expertise in the following domains:

- Anatomy of cerebral and spinal vascular systems
- Physiology of cerebral and spinal blood flow
- Clinical epidemiology (basic elements of methodology/biostatistics), risk factors (traditional and novel), prevention (primary/secondary), etiology, pathophysiology, clinical features, investigation and management of cerebral/spinal ischemia (ischemic stroke/TIA) and related disorders, including:
 - Atherothrombotic infarction and carotid stenosis
 - Embolic infarction and cardio-embolic disorders
 - Lacunar infarction



Training Requirements and General Objectives

- Arterial dissection
- Prothrombotic states, vasculitis and other medical conditions associated with cerebrovascular diseases
- Biomarkers for diagnostic/prognostic assessment of ischemic and hemorrhagic cerebral disorders
- Thrombosis of cerebral veins and venous sinuses
- Strokes in adolescents, children and neonates, and during pregnancy
- Management of hyperacute/acute ischemia including medical complications (hypertension, cardiac arrhythmias, raised intracranial pressure, seizures, sepsis and others)
- Clinical epidemiology, risk factors (traditional and novel), prevention (primary/secondary), etiology, pathophysiology, clinical features, investigation and management of cerebral/spinal hemorrhagic disorders including but not limited to:
 - Primary and secondary non-traumatic intracerebral hemorrhage
 - Subarachnoid hemorrhage and cerebral aneurysms
 - Vascular malformations including arteriovenous fistulas, arteriovenous malformations and cavernous angiomas
- Radiological (CT/CTA, multimodal MRI, perfusion-imaging, cervical and possibly transcranial ultrasound) interpretation skills of cerebral ischemic and hemorrhagic conditions (including ischemic and hemorrhagic scores or rating scales including ASPECTS, volume measurements, etc.)
- Working knowledge of appropriate validated clinical tools (pre-hospital and acute stroke scales, functional/ADL scales, prognostic scores, QoL including but not limited to NIHSS, mRS, Barthel, CHADS2)
- Risk factors, prevention, etiology, pathophysiology, clinical features, investigation and management of vascular diseases of the spinal cord



Training Requirements and General Objectives

Upon completion of training, all fellows, regardless of stream, must demonstrate the necessary knowledge, skills, and attitudes for effective patient-centered care and service to a diverse population. The fellows must be able to address issues of gender, sexual orientation, age, culture, ethnicity and ethics in a professional manner.

In summary, by the end of training, all physicians trained in a Stroke Medicine fellowship program should, at a level commensurate with their level of training (Stroke Certificate, Stroke Expert, Stroke Scholar):

- a. Be able to interpret clinical information with investigations, in order to make accurate and timely diagnosis of cerebrovascular conditions;
- b. Be able to formulate an evidence-based management plan;
- c. Demonstrate timely and correct use of diagnostic and therapeutic (invasive and non-invasive), modalities in stroke management;
- d. Be able to evaluate and manage the wide spectrum of neurovascular diseases, including TIA, ischemic stroke, intracerebral hemorrhage, cerebral venous thrombosis, spinal cord infarction, vascular malformations and stroke mimics in the in-patient, out-patient and critical care setting;
- e. Possess competence in evaluating complex and/or rare neurovascular conditions, including genetic conditions, hematological disorders, metabolic disorders, vasculitis, non-vasculitic vasculopathies (ex. Moyamoya disease) and arterial dissection;
- f. Be able to recognize and manage complications arising from cerebrovascular disease, including raised intracranial pressure, hemorrhagic transformation, seizures, sepsis, and deep venous thrombosis as well as non-acute complications including post-stroke depression, fatigue, pain and cognitive deficits;
- g. Possess the ability to work effectively within a multidisciplinary stroke service;
- h. Function effectively as consultants, integrating all CanMEDS Roles to provide optimal, ethical and patient-centered medical care related to vascular neurology issues.



V. STROKE EXPERT AND STROKE SCHOLAR STREAMS

I. Expected Competencies to be Acquired at the Completion of Training

N.B. COMPETENCIES DESCRIBED HEREIN ARE BASED ON CanMEDS TERMINOLOGY AS PROPOSED BY THE ROYAL COLLEGE OF PHYSICIANS AND SURGEONS OF CANADA

<http://www.royalcollege.ca/rcsite/canmeds/canmeds-framework-e>

At the completion of training, the trainee will have acquired the following competencies and will function effectively as a:

A. Medical Expert

Definition: As *Medical Experts*, Adult stroke physicians integrate all of the CanMEDS Roles, applying medical knowledge, clinical skills, and professional attitudes in their provision of patient-centered care. *Medical Expert* is the central physician Role in the CanMEDS framework.

