

NSW Stroke Ambulance pilot model of care

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The information in this resource should not replace a clinician's professional judgement.

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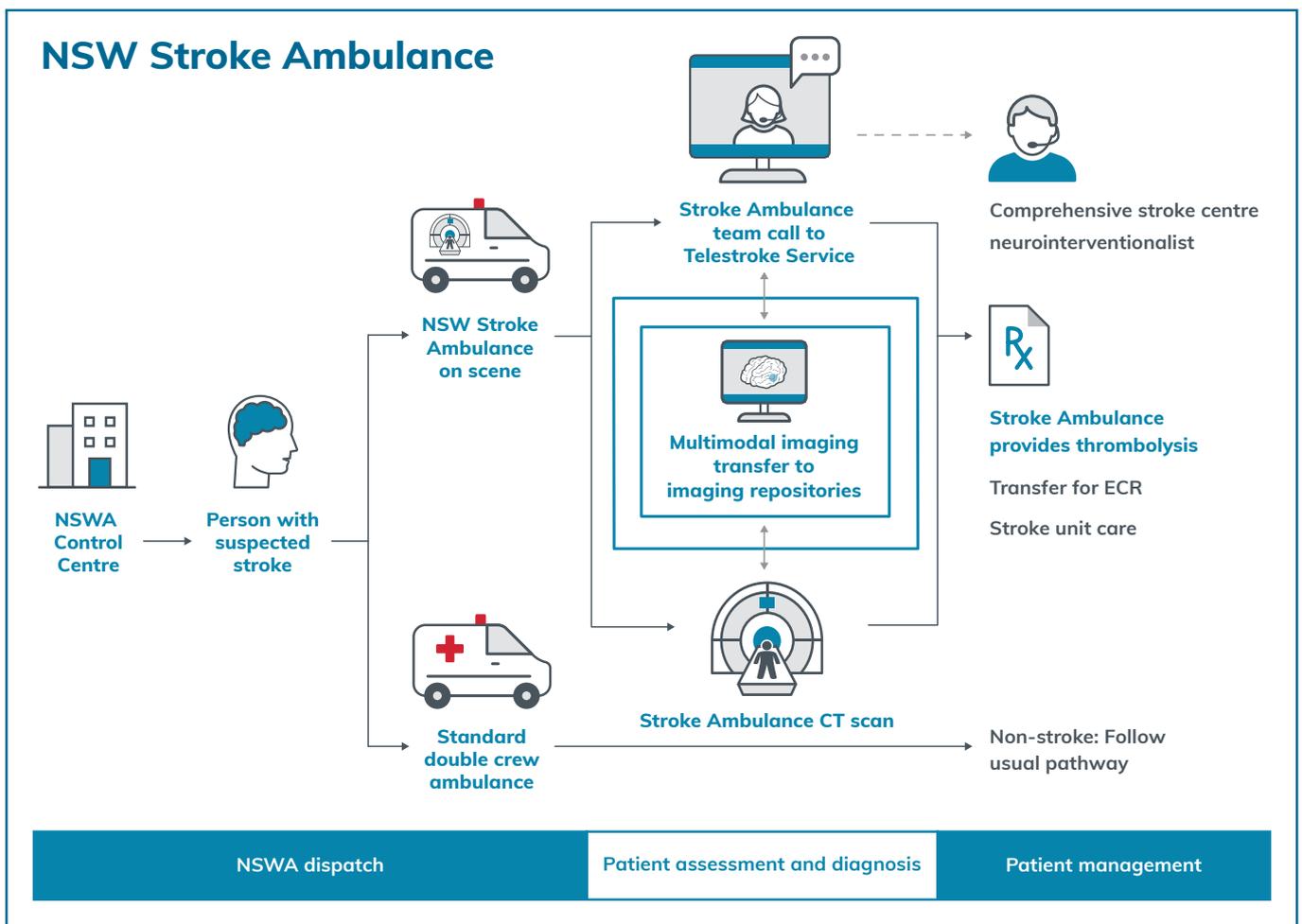
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NSW Stroke Ambulance pilot model of care, at a glance

The NSW Stroke Ambulance is a specially equipped ambulance that offers the capability to diagnose stroke patients, administer thrombolysis before arrival at hospital and direct transport to a comprehensive stroke centre for endovascular clot retrieval, if clinically appropriate.



