Evaluation of the state-wide stroke thrombolysis program in NSW. Actions from the NSW Stroke Network 2014.

John M Worthington,¹,²,³, ⁴

¹Ingham Institute for Applied Medical Research, Liverpool, NSW, Australia.
²Associate Professor (Conjoint) South Western Sydney Clinical School, The University of New South Wales.
³Senior Staff Specialist Department of Neurology, Liverpool Health Service, Sydney, Australia.
⁴Medical Co-chair Stroke Services New South Wales, Agency of Clinical Innovation.
The Team & The Network

Statewide Stroke Services (SSS) Coordinating Committee
(90 clinicians) + 1,000 clinicians on the email distribution list

Statewide Partnerships
- Ambulance Service NSW
- The Ingham & George Institutes
- Hunter and Illawarra Medical Research Institutes
- NSW Rural Stroke Network
- Stroke Recovery Assn NSW
- National Heart Foundation (NSW Division)
- ACU/UNSW/USYD/Uni Newcastle

National Partnerships
- Australian Stroke Coalition
- National Stroke Foundation
- Australian Stroke Clinical Trials Network
- The Florey Institute-Monash University
- Stroke Society of Australasia

Working Parties
- Consumer Liaison
  - Community Education
  - Australian Aphasia Assn
  - Stroke Recovery Assn NSW
  - CALD Carer Framework NSW Health
- Research
  - Research training
  - Research applications
  - Academic engagement
- Strategic Planning, including Workforce, Pre Hospital Emergency
  - Stroke unit development
  - Rural stroke services
  - Statewide Thrombolysis Project
- Rehabilitation Ambulatory Care
  - Model of care
  - Service development
  - Quality improvement
- Education & Professional Development (including protocols)
  - Statewide Education & Training
  - Annual SNAHSF
  - Annual SMART STROKES Conference
  - Guidelines, Protocols & Models of Care
- Stroke Rehabilitation & Stroke Recovery
  - Service gap delivery
  - Workforce
Case for change

• In 2012-13, 11,367 stroke patients with an ALOS 7.2 days were discharged from NSW public hospitals (HIE data).

• Disability is the main outcome of stroke and stroke remains the leading cause of disability in Australia.

• Stroke is the second largest cause of death in Australia and the 30-day and one-year mortality of ischaemic stroke in NSW is 17% and 27%, respectively.

• Stroke care has become significantly more organised in the past decade and death from stroke has decreased in that time.

• There are now 30 acute stroke units in NSW, providing basic infrastructure for expanded thrombolysis. Nine other hospitals have stroke services.

• In 2012 nationally only 7% of ischaemic stroke patients received intravenous rt-PA in Australia (2012 NSF Clinical Audit).

• Large parts of NSW with no access (still). No South Eastern thrombolysis south of Liverpool.

• In best practice (Helsinki) the hospital rates can be 36% and population rates 16%.

• With hospital and pre-hospital redesign two NSW centres achieved ~ 20%.

• Improving systems for thrombolysis improve outcomes for all stroke patients.

• **Nominal one-year targets of 10% at each site towards a 20% target and a two year target of 10% in each LHD.**
State-Wide Stroke Reperfusion Program

Improving timely access to care:

- State-wide Pre-hospital redesign including an ASNSW modelling of flows and impact (which proved remarkably accurate).
- New NSW Health Patient Allocation Matrix
  - Stroke FAST positive
- Pre-notification and hospital bypass.
- Locally governed Hospital redesign (Thrombolysis committees).
- Rehabilitation and repatriation pathways.

LHD sign-up/buy-in.

Clinician led and driven:

- Working parties and reference groups.
- Local leaders and champions.
- ACI implementation team of clinicians.
- Local walk-throughs.

Partnerships:

- ASNSW/ACI/Clinical Networks/LHDs/ATC Hospitals
- Local Thrombolysis Committees. Managers and Clinicians including ED, imaging, pharmacy and stroke.
Early Assessment for Stroke Reperfusion

Time is brain

1. Symptom onset
2. Standard assessment
3. Likely stroke
4. Phone ahead
5. Transport to 24/7 Acute Thrombolytic Centre (ATC)
6. <3hrs Reperfusion Administered
7. Return flow of patients to appropriate care

ACI
NSW Agency for Clinical Innovation
Stroke FAST positive. Stroke signs under 3 hours.

Regional experience: An NSF survey suggests 80% of strokes arrive at DUBBO in less than 3 hours, which is much better than most metropolitan sites.
Pre-hospital: Ambulance Service NSW

- Road based transport for stroke patients aim to arrive at ATCs within 3 hours of symptom onset.
- Training of all paramedics by Dec 2014 in a single assessment tool FAST (Face, Arm, Speech and Time) for those with onset or last well in 3 hours.
- Addition of ‘Stroke FAST positive’ to the NSW Health Patient Allocation Matrix.
- Estimated 27.5% of strokes Stroke FAST positive.
- The Program will link paramedics to ATCs.
- Pre-notification to ATC Emergency (and some stroke teams) to ready the hospital response.
# A statewide process... and a long one

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2010</td>
<td>Stroke Reperfusion Committee formed by stroke clinicians</td>
</tr>
<tr>
<td>Sep 2010</td>
<td>Partnering with key stakeholders, meeting with DDG to discuss:</td>
</tr>
<tr>
<td></td>
<td>Stroke rehabilitation.</td>
</tr>
<tr>
<td></td>
<td>Interventional Neuroradiology?</td>
</tr>
<tr>
<td></td>
<td>Coding</td>
</tr>
<tr>
<td></td>
<td>Improving access to stroke thrombolysis</td>
</tr>
<tr>
<td></td>
<td>New NSW Health Patient Allocation Matrix-Stroke FAST Positive</td>
</tr>
<tr>
<td>Sep 2012</td>
<td>Innovative Model of Care built ASNSW, ACI, Clinician Networks</td>
</tr>
<tr>
<td></td>
<td>Joint agreement on implementation process</td>
</tr>
<tr>
<td></td>
<td>ATCs identified in ACI approach to LHD CEs</td>
</tr>
<tr>
<td>Nov 2012-Jan 2013</td>
<td>Hospital Site Visits with Thrombolysis Committees</td>
</tr>
<tr>
<td></td>
<td>‘Go-live’ with 20 ATCs. Hon. Jillian Skinner</td>
</tr>
<tr>
<td></td>
<td>Follow up site support</td>
</tr>
<tr>
<td>April 2013</td>
<td>Determining formal evaluation of the implementation process.</td>
</tr>
<tr>
<td>2014</td>
<td>A need for governance and on-going evaluation of the programme.</td>
</tr>
</tbody>
</table>
Local Health Districts

A loose affiliation to be dealt with individually
Acute Thrombolytic Centres (ATC)

- 20 ATCs Identified by LHD Chief Executives and General Managers.
- Locally assessed. CE sign-up undertakes provision of service and resources.
- ATCs needed:
  - Stroke unit with co-located monitoring.
  - Emergency Department
  - 24/7 Thrombolysis commitment
  - 24/7 Medical Imaging. (CT brain 24/7)
  - A Clinical Leader and Clinical Champion.
  - Thrombolysis Committee.
- Pre-notification process and rapid stroke team response were needed.
- Standardising best practice adapted to local conditions.
- Rehabilitation and Repatriation pathways in line with ACI protocol and checklists.
Pre-hospital: Onset-to-door and home-to-door time

