eFigure 1: The Wellington Free Ambulance Clinical Procedures and Guidelines Manual, section on stroke.

12.6 Stroke

Use this section for adults with signs and/or symptoms of a stroke. Seek clinical advice if the patient is a child.

- Measure the blood glucose concentration and treat accordingly. Do not treat the patient as having a stroke if the patient is hypoglycaemic or has received treatment for hypoglycaemia, even if there are signs or symptoms of stroke.
- Do not treat the patient as having a stroke if the patient has had a seizure, even if there are signs or symptoms of stroke.
- Assess the patient using the FAST test.
- Perform an additional assessment using the PASTA tool if the FAST test indicates acute stroke, and the PASTA tool is formally included in the stroke pathway for that geographical area.
- Designate the patient as status two, gain IV access and transport to a designated stroke hospital without delay, as per the local stroke pathway, if signs or symptoms of a stroke are present and:
  a) The patient will arrive in a designated stroke hospital within four hours of the time of symptom onset, or
  b) Transport is occurring to Auckland City Hospital, Wellington Regional Hospital or Christchurch Hospital and the patient will arrive within six hours of the time of symptom onset.
- Alert hospital staff early if the stroke pathway is being followed and provide the following information:
  - FAST results, and
  - PASTA tool results (if applicable), and
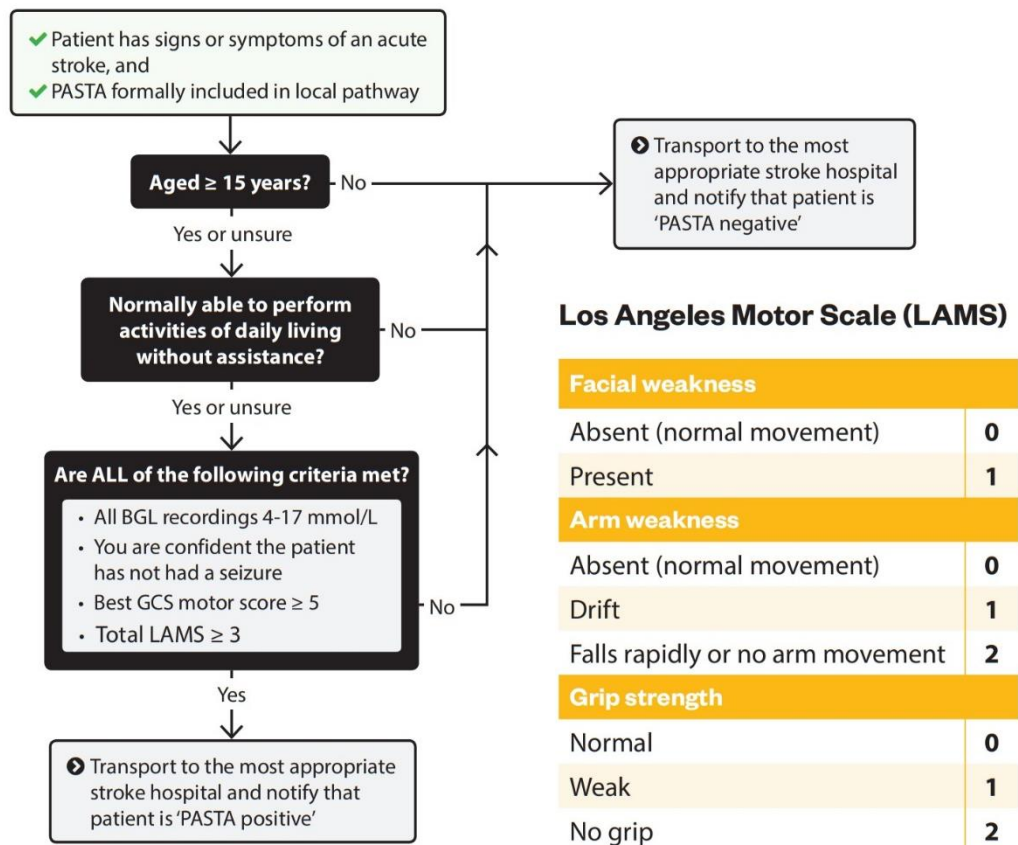 - Time of symptom onset, and
  - NHI number.

Referral and transport
- Provide a clear recommendation for the patient to be transported to an ED by ambulance if there are signs or symptoms of an acute stroke.
- Transport the patient to a designated stroke hospital without delay if they are within the time window (as above) for reperfusion therapy.
- Transport the patient to the most appropriate hospital (this may not be a designated stroke hospital) if the patient is clearly outside the time window for reperfusion therapy. Personnel should seek clinical advice if they are uncertain.
- Transport a relative with the patient whenever this is feasible and safe as the relative may be required to help with consent for reperfusion therapy.
- Provide a handover while the patient is on the ambulance stretcher and convey the patient direct to the CT scanner if asked to do so, provided this is not associated with significant delay.

