



Australian  
Stroke Alliance



February 2024

**The Australian Stroke Alliance**

# Creating a Sustainable NSW Telestroke Service

## SNAPSHOT

## Stroke in NSW

- > One in four of us will have a stroke
- > In NSW, every 19 minutes, someone experiences a stroke
- > The number of young people affected is increasing
- > 43% of strokes happen to regional Australians

Now is the time to plan an improved, economical and sustainable NSW telestroke service to care for those who live far from a metropolitan stroke unit.

## Foreword

The Australian Stroke Alliance's five-year research program, funded in 2020 by the Commonwealth to conduct a five-year program, is the leading prehospital stroke research organisation that integrates clinical, academic, scientific and paramedical expertise, to improve urgent stroke care.

The aim is to fundamentally transform stroke outcomes for Australians, particularly in hard to reach rural and remote locations, and alongside Aboriginal and Torres Strait Islander communities who experience significant disparities in access to care and health outcomes.

A pillar of the Stroke Alliance is a national evaluation platform. This platform is focused on:

- > identifying enablers of changing systems of stroke care using mixed methods (surveys, interviews, focus groups) and quantitative data
- > optimisation models that can facilitate translation of stroke research into health policy
- > building upon the Australian Stroke Data Tool (with the Stroke Foundation, a principal partner), to establish new data linkages and assess areas of improvement
- > laying the foundation for continuous, systematic data collection to show improved equity of access for rural, remote and Indigenous populations
- > setting future priorities to inform new government policy for prehospital clinical stroke services.

In March 2023, the Stroke Alliance partnered with 10 leading healthcare organisations to deliver the highly influential *Access to Mechanical Thrombectomy in Australia* white paper. It called on the Commonwealth Government to improve access to mechanical thrombectomy, thereby cutting mortality and long-term expenditure on disability.

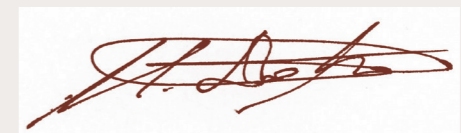
This white paper, *Creating a Sustainable NSW Telestroke Service*, provides an independent analysis of the potential economic, social and commercial benefits of prehospital stroke care in the Hunter region and across NSW more broadly.

The analysis provides:

- > a health economic benefits assessment of optimised health service delivery over 10 years conservatively estimated to be between \$1.5 billion and \$3 billion over 10 years.
- > quantified clinical and societal benefits
- > identified resource savings, likely to accrue using novel technologies in road and air medical transports
- > a framework for continuous, systematic data collection that will link to the electronic medical record.

This white paper recommends a cost-effective and sustainable path for NSW telehealth; a model that provides stroke services using regional hubs that are supported by centralised stroke services. This builds on current strengths, existing economic resources and relationships, while improving capability.

Thank you to the authors at the independent advisory firm, Strategic Project Partners, as well as those who have contributed to this significant piece of work including our colleagues at NSW hospitals John Hunter, Liverpool, Prince of Wales and Royal Prince Alfred. I'd particularly like to thank the following contributors: Professor Chris Levi, director of the John Hunter Health and Innovation Precinct, Dr Carlos Garcia Esperon, staff consultant neurologist at John Hunter Hospital, Dr Ferdinand Miteff, interventional neurologist at John Hunter Hospital, Professor Mark Parsons, professor of Neurology UNSW and Liverpool Hospital, Dr Andrew Cheung – neurointerventionist at Liverpool and Prince of Wales hospitals, Dr Martin Jude, neurologist at Wagga Wagga, and finally, Professor Stephen Davis AO, and Professor Geoffrey Donnan AO, Co-chairs of the Australian Stroke Alliance.




**Dr Henry De Aizpurua**  
CEO, Australian Stroke Alliance

## Project context

Stroke is one of Australia's leading causes of death and disability, incurring an annual financial cost of \$6.2bn and a loss of quality of life valued at \$26bn<sup>1</sup>. Treatment is time-critical, however, access to early treatment is poor, particularly in regional and remote Australia.

- > **65% of stroke survivors suffer a disability** which impedes their ability to carry out daily living activities unassisted
- > **Around 30% of stroke survivors are of working age** (under the age of 65)
- > **The overall financial and well-being impact** of stroke upon Australian society is estimated at **\$32.2B** p.a.<sup>1</sup>
- > **The incidence of stroke is projected to increase significantly** with an ageing and growing population

As the NSW Telestroke five-year funding period nears its end, there is an opportunity to explore alternative models for the telestroke service to address some of the key challenges introduced:

- > impacts on service delivery
- > lost opportunities for clinical collaboration
- > erosion of previously longstanding relationship building, and training between comprehensive stroke centres and referral site hospitals
- > impediments to ongoing development of stroke capability (diagnosis and care)
- > absence of training and opportunities for new neurologists
- > disparity of access to stroke care across hospitals
- > reduction in regional access to high quality face-to-face care.

As such, Strategic Project Partners has been engaged to articulate and assess viable alternative models for delivering telestroke services in NSW.

Since 2019, NSW has operated a centralised telestroke service at Prince of Wales hospital in Randwick, connecting 23 rural and regional hospitals across NSW with a network of virtual specialist stroke doctors. As of January 2023, the service has remotely assessed more than 3,000 stroke patients via telemedicine. Within this network, there are four 24/7 comprehensive stroke centres in NSW – John Hunter Hospital is one such centre, servicing northern NSW, and the only hospital outside of metropolitan NSW to offer a full stroke service, including clot retrieval.

Whilst the centralised telestroke model has delivered benefits in terms of coordination and technology enablement, the sustainability of the model going forward is challenged.

<sup>1</sup> Stroke Foundation, Economic impact of stroke in Australia, 2020. Healthcare IT news, Telestroke service reaches rural NSW faster than the metro, 2023.

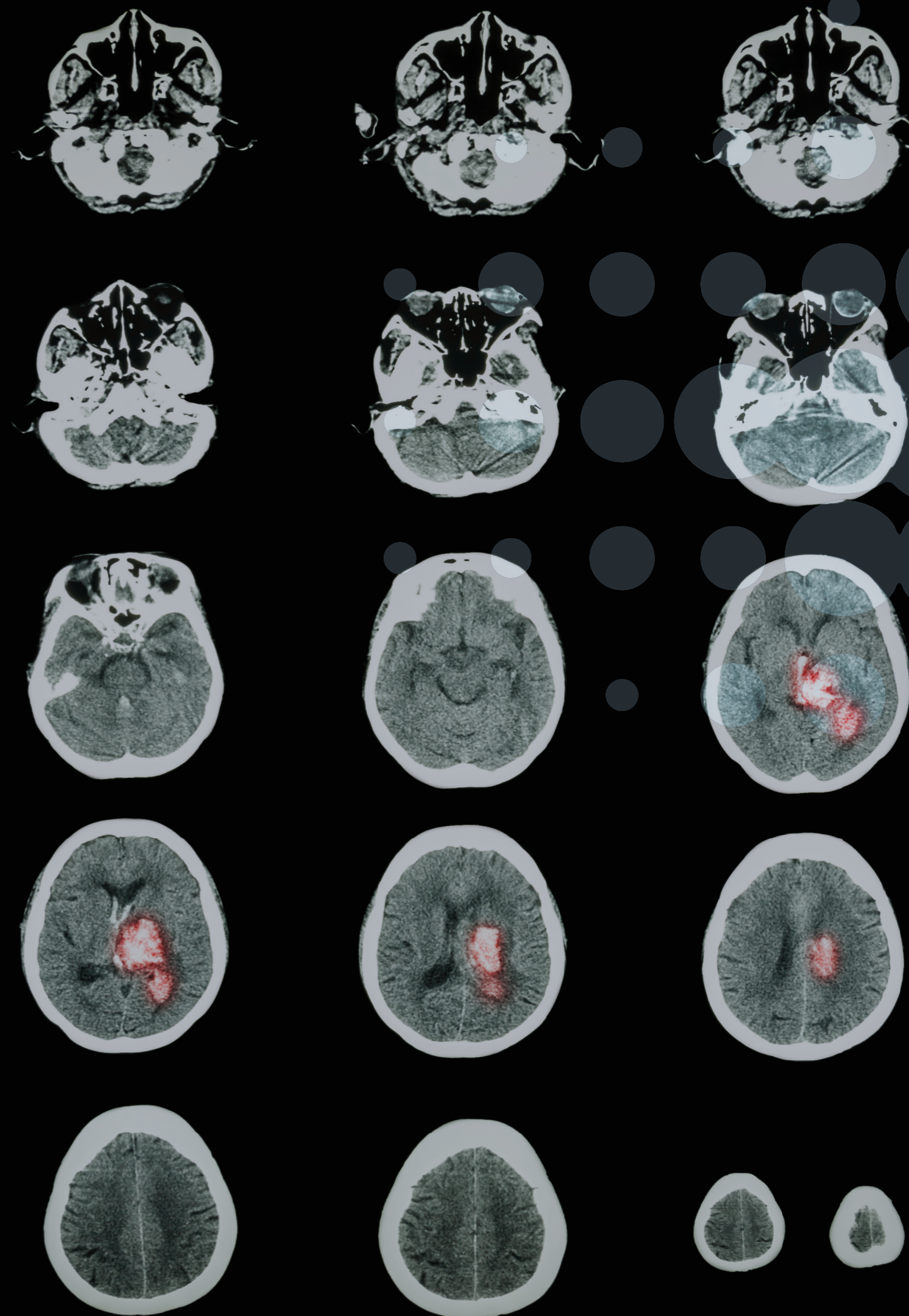
## Contents

Contents	Page
<b>Section 1: Introduction and review of the current model</b>	10
<b>Section 2: Major barriers for NSW Telestroke</b>	20
<b>Section 3: Addressing the specialist workforce gap</b>	42
<b>Section 4: Potential telestroke models</b>	52
<b>Section 5: Recommendations</b>	58
<b>Section 6: Implementing the hybrid regional model</b>	94
<b>Section 7: Appendix</b>	108

# Executive Summary

The hybrid system would deliver at least \$2.72 billion in economic benefits to NSW across the next decade:

- > \$1.17B: Reduced mortality from treatment time improvement
- > \$1.45B: Increased labour force productivity from treatment time improvement
- > \$108M: Reduced cost of bed days from onset-to-puncture time improvement.



## Executive Summary

Moving to a hybrid regional model for the future delivery of the NSW telestroke service will ensure sustained, quality outcomes.

### NSW HAS BEEN ON A JOURNEY TO IMPLEMENTING A STATE-WIDE TELESTROKE MODEL SINCE 2013

- > Prior to 2019, John Hunter Hospital operated a regional telestroke service for the northern region of NSW. The regional hub and spoke model functioned well with the available resources and was the preferred model to roll out to the rest of the state due to substantial evidence of effectiveness.
- > In 2019, the current centralised telestroke model was established due to a relative lack of stroke neurologists. This cost NSW \$21.7 million over four years.

### AS THE TELESTROKE SERVICE FUNDING PERIOD ENDS, IT IS TIMELY TO REVIEW THE MOST EFFECTIVE MODEL FOR TELESTROKE DELIVERY

- > The primary aim is to ensure sustained, quality outcomes for patients.
- > Whilst there are many strengths to leverage within the current model (such as the centralised IT system and state-wide access to stroke imaging, existing data capture and tools for quality control, the provision of improved stroke treatment capabilities and support for smaller regional hospitals, and having 24/7 access to a stroke expert), many next-generation improvements can be made to these areas.
- > The current model has several economic and structural/operational limitations including the erosion of relationships across the network, the disparity and utilisation between the network sites, the absence of stroke training and development especially for new stroke neurologists, patient care improvements not being realised, and increasing economic strain on the service.

### GOING FORWARD, NSW WOULD BENEFIT FROM ADOPTING A HYBRID REGIONAL MODEL

- > The hybrid regional model is a blended approach that creates regional stroke services using a hub-and-spoke format. It connects a comprehensive stroke centre as the regional hub to stroke referral sites in a regional catchment as the spokes while maintaining a centralised stroke service. This approach leverages and builds upon the current strengths of the centralised service, including IT/infrastructure.
- > NSW will be organised into Northern, Southern, and Western regions that have an independent telestroke service hosted by the region's comprehensive stroke centre. The Northern region will be run by John Hunter Hospital, the Southern by Liverpool and Prince of Wales Hospital, and the Western by the Royal Prince Alfred Hospital. The Prince of Wales Hospital will also continue to host the centralised telestroke service which will focus on delivering technological telehealth solutions and analysing regional performance data for insights.
- > The new model will build sustainable workforce capability in the regions as well as enable the distribution of human and economic resources, facilitate stronger hospital-to-hospital relationships, provide better patient care, and improve the network's capability.
- > This aligns with findings of the legislative council enquiry that centralised virtual care was not well received by patients in the regions and that skill erosion was occurring.<sup>1</sup>

### THIS MODEL COULD BE IMPLEMENTED IN PHASES, BEGINNING WITH JOHN HUNTER HOSPITAL OPERATING UNDER A HYBRID REGIONAL MODEL, WHILE OTHER COMPREHENSIVE STROKE CENTRES DEVELOP THEIR CAPACITY BEFORE BECOMING REGIONAL HUBS

- > After 12 months of John Hunter Hospital operating as a regional hub, Liverpool, Prince of Wales and Royal Prince Alfred Hospitals should be transitioned to the hybrid regional model.

Note: Data and cost analysis has yet to occur however may create a stronger case for the redeployment of resources to a hybrid regional model. This could result in NSW being able to treat the same/more patients in a more effective manner and reducing the overall cost of strokes to the NSW society

<sup>1</sup> Health outcomes and access to health and hospital services in rural, regional and remote New South Wales, May 2022

SECTION 1:

# Introduction and review of the current model

- > Evolution of the NSW telestroke system
- > Features of the first local, regional telestroke service
- > Key benefits of the centralised model.



**Section 1: Introduction and review of the current model**

NSW has been on a continuous journey to deliver a high quality state-wide telestroke service

**EVOLUTION OF THE NSW TELESTROKE SYSTEM**



<sup>1</sup> Carlos Garcia-Esperon, et al., Implementation of multimodal computed tomography in a telestroke network: Five year experience, 2019

Section 1: Introduction and review of the current model

## From 2013 - 2019 John Hunter Hospital trialled NSW's first local regional telestroke service

### Between 2013 and 2019 John Hunter Hospital successfully operated NSW's first local regional telestroke network

In April 2013, JHH operated a regional telestroke network providing services to two local health districts (LHD) across the Hunter New England and Mid North Coast<sup>1</sup>. As part of the network, local hospitals were equipped with cameras and the physicians were trained in the face, arm, speech, time (FAST) scale and the stroke severity assessment tool - the NIHSS.

The regional sites were equipped with the expertise to routinely conduct multimodal CTs (mCT) to identify potential candidates for thrombolysis and Endovascular Thrombectomy (EVT) across all regional sites. These were performed by trained radiology technicians and scans were interpreted in the acute phase by the stroke neurologist.

Although previously routine use of mCT in acute stroke patient assessment had been restricted to comprehensive stroke centres, a five-year trial by the JHH ending in 2018 **provided a strong rationale for its implementation to smaller regional centres** to aid in telestroke assessment and decision-making, including when to give thrombolysis and whether to transfer to JHH for EVT.

In the trial, **334 patients were assessed**, with 240 receiving mCT and 58 of them were thrombolysed (24.2%). Three months post-stroke, 55% of the thrombolysed group were independent, compared to 70% in the non-thrombolysed group. The high rate of good outcomes in the non-thrombolysed group shows that not all stroke patients require thrombolysis for a positive outcome. This finding also emphasizes the potential for misinterpretation when using thrombolysis rates as the primary measure of service effectiveness.

#### BENEFITS OF THE REGIONAL MODEL

- > Strong relationships between JHH, the connecting regional spoke hospitals, and the individual clinicians and leaders in stroke, emergency medicine and internal medicine
- > Patients were able to receive in-person care with a follow-up from their treating neurologist
- > High quality training being delivered to neurologists in training and clinicians at regional hospitals
- > Did not exaggerate rates of thrombolytic treatment as the main determinant of service effectiveness

#### ISSUES OF THE REGIONAL MODEL

- > JHH was providing the funding for the network and as demand increased, it was unable to continue to fund the model
- > Resourcing challenges emerged: namely, co-funding was not available at the time, in contrast to 2020 when TSS was generously funded.

- Hospitals hosting telestroke neurologists
- Stroke referral hospitals



<sup>1</sup> Carlos Garcia-Esperon, et al., Implementation of multimodal computed tomography in a telestroke network: Five year experience, 2019



**Section 1: Introduction and review of the current model**

Due to network capability challenges in delivering a regional hub and spoke, CSC-led model, NSW adopted a centralised telestroke model in 2020

**In 2020, NSW began operating a centralised telestroke model of care**

The NSW Telestroke Service has 23 hospitals in the network which connects local emergency doctors to specialist stroke physicians via video consultation. Determining whether a patient is having a stroke, the stroke type, and treatment options, can be challenging for clinicians who are not stroke experts.

The service is a collaboration between the Prince of Wales Hospital, eHealth NSW, the Agency for Clinical Innovation and the NSW Ministry of Health. The Prince of Wales Hospital hosts the NSW Telestroke Service.

The NSW Government jointly with the Commonwealth Governments have committed to funding \$21.4m over five years, the funding for the model was exhausted within four years with the service seeking additional funding.

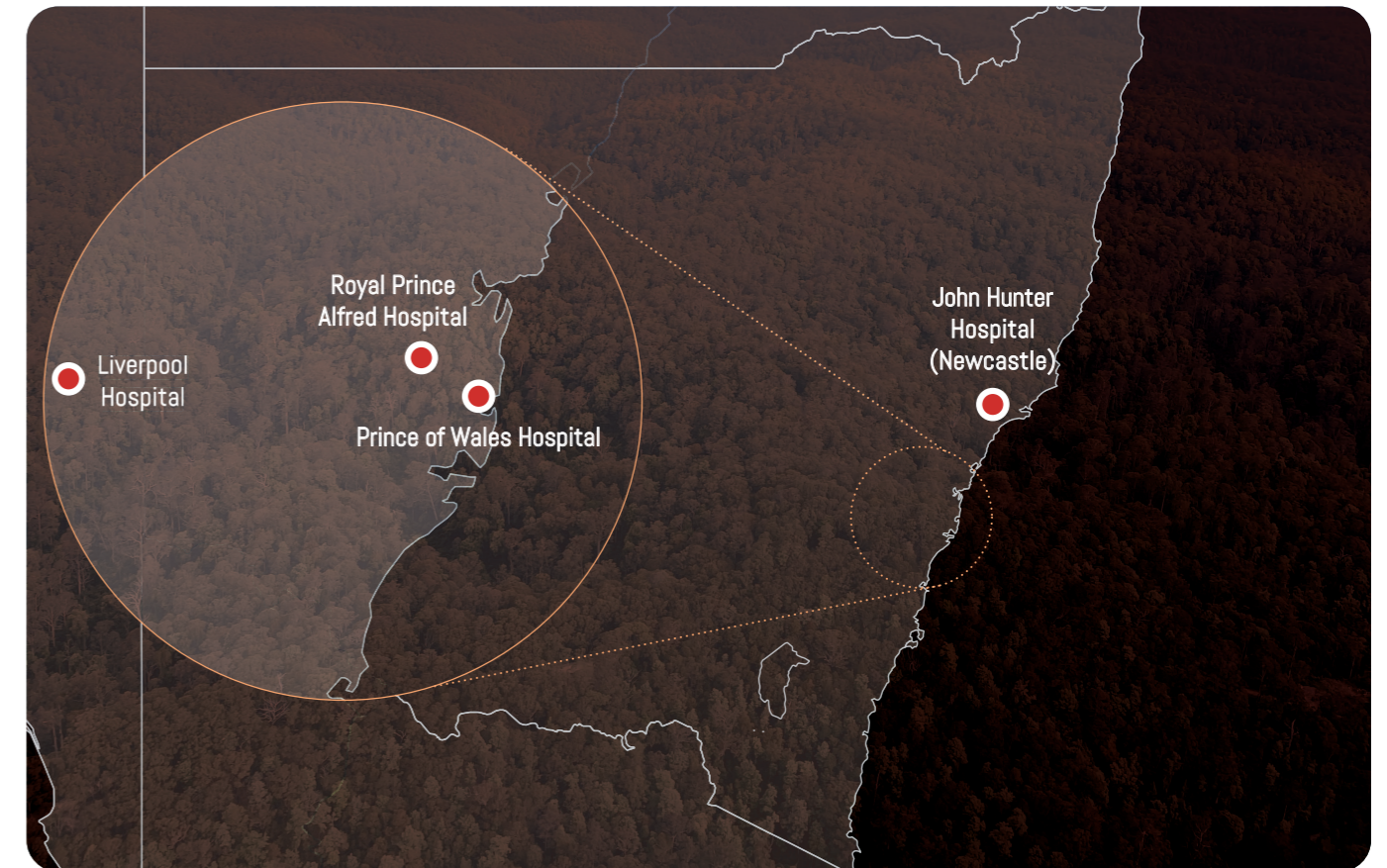
The telestroke service has performed over 3,000<sup>1</sup> telemedicine consultations for possible stroke presentations.