Key:

- EIR - enterprise image repository
- ECR - endovascular clot retrieval
- NSWA - NSW Ambulance

Summary

Stroke is a medical emergency requiring timely access to specialist clinical assessment, diagnosis and treatment. It requires organisation of pre-hospital services and rapid access to diagnosis and specialist management.

Approximately 85% of strokes are caused by a blood clot that blocks a blood vessel in the brain (ischaemic stroke). Effective hyperacute care for ischaemic stroke relies on timely reperfusion in eligible cases – using thrombolysis and/or endovascular clot retrieval. These therapies are time-critical following diagnostic imaging and clinical assessment.

Treatment in the ambulance

In the NSW Stroke Ambulance, the patient is managed in an enhanced ambulance equipped with:

- a computerised tomography (CT) scanner
- a mobile laboratory
- specialist multidisciplinary team with a virtual care connection to the NSW Telestroke Service.

The patient can receive a multimodal CT and thrombolysis in the ambulance before being transported to the appropriate hospital.

The NSW Stroke Ambulance takes diagnosis and treatment to the patient in the community, delivering evidence-based care within a time-critical window of opportunity. The Stroke Ambulance is a mobile referring site of the NSW Telestroke Service.

The Service provides a specialist stroke physician workforce to the back of the ambulance via virtual care.

NSW Stroke Ambulance aims

- Improve access to evidence-based stroke assessment, diagnosis and treatment for patients with stroke symptoms in the pre-hospital setting
- Reduce time to treatment
- Improve access to reperfusion for patients in the catchment area
- Improve patient outcomes and experiences
- Support health practitioners to deliver evidence-based care for hyperacute stroke

NSW Stroke Ambulance pilot model of care

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Introduction

Stroke is a medical emergency and time-critical condition requiring the organisation of pre-hospital services and rapid access to diagnostic imaging, diagnosis and specialist management.

17,045 hospital episodes
for stroke in NSW¹

Time is critical

Hospitals in NSW take 78 minutes to start thrombolysis³

Patients lose one month of healthy life

for every 15-minute treatment delay²

Stroke costs can be reduced

Inpatient stroke care in Australia was estimated to cost \$714.5 million in 2020⁴

Treatment is needed

Approximately 25% of all ischaemic strokes are eligible for thrombolysis, and 10–12% are eligible for ECR⁵

Around 85% of strokes are due to a blockage in the brain (ischaemic), and 15% are caused by a rupture to the vessel in the brain (haemorrhagic). Strokes require multimodal brain imaging to distinguish the difference. This is critical as the treatment for the blocked artery is fatal if given to a patient with haemorrhage.

Brain imaging can identify if there is brain tissue that can be salvaged and where the clot is located. In usual stroke pathways, these scans are performed in the hospital radiology department. However, stroke ambulances can do the scans in the pre-hospital setting, supporting faster diagnosis and treatment.

Effective hyperacute care relies on timely reperfusion – using thrombolysis and/or endovascular clot retrieval (ECR). Reperfusion therapies are internationally acknowledged as best practice treatment for ischaemic strokes, proven to reduce disability and improve survival.

Impact

Reduce assessment and treatment times

Faster onset to treatment times^{7,9-18}

Reduce costs

Pre-hospital treatment of acute stroke is highly cost-effective²¹⁻²³

More significant effects with increasing population density^{21,22}

Improve stroke care and outcomes

Higher thrombolysis rates^{9-11,15,18,19}

Up to a third of patients treated within an hour²⁴

Better clinical outcomes²⁰

For every 100 patients treated by a stroke ambulance, 27 will have less disability and 11 will be disability-free compared to conventional care⁸

The NSW Stroke Ambulance is an enhanced ambulance that provides rapid community stroke care, supported by:

- advanced diagnostics
- specialist clinical assessment
- treatment.