The FAST test

Face	Look for new onset of unilateral facial weakness. Ask the patient to smile and show all of their teeth/gums.
Arm	Look for new onset of unilateral arm weakness. Ask the patient to raise their arms to 90° from the body, with their palms facing upward, close their eyes and keep their arms raised. Look for inability to raise one arm or for one arm that drifts downward.
Speech	Look for new onset of abnormal speech. Ask the patient to repeat a sentence and listen for slurring of words. Ask the patient to name several common objects shown to them and observe any difficulty or inability to name them.
Time	Note the time of onset. This is normally recorded as the time that the patient was last seen or known to be symptom-free. If the patient has woken up with the symptoms, record the time that the patient was last seen or known to be awake and symptom-free, as well as the time of waking.

Pre-hospital acute stroke triage and assessment (PASTA)

✔ Patient has signs or symptoms of an acute stroke, and
✔ PASTA formally included in local pathway

Aged ≥ 15 years? — No →

Yes or unsure ↓

Normally able to perform activities of daily living without assistance? — No →

Yes or unsure ↓

Are ALL of the following criteria met?
- All BGL recordings 4-17 mmol/L
- You are confident the patient has not had a seizure
- Best GCS motor score ≥ 5
- Total LAMS ≥ 3

— No →

Yes ↓

❯ Transport to the most appropriate stroke hospital and notify that patient is 'PASTA positive'

❯ Transport to the most appropriate stroke hospital and notify that patient is 'PASTA negative'

Los Angeles Motor Scale (LAMS)

Facial weakness	
Absent (normal movement)	0
Present	1
Arm weakness	
Absent (normal movement)	0
Drift	1
Falls rapidly or no arm movement	2
Grip strength	
Normal	0
Weak	1
No grip	2

📖 Additional information

General principles

- A patient is having a stroke until proven otherwise if there are new abnormalities as detected by the FAST test.

- Hypoglycaemia can cause signs and symptoms that mimic a stroke and these may persist for many hours following treatment. Treat the patient using the 'hypoglycaemia' section and not this section if the patient is hypoglycaemic, or has received treatment for hypoglycaemia.

- Seizures can cause signs and symptoms that mimic a stroke, particularly during the postictal phase and these may persist for many hours following the seizure. Treat the patient using the 'seizures' section and not this section if the patient has had a seizure.

- A patient with a stroke will have signs and symptoms that relate to the part of the brain that has lost blood supply. Most commonly these include any combination of:
    - Unilateral face weakness.
    - Unilateral arm weakness.
    - Unilateral leg weakness.
    - Speech disturbance.
    - Visual disturbance.

- The FAST test detects approximately 85% of patients with an ischaemic stroke, and in particular will not usually detect stroke affecting the cerebellum.

- Observing the patient walking (provided this is feasible and safe) may detect new onset of abnormal balance. Performing the finger-nose test (see the 'concussion and minor TBI' section) may detect new onset of abnormal coordination. A new onset of abnormal balance or abnormal coordination may indicate a stroke affecting the cerebellum.

The PASTA tool

- The PASTA tool is designed to help select patients that are most likely to receive reperfusion therapy.

- Only use the PASTA tool if it has been formally introduced into a local stroke pathway within that geographical area.

Reperfusion therapy

- The earlier reperfusion therapy is provided for ischaemic stroke, the more likely the patient is to make a good recovery.

- Delays to reperfusion therapy worsen outcomes and ambulance personnel have an important role in identifying patients with stroke, minimising time on scene, minimising transport time, transporting patients to the most appropriate hospital and ensuring timely notification prior to arrival.

Supplementary Figure 1: The Wellington Free Ambulance Clinical Procedures and Guidelines Manual, section on stroke.

- Two forms of reperfusion therapy are available in New Zealand:
  - Fibrinolytic therapy is available at all designated stroke hospitals.
  - Stroke clot retrieval is available at Auckland City Hospital, Wellington Regional Hospital and Christchurch Hospital.