<sup>1</sup> Healthcare IT News, Telestroke service reaches rural NSW faster than the metro, January 2023

Source: SPP Consultations 2023. Desktop research 2023. Implementation of multimodal computed tomography in a telestroke network: Five year experience, July 2019.

Four comprehensive stroke centre locations

- Regional telestroke referral sites
- Comprehensive stroke centres



23 regional telestroke referral sites



**Section 1: Introduction and review of the current model**

The current centralised model has a number of key benefits to continue to leverage

	Key strengths			
	<p><b>Centralised IT system and state-wide access to stroke imaging</b> ✓</p> <ul style="list-style-type: none"> <li>&gt; Provided hospitals with state-wide access to stroke imaging through eHealth</li> <li>&gt; Provided Central IT assistance to all hospitals</li> <li>&gt; Unified communication capabilities of all stroke sites and comprehensive stroke centres</li> <li>&gt; Improved stroke imaging quality</li> </ul>	<p><b>Existing data capture and tools for quality control</b> ✓</p> <ul style="list-style-type: none"> <li>&gt; Treatment performance data is being consistently captured across the network</li> <li>&gt; Established an audit and quality control tool to track patient care quality</li> <li>&gt; Standardised and consolidated stroke patient documentation across all sites</li> <li>&gt; Implemented the program SCRAWL to capture metrics and guide patient assessments</li> </ul>	<p><b>Provided small regional hospitals with improved stroke treatment capabilities &amp; support</b> ✓</p> <ul style="list-style-type: none"> <li>&gt; Established stroke coordinators in regional hospitals that enhanced stroke patient care capabilities of hospitals</li> <li>&gt; Hospitals in the network gained access to state-wide stroke imaging with eHealth</li> <li>&gt; Stroke education and training were centralised which benefited smaller regional hospitals that lacked the resources to run it in house</li> </ul>	<p><b>Stroke patients making it to ED have a stroke expert to assist</b> ✓</p> <ul style="list-style-type: none"> <li>&gt; Telestroke provides all emergency rooms and hospitals with a direct line to a neurologist who helps to rapidly assess, diagnose and manage acute stroke patients, supporting inexperienced staff</li> <li>&gt; Use of the stroke screening "ASAP" tool, increasing identification of a stroke patient</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>&gt; Provided hospitals with state-wide access to stroke imaging through eHealth</li> <li>&gt; Provided Central IT assistance to all hospitals</li> <li>&gt; Unified communication capabilities of all stroke sites and comprehensive stroke centres</li> <li>&gt; Improved stroke imaging quality</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Treatment performance data is being consistently captured across the network</li> <li>&gt; Established an audit and quality control tool to track patient care quality</li> <li>&gt; Standardised and consolidated stroke patient documentation across all sites</li> <li>&gt; Implemented the program SCRAWL to capture metrics and guide patient assessments</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Established stroke coordinators in regional hospitals that enhanced stroke patient care capabilities of hospitals</li> <li>&gt; Hospitals in the network gained access to state-wide stroke imaging with eHealth</li> <li>&gt; Stroke education and training were centralised which benefited smaller regional hospitals that lacked the resources to run it in house</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Telestroke provides all emergency rooms and hospitals with a direct line to a neurologist who helps to rapidly assess, diagnose and manage acute stroke patients, supporting inexperienced staff</li> <li>&gt; Use of the stroke screening "ASAP" tool, increasing identification of a stroke patient</li> </ul>
<b>Considerations going forward</b>	<ul style="list-style-type: none"> <li>&gt; Infrastructure should be kept and continued to be improved across the network</li> <li>&gt; Maintain the IT system due to its existing strength and operational familiarity</li> <li>&gt; Continue providing improved systems and imaging capabilities</li> </ul>	<ul style="list-style-type: none"> <li>&gt; To ensure data and quality control tools are used in a meaningful capacity to deliver uplifts in patient care</li> <li>&gt; Utilise the future SDPR EPIC system to gather meaningful data on service effectiveness and patient outcomes, and integrate with digital stroke care performance tools</li> <li>&gt; Ongoing improvement programs including assigning key accountabilities, building capability and supporting with resources where required</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Continue empowering local stroke coordinators in regional hospitals to improve upon local stroke care by connecting them to their regional comprehensive stroke centre hub</li> <li>&gt; Enhance telestroke service, education and training to provide a tailored service that maximises the capability of regional hospitals</li> <li>&gt; Extend training to new stroke care specialists at CSCs and telestroke referral sites to support workforce development in their local region, as recommended</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Support a more meaningful case-based learning interaction via comprehensive stroke centres, to prevent ongoing erosion of the community of practice</li> <li>&gt; Assess the ASAP stroke screening tool to determine areas of improvement due to evidence emerging of a potential risk of low-value care and over-servicing</li> <li>&gt; Ensure health staff are properly trained in the use of stroke screening tools</li> <li>&gt; Ensure local pathways are capable of managing less severe stroke patients via locally tailored rapid response outpatient services that can be tele-enabled</li> <li>&gt; JHH has a pilot program currently underway at both Manning and Maitland Hospitals, funded independently</li> </ul>

## SECTION 2:

# Major barriers for NSW Telestroke

- > Erosion of relationships across the network
- > Resource disparities across network sites
- > Inadequate stroke training and development
- > Improvements needed in patient care
- > Increased economic strain.



### THE HUMAN COST OF POOR STROKE CARE

Bill was picked up in an ambulance within minutes of his stroke at 1.30am. But due to his remote location, he was taken to a regional hospital and endured a night in a darkened room. The next day he was transferred to a larger regional hospital and eventually was flown to a city stroke unit. More than 40 hours had passed before his diagnosis. Bill has been left with serious disabilities and will not work again.

**Section 2: Major barriers for NSW Telestroke**

Sustainability of NSW's telestroke service is challenged by five key factors



**Erosion of relationships across the network**

1

Discontinuity of care impacts patient recovery and safety.

The disconnection of the CSC team from the workforce managing the acute patient interaction in the regional hospitals has led to discontinuity of care, impacting patient recovery and safety.



**Resource disparities across network sites**

2

Some hospitals and stroke centres are overburdened, others underutilised.



**Inadequate stroke training and development**

3

A small centralised roster absorbs almost all stroke consultations in NSW leading to de-skilling of neurologists, especially in the regions.

Erosion of cross-disciplinary education and training opportunities across the traditional regional catchment.



**Improvements needed in patient care**

4

The Telestroke Service structure limits the ability to improve patient care, increasing the likelihood of local non-acute stroke patients having worse outcomes.



**Increasing economic strain**

5

The current model is expensive and unsustainable, leaving stroke care in regional areas without much needed investment.

Section 2: Major barriers for NSW Telestroke

Sustainability of NSW's telestroke service is challenged by five key factors



Section 2: Major barriers for NSW Telestroke

1 Diminishing relationships is reducing the network resilience and patient outcome



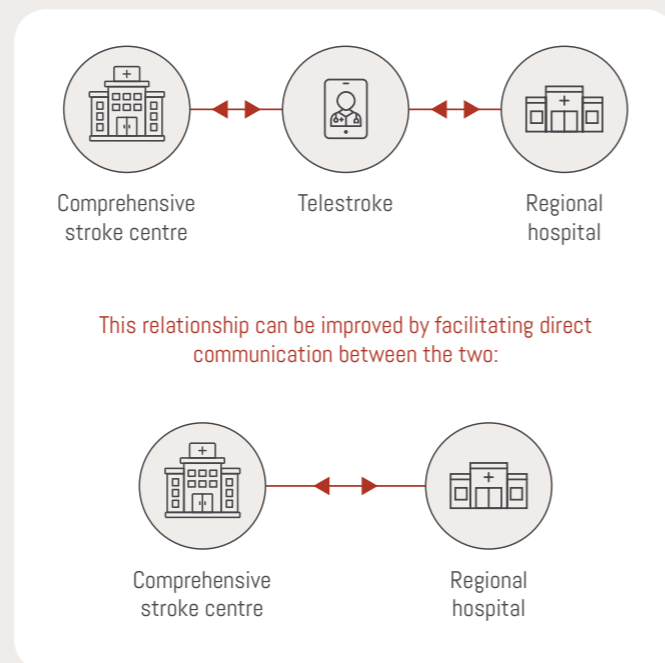
The centralised telestroke service is eroding the relationships between regional hospitals and stroke centres, and between patients and the neurologists who treat them.

**THE DECREASED COLLABORATION IN HOSPITAL AND STROKE CENTRE RELATIONSHIPS**

Regional hospitals and comprehensive stroke centres no longer maintain a direct relationship when it comes to stroke care patients, instead, the centralised telestroke service functions as an intermediary between the two. The loss of control for hospitals and stroke centres is disempowering and can obfuscate accountability in improving stroke services leading to the stagnation of the service. The continued decline of this relationship will have significant long-term impacts that will see increasing inefficiency of operations and a decline in patient care long term.

This strong relationship is key for:

- > Ensuring the effective collaboration and sharing of resources<sup>1</sup> which a telestroke operator is often not privy to
- > Enhancement of patient care by allowing for the exchange of best practices and standards for care<sup>1</sup>
- > Increased efficiency as a close working relationship reduces errors<sup>2</sup>
- > Improved resilience through stronger communication and coordination<sup>3</sup>



**THE WEAKENING CONNECTION BETWEEN PATIENTS AND NEUROLOGISTS**

In the current telestroke model, if a patient requires endovascular clot retrieval or reperfusion therapy, they will be transferred to a comprehensive stroke centre. During the transfer, a patient handover will occur between the stroke centre neurologist and the telestroke physician and will end with the telestroke physician disappearing from the patient care journey. Furthermore, overall responsibility for the patient is unclear when they are in transit to the comprehensive stroke centre which often means no neurologist is responsible patient. This has resulted in poor patient management that has put the well being patients at risk.

Often patients fail to have continuity of care from a neurologist which establishes a degree of disconnect between the comprehensive stroke centre and the patient.

This fracture of care experienced by the patients damages the relationship between them and the neurologist. Studies show that fractured coordination of care results in far less trust between the patient and the physician. For the neurologists involved, they can grow disengaged in monitoring patient recovery due to frequent hand over or reception of patient responsibility.

23 out of 25 studies show that continuity of care reduced the use of care<sup>1</sup>

17% lower medical costs when home-based primary care is coordinated<sup>1</sup>

63% of patients/caregivers value seeing someone they know and trust<sup>1</sup>

<sup>1</sup> Quality of Care and Interhospital Collaboration: A Study of Patient Transfers in Italy, National Library of Medicine, 2015.  
<sup>2</sup> Focusing on Teamwork and Communication to Improve Patient Safety, American Hospital Association, 2017  
<sup>3</sup> Teamwork in Healthcare: Key Discoveries Enabling Safer, High-Quality Care, 2018. Continuity of Care Matters in All Health Care Settings, Jamanetwork 2021.

<sup>1</sup> Continuity and coordination of care, WHO 2018

Section 2: Major barriers for NSW Telestroke

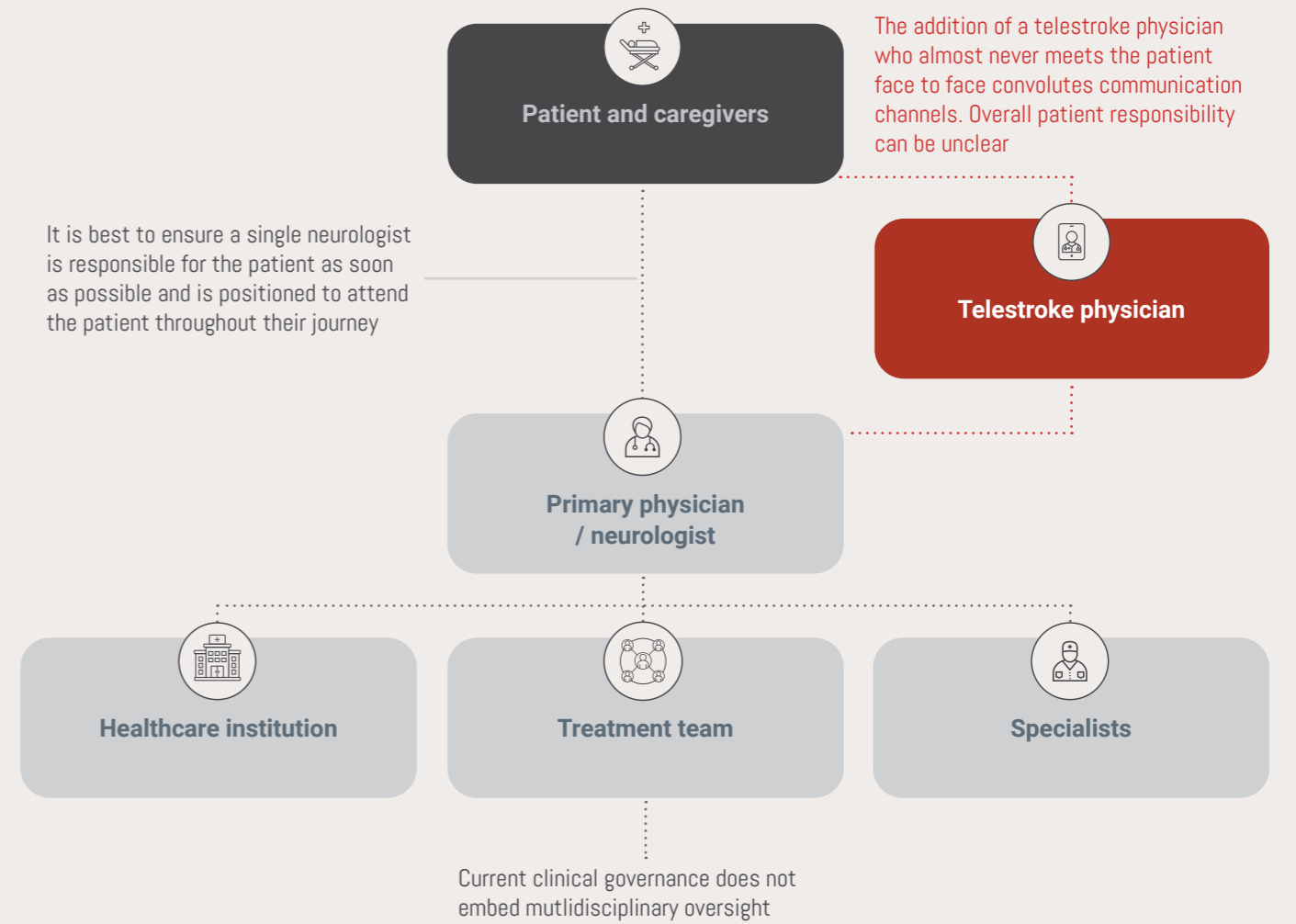
1 The patient to neurologist relationship is eroding as a result of discontinuity of care in the patient journey



**THE CENTRALISED TELESTROKE MODEL DOES NOT FACILITATE OPTIMAL PATIENT COMMUNICATION WITH CARE PROVIDERS**

- > **Neurointerventionalist and other stroke specialists are feeling disenfranchised** with stroke care as the service does not include them in learning, decision making, or even keep them informed of patient outcomes of those who were referred through the service.
- > **The model of care does not follow the multi-disciplinary** (Neurointerventionalist, stroke neurologist, specialist stroke nurse, etc) **shared decision making process** that is the norm at comprehensive stroke centres.

**THE CURRENT SYSTEM CAN FRACTURE CLINICAL RESPONSIBILITY AND COMMUNICATION**



## Section 2: Major barriers for NSW Telestroke

### 2 The inherent resource disparity of each hospital is not addressed by the current centralised telestroke service



As such, the service finds itself unable to improve on patient hand over and delivery which are the weakest links in the stroke care chain.

#### THERE ARE SIGNIFICANT DIFFERENCES IN THE RESOURCES OF REGIONAL HOSPITALS

- > Numerous regional hospitals that serve as referral sites require improved patient delivery methods and or infrastructure that the TSS is not structured to provide
- > Regional hospitals need more neurologists, but struggle to compete with comprehensive stroke centres and TSS to attract them due to fewer work opportunities.
- > TSS often operates under the assumption that there are no stroke experts in the area which hinders neurologists in the region from working as efficiently
- > Recent improvements implemented by TSS make little impact on overall patient transfer and treatment times as they don't address the unique root issues of each regional hospital

#### PATIENT TRANSPORTATION CAPABILITIES ACROSS HOSPITALS DIFFER SIGNIFICANTLY

- > The transfer and transport capabilities of hospitals are not always a consideration under the current model
- > Issues with adequate transportation capabilities of some regional hospitals means that some regional patients are transferred across state borders which comes with additional processing time
- > There have been cases where upwards of two hours have been spent trying to establish official contact with out-of-state stroke centres
- > Delivery time of patients to stroke treatment sites is the weakest link in the patient treatment chain which the current structure struggles to improve upon

#### SOME HOSPITALS AND STROKE CENTRES ARE OVERBURDENED OR UNDERUTILISED

- > Currently, the TSS expands the reach of comprehensive stroke centres by funnelling stroke patients across NSW to them but without enhancing the capabilities of the centres which is leading to centres becoming overburdened
- > Prince of Wales Hospital frequently functions near or over its capacity and at times struggles to receive new stroke patients
- > Liverpool hospital (the largest volume NSW CSC) does not receive any regional EVT patients via NSW telestroke
- > The resources of the TSS are not distributed to enable greater utilisation of regional hospitals which would free overburdened hospitals
- > Most regional hospitals can house neurologists and operate as a stroke centre however do not have the adequate resources (staff and funds) to realise this latent capacity



## Section 2: Major barriers for NSW Telestroke

### 3 Centralised telestroke services provide inadequate training and development for stroke care, especially in the regions



NSW: only 12 neurologists servicing the state roster at a cost of \$21.4m over four years



This closed and expensive roster has locked out other neurologists



By comparison, the Victorian Telestroke Service has 30+ neurologists



In NSW, >100 young fellows who are in training over the next two years are precluded from the roster



This exacerbates costs for the State, reduces patient access to care and prevents high quality training.

#### A SMALL 12-PERSON ROSTER ABSORBS ALMOST ALL STROKE CONSULTATIONS LEADING TO THE DE-SKILLING OF NEUROLOGISTS ACROSS NSW

- > The TSS will consult for every stroke patient that doesn't immediately arrive at a comprehensive stroke centre thus, the rostered neurologists absorb almost all stroke consultation work and leave little for other neurologists
- > Joining the centralised telestroke service has turned into a career pathway that results in rostered neurologists experiencing some level of deskilling from their separation of direct patient treatment, this has been noticed due to their increased frequency in reaching out to CSC for second opinions
- > There are only 12 slots in the TSS roster and aspiring applicants are required to be at the consultant level
- > New neurologists are unable to join the TSS and find few opportunities to provide stroke consultation
- > New neurologists lack adequate training and learning opportunities and thus are de-skilling overtime – fundamentally new neurologists need consultation experience and guidance from senior stroke neurologists which they currently are not receiving

#### REGIONAL HOSPITALS STRUGGLE WITH ATTRACTING AND DEVELOPING NEUROLOGISTS

- > Of the 19,000 NSW residents who suffer a stroke per year, more than a third of them are from regional areas<sup>1</sup>, and would benefit from having a regional neurologist at their nearest hospital
- > Stroke neurologists are in short supply in regional hospitals, and they struggle to retain them while competing with the TSS to attract them
- > TSS operates under the assumption that there are no stroke experts in the area which impedes the ability of regional neurologists to consult and learn
- > Regional hospitals struggle to attract stroke neurologists which is leaving the hospitals less capable of treating stroke patients and more dependent on an increasingly strained centralised system
- > Stroke neurologists are needed in the regions, especially in cases of a mild stroke where the TSS chooses to leave non-acute stroke patients to local care as they do not require thrombolysis or ECR

#### THE TSS AND STROKE CENTRES ARE NOT RESOURCED TO RESEARCH STROKE CARE

- > The primary focus of the TSS is to provide timely and high-quality care
- > Research studies require additional resources, including funding, persons and time, the central network has limited resources to devote to research activities
- > Research requires significant autonomy and on-the-ground personnel to oversee and measure performance outcomes which aren't possible with the current centralised stroke care service where stroke operational authority is consolidated off-treatment site
- > Conducting research require complying with regulatory and ethical guidelines to protect patient privacy and ensure the safety of research participants, this is an additional layer of complexity and time

<sup>1</sup> Healthcare IT news, Telestroke service reaches rural NSW faster than the metro, 2023.

Section 2: Major barriers for NSW Telestroke

4 Improvements to patient care delivered by the current telestroke service have plateaued



Performance metrics for patient care have remained unchanged for 2½ years despite room for improvement.<sup>1</sup>

Lack of improvement reflects the disconnect between patient and neurologist, and between clinicians

59 minutes Door-to-needle times have remained unchanged since 2021.



