Stroke: What’s new in 2019?

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National Clinical Lead for Stroke Medicine
GIRFT Stroke Programme – NHS Improvement

Consultant Stroke Physician & Geriatrician
Wirral University Teaching Hospital NHS Foundation Trust
The burden of stroke

• Stroke is the leading cause of disability and the fourth largest cause of death in the UK

• Every year 80,000 people in England are admitted to hospital having had a stroke, 50% stroke survivors will be left with disability (physical, communication, cognitive, psychological, visual, fatigue)

• Stroke costs the UK economy £26 billion per year, including £3.2bn cost to NHS, £5.2bn to social care and £15.8bn in informal care.

• This is forecast to rise to £91bn by 2035. The cost of someone having a stroke over a year is over £45,000

• By 2035, the number of strokes will increase by almost half and the number of stroke survivors by a third

• Half of stroke survivors are living with four or more co-morbidities
Outcome after stroke

- About 25% will die within 1 month
- 90% stroke deaths are >65yrs
- By one year:
  - Dead - 30%
  - Dependent - 25%
  - Moderate /Severe disability – 50%
- After first stroke, 10% will have another stroke in the first year, and 5% per year thereafter
- Increased risk of MI / ‘vascular event’ following stroke
Economic burden of stroke care to NHS is considerable

Table 2. Baseline mean costs per patient at one and five years.

<table>
<thead>
<tr>
<th>Mean healthcare costs per patient</th>
<th>1 Year</th>
<th>5 Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean social care costs per patient</td>
<td>£8977</td>
<td>£28,076</td>
</tr>
<tr>
<td>Mean total health and social care costs per patient</td>
<td>£22,429</td>
<td>£46,039</td>
</tr>
<tr>
<td>Combined total cost for all patients included in SSNAP April 2015–March 2016 (n=84,184)</td>
<td>£1,736,338,300</td>
<td>£3,604,672,200</td>
</tr>
<tr>
<td>Mean health and social costs per patient with ischaemic stroke</td>
<td>£20,121</td>
<td>£41,432</td>
</tr>
<tr>
<td>Mean health and social costs per patient with ICH stroke</td>
<td>£24,297</td>
<td>£52,726</td>
</tr>
</tbody>
</table>

ICH: intracerebral hemorrhage; SSNAP: Sentinel Stroke National Audit Programme

*Healthcare costs include: ambulance, MRI or CT scan, thrombolysis, acute stroke unit care, rehabilitation stroke unit care, general medical ward care, community rehabilitation, GP visits, secondary prevention, and ESD therapies.

*Social care costs include: care home, home help, meals on wheels, and social service day centre visits.

- Older age
- Increasing stroke severity
- Intracerebral haemorrhage stroke

An individual patient simulation model was built to estimate health and social care costs at one and five years after stroke, and the cost-benefits of thrombolysis and early supported discharge. The results were illustrated using data on all patients with stroke included in Sentinel Stroke National Audit Programme from April 2015 to March 2016 (n=84,184).
Quality Improvement in Stroke

- Huge achievements since National Stroke Strategy in 2007, but many focused on Hyper/acute redesign
- Improved performance in SSNAP across the country since 2013
- Limited focus on post discharge rehabilitation and Life after Stroke
Reduction in 30-day mortality from acute stroke 1998-2014

50%
Reduction in hospital length of stay for acute stroke 2001-2014

49%
Decline in institutionalisation for acute stroke

2004-2013

46%
Prevention is better than Cure

“What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?”
Modifiable Vascular risk factors

Conditions and lifestyle characteristics identified as a risk factors for stroke:

- High blood pressure
- Atrial fibrillation
- Smoking
- Carotid artery disease
- Myocardial infarction
- Obstructive sleep apnoea
- High Cholesterol
- Diabetes mellitus
- Obesity
- Heavy alcohol use
- Physical inactivity
- Hyperhomocysteinaemia
Relationship between AF and stroke

Source: QoF 2015
Failure to anticoagulate patients with known Atrial Fibrillation

