Translating new knowledge into practices: reconceptualising stroke as an emergency condition

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Abstract

Objectives: To examine how the new concept of stroke as an emergency condition led to the development of new clinical pathways for stroke patients in Newcastle Upon Tyne, implemented through protocols which were then rapidly adopted across the UK and further afield.

Methods: Historical analysis using health policy documents, published papers and correspondence on stroke alongside 17 interviews with stroke clinicians and managers in the UK and the US.

Results: The challenges of implementation stemmed from organisational and professional barriers rather than scientific or technological difficulties. Stroke's historical status as a non-treatable illness was a barrier to the adoption of acute treatments. Building new pathways for stroke patients by developing protocols for paramedics and emergency room staff originated as a local solution to a local problem but were taken up widely.

Discussion: Understanding the clinical response to the reconceptualisation of stroke as a treatable disease contributes to our understandings of the relations between clinical research and practice. These findings have implications for how we understand the translation of new knowledge into practice and its transfer across different clinical communities and settings. Protocols are shown to be a particularly valuable tool, bridging knowledge between communities and manifesting a new identity for stroke.

Keywords

Stroke, thrombolysis, emergency medicine, evidence-based medicine, knowledge transfer

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Introduction

Stroke is a primary cause of death across the world and a leading cause of disability in developed countries.¹ Yet historically it has been conceptualised as a chronic condition with longstanding and disabling effects for

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which there was no acute treatment. In the mid-1990s the successful trials of tissue plasminogen activator (tPA), a clot-busting drug, established tPA as the first acute treatment for ischaemic stroke which offered significant improvements in outcomes and complete cure for some patients.² However, its use is dependent on an appropriate diagnosis being made within 3 h of the onset of stroke and subsequent trials have confirmed that time to treatment is the key to good outcomes.³ These new paradigms of treatment have generated new clinical and service models for the treatment of stroke worldwide. Here I draw on documents and interviews with clinicians and managers to analyse the development of an acute stroke service in Newcastle Upon Tyne in the North East of England and the introduction of tPA into practice. I show how new pathways for stroke patients were created through protocols for paramedics and emergency room staff and suggest the findings have implications for our understanding of the translation of new knowledge into practices and its transfer across clinical communities.

Methods

The evidence employed here arises from an ongoing broader historical study, which is exploring how and why the understanding, research, diagnosis, treatment and experience of stroke has changed over the past 60 years. It uses documentary sources such as health policy documents, published papers and correspondence on stroke together with 17 interviews with stroke physicians, neurologists, managers and patient activists in the UK and the US. Oral history was used as a tool to reconstruct participants' responses to the new understandings of stroke, partly because it is the most sensitive method of exploring experiences of work^{4,5} and is especially suited to revealing how local networks, relationships, and communication

pathways underpin medical practice at local level.⁶ Manchester Local Research Ethics Committee decided that formal NHS approval was not required. Permission was sought to audio-record and fully transcribe the interviews.

Results

The evidence shows that the challenges of implementing the new paradigms of practice which are contingent on conceptualising stroke as an emergency condition have stemmed from organisational and professional barriers rather than scientific or technological difficulties. The difficulties experienced by clinicians attempting to establish an acute stroke service at the Freeman Hospital in Newcastle Upon Tyne originated from multiple sources: stroke's historical status as a non-treatable illness which was primarily suffered by older patients; local configurations of emergency services; and inter-professional disputes about the ownership of patients. The multi-disciplinary stroke team built new pathways for stroke patients across the city by designing protocols for paramedics and emergency room staff to improve the diagnostic accuracy of stroke in the various settings and the rapid triaging of patients to the acute stroke service. The Newcastle Upon Tyne experience is not unique but is illustrative of the barriers stroke clinicians have encountered worldwide when setting up acute thrombolysis services. It is not surprising then that the Newcastle Upon Tyne stroke protocols which were developed as a local solution to a local problem were adopted nationally and disseminated further afield. My analysis explores first the way in which stroke was reconceptualised during the 1990s as an emergency condition then moves to the establishment of stroke services, the creation of the protocols, and the dynamics of the Newcastle Upon Tyne setting, which shaped their final form. The protocols, I suggest,

bridged knowledge and practices between the different clinical communities prompting actors to channel acute stroke patients on to new pathways. Finally I argue that the adoption of protocols for acute stroke in many parts of the world says much about the broader characteristics of contemporary medicine as well playing a highly significant role in reconceptualising stroke as an emergency condition.