Every 15-20 minutes saved makes a substantial difference

20 NSW ATCs
Royal Prince Alfred
Concord
Royal North Shore
Hornsby-Kur-ing-gai
Sydney Adventist
Prince of Wales
St Vincent’s
St George
Liverpool
Campbelltown
Bankstown
Westmead
Nepean
Blacktown
Gosford
John Hunter
Wagga
Tamworth
Orange
Bathurst

Stroke care in your Ambulance

• ABC
• Stroke FAST (positive) screening
• Supplemental oxygenation
• Avoid anti-hypertensives
• Pre-notification
• Direct to CT in the ‘Helsinki model’?
A statewide process... and a long one

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2010</td>
<td>Stroke Reperfusion Committee formed by stroke clinicians</td>
</tr>
<tr>
<td>Sep 2010</td>
<td>Partnering with key stakeholders, meeting with DDG to discuss:</td>
</tr>
<tr>
<td></td>
<td>- Stroke rehabilitation.</td>
</tr>
<tr>
<td></td>
<td>- Interventional Neuroradiology?</td>
</tr>
<tr>
<td></td>
<td>- Coding</td>
</tr>
<tr>
<td></td>
<td>- Improving access to stroke thrombolysis</td>
</tr>
<tr>
<td></td>
<td>- New NSW Health Patient Allocation Matrix</td>
</tr>
<tr>
<td>Sep 2012</td>
<td>Innovative Model of Care built ASNSW, ACI, Clinician Networks</td>
</tr>
<tr>
<td></td>
<td>- Joint agreement on implementation process</td>
</tr>
<tr>
<td></td>
<td>- ATCs identified in ACI approach to LHD CEs</td>
</tr>
<tr>
<td>Nov 2012-Jan</td>
<td>Hospital Site Visits with Thrombolysis Committees</td>
</tr>
<tr>
<td>Jan 2013</td>
<td>- ‘Go-live’ with 20 ATCs. Hon. Jillian Skinner</td>
</tr>
<tr>
<td>April 2013</td>
<td>- Follow up support</td>
</tr>
<tr>
<td>April 2013</td>
<td>Determining formal evaluation of the implementation process.</td>
</tr>
<tr>
<td>2014</td>
<td>A need for governance and on-going evaluation of the programme.</td>
</tr>
</tbody>
</table>
Collaboration

Blacktown ED team

POWH Local team

WSLHD team

Gosford local team

Concord local team
Via Plane, Train, Ambulance..
The Helsinki protocol a guide to hospital redesign
Rapid onset-to-needle and best practice

- Onset-to-needle time (ONT) improved from 160 to 115 minutes
- Door-to-needle (DTN). Half are treated in 20 minutes, 72% in 30 minutes and 94% in 60 minutes.
- Thrombolysis of 36% of strokes at the centre with a regional population-based rate of 16%
- In the US Get With the Guidelines registry only 26% have a DNT < 60 minutes.

Challenges: Performance and Evaluation

- ATC selection. Grandfathering and Boot-strapping.*
- No DRG. No ABF of DRG related funding.
- No DRG/ICD code. Thrombolysis is invisible in routinely collected data.
- No specified data collection in the programme.
- Thrombolysis committees have stopped meeting at many sites.
- Who reports to who?

*Requirements for future ATCs will be very specific compared with inception.
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2010</td>
<td>Stroke Reperfusion Committee formed by stroke clinicians</td>
</tr>
<tr>
<td>Sep 2010</td>
<td>Partnering with key stakeholders, meeting with DDG to discuss: Stroke rehabilitation. Intervventional Neuroradiology? Coding Improving access to stroke thrombolysis New NSW Health Patient Allocation Matrix</td>
</tr>
<tr>
<td>Sep 2012</td>
<td>Innovative Model of Care built ASNSW, ACI, Clinician Networks Joint agreement on implementation process ATCs identified in ACI approach to LHD CEs</td>
</tr>
<tr>
<td>Nov 2012-Jan 2013</td>
<td>Hospital Site Visits with Thrombolysis Committees ‘Go-live’ with 20 ATCs. Hon. Jillian Skinner Follow up support</td>
</tr>
<tr>
<td>April 2013</td>
<td>Determining a formal evaluation of the implementation process.</td>
</tr>
<tr>
<td>2014</td>
<td>A need for governance and on-going evaluation of the programme.</td>
</tr>
<tr>
<td>2014</td>
<td>Applying for a DRG in an ABF partnership.</td>
</tr>
</tbody>
</table>
**Evaluate what and why?**

**Why?**
- To improve quality of care and inform stakeholders.
- To improve future implementations in this and other programmes.
- Assess economic benefit.

**What?**
- The implementation process itself.
- The performance of the programme state-wide.
- The implementation of the FAST tool. Sensitive/Specific.
- Performance of the pathway at each stage of the stroke journey pre-hospital and hospital, locally. Times and barriers.
- Access.
- Identify unwarranted clinical variation.

Nominal one-year targets: of 10% at each site (towards a 20% target) and a two year target of 10% in each LHD.
We know unwarranted clinical variation exists. BHI’s publication of 30 day stroke mortality by named hospital

Figure 14: Ischaemic stroke 30-day risk-standardised mortality ratio, NSW public hospitals, July 2009 – June 2012. • no difference: = 90% limits; = 95% limits
Tools

- **Thrombolsysis databases.** SITS, TIPS and locally developed databases to provide at least a minimum data set.
- **A new DRG.**
- **ACI and National Stroke Foundation stroke audit tools** for patient level data.
- **Qualitative tools** to assess barriers and experience-the Stroke Reperfusion Assessment Tool (SRAT) developed by ACI.
- **PET.** Patient (and staff) Experience Tracking device.
- **Academic study.** Home-to-Outcome study (H2O) linked data-sets to assess system wide impact at each stage of the stroke patient journey.

Emerging tools such as data extraction from EMR and thrombolysis DRG data-linkage.
ATC remittance of an agreed minimum data-set on thrombolysed patients.

Unanimous network approval to collect an agreed Minimum Data Set on thrombolysed patients (Feb 2014).

- Time of stroke.
- Door time (arrival time).
- Needle time.
- Initial NIHSS.
- 2-7 day NIHSS.
- Pre-morbid & discharge modified Rankin score (mRS).
- Symptomatic ICH by PITS, SITS and or NIH definition.