The patient is managed in an ambulance equipped with specialised clinicians, a CT scanner, a mobile laboratory, and a connection to the NSW Telestroke

Service, providing specialist stroke physicians via virtual care. The patient can receive a CT scan and thrombolysis in the ambulance before being transported to the appropriate hospital.⁵

Stroke ambulances improve treatment times, patient outcomes, and the speed and accuracy of pre-hospital triage.⁶⁻⁸

The model of care

Organisational roles, principles, statewide standardised elements

As a mobile referring site of the NSW Telestroke Service (NSW TSS), the Stroke Ambulance must meet a list of criteria, including access to appropriate imaging, technology and staffing.

The model of care aligns with the principles of the NSW TSS, incorporating standard elements of telestroke:

- assessment
- multimodal imaging
- telehealth technology

- documentation
- treatment planning
- provision of care.

The model of care will be supported by detailed policies and procedures which will be developed by the participating organisations using a co-design approach. It comprises four main organisational elements: NSW Ambulance, host site, NSW TSS and eHealth NSW.

NSW Ambulance (NSWA)	NSWA operates a fleet of over 1,000 frontline ambulance vehicles. It owns and will manage the NSW Stroke Ambulance vehicle across the NSW Health system, delivering mobile health services and providing responsive clinical care in emergency situations. This includes pre-hospital care, rescue, retrieval and patient transport services.
NSW Stroke Ambulance host site	NSWA is responsible for liaising with the vendor regarding the servicing and maintenance of the Stroke Ambulance vehicle. It will manage the activation and dispatch of the Stroke Ambulance to support early access to the NSW Telestroke Service. It is also responsible for providing paramedics to deliver clinical care. In addition, NSWA will be responsible for the operational management of the Stroke Ambulance, specifically, vehicle and crew housing, scene management, patient transport, emergency management, stocking and provisions.
NSW Stroke Ambulance host site	The host site and NSWA will work together to co-design governance, procedures and protocols for the specialist multidisciplinary team. This includes linking to the NSW Telestroke Service.
NSW Telestroke Service (NSW TSS)	The pilot will be hosted by Liverpool Hospital, in South Western Sydney Local Health District. The host site will provide central administrative functions of the Stroke Ambulance, including rostering of host site staff, diagnostic radiology and interventional neuroradiology, human resources, stocking and provisions, leadership and governance. The host site and NSWA will work together to co-design governance, procedures and protocols for the specialist multidisciplinary team, including linking to the Telestroke Service.
NSW Telestroke Service (NSW TSS)	The NSW TSS is a virtual care service comprising a team of stroke physicians that provide a 24/7 remote clinical service, supported by a medical director, operations manager, and clerical staff. The NSW TSS host site, Prince of Wales Hospital, provides the central administrative functions. This includes rostering and human resources (nursing, data analytics, information technology and imaging co-ordination) to sustain service delivery.
eHealth NSW	eHealth NSW is a statewide shared service that provides leadership on the shape, delivery, and management of information technology-led healthcare. It is responsible for developing the technology model for the Stroke Ambulance and aligning it to the telestroke model. eHealth works together with other organisations to deliver training and troubleshoot, review and refine processes in the implementation of the Stroke Ambulance.

Responsibilities

NSW Ambulance

- Establish clinical and operations roles and implement a rostering system to ensure staff coverage of Stroke Ambulance operating hours (paramedic staff).
- Establish the Stroke Ambulance Operational Team, including an operational manager role and dedicated data support.
- Develop and implement Stroke Ambulance activation and dispatch procedures.
- Develop a shared care, team-based model for providing clinical stroke care in collaboration with the neurology and radiology departments, advanced practice nurses and neuro-interventionalists from the host site and NSW Telestroke Service.
- Implement pre-hospital protocols, processes and workflows to support the model of care.
- Educate and train clinical staff to ensure safe vehicle operations and delivery of care in the pre-hospital environment.
- Ensure appropriate paramedic staffing, including compliance with driving licence requirements for staff.
- Garage the Stroke Ambulance vehicle and ensure the vehicle is adequately insured and maintained.