<table>
<thead>
<tr>
<th></th>
<th>April – July 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total strokes</td>
<td>28,156</td>
</tr>
<tr>
<td>Known AF prior to admission</td>
<td>19.7% (5,547)</td>
</tr>
<tr>
<td>On oral antiplatelets prior to admission</td>
<td>19.5% (1,038)</td>
</tr>
<tr>
<td>On oral anticoagulation prior to admission</td>
<td>56.5% (3,009)</td>
</tr>
<tr>
<td>Contraindicated to anticoagulation</td>
<td>602 (11.3%)</td>
</tr>
</tbody>
</table>

Preventing avoidable strokes – primary and secondary prevention

• 9 out of 10 strokes associated with ten modifiable risk factors
• Population health approach (Making Every Contact Count, One You campaign, Salt Reduction, Tobacco Control Plan, weight management services, CQUIN’s for supporting alcohol reduction and smoking cessation)
• RightCare CVD Prevention programme, support from AHSN’s, PHE, NICE and third sector to help CCG’s improve detection and management
• ATRIAL FIBRILLATION – could prevent up to 14,220 strokes, saving £241 million over 3 years
• HIGH BLOOD PRESSURE – could prevent 14,500 strokes and 9,700 heart attacks over 3 years
• PHE Act FAST campaign,
• Stroke Association - Rebuilding Lives Campaign
Preventing cardiovascular disease: Addressing the A, B and C of secondary prevention over the next 10 years
CVD ambitions and secondary prevention

The NHS Long Term Plan includes a major ambition to prevent **150,000 strokes**, **heart attacks and dementia cases** over the next **10 years**

Independent PHE estimates show that if the ambitions are met, at least **49,000 strokes** and **32,000 heart attacks** could be prevented.

Other events that will be averted:
- Heart failure
- Transient ischaemic attacks
- Vascular dementia
- Angina

To complement this, the National CVD Prevention System Leadership Forum has agreed specific ambitions for the **detection** and **management** of the high risk conditions:

- A – Atrial fibrillation
- B – Blood pressure
- C – Cholesterol
NHS RightCare Stroke Pathway

NHS RightCare Pathways: Stroke

The National Challenge

- 42% don't get to a stroke unit within four hours
- Less than 10% of Trusts get an 'A' on all three SSNAP therapy measures
- 20% of CCGs don't commission Early Supported Discharge
- 1 in 3 areas in England, Wales and NI don't commission ongoing support services for patients and carers
- 70% don't receive a six month follow-up review
- 85% of post-acute services don't commission vocational rehabilitation

The RightCare Opportunity

- 3,800 more people would be admitted to a hyper acute stroke unit and 2,200 would be admitted within four hours of arrival at hospital if CCGs had the rate of their best 5 peers
- £51m could be saved on emergency admissions and over 600 lives saved if CCGs achieved the rate of their best 5 peers.
- 5,200 more people would be on treatment to prevent another stroke if CCGs had the same rate as their best 5 peers.
- 6,200 more people would return to their usual place of residence if CCGs had the same rate as their best 5 peers.

System Enablers

Whole system approach: single aim with shared accountability and responsibility
full use of assets from across the system, including third sector whole system-wide participation in SSNAP audits
effective implementation of CVD Prevention Pathway

Key Components

First 72 hours
- Rapid diagnosis and treatment

First Six Months
- Prompt and ongoing rehabilitation and support and secondary prevention

Beyond Six Months
- Individualised ongoing assessment and delivery of treatment plan including physical, psychological, practical and social support for all patients and carers

Priorities for optimisation & key messages

Admission to hyper acute stroke unit and swallow screening within 4 hours of arrival at hospital for all patients

Stroke unit and ESD delivered as 7 day specialist stroke rehabilitation in accordance with national clinical guidelines

Six month review then annual follow up in all settings using validated tool with timely access to further interventions
# The Size of the Prize in Cardiovascular Disease (CVD) Prevention

## North of England

### 1. The diagnosis and treatment gap, 2015/16

<table>
<thead>
<tr>
<th>Hypertension</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated adult population with hypertension</td>
<td>3,935,000</td>
</tr>
<tr>
<td>Estimated adult population with undiagnosed hypertension</td>
<td>1,598,200</td>
</tr>
<tr>
<td>GP registered hypertensives not treated to 150/90 mmHg target</td>
<td>453,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atrial Fibrillation (AF)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GP registered population with Atrial Fibrillation (AF)</td>
<td>291,000</td>
</tr>
<tr>
<td>Estimated GP registered population with undiagnosed AF</td>
<td>109,200</td>
</tr>
<tr>
<td>GP registered high risk AF patients (CHA2DS2VASC &gt;=2) not anticoagulated</td>
<td>52,300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CVD risk</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated adult population 30 to 85 years with 10 year CVD risk &gt;20%</td>
<td>1,110,000</td>
</tr>
<tr>
<td>Estimated percentage of people with CVD risk &gt;20% treated with statins</td>
<td>49%</td>
</tr>
</tbody>
</table>

