Reconfiguring Stroke Care in North Central London

I have heard such great things about the way we treat stroke patients in London and the role that this hospital plays and I wanted to come to see it for myself.

- Prime Minister David Cameron, speech at UCLH, 7 June 2011

This new model of care constitutes a quantum leap forward and will deliver world-class treatments for Londoners who have had a stroke. Never before have we had the opportunity to make so much positive change in one single, and much needed, health reform.

- Dr. Nick Losseff, stroke physician and Interim Clinical Director for Stroke Services in London, 2010

Stroke was a major medical problem in the UK and other countries, with high morbidity and mortality and substantial costs of care delivery. In 2006, an institution began to improve stroke care in the London region through restructuring care across the system of providers.

Overview of Stroke and Stroke Care

In 2010, stroke was the third most common cause of death in the UK and one of the most important causes of on-going physical and psychological disability. In line with other cardiovascular diseases, population changes over the last 15 years, such as reduced smoking and better control of blood pressure and diabetes, had led to decreasing stroke incidence and mortality. Still, 110,000 people in the UK suffered a stroke in 2010, of which half would die as a direct result or from a related complication. Eleven thousand of those strokes happened to people living in London.

The direct cost of treating stroke patients and the indirect costs of productivity loss in the UK were huge:1 direct health and social care costs for stroke patients were estimated at £4.5b/year, representing 5% of total UK health care spend, and the cost of patients’ lost productivity represented another £4.5b. Taking into account a broader set of social costs (including, for example, lost productivity from family members taking on caregiver roles), the total cost to the UK was estimated to be as high as £15.5b/year.
Strokes resulted from disruption in the blood supply to the brain. They typically presented as sudden onset disturbances in motor functioning, speech impediment and/or disturbed vision. These symptoms came on rapidly because the brain was unable to function with even a short interruption to its blood supply. Over 70% of strokes occurred in people over the age of 65. The majority (85%) of strokes were ischaemic, caused by a rapid block in blood supply to the brain. The remaining 15% were haemorrhagic, due to an intra-cerebral or subarachnoid rupture of a blood vessel. The main mechanisms for ischaemic stroke were large-artery atherosclerosis, cardio-embolism and small-vessel occlusion. Beyond age, risk factors common to all strokes included: smoking, hypertension, elevated cholesterol and poor diet, diabetes, obesity, lack of exercise, atrial fibrillation and social deprivation. Additional risk factors for haemorrhagic stroke included excessive alcohol consumption and recreational drug use.

Since the 1980s, there had been increasingly robust clinical evidence that patients treated in dedicated stroke units had better outcomes: for example, a greater proportion of surviving patients who were treated on stroke units were independent in walking, personal hygiene and dressing than patients treated on geriatric or general medical wards. Stroke units cared for a high volume of stroke patients and were staffed by experienced, multidisciplinary teams. Stroke units were jointly led by a stroke nurse and medical expert in stroke, who were assisted by the full range of personnel needed for optimal care and recovery, including: medical, nursing, speech therapy, physical therapy, occupational therapy, dieticians and psychological therapists. Stroke units maintained an early focus on rehabilitation and on patient and family education.

In 1995, the first substantive clinical trial was published showing that morbidity and mortality from ischaemic stroke could be substantially improved if rapid thrombolysis was used to open up blocked vessels within three hours of onset of symptoms. Of note, the differentiation of ischaemic from haemorrhagic strokes required a CT scan to visualise the brain and surrounding tissue. Thrombolysis of a haemorrhagic stroke could worsen the patient’s clinical state and could even cause death.

Following success in improving care for heart attacks in the early 2000s through a national myocardial infarction audit and the development of national cardiac care standards, efforts to improve stroke care took a similar approach. The Department of Health published a set of quality standards for stroke care in 2007 highlighting the need for immediate access to CT scanning and expert multidisciplinary assessment for stroke patients. It was clear from the NHS assessment that parts of London lagged behind the rest of the country on several key process measures that were linked to better stroke outcomes, and that things were getting worse, not better. See Exhibit 1 for key results of the 2006 Sentinel Stroke Audit for London.