Key and Enabling Competencies: Adult stroke physicians are able to...

- 1. Function effectively as consultants, integrating all CanMEDS Roles to provide optimal, ethical and patient-centered medical care related to neurovascular issues.**
 - 1.1 Perform a consultation, including the presentation of well-documented assessments and recommendations in written and/or verbal form in response to a request from another health care professional.
 - 1.2 Demonstrate use of all CanMEDS competencies relevant to cerebrovascular diseases.
 - 1.3 Identify and appropriately respond to relevant ethical issues arising in patient care.
 - 1.4 Demonstrate the ability to prioritize professional duties when faced with multiple patients and problems.
 - 1.5 Demonstrate compassionate and patient-centered care.
 - 1.6 Recognize and respond to the ethical dimensions in medical decision-making.
 - 1.7 Demonstrate medical expertise in situations other than patient care, such as providing expert legal testimony or advising governments, as needed.



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- 2. Establish and maintain clinical knowledge, skills and attitudes appropriate to cerebrovascular diseases.**
 - 2.1 Demonstrate advanced knowledge of the mechanisms underlying normal and abnormal cerebrovascular function including but not limited to the anatomy and cellular/subcellular physiology of the cerebrospinal vascular system.
 - 2.2 Demonstrate advanced knowledge of antithrombotic (anticoagulants, antiplatelets), thrombolytic, lipid lowering (including statins), antihypertensive, antidepressant, hypoglycemic and antiepileptic agents including pharmacology, indications, contraindications, potential risks and benefits.
 - 2.3 Demonstrate advanced knowledge of inherited cerebrovascular conditions together with an understanding of their respective epidemiologies, diagnoses and management strategies.
 - 2.4 Demonstrate knowledge of the diagnostic and predictive value of the clinical exam (including stroke severity scales like the NIHSS) biomarkers, CT, CTA, MRI, MRA, ECG, echocardiogram (TTE, TEE), Holter and prolonged cardiac recording in the investigation of patients with cerebral ischemic events.
 - 2.5 Demonstrate knowledge in the interpretation of the imaging modalities that can be useful in the investigation of stroke patients (CT, CTA, ultrasonography, MRI, MRA, angiography, perfusion studies, nuclear imaging).
 - 2.6 Demonstrate knowledge of current indications and contraindications for IV thrombolysis in acute ischemic stroke and be able to administer thrombolysis.
 - 2.7 Demonstrate knowledge of potential complications of IV thrombolysis and management of such complications.
 - 2.8 Demonstrate knowledge of indications, contra-indications and complications of mechanical thrombectomy.
 - 2.9 Demonstrate knowledge of post-stroke care, potential medical and surgical complications of acute stroke (neurological, infectious, cardiac and others) and appropriate management strategies.
 - 2.10 Demonstrate knowledge of the principles and practice of post-stroke rehabilitation and community reintegration within a multidisciplinary team.
 - 2.11 Demonstrate knowledge of the principles, indications, contraindication comparative efficacy and safety of different vascular revascularization procedures including carotid endarterectomy, carotid artery stenting and when indicated, bypass techniques.



Training Requirements and General Objectives

- 2.12 Demonstrate knowledge of and ability to institute appropriate secondary stroke prevention strategies, both non-pharmacological and pharmacological.
- 2.13 Demonstrate knowledge and ability to manage acute cerebrovascular emergencies including acute ischemic and hemorrhagic stroke, high-risk TIA and stroke mimics.
- 2.14 Demonstrate knowledge of clinical trials that affect management of patients with cerebrovascular disease.

3. Perform a complete and appropriate assessment of a patient.

- 3.1 Elicit a history that is relevant, concise and accurate to both the clinical neurovascular problem and the patient's context, including but not limited to personal situation and beliefs.
- 3.2 Assess patient preferences for the purposes of prevention, diagnosis and management.
- 3.3 Perform a focused physical examination that is relevant and accurate for the purposes of prevention and health promotion, diagnosis and/or management.
- 3.4 Assess and explain the indications for and complications of the different therapeutic approaches proposed either in the hyperacute/acute or prevention context.
- 3.5 Assess and explain the indications for and complications for the different investigative procedures suggested.