### 2. The burden: first ever CVD events, 2015/16

<table>
<thead>
<tr>
<th>Coronary Heart Disease</th>
<th>40,900</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>21,100</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>14,750</td>
</tr>
</tbody>
</table>

### 3. The opportunity: potential events averted and savings over 3 years by optimising treatment in AF and hypertension, 2015/16

- **Optimal anti-hypertensive treatment of diagnosed hypertensives averts within 3 years:**
  - 2,720 heart attacks, **Up to £20.4 million saved†**
  - 4,060 strokes, **Up to £56.4 million saved†**

- **Optimally treating high risk AF patients averts within 3 years:**
  - 4,180 strokes, **Up to £70.8 million saved†**

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† Based on data from Health Outcomes in Action (HOIA) and Health Outcomes in Action: Preventing Heart Failure (HOIA: FH) in the North of England.
We know what a good stroke service should provide

- Effective primary prevention
- Public education about stroke symptoms and how to respond
- Hyperacute stroke care for about first 72 hours
- Acute stroke unit care for whole admission including in-patient rehabilitation
- Early supported discharge
- Longer term rehabilitation as needed
- Vocational rehabilitation and psychological support
- Secondary prevention
- Patient and carer support and education
- Participation in research
- Continuous quality improvement
# Impact of different service and medical interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Clinical trials (participants)</th>
<th>Trial results (extra independent survivors per 100 patients treated)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid secondary prevention ¹</td>
<td>1 (1278)</td>
<td>2</td>
<td>P=0.0001</td>
</tr>
<tr>
<td>Stroke unit (CSU) ²</td>
<td>28 (5855)</td>
<td>5</td>
<td>P=0.0007</td>
</tr>
<tr>
<td>Rehabilitation (Early Supported Discharge) service ³</td>
<td>14 (1957)</td>
<td>5</td>
<td>P=0.02</td>
</tr>
<tr>
<td>Aspirin ⁴</td>
<td>12 (43,041)</td>
<td>1</td>
<td>P=0.008</td>
</tr>
<tr>
<td>rtPA within 0-3 hrs ⁵</td>
<td>12 (7012)</td>
<td>11</td>
<td>P=0.001</td>
</tr>
<tr>
<td>rtPA within 3-4.5 hrs</td>
<td></td>
<td>5</td>
<td>P=0.04</td>
</tr>
<tr>
<td>Mechanical thrombectomy ⁶</td>
<td>8 (2423)</td>
<td>11</td>
<td>P=0.00001</td>
</tr>
<tr>
<td>Hemicraniectomy ⁷</td>
<td>3 (93)</td>
<td>20</td>
<td>P=0.014</td>
</tr>
</tbody>
</table>

## Population impact of services

5.4 million inhabitants (7,000 strokes per year)  
Impact in terms of extra independent survivors per year

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Maximum impact</th>
<th>Proportion eligible for treatment (%)</th>
<th>Actual impact Extra independent survivors per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid secondary prevention</td>
<td>140</td>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>Stroke unit (CSU) service</td>
<td>350</td>
<td>80</td>
<td>280</td>
</tr>
<tr>
<td>Rehabilitation (ESD) service</td>
<td>350</td>
<td>30</td>
<td>105</td>
</tr>
<tr>
<td><strong>Service total</strong></td>
<td>-</td>
<td>-</td>
<td><strong>455</strong></td>
</tr>
<tr>
<td>Aspirin</td>
<td>70</td>
<td>80</td>
<td>56</td>
</tr>
<tr>
<td>rtPA within 0-3 hrs</td>
<td>770</td>
<td>10</td>
<td>112</td>
</tr>
<tr>
<td>rtPA within 3-4.5 hrs</td>
<td>350</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Mechanical thrombectomy</td>
<td>770</td>
<td>5</td>
<td>39</td>
</tr>
<tr>
<td>Hemicraniectomy</td>
<td>1400</td>
<td>0.5</td>
<td>7</td>
</tr>
<tr>
<td><strong>Acute medical total</strong></td>
<td>-</td>
<td>-</td>
<td><strong>214</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>-</td>
<td>-</td>
<td><strong>669</strong></td>
</tr>
</tbody>
</table>