Imaging-to-ECR-consultation-time has gone from about 15 minutes in the past to 30 to 40 minutes today.



Patients have been on hold for upwards of two hours waiting for a transfer across borders. The current TSS has not been able establish effective agreements with out of state stroke centres.



Most patients don't remember a telestroke physician being present in their consultation or any other part of their recovery journey.

Rural patients don't like having their care being directed from outside their local area.



Some rural telestroke referral site have grown over-reliant on the TSS and have become isolated from nearby hospitals due to TSS eroding the natural hub and spoke relationship of hospitals.

These factors have combined to hinder the development of effective management pathways for non-acute stroke patients who do not require thrombolysis or ECR and are turned away from TSS. This has created challenges for these patients in accessing appropriate care.

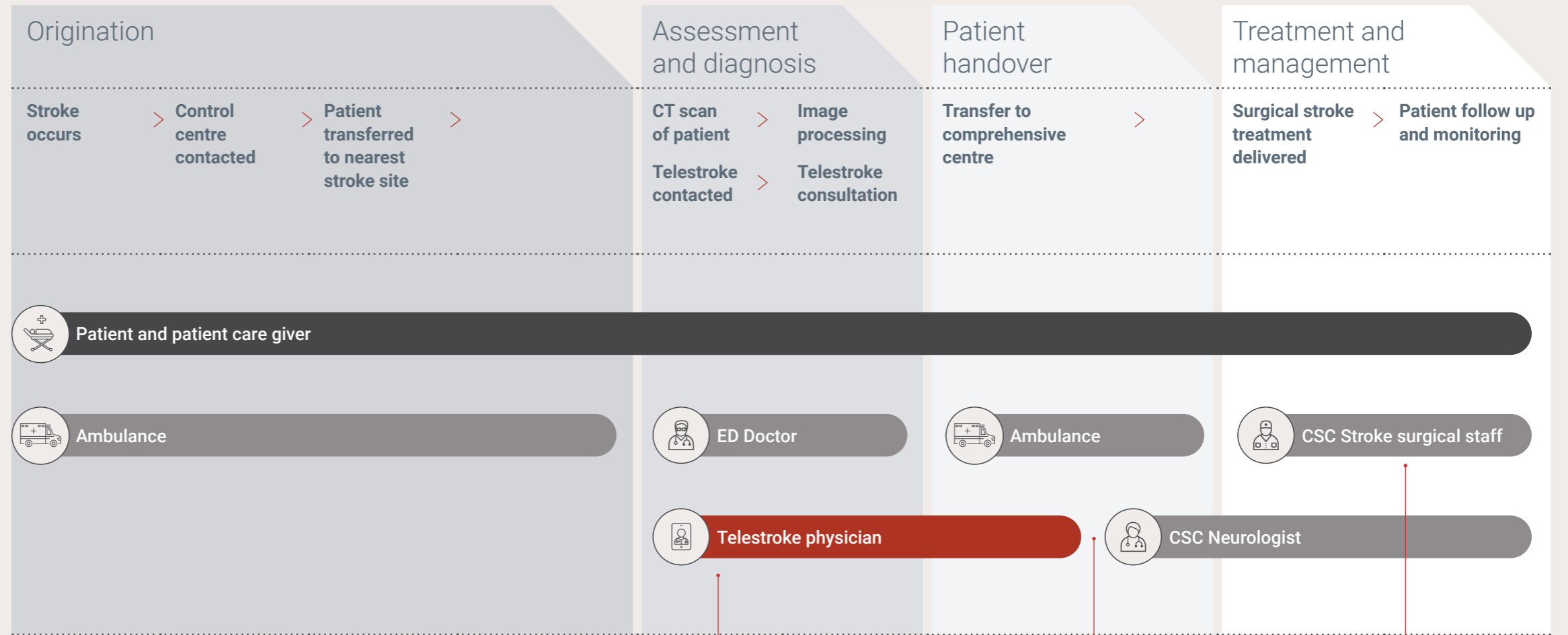
<sup>1</sup> <https://pubmed.ncbi.nlm.nih.gov/33897601/>

Section 2: Major barriers for NSW Telestroke

4 The structure of the telestroke service is a barrier to realising improvements needed in patient care



The centralised telestroke model does not allow for a single neurologist to be a part of the patient journey from assessment and diagnosis to treatment and management and muddies patient responsibility.



The lack of an established intercollegiate and organisational relationships between telestroke and regional emergency department doctors hinders their ability to collaborate effectively

Patient handover between the telestroke physician and a stroke centre neurologist is sudden and often inefficient

Furthermore, patient responsibility during patient transfer is unclear as there is no clear stroke specialist to contact post-handover in the event of an emergency until the patient arrives at the CSC

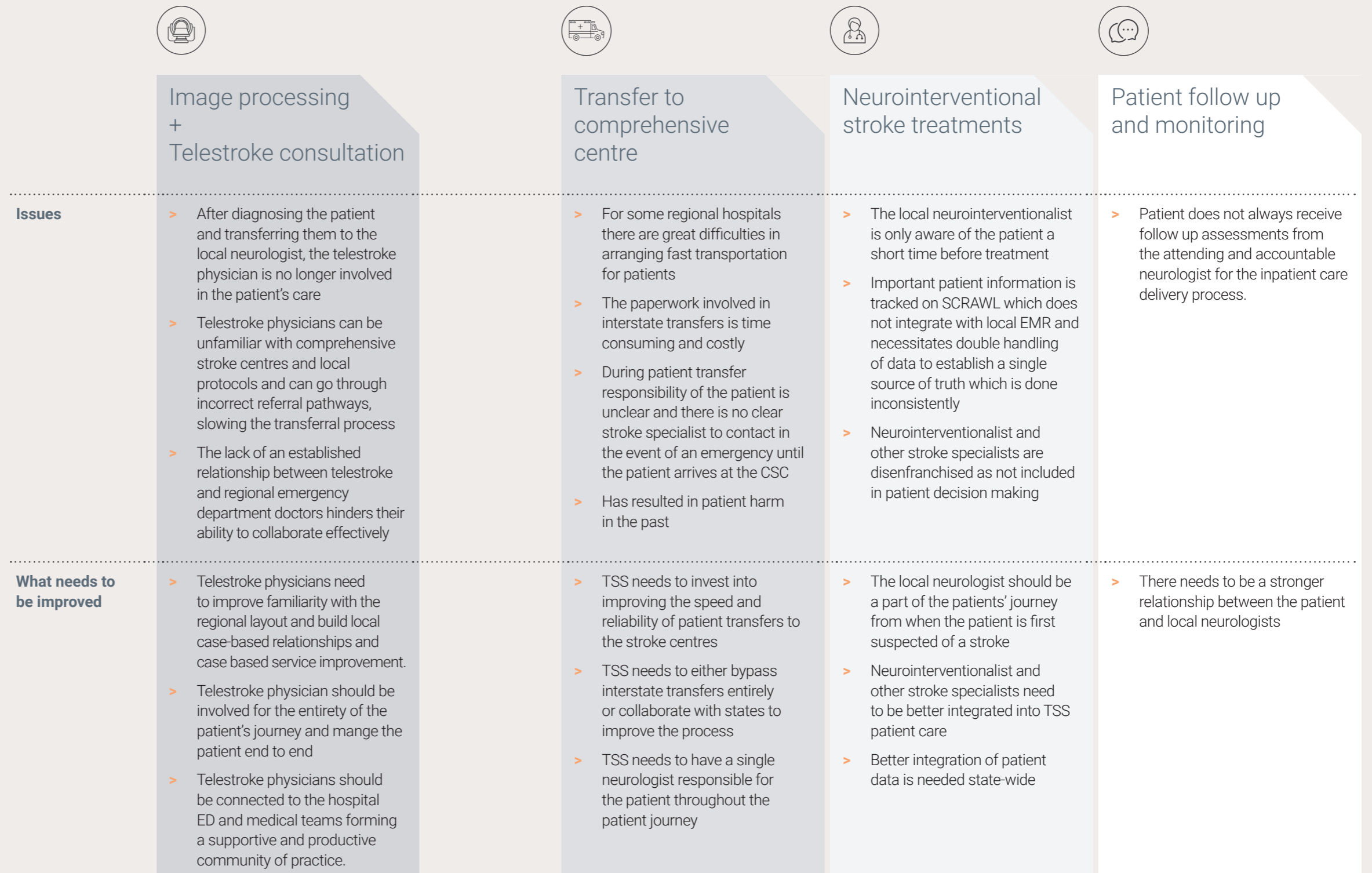
Neurointerventionalist can be notified of the patient late and are rushed

Section 2: Major barriers for NSW Telestroke

4 The telestroke service is unable to improve patient handover, often the weakest link in the treatment chain



The telestroke service is detached from patient handover to treatment and management, resulting in its inability to improve these parts of the patient journey.



Section 2: Major barriers for NSW Telestroke

5 The current telestroke model is not economically sustainable




**FUNDING IS NOT ALLOCATED ACROSS THE NETWORK**


- > The five year allocated budget of \$21.4m has been expended in four years. There is an opportunity to review how costs are allocated across the network to ensure a sustainable cost structure going forward
- > There are two areas where costs could be improved including people and remuneration structures and inter state and cross-border transfers. Specific examples of inter/cross boarder transfers include:
  - Wagga and Goulburn are often asked to transfer stroke patients to Canberra which incurs high cost and is time consuming
  - Liverpool hospital (the largest volume NSW CSC) does not receive any regional EVT patients via NSW telestroke - despite the fact patients from regional Southern NSW are often transferred across state borders for EVT (at great cost to NSW Health)
  - Cross border transfers of patients will remain expensive and could largely be avoided with a regional CSC hub and spoke model

**TELESTROKE PHYSICIAN COSTS DON'T TRACK WITH THE NUMBER OF CONSULTATIONS**

- > There are many calls to the centralised service which are not stroke related. Better training is required for the telestroke referral sites to ensure they understand how to use the available diagnosis tools and are not overly reliant on the centralised service for a second opinion.



Rostered telestroke physicians are remunerated on a per hour (minimum one hour) basis rather than per necessary stroke consultation. This inflates TSS staffing costs particularly when there are a large volume of calls which are not stroke related and enables remuneration over-servicing for low value care



Telestroke physicians on the day shifts earn \$2,500 a day on top of their hospital salary and regardless of the number of telestroke consultations provided which is a concern given recent media attention regarding payments to VMO<sup>1</sup>

Work type	Day shift 8am–6pm	After hours
On-call	\$250/hr	\$15/hr
Consultation	\$250/hr	\$250/hr

**FUNDING TO IMPROVE STROKE CARE IS NOT BEING DIRECTED TO WHERE IT IS MOST NEED**

- > Telestroke funding is focused on partially managing a small percentage of total stroke patients at the cost of establishing effective local management of stroke cases that do not require thrombolysis or ECR
- > Regional hospitals such as Wagga and Goulburn would benefit from investments into patient transport to better facilitate patient transfers to NSW CSC to avoid high inter-state transport costs and transfer times
- > Regional stroke patients prefer and benefit more from face-to-face interactions with neurologists; funding could be directed towards incentivising neurologists to go regional or to facilitate neurologist rotations
- > The centralised telestroke service has supplanted the natural hub and spoke system of hospitals which has stunted effective local stroke patient management for non-severe stroke cases that don't require thrombolysis or ECR and who are often left to the care of local hospitals. Effective local development regional patient capabilities use to be a focus for the original regional telestroke service but are now absent
- > Professional development programs would support stroke trainees within the CSCs who employ the workforce pipeline of advanced trainees and fellows, enabling the enrichment suppressed under the current model

<sup>1</sup> Fix NSW Health, Gerard Hayes Youtube, 2023.

SECTION 3:

# Addressing the specialist workforce gap

- > Early clinical participation of interventional neuroradiologists (INRs) in telestroke delivery has the potential to achieve \$220M in incremental benefits.

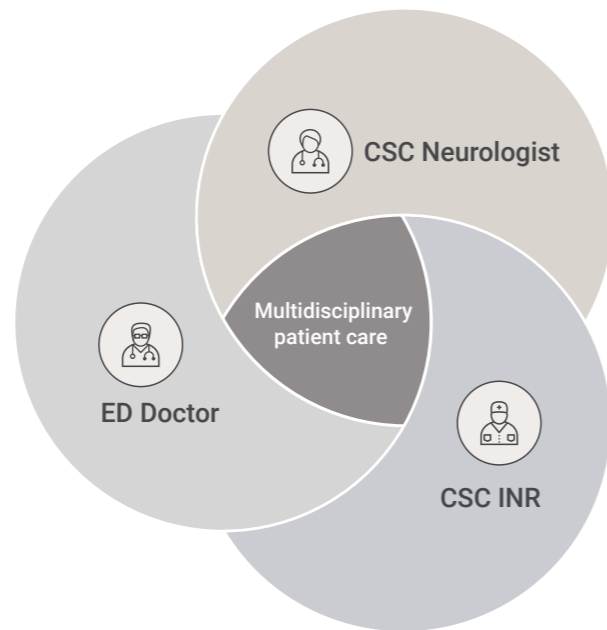


**Section 3: Addressing the specialist workforce gap**

Currently a multidisciplinary approach to telestroke is not consistently delivered across the state

**LIVERPOOL AND JOHN HUNTER HOSPITALS**

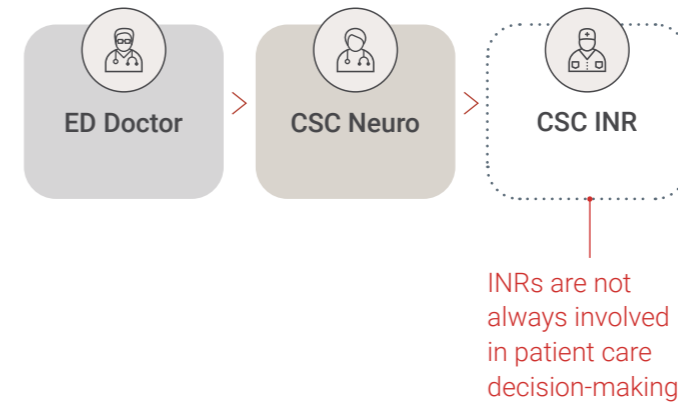
Liverpool and John Hunter Hospital take a multidisciplinary approach to stroke care. Multidisciplinary teams are proven to enabling better quality decisions, even in hyper-acute and time constrained settings.<sup>1</sup> INRs complement the expertise of emergency doctors and neurologists to provide leading capabilities and insights in LVO identification, diagnosis and treatment, maximising patient health outcomes.



<sup>1</sup> "Association of Integrated Team-Based Care With Health Care Quality, Utilization, and Cost", Journal of the American Medical Association, August 2016.

**PRINCE OF WALES AND ROYAL PRINCE ALFRED HOSPITALS**

Prince of Wales and the Royal Prince Alfred Hospitals have continued to use the existing centralised NSW telestroke service which does not consistently provide continuity of care for patients. INRs are not always included in consultations, which can result in incorrect scan interpretations and treatment recommendations that deliver negative patient outcomes.



Sideling INRs from patient care decision-making can delay treatment. Consultations have revealed cases where INRs have not been included in patient diagnosis discussions, which has led to brain scans being misinterpreted. In one case the presence of an LVO was not initially identified, which caused the delay of appropriate EVT treatment by up to five hours, significantly impacting patient outcomes.

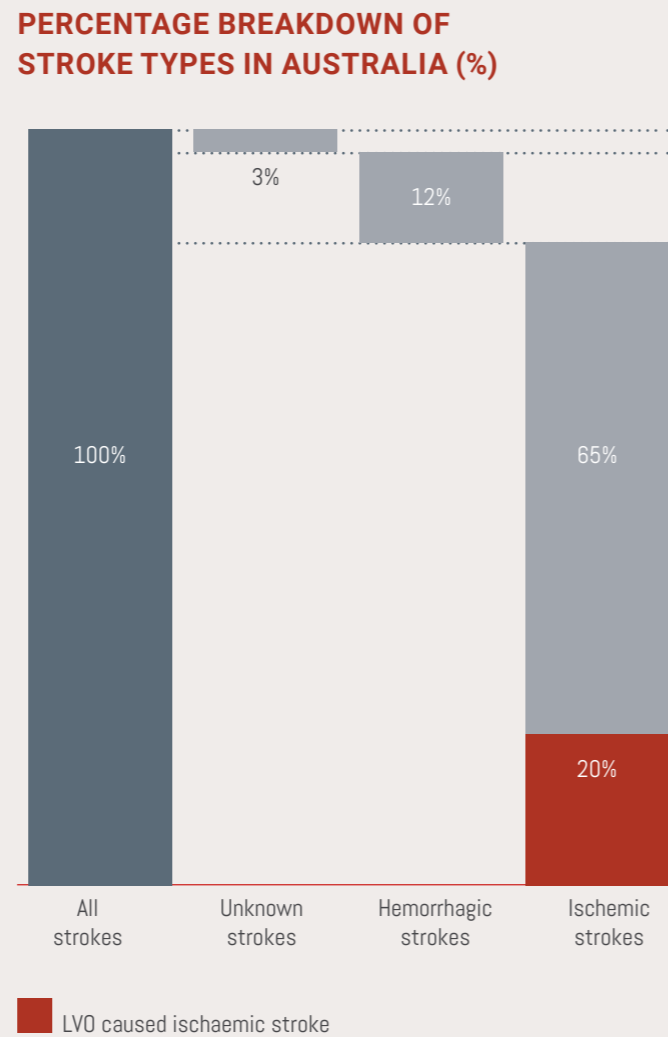
A multidisciplinary approach to stroke care across the state could deliver equitable and optimal patient outcomes

**Section 3: Addressing the specialist workforce gap**

**Interventional neuroradiologists (INRs) play a critical role in the diagnosis and treatment of acute ischemic stroke types**

Ischemic strokes are the most frequent type of strokes in Australia (80-85 per cent of all strokes in Australia), with 24% to 46% of all ischemic strokes caused by large vessel occlusions (LVOs), which can have severe and life-threatening implications for patients.

Timely involvement of INRs in the multidisciplinary diagnosis and treatment of LVO patients results in superior patient outcomes compared to those being diagnosed by neurologists alone.



LVO's cause between 24% to 46% of all ischemic strokes are caused by LVOs, which can have severe and life-threatening implications.

**ENDOVASCULAR THROMBECTOMY (EVT) IS A CRITICAL TREATMENT OPTION FOR ACUTE ISCHEMIC STROKE**

- > Mechanical thrombectomy is considered the gold standard in treating patients with LVOs, which uses image led EVT methods to remove clotting from the brain
- > Thrombectomy is the most effective treatment, which delivers positive patient outcomes for one in every two operations, compared to one in ten who receive lysis
- > The efficacy of thrombectomy treatment is highly time-dependent, with the probabilities of mortality or ongoing disability steeply rising from LVO onset – for every minute an LVO is left untreated, the average patient loses 1.9 million neurons and 13.8 billion synapses
- > Reducing the time between stroke onset and blood flow restoration dramatically improves likelihood of survival and reduces the risk and severity of disability

**INRs ARE THE EXPERTS IN DIAGNOSIS AND TREATMENT OF LVOs**

- > INRs are the foremost experts in assessing stroke imaging and are the only qualified clinicians to perform mechanical thrombectomy
- > This expertise is widely recognised across other clinical roles including neurology and radiology – the timely engagement of INRs in stroke patient care (particularly LVO) is considered critical to accurate patient triaging and ensuring optimal patient outcomes
- > Not all LVO stroke cases are straightforward – INRs play a critical role in working with neurologists to assess the nature of LVOs, whether they are accessible and retrievable to ensure patients receive the right treatment in a time critical manner.

Source: SPP Analysis (2023), Consultations with Telestroke stakeholder (2023). "The future of interventional and neurointerventional radiology: learning lessons from the past", British Institute of Radiology, September 2017. Goyal, et al. (2016), "Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials", Lancet. Emberson et al. (2014) "Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: a meta-analysis of individual patient data from randomised trials" Lancet. "What we think about: Thrombectomy", Stroke Association, 2019.