NSW Stroke Ambulance host site

- Establish clinical and operations roles and implement a rostering system to ensure staff coverage of Stroke Ambulance operating hours (non-paramedic staff).
- Establish standard operating procedures.
- Support the implementation of the Stroke Ambulance as a telestroke referring site.
- Implement standardised assessment and documentation tools aligned with NSW TSS.
- Establish real-time clinical analytics to support quality improvement.
- Provide diagnostic radiology reporting for imaging acquired on the Stroke Ambulance
- Provide neuro-interventional services when required.
- Co-design procedures and protocols for the specialist multidisciplinary team, including linking to the Telestroke Service.
- Comply with NSW Environment Protection Authority requirements and comply with legislation and regulations concerning the use of radiation.
- Once the model of care has been embedded, and based on the advice of the Stroke Ambulance Pilot Working Group, training opportunities can be considered for clinical specialties, namely paramedic, nursing, radiography and medical trainees.

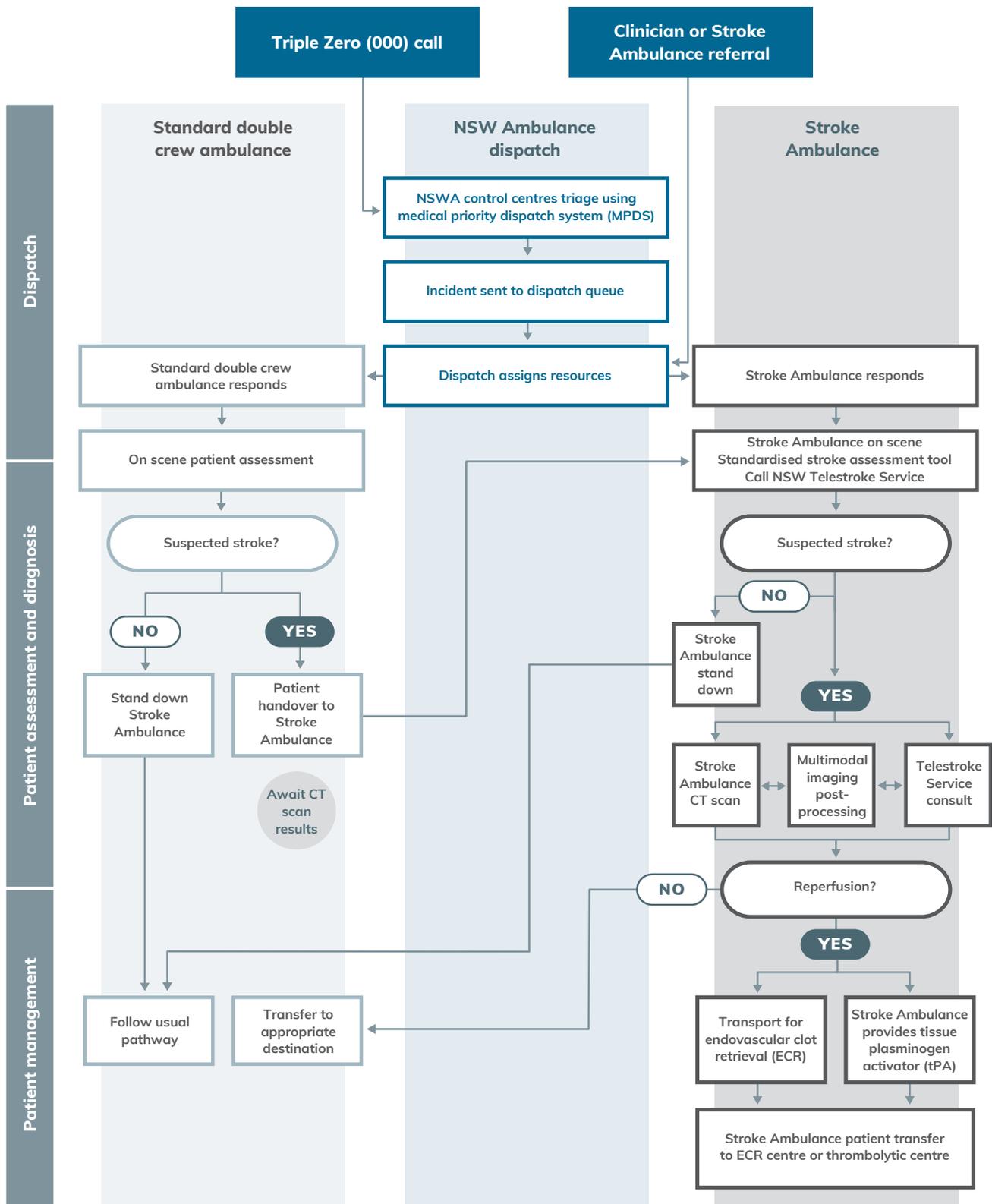
Stroke Ambulance host site and NSW Telestroke Service