Slide courtesy Prof Peter Langhorne
We work in a country that is failing to deliver thrombectomy to the vast majority of patients with Large Vessel Occlusion who would benefit.
## Stroke and unwarranted variation

### Routinely Admitting Teams

<table>
<thead>
<tr>
<th>Trust</th>
<th>Team Name</th>
<th>Number of patients</th>
<th>Overall Performance</th>
<th>Patient Centred Data</th>
<th>Six Month Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Admit</td>
<td>Disch</td>
<td>SU</td>
<td>Throm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Spec Acid</td>
<td>DT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>GMF</td>
<td>PT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MALT</td>
<td>MDT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Std Disch</td>
<td>D1</td>
</tr>
<tr>
<td>North of England - North West Coast SCN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North West Coast SCN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrowe University Hospitals NHS Foundation Trust</td>
<td>University Hospital Aintree</td>
<td>152</td>
<td>147</td>
<td>C↓</td>
<td>A</td>
</tr>
<tr>
<td>Blackpool Teaching Hospitals NHS Foundation Trust</td>
<td>Blackpool Victoria Hospital</td>
<td>153</td>
<td>159</td>
<td>E</td>
<td>A↑</td>
</tr>
<tr>
<td>Countess of Chester Hospital NHS Foundation Trust</td>
<td>Countess of Chester Hospital</td>
<td>189</td>
<td>189</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>East Lancashire Hospitals NHS Trust</td>
<td>Royal Blackburn Hospital</td>
<td>216</td>
<td>207</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>Lancashire Teaching Hospitals NHS Foundation Trust</td>
<td>Royal Preston Hospital</td>
<td>174</td>
<td>182</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Mid Cheshire Hospitals NHS Foundation Trust</td>
<td>Leighton Hospital</td>
<td>197</td>
<td>209</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Royal Liverpool and Broadgreen University Hospitals NHS Trust</td>
<td>Royal Liverpool University Hospital</td>
<td>170</td>
<td>171</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Southport and Mid Cheshire NHS Foundation Trust</td>
<td>Southport and District General</td>
<td>149</td>
<td>148</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>St Helens and Knowsley Teaching Hospitals NHS Trust</td>
<td>St Helens Hospital</td>
<td>298</td>
<td>276</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>University Hospitals of North Staffordshire NHS Foundation Trust</td>
<td>University Hospital of North Staffordshire</td>
<td>67</td>
<td>62</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>University Hospitals of Shrewsbury and Telford NHS Foundation Trust</td>
<td>University Hospital of Shrewsbury and Telford</td>
<td>90</td>
<td>104</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Wirral University Teaching Hospitals NHS Foundation Trust</td>
<td>Wirral University Teaching Hospital</td>
<td>93</td>
<td>99</td>
<td>A</td>
<td>B</td>
</tr>
</tbody>
</table>

### Patient Centred Data

- **SU**: Scan
- **Throm**: Thrombolysis
- **Spec Acid**: Specimen acidosis
- **DT**: Delirium
- **MALT**: Malnutrition
- **Std Disch**: Standard discharge
What are your chances of getting admitted to a stroke unit within 4 hours?