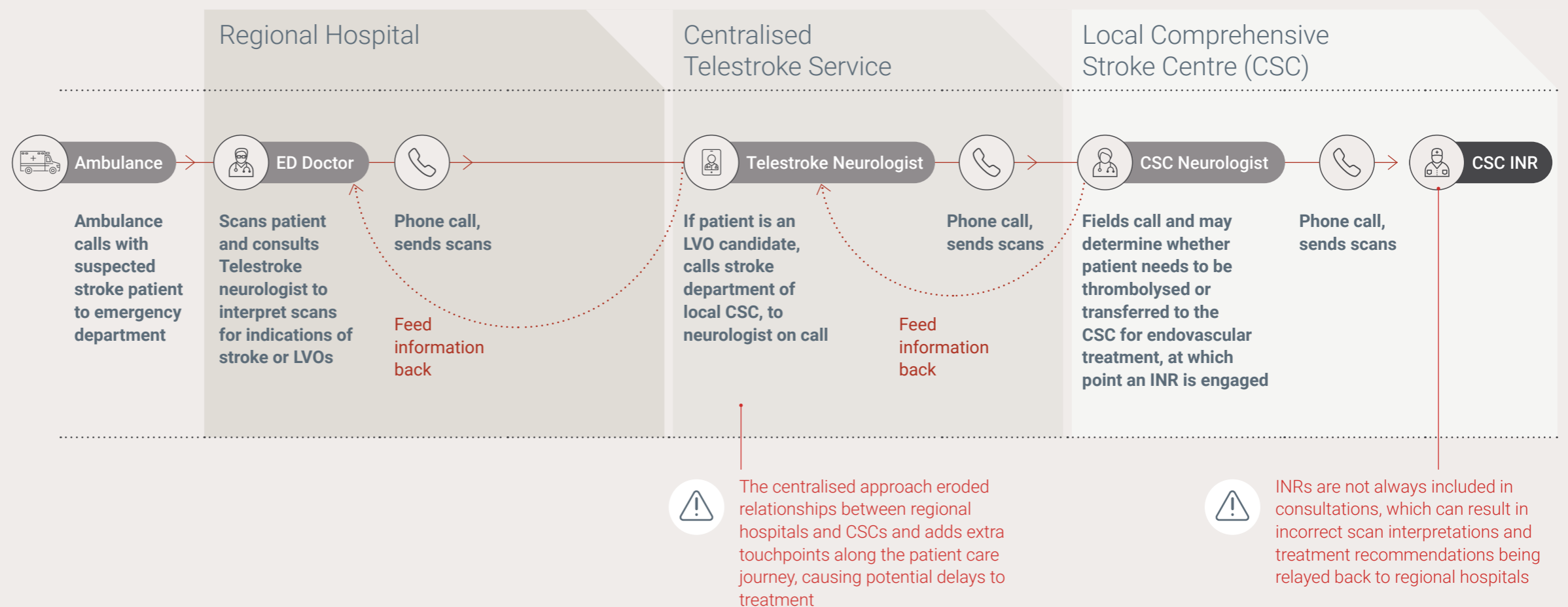
**Section 3: Addressing the specialist workforce gap**

The centralised telestroke model does not always involve the INR in a timely manner, impacting on patient outcomes and system efficiency

Interventional Neuroradiologists (INRs) play a critical lifesaving role in the diagnosis and image led, endovascular treatment of high-risk stroke types, however are not always involved in diagnosis and treatment decisions under the current centralised Telestroke model.

CSC INRs are often reduced to a reactive role in the current centralised Telestroke service model, which impacts the timeliness of interventional surgery and in some case misdiagnosis resulting in poor patient outcomes and inefficient use of scarce resources.

**THE ROLE OF INRs IN THE CURRENT CENTRALISED TELESTROKE PATIENT CARE JOURNEY**

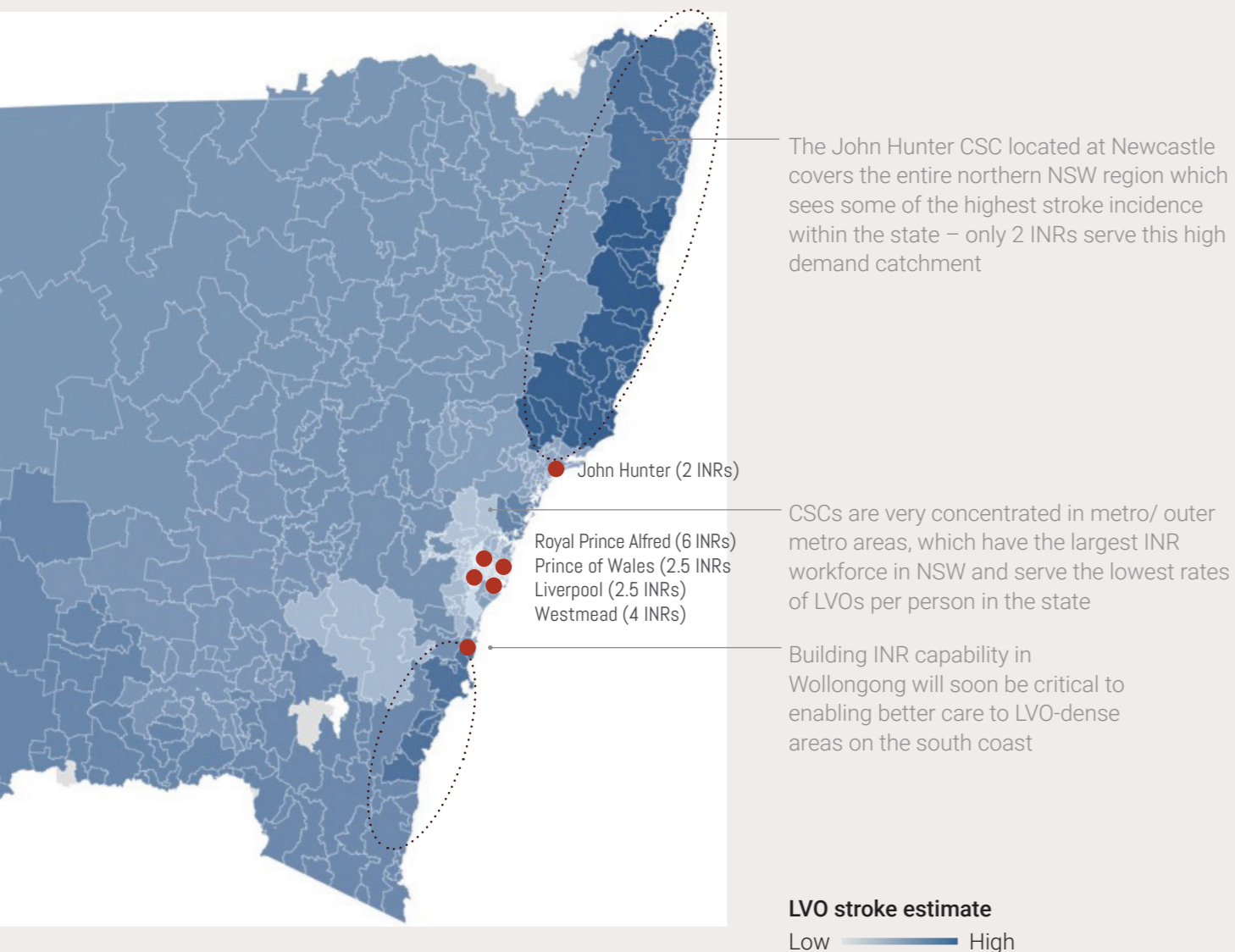


**Section 3: Addressing the specialist workforce gap**

There must be focus on ensuring a more equitable distribution of funding across the state ensure INR capacity where it is needed most

**STROKE DISTRIBUTION ACROSS NSW ELECTORATES 2020**

(LVO strokes per 100,000 people by postcode)



**Stroke funding is not allocated to areas of high LVO stroke concentration**

- > 4 out of 5 NSW CSCs are located within metropolitan Sydney, where current telestroke funding is allocated
- > Highest concentration of stroke incidence is in the regions, where there are fewer INR resources funded
- > Future INR funding should consider locations where LVO stroke concentration is high, and where there is a greater need for the development of stroke capabilities
- > Building an INR workforce in strategic regional areas like Wollongong and John Hunter (expanding on existing INRs) will ensure LVIO-dense areas are better served

**THE CURRENT INR WORKFORCE IS NOT ALIGNED TO DEMAND FOR INR CAPABILITIES ACROSS NSW**

Regional areas are typically under resourced in terms of INR capabilities and accessibility, which presents a significant challenge in providing comprehensive treatment for regional LVO stroke patients. These regions have a much greater concentration of LVO incidence and need to travel much further for comprehensive care, delaying treatment times

More funding is required to build INR capabilities in regional areas – building INR capabilities at John Hunter Hospital and Wollongong will help alleviate the high caseloads outside of the metropolitan area where 4 out of 5 current CSCs is located.

Source: <sup>1</sup>"No Postcode Untouched Stroke in Australia 2020", Deloitte, November 2020. <sup>2</sup>"Access to Mechanical Thrombectomy in Australia", Stryker, March 2023. <sup>3</sup>"CCINR Register of Australian and New Zealand INRs", CCINR, Retrieved December 2023 (note some INRs have not been accounted for as it is unclear which CSC they were located at; where multiple CSCs are listed for an INR, it is assumed they split their time between CSCs evenly). \* Westmead Hospital does not offer 24/7 Endovascular Clot Retrieval and thus its workload will be distributed to Royal Prince Alfred and Liverpool Hospital during the night. \*\*Estimated LVO numbers allocated to CSC according to proximity of electorate to CSC and matches the proposed regional hybrid model of stroke centre allocation, and therefore, may not be reflective of current state.

## SECTION 4:

# Potential telestroke models

- > Three options for NSW telestroke delivery
- > A hybrid regional model.



## COORDINATION IS THE KEY

Kate, a radiographer in a country town suspected she was having a stroke while picking up her child from kinder. Her colleagues at the local hospital called for aeromedical retrieval and she was offered endovascular clot removal within six hours of her stroke - a fast response thanks to excellent communication between the regional centre and city-based neurologists. (NB singular regional centre)

Section 4: Potential telestroke models

Alternative options for NSW's telestroke delivery model have been considered



### Current Centralised Model

**Purpose**

- > To provide world-class hyperacute stroke care (care delivered within 24 hours of stroke onset) for patients with suspected stroke in NSW, regardless of their location

**Overview**

- > A centralised virtual stroke service that provides a consistent experience and streamlines access to specialised stroke physicians for telestroke referral sites and stroke ambulances across the state

**Service structure**

- > Single virtual service 'hosted' by a facility and serviced by a roster of specialist stroke physicians who provide remote specialist assessment, diagnosis and treatment planning for the state
- > All request for telestroke consultation goes through one channel that distributes and allocates resources to the network

**Value proposition**

- > Enforces a baseline of quality across the network
- > Streamlines government funding



### Hybrid Regional Model

**Purpose**

- > To provide world-class hyperacute stroke care (care delivered within 24 hours of stroke onset) for patients with suspected stroke in NSW, regardless of their location

**Overview**

- > A blended model that establishes regional hub and spoke stroke services and maintains a centralised stroke service to unify technological solutions and provide backend assistance

**Service structure**

- > The state is organised into defined regions where a hub and spoke virtual network is hosted by a comprehensive stroke centre that acts as the regional hub and with stroke referral sites act as spoke hospitals
- > Local stroke physicians at the hub provide remote consultation, diagnosis and treatment planning
- > A centralised telestroke service will remain in charge of technological solutions and stroke standards

**Value proposition**

- > Enables regional structures to innovate and improve upon services while maintaining a baseline of quality across the state network
- > Technology is handled by central specialists



### Local Regional Model

**Purpose**

- > To provide world-class hyperacute stroke care (care delivered within 24 hours of stroke onset) for patients with suspected stroke in NSW, regardless of their location

**Overview**

- > A regional virtual stroke service tailored to an area to best serve regional stroke treatment needs and maximise the use of available resources
- > Focuses resources into regional elements that are most in need, leading to improved regional capability long term

**Service structure**



















- > The state is organised into regional centres where a hub and spoke virtual network is hosted by a comprehensive stroke centre that acts as the regional hub and the stroke referral sites act as spoke hospitals
- > Local stroke physicians at the hub provide remote consultation, diagnosis and treatment planning
- > Each region sets its own standards and establishes its technology systems to best provide for their region
- > Local stroke physicians provide outreach services, and face-to-face training opportunities, assist in tailored treatment pathway development and maintain channels for communication with all involved clinicians post-acute management

**Value proposition**

- > Greater autonomy for the hub and spoke regional hospitals fosters improved collaboration and patient care and will facilitate an embedded clinical research culture currently lacking in state-wide service
- > Better distribution and utilisation of resources on the ground

Section 4: Potential telestroke models

A hybrid regional model can mitigate the key challenges with the current delivery model

	 <b>Current Centralised Model</b>	 <b>Hybrid Regional Model</b>	 <b>Local Regional Model</b>
<b>1 Erosion of relationships across the network</b>	 <ul style="list-style-type: none"> <li>&gt; Can hinder interhospital coordination while also preventing continuous face-to-face care between local physicians and patients</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Supports the natural hub and spoke system for all hospitals in the network</li> <li>&gt; Provides more face-to-face time between doctors and patients</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Supports the natural hub and spoke systems for all hospitals in the network</li> <li>&gt; Provides more face-to-face time between doctors and patients</li> </ul>
<b>2 Resource disparities across network sites</b>	 <ul style="list-style-type: none"> <li>&gt; Has difficulty in addressing the disparity in resources and capabilities between network hospitals</li> <li>&gt; Ensures minimum standard</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Greater capacity to address resource and capability disparities in the network</li> <li>&gt; Ability to provide unique solutions in resolving disparities</li> <li>&gt; Leverages existing technology</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Greater capacity to address resource and capability disparities in the network</li> <li>&gt; Ability to provide unique solutions in resolving disparities</li> </ul>
<b>3 Inadequate stroke training and development</b>	 <ul style="list-style-type: none"> <li>&gt; Can worsen regional workforce shortages</li> <li>&gt; Underutilises CSC neurologists</li> <li>&gt; Has no focus on clinical research</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Improves regional collaboration</li> <li>&gt; Facilitates research</li> <li>&gt; Maintains a minimum standard of collaboration and stroke training</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Improves collaboration between neurologists and telestroke Facilitates research</li> <li>&gt; Greater utilisation of existing regional resources</li> </ul>
<b>4 Improvements needed in patient care</b>	 <ul style="list-style-type: none"> <li>&gt; Missing on-the-ground local knowledge to improve areas of patient care</li> <li>&gt; Telestroke neurologists are often unable to provide ongoing patient care</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Maximises the number of patients who can receive ongoing face-to-face care</li> <li>&gt; The centralised component can assist during times of high demand</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Maximises the number of patients who can receive ongoing face-to-face care</li> <li>&gt; Suited to delivering on the ground insights to improve care</li> </ul>
<b>5 Increasing economic strain</b>	 <ul style="list-style-type: none"> <li>&gt; Funding structure may not effectively prioritise areas of need especially with respect to development of regional clinician workforce</li> <li>&gt; Streamlines service funding</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Equitable distribution of funding in areas of need</li> <li>&gt; Funding must be distributed across multiple regions</li> </ul>	 <ul style="list-style-type: none"> <li>&gt; Equitable distribution of funding in areas of need</li> <li>&gt; Funding must be distributed across multiple regions</li> </ul>

● Able to address challenge  
 ● Does not address challenge

## SECTION 5:

# Recommendations

- > A hybrid regional model – features, advantages
- > Improved patient care
- > Standardised components and benefits
- > Improved service, training and capability
- > Empowering paramedics; a case study
- > \$3 billion in savings.



**Section 5: Recommendations**

The hybrid regional model will organise the state into three regions while preserving a central service that consolidates information and technological solutions

The regional components of the model are standardised and optimised to fully leverage the strengths of the regional approach.

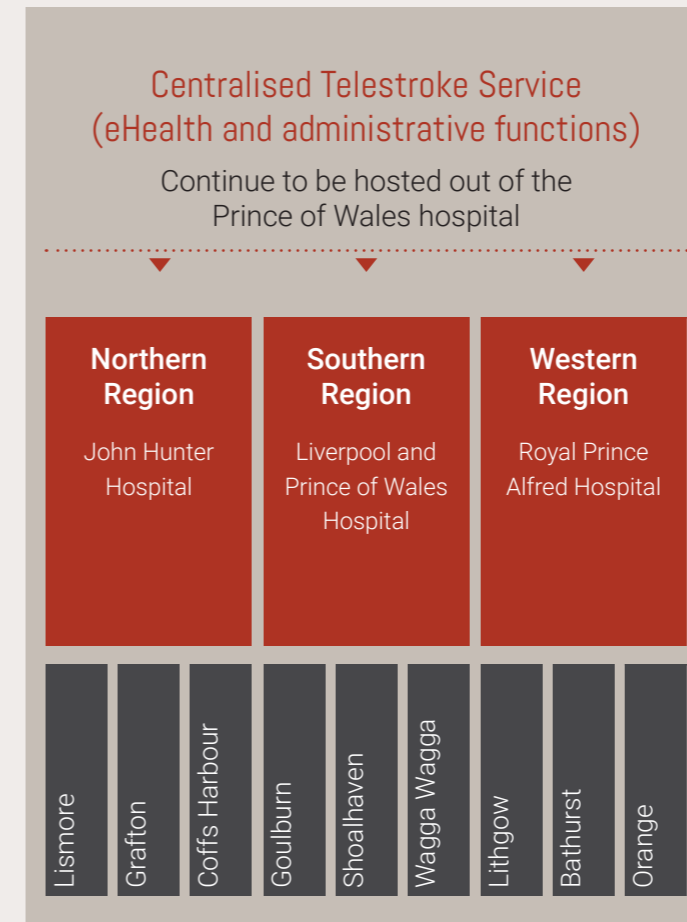
**MODEL OVERVIEW**

The hybrid regional model is a blended model that incorporates the existing infrastructure and technology of the centralised service while establishing a hub and spoke regional model across the state.

Each CSC will operate its own telestroke service for its region and will rely on the centralised telestroke service for technology, database, and quality control tools.

Note: For this report, eHealth is considered to be a part of the centralised service in the hybrid model. eHealth is not expected to be hosted out of the host site.

**MODEL STRUCTURE**



**RESPONSIBILITIES**

- Central**
  - > Develop and maintain technology for telestroke services
  - > Manage state-wide stroke patient database
  - > Analyses regional performance data for insights
  - > Conduct regular network meetings to share lessons learned and research findings from stroke centres
- CSC**
  - > CSCs operate 24/7 telestroke service and act as central hub hospitals for stroke care
  - > Responsible for improving operational aspects of stroke care in the region
  - > Provides training for referral sites in the region
  - > Runs research to improve stroke care
- Telestroke Referral Sites**
  - > Telestroke referral sites function as spoke hospitals to the CSC's central hub hospital
  - > Coordinates with CSCs to provide stroke care for patients
  - > Identifies areas of improvement

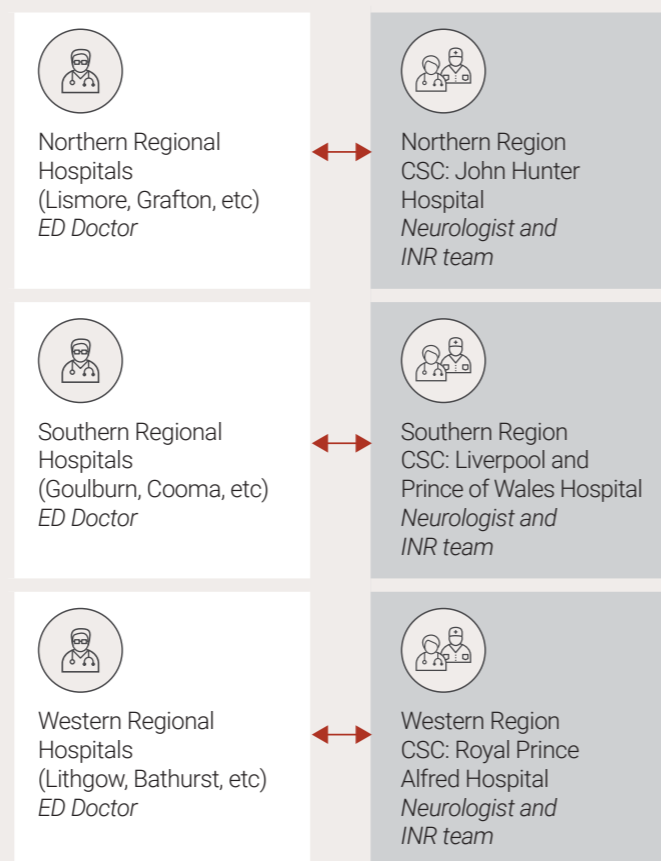
**Section 5: Recommendations**

**Positioning INRs at comprehensive stroke centres (CSCs) in the hybrid-regional model enables equity of access to interventional specialists for regional stroke centres**

Positioning INRs at CSCs and driving an increase in their clinical participation will enable greater access to their expertise for regional stroke centres.

