Diagnosis and Management of Acute Stroke in the Rural Setting

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Clinical Professor of Neurology

Head, Neurology Vancouver Acute (VGH&UBCH)

March 14, 2024| 0800-0900

LAND ACKNOWLEDGMENT

We acknowledge that we work on the traditional, ancestral and unceded territory of the Skwxwú7mesh (Squamish), xʷməθkwəy̓əm (Musqueam), and Sə́lílwətaʔ/Selilwitulh (Tsleil-Waututh) Nations.

PRESENTER DISCLOSURES

Name: Philip Teal MD FRCPC

No Relationships or commercial interests to disclose.

- Grants/Research Support: no personal remunerations
- Speakers Bureau/Honoraria: None
- Consulting Fees: None
- Other: Clinical Service Contract Vancouver Coastal for Hospital Stroke Work

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MITIGATION OF BIAS

- Content developed as part of this program are based on best practice guidelines and authoritative recommendations including:
    1. Canadian Stroke Best Practice Recommendations for Acute Stroke 2022
    2. Canadian Stroke Best Practice Recommendations: Telestroke update 2017

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LEARNING OBJECTIVES

- Review organized stroke care in BC
- Review current best practice guidelines for acute stroke
- Review role of neuroimaging
- Review access to telehealth
- Discuss strategies to reduce disparities in stroke care

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Stroke in Canada

- One stroke every 5 minutes
- 4th leading cause of death
- Most common cause of major adult-acquired disability
- A leading cause of dementia
- 14,000 deaths/year
- 110,000 strokes annually
- 880,000 Canadians living with stroke
- Most expensive diagnosis/case

Urban-rural Differences in Stroke Care/Outcomes

- Individuals in rural areas are likely to have worse stroke risk factor profiles
- Individuals in rural areas are likely to have higher incidence stroke rates
- Rural populations have comparatively limited access to acute stroke care services than their urban counterparts
- Service delivery in rural areas is variable, time elements are challenging

Urban-rural Differences in Stroke Care/Outcomes

- The existing gap between rural and urban acute stroke management has widened in recent years due to rapid advances in urban-tested interventions for acute stroke

- Access to neuroimaging and advanced neuroimaging may be limited or absent

- Access to advanced stroke care is challenging due to time and distance

CASE

- 19 yo first nations single mother, lives 40 minutes outside of Prince George.
- Mechanical MV for rheumatic heart disease. On warfarin
- 09:30 symptom onset
- 11:10 arrives at UHNBC
- Examination: Aphasic, right hemiplegia, eye deviation, visual field cut, NIHSS 23
- 11:45 CT scan performed – small early infarct changes (ASPECTS 8/10) , no ICH
- INR 1.6

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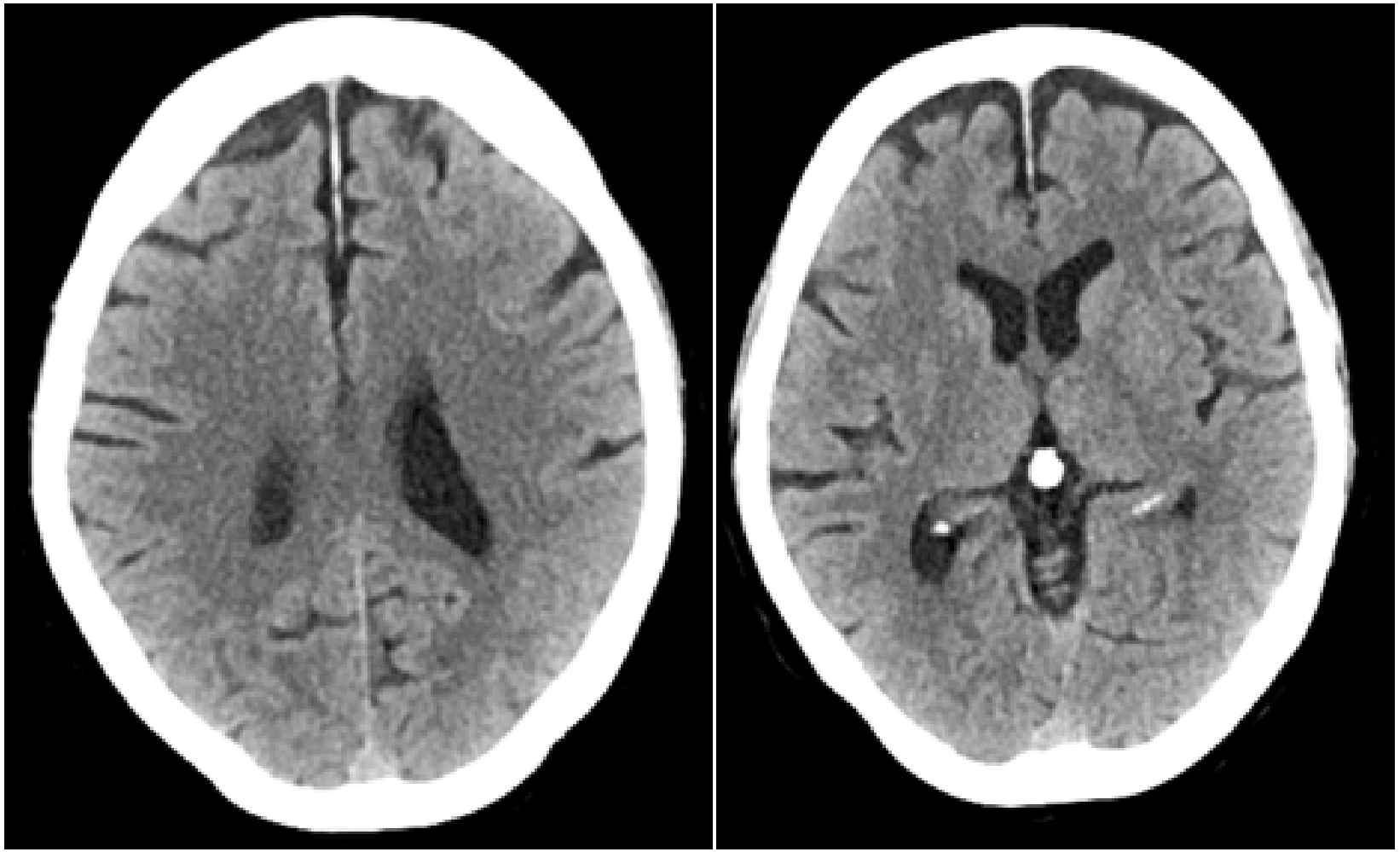
Case



Case

National Institute of Heath Stroke Scale (NIHSS)

Abbreviated neurological exam targeted for stroke

Easily adequate to other non-cooperative patients for neurological assessment

0	No stroke symptoms
1-4	Mild stroke
5-15	Moderate stroke
16-20	Moderate to severe stroke
21-42	Severe stroke

POLL QUESTION

What is the optimal care for this patient?

- Option 1: Admit for general and supportive care, no thrombolysis
- Option 2: IV thrombolysis with tPA, admit
- Option 3: No thrombolytic treatment but arrange for immediate transfer for higher level of care
- Option 4: Telestroke for advice regarding thrombolysis, eligibility for EVT, and LOL possible transfer

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POLL QUESTION 2

Referring to the concept of "**Time is Brain**", which of the following statements is true?

a) 1.9 million neurons are destroyed each minute during a large ischemic stroke

b) Organized stroke care and prompt treatment with IV thrombolysis can restore flow and improve functional outcomes

c) Early treatment with IV thrombolysis reduces death and disability at 90 days

d) Target median door to needle time recommendation is 30 minutes

e) All of the above

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Case – clinical features

"Cortical Features":

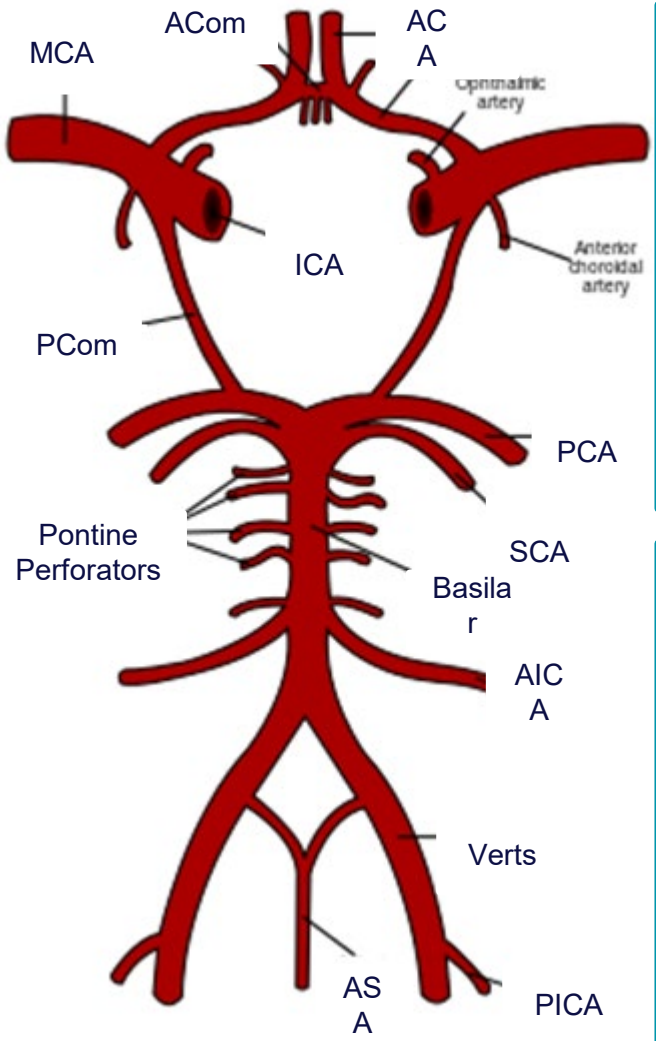
- **Aphasia (Wernicke's/Broca's Areas)**
- **Gaze deficit (Frontal Eye Fields)**
- **Visual field deficits (optic radiation in temporal and parietal lobes)**

Right sided weakness (Left pre-central gyrus)