- 84% - 2014/15
- 87% - 2016/17

206 out of 211 CCGs (5 removed due to small numbers)
GIRFT Stroke Programme

- Doing things a little differently in Stroke
- Clinical Leads- Dr Deb Lowe, Dr David Hargroves
- Regional visits started Nov 2018
- STP / ICS based visits
- Individual meetings with Clinical Leads, Trust Execs and Operational Management, Commissioners
- Individual data packs –SSNAP/HES/ONS
- Additional data collection via SSNAP Acute Organisational Audit June 2019
- Local reports with Trusts based and STP based recommendations for improvement
- Support for delivery by GIRFT Implementation teams
What’s new?
Mechanical Thrombectomy: the game changer
Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials

OR: 2.49 (95% CI, 1.76 to 3.53; P<0.0001)
Patients with acute ischaemic stroke should be considered for combination intravenous thrombolysis and intra-arterial clot extraction (using stent retriever and/or aspiration techniques) if:

- they have a proximal intracranial large vessel occlusion
- a disabling neurological deficit (National Institutes of Health Stroke Scale [NIHSS] score of 6 or more)
- the procedure can begin (arterial puncture) within 5 hours of known onset.
NICE guideline

Stroke and transient ischaemic attack (TIA) in over 16s: diagnosis and initial management (update)

Planned publication: May 2019
Recommendations with significant impact

• Offer thrombectomy to people who were last known to be well between 6 hours and 24 hours previously (including wake-up strokes):
  – who have acute ischaemic stroke and confirmed occlusion of the proximal anterior circulation demonstrated by CTA or MRA and
  – if there is the potential to salvage brain tissue, as shown by CT or MRI scanning techniques.

• Consider thrombectomy alongside intravenous thrombolysis (where not contraindicated and within the licensed time window) for people last known to be well up to 24 hours previously (including wake-up strokes):
  – who have acute ischaemic stroke and confirmed occlusion of the proximal posterior circulation (that is, basilar or posterior cerebral artery) demonstrated by CTA or MRA and if there is the potential to salvage brain tissue, as shown by CT or MRI scanning techniques.
How to improve delivery of Mechanical Thrombectomy

- Workforce, capability, geographical and population modelling required.
- Specialist commissioning (each case £12,000)
- New credentialing planned via GMC/ RCR to train non INR’s (+ CQUIN)
- Encourage neuroscience centres and others centres to deliver 24/7
- Geographical modelling undertaken to estimate how many comprehensive centres are required or drip and ship model
- Neuro-interventionalist (currently we have 82, one third of whom work in London)

- Very little or no data on:
  Basilar artery stroke (BASICS, BEST)
  Optimal imaging identifying collaterals
  Non stent retriever intervention
  Use of other thrombolytic agents (Tenecteplase) EXTEND IA-TNK
  Non neuro-interventional radiologists delivering intervention
Drip and Ship v’s Mothership?

Key
- Drip and ship
- Mothership

Local acute stroke unit
- Service available: Thrombolysis

Comprehensive acute stroke unit
- Services available: Thrombolysis, Thrombectomy

PEARS/PENCHORD Collaboration
National Modelling

24 Thrombectomy centres (the 24 Neuroscience centres) - Thrombectomy centre
Potential stroke centre

Travel (mins)  Thrombectomy admissions
0-15 1013
1.5-30 2459
30-45 2268
45-60 1208
60-90 814
90+ 320

Thrombectomy centres with <200 thrombectomy admissions
King’s college 126
St George’s 141

Courtesy of: Ford, G. UKSF Dec 2018, on behalf of PenCLAHRC
Recommendations with significant impact

• Refer immediately people who have had a suspected TIA for specialist assessment and investigation, to be done within 24 hours of onset of symptoms

• Do not offer CT brain scanning to people with a suspected TIA unless there is clinical suspicion of an alternative diagnosis that CT could detect – for example, intracerebral haemorrhage or mass lesion

• Consider MRI (including diffusion-weighted and blood-sensitive sequences) to detect ischaemia, haemorrhage or alternative pathologies after specialist assessment in the TIA clinic. If imaging is done, perform it on the same day as the assessment.
New Trial Results

• Thrombolysis-WAKE UP

• Intra-arterial interventions – DEFUSE 3, DAWN

• Haemorrhagic Stroke - TICH 2

• Secondary Prevention – CROMIS 2

• Secondary Prevention – NAVIGATE ESUS
Artificial Intelligence and Technology in Stroke
Automated CT/CTA interpretation

- Suspected Stroke → CT stroke protocol
- CT → e-ASPECTS
  - Ischemic core (ASPECTS and volume)
- CTA → e-CTA
  - Collaterals
- CTP → OLEA SPHERE®
  - Mismatch
- PACS → Web UI
  - Decision to treat patient
  - Email
Results formats

PACS
New series in existing patient study

Mobile phone notifications and email
Anonymized result images

Web browser UI
Available within the hospital network
RAPID

What is RAPID?