Enhancing equity of access to expert knowledge for regional hospitals and emergency department doctors fosters continuous capability development, bolstering regional healthcare infrastructure over time

**CONCEPTUAL VIEW OF HOW CSC INRs WILL DIRECTLY FACE AND ENGAGE REGIONAL STROKE CENTRES UNDER THE NEW MODEL**



**GREATER EQUITY OF ACCESS TO INRs FOR THE REGIONS IS ENABLED**

- > Regional emergency department doctors are able to directly collaborate with the CSC team and develop their stroke knowledge and capabilities
- > Direct contact with CSC neurologists and INRs strengthens the connections between the ED doctors and enhances relationship building
- > A stronger relationship with regional stroke hospitals will result in more efficient collaboration and communication of patient information which accelerates patient treatment and minimises cases where patients unnecessarily relocated further from their homes
- > Direct engagement between regional clinical staff and trainees with CSC INRs supports capacity and capability building of regional staff – having the pinnacle LVO stroke expert in the room provides an enriched experience and development opportunity for regional staff, which ultimately helps uplift quality improvement across the cluster



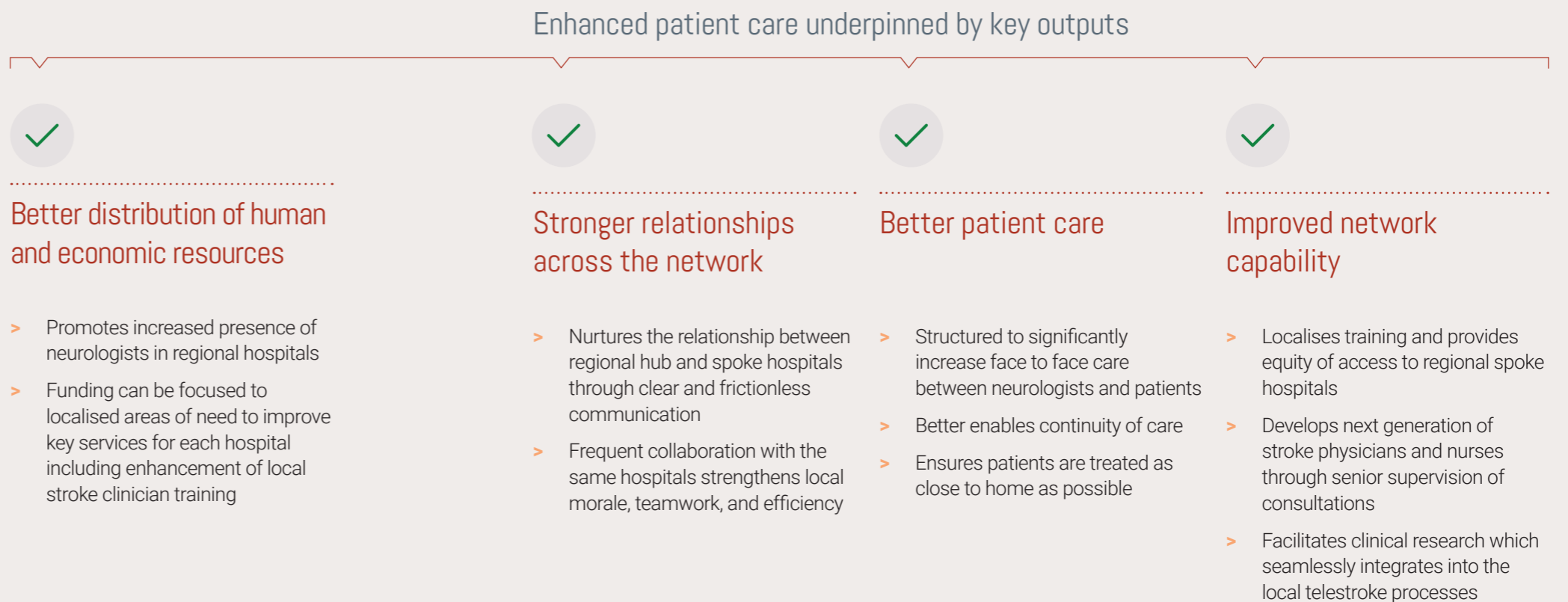
**Section 5: Recommendations**

**A hybrid model will result in more efficient patient care across the network**

The key outputs achieved by the hybrid regional structure form the pillars that support a sustainable and resilient telestroke service.

**CONTINUITY OF CARE IS VITAL FOR PATIENT RECOVERY AND SAFETY**

It provides:



**Better distribution of human and economic resources**

**Stronger relationships across the network**

**Better patient care**

**Improved network capability**

- > Promotes increased presence of neurologists in regional hospitals
- > Funding can be focused to localised areas of need to improve key services for each hospital including enhancement of local stroke clinician training

- > Nurtures the relationship between regional hub and spoke hospitals through clear and frictionless communication
- > Frequent collaboration with the same hospitals strengthens local morale, teamwork, and efficiency

- > Structured to significantly increase face to face care between neurologists and patients
- > Better enables continuity of care
- > Ensures patients are treated as close to home as possible

- > Localises training and provides equity of access to regional spoke hospitals
- > Develops next generation of stroke physicians and nurses through senior supervision of consultations
- > Facilitates clinical research which seamlessly integrates into the local telestroke processes



**Improved communication**

When patients and doctors have built a relationship, a deeper understanding of needs and preferences is realised<sup>1</sup>



**Better coordination of care**

Continuity of care allows for better coordination of care as health workers grow familiar with both the patient and those responsible for them<sup>2</sup>



**Reduced medical errors**

Having a consistent doctor who is familiar with the patient's medical history and situation can reduce the risk of medical errors<sup>3</sup>



**Improved patient satisfaction**

Patients who receive continuity of care report higher levels of satisfaction with their care which can contribute to improved patient outcomes<sup>1</sup>

1 The impact of continuity of care on health outcomes: a systematic review, Annals of Family Medicine 2005.  
 2 Continuity and coordination of care, WHO 2018.  
 3 Medical Errors Related to Discontinuity of Care from an Inpatient to an Outpatient Setting, Journal of General Internal Medicine 2003

**Section 5: Recommendations**

The state would be organised into Northern, Southern, and Western telestroke regions

**OPTIMISED NETWORK DISTRIBUTION**

- > John Hunter and Liverpool hospital have the capability to function as regional hubs that can operate a local regional telestroke model with some direct investment
- > The Royal Prince Alfred hospital requires more neurologists to function as a regional hub for telestroke service, as such it should transition to a central model at a later stage once a greater capability is reached through enhanced training
- > Prince of Wales hospital should remain as the host of the central service and continue with administrative functions such as state-wide performance data consolidation and analysis and will assist Liverpool in managing the Southern Region
- > The comprehensive stroke centres will continue to service the metro and the greater Sydney area
- > Hospitals that are significantly closer to strong, out-of-state, 24/7 comprehensive stroke centres should be formally connected with these stroke centres for better patient outcomes, for example, Broken Hill could be better serviced by the Royal Adelaide Hospital in SA (1hr 15min by flight compared to 2hr 10min to RPA)

- Northern Region
- Western Region
- Southern Region
- Remote
- Hub – John Hunter
- Hub – Royal Prince Alfred
- Hub – Liverpool and Prince of Wales



Section 5: Recommendations

The hybrid regional model will have standardised components

Elements of central support	Standardised Components	Description	Standardised Components of the Hybrid Regional Model				Benefits of approach
<p><b>Infrastructure</b> including telehealth technology system, centralised IT system, state-wide stroke imaging through eHealth</p>	<p><b>Access local network</b></p>	<p>Facilitated by NSW ambulance who notifies their regional Comprehensive Stroke Centre that a patient has a suspected stroke (FAST+)</p>	Symptom onset	NSW Ambulance (FAST+)	Emergency Department TTS	Radiology (CT)	<ul style="list-style-type: none"> <li>&gt; Improved patient access to care (time)</li> <li>&gt; Reduce unnecessary transfers and optimising the use of resources</li> <li>&gt; Quick access to stroke expertise</li> <li>&gt; Enhanced communication and collaboration</li> </ul>
<p><b>Processes and tools</b> including state-wide stroke patient data-base, a digital stroke care performance tool, a stroke diagnoses tool</p>	<p><b>Triage</b></p>	<p>On arrival to the hospital, telestroke referral sites staff assess patient using the standardised triaging tool (FAST+), and then contacts the CSC to notify prior to being sent to radiology</p>	Emergency Department telestroke referral site	Triage using standardised triage tool	Call your nearest Comprehensive stroke centre	<ul style="list-style-type: none"> <li>&gt; CSC works closely with and trains the telestroke referral sites</li> <li>&gt; Direct relationship between the transferring site and the CSC</li> <li>&gt; Reduced time to allocate a neurologist at the CSC</li> </ul>	
<p><b>People resources</b> including the use of established stroke coordinators and other support as required</p>	<p><b>Comms, diagnosis, treatment plans and ongoing review</b></p>	<p>Rapid access to radiology at the telestroke referral sites, with the CSC conducting the teleconsultation. Full neurological assessment is performed</p>	ED Telestroke Referring site	Multimodal acute stroke imaging	CSC telestroke consultation (Support by the Centralised Telestroke resources)	CSC ongoing patient review	<ul style="list-style-type: none"> <li>&gt; Leverage the centralised networks IT infrastructure (screen sharing, remote access) to interact with the local teams</li> <li>&gt; Backup support via the centralised network</li> <li>&gt; Better continuity of care and increased patient engagement and satisfaction</li> </ul>

## Section 5: Recommendations

### The telestroke service will fulfill three distinct lines of activities in each region

The hybrid regional telestroke model must recognise that the stroke telehealth service will serve as a supplementary solution to stroke care across the state and will work to support the development of a strong, distributed network of stroke care-capable hospitals across NSW.

Service lines	Key activities	Responsibility*
<b>Telehealth service</b>	Patient assessment	CSC and Hospitals
	Patient diagnosis	CSC and Hospitals
	Patient management	CSC and Hospitals
<b>Education and training</b>	Training of new specialist stroke neurologists (direct consultation supervision) and nurses within region	CSC
	Training of stroke related healthcare workers in the use of digital tools	CSC
	Training of healthcare workers in the use of technology and quality control tools	Central service
	Conduct stroke research	CSC
	Stroke education for local stroke related health workers	CSC
<b>Capability development</b>	Implementation of digital health technologies	eHealth NSW
	Improve means of patient transportation between hospitals	CSC and Hospitals
	Deployment of neurologist in regional hospitals	Hospitals
	Develop inter-state relations with important health care providers	CSC
	Conduct state-wide network meetings to share lessons learned and new research	Central service
	Analyse network performance data for insight	Central service
	Develop and rollout stroke protocols and guidelines	Central service
	Maintain stroke database for treatment performance and patient information	Central service

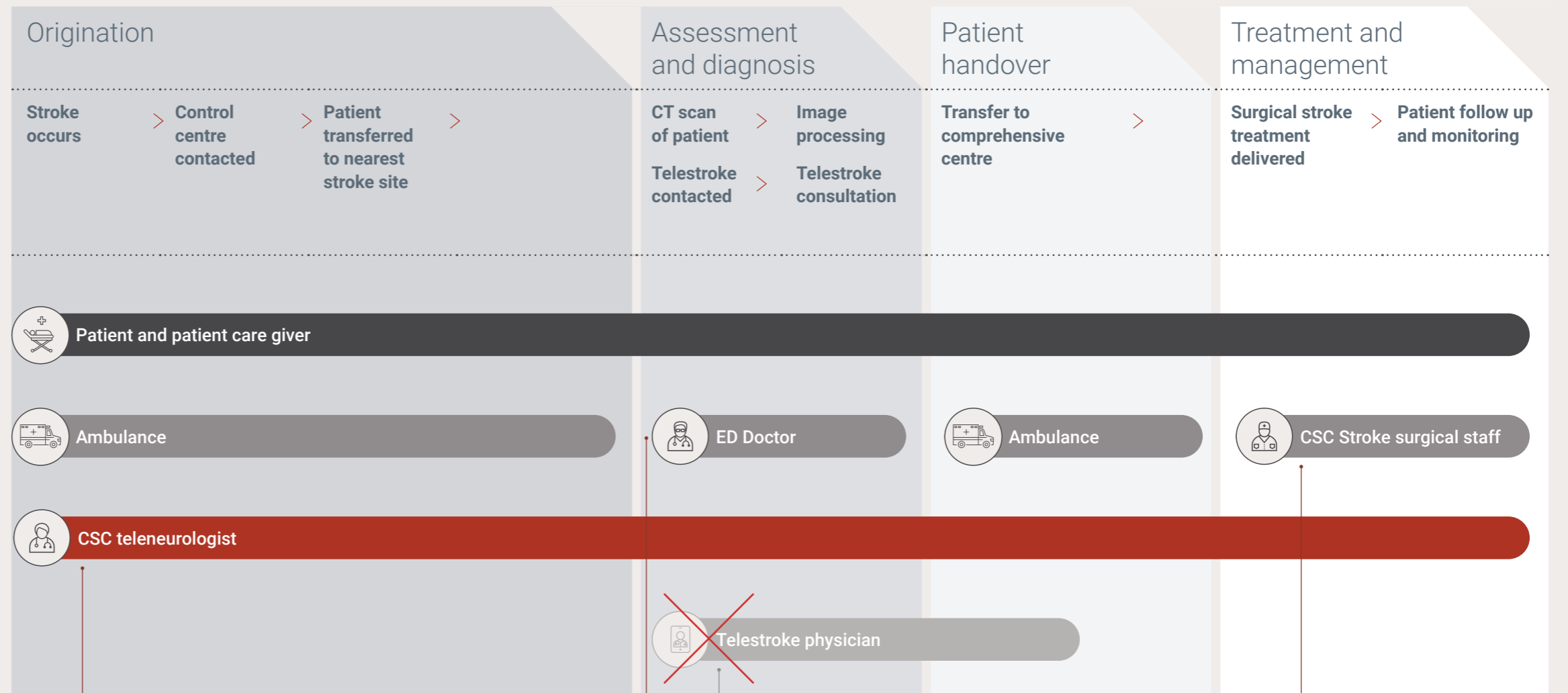
\*The responsible party will lead the change management effort when evolving or implementing an activity, but stakeholders must be involved for the process to succeed

Section 5: Recommendations

A reconfigured telestroke service will provide continuous care for regional patients



HYBRID MODEL PATIENT JOURNEY



The patient journey for those who are transferred to a stroke centre lack continuity of care and are exposed to many issues along the way.

A hybrid local-regional telestroke model streamlines stroke patient treatment and care by combining the telestroke physician and the CSC neurologist which enables continuous care of the patient.

CSC neurologist now functions as a telestroke operator and the neurologist in charge of the patient once they arrive at the CSC, thus enabling better continuous care.

Too removed from patient treatment and thus functioned as an unnecessary middleman  
 Collaboration is smoother during telestroke consult due to strong relationship with CSC

Having an existing relationship with the neurologist allows for a smoother transition to surgery.

**Section 5: Recommendations**

Timely clinical participation of INRs in a truly multidisciplinary telestroke model further optimises the hybrid-regional model

This report considers the incremental benefit that can be achieved for the proposed hybrid model by better involving INRs in diagnostic, treatment and care discussions, taking a multidisciplinary approach to Telestroke.



## Section 5: Recommendations

# Timely involvement of INRs in a multidisciplinary telestroke service could add \$220M in benefit to the proposed hybrid telestroke model

### THERE IS STRONG EVIDENCE THAT EARLY INVOLVEMENT OF INRs IN DIAGNOSING AND TREATING HIGH-RISK STROKES DELIVERS BETTER OUTCOMES

- > INRs are pre-eminent experts and have a critical role to play in the comprehensive diagnosis and treatment of high-risk stroke types. However, INRs are not proactively engaged as part of a multidisciplinary team in NSW's centralised telestroke model, which has impacted patient care and clinical relationships across the network
- > Some parts of NSW, including John Hunter and Liverpool are already taking a multidisciplinary approach to stroke care, where CSCs are contacted directly and INRs are jointly involved in stroke patient diagnosis and treatment decisions – particularly for high-risk ischaemic stroke patients that are due to large vessel occlusions (LVO) which represent anywhere up to 24% to 46% of all ischaemic strokes
- > Other jurisdictions that have adopted a multidisciplinary, regionalised approach (Vic, Gold Coast), have delivered improved patient outcomes, a more satisfied INR workforce and more efficient allocation of resources

### TIMELY INVOLVEMENT OF INRs COULD BRING THE TOTAL BENEFIT OF THE PROPOSED HYBRID-REGIONAL TELESTROKE MODEL TO \$2.9B OVER 10 YEARS

- > The timely clinical participation of INRs as part of an integrated stroke response team enables greater outcomes for stroke patients through more accurate diagnoses and expedited treatment pathways. This delivers \$93M of quality adjusted life years, \$118M in improved labour force productivity, and \$8.6M of reduced hospital costs (over a 10-year period)
- > This approach enhances the professional development of INRs and other local clinical team members through integrated case-based learning, enabling a more fulfilling role and workplace experience for INRs
- > Frontline INR activity also provides equity of access to INR specialty for regional hospitals, enabling greater opportunities for collaboration, relationship building, learning and development and capacity building in the regions, as regional clinical staff have a chance to engage directly with INR expertise

### FOUR KEY REQUIREMENTS HAVE BEEN IDENTIFIED TO ENABLE THE BENEFIT OF TIMELY INR INVOLVEMENT IN THE PROPOSED HYBRID-REGIONAL MODEL




1. Building INR capability and capacity in regional 'hubs' (such as Wollongong) to ensure regional areas are better equipped to serve areas of high LVO concentration
2. Available technology should be leveraged to ensure that the capacity of the existing INR workforce is prioritised appropriately – for the benefit of patients as well as sustainability of the INR workload
3. Dedicated training and development for how INRs and Neurologists will work together under the new model will improve the consistency of clinical involvement for INRs across the network
4. Investment in succession planning is required to overcome existing challenges to building a sustainable INR workforce to meet future demand - this requires:
  - Reviewing the clinical caseload of INRs and exploring opportunities to increase this (in line with CCINR standards)
  - Investing in a dedicated rotational training program for INRs to build capabilities across the network, including coordination of the administrative components of INR fellowship training
  - Campaigning for investment in INR training positions in strategic regional hubs (like Wollongong) to ensure appropriate and equitable distribution of future INR workforce across the state

**Section 5: Recommendations**

Proactively involving INRs in patient decision-making helps reduce the delay of treatment, enabling \$220M of benefits over 10 years

By involving INRs earlier in LVO patient decision-making processes, pathways to EVT can be expedited.

Consultations with INRs and clinical staff were clear: involving INRs earlier in patient decision-making as part of rapid response teams is likely to reduce time to treatment by an average of 10 minutes (conservative estimate), which enables these benefits

			
<b>Value</b>	\$93M	\$118M	\$8.6M
<b>Benefit</b>	Quality Adjusted Life Years	Improved economic contributions from patients recovering from stroke	Improved system productivity from quicker patient discharge
<b>Description</b>	The value of improved quality of life from reducing treatment times for LVO patients.	The value of economic activity from expediting the treatment and return to work of patients with LVOs.	The money saved by hospitals from discharging patients earlier, due to quicker EVT for LVO patients.

NB: The multidisciplinary approach also minimises the misdiagnosis of patients and their deployment along incorrect patient care pathways. This will reduce healthcare costs and alleviate the financial burden on patients and their families – these benefits have not been quantified here. For a breakdown of the calculation logic, please reference the Appendix

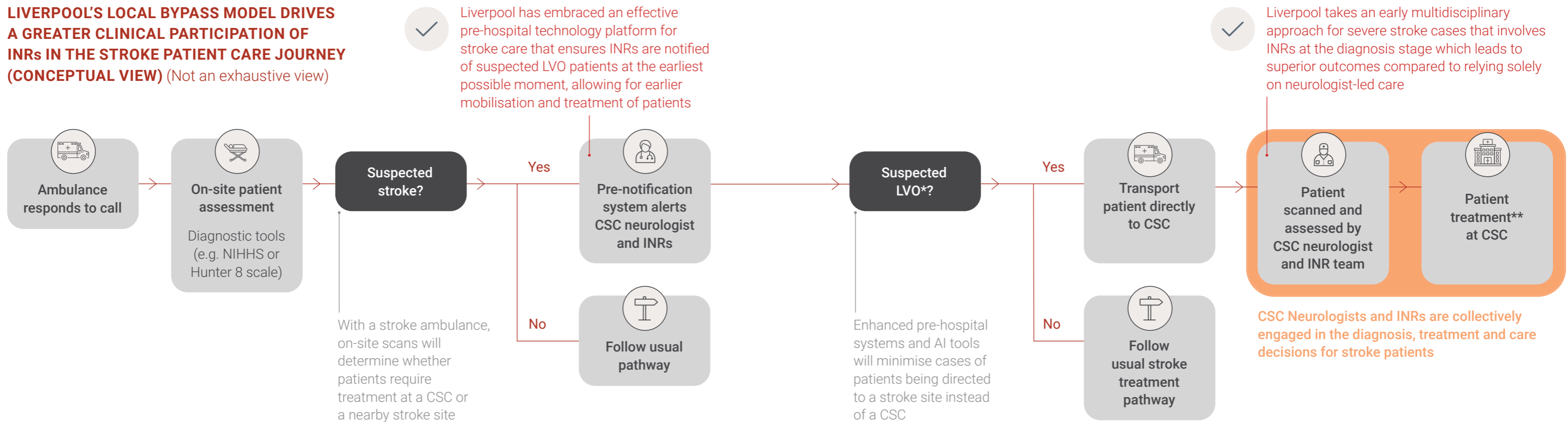


**Section 5: Recommendations**

Liverpool and John Hunter are trialling a localised Telestroke approach, where CSCs are contacted directly, and INRs are involved earlier

This approach is similar to the Victorian and Gold Coast models and is indicative of the newly proposed hybrid model – this can be scaled to enable better patient outcomes over a larger region.