Localization: Left MCA, proximal occlusion

LARGE VESSEL OCCLUSION

Stroke Localization



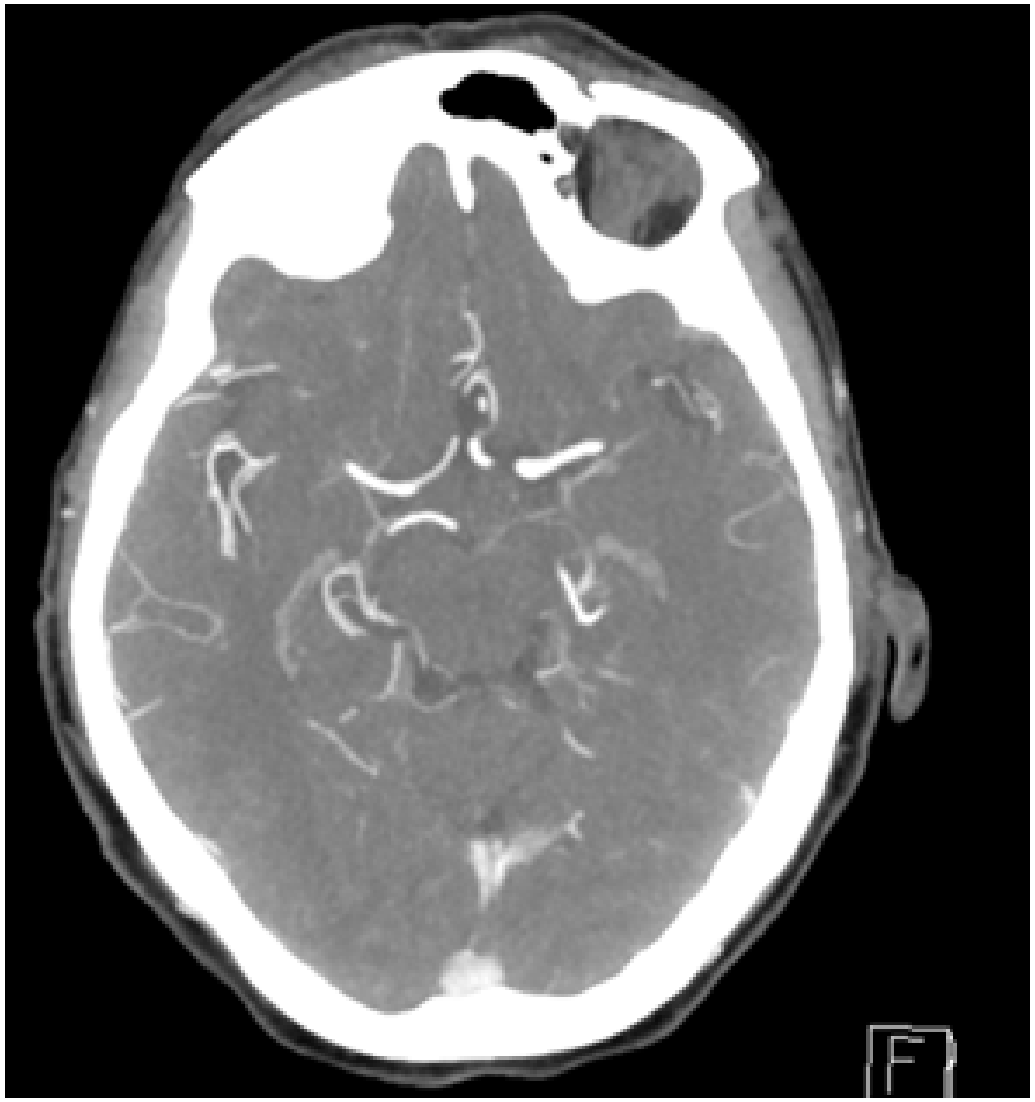
Large Vessel Occlusion

- Anterior circulation
  - ACA → Weakness of Leg>>Arm
  - MCA → Aphasia/Neglect, Gaze Deviation, Field Cuts, Hemi-paresis
- Posterior Circulation (Vertebral Artery/PICA/AICA/SCA)
  - PCA/Occipital lobes → Homonymous Hemianopsia
  - Brainstem → Crossed sensory motor findings, cranial nerve findings, vertigo, nystagmus
  - Cerebellum → Nystagmus, ataxia, dysmetria, vertigo
  - Thalamus → Sensory, pain, aphasia, visual field cuts, confusion, coma vigil (bilateral)

Lacunar Syndrome

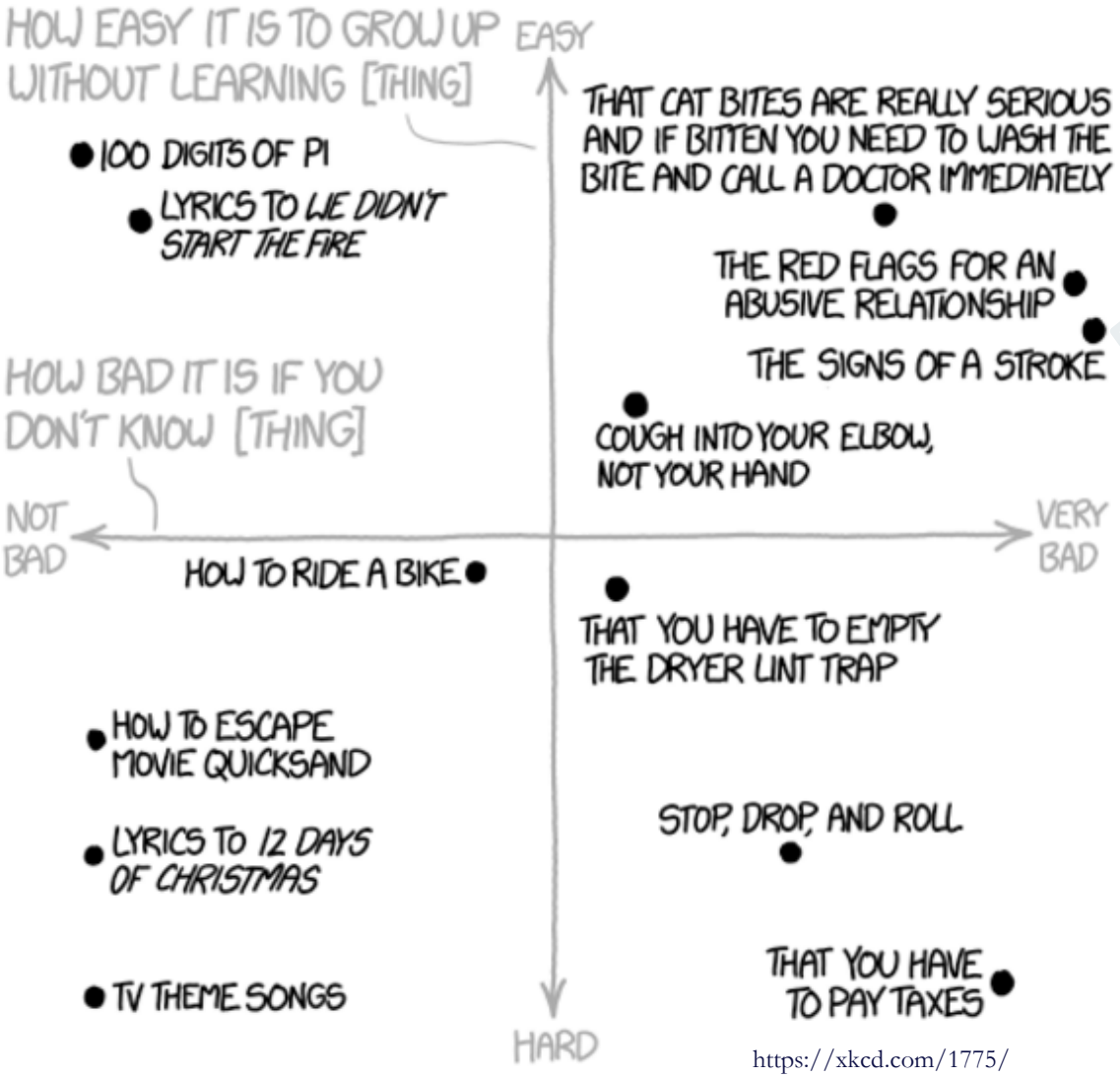
- Pure Hemiparesis: Internal Capsule
- Mixed Motor Sensory
- Ataxia-Hemiparesis
- Dysarthria-Clumsy Hand
- Pure Hemi-sensory Loss: Thalamus

Case



Improve equity and access for Stroke Care

- Education – patients, health care providers, administrators, MOH
- Best Practice Guidelines
- Stroke pathways – " HOT stroke" or code stroke protocols
- Improve access to technology- CT and advanced imaging protocols
- Organized/Regionalized Stroke Care Systems
- Telestroke
- Transfer protocols



https://xkcd.com/1775/

American Heart Association | American Stroke Association

Together to End Stroke™

UBC Neurology Curriculum

FAST- VAN

A clinical tool to identify Large Vessel Occlusion

Visual

Aphasia

Neglect

< 4.5 Hours **for IV tPA (up to 9 hours with appropriately selected patient using perfusion imaging)**

6+ Hours **for IA therapies (up to 24 hours for carefully selected patients using perfusion imaging)**

Time is Brain

In typical large vessel stroke: **1.9 million** neurons and **14 billion synapses** are lost per minute prior to treatment.

The Canadian best practice guidelines recommend **median Door-to-Needle time** (time from hospital triage to IV tPA administration) of **under 30 min** and a CT-to-Intra-arterial thrombectomy time of under **60 min.**

Thrombolysis- Time Relationship

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- Early treatment with IV thrombolysis reduced death and disability at 90 days
- Advantages to using TNK
  - Bolus only, no time need to set up infusion pump
  - Weight band dosing, easier to determine dose per patient
  - Nursing not needed for transport of stable patients, can transfer patients more quickly to Comprehensive Stroke Centers