1. Fully automated platform
2. Stroke imaging tool
3. Brain physiology analysis
4. Patient selection for reperfusion therapy
Acute Bundle of Care for ICH (ABC-ICH) project

**Design:** Single centre quality improvement project and evaluation

**Site:** Salford Royal Hospital, Greater Manchester, UK

**Aim:** 10 percentage point reduction in 30-day case fatality after admission with acute ICH by the end of 2016.

**Methods:**
- Model for Improvement used to conduct QI project
- Improvement phase: June 2015 – June 2016
- Data entered in QI registry from Jun 2013 – Jan 2017
- All spontaneous ICH included (excluded traumatic ICH, haemorrhagic transformation)
The ABC hyperacute care bundle

A. **Anticoagulant reversal**: Deliver reversal agent < 90 min from arrival

B. **Blood pressure lowering**: Deliver intensive blood pressure lowering with needle-to-target time < 60 min

C. **Care pathway**: Refer patients with good pre-morbid function (mRS ≤ 2) and **any** of the following to Neurosurgery:
   - GCS < 9
   - Posterior fossa ICH
   - Obstructed 3rd/4th ventricle
   - Haematoma volume > 30 ml
VKA-ICH: Improving door-to-needle times

Three key changes:
1. PCC stock in the ED
2. Point-of-care INR device
3. Standard protocol to deliver PCC without Haematology referral for every case

Intensive BP lowering – NTT by month

- INTERACT2 published
- Protocol introduced
- Change to GTN first

NTT (min)

2013-06
2013-09
2013-11
2014-01
2014-03
2014-06
2014-08
2014-10
2014-12
2015-02
2015-04
2015-06
2015-08
2015-10
2015-12
2016-02
2016-04
2016-06
2016-08
2016-10
2016-12

Target = 60 min
Neurosurgery - operations per quarter

operations / quarter

Pre QI | Post QI

DNAR order by < 24 h - % by quarter
So new, it's not happened yet!

WHAT’S NEXT?
Pre-hospital stroke stratification

Is this stroke?

Is this a mimic condition?

Is the territory small or large vessel?

Is thrombectomy appropriate?

Is thrombolysis appropriate?

Mobile telemedicine

Point of care diagnostic

Point of care diagnostic

ED

HASU

LVO?
## Stroke Mimics: a systematic review

<table>
<thead>
<tr>
<th></th>
<th>Prehospital</th>
<th>Mixed</th>
<th>Thrombolysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papers</td>
<td>6</td>
<td>37</td>
<td>16</td>
</tr>
<tr>
<td>Population</td>
<td>2,713</td>
<td>27,515</td>
<td>11,909</td>
</tr>
<tr>
<td>Mean % mimics</td>
<td>29</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td>Top mimic diagnoses</td>
<td>seizures</td>
<td>seizures</td>
<td>migraine</td>
</tr>
<tr>
<td></td>
<td>migraine</td>
<td>migraine</td>
<td>psychological</td>
</tr>
<tr>
<td></td>
<td>tumour</td>
<td>decompensation</td>
<td></td>
</tr>
</tbody>
</table>
Do normal purine levels predict most mimics?
Double blinded diagnostic accuracy study
The added value of a point of care assay <4hours in any pre-hospital suspected stroke
Main study: Day 7 clinical diagnosis of a stroke or mimic condition.
Sub-study: the presence of large vessel occlusion on cerebral angiography
Three ambulance services
958 patients
A new biomarker for ischaemic stroke
NR2 Peptide

- 101 stroke <72hrs; 91 mimics; 100 controls +/- vascular risk factors
- At an NR2 peptide threshold of 1ug/l:
  - Sensitivity for ischaemic stroke 92%
  - Specificity for ischaemic stroke 96%
- But a larger diagnostic accuracy trial needed of all suspected stroke
A biomarker for haemorrhagic stroke
Plasma Glial Fibrillary Acidic Protein (GFAP)

270 suspected stroke <6 hours (ICH=34)
Onset to sampling ~ 170 minutes
Specificity 97%
Sensitivity 91%

74 stroke < 3 hours (ICH = 74)
Onset to sampling ~ 63 minutes
Specificity 100%
Poor sensitivity < 1 hour