A work in progress with efforts to harmonise with a new national data dictionary.
Expected governance. Bringing the band back together.
<table>
<thead>
<tr>
<th>Clinical Care Point/Process</th>
<th>Description</th>
<th>Comments</th>
<th>Owner</th>
<th>Timeframe/Occurrence</th>
<th>Status (Complete/Partially Incomplete)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Hospital Care Coordination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you receive Stroke FAST positive patients?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there systems in place for activating a stroke page/alert?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is ED pre-notified of stroke FAST positive patients?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the Acute Stroke team pre-notified of stroke FAST positive patients?</td>
<td>Always/Usually/Sometimes/Never</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is Medical Imaging pre-notified of stroke FAST positive patients?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are patients triaged as category 2</td>
<td>Always/Usually/Sometimes/Never</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are after hours ED, neurology, radiology, stroke unit and patient flow staff aware of processes after hours for Stroke FAST positive patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the process for Stroke FAST positive the same 24 hours a day 7 days a week? If not what are the differences?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ACI ‘one-off’ process-outcome evaluation

The overall purpose of the evaluation of the Stroke Reperfusion Program is to examine if the aims of the program have been achieved at a system, staff and patient level (a process-outcome evaluation), and if the implementation approach has been effective, well designed and appropriate. Having several components, the evaluation will be undertaken in stages.

- Interviews performed by Sigrid Paterson, using the SRAT tool.
- Interviews mediated by the ACI implementation team through the Thrombolysis Committees. Piloting at 6 ATCs.
- Patient and staff experience assessment.
- Piloting of the Patient Experience Tracking device and approach at sites.
- The minimum data set and information from ambulance.
- The piloting will establish gaps in data as they relate to key performance issues.
Features of the Home-to-Outcome H2O Study

• Stroke data linkage 2.0
• Uses an expanded linkage to describe the whole stroke patient journey from home to at least one year follow-up.
• Includes pre-hospital (ambulance data) with administrative and clinical details such as vital signs, Glasgow Coma Score as a measure of stroke severity and the results of the FAST Stroke Positive screening tool, which determines suitability for transport to one of the states 20 Acute Thrombolysis Centres established in the Early Access to Stroke Thrombolysis programme implemented in 2013.
• Includes detailed rehabilitation data assessment pre and post-rehabilitation including validated bed-side measures of disability (FIM), co-morbidities and discharge destination.
• Brings together 11 databases in all.
• Greatly expands individual clinical details and outcome measures for stroke epidemiology, health services research including detection of unwarranted clinical variation and the measurement of outcomes according to patient level and health service factors.
• A model for studying any common acute and disabling condition
**Ambulance datasets:** All cases recorded in the ASNSW CAD and PEMR for patients aged 18 years+ at time of presentation 2005-

**Selection Codes:** Stroke and the (FAST) Stroke Positive code post-Jan’13

**Time:** January 1, 2005 to latest available data at time of extraction

---

**Emergency datasets:** All Emergency Department presentations, recorded on the EDDC. Patients aged 18 years+ at time of presentation. 2005-on. ACT and NSW.

**Selection Codes:** Stroke

**Time:** January 1, 2005 to latest available data at time of extraction

---

**Admitted (hospitalised datasets:** All APDC separations of those with diagnoses listed below. 5 year look-back for co-morbidities. Patients aged 18 years+ at time of admission 2000-. ACT and NSW

**Selection Codes:** ICD-10 I60.x, I61.x, I63.x, I64.x and G45.x and co-morbidities (eg AF I48)

---

**Rehabilitation datasets:** All NSW-SNAP and Australasian AROC separations aged 18 years+ at time of admission. Specified ‘Minimum dataset’. 2005-

**Selection Codes:** ICD-10 I60.x, I61.x, I63.x, I64.x

---

**Death and Cause of death datasets:** All NSW registry and NSW related ABS recorded deaths for people aged 18 years+ at time of death. 2005-

**Selection Codes:** ICD-10 I60.x, I61.x, I63.x, I64.x

---

The same PPN will be assigned to patients meeting more than one case definition. Cases meeting only one case definition will not match to other data-extractions.

---

A) All episodes of care recorded in The Admitted Patient Data Collections (APDC) ACT and NSW from July 1, 2000 to latest available data at time of extraction for each PPN. Case selection from 2005.
B) All presentations recorded in the Emergency Department Data Collection (EDDC) ACT and NSW from January 1, 2005 to the latest available data at time of extraction for each PPN.
C) All episodes of care in the Ambulance Service of NSW (ASNSW) database from January 1, 2005 to the latest available data at time of extraction for each PPN.
D) All episodes of care in the NSW Australian National Subacute Non-Acute Patient Classification System (SNAP) and Australasian Rehabilitation Outcomes Centre (AROC) data-bases from January 1, 2005 to the latest available data at time of extraction for each PPN.
E) Death registrations from January 1, 2005 to the latest available data at time of extraction. (Registry of Birth, Deaths and Marriages)
F) Cause of Death Data from January 1, 2005 to the latest available data at time of extraction. (ABS Cause of Death Data)

---

**Linkage Update if more recent ABS Cause of Death Data are added to the Master Linkage Key**
Acknowledgements: Andy Evans and the late Dr Ian Black

With thanks to: Mark Longworth, Bruce Paddock and Mellissa Tinsley

Funding: NHMRC, MBF (BUPA), Clinical Excellence Commission, OSMR NSW and UNSW

No conflicts of interest: No payments accepted from pharma post 2004 (honorariums donated to charity at arms length)

In memoriam: Dr Tiziana Savio and Dr Ian Black

THANK YOU
There is unwarranted clinical variation in stroke care

- The NSW Stroke Network accepts that unwarranted clinical variation exists.
- That average stroke outcomes can also be improved.
- Refinement of stroke outcome measures (data analysis) and on-going surveillance of stroke outcomes is needed.
- Favour a site-by-site approach to achieve improved outcomes.
- Site audits for ‘diagnostic’ and validation purposes.
- Audit, feedback and QI requires direct engagement with LHD executives and clinicians (in the same room).

Data from audit tools will be used to identify gaps in service delivery
## Unwarranted clinical variation in Stroke. Actions.

### Data
- Identification of clinical variation in ischaemic stroke.
- Health Care in Focus (BHI). Published December 2012.
- Ongoing process to refine ascertainment, analysis, reporting.
- Regular Work Group meetings of ACI and BHI members.

### LHD Feedback
- ACI letters to LHD CEs and clinician leaders. 7th March, 2013.
- Clinical Variation Workshop. ACI, BHI, UCV Taskforce. 3rd April.
- Workshop feedback on required reporting and QI processes.

### Audit and analysis
- Expert Reference Group meetings to discuss site audit tools and processes. BHI, ACI and SSNSW and the Florey and Ingham Institutes. First meeting 22nd April.
- Finalising audit tool and access to other site data. 28th June.

### QI
- Implementation Team meet to plan site visits May 10.
- Invitation letter to LHDs for participation in QI process.
- Site audits to begin 7th July and site visits start 7th August.
- Audit data and further consultation refines BHI data analyses.
# A statewide process... and a long one

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2010</td>
<td>Stroke Reperfusion Committee formed Stroke clinicians</td>
</tr>
<tr>
<td>Sep 2010</td>
<td>Partnering with key stakeholders, meeting with DDG to discuss: Stroke rehab Interventional Neuroradiology? Coding Improving access to stroke thrombolysis (cardiac and stroke) The NSW Health Patient Allocation Matrix</td>
</tr>
<tr>
<td>Sep 2012</td>
<td>Innovative Model of Care Joint agreement on implementation process ATCs identified in approaches to LHD CEs</td>
</tr>
<tr>
<td>Nov 2012-Jan 2013</td>
<td>Site Visits ‘Go-live’ with 20 ATCs. Hon. Jillian Skinner Follow up support</td>
</tr>
<tr>
<td>April 2013</td>
<td>Determining formal evaluation of the implementation process.</td>
</tr>
<tr>
<td>2014</td>
<td>A need for governance and on-going evaluation.</td>
</tr>
</tbody>
</table>

ATCs needed 24/7:  
- Medical Imaging  
- Neurology/Stroke Services  
- Emergency Department  
- Stroke unit with co-located monitoring  
- Multidisciplinary team
Actions

• We have had access to previous ACI stroke audit tool data from the Florey/NSRI and obtained permission to access National Stroke Foundation (NSF) Clinical and Organisational Audit data.