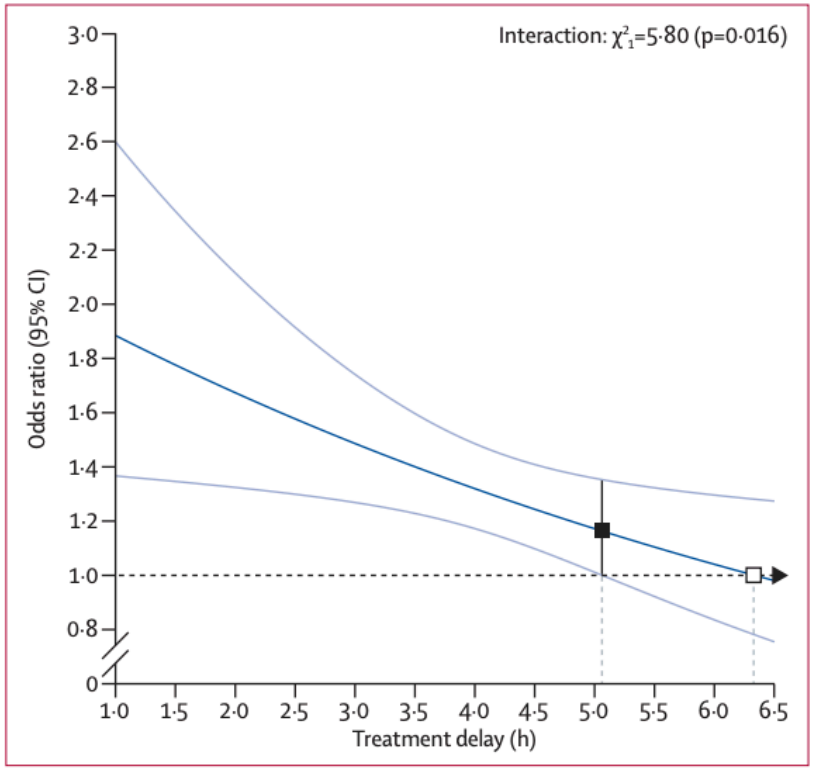


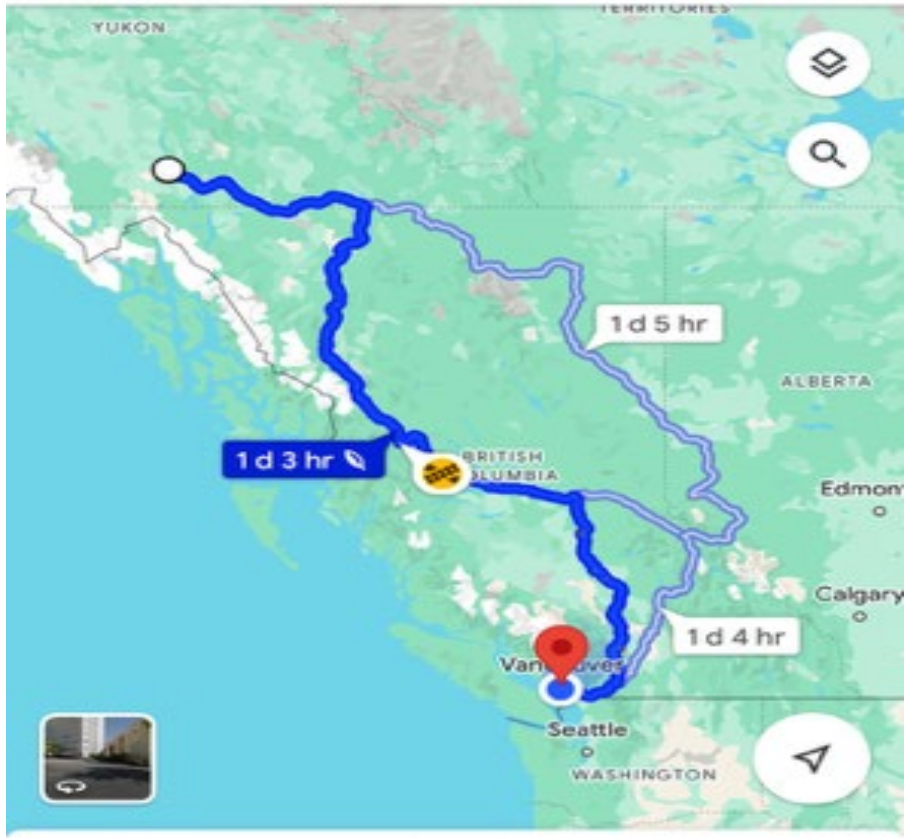
Figure 1: **Effect of timing of alteplase treatment on good stroke outcome (mRS 0–1)**

Emberson et al., 2014
https://www.thelancet.com/action/showPdf?pii=S0140-6736%2814%2960584-5

Whitehorse General Hospital

Vancouver General Hospital

27 hr — 8 d 3 d 2 hr 15



1 d 3 hr (2,400 km)

Fastest route now due to traffic conditions

Your destination is in a different time zone.

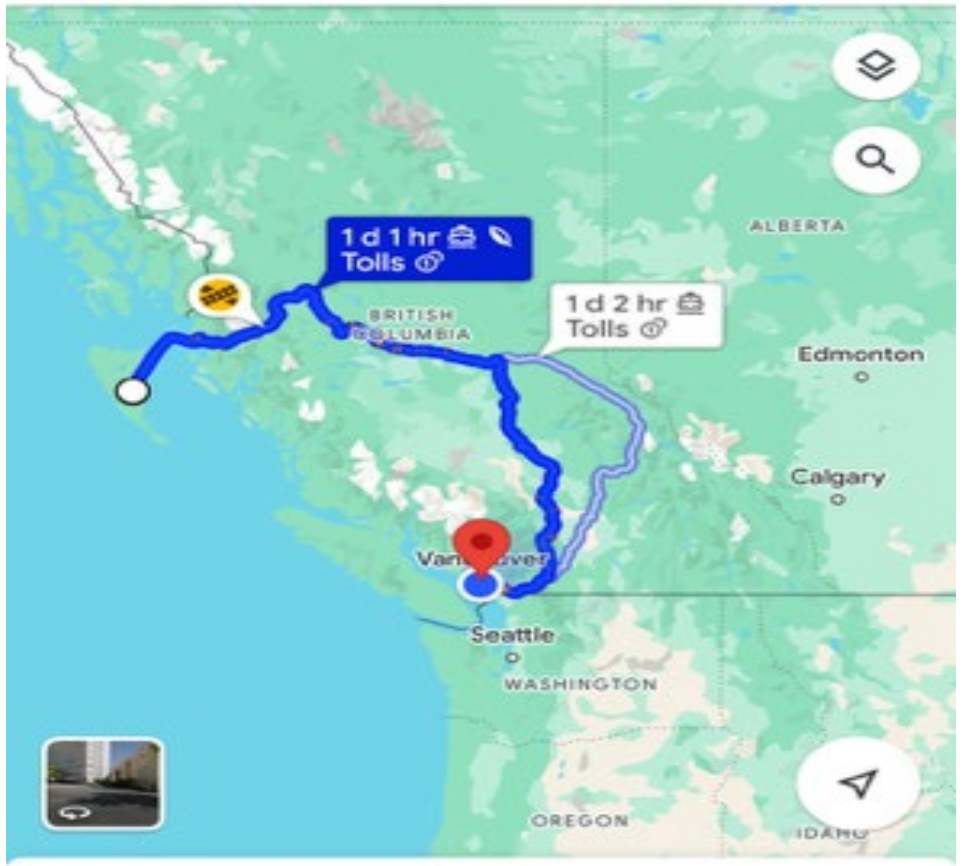
Saves 7% gas · Medium

Preview Steps Pin

Skidegate Health Centre

Vancouver General Hospital

25 hr — 5 d 2 d 1 hr 35



1 d 1 hr (1,699 km)

Fastest route now due to traffic conditions

This route includes a ferry. · Tolls · Saves 10% gas

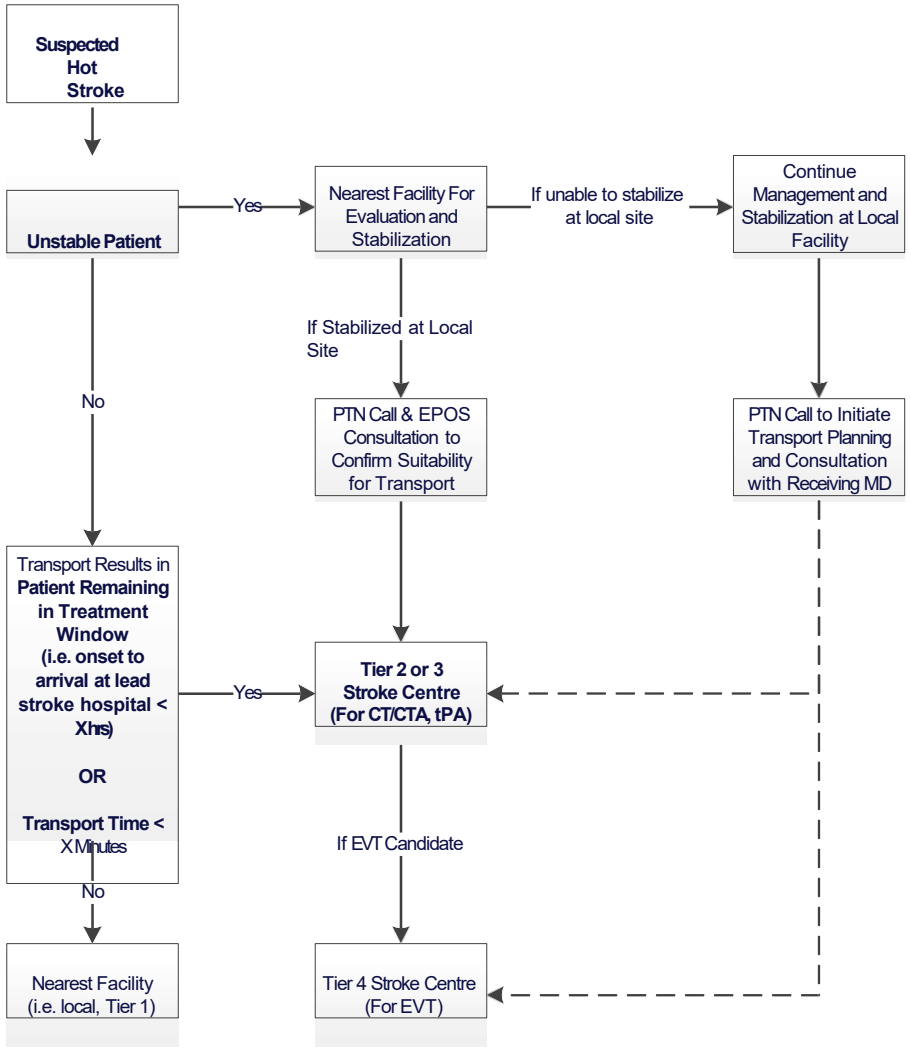
IV Thrombolysis

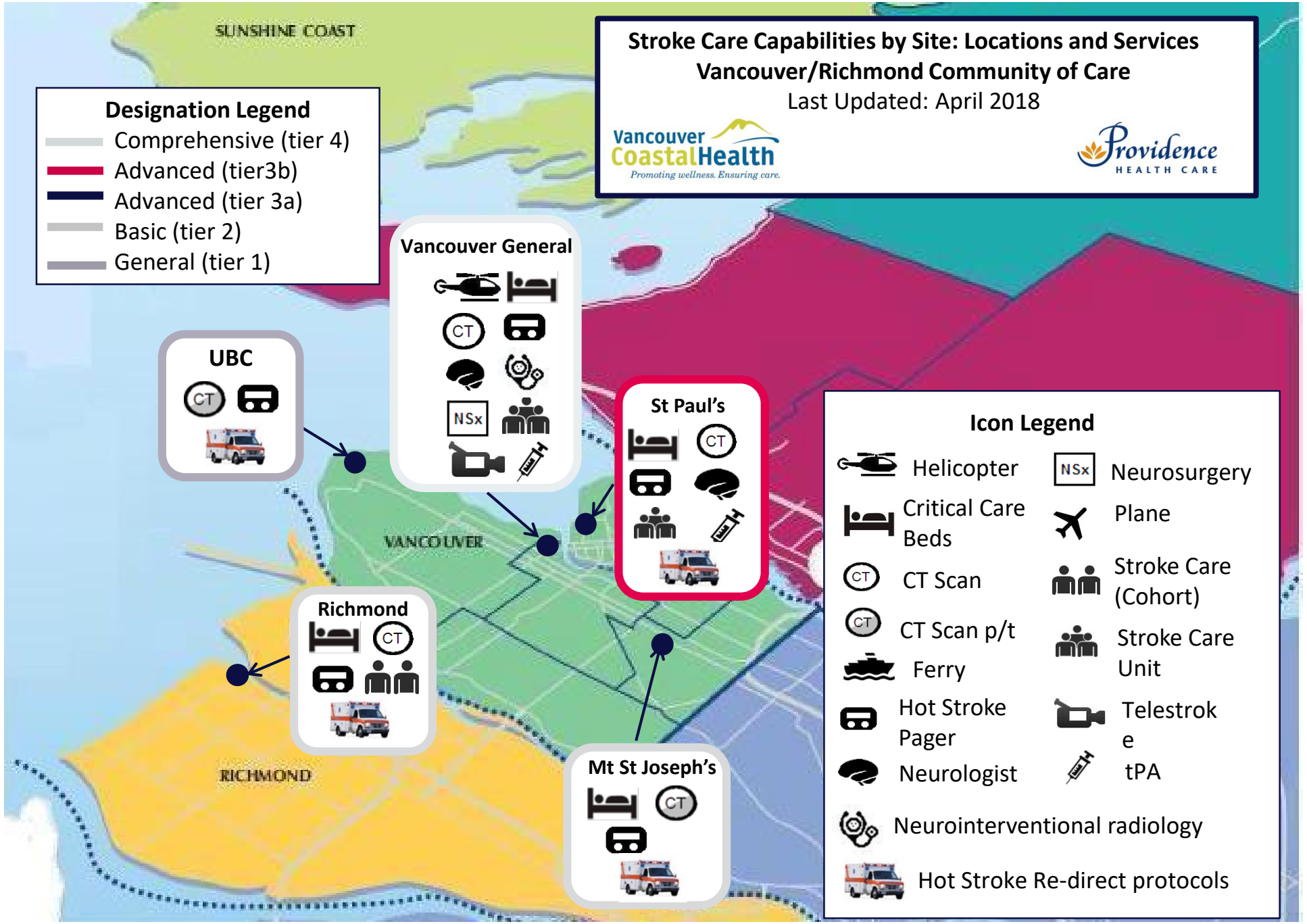
Indications: Acute stroke <4.5h from symptom onset, age >18 years