**Stroke Care in London until 2009**

The dominant model of care for stroke patients in London, as well as the rest of the NHS, had centered on the local hospital. In 2006, 34 London hospitals were set up to receive ‘blue-light’ ambulances transporting patients who had suffered an acute stroke. There was wide variation in the number of patients treated across settings, and analysis showed that more strokes occurred in outer London (where the majority of the elderly population live), but most hospital beds were located in inner London.

Overall, there was substantial variation across hospitals in both the diagnostic process and the subsequent care pathway. There was further variation within each hospital by time of day and day of the

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*a Atrial fibrillation was a common form of irregular heart rhythm which predisposes to clots forming in the heart that could cause stroke and other problems.*
week. Sometimes patients would undergo a diagnostic CT scan toward thrombolysis and be cared for by specialist stroke physicians, but this was more the exception than the rule. Exhibit 2 shows the typical care pathway for stroke in London until 2009.

Following the sudden onset symptoms of visual or speech disturbance and weakness of an arm or leg, the patient or someone else would typically call the emergency services on 999, and a blue light ambulance would take the patient to the nearest Accident and Emergency (A&E) Department. There, A&E medical and nursing staff would assess the patient and arrange admission to a medical assessment unit where a general medical or geriatric physician would take over the patient’s care and arrange admission to a ward. Sometimes, patients would be admitted to a specialist stroke unit, but this was highly variable. Not all local hospitals had a stroke unit, and even if there was one, beds were often full or inaccessible. For example, a patient presenting to A&E at 5 pm on a Friday would typically be admitted to an acute medical or geriatric ward where they would stay over the weekend. They might be picked-up by the stroke service on Monday and transferred to the stroke unit by Monday evening, but even this was not reliable. In any case, several time-limited opportunities to improve outcomes had already been missed.

London’s health system was divided into five administrative sectors. North Central London (NCL) was one, and comprised five Primary Care Trusts (PCTs): Barnet, Enfield, Harringey, Islington and Camden. Within the NCL area, there were around 1,500 cases of stroke among the 1.2m population in 2006. Given the population diversity of the area, its social and health care needs were above the London average.

Five acute hospital trusts served NCL’s population: Barnet and Chase Farm, North Middlesex, Royal Free, University College London Hospital (UCLH) and the Whittington. Each of these received stroke patients through their A&E Departments, with volumes ranging from 150 to 400 patients/year. Across these hospitals, the availability of dedicated stroke beds and care resources varied greatly, from 24/7 access in some to an exception basis in others. Across the five hospitals, the proportion of patients treated in dedicated acute stroke units ranged from 16%–99%, the proportion of patients receiving full physiotherapy assessment within 72 hours of admission ranged from 17%–90%, and the proportion of patients receiving a CT scan within 24 hours of admission ranged from 22%-83%. Across the same five hospitals, acute stroke mortality (measured at 30 days post stroke) ranged from 12% to over 30%.

Designing a New Model of Stroke Care for London

Surgeon Ara Darzi (who would shortly become Lord Darzi of Denham, a health minister in Prime Minister Gordon Brown’s Labour Government) identified key areas, including stroke, for improving

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**Exhibit 2** shows the typical care pathway for stroke in London until 2009.

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**Thrombolysis** was a treatment which broke down blood clots. Its use in stroke was analogous to the earlier use of thrombolysis in acute myocardial infarction (heart attack), which aims to restore blood circulation to heart muscle. In stroke, the aim was to restore circulation to the brain. As of 2011, the therapeutic window was considered to be 4½ hours rather than 3 hours.

**For example,** guidelines stated that patient should be CT scanned within 24 hours of admission, but none of London’s 34 hospitals treating stroke met this standard in 2006.

**The equivalent of an Emergency Room in US**

**Typically,** only stroke physicians had admitting rights to stroke units. Therefore if a stroke physician was not on duty, a patient could not be admitted to the stroke unit, even if a bed was available.
health and health care across London in his 2006 report. NHS London (London’s Regional Health authority) prioritised stroke as a focus condition for early adoption of a new, clinically-driven and clinically-owned model of care. The overall aim was to ensure a uniformly high treatment standard for stroke patients, irrespective of where in London they suffered their stroke.