• We selected 6 representative hospital sites at which to engage clinicians and managers with audit and feedback and to discuss the overall process and local strategies for quality improvement.

• We modified and deployed the ACI Stroke Audit tool at 6 pilot sites; now auditing for fever treatment, patient transfers, in-hospital stroke, ICD-10 codes and palliative care management and modified for greater compatibility with the NSF audit tool.

• All 6 initial site audits and site visits have been completed by the ACI/BHI team. (Additional sites have invited audits and site visits)

Data from audit tools have been used to identify gaps in service delivery
First six rural and metropolitan site visits.

<table>
<thead>
<tr>
<th>Site and date</th>
<th>Type</th>
<th>N</th>
<th>Crude 30 day Mortality%</th>
<th>Standardised (Adjusted) Mortality %</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 1 14&lt;sup&gt;th&lt;/sup&gt; August</td>
<td>Principal referral ATC/SU</td>
<td>353</td>
<td>17.1</td>
<td>20.7</td>
<td>15.3-27.2</td>
</tr>
<tr>
<td>Hospital 2 7&lt;sup&gt;th&lt;/sup&gt; August</td>
<td>Principal referral ATC/SU</td>
<td>289</td>
<td>8.0</td>
<td>8.2</td>
<td>5.0-12.6</td>
</tr>
<tr>
<td>Hospital 3 14&lt;sup&gt;th&lt;/sup&gt; August</td>
<td>Non-principal, Metro. SU</td>
<td>138</td>
<td>11.6</td>
<td>9.2</td>
<td>5.2-15.1</td>
</tr>
<tr>
<td>Hospital 4 15&lt;sup&gt;th&lt;/sup&gt; August</td>
<td>Rural SS/No SU</td>
<td>197</td>
<td>20.8</td>
<td>19.1</td>
<td>13.6-26.15</td>
</tr>
<tr>
<td>Hospital 5 29&lt;sup&gt;th&lt;/sup&gt; August</td>
<td>Rural No SU</td>
<td>83</td>
<td>22.9</td>
<td>30.6</td>
<td>7.6-63.0</td>
</tr>
<tr>
<td>Hospital 6 30&lt;sup&gt;th&lt;/sup&gt; August</td>
<td>Rural ATC/SU</td>
<td>213</td>
<td>8.9</td>
<td>9.6</td>
<td>5.6-15.3</td>
</tr>
</tbody>
</table>

Our care varies and there is a wide clinical variation in ischaemic (and haemorrhagic) stroke outcomes.
Example: Hospital 6 Audit Results

- Similar results to 2008/9
- 55% transferred in (one for rehab.)
- Average age 71 years
- 35% had AF
- 15% a previous stroke
- All were admitted to the stroke unit!
- 75% were on a clinical pathway during the admission.
- 65% had a CT within 2 hours and 100% in 24 hours.
- Stroke investigation rates shown in figure
- 100% received neurological observations in the first 24 hours
- 72% received aspirin in the first 24 hours.
- Documented swallow assessment in 4 hours of 40% (45% in speech impaired)

No hospital unit performed consistently well across all clinical care processes that are likely to influence patient outcomes. Where outcomes appeared worse the gaps in evidence-based care were generally greater.
## First three metropolitan site audits.

<table>
<thead>
<tr>
<th>Site and date</th>
<th>Type</th>
<th>Adjusted mortality %</th>
<th>Selection of audit characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 1 14(^{th}) August</td>
<td>Principal referral ATC N=353</td>
<td>20.7</td>
<td>July-Aug 2011. 3 transfers in. Nil reported palliative. Rapid CT brain; rate 100%. 100% reached stroke unit or HDU. 100% Neuro obs in 1(^{st}) 24 hours. Low rate of cardiac ultrasound 30%. No use of a clinical pathway. Only 78% on antithrombotics at discharge. 44% on aspirin in 24 hours. Documentation of swallowing at 4 hours 25%.</td>
</tr>
<tr>
<td>Hospital 2 7(^{th}) August</td>
<td>Principal referral ATC N=289</td>
<td>8.2</td>
<td>Aug 2011-Nov 2011. 1 transfer in. 1 documented for palliative care and 2 t/f to a Pal care facility. Rapid CT brain; rate 100%. 100% reached stroke unit or HDU. 95% Neuro obs. Cardiac ultrasound TOE + TTE 76%. Clinical pathway 45%. 84% on antithrombotic on discharge. 58% on aspirin in 24 hours. Swallowing documentation at 4 hrs 70%.</td>
</tr>
<tr>
<td>Hospital 3 14(^{th}) August</td>
<td>Non-principal Metro. SU N=138 .</td>
<td>9.2</td>
<td>July 2011-Jan 2012. Note: major service changes. No transfers in. Two documented as palliative care. 63% reached the stroke unit. TOE + TTE 97%. 63% Neuro obs. 85% on a clinical pathway. 93% on antithrombotics at discharge. 60% on aspirin at 24 hours. Swallowing documentation &lt; 4 hrs 20%.</td>
</tr>
</tbody>
</table>
## First three rural site audits