Contraindications:

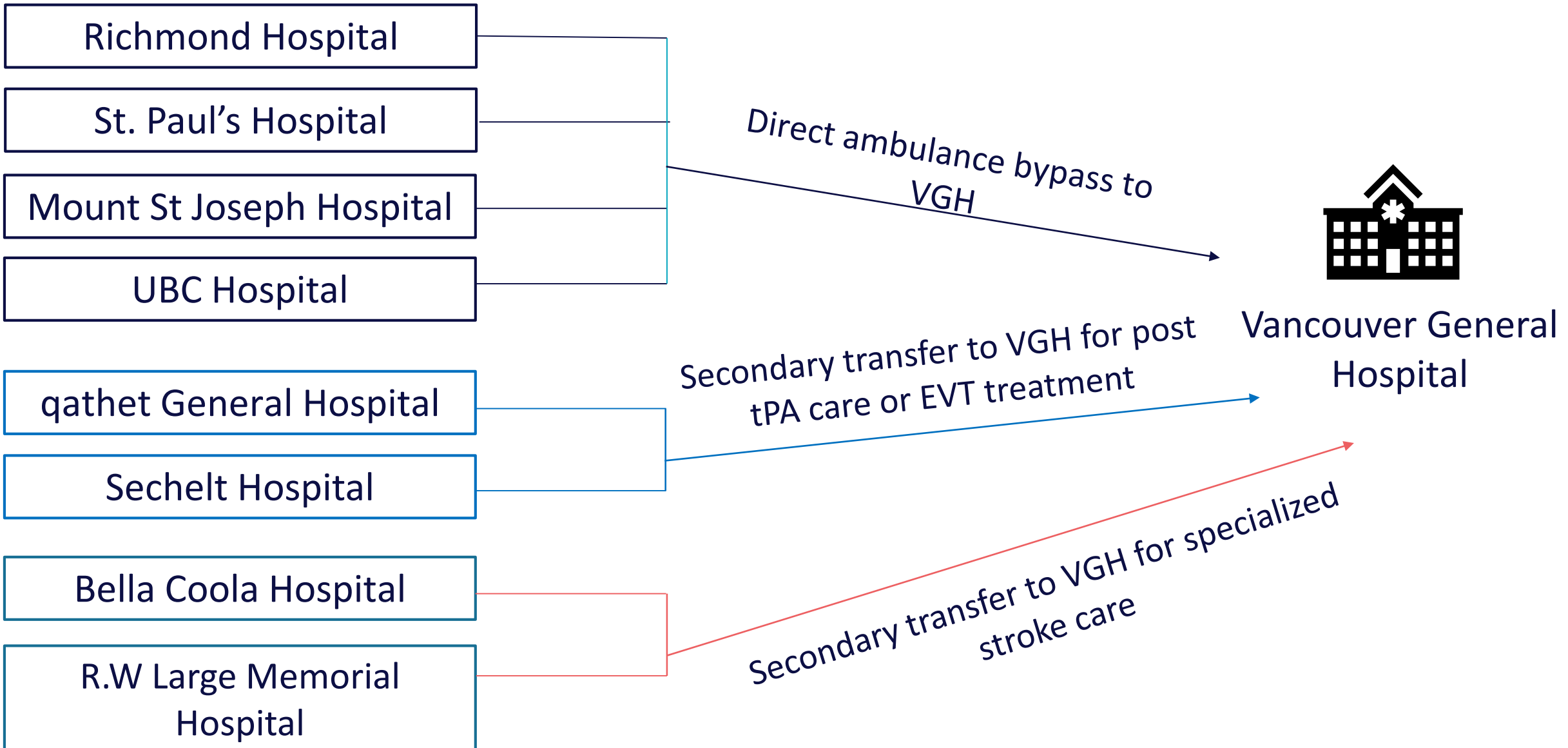
Historical
Significant stroke or head trauma in the previous three months
Previous intracranial hemorrhage
Intracranial neoplasm, arteriovenous malformation, or aneurysm
Recent intracranial or intraspinal surgery
Arterial puncture at a noncompressible site in the previous seven days
Clinical
Symptoms suggestive of subarachnoid hemorrhage
Persistent blood pressure elevation (systolic ≥185 mmHg or diastolic ≥110 mmHg)
Serum glucose <50 mg/dL (<2.8 mmol/L)
Active internal bleeding
Acute bleeding diathesis, including but not limited to conditions defined in 'Hematologic'
Hematologic
Platelet count <100,000/mm^3*
Current anticoagulant use with an INR >1.7 or PT >15 seconds*
Heparin use within 48 hours and an abnormally elevated aPTT*
Current use of a direct thrombin inhibitor or direct factor Xa inhibitor with evidence of anticoagulant effect by laboratory tests such as aPTT, INR, ECT, TT, or appropriate factor Xa activity assays

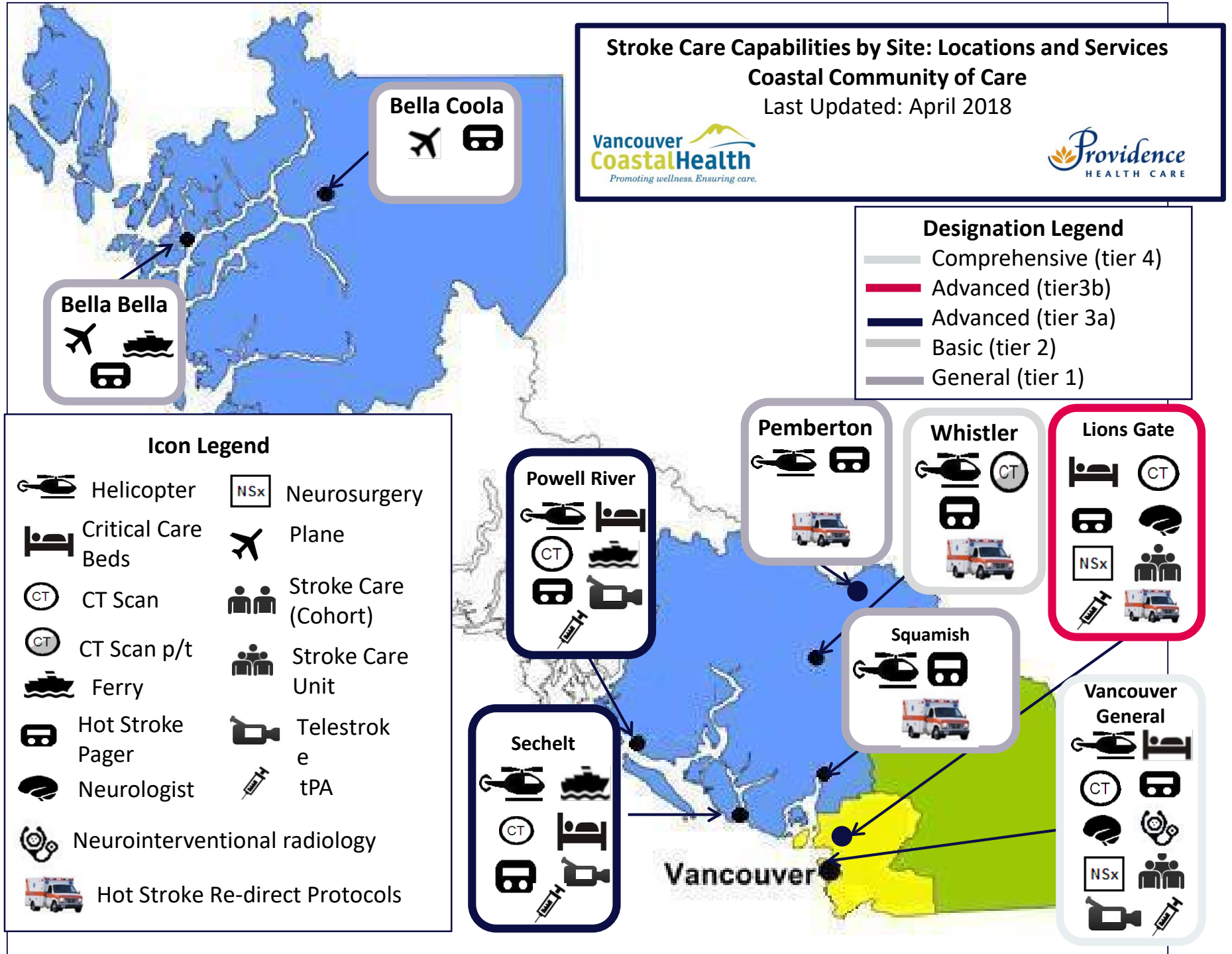
Urban Non-EVT Catchment and Rural Settings




SUNSHINE COAST
Stroke Care Capabilities by Site: Locations and Services
Vancouver/Richmond Community of Care
Last Updated: April 2018
Vancouver CoastalHealth
Promoting wellness. Ensuring care.
Providence HEALTH CARE
Designation Legend
Comprehensive (tier 4)
Advanced (tier3b)
Advanced (tier 3a)
Basic (tier 2)
General (tier 1)
Vancouver General
UBC
St Paul's
Richmond
Mt St Joseph's
VANCOUVER
RICHMOND
CT
NSx
Icon Legend
Helicopter
Neurosurgery
Critical Care Beds
Plane
CT Scan
Stroke Care (Cohort)
CT Scan p/t
Stroke Care Unit
Ferry
Hot Stroke Pager
Telestroke
Neurologist
tPA
Neurointerventional radiology
Hot Stroke Re-direct protocols

Urban Ambulance Stroke Bypass Protocols




Stroke Care Capabilities by Site: Locations and Services
Coastal Community of Care
Last Updated: April 2018
Vancouver Coastal Health
Promoting wellness. Ensuring care.
Providence HEALTH CARE
Designation Legend
Comprehensive (tier 4)
Advanced (tier3b)
Advanced (tier 3a)
Basic (tier 2)
General (tier 1)
Icon Legend
Helicopter
Critical Care Beds
CT Scan
CT Scan p/t
Ferry
Hot Stroke Pager
Neurologist
Neurosurgery
Plane
Stroke Care (Cohort)
Stroke Care Unit
Telestroke
tPA
Neurointerventional radiology
Hot Stroke Re-direct Protocols
Bella Coola
Bella Bella
Powell River
Pemberton
Whistler
Lions Gate
Squamish
Sechelt
Vancouver General
Vancouver
CT
NSx

Air Ambulance for Acute Stroke

Urban-rural Differences in Stroke Care/Outcomes

- Stroke Management/Best Practice
- Acute management
- Antiplatelet therapy
- Thrombolysis –tPA/TNK
- Endovascular Thrombectomy (EVT)
- Stroke Unit Care

Canadian Stroke Best Practice Recommendations

The Canadian Journal of Neurological Sciences (2024), **51**, 1–31
doi:10.1017/cjn.2022.344