New paradigms for stroke

In high and middle income countries stroke is the second leading cause of death and the World Health Organisation predicts that heart disease and stroke will remain the single leading causes of death globally for several decades to come.⁷ The onset of a stroke can be rapid, with symptoms occurring without warning; clinically it is defined as 'acute neurological dysfunction usually due to a pathological process in blood vessels'.⁸ The commonest cause of stroke – around 90% of cases – is through ischaemia, where a clot prevents blood reaching a cerebral vessel and causes cell death. For the first half of the 20th-century physicians treated stroke patients by practising 'masterly inactivity' or 'skilful neglect'.⁹ Stroke was understood to be a terminal although protracted disease process.¹⁰ But in the 1950s in parallel with the growing use of anticoagulants, enzymes such as fibrinolytic, and hypotensive drugs, specialist stroke units were developed from within departments of geriatric medicine. These were generally non-acute services and offered a range of rehabilitative therapies including physiotherapy and speech and language therapy.¹¹ A few studies suggested organising stroke services in these configurations could help stroke patients achieve the maximum return to functionality.¹¹ In the US, some intensive care units for stroke patients were set up but these seemed to have little significant impact on mortality and

morbidity and this type of unit dwindled from the 1970s onwards.¹² By the 1980s, new models of care emerged which focused on rehabilitating patients from the earliest days, sometimes in designated stroke units and sometimes through mobile stroke teams.¹¹ Nevertheless in 1988 a King's Fund Forum on stroke drew attention to the poor quality of services in relation to both the organisation and therapeutic treatments.

The services that are provided in hospital, primary care, and the community seem haphazard, fragmented, and poorly tailored to patients' needs, and there is a striking lack of convincing data on the effectiveness of widely used medical, psychological, and specific rehabilitative treatments.¹³

Stroke was not therefore considered to be an acute condition requiring emergency treatment, nor indeed did it necessarily result in hospital admission.

But during the early 1990s, the National Institute of Neurological Disorders and Stroke (NINDS) in the US carried out trials of the use of tPA in eight university medical centres and around 40 hospitals countrywide. NINDS researchers were called in to all stroke patients to treat them as acute emergencies using tPA and a placebo. Laboratory work had confirmed that tPA could restore blood flow and limit cell loss but there was a significant risk of cerebral haemorrhage which had been a major and frequent complication of earlier trials with thrombolytic therapies. The idea of using drugs to dissolve the clot came from cardiology. Thrombolytic agents had been used to treat acute myocardial infarction since the late 1950s and by the 1980s were the primary treatment option.¹⁴ Treating acute stroke in an equivalent fashion 'made sense; it's working in the heart, it should work on the brain', said Patricia Grady who was Deputy and Acting Director of NINDS

in the early 1990s. But the context of the brain was very different to that of the heart and made the implementation of thrombolysis 'really tricky and very exciting'. Whereas the heart had one terminal artery the brain had four vessels and although in most drug trials 'if you're giving a drug you can withdraw the drug, this one ... you can't take it back', noted Grady.^a John Marler, the neurologist who designed the NINDS trials, commented that the most difficult clinical aspect of tPA was its potency to do 'harm in a time measured in minutes' and so the challenge had been to build a trial that enabled tPA to demonstrate its full potential whilst limiting its risks.^b The trials were therefore set up for tPA to be administered in very tight timeframes of 90 and 180 min of the onset of stroke to reduce the risk of haemorrhage, as well as maximise the potential for recovery.²

'Tissue Plasminogen Activator for Acute Ischaemic Stroke' was published in the *New England Journal of Medicine* in December 1995 accompanied by a major press conference and, for the first time in the history of stroke, provided evidence of the effectiveness of an emergency treatment during its acute stage. When those involved in the trials gathered to see the results of the statistical analysis, it was, said Mike Welch who had been in charge of the study's Coordinating Centre in Detroit, 'a remarkable moment, the first time ever that anything had ever proven to be effective for acute stroke'.¹⁵ 'You just know you're in a moment that's a paradigm change', noted Patrick Lyden, the principal investigator in Virginia.¹⁵ The approval of tPA was a 'wake-up call' to the established patterns of 'therapeutic nihilism' that dominated the treatment of stroke patients, wrote Louis R Caplan, Professor of Neurology at Harvard Medical School in 2008.¹⁶ Nevertheless, the

introduction of tPA into practice has proved controversial as suggested by current statistics: only 2–5% of acute stroke patients are treated with the new treatments; less than 15–40% of patients arrive at emergency centres within the timeframe.¹⁷ Many of the difficulties as we shall see through the Newcastle Upon Tyne exemplar have arisen from organisational and professional barriers rather than scientific or technological problems.