London’s overall Clinical Advisory Group (CAG), set up by the NHS, ensured any reforms were clinically sound and acted as a peer advocate for change. After extensive consideration of clinical evidence, best practices and other models of stroke care in the UK and overseas, the decision was made to re-organise the earliest phase of care around eight ‘stroke hubs’ called Hyper Acute Stroke Units (HASUs) that covered London’s five sectors. These would be equipped with all the staff and investigative equipment necessary to perform a thorough assessment and treatment of patients in the first 48 to 72 hours after a stroke. From there, patients who were not yet ready to be discharged home would typically pass to one of 24 Acute Stroke Units (ASUs), and from there to home or community services.

Although the majority of physicians were behind the change, not all senior clinicians were supportive. One said: “I don’t understand how all this is in patients’ best interests. First, we can thrombolyse patients at their local hospital perfectly well if we can arrange for the CT scans to be done. Second, how does it benefit a frail, elderly, demented patient to be taken an hour across London only to be told they are not a candidate for thrombolysis and to be brought back to the local hospital or to their home?”

All units who wished to provide HASU and ASU services submitted a bid to an expert panel (assembled by NHS London) of clinicians from outside London. Sites were chosen on the basis of quality, performance, aspirations to achieve challenging new quality standards, multidisciplinary expertise, and geographic ‘fit’ to ensure adequate coverage and provision across London. Exhibit 3 shows the location of HASUs and ASUs across London.

Some units were chosen to be upgraded in status, while others were downgraded. The process of persuading units to change status was difficult. For example, in North Central London (NCL), both the Royal Free and UCLH had demonstrated excellent outcomes in national audits, though UCLH achieved a higher score (the highest of any centre across London). For geographic reasons (distances and travel times between existing sites) and patient volumes, NHS London decided that the NCL sector required only one HASU (most other London sectors were allocated two), and UCLH was chosen as the preferred site.

With the selections of UCLH, the Royal Free stroke team leadership faced a choice: either exit hyper-acute stroke care, or collaborate with UCLH. They decided to work with colleagues across NCL to develop a ‘flagship’ HASU at UCLH.

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8 For example, the Royal Free had come top or second nationally on stroke care quality in the National Audit over the last four years, and had been nominated for a British Medical Journal hospital care award for its innovative 24 hour thrombolysis model run jointly across the stroke, cardiology and neurology departments.

h NCL was more compact than the other four London sectors, reducing maximum travel times.

i This collegial approach was facilitated by the development around the same time of UCLPartners, an Academic Health Sciences System encompassing University College London (UCL) and NHS hospitals (including the Royal Free and UCLH) and other bodies in NCL which allowed the development of joint working arrangements across the local hospitals.
Implementing the New Model

Ensuring the necessary flow of patients through HASU (and ASU) beds and how best to ‘repatriate’ patients from HASUs to their local ASU were immediate and complex challenges. The challenges of coordination between health and social care, physiotherapy, occupational therapy, dieticians, and medical and nursing care also remained significant.

Clinicians of many types were required to work not only in their local hospital, but also in the relevant HASUs and ASUs to which their institutions were now attached. There was concern about ‘de-skilling’ units, e.g., that stroke neurologists and physicians at hospitals without a HASU might discontinue providing acute stroke care at their local hospital and move to jobs elsewhere.\(^1\) There were also concerns about breaking up local teams and the potential economic impact on local hospitals of losing stroke care activity.

The pre-hospital care phase was key to success in implementing the model: patients and their families needed to recognise signs and symptoms of stroke and call 999 urgently. To accomplish this, a major public health education campaign, including advertisements in local press and radio/TV, was run about the classic signs and symptoms of stroke and the importance of rapid action by patients and relatives to ensure early definitive clinical assessment and treatment. These campaigns centred on “FAST,” which stood for Facial or Arm weakness and Sight problems = Time to telephone for an ambulance (see Exhibit 4).