Ischaemic stroke and time to fibrinolytic treatment

- A patient with an ischaemic stroke who can be transported to a designated stroke hospital within four hours of the time of symptom onset, is a potential candidate for fibrinolytic treatment. However, fibrinolytic treatment is only suitable for approximately 20% of patients with an acute ischaemic stroke.
- The earlier fibrinolytic treatment is provided, the more likely the patient is to recover from their stroke. However, fibrinolytic treatment must be provided within four and a half hours from the time of symptom onset. If the patient is arriving at a designated stroke hospital at four hours from the time of symptom onset, hospital personnel have only 30 minutes to perform a CT scan, make a diagnosis and initiate treatment.
- IV access should be obtained, noting that multiple attempts should not occur because of the subsequent risk of bleeding if fibrinolytic treatment is administered.
- Transport under lights is not routinely required, but should be considered if a clinically significant time saving will occur.
- A patient who cannot be transported to a designated stroke hospital within four hours of the time of symptom onset is usually not a candidate for fibrinolytic treatment. However, transport should not be delayed because the use of CT perfusion imaging means that some of these patients are still suitable to receive fibrinolytic treatment or stroke clot retrieval.

Ischaemic stroke and time to stroke clot retrieval (SCR)

- Stroke clot retrieval (SCR) is also known as endovascular clot retrieval (ECR), percutaneous stroke intervention (PSI) and thrombectomy.
- SCR is a procedure where the occluded cerebral artery is accessed and the clot removed, thus re-establishing blood flow.
- SCR is a very effective treatment for ischaemic stroke. The potential 'treatment window' for SCR from time of symptom onset is much longer than with fibrinolytic therapy, and is up to 24 hours in selected patients.
- Do not bypass a designated stroke hospital to transport a patient direct to a hospital with SCR facilities, unless this is a formal part of a local stroke pathway.

Supplementary Figure 1: The Wellington Free Ambulance Clinical Procedures and Guidelines Manual, section on stroke.

Transport mode

- Transport to hospital should usually be by road, as only a small number of patients will benefit from transport by helicopter. However, the possibility of transport by helicopter should be considered if:
  - The patient is independent and without severe comorbidities, and
  - The diagnosis is clear, and
  - The patient has severe weakness, and
  - The patient will clearly reach a designated stroke hospital within four hours of the onset of symptoms, and
  - Helicopter transport will clearly save more than 30 minutes compared with road transport.
- Severe comorbidities are chronic diseases that significantly limit a patient's life expectancy. Examples include severe COPD, severe heart failure, metastatic cancer with weight loss and living in an aged residential care facility.

Haemorrhagic stroke

- A patient with a haemorrhagic stroke will present very similarly to a patient with an ischaemic stroke, but in addition will usually have a sudden onset of headache, an altered or falling level of consciousness and vomiting.
- It is not possible to confidently distinguish between an ischaemic stroke and a haemorrhagic stroke without a CT scan.
- Even if haemorrhagic stroke is suspected, the stroke pathway should still be followed.

eTable 1: Diagnostic accuracy of Teleambulance versus PASTA assessment, after exclusion of four patients seen by the same neurologist pre-hospital and in the emergency department

	ED Diagnosis		Final Outcome	
	Teleambulance (95% CI)	PASTA (95% CI)	Teleambulance (95% CI)	PASTA (95% CI)
Stroke Eligible for Reperfusion				
Accuracy (%)	100 (88.8-100)	70.7 (54.5-83.9)	80.6 (62.5-92.6)	61.0 (44.5-75.8)
Sensitivity (%)	100 (63.1-100)	76.5 (50.1-93.2)	100 (15.8-100)	77.8 (40.0-97.2)
Specificity (%)	100 (85.2-100)	66.7 (44.7-84.4)	79.3 (60.3-92.0)	56.3 (37.7-73.7)
PPV (%)	100	61.9 (46.5-75.2)	25.0(14.1-40.5)	33.3 (22.8-45.8)
NPV (%)	100	80 (61.9-90.8)	100	90.0 (71.9-96.9)
LR +	--	2.29 (1.2-4.3)	4.83 (2.4-9.9)	1.78 (1.1-3.0)
LR -	0	0.35 (0.14-0.87)	0	0.40 (0.11-1.4)
C-Statistic	1.00	0.71	0.81	0.62
Stroke Eligible for IVT				
Accuracy (%)	96.8 (83.3-99.9)	61.0 (44.5-75.8)	83.9 (66.3-94.6)	56.1 (39.8-71.5)
Sensitivity (%)	100 (54.1-100)	72.7 (39.0-94.0)	100 (15.8-100)	71.4 (29.0-96.3)
Specificity (%)	96.0 (79.7-99.9)	56.7 (37.4-74.5)	82.8 (64.2-94.2)	52.9 (35.1-70.2)
PPV (%)	85.7 (46.8-97.6)	38.1 (26.3-51.5)	28.6 (15.3-47.1)	23.8 (14.8-36.0)
NPV (%)	100	85.0 (67.3-94.0)	100	90 (72.8-96.8)
LR +	25 (3.7-171)	1.68 (0.97-2.9)	5.8 (2.6-13)	1.52 (0.84-2.7)
LR -	0	0.48 (0.17-1.3)	0	0.54 (0.16-1.8)
C-Statistic	0.97	0.62	0.84	0.57
Stroke Eligible for EVT				
Accuracy (%)	96.8 (83.3-99.9)	73.2 (57.1-85.8)	--*	56.1 (39.8-71.5)
Sensitivity (%)	80 (28.4-99.5)	91.7 (61.5-99.8)	--	100 (29.2-100)
Specificity (%)	100 (87.8-100)	65.5 (45.7-82.1)	87.1 (70.2-96.4)	52.6 (35.8-69.0)
PPV (%)	100	52.4 (39.3-65.1)	--	14.3 (10.7-18.9)
NPV (%)	96.2 (81.8-99.3)	95.0 (74.1-99.2)	100	100
LR +	--	2.66 (1.6-4.5)	--	2.11 (1.5-3.0)
LR -	0.2 (0.03-1.2)	0.13 (0.02-0.85)	--	0
C-Statistic	0.97	0.74	--	0.57
Any stroke				
Accuracy (%)	74.3 (66.3-94.6)	70.7 (54.5-83.9)	80.6 (62.5-92.6)	73.2 (57.1-85.8)
Sensitivity (%)	92.9 (66.1-99.8)	66.7 (46.0-83.5)	100 (71.5-100)	70.8 (48.9-87.4)
Specificity (%)	76.5 (50.1-93.2)	78.6 (49.2-95.3)	70.0 (45.7-88.1)	76.5 (50.1-93.2)
PPV (%)	76.5 (57.7-88.6)	85.7 (68.0-94.4)	64.7 (48.4-78.2)	81.0 (63.5-91.2)
NPV (%)	92.9 (65.9-98.9)	55 (40.2-69.0)	100	65 (48.6-78.5)
LR +	4.0 (1.7-9.4)	3.11 (1.1-8.8)	3.33 (1.7-6.5)	3.01 (1.2-7.4)
LR -	0.09 (0.01-0.63)	0.42 (0.23-0.77)	0	0.38 (0.19-0.75)
C-Statistic	0.74	0.70	0.81	0.73