tPA was a simple treatment. The dose, based on a patient's body weight, was administered by injection and intravenous drip. The clinical diagnosis was determined through patient history, observation and examination and used established technology – computerised tomography (CT) scanning. Scanning provided visual images of the brain's soft tissue that could definitively diagnose whether the stroke was ischaemic or haemorrhagic. tPA, of course, was licensed only for use in ischaemic strokes because of the risks of it exacerbating bleeding. The treatment could produce dramatic results within hours of its administration and the NINDS trials had shown how long-term outcomes were improved by its use. But tPA was only licensed for use within 3 h of the onset of stroke which meant that there was a very tight timeframe in which to achieve clinical diagnosis of ischaemic stroke confirmed by scanning. Diagnosis was not an easy clinical task, even for those with experience:

'stroke has protean manifestations and differentiation of stroke mimics in the hyperacute setting can be challenging even for experienced vascular neurologists and stroke physicians'.¹⁸

The proposal in the 1995 NINDS paper that stroke patients could present to a stroke centre and be diagnosed and treated within a

^aInterview with author, 18 April 2012.

^bInterview with author, 22 April 2012.

few hours of the onset of stroke provoked disbelief amongst clinicians worldwide. Accustomed to thinking of stroke patients as non-acute cases, clinicians struggled to reconstruct stroke within the parameters of time-driven urgency and the high tech interventions usually associated with dramatic medical emergencies such as heart attacks or road traffic accidents. The idea of treating stroke within 60 min of the onset of symptoms was deemed 'crazy' by most neurologists, recalled Marler (see footnote b). The difficulties have their roots in the long-held concepts of stroke as a terminal although protracted illness from which there is no respite and stroke's associations with geriatric medicine which has always had low medical status. They were also driven by the culture of neurology which was not practised as an acute specialty. Rafael Llinas, Associate Professor of Neurology, Johns Hopkins University School of Medicine was a resident in neurology at Brigham and Women's Hospital, Boston, MA in the mid-1990s. He explained that:

Most of the great neurologists of that time [pre-tPA] were diagnosticians; this is where the lesion is, this is the aphasia... people come in with a stroke and they would see them three or four days later and they would pour over them for an hour and very, very quickly it became from that to - you have to come, you have to come right now, you have to come in 15 minutes... in the middle of the night... you have to make a decision and... it's an entirely different culture [post-tPA].^c

The way in which tPA was set to fundamentally change neurological practice was augured during the trials. Marler recalled being thanked by a nurse who worked in one of the tPA trial emergency centres: 'Well,' she said, 'you've made our job so much more

fun. First of all we see the neurologists in the emergency room when we've never seen them before, and second we see them move so quickly' (see footnote b). And over recent years some clinicians have begun to refer to stroke as 'brain attack' in order to encourage the same cultural responses that are embedded in medical and social structures for heart attacks. In essence the challenge presented by tPA was not one of technical or scientific complexity, but in getting the right patient to the right place for treatment within the timeframe.

In the UK, Professor Gary Ford, stroke physician in Newcastle Upon Tyne, remembered reading the NINDS trials results showing tPA was effective and thinking: 'this is of no relevance to the NHS, we can't implement it'.^d However, as we shall see now, Ford did indeed become an early adopter of thrombolysis, developing an acute stroke service and creating new standards for practice.

Stroke services in Newcastle Upon Tyne

Gary Ford had trained in geriatrics and clinical pharmacology and when he became a senior lecturer in Newcastle Upon Tyne in 1992, with a clinical position at the Freeman Hospital, he set up a stroke service encompassing research as well as clinical practice. At the time there were no models of acute stroke services but he surmised that in view of the new neuroprotective drugs then being developed for stroke, acute stroke units may well become the models for the future. The service began in a very low-key way: 'we just decided we'd put all the acute strokes on one ward' (see footnote d). Over the next few years Ford acquired an offsite ward and allocated half the beds to stroke rehabilitation patients. Stroke patients were all referred by their general practitioners

^cInterview with author, 25 April 2012.