London Ambulance Service staff, in turn, also needed to be educated to recognise signs of stroke and to take that patient directly to the nearest HASU, which in most cases was no longer the nearest hospital. The ambulance network had to prepare for longer journeys, increasing overall demand for ambulance services. A commitment was made that no journey to a HASU would take longer than 30 minutes, which was achieved in 96% of cases based on 2010 data.

Most challenging of all, patients and relatives (often frail and elderly) had to understand why their local hospital was no longer the best place for stroke care to begin, unless it happened to have a HASU. Relatives now had further to go (often with suboptimal public transport) to visit loved ones in the HASU.

Between 2009 and 2010, the new model of stroke care was implemented London-wide through a combination of planning, certification and investment by NHS London and local clinical leadership. NHS London made an overall capital investment of £7m to upgrade units to HASU and ASU status (for example, installing CT scanners and refurbishing facilities). It also increased reimbursement for stroke care: the nationally set tariff of £4765 for stroke care was increased in London by 50% per patient to £7193 (broken down as £1343 tariff for the HASU phase of care and £5850 for the ASU phase). The total additional staffing cost of the model across London in the first year was approximately £20m, with £13m additional staffing in HASUs and £7m in ASUs.

In February 2010, stroke care in North Central London was consolidated into a single hyper-acute stroke unit (HASU) at University College London Hospital (UCLH). The single HASU received all ‘FAST’ positive strokes, which totaled over 100 patients per month. A single standard of care was now being delivered to all stroke patients from North Central London. \textit{Exhibit 5} shows the care pathway post reconfiguration. The model included rapid, thorough expert clinical assessment, through a careful clinical

\(^1\) One of 13 consultants in NCL chose to move elsewhere rather than be part of the new stroke service.
history and neurological examination. Diagnostic CT scanning within the first hours of admission\textsuperscript{k} was now performed on all ‘FAST’ positive strokes to inform the decision to thrombolysys within the 4½ hour window from the onset of symptoms and signs, consistent with current evidence.\textsuperscript{l} Twelve consultant\textsuperscript{m} medical staff, either stroke-trained neurologists or general physicians with particular experience in stroke, covered a 24/7 rotation in the HASU. The consultants were drawn from the five local hospitals. They worked week-long shifts, every other month, and worked in their local hospital ASUs and out-patient facilities the rest of the time. When on HASU shifts, they led daily patient ward rounds (including weekends) and were available on call 24/7 to advise registrars,\textsuperscript{n} who were continually present in the HASU. These registrars were in training to become consultant stroke physicians or neurologists, and spent six months covering the HASU. They in turn were supported by more junior trainee doctors. All medical staff in the HASU worked alongside A&E staff to care for patients as they were admitted to the hospital.

The HASU was staffed by all professions required to offer excellent care to patients in the first 72 hours after a stroke. In London, minimum staffing ratios were specified for these professions. The non-medical clinical staff included:

\begin{itemize}
\item \textit{specialist nursing}: HASUs were required to staff at least 2.9 whole time equivalent (WTE) nurses per HASU bed, with an 80:20 trained to untrained ratio.\textsuperscript{o}
\item \textit{physiotherapists}: performed early assessment and began mobilising patients early to prevent the development of muscle contractures and other complications.
\item \textit{speech therapists}: beyond their role in restoring speech, speech therapists played a crucial role in preventing aspiration pneumonia, a recognisable and preventable complication of stroke, with a high mortality rate. Aspiration pneumonia occurred when patients were fed after their stroke despite having disabled swallowing reflexes. Swallow assessment on admission ensured that patients with insecure swallowing reflexes were hydrated intravenously and fed by alternative routes until the reflex recovered.
\item \textit{dieticians}: ensured adequate hydration and nutrition to patients, especially when they were unable to take food and drink by mouth.
\item \textit{occupational therapists}: helped return patients to self-sufficiency in activities of daily living (such as washing, dressing, boiling a kettle) and planned discharge support packages where required.
\end{itemize}

\textsuperscript{k} The CT scan, paired with clinical presentation, was central to the crucial decision to thrombolysys or not. Haemorrhagic stroke showed up immediately on CT as blood in or around the brain. However, in the early stages of an ischaemic stroke, the CT scan was often \textit{normal}. CT changes from ischaemia developed after the 4½ hour time window for thrombolysis. Therefore patients who received thrombolysis typically had convincing clinical presentation for stroke combined with a normal CT scan.