4. Use preventive and therapeutic interventions effectively.

- 4.1 Implement a management plan in collaboration with a patient and the patient's family.
- 4.2 Demonstrate appropriate and timely application of preventive and therapeutic interventions relevant to:
 - 4.2.1 Diagnostic cerebrovascular studies.
 - 4.2.2 Acute reperfusion therapies (IV thrombolysis and mechanical thrombectomy).
 - 4.2.3 Secondary stroke prevention targeting vascular risk factors with non-pharmacological and pharmacological approaches.
 - 4.2.4 Post-stroke rehabilitation and post-stroke complications within a multidisciplinary team.
- 4.3 Ensure appropriate informed consent is obtained for diagnostic testing and therapies.
- 4.4 Ensure patients receive appropriate end-of-life care.



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5. Demonstrate proficient and appropriate use of procedural skills, both diagnostic and therapeutic.

- 5.1 Perform lumbar puncture safely and appropriately.
- 5.2 If available, perform transcranial doppler safely and appropriately.
- 5.3 Recognize and manage procedural complications of diagnostic/therapeutic interventions.
- 5.4 Ensure appropriate informed consent is obtained for procedures.
- 5.5 Document and disseminate risk/benefit information related to procedures performed and their outcomes.
- 5.6 Ensure adequate follow-up is arranged for procedures performed.

B. Communicator

Definition: As Communicators, Adult stroke physicians effectively facilitate the doctor-patient relationship and the dynamic exchanges that occur before, during, and after the medical encounter.

Key and Enabling Competencies: Adult stroke physicians are able to...

1. Inform the patient and their family about their neurovascular problem, prognosis, management and plans for follow-up.
2. Communicate with the health care team regarding the neurovascular management plan.
3. Write consultation/discharge letters to referring physicians and other members of the treating team.
4. Obtain informed consent if required for the different diagnostic, therapeutic and research-related procedures.



C. Collaborator

Definition: *As Collaborators, Adult stroke physicians effectively work within a health care team to achieve optimal patient care.*

Key and Enabling Competencies: *Adult stroke physicians are able to...*

1. Participate effectively and appropriately in an interprofessional health care team:

- 1.1 Work with the medical team and other health professionals in the care of patients with neurovascular problems.
- 1.2 Act as consultant for outpatient and inpatient management of patients with neurovascular problems.
- 1.3 Demonstrate an understanding of and support the roles of other health professionals, including but not limited to nurses, allied health (rehabilitation experts) and technologists, including support staff in stroke prevention clinics.
- 1.4 Work closely with other health care professionals whose patients require specialized neurovascular care, including but not limited to family physicians, emergency physicians, cardiologists, internal medicine specialists, neurosurgeons, vascular surgeons, neuroradiologists, neurointerventionalists, neuro-intensivists, rehabilitation specialists, neuro-geneticists and genetic counselors.

D. Leader

Definition: *As Leaders, Adult stroke physicians are integral participants in health care organizations, organizing sustainable practices, making decisions about resource allocation, and contributing to the effectiveness of the health care system.*

Key and Enabling Competencies: *Adult stroke physicians are able to...*

1. Participate in activities that contribute to the effectiveness of their health care organizations and systems.

- 1.1 Participate in continuous quality improvement in the health care environment.
- 1.2 Assess appropriateness and timeliness of access to neurovascular care with particular attention to time-sensitive therapies like IV thrombolysis and mechanical thrombectomy.
- 1.3 Perform quality assurance reviews of morbidity and mortality as related to patients with neurovascular conditions.



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- 1.4 Critically appraise new diagnostic/therapeutic neurovascular technologies and procedures.

2. Manage their practice and career effectively.

- 2.1 Implement processes to ensure personal practice improvement.
- 2.2 Assess and adopt new technologies to facilitate and improve patient care and follow-up.

3. Allocate finite health care resources appropriately.

- 3.1 Recognize the importance of just allocation of health care resources, balancing effectiveness, efficiency and access with optimal patient care, particularly with respect to newer diagnostic or interventional technologies.
- 3.2 Apply evidence and management processes for cost-appropriate care.