- Develop and implement a stroke clinical pathway that includes the NSW Telestroke Service triage tool.
- Revise stroke protocols, processes and workflows to include the Stroke Ambulance.
- Educate and train clinical staff on Telestroke clinical processes.

Stroke Ambulance host site and eHealth NSW

- Establish acute stroke image acquisition protocol, transfer of images to host site, including equipment, access to radiography services and training for radiographers in acute stroke imaging acquisition.
- Enhance or enable the Stroke Ambulance with the NSW Health supported unified communications platform to allow for virtual telestroke consults.

Stroke Ambulance pathway



Variation to the model of care may occur - this flowchart outlines the standard pathway.

If for any reason the Stroke Ambulance is not available a standard double crew ambulance will be dispatched to attend to the patient and usual care pathways will be followed.

Patients will be taken to the most clinically appropriate hospital according to their clinical need, noting this may include non-host sites.

Principles and standardised elements

Local governance and leadership

Patients receive high-quality care underpinned by sound governance structures and clinical leadership.

	Host site	NSWA	NSW TSS
Formal governance arrangements are documented and in place to support implementation and to identify and manage risks.	Y	Y	Y
The Stroke Ambulance has executive sponsorship and oversight and implementation support.	Y	Y	Y
There is clinical leadership to provide management of the medical, paramedic, nursing and radiography workforce and strategic service planning.	Y	Y	Y
The Stroke Ambulance has an identified operations manager to provide organisational, divisional and contractual governance, including rostering.	Y	Y	Y
There is administrative and data support to undertake administration collection and analysis for the service.	Y	Y	Y
Clinical roles and responsibilities are clearly defined and documented, including scopes of practice and interdependencies for paramedics, nurses, radiographers on the vehicle and virtual specialist support from the host site and NSW TSS.	Y	Y	Y
There are local documented and implemented processes to include patient eligibility criteria, pre-hospital triage, referrals to NSW TSS, clinical pathways and workflows, including feedback mechanisms. The processes also need to include standardised documentation using the telestroke consultation tool, decision-making processes for patients who require transfer or retrieval for escalation of care and formal and documented arrangements between the NSW TSS and the Stroke Ambulance as a telestroke referring site.	Y	Y	Y
Roles and responsibilities are clearly defined for the various steering and operational committees and groups, management, clinicians and the workforce.	Y	Y	Y
Registration, compliance and licensing of Stroke Ambulance equipment (including CT scanner and power source) are in place.	Y	Y	
Vehicle registration, insurance, and maintenance scheduling.		Y	

Access

Patients receive timely access to hyperacute stroke care coordinated across pre-hospital, emergency and specialist services.

Effective prioritisation and dispatch, triage, service coordination and use of available technologies and communication enable timely access to assessment, diagnosis and management.

Prioritisation and dispatch

- Triple zero (000) call: These calls are globally routed and presented to the first available call-taker at one of four NSW Control Centres.
- NSW Control Centre triages call: Call takers use the medical priority dispatch system to determine the patient's likely condition and allocate a response category.
- Dispatcher assigns resources: Stroke Ambulance and standard ambulance units are both assigned according to defined criteria. Computer aided dispatch software tracks the location and status of dispatched vehicles, which enables rapid response to other incidents. Non-standard tasking options may also be used. For example, attending paramedic crews, coordinated by Control following specialist review or by the Stroke Ambulance team, who may monitor radio traffic and/or dispatch software via a web link to identify appropriate cases.