Canadian Journal of Neurological Sciences
Journal Canadien des Sciences Neurologiques

Review Article

Canadian Stroke Best Practice Recommendations: Acute Stroke Management, 7th Edition Practice Guidelines Update, 2022

Manraj Heran[1], Patrice Lindsay[2], Gord Gubitz[3,4], Amy Yu[5,6], Aravind Ganesh[7], Rebecca Lund[2], Sacha Arsenault[8], Doug Bickford[9], Donnita Derbyshire[10], Shannon Doucette[11], Esseddeeg Ghrooda[12], Devin Harris[13,14], Nick Kanya-Forstner[15,16], Eric Kaplovitch[6,17], Zachary Liederman[6,17], Shauna Martiniuk[6,18], Marie McClelland[19], Genevieve Milot[20], Jeffrey Minuk[21], Erica Otto[22], Jeffrey Perry[23], Rob Schlamp[24], Donatella Tampieri[25], Brian van Adel[26], David Volders[27], Ruth Whelan[28], Samuel Yip[29], Norine Foley[30], Eric E. Smith[7], Dar Dowlatshahi[31], Anita Mountain[32], Michael D. Hill[7], Chelsy Martin[2] and Michel Shamy[31]

[1]Division of Neuroradiology, University of British Columbia, Vancouver, Canada, [2]Heart and Stroke Foundation of Canada, Toronto, Canada, [3]Queen Elizabeth II

Canadian Stroke Best Practice Recommendations

1. Stroke awareness, recognition, response
   - FAST – Face, Arms, Speech, Time
   - FAST-VAN - adds visual field, aphasia, neglect. (BCEHS and ER)
   - Call 911
2. Triage and initial diagnostic evaluation
   - Patients presenting within 48 hours are at highest risk for recurrent events
   - Stroke Activation – Hot Stroke Protocol
   - Urgent brain and vascular imaging – CT, CTA, CTP, or MRI, MRA
   - SSBC has standardized imaging packages – CT, multiphase CTA, CTP(if available)
   - Blood work – CBC, INR, aPTT, Cr, GFR, glucose, A1C, lipid panel
3. Cardiac studies
   - EKG, Holter,
   - Echo – not required for all patients

Canadian Stroke Best Practice Recommendations Antiplatelet Therapy

- All patients not already on APT should be treated with at least 160 mg of ASA as a one time loading dose after brain imaging (strong recommendation, high level of evidence)
- If thrombolysis is being given, avoid APT for first 24 hours, then scan
- For patients with acute high risk TIAs or minor non-cardioembolic strokes, who are not at high risk of bleeding , dual APT (DAPT) therapy
  - ASA 162 mg followed by ASA 81 mg daily plus clopidogrel 300-600 mg followed by 75 mg daily for 3 weeks
  - Or ASA as above plus ticagrelor 180 mg loading dose followed by ticagrelor 90 mg BID for 30 days
- Patients not meeting criteria for DAPT should receive single APT either ASA or clopidogrel

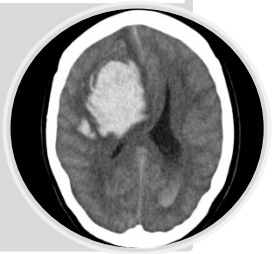
Canadian Stroke Best Practice Recommendations Anticoagulation Therapy

- All patients with **TIA** who have atrial fibrillation should receive OAC instead of APT (strong recommendation, moderate quality evidence)
- Patients with **stroke** and atrial fibrillation should receive OAC instead of antiplatelet therapy (Strong recommendation, high quality evidence) with timing of initiation at the discretion of the physician based on patient specific factors including size of infarct (strong recommendation, moderate quality evidence)
- For patients with acute high risk TIAs or minor non-cardioembolic strokes, who are not at high risk of bleeding , dual APT (DAPT) therapy

Non-Contrast CT Head

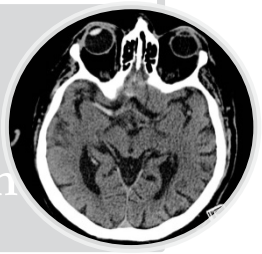
- ICH score: Age? GCS? IVH? Infra-tentorial? ICH volume?

ICH



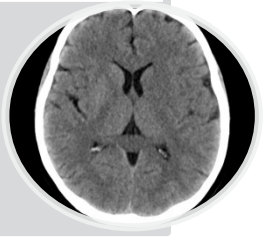
- Dense MCA Sign
- MCA Dot Sign

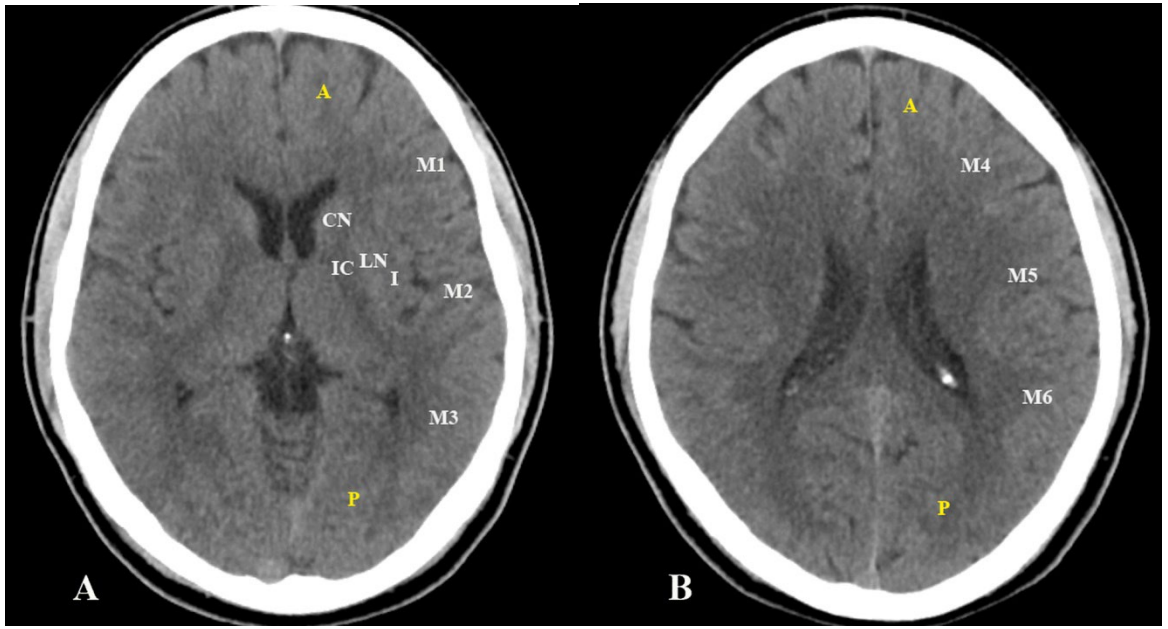
Large Vessel Occlusion



- Loss of grey-white differentiation
- Swelling with sulci effacement

Early Infarct Changes

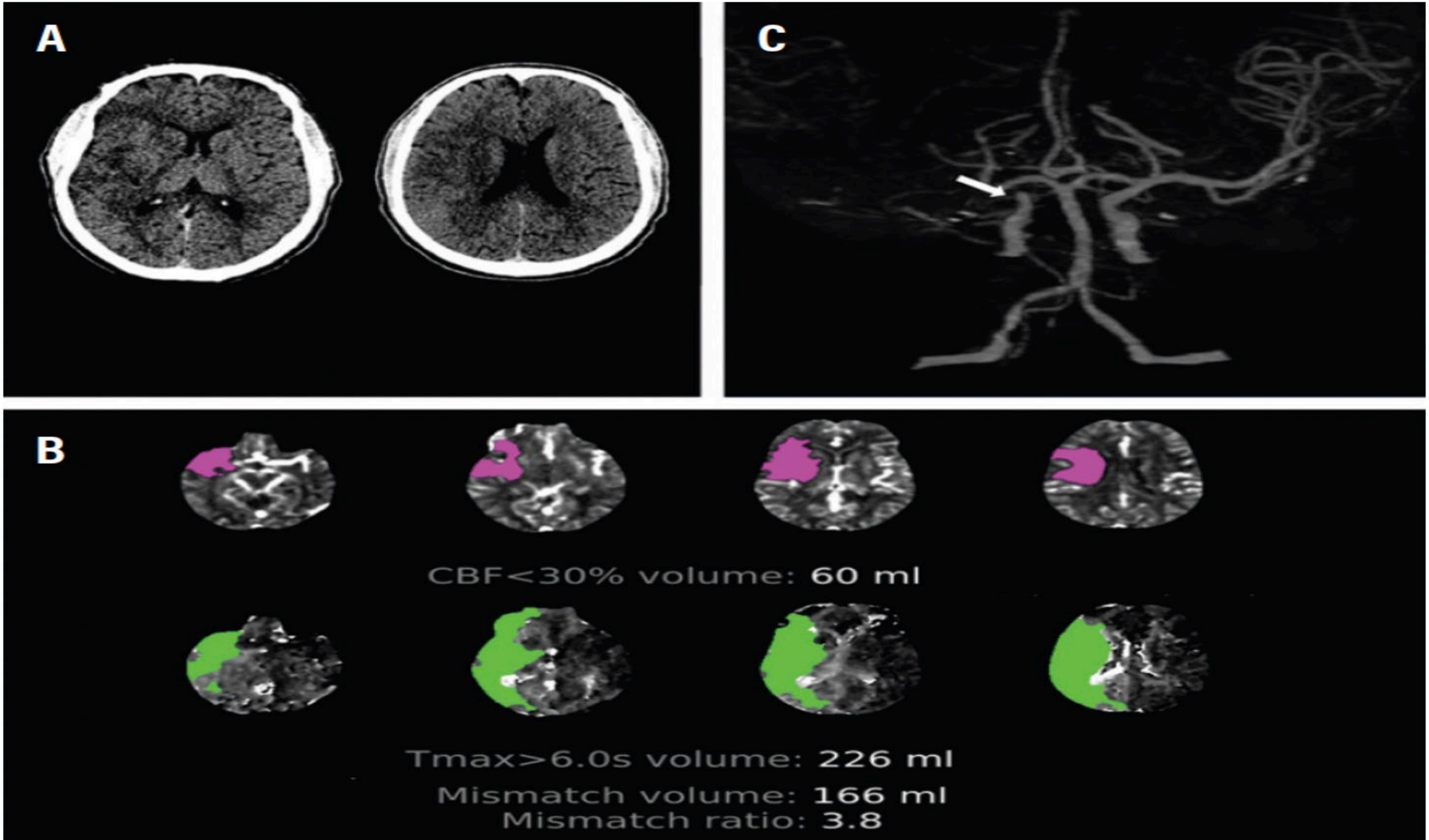




Case courtesy of Dr Subash Thapa, Radiopaedia.org, rID: 40018

ASPECT score-MCA

Caudate
Internal Capsule
Lentiform Nucleus
Insula
M1
M2
M3
M4
M5
M6


A
C
B
CBF<30% volume: 60 ml
Tmax>6.0s volume: 226 ml
Mismatch volume: 166 ml
Mismatch ratio: 3.8

POLL QUESTION 3

Tenecteplase (TNKase) as of July 2022 has been shown to be equivalent (non-inferior) to alteplase (Activase) for stroke treatment and has become the new standard of care.