**LIVERPOOL'S LOCAL BYPASS MODEL DRIVES A GREATER CLINICAL PARTICIPATION OF INRs IN THE STROKE PATIENT CARE JOURNEY (CONCEPTUAL VIEW)** (Not an exhaustive view)



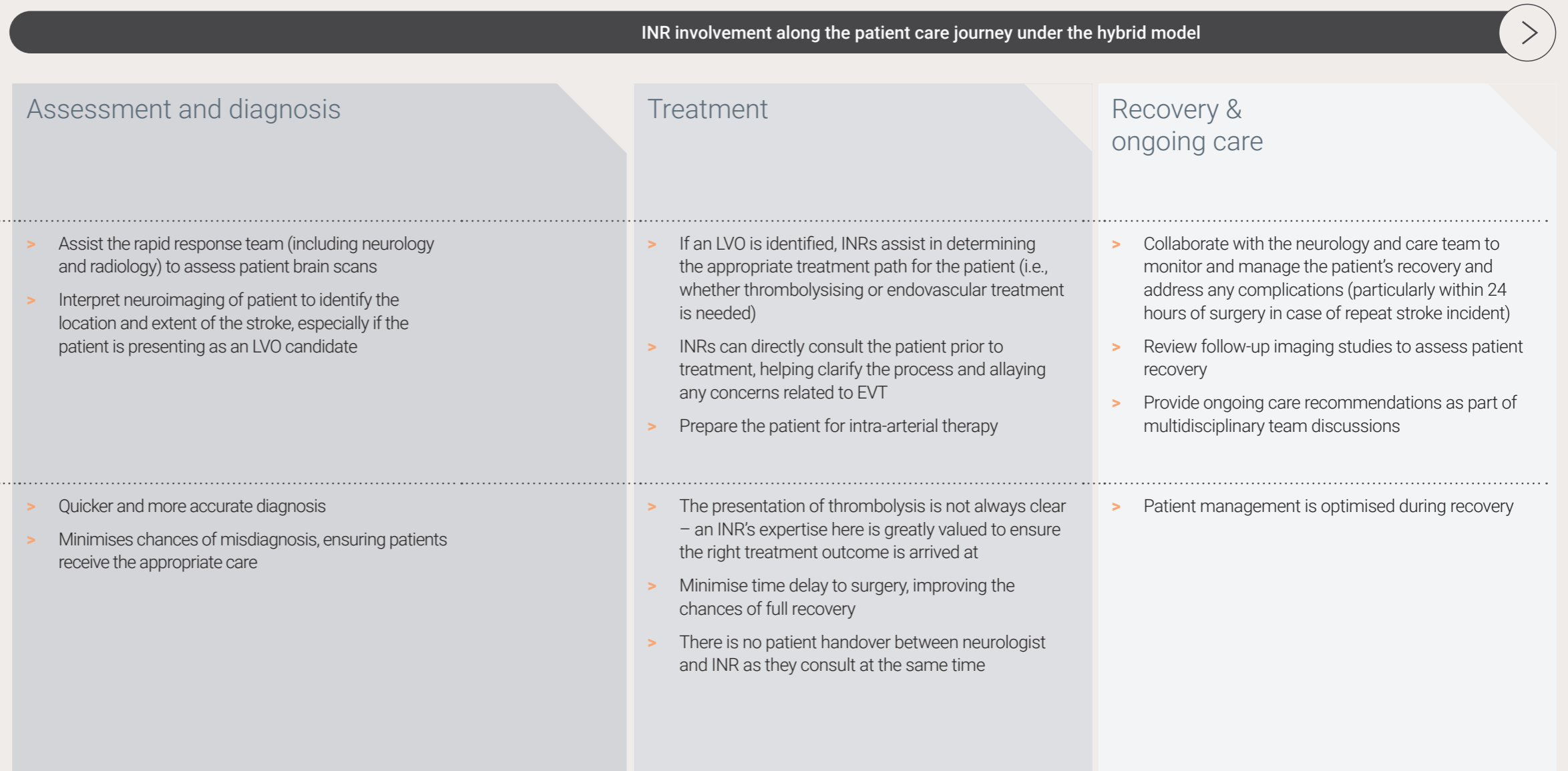
Evidence supporting the early involvement of INRs in diagnosis and care: There is strong evidence that early involvement of INRs as part of a multidisciplinary clinical team in diagnosing and treating high-risk strokes delivers better outcomes

**Section 5: Recommendations**

This is a truly multidisciplinary approach to stroke patient care and enables improved patient outcomes

The INRs have a critical role to play in the diagnosis, treatment and ongoing care of LVO patients –there is clear rationale for involving them more proactively in these clinical decisions under the new model

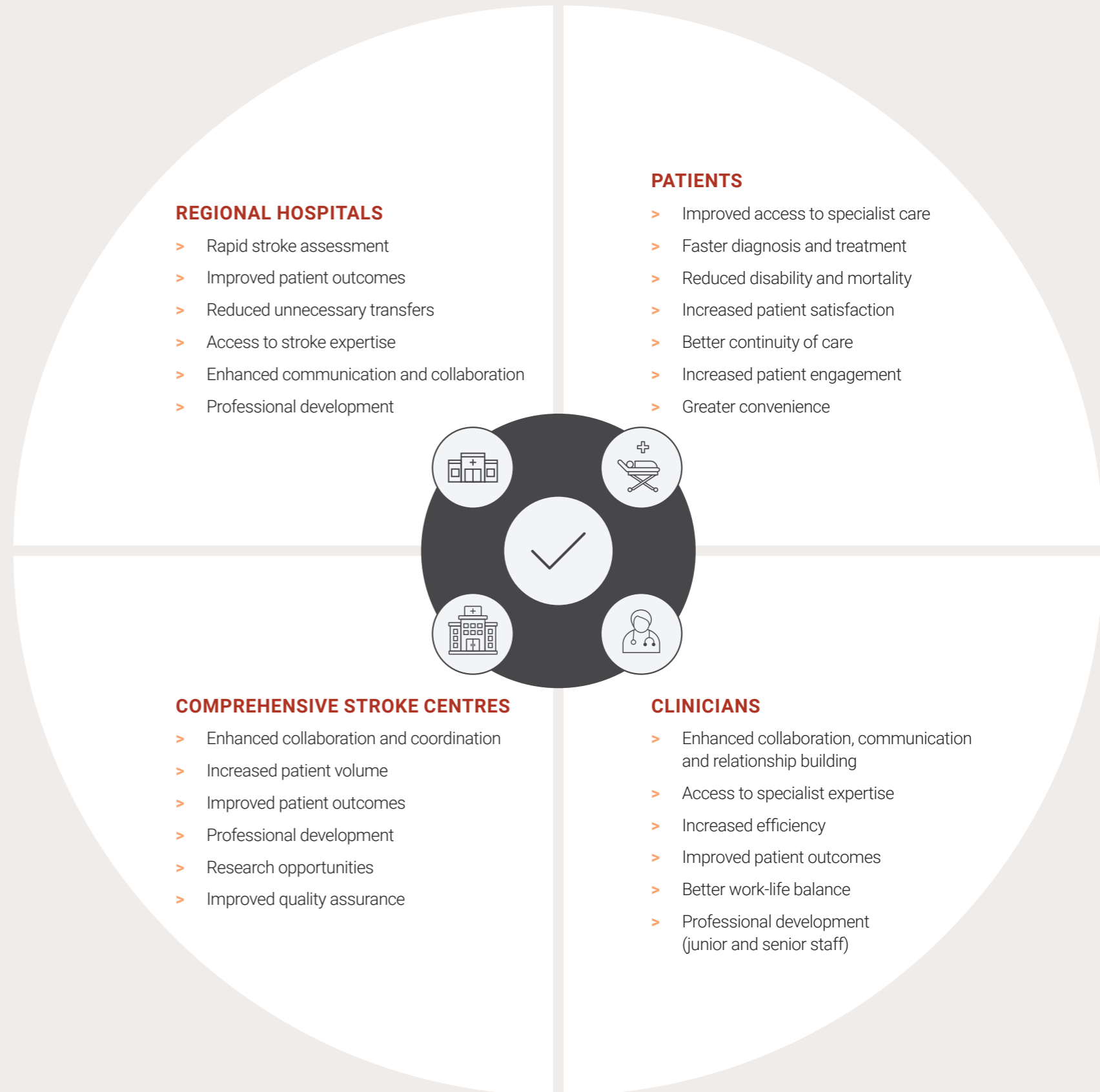
**WHERE A PATIENT PRESENTS AS AN LVO CANDIDATE AN INR SHOULD BE PROMINENT ACROSS THE PATIENT CARE JOURNEY ONCE THEY ENTER THE HOSPITAL**



**Section 5: Recommendations**

A sustainable hybrid regional model delivers many benefits to key stakeholders

Benefits of a Regional Hybrid Model to Key Stakeholder Groups:



**Section 5: Recommendations**

Investing in a regional telestroke model can facilitate the integration of novel paramedic-led models of care such as the Stroke Smart Ambulance pilot

The Stroke Smart Ambulance pilot program commenced in December, and is already delivering faster access to life-saving interventions for patients, streamlined clinical pathways, and improved equity in patient access, particularly in regional areas.

**INVESTMENT IN THE REGIONAL TELESTROKE MODEL WILL ENABLE PLUG-IN OF NEW PARAMEDIC-LED MODELS OF CARE**

Stroke Smart Ambulance pilots are now active across NSW and VIC<sup>1</sup> in 14 regions, 82 vehicles, 1050 paramedics, 130 teams and 153 stroke patients<sup>2</sup>.

The pilots are patient-centred, paramedic-led and neurologist-enabled.

The Hunter region is at the epicentre of the NSW pilot, testing ambulances with digital telehealth enabled care and additional portable brain scanning equipment.

The pilot is using advanced telehealth which is a transformative telestroke platform designed to improve efficiency and accessibility of stroke treatment.

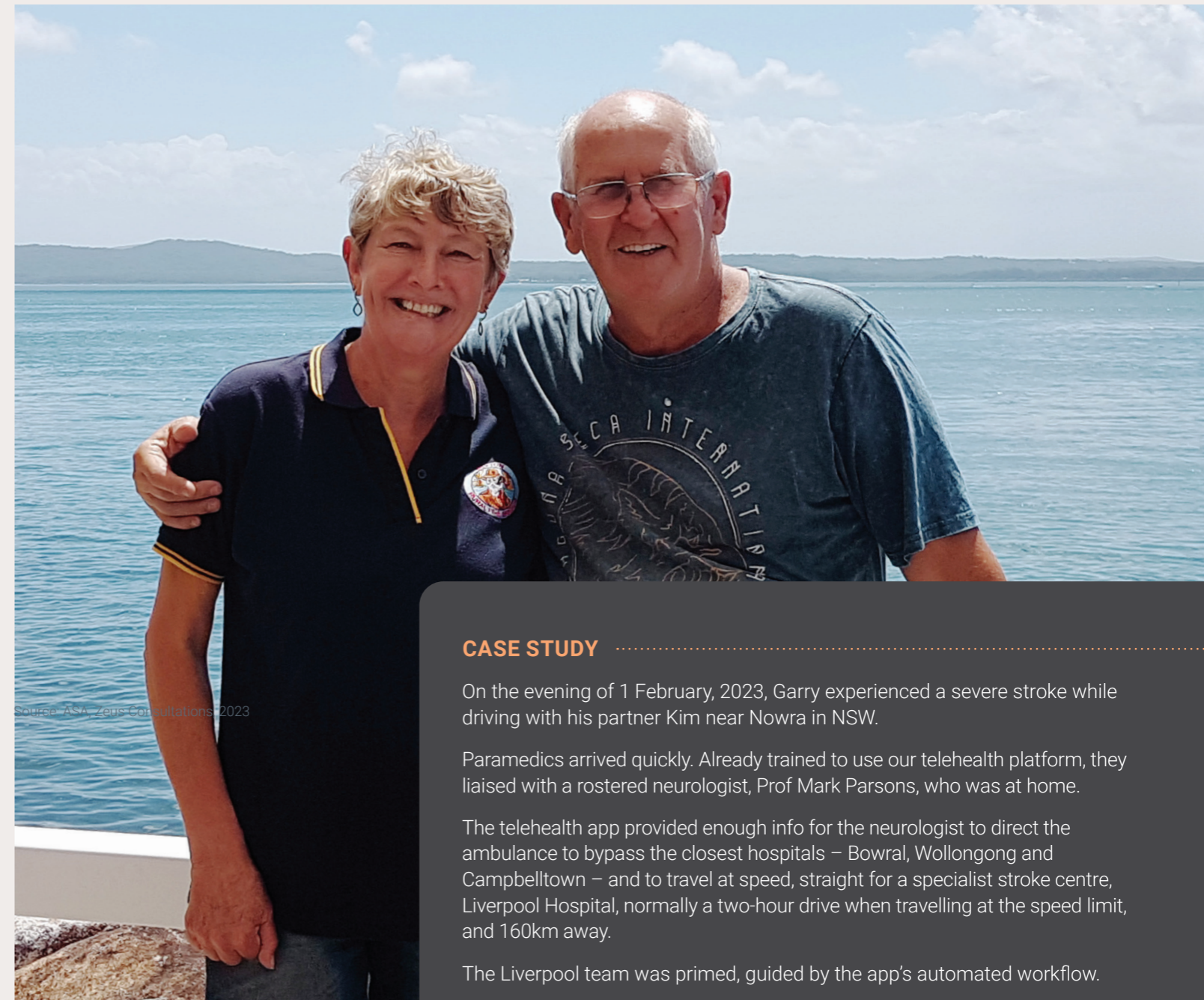
The technology provides healthcare workers such as remote stroke clinicians, emergency medical services and hospitals with virtual access to stroke specialists to diagnose and treat suspected stroke patients.

**EMERGING LOCO-REGIONAL STATISTICS FROM THE PILOT:**

- ✓ **Over 60% reduction in the time** to thrombectomy for Ischemic Stroke to a median of 2.1 hours from over 5 hours as a result of the advanced pre-notification through the study app
- ✓ **Reduced inter-hospital transfers** through introducing a bypass protocol with 90% efficiency and accuracy
- ✓ **Over 50% reduction** in door to needle time, from 60-90 minimum to 31 minutes on arrival
- ✓ **50% reduction in time** to groin (pre and post) to 2.36 hours from 5.46 hours
- ✓ **Over 50% reduction** stroke onset to treatment time from a 3-hour minimum to 90 minutes
- ✓ **Increased workflow efficiency** through reducing the number of handovers between paramedics and hospitals



1 NSW pilot commenced December 2022, with 650 paramedics, 70 teams, and 127 stroke patients, and Victoria commenced March 2023 with 400 paramedics, 60 teams and 26 stroke patients  
 2 Paramedics currently need to opt in to the pilot program, should more paramedics opt in the benefits could be accelerated



**CASE STUDY**

On the evening of 1 February, 2023, Garry experienced a severe stroke while driving with his partner Kim near Nowra in NSW.

Paramedics arrived quickly. Already trained to use our telehealth platform, they liaised with a rostered neurologist, Prof Mark Parsons, who was at home.

The telehealth app provided enough info for the neurologist to direct the ambulance to bypass the closest hospitals – Bowral, Wollongong and Campbelltown – and to travel at speed, straight for a specialist stroke centre, Liverpool Hospital, normally a two-hour drive when travelling at the speed limit, and 160km away.

The Liverpool team was primed, guided by the app’s automated workflow.

Garry was scanned and treated with clot-busting meds within 31 minutes of arrival – a record for the busy hospital which receives four stroke patients a day.

Just 90 minutes elapsed from stroke onset to treatment.

Garry has completely recovered and is pictured here on holiday with his partner Kim, just 17 days after his stroke.

This is the future of advanced prehospital stroke care.

World leading. Economical. Life-saving.

Section 5: Recommendations

Investing in paramedic-led novel technologies now will deliver six key benefits by 2027



Key benefits to be realised through investing now:

1	2	3	4	5	6
Efficiencies in workflow	Cost and risk reduction	Enhance the resilience and preparedness of healthcare facilities	Regional collaboration and innovation	Improve scalability and interoperability	Futureproof infrastructure delivery
Digitisation of the acute stroke workflow and connection between all clinical stakeholders to improve time to treatment and patient outcomes.	Create an environment for new trials and models of care with a focus on 'continuous improvement'. This approach will de-risk and reduce the cost of future investments in enabling platforms in the acute and hyperacute setting.	Future-proof key remote and regional hubs for engagement with expanded health service delivery and strengthens our health partners ability to engage with future research	Will establish the basis of a Regional Innovation Consortium, led by JHH and reflecting the program's dedication to centring regional and remote community needs.	Ecosystem enabled for future developments to activate other parts of Australia as new Primary and Local Health Networks to join the larger national roadmap.	Lay the infrastructural foundations for the future prehospital ecosystem, not just for stroke but in prehospital cardiac and mental health care and beyond.

**Section 5: Recommendations**

## Implementation of a novel model of care across NSW could deliver significant social and economic benefit

The NSW pilot’s success indicates significant benefit for regional and remote NSW stroke patients, from deploying a Regional Telestroke Model.

**EARLY INDICATION OF BENEFITS THAT COULD BE REALISED (10 YEARS):**

REGIONAL TELESTROKE MODEL – BENEFIT ESTIMATE (2023-2032)

	Impact	Benefit	
<b>\$1.5B</b> <b>Estimated economic benefit</b> (2023-2032) Improved Stroke-Related Outcomes*	Healthy life years gained	Reduced mortality from treatment time improvement	<b>\$666M</b> (2023-2032)
	Workforce Productivity	Increased labour force productivity from treatment time improvement	<b>\$849M</b> (2023-2032)
	Reduced burden on hospital	Reduced cost of bed day from onset-to-puncture time improvement	<b>\$6.5M</b> (2023-2032)



**OVERALL OUTCOME:**

- > In NSW’s telehealth trial, patients are treated faster through reducing interhospital transfers and improving treatment times

**HEALTHY LIFE YEARS GAINED OUTCOMES:**

- > For every 15-minute treatment time improvement, patients gain one month of healthy life
- > Stroke victims therefore have increased life expectancy and can participate in the workforce for longer

**REDUCED BURDEN ON HOSPITAL OUTCOMES:**

- > For every 60-minute decrease in onset-to-puncture, 10% more patients can be discharged home
- > The burden on the NSW health system will be alleviated through a reduction in bed days for stroke victims

Note: This model is an early indication of the benefits to Regional and Remote NSW stroke patients arriving for thrombectomy via ambulance and further work should be completed when more data is available.