E. Health Advocate

Definition: *As Health Advocates, Adult stroke physicians responsibly use their expertise and influence to advance the health and well-being of individual patients, communities, and populations.*

Key and Enabling Competencies: *Adult stroke physicians are able to...*

1. Respond to individual patient health needs and issues as part of patient care.

- 1.1 Identify the health needs of an individual neurovascular patient.
- 1.2 Identify opportunities for advocacy, health promotion and disease prevention with individuals to whom they provide care.
- 1.3 Identify issues related to end of life care.
- 1.4 Demonstrate knowledge of radiation safety protection for staff and patients.
- 1.5 Contribute to the enhancement of quality care and patient safety in neurovascular diseases integrating the available best evidence and best practices.

2. Respond to the health needs of the communities that they serve.

- 2.1. Describe the practice communities that they serve.
- 2.2. Identify opportunities for advocacy, health promotion and disease prevention in the communities that they serve and respond appropriately.
- 2.3. Promote greater awareness about the causes, prevention and treatment of stroke.



3. Identify the determinants of health for the populations that they serve.

- 3.1 Identify the determinants of health of the populations, including barriers to access to care and resources, particularly those specialized resources required in neurovascular disease.
- 3.2 Identify vulnerable or marginalized populations within those served and respond appropriately.

F. Scholar

Definition: As Scholars, Adult stroke physicians demonstrate a lifelong commitment to reflective learning, as well as the creation, dissemination, application and translation of medical knowledge.

Key and Enabling Competencies: Adult stroke physicians are able to...

1. Recognize gaps in one's knowledge regarding patient problems and develop strategies to fill the gap through reading and consulting other members of the health care team.
2. Contribute knowledge learned to patient care.
3. Continue to learn about new and evolving technologies in the field of neurovascular diseases and understand how to adapt these innovations to current clinical care.
4. Apply lifelong learning skills of the Scholar Role to implement a personal program to keep up-to-date and enhance areas of professional competence.
5. Academic stroke physicians perform or participate in basic, clinical or translation research aimed at better understanding and better managing neurovascular diseases. They also participate in training of medical students, residents and fellows locally and disseminate knowledge via conferences, workshops and symposia.



G. Professional

Definition: As Professionals, Adult stroke physicians are committed to the health and well-being of individuals and society through ethical practice, profession-led regulation, and high personal standards of behaviour.

Key and Enabling Competencies: Adult stroke physicians are able to...

- 1. Demonstrate a commitment to their patients, profession, and society through ethical practice.**
 - 1.1 Deliver care with integrity, honesty and compassion.
 - 1.2 Demonstrate knowledge of the professional, legal and ethical codes to which physicians are bound.
 - 1.3 Exhibit appropriate professional behaviors in practice, including honesty, integrity, commitment, compassion, respect and altruism.
 - 1.4 Recognize and appropriately respond to ethical issues encountered in practice.
 - 1.5 Recognize and address potential conflicts of interest.
 - 1.6 Adhere to established professional guidelines in dealing with industry (pharmaceutical and device).

II. Required Training Experiences

1. Experiences in the hospital involving management of hyperacute/acute strokes (ischemic and hemorrhagic) in the emergency and in-hospital setting, neuro-angiography suite and the inpatient stroke unit as well as TIAs in the emergency or outpatient setting.
2. Experiences in the outpatient stroke prevention clinic involving consultation and follow-up of patients with neurovascular conditions.
3. Experience in diagnostic neuroradiology including CT, CT angiography and MRI and in interventional neuroradiology (exposure to the neuro-angiography suite and the basics of endovascular therapy).
4. Experience in neurocritical care for patients with severe neurovascular diseases and complications of these diseases.
5. Experience in post-stroke rehabilitation including involvement in multidisciplinary teamwork and issues related to post-stroke pain and spasticity.



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6. Experience in teaching more junior house staff issues related to neurovascular disease at the bedside and during more formal rounds.
7. Experiences at rounds and journal club involving scholarly interpretation of stroke literature and presentation to peers.
8. Experience in postulating and refining a research question and in data analysis of a research project with presentation at a regional or international scientific conference.

III. Recommended Training Experiences

1. Experience in application and interpretation of neuro-sonology.
2. Experience in palliative care for patients with terminal strokes requiring end-of-life care.