DOI:10.1161/STROKEAHA.117.018409

Rozanski et al; Cerebrovasc Dis 2017;43:76–81
Point of care LVO diagnosis

- Volumetric Integral Phase-shift Spectroscopy (VIPS)
- New biomarker: cerebral bio-impedance asymmetry
- Measurement in real time over 30 seconds
- USA hospital blinded diagnostic accuracy study
- Dec 2017: FDA approval for “CBA monitoring”
- Dec 2018: MRC funded UK diagnostic accuracy study

<table>
<thead>
<tr>
<th>Group</th>
<th>Patients</th>
<th>%CBA (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Large” stroke</td>
<td>55 LVO IS + 2 ICH ≥ 60ml</td>
<td>16.5 (14.6-18.4)</td>
</tr>
<tr>
<td>“Minor” stroke</td>
<td>16 non-LVO IS + 10 ICH &lt; 60ml</td>
<td>8.0 (6.9-9.0)</td>
</tr>
<tr>
<td>Control</td>
<td>79 healthy volunteers</td>
<td>5.0 (4.5-5.5)</td>
</tr>
</tbody>
</table>

Other technologies undergoing evaluation

Strokefinder MD100

SPIDER
Stroke Prehospital Informed Decision-making using EEG Recordings

STUDY COMMENCEMENT 3RD SEPTEMBER 2018

To investigate accuracy of Electroencephalography (EEG) in identifying large vessel occlusion (LVO) stroke in the prehospital setting

- Identification of large vessel occlusion stroke is critical to patient outcomes
- Clinical scores have limited effectiveness
- In controlled settings, alterations in EEG activity shown to be highly specific for acute stroke
Long Term Plan
Milestones for Stroke Care

• In 2019 we will, working with the Royal Colleges, pilot a new credentialing programme for hospital consultants to be trained to offer mechanical thrombectomy

• By 2020 we will begin improved post-hospital stroke rehabilitation models, with full roll-out over the period of this Long Term Plan

• By 2022 we will deliver a ten-fold increase in the proportion of patients who receive a thrombectomy after a stroke so that each year 1,600 more people will be independent after their stroke

• By 2025 we will have amongst the best performance in Europe for delivering thrombolysis to all patients who could benefit
3.74. There is strong evidence that hyper acute interventions such as brain scanning and thrombolysis are best delivered as part of a networked 24/7 service\textsuperscript{126}. Areas that have centralised hyper-acute stroke care into a smaller number of well-equipped and staffed hospitals have seen the greatest improvements\textsuperscript{127}. This means a reduction in the number of stroke-receiving units, and an increase in the number of patients receiving high-quality specialist care.
3.75. Mechanical thrombectomy and clot-busting treatment (thrombolysis) can significantly reduce the severity of disability caused by a stroke. These treatments carefully remove a blood clot from the blood vessel causing an interruption to the brain’s blood supply, or use drugs to dissolve the clot. ISDNs will support STPs and ICSs to reconfigure stroke services into specialist centres, improve the use of thrombolysis and further roll out mechanical thrombectomy. This will ensure 90 percent of stroke patients receive care on a specialist stroke unit and that all patients who could benefit from thrombolysis (about 20 percent) receive it, up from just over half of eligible patients now. Expanding mechanical thrombectomy – from 1% to 10% of stroke patients – will allow 1,600 more people to be independent after their stroke each year.
The NHS will work with Health Education England to modernise the stroke workforce with a focus on cross-specialty and in some cases cross-profession accreditation of particular ‘competencies’. This will include work with the medical Royal Colleges and specialty societies to develop a new credentialing programme for hospital consultants from a variety of relevant disciplines who will be trained to offer mechanical thrombectomy.
3.78. **National support for the scaling of technology will assist the expansion of life-changing treatments to more patients.** This includes the use of CT perfusion scans to assess the reversibility of brain damage, improved access to MRI scanning and the potential use of artificial intelligence interpretation of CT and MRI scans to support clinical decisions regarding suitability for thrombolysis and thrombectomy. Interoperable information systems supported by telehealth will aid more timely transfer of information between providers, enabling more effective hyper-acute pathways and improving access to and intensity of rehabilitation.