<table>
<thead>
<tr>
<th>Site and date</th>
<th>Type</th>
<th>Adjusted mortality %</th>
<th>Selection of audit characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 4</td>
<td>Rural no SU</td>
<td>19.1</td>
<td>April 2012-June 2012. 7 transferred in. Nil documented palliative. CT 95%&lt;24 hours. No stroke unit. Neuro obs 55%. Low rate of cardiac echo. 80% clinical pathway (new stroke co-ordinator). 71% on antithrombotics at discharge. 47% on aspirin in 24 hours. Swallowing documentation &lt; 4 hrs 10%.</td>
</tr>
<tr>
<td>15th August</td>
<td>N=197</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 5</td>
<td>Rural no SU</td>
<td>30.6</td>
<td>July 2011-May 2012 (N=11). High rate of missing data. 1 transfer. 3 palliative care. No on-site CT. 36% documented CT. No stroke unit. Neuro obs 9%. No cardiac echo. No documented carotid imaging. No clinical pathway. 80% on antithrombotics at discharge. 20% on aspirin at 24 hours. Documentation of swallowing &lt; 4 hours 0.</td>
</tr>
<tr>
<td>29th August</td>
<td>N=83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 6</td>
<td>Rural ATC</td>
<td>9.6</td>
<td>Aug-Nov 2012. 55% transferred in. All with protocols. Delays in t/f post-onset. No documented pal care. CT 100% &lt; 24 hours. 100% reached stroke unit. Cardiac echo&gt;95%. 100% neuro obs. 75% clinical pathway. 100% on antithrombotics at dc. 72% on aspirin at 24 hours. Documentation of swallowing &lt; 4 hrs 40%.</td>
</tr>
<tr>
<td>30th August</td>
<td>N=213</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A comparison of some processes that may influence or reflect outcomes.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Adjusted 30 day Mortality (%)</th>
<th>SU/HDU Bed (%)</th>
<th>24 hr Neuro Ob's (%)</th>
<th>Clinical P'way (%)</th>
<th>Swallow test&lt; 4 hrs (%)</th>
<th>%Discharged on A'thrombotics</th>
<th>Aspirin at 24 hours (%)</th>
<th>Pall' Care (N)</th>
<th>% D/C on Statin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.7</td>
<td>100</td>
<td>100</td>
<td>0</td>
<td>25</td>
<td>78</td>
<td>44</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>2</td>
<td>8.2</td>
<td>100</td>
<td>95</td>
<td>45</td>
<td>70</td>
<td>84</td>
<td>58</td>
<td>3</td>
<td>63</td>
</tr>
<tr>
<td>3</td>
<td>9.2</td>
<td>63</td>
<td>63</td>
<td>85</td>
<td>20</td>
<td>93</td>
<td>60</td>
<td>2</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>19.1</td>
<td>0</td>
<td>55</td>
<td>80</td>
<td>10</td>
<td>71</td>
<td>47</td>
<td>0</td>
<td>43</td>
</tr>
<tr>
<td>5</td>
<td>30.6</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>80</td>
<td>20</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>9.6</td>
<td>100</td>
<td>100</td>
<td>75</td>
<td>40</td>
<td>100</td>
<td>72</td>
<td>0</td>
<td>67</td>
</tr>
</tbody>
</table>

No hospital unit performed consistently well across all clinical care processes that are likely to influence patient outcomes. Where outcomes appeared worse the gaps in evidence-based care were generally greater.
Where to next?

Unwarranted clinical variation in stroke is explicable variation. At present stroke patients do not always receive evidenced-based care. This may be the result of being admitted to a smaller hospital with no organised stroke care and little prospect of providing it, admission to a hospital where stroke unit care could reasonably be provided but no unit has been established, because a patient fails to reach a stoke unit bed in a hospital with a stroke unit or because of a variations in the quality of care in existing stroke units.

A process is needed to improve access to stroke care and improve outcomes.
- Expand access to stroke unit care with new units. Consider bypass of some sites.
- Build a project team to continue the process of audit and feed-back to improve organised stroke care. (Stroke units and services).
- Ensure urgent access to stroke unit beds in stroke unit hospitals.

Review Stroke Thrombolysis and the Early Stroke Reperfusion Programme.
- Reinforce local Thrombolysis Committee governance, deploy a qualitative audit tool to assess barriers to rapid door-to-needle times and develop and deploy a regular minimum dataset collection. Develop a DRF and improve access through Tele-Stroke.
- Improve data quality and its reporting to management, clinicians and the public.
- Specific recommendations on data collection, analysis and reporting.
Thank you

Special thanks to Mark Longworth (ACI), Kim Sutherland and Doug Lincoln (BHI), Melina Gattellari (Ingham Institute), Dominique Cadhillac (Florey Institute) and the clinicians and managers at the 6 pilot sites.
## The first six rural and metropolitan site visits.

<table>
<thead>
<tr>
<th>Site and date</th>
<th>Type</th>
<th>N</th>
<th>Crude 30 day Mortality%</th>
<th>Standardised (Adjusted) %</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 1 14(^{th}) August</td>
<td>Principal referral ATC</td>
<td>353</td>
<td>17.1</td>
<td>20.7</td>
<td>15.3-27.2</td>
</tr>
<tr>
<td>Hospital 2 7(^{th}) August</td>
<td>Principal referral ATC</td>
<td>289</td>
<td>8.0</td>
<td>8.2</td>
<td>5.0-12.6</td>
</tr>
<tr>
<td>Hospital 3 14(^{th}) August</td>
<td>Non-principal, Metro.</td>
<td>138</td>
<td>11.6</td>
<td>9.2</td>
<td>5.2-15.1</td>
</tr>
<tr>
<td>Hospital 4 15(^{th}) August</td>
<td>Rural</td>
<td>197</td>
<td>20.8</td>
<td>19.1</td>
<td>13.6-26.15</td>
</tr>
<tr>
<td>Hospital 5 29(^{th}) August</td>
<td>Rural</td>
<td>83</td>
<td>22.9</td>
<td>30.6</td>
<td>7.6-63.0</td>
</tr>
<tr>
<td>Hospital 6 30(^{th}) August</td>
<td>Rural ATC</td>
<td>213</td>
<td>8.9</td>
<td>9.6</td>
<td>5.6-15.3</td>
</tr>
</tbody>
</table>
STROKE UNITS

Original Contributions

Stroke Unit Care in a Real-Life Setting
Can Results From Randomized Controlled Trials Be Translated Into Every-Day Clinical Practice? An Observational Study of Hospital Data in a Large Australian Population

Melina Gattellari, PhD; John Worthington, MBBS; Bin Jalaludin, PhD; Mohammed Moksin, PhD

Stroke units improve outcomes as much or more than thrombolysis


You have to survive the complications of stroke to recover

(Stroke. 2009;40:10-17.)
Causes of death after stroke

Management in the first 2-3 weeks has a major impact on mortality, long-term function and discharge destination.

- Aspiration, sepsis and fever
- Venous thrombosis
- Hypoxia
- Dehydration
- Tachycardia eg; poor rate controlled AF

A hectic three weeks

Figure 4. Diagramatic representation of the causes of death following supratentorial infarction and hemorrhage. (TTH = transtentorial herniation; Pneu = pneumonia; PE = pulmonary thromboembolism).

The Silver et al Stroke 1984
Evidence based practice in ischaemic stroke

There is substantial evidence around what constitutes good ischaemic stroke care.

Major elements of good stroke care include:

• Stroke units. With co-localised stroke beds served by a multidisciplinary stroke team that uses evidenced-based pathways improve stroke outcomes by approximately 30%, at all ages.¹

• Clot-busting. IV rt-PA within three hours, reduces death and disability by 44% (Cochrane), with more modest benefits at 3-4.5 hours (favourable Odds Ratio 1.34). There is an all-hours cost-of-readiness and no DRG.