^dInterview with author, 14 July 2011.

(GPs) as the Freeman Hospital had no Accident and Emergency (A&E) department. Local A&E services were situated at the Royal Victoria Infirmary (RVI), a few miles away from the Freeman. At this point – pre-announcement of the tPA trial results – acute stroke patients were defined as those who had suffered a stroke in the last seven days.¹¹ In specialist units like the one set up by Ford, CT scanning was one of the assessment tools but Ford had found it difficult to establish scanning as part of the routine treatment: ‘we could barely get scans on everybody and ... [nobody] had a scan, you know, within an hour’.¹⁹ It was the difficulties experienced by Ford in setting up his stroke service which informed his immediate reaction to the announcement of tPA that it would be impossible to implement a new treatment which required such a tight timeframe for its administration. Indeed, Ford may well not have pursued the potential of tPA without the intervention of Jo Harbison, Ford’s registrar of the time who had a keen interest in stroke.^c Harbison suggested: ‘you should get the ambulances just to bring the stroke patients to ... the Freeman Hospital directly’. This, said Ford, ‘was a simple thing to say but actually not that easy to do’. Ford discussed the matter with the Chief Executive of the Ambulance Service for North East Northumbria and in 1997 they established a rapid ambulance protocol enabling paramedics to take potential stroke patients directly to the Freeman Hospital’s acute assessment area where there was an on-call stroke nurse, rather than to the A&E department of the RVI.²⁰ However, this provoked much local resistance.

there was a lot of opposition to that. ... my physician colleagues ... in the Freeman Hospital thought this was a really bad

thing because they thought the paramedics would bring all sorts of stroke patients, old ladies falling over ... so they were anti it. ... colleagues at the other hospitals ... didn’t have a stroke unit or stroke service ... they were opposed to it ... they thought they were not going to get patients, and the neighbouring trust in North Tyneside immediately wrote a letter ... stating under no circumstances should any patient in North Tyneside be directed to the Freeman Hospital. So there was a lot of opposition ... which is a general feature of innovation in the NHS actually (see footnote d).

It is perhaps useful to add here that these pressures were in part driven by the new arrangements for the NHS which had created a quasi-market in 1991 which involved the separation of purchasers and providers of care. Hospitals became independent Trusts and were not guaranteed funding but had to compete with other providers, including non-local Trusts and private hospitals for contracts.²¹ Thus although the opposition to Ford’s plan was driven by persistence of historical attitudes to stroke patients and their treatment, it was also exacerbated by the wider tensions in health service organisation.

Initially only two or three stroke patients a month were brought to Ford’s service but numbers increased after Ford wrote directly to paramedics and reassured them that there was no problem if they brought a patient who turned out not to have a stroke (see footnote d). After the first 15 months a review showed that 84% of patients admitted via the rapid ambulance protocol had a confirmed diagnosis of acute stroke or transient ischaemic attack (TIA).²⁰ As Harbison et al. pointed out in their report to the *Lancet*, the protocol had been established without additional training for

^cJo Harbison, now Lead Consultant Stroke Physician and Senior Geriatrician, St James’s Hospital, Dublin; National Clinical Lead in Stroke Medicine; Senior

Lecturer, Department of Medical Gerontology, Trinity College Dublin.

paramedics (i.e. little additional costs had been required) and yet had proved remarkably effective. During this period, Newcastle Upon Tyne was one of only two centres in the UK using the new therapies. In many other centres, the fact that tPA had not yet been licensed in Europe created too many uncertainties for physicians to implement it.^f

Face, arm, speech test

Ford's direct engagement with the Emergency Services caused him to think more deeply about the critical role served by paramedics in the case of stroke patients: 'they could potentially in the long run be giving drugs in the ambulance' (see footnote d). A pharmaceutical company, Janssen Cilag, interested in marketing thrombolytic drugs, agreed to fund the development of a diagnostic stroke instrument for paramedics and a promotional educational video. In 1998 Ford drew together a small group of stroke and A&E physicians and ambulance personnel and together they undertook:

'a quick review of what was out there and we came across the Los Angeles paramedic stroke scale and the Cincinnati...stroke recognition instrument. We basically did a minor modification to the Cincinnati instrument...adding in a GCS (Glasgow Coma Scale)' (see footnote d).