1. True
2. False

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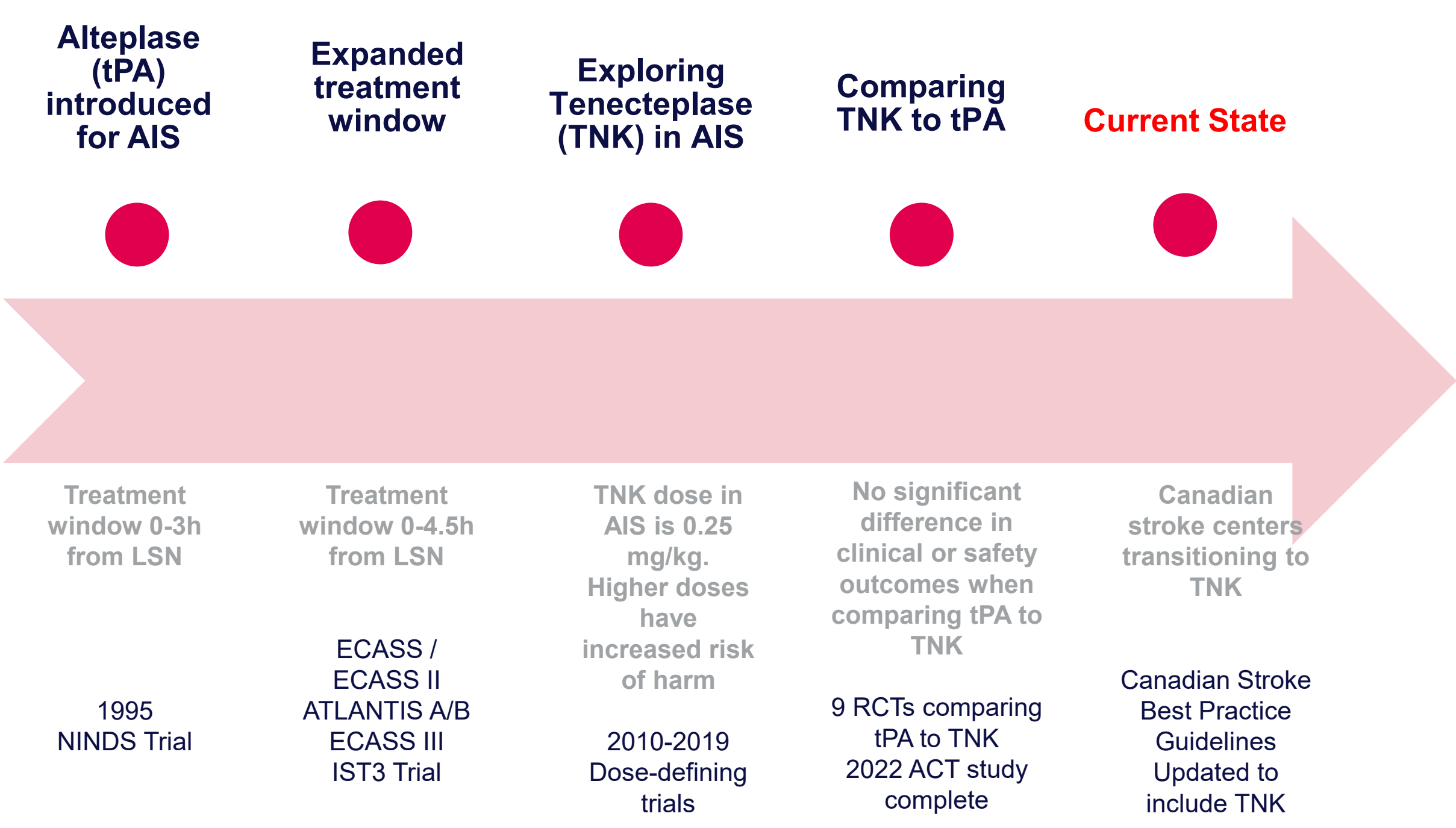
Canadian Stroke Best Practice Recommendations

1. Acute ischemic stroke < 6 hours
   - Conventional time window for IV thrombolysis is **4.5 hours**
   - Conventional time window for EVT is **6 hours** but extended up **to 24 hours** selectively based on clinical and radiographic features
2. tPA or TNK
   - All eligible patients with disabling ischemic stroke who can receive thrombolysis within 4.5 hours of symptom onset time or LKW should be offered IV thrombolysis (Strong recommendation, High quality of evidence)
   - Target median door-to-needle time of < 30 minutes, 90% should be < 60 minutes
   - tPA (Alteplase) dose 0.9 mg/kg, maximum dose 90 mg, 10% as bolus, rest over 60
   - **Tenecteplase – dose of .25 mg/kg to a maximum of 25 mg, given as a 5 second bolus**
   - Consent issues – IV thrombolysis and EVT are considered standard of care, routine procedures for emergency consent apply.


Alteplase (tPA) introduced for AIS
Expanded treatment window
Exploring Tenecteplase (TNK) in AIS
Comparing TNK to tPA
Current State
Treatment window 0-3h from LSN
1995
NINDS Trial
Treatment window 0-4.5h from LSN
ECASS /
ECASS II
ATLANTIS A/B
ECASS III
IST3 Trial
TNK dose in AIS is 0.25 mg/kg. Higher doses have increased risk of harm
2010-2019
Dose-defining trials
No significant difference in clinical or safety outcomes when comparing tPA to TNK
9 RCTs comparing tPA to TNK
2022 ACT study complete
Canadian stroke centers transitioning to TNK
Canadian Stroke Best Practice Guidelines Updated to include TNK

Comparing Thrombolytics Used in AIS

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	Tenecteplase (TNK)	Alteplase (tPA)
Eligibility Criteria	**No difference**	
Eligibility Time Window	**No difference**	
Dose	0.25 mg/kg (max: 25 mg)	0.9 mg/kg (max: 90 mg)
Administration	Single IV push dose over 5 seconds	Bolus (10%) + Infusion (90%) over 60 min
Half Life	~20-24 mins	~5 mins
Rate of Complications	**No difference**	
Transport Impact	Basic crew for transport Immediate transport post bolus possible	Advanced crew required for transport with tPA infusion or transport delayed until post-infusion if only basic crew available
Cost	**No difference**	
Monitoring and post-care	**No difference**	

- **Tenecteplase dosing is 0.25mg/kg with max of 25mg but for ease of administration, weight bands are used**
- **TNK dose for stroke is not the same as dosing protocol for myocardial infarction**

Patient Weight	Tenecteplase Dose	Tenecteplae Volume (5mg/mL)
Less than 40kg	0.25mg/kg- confirm with neurologist	
40-49.9kg	12.5mg	2.5mL
50-59.9kg	15mg	3.0mL
60-69.9kg	17.5mg	3.5mL
70-79.9kg	20mg	4.0mL
80-89.9kg	22.5mg	4.5mL
90kg or more	25mg	5.0mL

High Alert Medication

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- Tenecteplase and alteplase are identified as High-Alert Medications in the Regional Parenteral Manual
- High-alert medications are medications that bear a heightened risk of causing significant harm when used in error. Although mistakes may or may not be more common with these drugs, the consequences of an error are devastating to patients
- Tenecteplase has all the same indications, contraindications, and post administration monitoring needs as alteplase (tPA)

Where can I go for more information?

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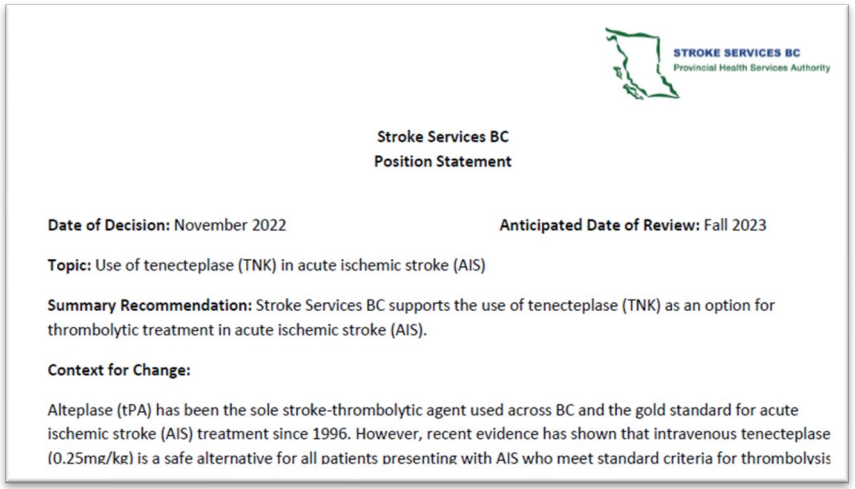
Provincial Health Services Authority

Position Statement:
[SSBC]



STROKE SERVICES BC
Provincial Health Services Authority

Stroke Services BC
Position Statement

Date of Decision: November 2022 **Anticipated Date of Review:** Fall 2023

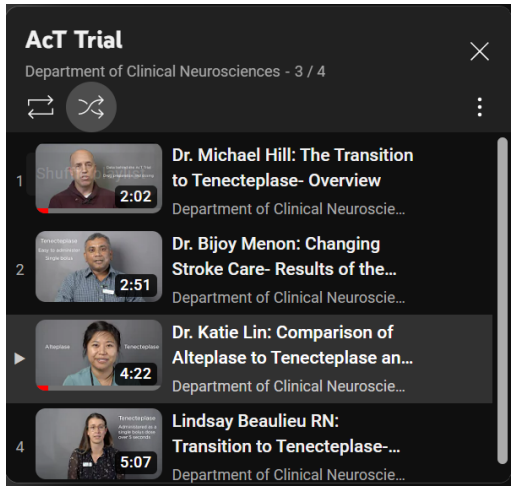
Topic: Use of tenecteplase (TNK) in acute ischemic stroke (AIS)

Summary Recommendation: Stroke Services BC supports the use of tenecteplase (TNK) as an option for thrombolytic treatment in acute ischemic stroke (AIS).

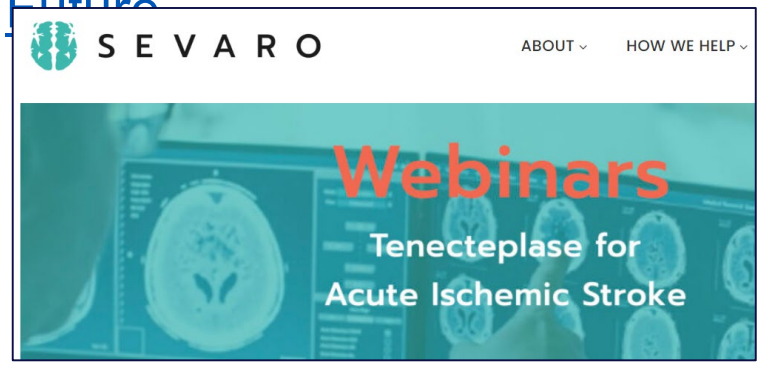
Context for Change:

Alteplase (tPA) has been the sole stroke-thrombolytic agent used across BC and the gold standard for acute ischemic stroke (AIS) treatment since 1996. However, recent evidence has shown that intravenous tenecteplase (0.25mg/kg) is a safe alternative for all patients presenting with AIS who meet standard criteria for thrombolysis

Educational Videos:
[Alberta Health Services]



Webinars:
[TNK Past, Present and Future]



For CSC members:
[Educational Resource (strokeconsortium.ca)]

Guidelines

STROKE SERVICES BC
Provincial Health Services Authority

Canadian Stroke Best Practices

CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Acute Stroke Management

7th Edition, Update 2022

Acute Stroke Management Scientific Writing Group:
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on behalf of the Canadian Stroke Best Practice Recommendations Advisory Committee, in collaboration with the Canadian Stroke Consortium.