²Wardlaw et al, Cochrane Database of Systematic Reviews. 2003 (3).
Outcomes for ischaemic stroke before and after introduction of stroke units in 10 Non-Principal Referral NSW hospitals

<table>
<thead>
<tr>
<th>DISCHARGE DESTINATION</th>
<th>Home</th>
<th>Nursing home</th>
<th>Death</th>
<th>Other*</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 NON-PRINCIPAL REFERRAL HOSPITALS (METRO) Age &gt; 85 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before ASU</td>
<td>20.3%</td>
<td>12.9%</td>
<td>26.8%</td>
<td>40.0%</td>
</tr>
<tr>
<td>After ASU</td>
<td>↑ 28.7%</td>
<td>↓ 10.3%</td>
<td>↓ 19.7%</td>
<td>41.4%</td>
</tr>
<tr>
<td>10 NON-PRINCIPAL REFERRAL HOSPITALS (METRO) All adults</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before ASU</td>
<td>38.7%</td>
<td>6.3%</td>
<td>13.8%</td>
<td>41.2%</td>
</tr>
<tr>
<td>After ASU</td>
<td>↑ 44.5%</td>
<td>↓ 4.9%</td>
<td>↓ 10.5%</td>
<td>40.2%</td>
</tr>
</tbody>
</table>

*transfer to other hospitals/change in type

p<0.001 (significant main effect and interaction type*time). Controlling for: age, co-morbidity (modified Charlson Index), sex, marital status, country of birth, hours on mechanical ventilation, insurance status, and clustering of outcomes by hospital in GEE multivariate model. Gattellari et al Stroke, 2008.
NSW Stroke Reperfusion Program
2010-2014
## Process

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2010</td>
<td>Stroke Reperfusion Committee formed</td>
</tr>
<tr>
<td></td>
<td>Stroke clinicians</td>
</tr>
<tr>
<td>Sep 2010</td>
<td>Partnering with key stakeholders, meeting with DDG to discuss:</td>
</tr>
<tr>
<td></td>
<td>Stroke rehab</td>
</tr>
<tr>
<td></td>
<td>Interventional Neuroradiology</td>
</tr>
<tr>
<td></td>
<td>Coding</td>
</tr>
<tr>
<td></td>
<td>Improving access to stroke thrombolysis</td>
</tr>
<tr>
<td></td>
<td>The NSW Health Patient Allocation Matrix</td>
</tr>
<tr>
<td>Sep 2012</td>
<td>Innovative Model of Care built</td>
</tr>
<tr>
<td></td>
<td>Joint agreement on implementation process</td>
</tr>
<tr>
<td></td>
<td>ATCs identified</td>
</tr>
<tr>
<td>Nov 2012 -</td>
<td>Site Visits</td>
</tr>
<tr>
<td>April 2013</td>
<td>Follow up support</td>
</tr>
<tr>
<td>April 2013</td>
<td>Formal evaluation</td>
</tr>
</tbody>
</table>
Patient Journey: Process map for Pre-hospital Acute Stroke Triage and transfer to Acute Stroke Thrombolysis Centre

Symptom onset → Patient call 000 → Paramedic Assessment → Control Centre → Hospital → Rehabilitation → HOME

Rehabilitation Models of Care
Six Care Settings
8 Principles

The NSW Rehabilitation Model of Care will improve patient outcomes, service delivery, efficiencies and collaboration with health care providers across the health system.

The new Rehabilitation Model of Care 6 good practice principles have been defined that are applicable across all 6 newly agreed care settings. Currently, most rehabilitation is delivered in the sub-acute inpatient setting. The new model will also define intensity of therapy at each setting.

NSW Agency for Clinical Innovation
Pre-hospital: Onset-to-door and home-to-door time

20 NSW ATCs
Royal Prince Alfred
Concord
Royal North Shore
Hornsby-Kuring-gai
Sydney Adventist
Prince of Wales
St Vincent's
St George
Liverpool
Campbelltown
Bankstown
Westmead
Nepean
Blacktown
Gosford
John Hunter
Wagga
Tamworth
Orange
Bathurst

Every 15-20 minutes saved makes a substantial difference

Stroke care in the Ambulance

• ABC
• Stroke FAST (positive) screening
• Supplemental oxygenation
• Avoid anti-hypertensives
• Pre-notification
• Direct to CT in the ‘Helsinki model’?
Early Assessment for Stroke
Reperfusion “Time is Brain”

Symptom onset
Standard assessment
Likely stroke

000
Transport to 24/7 Acute Thrombolytic Centre (ATC)

<4.5hrs
Reperfusion Administered

Phone ahead
Return flow of patients to appropriate care
Where are we at today?

- Local Governance committees at every site
- **Program launched 21st January 2013**
- Ongoing support of ATCs
- Capacity building
- Formal evaluation-2014
- Evaluation partners: ACI Clinical Program Design & Implementation Health Economics Group, Emergency Care Institute, Florey Institute & ASNSW
- Evaluation markers include:
  - Morbidity and Mortality
  - Thrombolysis rates
  - Further ASNSW Patient Impact Modelling
  - Levels of implementation-Emergency Department Stroke Reperfusion Assessment Tool
NSW Stroke Reperfusion Program

John M Worthington,1,2,3, 4
1Ingham Institute for Applied Medical Research, Liverpool, NSW, Australia.
2Associate Professor (Conjoint) South Western Sydney Clinical School, The University of New South Wales.
3 Senior Staff Specialist Department of Neurology, Liverpool Health Service, Sydney, Australia.
4 Medical Co-chair Stroke Services New South Wales, Agency of Clinical Innovation.
Catalyst: The BHI publication of 30 day mortality by named hospital

Figure 14: Ischaemic stroke 30-day risk-standardised mortality ratio, NSW public hospitals, July 2009 – June 2012.

- Lower mortality
- No difference
- Higher mortality
- 90% limits
- 95% limits

Graph showing risk-standardised mortality ratio with observed/expected values for various hospitals.
Unwarranted clinical variation in Stroke. Actions.

Data
- Identification of clinical variation in ischaemic stroke.
- Health Care in Focus (BHI). Published December 2012.
- Ongoing process to refine ascertainment, analysis, reporting.
- Regular Work Group meetings of ACI and BHI members.

LHD Feedback
- Letters to LHD CEs and clinician leaders. 7th March, 2013.
- Clinical Variation Workshop. ACI, BHI, UCV Taskforce. 3rd April.
- Workshop feedback on required reporting and QI processes.

Audit and analysis
- Expert Reference Group meetings to discuss site audit tools and processes. BHI, ACI and SSNSW and the Florey and Ingham Institutes. First meeting 22nd April.
- Finalising audit tool and access to other site data. 28th June.

QI
- Implementation Team. Site visit planning meeting May 10.
- Invitation letter to LHDs for participation in QI process.
- Site audits to begin 7th July and site visits start 7th August.
**Actions**

- We have had access to previous ACI stroke audit tool data from the Florey/NSRI, obtained permission to access National Stroke Foundation Clinical and Organisational Audit data and will explore access to the QASC implementation dataset.

- We have modified and deployed the ACI Stroke Audit tool; additions include fever Tx, patient transfers, in-hospital stroke, ICD-10 codes and palliative care management as well as modifications for greater compatibility with NSF tool.

- We selected 6 representative hospital sites at which to engage clinicians and managers with audit and feedback and discuss the overall process.

- All 6 initial site audits and site visits by the ACI/BHI team have been completed.

Data from audit tools have been used to identify gaps in service delivery.
# First six rural and metropolitan site visits.

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>N</th>
<th>Crude 30 day Mortality%</th>
<th>Standardised (Adjusted) %</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 1 14(^{th}) August</td>
<td>Principal referral ATC</td>
<td>353</td>
<td>17.1</td>
<td>20.7</td>
<td>15.3-27.2</td>
</tr>
<tr>
<td>Hospital 2 7(^{th}) August</td>
<td>Principal referral ATC</td>
<td>289</td>
<td>8.0</td>
<td>8.2</td>
<td>5.0-12.6</td>
</tr>
<tr>
<td>Hospital 3 14(^{th}) August</td>
<td>Non-principal, Metro.</td>
<td>138</td>
<td>11.6</td>
<td>9.2</td>
<td>5.2-15.1</td>
</tr>
<tr>
<td>Hospital 4 15(^{th}) August</td>
<td>Rural</td>
<td>197</td>
<td>20.8</td>
<td>19.1</td>
<td>13.6-26.15</td>
</tr>
<tr>
<td>Hospital 5 29(^{th}) August</td>
<td>Rural</td>
<td>83</td>
<td>22.9</td>
<td>30.6</td>
<td>7.6-63.0</td>
</tr>
<tr>
<td>Hospital 6 30(^{th}) August</td>
<td>Rural ATC</td>
<td>213</td>
<td>8.9</td>
<td>9.6</td>
<td>5.6-15.3</td>
</tr>
</tbody>
</table>
First three metropolitan site audits.

<table>
<thead>
<tr>
<th>Site and date</th>
<th>Type</th>
<th>Adjusted mortality %</th>
<th>Selection of audit characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 1</td>
<td>Principal referral ATC</td>
<td>20.7</td>
<td>July-Aug 2011. 3 transfers in. Nil reported palliative. Rapid CT brain; rate 100%. 100% reached stroke unit or HDU. 100% Neuro obs in 1st 24 hours. Low rate of cardiac ultrasound 30%. No use of a clinical pathway. Only 78% on antithrombotics at discharge. 44% on aspirin in 24 hours. Documentation of swallowing at 4 hours 25%.</td>
</tr>
<tr>
<td>14th August</td>
<td>N=353</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 2</td>
<td>Principal referral ATC</td>
<td>8.2</td>
<td>Aug 2011-Nov 2011. 1 transfer in. 1 documented for palliative care and 2 t/f to a Pal care facility. Rapid CT brain; rate 100%. 100% reached stroke unit or HDU. 95% Neuro obs. Cardiac ultrasound TOE + TTE 76%. Clinical pathway 45%. 84% on antithrombotic on discharge. 58% on aspirin in 24 hours. Swallowing documentation &lt; 4 hrs 70%.</td>
</tr>
<tr>
<td>7th August</td>
<td>N=289</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 3</td>
<td>Non-principal Metro. SU</td>
<td>9.2</td>
<td>July 2011-Jan 2012. Note: major service changes. No transfers in. Two documented as palliative care. 63% reached the stroke unit. TOE + TTE 97%. 63% Neuro obs. 85% on a clinical pathway. 93% on antithrombotics at discharge. 60% on aspirin at 24 hours. Swallowing documentation &lt; 4 hrs 20%.</td>
</tr>
<tr>
<td>14th August</td>
<td>N=138</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## First three rural site audits

<table>
<thead>
<tr>
<th>Site and date</th>
<th>Type</th>
<th>Adjusted mortality %</th>
<th>Selection of audit characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 4 15th August</td>
<td>Rural no SU N=197</td>
<td>19.1</td>
<td>April 2012-June 2012. 7 transferred in. Nil documented palliative. CT 95%&lt;24 hours. No stroke unit. Neuro obs 55%. Low rate of cardiac echo. 80% clinical pathway (new stroke co-ordinator). 71% on antithrombotics at discharge. 47% on aspirin in 24 hours. Swallowing documentation &lt; 4 hrs 10%.</td>
</tr>
<tr>
<td>Hospital 5 29th August</td>
<td>Rural no SU N=83</td>
<td>30.6</td>
<td>July 2011-May 2012 (N=11). High rate of missing data. 1 transfer. 3 palliative care. No on-site CT. 36% documented CT. No stroke unit. Neuro obs 9%. No cardiac echo. No documented carotid imaging. No clinical pathway. 80% on antithrombotics at discharge. 20% on aspirin at 24 hours. Documentation of swallowing &lt; 4 hours 0.</td>
</tr>
<tr>
<td>Hospital 6 30th August</td>
<td>Rural ATC N=213</td>
<td>9.6</td>
<td>Aug-Nov 2012. 55% transferred in. All with protocols. Delays in t/f post-onset. No documented pal care. CT 100% &lt; 24 hours. 100% reached stroke unit. Cardiac echo&gt;95%. 100% neuro obs. 75% clinical pathway. 100% on antithrombotics at dc. 72% on aspirin at 24 hours. Documentation of swallowing &lt; 4 hrs 40%.</td>
</tr>
</tbody>
</table>
Example: Selected Wagga Wagga Audit Results

- Similar results to 2008/9
- 55% transferred in (one for rehab.)
- Average age 71 years
- 35% had AF
- 15% a previous stroke
- All were admitted to the stroke unit!
- 75% were on a clinical pathway during the admission.
- 65% had a CT within 2 hours and 100% in 24 hours.
- Stroke investigation rates shown in figure
- 100% received neurological observations in the first 24 hours
- 72% received aspirin in the first 24 hours.
- Documented swallow assessment in 4 hours of 40% (45% in speech impaired)

No hospital unit performed consistently well across all clinical care processes that are likely to influence patient outcomes. Where outcomes appeared worse the gaps in evidence-based care were generally greater.
Where to next?

A process is needed to improve stroke care and outcomes. Unwarranted clinical variation in stroke is explicable variation. At present stroke patients do not always receive evidenced-based care. This may be the result of being admitted to a smaller hospital with no organised stroke care and little prospect of providing it, admission to a hospital where stroke unit care could reasonably be provided but no unit has been established, because a patient fails to reach a stroke unit bed in a hospital with a stroke unit or because of a variations in the quality of care in existing stroke units.

- Build a project team to extend the pilot process of audit and feedback.
- Expand the stroke network to improve access and use audit and feedback to improve organised stroke care, where it is already provided.
- Review Stroke Thrombolysis and the Early Stroke Reperfusion Programme.
- Reinforce local Thrombolysis Committee governance, deploy a qualitative audit tool to assess barriers to rapid door-to-needle times and collect a minimum dataset from ATCs to benchmark performance.
- Improve data quality and reporting.
- Develop specific recommendations on data collection, analysis and reporting.
- A UCV workshop on proposed work to be held during 2014.
Summary: Is the journey complete?

- A statewide infrastructure & a network of 1000 clinicians.
- Enhancing equity of access to SU and thrombolysis.
- Evaluating the Rural Stroke Network and other implementations.
- Assessing health service performance at each step of the stroke journey.
- Improving governance of stroke reperfusion.
- Addressing unwarranted clinical variation.
- Developing the capacity to deliver Tele-stoke to rural settings.
- Address specific barriers to efficient and effective care with the current focus on the models of care used to access rt-PA and stroke rehabilitation.
Acknowledgements

- NSW Rural Stroke Network
- Statewide Stroke Reperfusion Stroke Services NSW
- NSW Bureau of Health Information
- Melissa Tinsley
- James Dunne
- Bruce Paddock
- Shireen Martin
- Daniel Comerford
- The many clinicians who have contributed to model design, implementation and provide stroke care across NSW
The journey commences

- There is Level 1 evidence for the benefits of Stroke Unit (SU) care.
- Stroke units with co-localised stroke beds served by a multidisciplinary stroke team that using evidenced-based pathways improve stroke outcomes by approximately 30%, at all ages, in NSW.¹
- In 2002 there were 4 Stroke Units in metropolitan Sydney
- In 2002-NSW Health set an objective to increase access to Stroke Units.
- “The Government will establish SU…to ensure people suffering stroke are delivered the right treatment at the right time at the right location.”
- Now we have 20 Acute Thrombolysis Centres (ATCs) nested in 30 acute stroke units across NSW. Nine other hospitals have stroke services.
- In 2012-13 11,367 stroke patients with an ALOS 7.2 days were discharged from NSW public hospitals. (HIE data).
- The 30 and 365 day ischaemic stroke mortality in NSW is 17 and 27%, respectively.

### Outcomes for ischaemic stroke before and after introduction of stroke units in 10 Non-Principal Referral NSW hospitals

<table>
<thead>
<tr>
<th>DISCHARGE DESTINATION</th>
<th>Home</th>
<th>Nursing home</th>
<th>Death</th>
<th>Other*</th>
</tr>
</thead>
</table>

#### 10 NON-PRINCIPAL REFERRAL HOSPITALS (METRO) Age > 85 years

<table>
<thead>
<tr>
<th></th>
<th>Before ASU</th>
<th>After ASU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.3%</td>
<td>28.7%</td>
</tr>
<tr>
<td></td>
<td>12.9%</td>
<td>10.3%</td>
</tr>
<tr>
<td></td>
<td>26.8%</td>
<td>19.7%</td>
</tr>
<tr>
<td></td>
<td>40.0%</td>
<td>41.4%</td>
</tr>
</tbody>
</table>

#### 10 NON-PRINCIPAL REFERRAL HOSPITALS (METRO) All adults

<table>
<thead>
<tr>
<th></th>
<th>Before ASU</th>
<th>After ASU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38.7%</td>
<td>44.5%</td>
</tr>
<tr>
<td></td>
<td>6.3%</td>
<td>4.9%</td>
</tr>
<tr>
<td></td>
<td>13.8%</td>
<td>10.5%</td>
</tr>
<tr>
<td></td>
<td>41.2%</td>
<td>40.2%</td>
</tr>
</tbody>
</table>

*p<0.001 (significant main effect and interaction type*time). Controlling for: age, co-morbidity (modified Charlson Index), sex, marital status, country of birth, hours on mechanical ventilation, insurance status, and clustering of outcomes by hospital in GEE multivariate model. Gattellari et al Stroke, 2008.*
Stroke Service development post 2003 and the introduction of Rural Stroke Care Coordinators (RSCC)

- Armidale RSCC
- Bankstown
- Bathurst (24/7 rt-PA) RSCC
- Batesman Bay/Moruya-Audit Oct 2012
- **Bega (4 bed SU online 2016)**
- Belmont
- Blacktown (24/7 rt-PA)
- Broken Hill
- Campbelltown (24/7 rt-PA)
- **Coffs Harbour-Funded RSCC position vacant**
- Cooma Audit being negotiated 2014
- Concord (24/7 rt-PA)
- **Dubbo RSCC**
- Gosford (24/7 rt-PA)
- **Goulbourn-Audit November 2013**
- John Hunter (24/7 rt-PA)
- Hornsby (24/7 rt-PA)
- **Lismore SU online March 2014 RSCC**
- Liverpool (24/7 rt-PA)
- Manly
- Manning-Taree RSCC
- Calvary – Newcastle
- Nepean (24/7 rt-PA)
- Orange (24/7 rt-PA) RSCC
- Port Macquarie RSCC
- Prince of Wales (24/7 rt-PA)
- Royal North Shore (24/7 rt-PA)
- Royal Prince Alfred (24/7 rt-PA)
- Tamworth (24/7 rt-PA) RSCC
- **Tweed-Clinical Audit Nov 2012 ? RSCC 2014**
- Shoalhaven(CNC-Stroke Rural Hospitals)
- Sutherland
- St George (24/7 rt-PA)
- St Vincent's (24/7 rt-PA)
- **Wagga (24/7 rt-PA) RSCC**
- Westmead (24/7 rt-PA)
- Wollongong
- Wyong
- **LHD Funded stroke services**
- Bowral
- Fairfield
- Maitland Stroke CNS
Building capacity for stroke services in rural locations:

The effectiveness of Rural Stroke Care Coordinators in Australia
Results

• Improved documentation of swallow assessment within 24 hours - baseline 52% post enhancements 76% (p<0.001)

• Improved access to an Acute Stroke Unit - baseline access 1% post enhancement access was 58% (p<0.001)

• Use of clinical pathways - baseline 15%; post enhancement 63% (p<0.001).

• Patients with stroke had an 87% greater odds of being discharged to a home setting following the service enhancements if admitted directly to a ‘hub’ site when differences in age, gender, stroke severity and organisational factors such as time on a stroke unit were taken into account

• The appointment of RSCCs was the catalyst for achieving the majority of improvements in stroke care, including the establishment of stroke units.

• The funding of RSCCs has proven to be a major link in the chain of delivering improved stroke care in rural NSW.
Acknowledgments:
D Cadilhac, M Pollack, T Purvis, M Kilkenny, C Levi
Rural Stroke Care Coordinators et al:
F Ryan, R Peake, K Parrey, A Chandler, B Foye, K O’Leary,
M Christos, A Little, C Mohr, M Gill, D Marsden, L Cutler, J Preece
Ischaemic stroke care in NSW

• 20 Acute Thrombolysis Centres (ATCs) are now nested in 30 acute stroke units across NSW. Nine other hospitals have stroke services.

• The 30 and 365 day ischaemic stroke mortality in NSW is 17 and 27%, respectively (Gattellari et al, Cerebrovascular Diseases, 2011).

• 35% of stroke patients are discharged to in-patient rehabilitation (public hospitals).

• 5% are discharged directly to nursing home.

• 20-25% return to independent living, many with some disability, including cognitive impairment.
Ischaemic stroke

Most ischaemic strokes are due to clot embolism from an extra-cranial artery or from the heart, travelling to and blocking distal artery.

The main outcome of ischaemic stroke is disability
Evaluating on-going performance.

- Data from ambulance flows.
- Data from ATC-a minimum data-set.
- Hospital redesign with 20 24/7 Acute Thrombolysis Centres.
- Paramedic stroke screening using the FAST tool in those with onset under 3 hours.
- Direct transport to an available ATC with ED/clinician pre-notification, bypassing non-ATC hospitals.
- Locally driven system improvement to improve door-to-needle time, by local Thrombolysis Committees of stakeholders, Management, ED, Imaging, Bed-management, Pharmacy, Nursing, Ambulance representatives, ACI implementation team members and the Stroke Team.
- 2014 qualitative (SRAT) assessment of the implementation process and pathway performance.