CI = confidence interval, PPV = positive predictive value, NPV = negative predictive value, LR + = positive likelihood ratio, LR - = negative likelihood ratio; *after exclusion of patients assessed by the same neurologist pre- and in-hospital patient in the teleambulance group who underwent EVT=0 and thus some of these values could not be calculated.

eTable 2: Odds ratios (OR) of predictions comparing Teleambulance to ambulance scores (FAST + PASTA or FAST alone) excluding four patients assessed by the same neurologist pre-hospital and in the emergency department.

	Unadjusted		Cluster-Adjusted	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Odds of Accurately Predicting ED Diagnosis of:				
Reperfusion (FAST)	-	-	-	-
Reperfusion (PASTA)	-	-	-	-
Thrombolysis (FAST)	46.9 (5.8-378.5)	<0.0001	48.9 (4.8-453.7)	0.001
Thrombolysis (PASTA)	19.6 (2.4-155.1)	0.006	19.2 (2.0-185.8)	0.011
Thrombectomy (FAST)	72.2 (8.9-593.6)	<0.0001	72.5 (10.0-527.4)	<0.0001
Thrombectomy (PASTA)	11.0 (1.3-90.6)	0.03	11.0 (1.9-60.5)	0.006
Stroke (FAST)	2.7 (0.85-8.6)	0.92	2.7 (1.4-5.1)	0.002
Stroke (PASTA)	1.7 (0.6-5.2)	0.4	1.7 (0.9-3.5)	0.13
Odds of Accurately Predicting Final Diagnosis/Intervention of:				
Reperfusion (FAST)	14.8 (4.7-47.2)	<0.0001	14.8 (6.7-33.0)	<0.0001
Reperfusion (PASTA)	2.7 (0.9-7.9)	0.008	2.7 (1.3-5.3)	0.006
Thrombolysis (FAST)	6.6 (2.1-20.7)	0.001	6.6 (3.1-14.4)	<0.0001
Thrombolysis (PASTA)	4.1 (1.3-12.7)	0.02	4.1 (1.9-8.8)	<0.0001
Thrombectomy (FAST)	85.5 (68.8)	<0.0001	85.5 (20.2-362.0)	<0.0001
Thrombectomy (PASTA)	5.3 (1.6-17.6)	0.007	5.3 (1.4-20.6)	0.02
Stroke (FAST)	2.1 (1.3-3.5)	0.003	2.1 (2.1-5.6)	0.001
Stroke (PASTA)	1.5 (0.5-4.7)	0.46	1.8 (0.7-3.2)	0.26

OR = Odds ratio, aOR = cluster adjusted odds ratio, CI = Confidence interval