Stroke Ambulance triage

- Stroke Ambulance staff use the standardised triage tool used by all NSW Telestroke Service referring sites. The tool guides clinical staff through a rapid assessment of the patient and provides recommended actions.
- Stroke Ambulance calls NSW TSS: when an appropriate patient is identified, the Stroke Ambulance clinician (nurse or paramedic) responsible for care contacts the NSW TSS via the single statewide phone number and notifies them of the suitable patient before scanning. When ready, the patient is scanned in the Stroke Ambulance, and the NSW TSS physician prepares for the consultation.

Image acquisition and diagnosis and reporting

- Stroke Ambulance and NSW TSS initiate CT scans and diagnose and manage the patient. Screen sharing technology and remote control allow the NSW TSS stroke physician to interact with the Stroke Ambulance team during and/or after image acquisition. The NSW TSS stroke physician can manipulate images independently to generate a provisional diagnosis.
- The statewide unified communications platform enables audiovisual consultation. A complete neurological assessment can be performed via videoconference, and a proposed management plan can be discussed with the patient and family and consent for procedures obtained. At any point, consultation can occur between the interventional neuroradiologist and the virtual stroke team regarding ECR referrals. Images will be available rapidly to sites receiving patients.
- The host site will provide radiology reporting for imaging acquired on the Stroke Ambulance.

Communication and coordination

- Existing technology is leveraged and enhanced. Existing telestroke technology allows rapid communication between the:
 - Stroke Ambulance
 - host site emergency department staff
 - specialist stroke physicians, patients and carers
 - ECR centres
 - host site diagnostic radiology and interventional neuroradiology staff
 - and other receiving sites.

NSW Health's statewide unified communications platform supports real-time sharing of electronic medical records and multimodal imaging to inform diagnosis and treatment.

	Host site	NSWA	NSW TSS
NSW TSS provides rapid access via a dedicated 24/7 phone number (1300 878 887) to contact a specialist virtual stroke physician with call routing flows for business continuity.			Y
NSWA has documented activation protocols for the Stroke Ambulance, including through non-standard tasking options, such as by another ambulance.		Y	
NSWA control centre has documented triage and dispatch protocols that enable early access to the Stroke Ambulance.		Y	
Criteria and procedures for the regular ambulance to stand down the Stroke Ambulance are in place.		Y	
Criteria and procedures are in place for the Stroke Ambulance to leave the scene and the regular ambulance to transport the patient.	Y	Y	Y
Local protocols, procedures and pathways are in place in the Stroke Ambulance to enable appropriate referral to the NSW TSS (a standardised triage and referral process) and host site neurointerventional service.	Y	Y	Y
Local protocols, procedures and pathways enable immediate image acquisition, including access (e.g. intravenous), patient readiness, acute stroke imaging protocol and procedure (multimodal CT) and monitoring of the hyperacute stroke patient.	Y	Y	Y
Information technology services allow for standardised virtual access, conference and collaboration between the Stroke Ambulance, the NSW TSS, the host site services, ECR centres and other receiving sites.	Y	Y	Y

Protocols and procedures

Patients receive timely care from clinicians who are supported by standardised protocols and procedures.

The NSW TSS has established statewide referral criteria and provides a standard triage tool that includes an acute stroke assessment protocol. This protocol supports the Stroke Ambulance specialist multidisciplinary team to identify appropriate actions and support patient selection for telestroke consultation.

Standardised assessment and documentation processes support the virtual telestroke team. The results are subsequently recorded in the electronic medical record. These processes include:

- consultation
- assessment
- diagnosis
- a treatment plan.

Practice and delivery of high-quality care is supported by protocols and procedures for:

- patient consent
- monitoring
- deterioration
- workforce roles and responsibilities.

This model of care provides an overview of the requirements to support the Stroke Ambulance. It is not an operational guideline.