Canadian Stroke Best Practice Recommendations: Acute Stroke Management, 7th Edition Practice Guidelines Update, 2022

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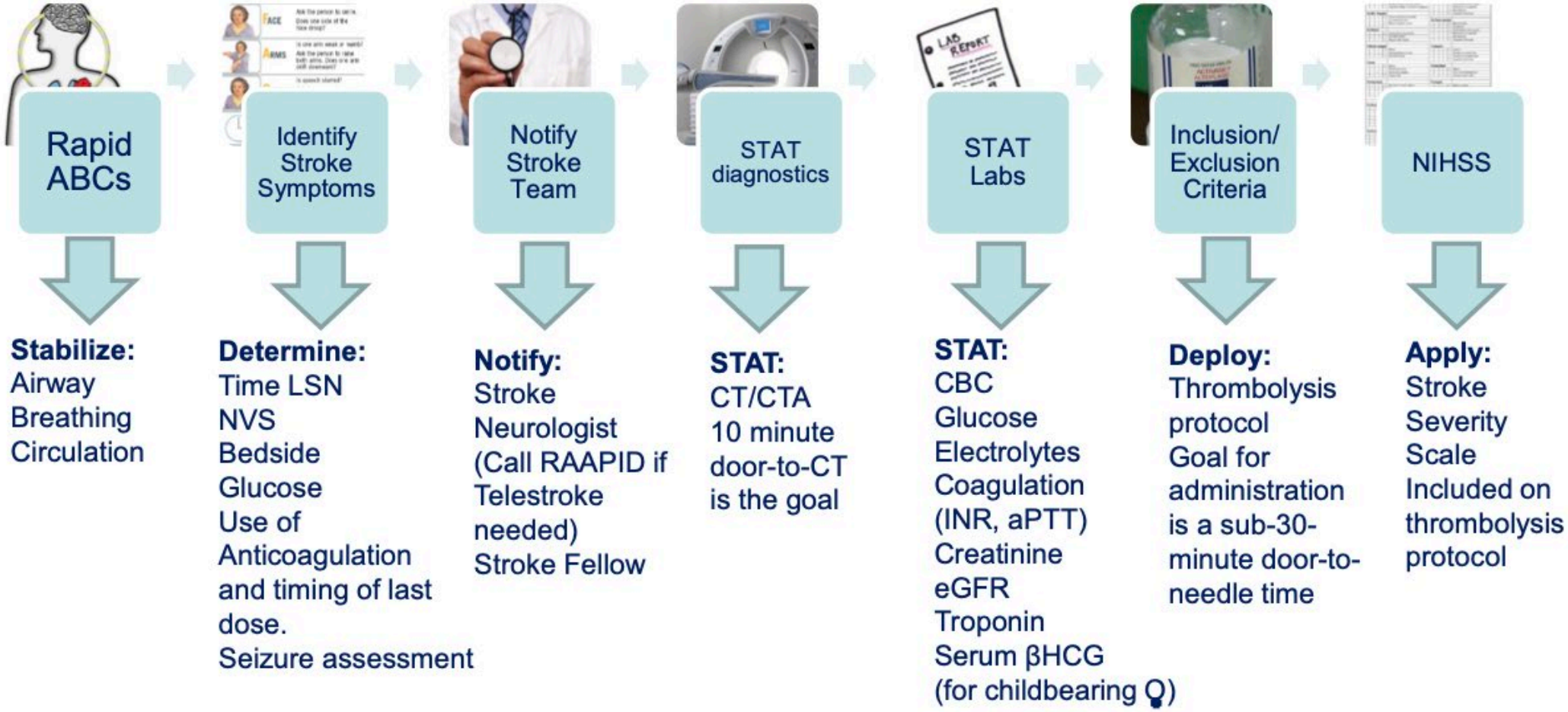
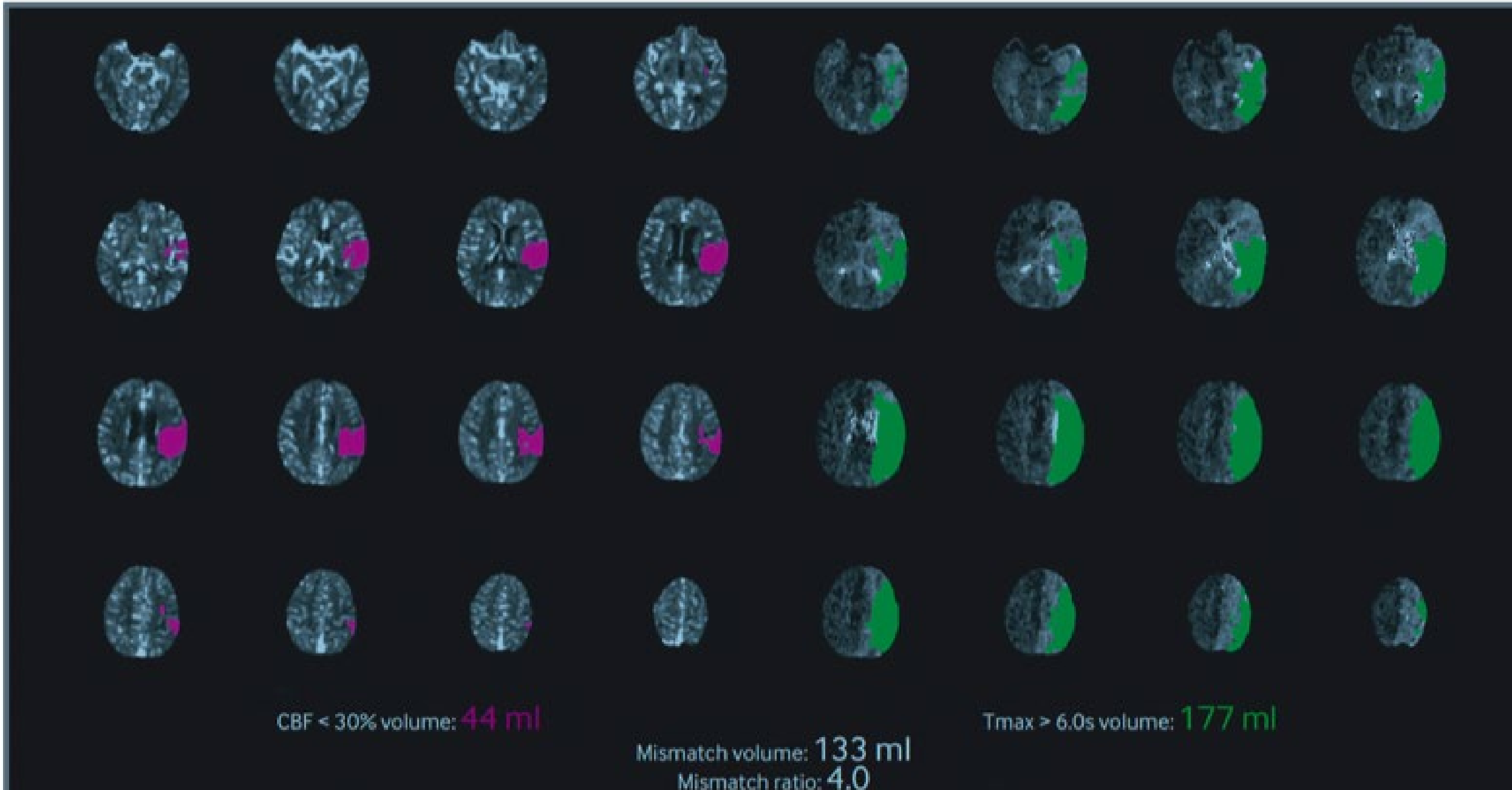
iv. **(NEW FOR 2022) Tenecteplase** may be considered as an alternative to alteplase within 4.5 hours of acute stroke symptom onset [Strong recommendation; Moderate quality of evidence].

a. **Tenecteplase dose:** If administering Tenecteplase, the dose of 0.25 mg/kg up to a maximum of 25 mg should be administered, given as a single bolus over 5 seconds [Strong recommendation; Moderate quality of evidence].

https://www.strokebestpractices.ca/recommendations/acute-stroke-management



Credit: Alberta Health Service Thrombolysis Learning Module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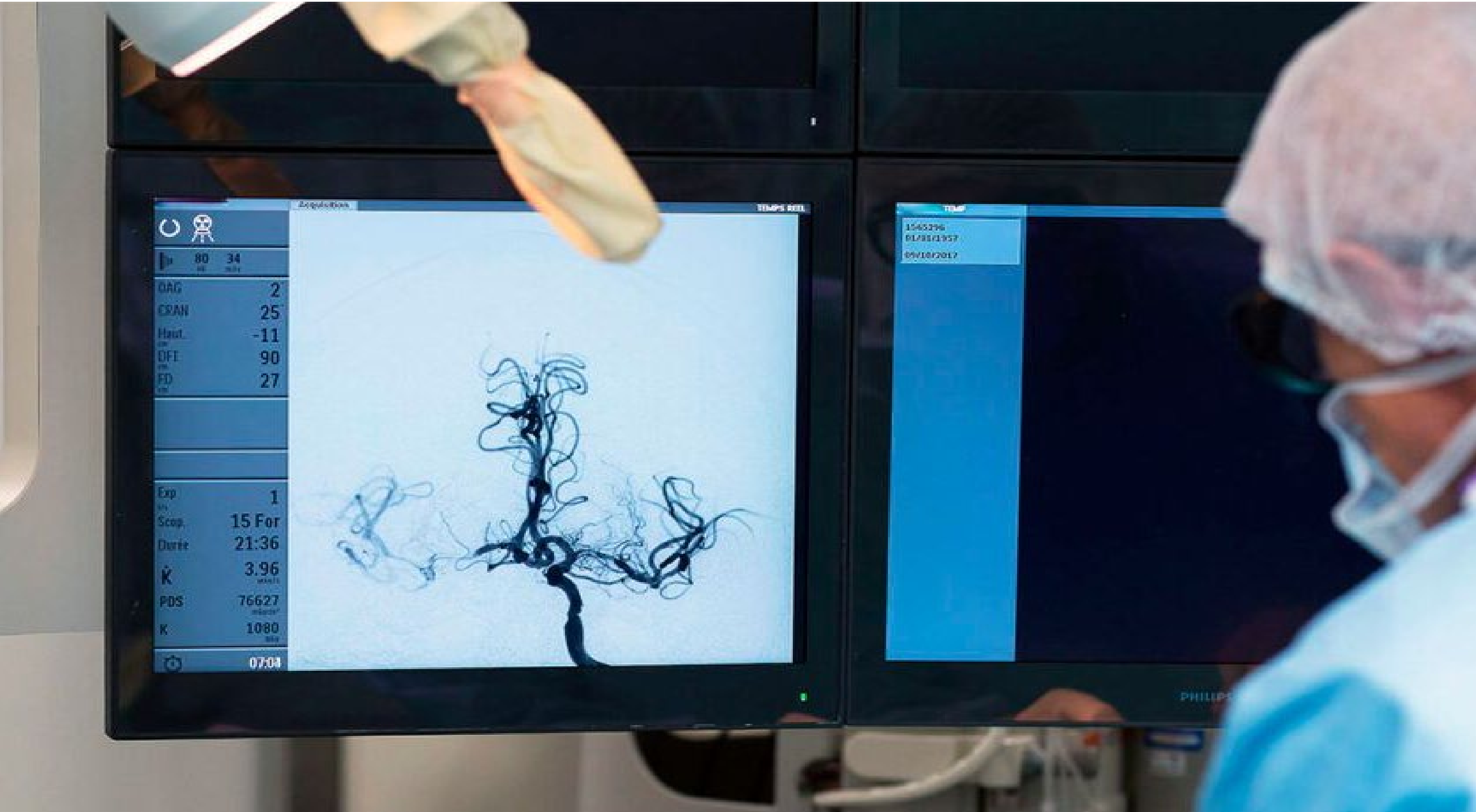
Tmax > 6.0s volume: 177 ml
Mismatch volume: 133 ml
Mismatch ratio: 4.0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Canadian Stroke Best Practice Recommendations