The purpose of the Newcastle Face Arm Speech Test (FAST) was to allow the rapid diagnosis of potential stroke patients by paramedics. The group designed FAST to integrate easily into existing assessment procedures used by emergency services such as the Glasgow Coma Scale. It contained three key elements: facial weakness, arm weakness and speech disturbance and these were incorporated into the ambulance report form used universally.²² To promote

FAST, the group also produced a training package for paramedics which was distributed to ambulance staff in Newcastle Upon Tyne and incorporated into the training programme for new recruits in 1998–1999. A prospective study of the acute stroke service at the Freeman Hospital in 2000 produced evidence that paramedics using FAST had achieved high levels of detection and diagnostic accuracy of stroke. FAST did not require paramedics to acquire new knowledge but rather to focus their existing knowledge on the key elements of stroke in order to differentiate their response to stroke patients from other emergency patients.

FAST was notable for showing how within the structures of the NHS, paramedics could effectively redirect patients to stroke centres. It also illustrated the way in which local configurations of A&E services around Newcastle Upon Tyne drove much of Ford and his team's work: 'In other places it was never so critical because the patients would be coming anyway' (see footnote d). FAST was developed to address the specific problems in Newcastle Upon Tyne yet it was later taken up as a diagnostic tool by many stroke guideline producers including the European Stroke Association and the American Stroke Association.¹⁹ The local context of Newcastle Upon Tyne was to trigger the development of a further protocol for use in the emergency room in the early 2000s.

Recognition of stroke in the emergency room

The 2000 prospective study, as well as confirming the effectiveness of FAST for paramedics, revealed that referrals to the acute stroke service from other health professionals, specifically GPs and A&E doctors, had around a 30% misdiagnosis rate. To address this issue Ford and his team

^ftPA was licensed in Europe in 2002.

decided to develop a specific stroke recognition tool for use by staff in the Emergency Room (ER) with the aim of improving the accuracy of stroke diagnosis. Thus ROSIER originated as a solution to a particular local problem. The development process undertaken by Ford et al. illustrates not just how tightly medical practice has become intertwined with scientific evidence over the recent past but also the continuing priority accorded to clinical observations and what may be termed as 'tacit' knowledge.

Work began by collecting data over a 12-month period on patient referrals to the acute stroke service from the ER. On arrival at the acute stroke unit patients were clinically assessed by a research neurologist who was qualified in the use of the US National Institutes of Health Stroke Scale (NIHSS), or by the on call registrar or consultant. At the time of the clinical examination, no access was given to imaging results or stroke team diagnoses. This first phase focused on creating data on stroke and non-stroke patients' characteristics and evaluating these against the literature so as to produce a set of standardised signs and symptoms which together formed a diagnostic profile for stroke patients. A combination of variables from this diagnostic profile was then chosen for the one-page proforma with a scoring system for each symptom or sign. Prospective stroke patients were to be scored on seven items consisting of clinical history (loss of consciousness, convulsive fits) and neurological signs (face, arm or leg weakness, speech disturbance, visual field defect). Scoring was simple and 'Yes' or 'No' were the only responses available thus allowing only quantifiable information to be recorded. The proforma also included basic demographic details, blood pressure and blood glucose concentrations – the latter to ensure early identification of hypoglycaemia, a potential stroke mimic. Here then, the process of standardisation

meshed clinical observations and scientific evidence to produce a form which gave a numerical score. That numerical score represented the clinical diagnosis.

Yet although the form's design ensured that it collected only quantitative data and numerical scores, the process of its design incorporated softer elements such as taking account of the implicit routines and practices of the ER. In other words the setting in which the scale was to be used was instrumental in shaping its design. For example, knowing that the ER was a very busy and crowded environment meant that Ford and his team consciously avoided:

'selecting items that are difficult to assess...such as confusion and gait or limb ataxia. Due attention to the instrument's clinical use by ER staff was one of our primary concerns'.¹⁸

The implementation of ROSIER into ER practice was supported by special teaching sessions for ER staff during which Ford and his team obtained feedback on the use of the scale in practice and refined it accordingly. Assessment of eye movement abnormalities for example, was not included because junior ER staff had raised concerns about the 'ease of eliciting these signs' although later analysis suggested that including this sign would have detected a further two of 101 stroke cases.¹⁸

The scale had limitations and the proforma warned that a score of 0 in some patients did not mean that a diagnosis of stroke could be dismissed completely. Patients suffering cerebellar strokes for example displayed no motor weakness, one of the key measures on the scale, and were therefore particularly unlikely to be recognised.²³ This illustrates the difficulties in bureaucratising medical practice to the extreme. Nevertheless, implementing ROSIER at the Freeman Hospital succeeded in improving diagnostic rates of ER staff to more than 90% of possible stroke

patients. ROSIER was welcomed widely by the stroke community.

The ROSIER scale is an important step forward... Nor and colleagues deserve praise for developing a well-designed, robust instrument... ROSIER represents a further step along the road to optimum stroke care – with only 1–2% patients in our leading centres receiving thrombolytic treatment, there is still a long way to go.²⁴

ROSIER's legitimacy in the UK was sealed when it was implemented nationally through the 2007 Stroke Strategy and included in the National Institute for Clinical Excellence guideline on acute stroke and TIA.²⁵ It has since become one of the best-known screening tools for diagnosing stroke in the ER and clinical guidelines on the management of acute stroke in many parts of the world including some of Europe, the US, Australia and China recommend its use.²⁶

Discussion

In summary, the paradigmatic shift to treating stroke acutely, established by the 1995 NINDS trials, created new conceptions of stroke as an emergency condition. The difficulties of implementing tPA say much about the inherent tensions engendered by the global application of new knowledge in early 21st-century medicine. These are generated as much by the size and complexity of health service organisations and the multiplicity of clinical specialties and practitioners as by the nature of the knowledge itself. There is no 'easy strategy' for equilibrating the 'generalised truth' generated through laboratory science and randomised control trials into medical settings and communities shaped through the specificities of time and place.²⁷ That Ford and his team chose to establish new pathways for acute stroke patients in Newcastle Upon Tyne through the development of protocols

reflects one of contemporary medicine's strongest characteristics: the standardisation of medical routines and practices through the production of evidence-based protocols/guidelines which has been part of medicine since the 1970s and is now 'ubiquitous'.²¹ The rise and spread of these instruments has been one of the strategies employed to tackle some of the most thorny issues in recent decades: economic savings in the face of soaring health costs; the preservation of professional autonomy; and the assertion of order and coherence over an expanding and increasingly diverse medical domain.^{28,29}

The purpose of the Newcastle Upon Tyne protocols was to translate the new evidence-based therapy of tPA into practice. As discussed earlier, the barriers to establishing stroke as an acute emergency condition were multiple and some were contingent on the local arrangements for emergency services in Newcastle Upon Tyne. The protocols proved to be a powerful bridging mechanism for transferring specialist knowledge and practices from the specialist stroke team to other communities within emergency care services. Ford and his team standardised the stroke diagnostic process by combining objective and subjective sources of knowledge and taking the implicit routines, practices and sensibilities of paramedics and ER staff into account. Specialist knowledge was distilled into the protocols in a meaningful form for the actors involved and promoted new responses. Notably the protocols did not require actors to develop new knowledge, but rather led them to use their existing knowledge in a new way and to respond differently if a positive diagnosis of stroke occurred by sending the patient to the acute stroke service as rapidly as possible. Stroke services in Newcastle Upon Tyne may well have developed differently if the Freeman Hospital had had its own emergency department, or if Ford had not succeeded in building strong working

relationships with the paramedics. The protocols were a local solution to a local problem. Nevertheless, the swift take-up of FAST and ROSIER as new standards in stroke strategies in many parts of the world suggest they offered a universal solution to diagnostic and organisational dilemmas around stroke.

The adoption of protocols to manage acute stroke can be explained in part through the striking way in which the meanings embedded in the protocols challenged historical attitudes and responses to stroke. Persistent conceptions of stroke as a non-urgent, non-treatable condition mediated strongly against the introduction of rapid triage systems for acute stroke patients, not just in Newcastle Upon Tyne but worldwide. We have seen how the difficulties were exacerbated by inter-professional disputes and the culture of neurology. But manifest in the protocols was a new identity for acute stroke patients. For the first time in the history of the specialty they were cast as medical priorities within health care services. No longer on the margins of medicine, stroke was a condition that charged the clinical community with swift and decisive action. The protocols served as a simple mechanistic device for re-routing a particular group of patients through health systems and were a highly effective means of bridging knowledge across clinical communities. Most importantly, however, they were a widespread declaration of the paradigm shift in stroke medicine that had resulted from the NINDS trials.

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