	Host site	NSWA	NSW TSS
Standardised tools are used for the identification, triage and assessment of potential stroke patients.	Y	Y	Y
Standardised clinical protocols, procedures and pathways are in place for referral to the NSW Telestroke Service (inclusion and exclusion criteria), and assessment by the virtual telestroke team.	Y	Y	Y
Protocols, procedures and pathways are in place for urgent image acquisition for stroke, including a standardised acute stroke imaging protocol.	Y		Y
Clinical guidelines and protocols are in place for transfer of care to receiving hospitals and subsequent management, in accordance with relevant clinical guidelines.	Y	Y	Y
Protocols and procedures for all staff working in the Stroke Ambulance and pre-hospital environment are in place.	Y	Y	
Protocols and procedures for host site radiology reporting of imaging acquired on the Stroke Ambulance.	Y		

	Host site	NSWA	NSW TSS
A standardised documentation protocol is in place for the Stroke Ambulance and NSW TSS outlining the responsibilities for documenting a NSW telestroke consultation in local electronic medical records, including assessment. These also need to be documented – the diagnosis and management plan, timelines for documentation in electronic medical records, ISBAR (identify, situation, background, assessment and recommendation) format to capture the consultation information and responsibilities for noting any changes to the patient management plan.	Y	Y	Y
Protocols, procedures and pathways are in place to provide thrombolysis, including inclusion and exclusion criteria, patient consent, storage and replacement of thrombolysis (tPA), monitoring of the patient, staff roles, responsibilities and accreditation requirements for tPA administration.	Y	Y	Y

Workforce, education and training

Patients receive access to high-quality hyperacute stroke care delivered by a team of specialist practitioners trained in the delivery of stroke care.

Stroke Ambulance clinicians will need clear guidance and training to ensure consistency of knowledge and capability to deliver high quality, evidence-based stroke care. All staff involved in delivering a telestroke consultation on the Stroke Ambulance will require training, including virtual clinicians providing the Telestroke Service.

In addition, there will be training specific to staff working in the Stroke Ambulance environment and for NSW staff involved in activation and dispatch of the Stroke Ambulance.

The host site and NSW will:

- conduct a workforce analysis to determine staffing capacity requirements
- conduct recruitment and selection to identify and appoint suitable staff
- prioritise the wellbeing of all staff.

	Host site	NSWA	NSW TSS
Workforce needs are identified, and roles and responsibilities defined and documented.	Y	Y	Y
Availability of specialist stroke physician through the NSW Telestroke Service.			Y
NSW Telestroke Service stroke physicians are credentialed to deliver high-quality stroke care to patients on the Stroke Ambulance.			Y
Availability of a specialist advanced practice stroke nurse who is trained to deliver high-quality stroke care to patients on the Stroke Ambulance as part of the multidisciplinary team.	Y		
Availability of specialist paramedics who are authorised to deliver high-quality stroke care to patients on the Stroke Ambulance as part of the multidisciplinary team.		Y	
Availability of diagnostic radiologists to support radiology reporting.	Y		
The host LHD provides operational management for the service. This function offers organisational, divisional, contractual and governance support, so the Stroke Ambulance delivers a high level of service and meets expected targets and outcomes.	Y		
There is a comprehensive education and training package for staff covering the use of telestroke equipment, documentation requirements, working in a pre-hospital environment, patient assessment, radiation safety, thrombolysis administration and monitoring.	Y	Y	Y
Staff at the receiving hospitals are trained in the pathway for stroke ambulance patients, including bypass of the emergency department for electronic case reporting.	Y*		

*Note: sites receiving patients may be non-host LHD sites. See Information technology.

Information technology

Information technology and telestroke consultations enable time-critical specialist stroke assessment and care.

The Stroke Ambulance model of care uses the standardised NSW Health statewide unified communications platform to allow the virtual team of stroke physicians to provide specialist assessment, diagnosis and treatment planning remotely. Screen sharing and collaboration enable remote viewing of electronic medical records, real-time review of scan images and live assessments of patients. It facilitates the inclusion of additional clinicians from ECR centres into the consultation and decision-making processes.

eHealth NSW is a central partner in Telestroke Services and is responsible for embedding new technologies in care to improve patient outcomes. eHealth will work with stakeholders to deliver training, troubleshooting and problem solving, review and refine information technology processes as the model is implemented. eHealth advises that the statewide unified communications platform meets all Australia's privacy and security requirements and has been implemented using rigorous design and security processes.