INCLUSION CRITERIA FOR ENDOVASCULAR TREATMENT

1. Ischemic disabling stroke
2. Proven, clinically relevant intra- or extracranial acute arterial occlusion that is amenable to EVT
3. Can be done with prior thrombolysis or not
4. Patients must qualify for imaging criteria
5. Suitable premorbid criteria
6. Potential window up to 24 hours

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VSP Telestroke Program

BRINGING ACUTE STROKE CARE TO REMOTE AREA

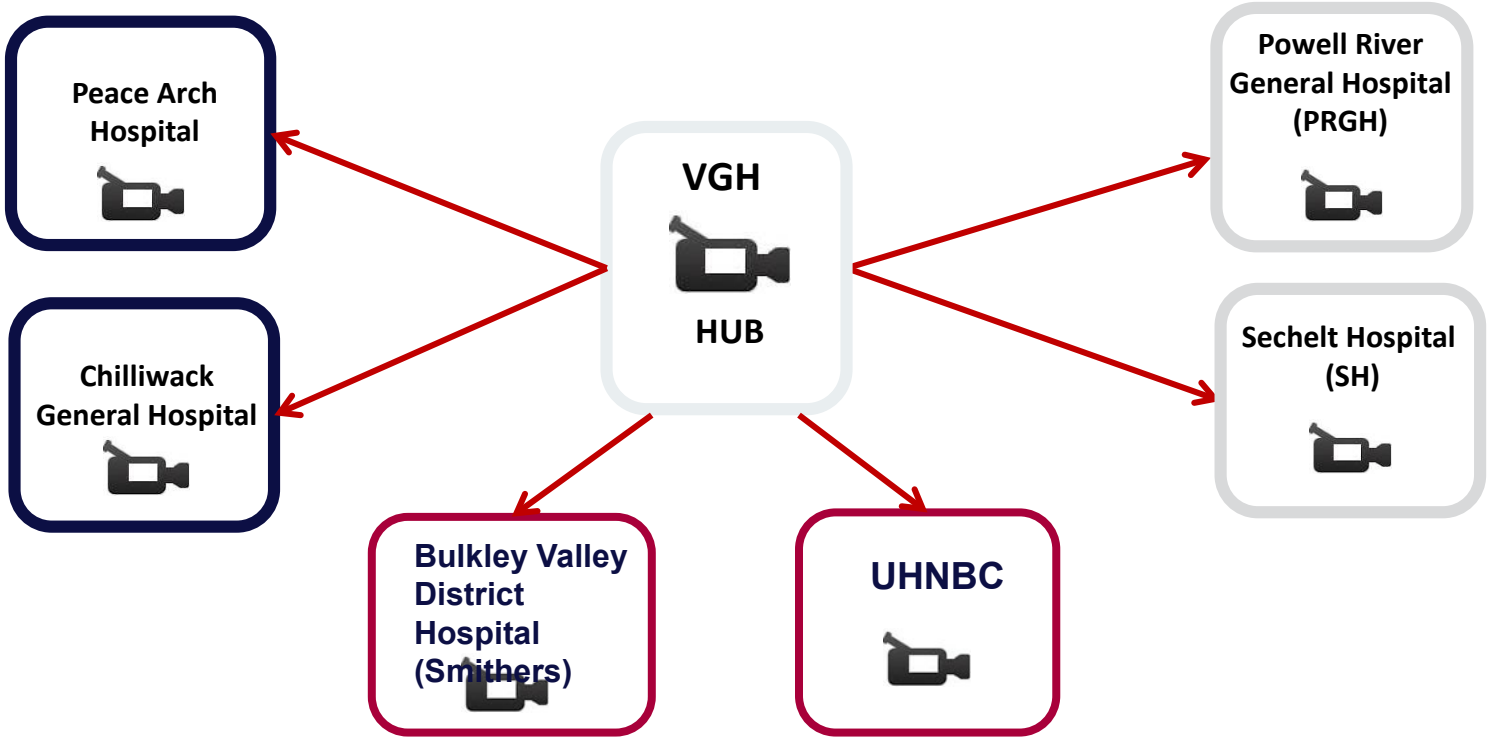
- Smithers
- UHNBC – Prince George
- Sunshine Coast
- Powell River
- Chilliwack
- White Rock

Canadian Stroke Best Practice -Telestroke

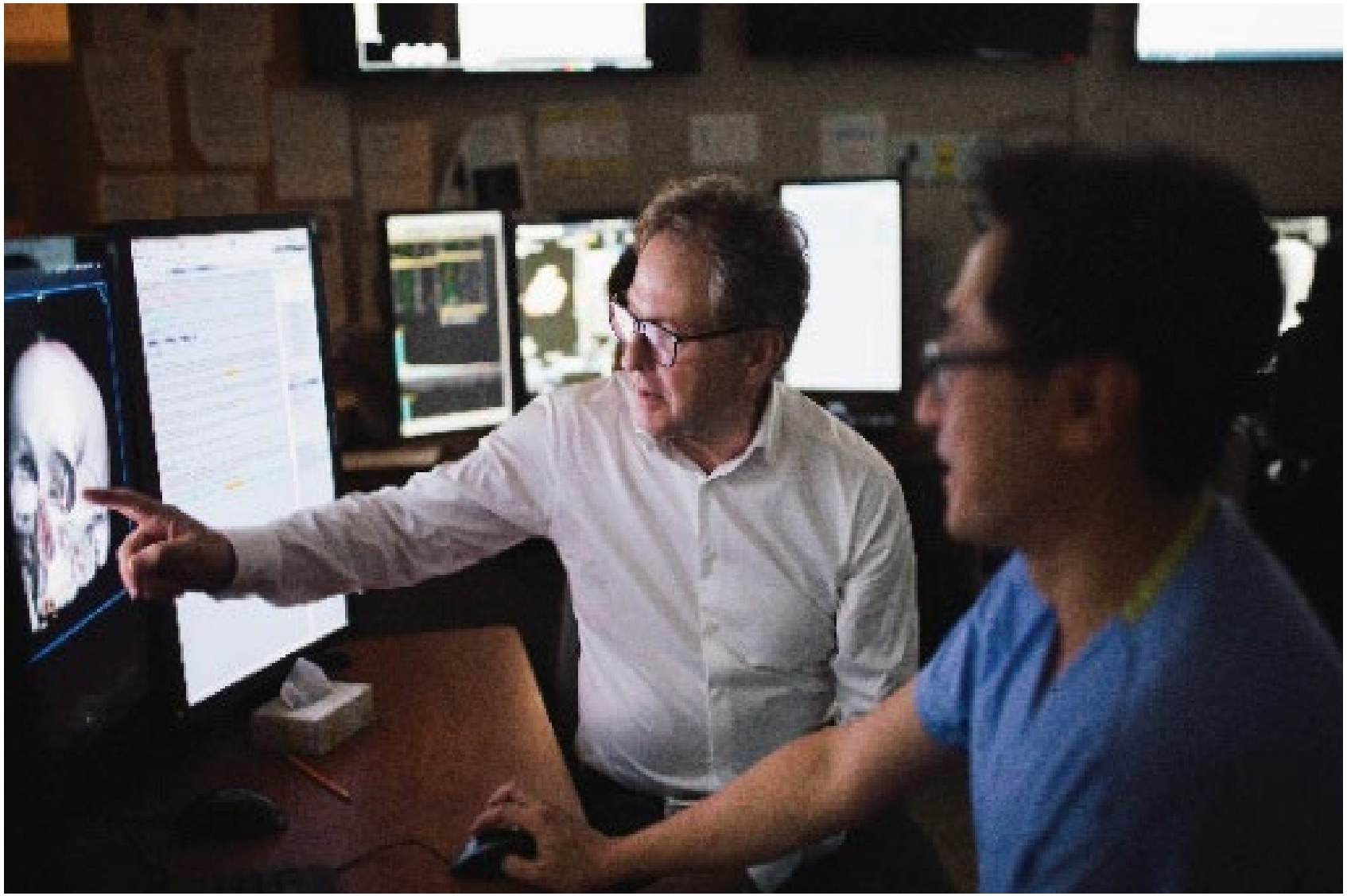
1. Telestroke networks should be implemented to provide access to stroke expert consultations for hyperacute and acute stroke assessment, diagnosis and treatment including thrombolytic therapy and decision – making for EVT
2. Telestroke modalities include videoconferencing and teleradiology
3. MRP remains the local physician. Decision making is a consensus process
4. Ideally, referring physicians would be trained in the administration of the NIH Stroke Scale

Hyperacute TeleStroke Services

Last Updated: April 2022



Acute Stroke Care at VGH



VGH's Role in Stroke Care

- Stroke Neurologists 24/7 coverage – multiple service lines
  - MRP for Neurology stroke ward – up to 35 patients
  - MRP for Neurology stroke B ward – up to 8 patients
  - Stroke consultation service – in-hospital and telestroke
  - Stroke prevention clinic – 5 days a week

- Provide stroke care to all hospitals in VCH, NH and in Eastern FH.

- Provide advance stroke care for VIHA, IHA.
- All EVT cases are performed by neuro-interventionalists
- Excellent vascular surgery services
- Excellent vascular neurosurgery services
- Subspecialty programs – Moyamoya, FMD, vasculopathies

CASE #1 PROGRESSION

- 19 year old – living on a rural reservation, lost her FD, poor compliance with INR testing
- VGH telestroke was contacted – recommended tPA and Priority 1 transport " Life or Limb"
- Arrived at VGH 6:30 hours post symptom onset
- Immediate re-imaging, MCA still occluded
- Successful " single pass" thrombectomy
- Excellent recovery – full independence
- Now has NP

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CASE #1 KEY TAKEAWAYS

- Lack of patient awareness of stroke symptoms lead to delay
- Living in rural area, delayed arrival at tPA-enabled site
- Lack of family doctor resulted in poor INR supervision
- Good time elements at initial hospital
- Telestroke activation for tPA advice, transfer as ”LOL”, unusually rapid transfer
- EVT is a breakthrough therapy for large vessel occlusion

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Thank you

ANY QUESTIONS?

RESOURCES & REFERENCES MENTIONED

- Canadian Stroke Best Practice Recommendations:" Acute Stroke Management, 7th Edition, Update 2022. Canadian Journal of Neurological Sciences2024:51:1-31
- Recommendations for implementation of telehealth in cardiovascular and stroke care. Circulation published on-line December 20, 2016
- Telemedical stroke care significantly improves patient outcome in rural areas. International Journal of Stroke 2024

UBC CPD Medicine CONTINUING PROFESSIONAL DEVELOPMENT