\textsuperscript{l} There was also evidence that within this therapeutic time window, the earlier the thrombolysis the greater the clinical benefit.

\textsuperscript{m} Consultant was the most senior level of medical practitioner, mirroring attending in the US.

\textsuperscript{n} Registrar was the term matching resident in the US (a doctor in higher training).

\textsuperscript{o} ASUs were required to have 1.35 WTE nurses per bed at a 65:35 specialist stroke trained to untrained ratio.
— psychologists: provided proactive and early psychological assessment and intervention to alleviate the high rates of depression and anxiety common in stroke patients.

Some patients arrived at the HASU with ‘FAST’ signs and symptoms, but were later found not to have had a stroke. These patients received diagnoses such as migraine, epilepsy, tumour, vasovagal disturbance or a vestibular or psychological problem. These so called “mimics” accounted for up to 30% of arrivals at the HASU. Even for these non-stroke patients, the consistent approach to diagnosis and care had benefits: previously many of these patients would have been admitted and treated as stroke patients and might have been inappropriately put on long-term preventive therapy. Now, following initial assessment, their care was rapidly passed on to the relevant clinical team such as a GP, neurologist, or mental health specialist.

Prior to introduction of the new care model, many medical and other clinical staff in non-HASU (‘spoke’) units had concerns about the changes in stroke care “de-skilling” both themselves and their hospital. However, experience showed the opposite - these clinicians now rotated through the HASU ‘hub’ and gained direct experience in a high volume acute stroke centre of excellence. In addition, they established wider professional networks and became part of a larger clinical/academic community. Overall, the medical consultants who worked between sites found it individually rewarding and plans were in place to develop rotations for nursing and therapists between ASUs and the HASU.

The new model of care in London was different from other models implemented at a similar time elsewhere in the UK and internationally. For example, in Manchester, UK, all patients were taken to a HASU but only remained there if initial clinical assessment and CT confirmed they were eligible for thrombolysis. In Connecticut, USA, patients were still taken to their local hospital, but CT images for the whole state were sent to a single on-call expert clinician at a regional hospital who discussed optimal care planning with the local clinical team.

**Results**

Significant improvement had been achieved on several key dimensions of quality across London, with the NCL sector performing particularly well. The London stroke project won the 2010 Health Service Journal national award for clinical service redesign.

Acute stroke mortality (measured at 30 days post stroke) for 2010 and 2011 year-to-date was 12% across London as a whole, and below 10% in NCL (the lowest recorded month had 6% mortality in NCL). NCL mortality before reconfiguration varied from 12-15% to above 30% across hospitals. Thrombolysis rates in NCL increased from 3.5% in February 2009 to 12% by October 2010. No major city in the world had a higher thrombolysis rate.

In the 2004 and 2006 National Sentinel Audits, London was the worst performing region but by the 2010 Audit, five of the six highest performing stroke services in England were in London. In London, 75% of HASUs achieved the seven standards for high quality processes/inputs to care compared to the England-wide average of 7%, and 75% of London’s patients now spend their first 72 hours in a dedicated stroke unit compared to the England-wide average of 39%.

Additionally, patient and family satisfaction increased. Some representative quotes were as follows:

“I was assessed straight away. Within an hour of admission, I was given the drugs I needed and I was back to normal the following day. The care was excellent, efficient and considerate.” *Patient, UCLH HASU*
“The care Dad received here has been excellent, and the staff have been wonderful.” Relative, Bart’s and the London Hospital

“The speed with which I was tested, scanned and then thrombolysed was amazing…after my treatment, I am a great fan of HASUs.” Patient, UCLH HASU

The average length of stay had fallen from 15 days in 2009-10 to 11.5 days in 2010-11 YTD, representing a potential savings of £3.5m over a six-month period in bed days based on nominal cost-per-bed-day calculations.\(^p\) Approximately 40% of all patients were discharged directly home from UCLH’s HASU, meaning they bypassed lower acuity units, saving resources and streamlining care for patients. This compared to 20% direct discharges home before the service change. Approximately 2–4 patients/month were transferred home with a full rehabilitation package, which avoided a secondary hospital admission to their local ASU. This new initiative, known as Early Supported Discharge, was expected to expand (to about 12 patients/month) as capabilities to provide intensive support at home were developed, and as patients and families (and staff) became more familiar with the concept and came to trust it.