\* Stroke incidence numbers sourced from Deloitte – No Postcode Untouched (2020) and only include large artery occlusion ischaemic strokes (ECR/thrombectomy), arriving via ambulance in Regional and Remote NSW, at a 60% market penetration rate

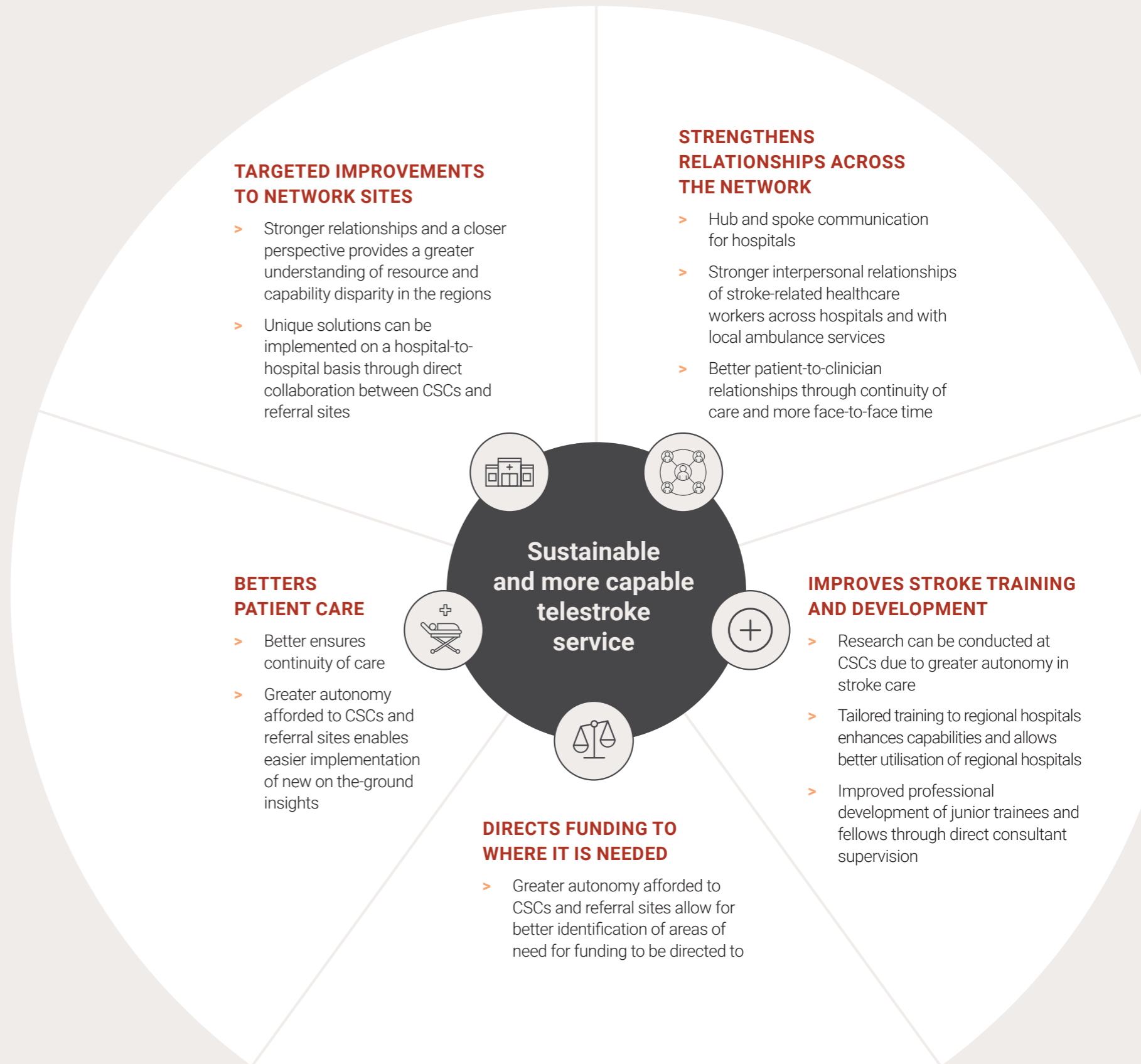
Note: If all paramedics opt in and telehealth can penetrate 100% of cases, the benefits could almost double in 10 years

**Section 5: Recommendations**

**A hybrid regional model provides improvements to the network**

Implementing the hybrid regional model will result in a sustainable telestroke service that improves the capability of the network and the outcomes of all stakeholders.

**Benefits of the Hybrid Regional Model:**



## SECTION 6:

# Implementing the hybrid regional model

- > A phased approach
- > Addressing the risks
- > Updated hybrid-regional telestroke benefit numbers
- > Benefits driver tree
- > Calculation Logic
- > Assumptions used for benefits calculations.



## A LIFE IN THE BALANCE

Charlotte, 34, experienced a stroke while at work. The mother of four children, and a proud Wiradjuri woman from Condobolin, was not diagnosed for more than 20 hours and experienced two hospital transfers.



**Section 6: Implementing the Hybrid Regional Model**

A phased approach should be considered in implementing the revised model

	<b>Immediate priorities</b>	<b>Within the next 12 – 18 months</b>	<b>Timing to be confirmed</b>
<b>Phase tasks</b>	<p>Pilot John Hunter as a regional Hub for 12 months</p> <p>Establish John Hunter Hospital as a pilot regional hub that operates its own 24/7 telestroke service for the Northern region of NSW</p> <p>Referral sites designated to the northern region will access John Hunter’s telestroke service</p>	<p>Move Liverpool/ Prince of Wales onto the hybrid regional structure</p> <p>Establish Liverpool Hospital and Prince of Wales Hospital as a regional hub to service the Southern region.</p> <p>Referral sites designated in the Southern region will now access Liverpool’s telestroke service</p>	<p>Transition the whole network to a Regional Hybrid structure</p> <p>Establish Royal Prince Alfred Hospital as a regional hub that operates its own 24/7 telestroke service for the Western region of NSW</p> <p>Ensure that referral sites in the Northern and Southern regions are seeing their capabilities built up with assistance from their regional hubs</p>
<b>Phase outcomes</b>	<ul style="list-style-type: none"> <li>&gt; Measure the performance of the pilot program</li> <li>&gt; Determine areas of improvement</li> <li>&gt; Track lessons learnt to enable easier regional transitions for the South and West regions</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Measure the performance of the two regions</li> <li>&gt; Establish sessions of shared learning between CSCs and referral sites in the region</li> <li>&gt; Northern referral sites seeing development</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Measure the performance of all regions</li> <li>&gt; Referral sites are seeing their stroke capabilities developed</li> </ul>

**Section 6: Implementing the Hybrid Regional Model**

More investment in succession planning is required to overcome existing challenges to building the future INR workforce

**SOLUTIONS TO BE CONSIDERED TO IMPROVE SUCCESSION PLANNING OF INRs UNDER THE NEW MODEL**

Current challenge	Suggested solution	Implication
Significant clinical experience Requirements	<ul style="list-style-type: none"> <li>&gt; Expand clinical tasks across the network so INRs and fellows have more opportunities to maintain accreditation</li> <li>&gt; Map existing activities against accreditation requirements</li> <li>&gt; Identify eligible clinical activities and opportunities to work with other medical professionals to drive greater INR involvement</li> <li>&gt; Expand the remit for INRs and fellows into stroke fields outside LVO diagnosis and treatment.</li> </ul>	Greater opportunities for clinical practise and accreditation
Limited availability of mentorship and a state-wide rotational training program	<ul style="list-style-type: none"> <li>&gt; Invest in a statewide INR training program to develop capability, rotating trainees through accredited hospitals for 6-12 month intervals</li> <li>&gt; Align with other health specialist training programs to build relationships, quality assurance and succession planning across the network</li> <li>&gt; Invest in administration of the training program across the CSC network to lift admin responsibilities from time-poor INRs</li> </ul>	Provide greater capacity for dedicated training
INR fellows are not equitably distributed across the healthcare network	<ul style="list-style-type: none"> <li>&gt; Drive investment in INR training positions in regional areas where heavier LVO caseload occur (per capita)</li> <li>&gt; Redistribute the INR workforce more equitably across NSW and enable strategic succession planning.</li> </ul>	More equitable distribution of INRs across the network

Investments in succession planning will ultimately ensure the sustainability of the INR's clinical responsibilities under the hybrid model

**Section 6: Implementing the Hybrid Regional Model**

Technology innovations should be leveraged to ensure the limited capacity of INRs is focused on tasks of critical value

**Pre-hospital notification systems for stroke response teams**

**Description**

A pre-hospital technology platform facilitates the provision of medical care to patients before they reach a hospital by providing the following:

- > Effective communication between paramedics, emergency department healthcare providers, hospitals, and specialist consultants
- > Facilitating data sharing of patient records to hospital staff and live documentation
- > Diagnostic tools to enable pre-hospital diagnosis of patient conditions
- > Patient monitoring systems that provide real-time updates on patient conditions
- > Clinical decision support systems to provide real-time guidance on patient care

Pre-hospital systems will need to meet some minimum requirements:

- > Secure and reliable data transmission
- > Real-time communication
- > Patient information management
- > Documenting and reporting
- > Medical imaging integration
- > Customisable notification system
- > Device and system compatibility
- > User-friendly
- > Scalable
- > Continuous support

**Implication**

- > **INRs:** INRs can be seamlessly notified of likely LVO candidates before they are transported to hospital EDs, giving them adequate time to prepare for interpreting brain scans
- > **Patients:** Improved patient outcomes due to streamlining information sharing that occurs in real-time

**Leverage available AI software**

The integration of AI tools into healthcare has improved patient care and should continue to be leveraged and scaled across regional areas:

- > The use of AI tools helps to speed up diagnosis across clinical services and can help clinicians personalise patient care<sup>1</sup>
- > Artificial intelligence can help with various aspects of the stroke treatment paradigm, including infarct or haemorrhage detection, segmentation, classification, large vessel occlusion detection, Alberta Stroke Program Early CT Score grading, and prognostication<sup>2</sup>
- > This helps better triage patients for early and appropriate INR intervention (system is currently in use in QLD)
- > AI tools will act as an enabler for more effective and efficient stroke patient treatment and tool choice must be approached agnostically as to select the most effective AI solution and to ensure its consistent usage across the state or region

- > **INRs:** Enhanced diagnostic accuracy which allows INRs to only be notified when they're needed for major stroke patients
- > **Patients:** Faster diagnosis which leads to faster treatment and better outcomes

Where available, technology should be leveraged to stratify patients for early INR intervention.

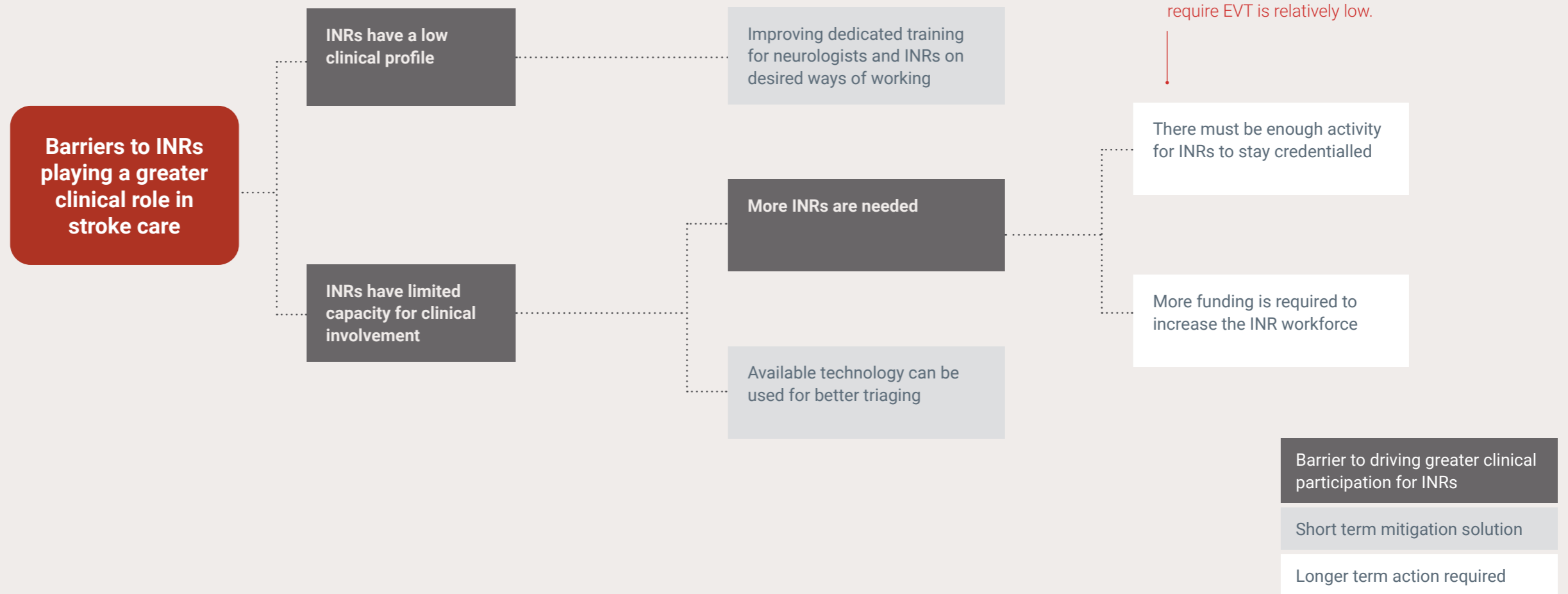
**Section 6: Implementing the Hybrid Regional Model**

There are existing barriers to this approach being adopted across the hybrid model, some of which can be mitigated in the short term

Enhancing the clinical presence of INRs in the diagnostic, treatment and care decisions for LVO patients is critical to optimising patient care – understanding which levers can be pulled to influence this is key to driving the implementation of this role under the hybrid model.

Improving training of neurologists so they better understand when to bring INRs into these discussions and leveraging available technology are clear and immediate pathways to ensuring this greater clinical role for INRs is upheld under the hybrid model

**BREAKDOWN OF KEY DRIVERS OF BARRIERS TO DRIVING GREATER CLINICAL PARTICIPATION OF INRs ACROSS THE HYBRID MODEL (CONCEPTUAL VIEW)**



### Section 6: Implementing the Hybrid Regional Model

There are a number of key risks to address

	Risk	Likelihood	Impact	Mitigation Strategy
1	<p><b>Not making a change will continue to erode relationships across the network</b> and result in burnout and fatigue of the small roster of telestroke physicians who work at their local hospital and on the TSS</p>	High	High	<ul style="list-style-type: none"> <li>&gt; Deploying a regional model to strengthen the relationships across the network; CRC to hospitals, hospital to hospital, and patient to hospital/CRS</li> <li>&gt; Expand the telestroke roster and establish equity of opportunity for work</li> </ul>
2	<p><b>Comprehensive stroke centres not having the capability and resources to operate a regional service that improves upon the centralised service</b></p> <p>The telestroke services provided by comprehensive stroke centres do not meet the quality standards set by the centralised stroke service</p>	Low	High	<ul style="list-style-type: none"> <li>&gt; Commence with JHH and ensure key learnings and documented and fed through to other CSC</li> <li>&gt; Ensure senior leadership and administration at comprehensive stroke centres are qualified and trained to implement and sustain regional telestroke services</li> <li>&gt; Encourage collaboration between comprehensive stroke centre management and the centralised service to collaborate on implementing and improving regional telestroke services</li> </ul>
3	<p><b>Rostered telestroke neurologists continue to handle the majority of consultations in a region</b></p> <p>The regional telestroke services roster handles nearly all stroke consultation work, leaving little opportunity for other neurologists to enhance their skills</p>	Low	High	<ul style="list-style-type: none"> <li>&gt; Establish roster guidelines that ensure stroke neurologists work equal hours</li> <li>&gt; Reduce the experience requirement for telestroke physicians so that newer neurologists can participate</li> <li>&gt; Establish a senior telestroke physician role that focuses on training new telestroke physicians at each CSC</li> </ul>
4	<p><b>Cost increase</b></p> <p>Funding independent telestroke services for three separate regions increases costs</p>	Medium	Medium	<ul style="list-style-type: none"> <li>&gt; Review a regional hub's scope of work to identify opportunities to streamline processes</li> <li>&gt; Revise the telestroke physician remuneration so that they are paid per stroke consultation rather than per hour VMO payments to doctors who are already paid to work at their local hospitals</li> <li>&gt; Identify regional partners to co-sponsor improvements at referral sites where investment leads to benefits beyond stroke care</li> </ul>
5	<p><b>Regional telestroke services are overwhelmed</b></p> <p>A surge in regional telestroke service demand overwhelms the regional telestroke service</p>	Low	High	<ul style="list-style-type: none"> <li>&gt; Ensure that each comprehensive stroke centre has more than one back up telestroke physician</li> <li>&gt; Maintain a skeleton centralised telestroke service that can be called upon during sudden surges in regional demand</li> </ul>

**Section 6: Implementing the Hybrid Regional Model**

Timely involvement of INRs could bring the total benefit of the proposed hybrid-regional telestroke model to \$2.9B over 10 years

The incremental benefits of driving greater clinical participation of INRs have been calculated.

Overall, benefits increase from \$2.7B to \$2.9B

**EARLY INDICATION OF BENEFITS THAT COULD BE REALISED (10 YEARS):**

REGIONAL TELESTROKE MODEL – BENEFIT ESTIMATE (2024-2033)

			Benefits of moving to a Hybrid Model	Benefits of driving greater clinical participation of INRs
<b>\$2.9B</b> <b>Estimated economic benefit</b> (2024-2033) Improved Stroke-Related Outcomes	Healthy life years gained	Reduced mortality from treatment time improvement	<b>\$1.17B</b> (2024-2033)	<b>\$93M</b> (2024-2033)
	Workforce Productivity	Increased labour force productivity from treatment time improvement	<b>\$1.45B</b> (2024-2033)	<b>\$118M</b> (2024-2033)
	Reduced burden on hospitals	Reduced cost of bed day from onset-to-puncture time improvement	<b>\$108M</b> (2024-2033)	<b>\$8.6M</b> (2024-2033)

SECTION 7:

# Appendix



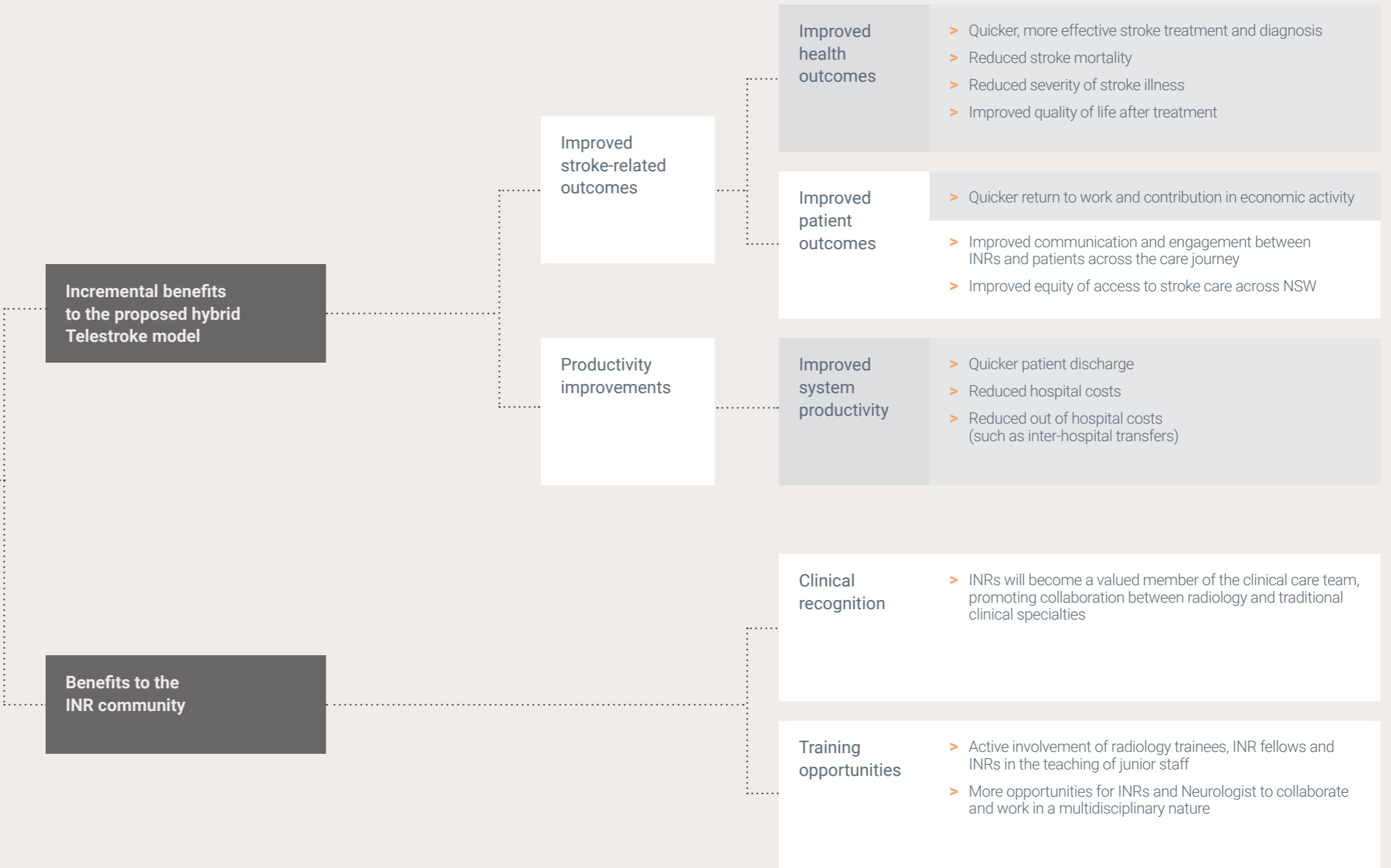
Section 7: Appendix

Driving greater clinical participation of INRs in the care of stroke patients enables incremental benefits

**THE INCREMENTAL BENEFITS OF INCREASING THE CLINICAL PARTICIPATION OF INRs**

- Quantifiable
- Qualitative

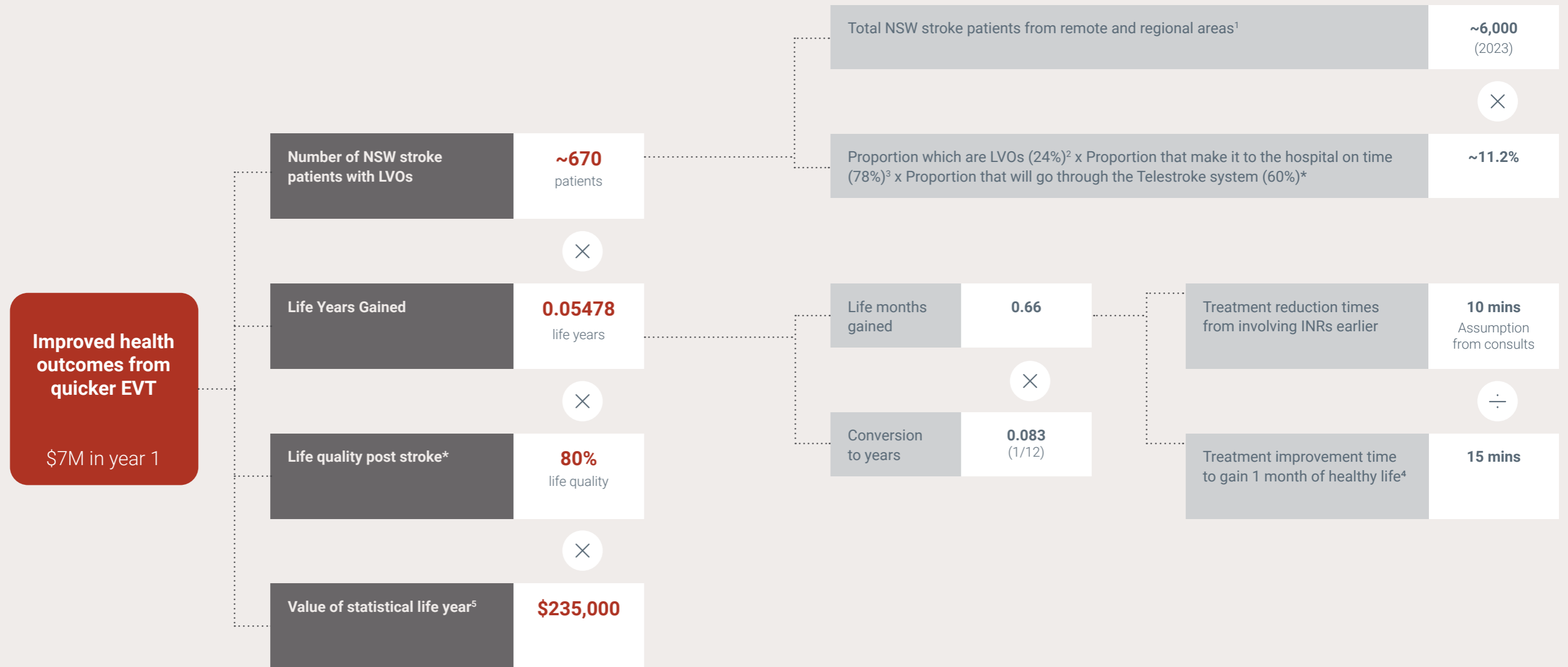
**The incremental benefits of increasing clinical participation of INRs along the Telestroke patient journey**





Section 7: Appendix

Calculation logic – Improved health outcomes from quicker EVT

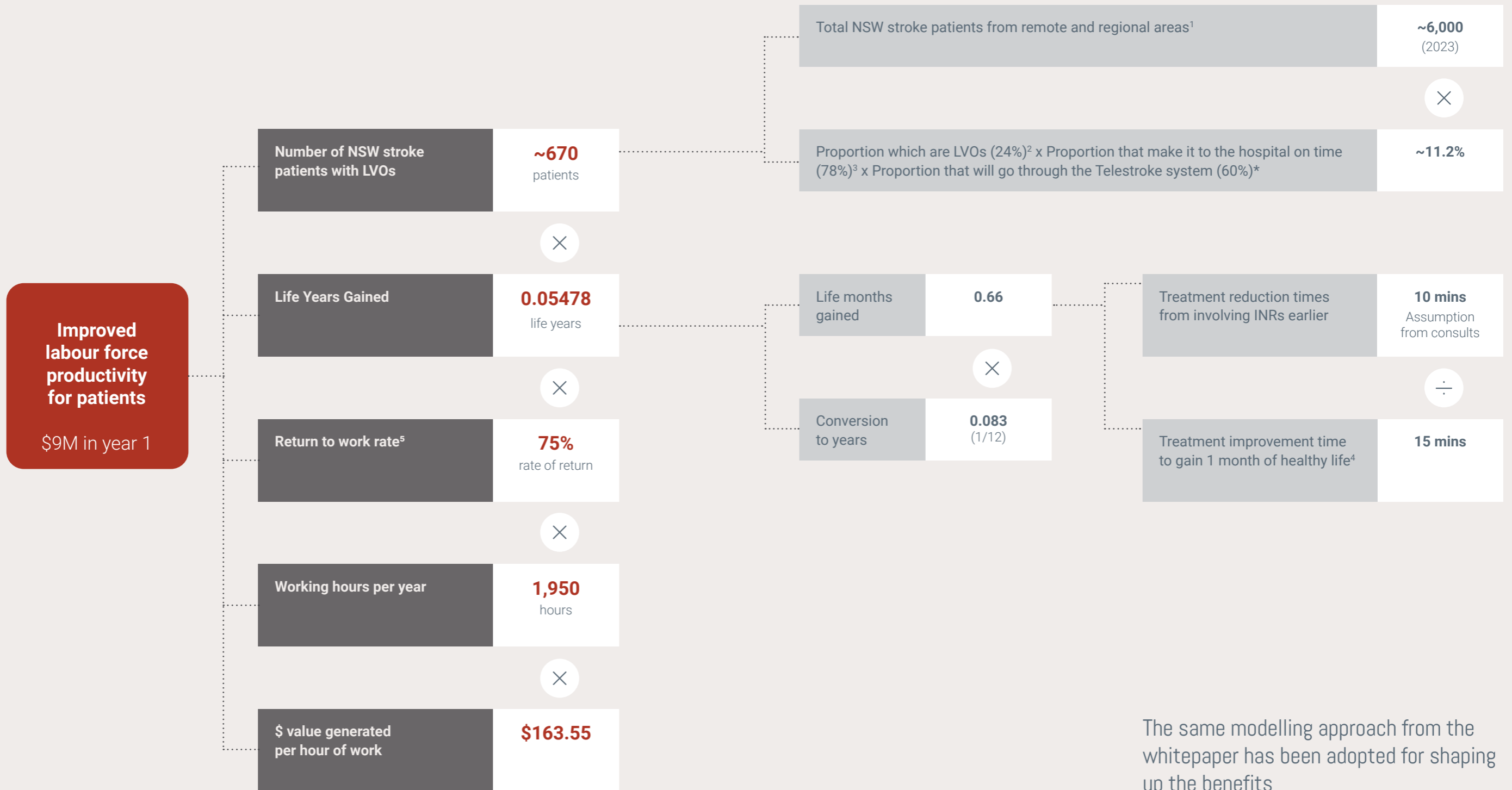


The same modelling approach from the whitepaper has been adopted for shaping up the benefits

Source: <sup>1</sup> "No Postcode Untouched Stroke in Australia 2020", Deloitte, November 2020. <sup>2</sup> "Access to Mechanical Thrombectomy in Australia", Stryker, March 2023. <sup>3</sup> "Annual Report 2021", Australian Stroke Clinical Registry, December 2022. <sup>4</sup> "Stroke thrombolysis: save a minute, save a day", Meretoja, Atte et al, March 2014. <sup>5</sup> "Value of a statistical life", AU Govt Department of the Prime Minister and Cabinet, October 2023. \* SPP Assumption.

Section 7: Appendix

Calculation logic –  
Improved labour force productivity for patients

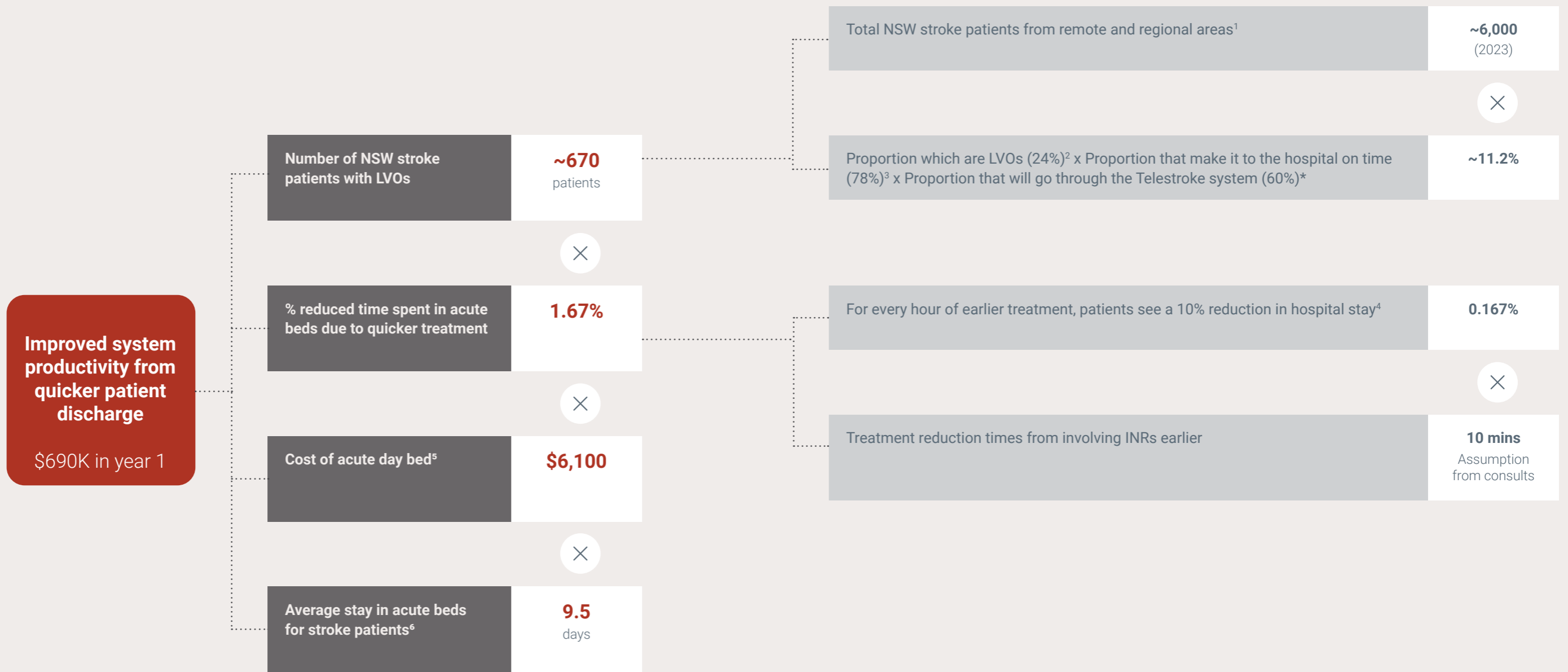


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Source: <sup>1</sup>"No Postcode Untouched Stroke in Australia 2020", Deloitte, November 2020. <sup>2</sup>"Access to Mechanical Thrombectomy in Australia", Stryker, March 2023. <sup>3</sup>"Annual Report 2021", Australian Stroke Clinical Registry, December 2022. <sup>4</sup>"Stroke thrombolysis: save a minute, save a day", Meretoja, Atte et al, March 2014. <sup>5</sup>"Returning to paid employment after stroke: the Psychosocial Outcomes In Stroke (POISE) cohort study", Hackett, Maree L et al, July 2012. \* SPP Assumption.

Section 7: Appendix

Calculation logic –  
Improved system productivity from quicker EVT



Source: <sup>1</sup> "No Postcode Untouched Stroke in Australia 2020", Deloitte, November 2020. <sup>2</sup> "Access to Mechanical Thrombectomy in Australia", Stryker, March 2023. <sup>3</sup> "Annual Report 2021", Australian Stroke Clinical Registry, December 2022. <sup>4</sup> "Stroke thrombolysis: save a minute, save a day", Meretoja, Atte et al, March 2014. <sup>5</sup> "National Hospital Cost Data Collection (NHDC) Public Sector Report 2020-21", IHACPA, June 2023. <sup>6</sup> "Australian Atlas of Healthcare Variation 2015", Australian Commission on Safety and Quality in Health Care, 2015. \* SPP Assumption.

## Section 7: Appendix

## Assumptions used for benefits calculations (1/2)

	Data Point	Value	Units	Source	Comments
<b>Global assumptions</b>	Minutes in an hour	60	minutes		
	Months in a year	12	months		
	Weeks in a year	52	weeks		
	Hours of work in a week	37.5	hours		
	USD:AUD conversion rate	1.53	\$(AUD)	<a href="https://www.xe.com/currencyconverter/convert/?Amount=1&amp;From=USD&amp;To=AUD">https://www.xe.com/currencyconverter/convert/?Amount=1&amp;From=USD&amp;To=AUD</a>	2023, August 9 conversion rate
	Treatment improvement time to gain a month of healthy life	15	minutes	Stroke thrombolysis: save a minute, save a day	Stat also mentioned in 'NSW Stroke Ambulance pilot model of care' October 2022
	Inflation rate (10 year)	3.00%	percentage	Consultation with ASA (2023)	
	Market penetration	60%	percentage	SPP Assumption	
	<b>Stroke case statistics by stroke type</b>	Haemorrhagic strokes	12%	Percentage of stroke cases	AUSCR 2021 Annual Report
Ischaemic strokes		85%	Percentage of stroke cases	AUSCR 2021 Annual Report	
Unknown strokes		3%	Percentage of stroke cases	AUSCR 2021 Annual Report	
Large artery occlusion ischaemic stroke		20%	Percentage of stroke cases	Consultation with ASA (2022)	
ECR/Thrombectomy		24%	Percentage of stroke cases	"Access to Mechanical Thrombectomy in Australia", Stryker, March 2023	24 to 48% of all ischaemic strokes are due to LVOs which require thrombectomy
<b>Patient hospital arrival type</b>	Ischaemic - Ambulance	78%	Percentage of stroke case type that arrive at hospital	AUSCR 2021 Annual Report	

## Section 7: Appendix

## Assumptions used for benefits calculations (2/2)

	Data Point	Value	Units	Source	Comments
<b>Value of life years gained</b>	Reduced time to thrombectomy	10	minutes	Conservative best guess in time saving by INRs in NSW	Conservative best guess in time saving by INRs in NSW
	Value of a statistical life year	\$235,000	\$(AUD)	<a href="https://oia.pmc.gov.au/resources/guidance-assessing-impacts/value-statistical-life">https://oia.pmc.gov.au/resources/guidance-assessing-impacts/value-statistical-life</a>	2023 value
	Quality of a life moderation	0.8	utility	SPP Assumption	It is assumed that the average stroke victim will have a quality of life lower than a healthy person
<b>Improved labour force productivity</b>	Haemorrhagic strokes	10	minutes	Conservative best guess in time saving by INRs in NSW	Conservative best guess in time saving by INRs in NSW
	Ischaemic strokes	75%	percentage	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3405015/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3405015/</a>	2012 study
	Unknown strokes	162.5	hours	SPP Calculation	Assuming 37.5 hours of work per week
	Large artery occlusion ischaemic stroke	103.78	\$(USD)	<a href="https://data.oecd.org/lprdy/gdp-per-hour-worked.htm">https://data.oecd.org/lprdy/gdp-per-hour-worked.htm</a>	2022 value
	ECR/Thrombectomy	158.78	\$(AUD)	SPP Calculation	2022 value - in AUD
<b>Reduced burden on hospital</b>	Reduced time to thrombectomy	10	minutes	Conservative best guess in time saving by INRs in NSW	Conservative best guess in time saving by INRs in NSW
	Increase in patients discharged home per 60-minute decrease in onset-to-puncture	10%	percentage	Impact of Time to Treatment on Endovascular Thrombectomy Outcomes in the Early Versus Late Treatment Time Windows (2023)	2023 study
	Cost of an acute care bed day	\$5,757	\$(AUD)	National Hospital Cost Data Collection (NHCDC) Public Hospitals Report 2020-21	2021 value
	Cost of an acute care bed day	\$6,108	\$(AUD)	SPP Calculation	2023 value
	Average length of stay (days)	9.5	days	<a href="https://www.safetyandquality.gov.au/sites/default/files/migrated/SAQ201_07_Chapter6_v7_FILM_tagged_merged_6-9.pdf">https://www.safetyandquality.gov.au/sites/default/files/migrated/SAQ201_07_Chapter6_v7_FILM_tagged_merged_6-9.pdf</a>	2013 value for patients 65 and over. PoW stay used. Assume this is representative of current conditions and for majority of stroke patients

Section 7: Appendix

Methodology

Value of life years gained

Stroke incidence numbers (NSW)\*



Months of healthy life gained

Decrease in thrombectomy time (mins)

15 mins

÷ 12



\$ value of a statistical life year

Life gained back by patients from faster thrombectomy (in \$)

Improved labour force productivity

Stroke incidence numbers (NSW)\*



Months of healthy life gained

Decrease in thrombectomy time (mins)

15 mins

Return to work rate

× 75%

Returning to Paid Employment after Stroke: The Psychosocial Outcomes In Stroke (POISE) Cohort Study (2012)

Number of working hours per month

× 162.5

Assuming 37.5 hours of work per week



\$ value generated per hour of work

Labour able to be generated by patients from faster thrombectomy (in \$)

Reduced burden on hospital

Stroke incidence numbers (NSW)\*



Decrease in thrombectomy time (hours)

Increased patients discharged home per 60-minute decrease in onset to puncture

× 10%

Impact of Time to Treatment on Endovascular Thrombectomy Outcomes in the Early Versus Late Treatment Time Windows (2023)



\$ cost per hospital bed day

Savings in bed days from patients receiving thrombectomy faster (in \$)

## Conclusion

At the end of its five-year funding period, the NSW regional telestroke service is ready to be revitalised, to improve patient care and to ensure it has a sustainable and cost-effective future.

This white paper, *Creating a Sustainable NSW Telestroke Service*, provides an independent analysis of the potential economic, social and commercial benefits of prehospital stroke care in the Hunter region and across NSW more broadly.

It also provides a snapshot of emerging pilot data, demonstrating the impact of faster prehospital care.

As Garry Tierney's case demonstrates on page 87, paramedics and tele-neurologists are working together to serve patients in regional settings – with life-saving results.

The independent authors, Strategic Project Partners, provide a health economic benefits assessment of optimised health service delivery estimated to be \$1.5 billion over 10 years. Over a decade, patients like Garry would gain healthy life years that translate into \$666 million in avoided death, rehabilitation and lifelong disability costs. The workforce would improve its capacity to treat a patient faster, saving \$849 million. There would be fewer bed days - from stroke onset to improvement after treatment – resulting in a \$6.5 million saving.

Australia is on the cusp of a new era in urgent prehospital stroke care. The Australian Stroke Alliance's novel brain-imaging technologies in road and air medical transports are set to be deployed mid 2024, further improving prehospital care for rural and regional patients while presenting a new way to collect continuous, systematic data that will link to the electronic medical record.

This white paper recommends a model that provides stroke services using regional hubs that are supported by centralised stroke services. This builds on current strengths, existing economic resources and relationships, while improving capability.

We recommend connecting comprehensive stroke centres (regional hubs) to stroke referral sites in regional catchments (the spokes), while maintaining a centralised stroke service, and leveraging and building upon existing IT and infrastructure.

The Northern region would be run by John Hunter Hospital – first to pilot the new model

The Southern region would be run by Liverpool and Prince of Wales Hospital – after 12 months

The Western region would be run by the Royal Prince Alfred Hospital – after 12 months - (also host of the centralised stroke service).

Keys to success:

- > Better distribution of human and economic resources
- > Stronger hospital to hospital relationships
- > Better patient care
- > Improved network capability.

Paramedics and remote health workers will build on their essential roles, employing novel technologies like advanced telehealth, to assist in diagnosis, alongside their tele-neurology colleagues. Pilot studies have already demonstrated:

- > Improved workflows with fewer inter-hospital transfers
- > Cost and risk reductions, embracing continuous improvement
- > In-built capability among paramedics and remote and regional hubs
- > Participation in research and innovation by regional workforce, centring community needs
- > Enabled networks with Primary and Local Health Networks, with a national roadmap
- > The potential for improved care in other prehospital care including cardiac and mental health care.

This proposal provides a sensible and cost-effective step into the future of prehospital care. It aims to discharge more patients to their homes, free of disability and with the capacity to return active lives, including the workforce. We aim to unburden the NSW health system by reducing the number of bed days for stroke patients.

Some of the most experienced neurologists in the country have contributed to this proposal. They look forward to discussing the benefits of this model to ensure no patient is denied urgent care, regardless of location.



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We acknowledge the Traditional Custodians of the Country throughout Australia and recognise their continuing connection to land, waters and sky. We pay our respects to their Elders past, present and emerging. We are committed to working together to address health inequities within our Aboriginal and Torres Strait Islander communities. The Uluru Statement from the Heart is a fundamental driver of our research, education program, and our commitment to equity and access.



An Australian Government Initiative

The Australian Stroke Alliance brings together seven principal partners, each committed to transforming prehospital stroke care across the nation:



Joint venture partners