	Standards	Host site	NSWA	NSW TSS	eHealth
The Stroke Ambulance has access to the NSW TSS via a single 1300 phone number.	Twilio interactive voice response		Y		Y
The Stroke Ambulance has unified communications capabilities. This should include the ability to use video conferencing, telephony, voice conferencing, instant messaging, screen sharing, remote control of screens, file transfer and integration with the active directory and Outlook address book. This enables consultations with local hospitals and the NSW TSS stroke clinicians.	Statewide unified communications platform	Y	Y		Y
NSW TSS stroke physicians have laptops enabled with unified communication capabilities to connect to the Stroke Ambulance.	Statewide unified communications platform			Y	
NSW TSS and the host LHD/NSWA have support agreements to cover all aspects of the technology used for patient care. This should also include standard procedures (business continuity plan) in case of technology failure.		Y	Y	Y	Y

	Standards	Host site	NSWA	NSW TSS	eHealth
All relevant clinicians have access to patient imaging (including perfusion post-processed scans) from the Stroke Ambulance and medical records systems at the host hospital/LHD. These clinicians include telestroke physicians, nurses and paramedics, emergency department staff, neurointerventional specialists, diagnostic radiologists and neurologists.	Standard build for perfusion post-processing	Y	Y	Y	Y
The Stroke Ambulance has access to the NSW Telestroke Service triage tool for decision support.	NSW Telestroke Service triage tool	Y		Y	Y
Telestroke Service physicians use standardised assessment and documentation tools.	Standardised telestroke documentation tool			Y	
Dedicated information technology and telehealth support provide training, education and business continuity processes for the service.		Y			Y

Measurement and data

Data collection for measurement and evaluation is critical to:

- determine the implementation process and readiness for go-live
- provide information about clinical effectiveness and the impact on patient outcomes and patient, carer and clinician experience.

The Stroke Ambulance Pilot Monitoring and Evaluation Plan outlines the monitoring and evaluation approach for the pilot.

The Ministry of Health will work in partnership with partner organisations to undertake overall monitoring of the service. The Stroke Ambulance will also link to the existing data collection mechanisms for the NSW Telestroke Service, as a mobile referring site.

Clinical research

Clinical research during the pilot phase could be considered pending approval from the Statewide Stroke Services Steering Committee. The utilisation of the Stroke Ambulance for research purposes should be in collaboration with Ministry for Health, host site, NSW TSS, NSWA and other relevant stakeholders.

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Glossary

Acute stroke unit	An organised in-hospital facility that is entirely (or almost entirely) devoted to care for patients with stroke. It is staffed by a multidisciplinary team with special knowledge in stroke care.
Endovascular clot retrieval (ECR)	Removal of a clot by a retractable mechanical device. A large clot blocking a vessel is removed via an artery (intra-arterial approach). ECR requires highly specialised teams and is restricted to major metropolitan hospitals.
Comprehensive Stroke Centre	A comprehensive stroke centre that provides access to endovascular clot retrieval for acute ischaemic stroke patients.
Tissue plasminogen activator (tPA)	Tissue plasminogen activator is a protein involved in the breakdown of blood clots. It is a serine protease found on endothelial cells, the cells that line the blood vessels. As an enzyme, it catalyses the conversion of plasminogen to plasmin, the major enzyme responsible for clot breakdown.
Unified communication platform	An integrated single platform for unified communications. Unified communications is a business and marketing concept describing the integration of enterprise communication services such as instant messaging (chat), presence information, voice (including internet protocol telephony), mobility features (including extension mobility and single number reach), audio, web and video.

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The Agency for Clinical Innovation (ACI) is the lead agency for innovation in clinical care.

We bring consumers, clinicians and healthcare managers together to support the design, assessment and implementation of clinical innovations across the NSW public health system to change the way that care is delivered.

The ACI's clinical networks, institutes and taskforces are chaired by senior clinicians and consumers who have a keen interest and track record in innovative clinical care.

We also work closely with the Ministry of Health and the four other pillars of NSW Health to pilot, scale and spread solutions to healthcare system-wide challenges. We seek to improve the care and outcomes for patients by re-designing and transforming the NSW public health system.

Our innovations are:

- person-centred
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*Our vision is to create the future of healthcare,
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