A formal economic evaluation was started by NHS London in June 2011, which aimed to include not only direct cost savings, but also estimates of the costs avoided in social care and other parts of the health economy as well as the economic impact outside of health (for example, the benefit to patients who were able to return to previous life roles rather than being dependent on ongoing health and social care). Despite these anticipated savings, the transition to the London model of care required significant capital investment and leadership focus from NHS London; funding was needed to create HASUs and ASUs, and leadership was required to achieve major changes in patient flows.

**Future Challenges and Opportunities**

In early 2011, the NHS was conducting an economic evaluation to shed light on whether the tariff uplift in London was cost-effective and whether the new stroke model should be sustained in the face of increasing demands for efficiency, which the NHS had targeted at 5% savings per year from 2011-2015.

The ultimate marker of quality for patients was successful return to health and their previous life roles. Leaders wanted to define measures of quality taking a “whole pathway” approach to stroke and to work to improve performance against those measures over time (see Exhibit 6 for an example). London’s focus on improving the acute phase of stroke served to highlight gaps in care and inadequate results in the rest of the stroke pathway. However good acute care was, it could not substitute for successful prevention.

\(^p\) This was the standard daily cost of an acute admission (£500) charged by the hospital to overseas visitors.
**Exhibit 1. 2006 National Sentinel Stroke Audit – London**

![Graph showing patients treated in acute stroke unit, physiotherapist assessment within 72 hours of admission, and CT scan within 24 hours of stroke for various hospitals in North Central London.]

Each bar represented one hospital; North Central London (NCL) hospitals labelled. Barnet Hospital and Chase Farm Hospital data were listed separately. These two hospitals merged to form a single trust in 1999, which continued to deliver care on both sites.

Source: National Sentinel Stroke Audit 2006

*Medical Assessment Unit: a defined set of beds used by most hospitals for patients awaiting admission to a bed on a medical ward or undergoing further assessment and treatment following A&E.


Exhibit 3. HASUs and ASUs in London, 2010

Note: Transient ischaemic attach was a ‘mini-stroke’ where signs and symptoms have fully resolved by 24hrs following onset. They could herald risk of true strokes, so detecting them and working patients up provided the opportunity to prevent future strokes (e.g., by medical therapy or carotid endarterectomy, a surgical operation to open up furred neck arteries).

Source: London Stroke Network, 2010
Exhibit 4. ‘FAST’ Public Awareness Campaign

Source: NHS London Public Information campaign, 2008-10

Exhibit 5. Model of Acute Stroke Care in London Post-reconfiguration

* 30 minutes was the maximum journey time agreed for any patient travelling by ambulance to a HASU (in 2010, 96% journeys met this standard).


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<th>Element of pathway</th>
<th>Whole-pathway process or outcome measure</th>
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<td>1. Stroke education and public awareness</td>
<td>• Population awareness of risk factors</td>
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<td></td>
<td>• Population awareness of FAST</td>
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<td>2. Primary prevention and population risk factors</td>
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<td>3. Stroke and TIA hospital admissions</td>
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<td>(acute management and treatment)</td>
<td>• % discharges direct to home from HASU</td>
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<td>• Readmissions</td>
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<td>4. Rehabilitation/access to services/PROMS*/Mortality</td>
<td>• Functional status</td>
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<td>• Return to pre-stroke life role</td>
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<td>• SF-36</td>
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<td>5. Follow-up/secondary prevention and hospital readmissions</td>
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<td>• Population mortality</td>
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<td>6. Measurement of patient experience</td>
<td>• Was care well-connected?</td>
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<td></td>
<td>• Did you understand the care plan and have a chance to make choices?</td>
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* PROMS: Patient Reported Outcome Measures

Source: NCL/UCLPartners stroke working group
Endnotes:


