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INVESTIGATION INTO THE ACCURACY OF THE FAST TEST WHEN DELIVERED BY AN ISLAND PARAMEDIC SERVICE AND THE IMPACT ON TREATMENT OF FAST TEST RESULT

DISSERTATION: LEVEL 7

Student Number: 05993960

Submission Date: 1st March 2017

ABSTRACT

OBJECTIVE: To evaluate the accuracy of the FAST tool when applied by paramedics in an island setting and to identify what the impact of the result is on treatment both statistically and clinically.

PARTICIPANTS: The records of 8032 people who had accessed an emergency ambulance to identify those who had had the FAST tool applied. 266 records were included in the final study.

METHODS: The research was completed using a retrospective observational study design which identified FAST result as well as paramedic diagnosis. It reviewed variables of age, sex, in-hours/out-of-hours, symptoms, past medical history and presence of a relative or carer. It collected data on outcomes including time to second screen, diagnosis at 4.5 hours, access to CT and acute stroke unit and treatment plan at 4.5 hours.

RESULTS: FAST had a sensitivity of 67.6% (95%CI) and specificity of 84.7% (95%CI) compared to paramedic sensitivity of 61.6% and specificity of 90%. Diagnosis was influenced by the symptoms present, with people being more likely to be diagnosed with an arm weakness than a speech deficit. The presence of a relative or carer was an influence with 78% of those diagnosed having one present. Access to treatment was improved by a positive FAST test or paramedic identification with a time to second screen for this group between 2.3 minutes and 9.4 minutes, depending on whether arrival was within working hours or not. False-negative diagnosis was limited to four people whose main effect was delay in time to second screen, but this was again influenced by whether in or out of working hours.

CONCLUSION: The FAST tool when applied by paramedics in an island setting had good specificity, and clinical significance was limited by service design rather than effects of diagnosis.

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Background

Stroke is the fourth largest cause of adult mortality in the UK and one of the biggest causes of adult disability (Stroke Association, 2016). With around 1.2 million stroke survivors in the UK, and over a third of them being dependant on family or friends (Stroke Association, 2016), it is not surprising that over the past 20 years, stroke care and treatment has developed at a rapid pace (Sinha and Warburton, 2000). Stroke incidence increases with age and the population of the researcher's practice area aged 65 or older is set to increase by 75% over the next 20 years (Ageing Population Working Group, 2013). That coupled with a 16% population increase could almost double the number of strokes occurring annually. As stroke has a devastating impact on people, society, the economy and health care, the need for efficient organised services has never been more necessary.

The single most important factor in stroke recovery is access to organised specialist stroke care (Stroke Unit Trialists' Collaboration, 1997). This has been shown to reduce death, dependency and the need for institutionalised care (Stroke Unit Trialists' Collaboration, 2013) when compared to care in general medical or neurological areas. The components of acute stroke unit (ASU) care have been identified via several studies, which highlight the need for rapid access to stroke specialists, and specify early management practices including rtPA (recombinant tissue plasma antigen) (Langhorne et al, 2002: Alonso De Leciñana-cases et al. 2009; Kucukyazici, 2009, Manawadu et al. 2014; Dworzynski et al. 2015).

The rapid delivery of rtPA is the single most effective acute intervention (Etgen et al. 2014) within stroke care. Despite its benefits, only a limited proportion of people affected by stroke

meet the stringent criteria (Paul et al. 2016). Of those suitable, other factors such as delays in seeking help, service delivery, stroke recognition both in hospital and within the community, and the availability of expertise (Ahmed et al. 2010) contribute to lower rtPA levels.

Whilst the research and guidelines are yet to establish a baseline or target rtPA delivery levels, it has been clearly demonstrated that organisational change, reorganisation of services and FAST (Face Arm Speech Time) campaign promotion can significantly increase rtPA delivery levels (Strbian et al. 2013; Camerlingo et al. 2014; Badachi et al 2015) and rapid access to specialist stroke care.

rtPA comes with a restrictive time window for delivery (3 hours for those aged >80 and 4.5 hours for those aged 18-80) (Ahmed et al. 2010), as such incorrect diagnosis, poor recognition rates and uncoordinated treatment pathways significantly delay treatment or prevent access (Eissa et al. 2012; Williams et al. 2013). Services which address all the individual aspects within the acute stroke pathway (ASP) and increase efficiency and accuracy within each step tend to have the highest thrombolysis rates and the best outcomes (Lahr et al. 2013).

Delays or barriers to rapid intervention can be separated into two sections; pre-hospital and post-admission. Pre-hospital relates mainly to stroke recognition by different groups: general practitioners, healthcare workers, the public and most importantly the emergency services, particularly paramedics. Post-admission relates to process, such as rapid assessment in the emergency department (ED), access to imaging and access to specialised stroke team.

Paramedic advanced notification can have a significant affected on care, providing diagnosis is accurate. Door to CT times have been increased by up to 17% and rtPA delivery doubled

(Abdullah et al. 2008, Gladstone et al. 2009). Within the researcher's practice area, all paramedic attendances have a pre-alert and the main focus is accuracy. In some other areas, lack of knowledge relating to identification of stroke and no formal assessment procedures meant that 98% of stroke patients (end point diagnosis on discharge) who arrived via ambulance were transferred to the nearest medical facility regardless of the availability of stroke services (Althubaity et al. 2013).

Studies relating to paramedic pre-alert have focussed on the knowledge base of paramedics and pathway or protocols available (Bouckaert et al 2009; Frendl et al. 2009; Gladstone et al. 2009; Eissa et al. 2012; Karlinski et al. 2015). An interventional study showed a positive correlation where sensitivity was increased from 78% to 94% by providing paramedic education and a simple stroke assessment tool, resulting in a rapid assessment on arrival to hospital and the presence of the stroke team on arrival at hospital (Bray et al. 2005a).

Approximately 65% of stroke admissions involve the ambulance service (Doggen et al. 2016). As such their knowledge and intervention can have a significant impact on treatment pathways and access to services.

The use of stroke assessment tools has been widespread for the past fifteen years, and over this time they have developed to reflect the specific groups using them, taking into account their level of stroke expertise and exposure (Rudd et al. 2015a). Paramedics have been no exception but with over ten different scales available for use (Kidwell et al. 2000; Asimos et al. 2004; Brandler et al. 2014), knowing the correct tool to use can be challenging.

Within the UK, the FAST tool is commonly used amongst ambulance professionals due to ease of use and rapid delivery (Robinson et al. 2013; Wolters et al. 2015). Whilst the 5th National Clinical Guidelines for Stroke (Intercollegiate Stroke Working Party, 2012 and 2016) identify that everyone with a suspected stroke or TIA should be assessed with a validated tool, however throughout the 2012 and 2016 guidelines they have been unable to recommend a specific tool which suits all areas of practice.

Whilst the researcher's practice area is yet to implement a 24-hour hyper-acute stroke service, it did successfully commence a Monday–Friday, 9am–5pm stroke thrombolysis service in 2015 and this is set to expand into a 24-hour service in 2017. The need for accurate rapid assessment of stroke patients within the community to enable accurate hospital pre-alert and access to specialist assessment, is necessary to support the service expansion and is well documented (Mosley et al. 2007a; Albright et al. 2010; Baldereschi et al. 2012). This will increase the number of people eligible for stroke thrombolysis (Chenkin et al. 2009; Fassbender et al. 2013) and will provide the required rapid access to specialist stroke care (Fassbender et al. 2013), the treatment most likely to improve outcomes for stroke patients (Evans et al. 2001).

Within the researcher's practice area, the FAST tool is currently used, but the accuracy of its assessment within an island setting has never been evaluated.

The assessment pathways for suspected stroke patients who call an ambulance commence within the community. As stroke is primarily a clinical diagnosis, much of the initial care is provided based on the assessment of symptoms, the accuracy of which trigger pathways which included but are not limited to:

- Category 1 ambulance response
- Paramedic stroke pre-alert
- Hospital stroke team pre-alert
- CT pre-alert

For clinical standards to be achieved, each stage is required to be as effective and efficient as possible.

The researcher seeks to establish if the current screening tool (FAST) adopted by paramedics in their practice area is accurate in identifying stroke, and to review the impact on treatment at 4.5 hours post-admission of this diagnosis, both statistically and clinically. The researcher hopes to find any commonalities of those who are misdiagnosed and suggest alternative tools or training which may prevent this.

The tool will be investigated and an assessment will be performed on paramedic diagnosis, regardless of FAST result, and the statistical and clinical significance of their diagnosis. This information will provide a comparison between paramedic knowledge and the use of the FAST.

Literature Review

A literature search was undertaken in Medline, cinahl, ProQuest and embase and reviewed information from 1995 – 2016.

It was completed as a title, abstract and full text review by the researcher.

The search period was selected to align with the introduction of the first National Clinical Guidelines for Stroke (1996) and the approval of rtPA as an emergency treatment for people affected by stroke.

Search terms are identified in appendix 1 and Boolean logic used to view the variety of terms in use which identify stroke, hyper-acute care, paramedics, assessment, recognition and accuracy.

A hand search of references was then conducted and text reviewed for relevance.

There are many tools available for the assessment of stroke in the field, either for use by general practitioners, the public or paramedics. Many researchers have tried to identify a specific tool for use in all areas, but there has been much debate relating to complexity of the tools, symptoms used, rationale for use, methodology of the research and education programmes relating to the introduction of the tool. As a result, comparison of the research is difficult to achieve and the identification of a tool which suits all areas has been unachievable (Brandler and Sharma, 2014; Rudd et al. 2015a).

The 5th National Clinical Guidelines for Stroke (Intercollegiate Stroke Working Party, 2016) and the AHA/ASA Guidelines in America (Adams et al. 2007) recommend the use of assessment tools

as part of a pathway which both increases access to treatment and prevents delays. Whilst the AHA/ASA Guidelines (Adams et al. 2007) mention the Los Angeles Pre-Hospital Stroke Scale (LAPSS) and the Cincinnati Pre-Hospital Stroke Scale (CPSS), it does not identify preference for which. The 5th National Clinical Guidelines for Stroke (Intercollegiate Stroke Working Party, 2016) have been unable to recommend a specific tool but suggests that:

"People seen by ambulance clinicians outside of the hospital with the sudden onset of focal neurological symptoms should be screened ……., and for stroke/TIA using a validated tool"

Recommendation 3.1.1.A page 57

Over the years there have been multiple tools specifically designed with the aim of increasing the accuracy of stroke recognition amongst primary care and paramedic services (Bray et al. 2005a; Bray et al. 2005b, Bouckaert et al. 2009; Frendl et al. 2009). Most of these assess similar symptoms, specifically facial weakness, arm weakness/drift and abnormal speech (slurring, mute or unable to get words out) (Table 1). These symptoms were identified in a trial by Kothari et al. (1997) who analysed the NIHSS (National Institute for Health Stroke Scale), a fifteen-point stroke severity scale developed to assess therapeutic benefit of treatment within stroke research (Brott et al. 1989). They identified the most likely symptoms which provided the highest sensitivity and specificity when recognising stroke patients. Since then the consistency of these three symptoms has been validated by several studies (Kothari et al. 1997; Goldstein, 2005; Kaps et al. 2014). Of the three symptoms, speech appears to be the least

predictive of stroke (Mosley et al. 2007b). Speech was identified in two formats within the NIHSS:

- Dysarthria - slurred speech
- Dysphasia - difficulty forming words

During interrater reliability studies, dysarthria had the lowest reliability (Lyden et al. 1999; Meyer et al. 2002) and may account for why it is over diagnosed/recognised.

The symptoms of face, arm and speech mainly relate to the anterior circulation (ACS), accounting for approximately two-thirds of all strokes (Kim et al. 2012; Musuka et al. 2015) which suggests that a third of all strokes could be unrecognised by these symptoms. This is a criticism of many assessment tools (Wolters et al. 2015; Rudd et al. 2015a; Gull and Markus, 2012) which appear to exclude Posterior Circulation Stroke (POCS) symptoms (vision, balance, ataxia).

It is argued that the majority of people with POCS also have ACS symptoms (Goldstein, 2005; Tao et al. 2012; Fothergill et al. 2013; Kaps et al. 2014) and that focussing on this may improve diagnostic accuracy (Goldstein, 2005), an approach disagreed with by Gulli and Markus (2012) who noted that POCS are significantly different to ACS and therefore recognition tools need to take them into account.

In an attempt to address this deficit, Nor et al. (2005) added the symptom of visual disturbance when they developed the Recognition Of Stroke In the Emergency Room tool (ROSIER). When it was compared to tools using ACS symptoms, it was questioned whether the visual element was

beneficial as it correlated to either face, arm or speech which could potentially act as proxy (Fothergill et al. 2013). In the study by Fothergill et al (2013), 22% of stroke patients were not identified by either a simple ACS tool or the ROSIER tool, but no information was available as to the stroke type or symptoms of these people so further analysis could not take place.

Table 1 Comparison of Items within Stroke Recognition Tools adapted from Brandler et al. (2014)

Scale	LAPSS	CPSS	OPSS	MASS	MED PACS	ROSIER	FAST
PHYSICAL EFFECTS							
Facial Droop	✓	✓	✓	✓	✓	✓	✓
Arm Weakness/ drift	✓	✓	✓	✓	✓	✓	✓
Leg Weakness/ drift			✓		✓	✓	
Handgrip	✓			✓			
Speech Difficulty		✓		✓	✓	✓	✓
Gaze Preference					✓		
Visual Fields						✓	
HISTORICAL FACTORS/ELIGIBILITY CRITERIA							
Age >45	✓			✓		✓	
Seizure at onset			✓				
History of seizures	✓			✓	✓		
Pt not wheelchair bound/bedridden prior to event	✓			✓			
Blood glucose	✓ 2.8-22.2 mmols		✓ >4mmols	✓ 2.8-22.2 mmols	✓ 2.8-22.2 mmols		
Time since onset	✓ ≤25hrs		✓ <2hrs		✓ ≤25hrs		
GCS >10			✓				
Symptoms not resolved			✓				
Canadian triage and acuity scale ≥2 and/or corrected airway, breathing or circulation problems			✓				
Pt not terminally ill or palliative			✓				
Pt conscious/syncope ruled out						✓	

It is suggested that 38% of all POC strokes are undiagnosed by these tools (Nor et al. 2005), approximately 9-11 strokes in every hundred. Whilst the clinical significance of this is unexplored, it has been identified that people most likely to contact the ambulance service and

be referred as a stroke would have suffered an ACS (Wester et al. 1999; Lacy et al. 2001; Harbison et al. 2003; Price et al. 2013). Clinically this group would gain the most benefit from rtPA and neurovascular intervention (Robinson et al. 2013). Despite this, the research notes the need for further investigation in to whether introducing symptoms of POCS would provide benefit whilst increasing time to deliver and therefore increased time to treatment for all (Wester et al. 1999; Lacy et al. 2001; Harbison et al. 2003; Price et al. 2013).

The FAST tool relies solely on face, arm and speech. It was developed in 1998 and reassessed in 2003 (Harbison et al. 2003) where it was found to be not superior or inferior to other tools. It is widely used throughout the UK (BBC, 2015; Wolters et al. 2015) and is the centre of national campaigns aimed at increasing stroke recognition (Wolters et al. 2015). Similar campaigns have been run in America by the Stroke Association (no date), Australia by the Stroke Foundation (no date) and Ireland by the Irish Heart Foundation (no date) and have a variation on T for either Time or Test. It is the simplicity and memorability of the tool which has made it useful in improving stroke awareness both with the public and healthcare professionals (Wolters et al. 2015; Robinson et al. 2013).

FAST along with CPSS has been evaluated on the largest number of people (Rudd et al. 2015a) including younger stroke patients and has been shown to have good sensitivity (Kaps et al. 2014; Purrucker et al. 2015) despite a large variation in results (Rudd et al. 2015a). In several studies when compared to other tools, FAST has been demonstrated not to be inferior and has good agreement between paramedics and stroke physicians on application (Rudd et al. 2016; Nor et al. 2004). In comparison, a recent systematic review found that FAST had difficulties with

operating characteristics which reduced its accuracy and that the CPSS and LAPSS were superior (Brandler et al. 2014) despite both FAST and CPSS having the same characteristics (table 1).

The CPSS is a shortened version of the National Institute for Health Stroke Scale (NIHSS) and was initially reported to have sensitivity of 100%. It is likely that within this validation only those with ACS symptoms were assessed, as the CPSS does not included symptoms relating to POCS, since it has had varied sensitivity 40-79% (Studnek et al. 2013; Oostema et al. 2015). In a study by Wild et al. (2012) a false-negative diagnosis was found in 47 of 5901 people. Whilst this is <1% of those assessed, there is no information as to the clinical significance of the false diagnosis (Wild et al. 2012). Both the LAPSS and the Melbourne Ambulance Stroke Scale (MASS) demonstrated false-negatives of <1% (Kidwell et al. 2000; Bray et al. 2005b) but none of these tools include POCS symptoms, casting doubt on this figure.

The LAPSS, initially developed in response to low thrombolysis rates within the US (Alberts, 1998), was felt to be accurate at recognition of stroke by emergency medical staff (EMS) (Kidwell et al. 2000) displaying both sensitivity and specificity of >90% as well as Positive Predictive Value (PPV) 86% and Negative Predictive Value (NPV) 98%. These results are significantly higher than those found in other studies (Purrucker et al. 2015) and appear to be related to the pre-determined set of criteria to whom the tool should be applied. In a comparison to FAST, the more complex scores such as LAPSS did not have an increased diagnostic performance (Purrucker et al. 2015).

Within the validation of LAPSS a slightly different version was used compared to subsequent studies where the “unknown” was taken to mean “yes”, preventing collation of data. This

difference is not mentioned in most of the literature, except for Purrucker et al (2015) who included both versions within their retrospective comparison, but did not discuss comparison of the results against each other or what effect the changes had.

Within the validation study there were four (out of 206) false-negatives and although identified that two of these were not candidates for aggressive management, there is no discussion as to the clinical significance of the results and no analysis relating to those to whom the tool was not applied.

The LAPSS has a range of history questions as well as blood glucose. The history questions focus on age, history of seizures and pre-morbid ability.

The LAPSS excludes people aged 45 or younger (Kidwell et al. 2000; Bray et al. 2010). As the number of people having a stroke aged 20-64 increased by 24% between 1999 -2010 (Feigin et al. 2010) it seems unethical to exclude people on the grounds of age and should raise clinical concerns about the use of such tools.

Similarly, the Melbourne Ambulance Stroke Screen (MASS) (Bray et al. 2005b) also excludes people under the age of 45. The MASS, a combination of LAPSS and CPSS retains the basic features included in most scales but includes items aimed at identifying stroke mimics such as seizures (Bray et al. 2005a).

The validation of MASS did not include the results of 17 out of 127 eligible patients, who were either not assessed or were false-negatives. Seven of these (false-negatives) were not eligible for rtPA but no information was available with regards to the other ten or the clinical effect on

them. As they were also not included in the statistical analysis, the accuracy of the specificity (74%) and sensitivity (90%) (Bray et al. 2005b) is in doubt. It is worth noting that the MASS was assessed along with an educational package and data cannot be extrapolated to identify if it was this, or the tool, that improved diagnostic accuracy. This level of sensitivity and specificity does provide a comparison to LAPSS and CPSS (Kothari et al. 1997) and suggests that they are not superior to FAST.

The MASS's inclusion of a history of seizures (epilepsy) as an exclusion criteria is also part of LAPSS and MedPACS. This raises a clinical concern due to the high incidence of post stroke epilepsy (Graham et al. 2013) and stroke risk increasing in those who have a history of stroke. To exclude people based on a single diagnosis may run the risk of missing a significant number of stroke patients. Conversely, seizure at onset has been shown to make stroke less likely (Nor et al. 2005) and is included in both ROSIER and OPSS (Ontario Pre-hospital Stroke Screening) tools.

The inclusion of seizures as a stroke mimic increased the sensitivity of tools used to recognise stroke (Kwiatkowski 2006; Fothergill et al. 2013), and it has been suggested that to improve some of the simpler tools, such as FAST, the inclusion of seizure activity could increase the detection of stroke mimics (Fothergill et al. 2013).

The inclusion of seizures at onset as an exclusion criteria is part of ROSIER (Nor et al. 2005). Designed for used within the ED, it has been identified as being superior to FAST in that setting (Nor et al. 2005), as its main focus is not to diagnose stroke but to assess likelihood only (Mingfeng et al. 2012). There have been attempts to transfer it to pre-hospital settings

(Kwiatkowski, 2006; Fothergill et al. 2013) however the results have been mixed and it has never been validated for use by paramedics. Despite this it has been included in several systematic reviews looking at stroke recognition tools within the pre-hospital setting. The researcher was unable to establish any areas within the UK where it was used within a pre-hospital setting, outside of a comparative clinical trial where is has not shown superiority to other, more simple tools, which are already in use (Fothergill et al. 2013).

ROSIER, like LAPSS and MASS, attempts to identify stroke mimics which adds to their complexity and increases their time to complete (Fothergill et al. 2013; Purrucker et al. 2015). There is no research which solely looks at the effects of time to complete an assessment tool on the outcomes for people affected by stroke. There is however a wealth of research identifying that "time is brain", and aiming to improve processes which cause unnecessary delays within the stroke pathway (Saver, 2005; Albright et al. 2010). By using more complex tools, practitioners are extending timeframe to treatment and a negative effect can be assumed.

The National Institute for Health Stroke Scale (NIHSS) (Brott et al. 1989) is also often included within systematic reviews but until it was shortened (sNIHSS) in 2002 it was only designed to ascertain stroke severity, improvement or deterioration (Tirschwell et al. 2002). When evaluated against several stroke recognition and severity scales, the sNIHSS was shown to be non-inferior and not superior. It demonstrated that pre-existing severity scores can be repurposed to be used as stroke recognition scales (Purrucker et al. 2015) but has never been evaluated for pre-hospital use.

The Kurashiki Pre-hospital Stroke Scale (KPSS) is another stroke severity scale, designed to enable paramedics to identify those patients suitable for rtPA and reduce the door to needle time (Iguchi et al. 2010). Whilst it has good correlation with the NHISS there is no evidence that it is able to accurately identify strokes within a pre-hospital setting. As its primary focus is on severity, it has been adapted to enable paramedics to distinguish between intracerebral haemorrhage and infarct with some success (Yamashita et al. 2011).

The use of stroke severity scores as a recognition tool has been argued to be a positive step towards treatment decision (Purrucker et al. 2015), however with the varying accuracy of stroke recognition tools and the risk of missing up to 30% of stroke diagnoses the researcher suggests that pre-hospital treatment decisions should not be the main focus, and the ability to recognise possible stroke symptoms may be the most important aspect. This is particularly important within the researcher's area of practice where there are not multiple hospital or specialist centre choices to affect care if taken to an inappropriate area. The use of pre-hospital severity and diagnostic tools maybe more important within services operating a hub and spoke model.

The OPSS, MASS and LAPSS tools focus on the triage of possible strokes who are suitable for rtPA and other acute interventions rather than recognition (Rudd et al. 2015b). When validated, OPSS had a high PPV (89.5%) but did not have any false-negatives (Chenkin et al. 2009). It appears that data on this group not transferred to the stroke centre was not collected, and therefore accuracy of diagnosis is unable to be obtained. Whilst the tool had a positive impact on those transferred as suitable for rtPA (double pre-tool rtPA numbers) it had a high false-positive group with 1 in 5 people being in this category (Gladstone et al. 2009). There was a suggestion to remove the facial weakness part of this tool leaving only arm or leg weakness as

the stroke symptom (Gladstone et al. 2009). This should be exercised with caution, and more information as to the number of false-negatives who are not triaged to a regional centre identified along with their symptoms, before alterations are made. A direct comparison to FAST is difficult as the tool's primary focus is on suitability for acute treatment, however two systematic reviews have shown it to have similar stroke recognition to LAPSS and there was no superiority exhibited (Rudd et al. 2015a; Brandler et al. 2014).

There are significant methodological barriers which prevent the standardisation of a single tool based on the research available and the comparison between tools. The sensitivity and specificity of the tools has been widely debated (Rudd et al. 2015a; Gordon-Perue and Rundek, 2014) with criticisms surrounding methodology (Rudd et al. 2015b). In particular Rudd et al. (2015b) felt that the application of stroke recognition tools was only related to those who were identified as a possible stroke, therefore the use of specificity inaccurately inflates the values of the scales. Brandler et al (2014) conducted a systematic review into the accuracy of pre-hospital stroke scales and were highly criticised for not taking the population boundaries into account and for using specificity as a means of comparing the tools due to its dependence on prevalence of disease within identified population (Gordon-Perue and Rundek, 2014; Rudd et al. 2015b). Brandler et al (2014) defended their position and identified that it was difficult to select a clear denominator and the retrospective nature of all the data reviewed meant that selection bias was almost impossible to avoid. They held to their conclusion that the Los Angeles Pre-hospital Stroke Screen (LAPSS) was the most sensitive and specific at identifying stroke.

In a more recent systematic review, a specific tool was unable to be recommended which would suit all areas, and acknowledgement was given that most tools were validated in large urban

areas (Rudd et al. 2015a). It is known that different studies have yielded different results when applied within different clinical settings (Brandler et al. 2014). This may be due to the suggestion that paramedic services within large urban areas have an increased exposure to stroke due to population density and socio-economic factors (Bermejo et al. 1997; Correia et al. 2004), however it was identified in London that suspected stroke/TIA accounts for 2.3% of the paramedic caseload whereas in the researcher's semi-rural practice area exposure is 4% (Crowe, 2016). How this may affect the accuracy of stroke recognition tools is unknown but the increased exposure by a smaller team could affect the accuracy of diagnosis due to experience.

There is no research that has specifically address an island location which has comparison to both urban and rural locations. The atypical location makes applying tools verified for specific populations more challenging and increases the need for self-assessment.

Stroke assessment tools are either purely recognition based or are aimed at identifying those suitable for treatment (Rudd et al. 2015a). The type requires should be influenced by the service delivery model in use within the clinical area. In the UK, there has been a movement towards hub and spoke models of care (Hunter et al. 2013). The identification of stroke mimics, and the focus on true positives is key to the success of these service models as people need to be transported to the most appropriate facility (Gladstone et al. 2009). Within the researcher's practice area the service delivery model is based on a single centre where all emergencies attend, negating the need for precise diagnosis and pre-hospital identification of stroke mimics.

Some of the tools were validated via retrospective application (Kothari et al. 1997; Studnek et al. 2013; Purrucker et al. 2015) and this could affect outcomes, as tools were applied without time,

family/next of kin pressures or input and a lack of environmental factors. This is a challenging factor to overcome as prospective application of tools to a single cohort would not be clinically acceptable and therefore to assess the effects on comparative groups requires a retrospective application. Within this research, a retrospective approach has been taken to allow some methodological comparison to other studies.

With only a few exceptions (Gladstone et al. 2009; Iguchi et al. 2010), the majority of stroke assessment tool research uses diagnosis at discharge as the end point (Bray et al. 2005b; Ramanujam et al. 2008; Fothergill et al. 2013; Chen et al. 2013; Studnek et al. 2013; Berglund et al. 2014; Oostema et al. 2015). The rationale for hospital pre-alert and improving accuracy of paramedic diagnosis is to improve access to rtPA and specialist stroke service (Yperzeele et al. 2014). If discharge diagnosis is used as the end point it may not reflect the effect of paramedics and their application of the tools on diagnosis. Discharge diagnosis is supported by stroke or neurology specialists and advanced imaging (CT/MRI). The comparison of a basic screening delivered in a timebound manner with no consideration as to its purpose appears flawed. A better assessment would be diagnosis at 4.5 hours post symptom onset, or diagnosis at second screen as these are areas that paramedic diagnosis influences (Nor et al. 2004). It is important to assess the impact of the positive/negative diagnosis on access to treatment as this has clinical significance for the person and the disease.

Previous studies have included those who had a discharge diagnosis of TIA as part of their data set even though it has been suggested that the inclusion of a TIA diagnosis is likely to be influenced by what was seen in the pre-hospital assessment (Rudd et al. 2015a; Brandler et al. 2014) which is difficult to validate. Without the ability to validate the information, confounding

bias may occur if TIA data is included in final results, as it is unlikely to be independent of the FAST assessment. The researcher attempted to remove confounding bias by excluding all those with a TIA at second screen whether FAST positive or negative. Whilst this should improve the validity of this research, it affects comparison to other research as little information was available in other studies to identify the numbers of stroke/TIA included.

Another factor affecting comparison is the level of training/education provided prior to the assessment of the tools. New tools undergoing validation such as LAPSS and MASS had training programmes attached to them and it would be difficult to identify if improvements were related to the tool, the training or both. Within this research there was no pre-delivered training programme and although initial stroke recognition is provided to new paramedics this is not updated on a regular basis and individual self-direct study is unknown.

Whilst this research attempts to look at the accuracy of stroke assessment tools, it is designed to reflect the local service delivery model and recognises that comparisons which rely on methodology, population, education and service similarities may not be appropriate. The research conducted up to this date also has these disparities, and comparison difficulties are well recognised (Rudd et al. 2015a; Brandler and Sharma, 2014). The research is intended to focus on accuracy and effects on the local population and not external validity.

Methodology

Philosophy

The application of stroke assessment tools and the effects of their usage are part of the researcher's daily practice. This poses challenges in terms of objectivity, and the application of the tool by paramedics would prevent a truly positivist approach to the research as no controls were present (Johnson and Onwuegbuzie 2004). Consequently, a post-positivist approach has been adopted.

A post-positivist research approach is based on the assumption that the method to be applied within the research should be selected based on the research question. The research described here takes a post-positivist approach using a retrospective observational research design which identifies both objective numerical data and subjective diagnosis.

The researcher has adopted a post-positivist approach as the research is relatively large-scale and the approach will allow comparison to other research.

The use of a positivist approach when assessing the efficacy of scales is common place as the validity and reliability of such tools should be normalised (Hissong et al. 2015). Some of the existing research has taken a completely positivist approach, which meant assessment of the tools without external influences (Bray et al. 2005a; Chenkin et al. 2009; Brott et al. 1989). Whilst this is beneficial in their early development the aim of this research is to recognise some of these external effects and subjective influences therefore a post-positivist approach was used.

The challenge of objectivity can be maintained due to this being a retrospective study which seeks to obtain a pre-specified data set designed to prevent personal interpretation during collection, including the subjective diagnosis by paramedics. By this standardisation, objectivity can be achieved (Flick, 2015).

The research reviews the use of FAST tool in real-time situations without any control of variables. The lack of variable control is supported by the ontology of a post-positivist approach and it is the recognition and assessment of these variables which provide meaning to the research (Ryan, 2006).

Approach

Post-positivist research adopts both a deductive and inductive approach. It hypothesises that the FAST test accuracy is limited to the symptoms of stroke, and that a negative FAST test will have a negative effect on treatment, whilst also using paramedic perception/diagnosis to lead to further questions and ideas.

The key variables relate to stroke symptoms and diagnosis processed by the paramedics, but assessment of data will include others identified below. Results will be compared to existing literature and will suggest themes for future research along with any interventions required.

Ethics

The Oxford English Dictionary (2017) defines ethics as:

“Moral principles that govern a person's behaviour or the conducting of an activity”

With regards to research this relates to planning, conducting and reporting, as well as the protection of subjects (Resources for Research Ethics, no date).

The study has some ethical considerations to which mitigations have been identified:

- Confidentiality: the use of name and date of birth for the identification of records only adheres to principal 3 of the Caldicott principles (Department of Health, 1997). Data collected will only be that identified within the collection sheet.

- Safe storage of data: maintenance of information within a password protected document on a secure server should support the safe storage of data. All data will be destroyed at the end of the research project.

- Data protection: the researcher is employed by the Department of Health and Social Care (DHSC) and is professionally required to adhere to data protection guidance provided by the Isle of Man Government (2002) and the Nursing and Midwifery Council (2015). The researcher has up to date data protection training and understands that the measures identified above should adhere to that policy. The second reviewer (if required) also has up to date data protection training and is a member of the General Medical Council and an employee of the Isle of Man Government.

The findings may identify an immediate risk which requires intervention. If identified, the researcher is in a position to action the changes/education which may be required. Any risks will also be escalated via the stroke service risk register to inform the senior management of the DHSC.

Access

As this is retrospective observational study it uses secondary data sources in the format of:

- Paramedic attendance sheets
- ED electronic clinical notes system
- ED written notes system
- Hospital electronic and written patient healthcare records system

Written agreement to access paramedic and healthcare records was provided by the Caldicott Guardian (appendix 2).

As the researcher is an employee of the service area within the research, access to the electronic and written healthcare records was already granted. The researcher had active passwords to appropriate systems and with Caldicott agreement retrieved information via this route.

Research strategy

The data was collected via a retrospective observational study. This design is suited to large amounts of data collection (Harbison et al. 2003; Mann 2003) and previous studies looking at the efficacy of pre-hospital stroke assessment tools have used prospective and retrospective observational study designs (Kidwell et al. 2000; Harbison et al. 2003; Ramanujam et al. 2008).

Whilst there has previously been debate regarding accuracy of observational studies when assessing the efficacy of therapy/intervention in comparison to randomised controlled trials (RCT) (Sackett, 2000), several recent studies have identified that they are equal to RCTs (Concato et al. 2000; Harbison et al. 2003; Mann 2003). The use of an observational platform is appropriate as the researcher cannot control who does, or does not, have a FAST test and to do so could have a potential effect of treatment and diagnosis of those involved (Thiese, 2014).

The benefit of a retrospective study is the potential reduction of bias, as information has been previously gathered for a different purpose it is less likely to be biased. However, there is a risk of recall bias (episodes occurred in the past) (Song and Chung, 2010), as well as bias created by reduced controls at time of data collection (Khakha and Hill, 2012). These risks can both be mitigated by the information sources used, which will be documented records which occurred at the time of the event. These records are already subject to a degree of control via the hospital records keeping policy and the individual clinician's clinical guidelines.

The research was conducted via the following quantitative approaches:

1. Ambulance records were assessed to identify all those who had had the FAST test applied. FAST test was deemed to have been applied if:
    a. FAST box was completed
    b. Written language FAST positive, FAST negative
    c. If all FACE, ARM and SPEECH were written and noted appropriately

2. Those who had the FAST test applied were further assessed to identify:

a. Category of response

b. Paramedic diagnosis

c. Transfer to acute hospital within the service area (if not transferred = excluded)

3. Patient healthcare records for those who had a FAST applied were reviewed to identify:

    a. Time to triage/assessment

    b. Place of care at 1 hour

    c. Working diagnosis at 4.5 hours

    d. CT head completed yes/no/not applicable

    e. Treatment decision at ≤ 4.5 hours

4. Information was also collected on variables such as:

    a. Age

    b. Sex

    c. Symptoms present

    d. Symptom side (this was not analysed due to less than 30% of the information available or not clear)

    e. Whether they arrived in working hours or out-of-hours

    f. Past medical history of stroke

    g. Relative or carer present

Treatment decision is defined as the treatment pathway commenced at or before 4.5 hours from admission. This could be either: thrombolysis pathway completed, transfer/admit to a

ward (these can be, but not exclusive to, ASU, medical assessment unit or other), refer to TIA service or discharge. Treatment decision will be obtained by reviewing the patient records and clinical decision making identified by the researcher. Where ambiguity exists a second acute care practitioner will be requested to review and identify initial treatment decision.

This definition of "treatment" has been chosen to reflect the best practice care of stroke patients which includes thrombolysis within 4.5 hours of symptom onset, and rapid transfer to a ASU, ideally within one hour (Intercollegiate Stroke Working Party, 2012).

Consent from individual patients was not obtained due to a DHSC disclosure that information could be used to support service improvement without consent if it did not affect care that was currently being delivered (Department of Health and Social Care, 2015). Agreement from the Caldicott Guardian was deemed to be sufficient for this study.

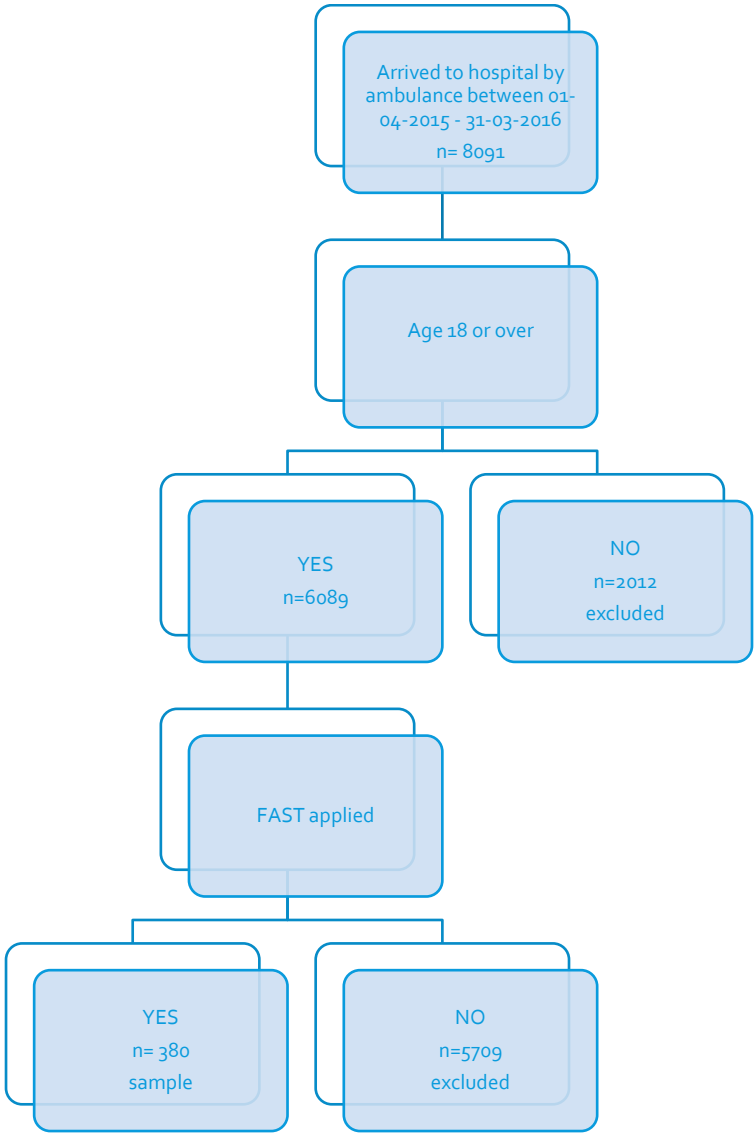
Data Collection

Sampling

The records from the year 2015-2016 were reviewed. A convenience sampling approach was chosen due to 2015-2016 being the first complete year where an accurate stroke data set was maintained, and the FAST test was included on the paramedic assessment sheet. The initial assessment identified 380 records which met inclusion criteria. This was deemed a manageable data set which was representative of the population. A year of data was used to allow for seasonal variations which had been noted within the service – see Figure 1.

This type of sampling is also known to be useful as expert judgement was required to understand and identify the population required (Carr, 2012).

Figure 1 Sampling Flow Chart



Secondary data collection

Secondary data was chosen as it provided ease of access to data. It could accurately identify who FAST was applied to, and what the outcomes were, without researcher influence. The

need to limit researcher influence was required as the researcher has a significant role within the service and would have been part of the reassessment process.

Whilst there are reliability implications relating to secondary data sources, the researcher felt that it was the most appropriate method, not only due to time constraints (Blaxter et al. 2010), but as the data being collected was specific and required clear information to be available, it assumes that reliability would not be altered. Secondary data may also prevent the Hawthorn effect (Hissong et al. 2015).

Analysis of research findings

Data analysis is aimed at identifying the sensitivity, specificity and accuracy of stroke diagnosis by the FAST tool when delivered by the researcher's paramedic service. Whilst the reliance on sensitivity could be argued as a priority when considering early stroke detection (Rudd et al. 2015a) the local aim is to limit the number of false-negative results and would prioritise specificity (Sackett et al. 2000).

The use of proportions to establish the positive predictive values (PPV) and negative predictive values (NPV) will be employed with further analysis using a 2x2 contingency table to identify any correlation between the variables and outcomes along with descriptive analysis.

For example:

Variable = paramedic diagnosis

	FAST positive	FAST negative
Paramedic stroke	a	b
Paramedic non-stroke	c	d

These tools have been chosen to reflect the analysis used in existing research on stroke assessment tools (Smith et al. 1999; Wild et al. 2012; Gordon-Perue and Rundek, 2014; Karlinski et al. 2015) and to provide the necessary information required to answer the question.

Limitations

- The major limitation would be the access, availability and completeness of information required.
    - The inclusion of a recent time period, in which healthcare records would not have been destroyed should limit this. However, it will be access to those records frequently in use which may be more challenging but by having a flexible approach to data collection it should be minimised.
    - Records which are incomplete or do not have clear information within the timeframe will be subject to review by a second practitioner. If agreement or

information cannot be clearly identified, these records will be excluded from the research but data regarding number excluded will be included within the analysis.

- The study does not look how the tool is applied or the knowledge and skills of paramedics applying it. Whilst information is available on the general education of paramedics with regards to the assessment of stroke this study does not analyse this information further or apply it specifically to their findings.
- There is a risk of confounding bias by the inclusion of paramedic diagnosed TIAs. To limit this risk, data sets which include a paramedic diagnosis of TIA have been removed.
- It does not represent the whole stroke population, only those which to whom FAST has been applied. It does not seek to identify those who arrived by ambulance and had a working diagnosis of stroke at 4.5 hours but did not have FAST applied. It is outside the limits of this research and may require further investigation in the future.
- Sampling was convenience rather than random. This was not possible to mitigate unless a prospective study was completed.
- There is the possibility of observation bias. The researcher is part of a small team working within a small stroke population and was unable to be blind to the research population. This was mitigated by inclusion of a clear criteria relating to data collection which asked for specific responses rather than interpretation. A second researcher was also available for any cases where ambiguity or influence may affect results.
- Verification bias is difficult to eliminated from the research. The sensitivity can be falsely increased due to the application of FAST mainly being related to the suspicion of stroke.

These patients are more likely to have the stroke scale performed and to test positive. True negatives may be inappropriately excluded, thereby falsely decreasing specificity.

- To reduce diagnostic bias the discharge diagnosis was not used for the end point. This would exclude true negatives and potentially falsely increase specificity. Diagnosis end point was based on the clinically significant time frame or 4.5 hours.

Results

Introduction

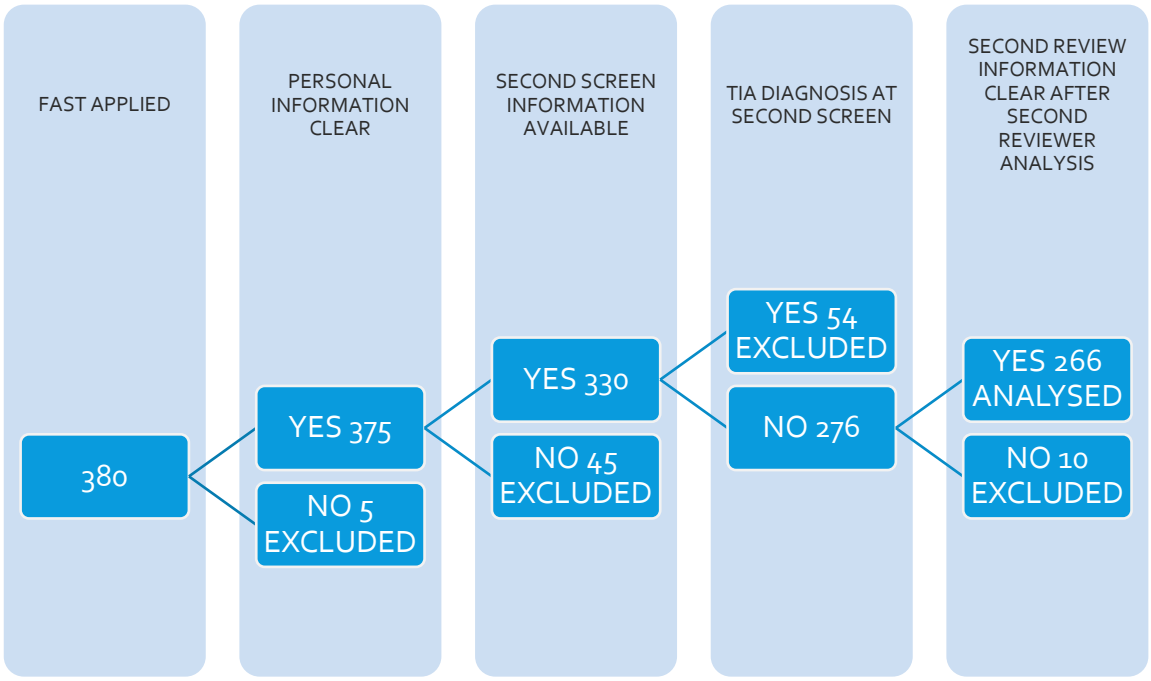
This chapter presents the results of the data collected and the comparison of the variables in four sections:

1. Describes the exclusion process along with context relating to the application of the tool and paramedic workload.
2. Presents demographics gathered from the ambulance data, including past medical history of stroke and provides a comparison of data to local and national stroke populations.
3. Analyses the accuracy of the FAST and paramedic diagnosis of stroke and the effects of variables on these results.
4. Reviews the effects on treatment of FAST and paramedic diagnosis in terms of: time to review, scan within an hour, access to ASU and ASP. It specifically describes the clinical significance on those who were missed by both FAST and paramedic services and contributing factors.

Raw data is displayed in appendix 4.

Section 1: Exclusion Process

Figure 2 Exclusion Process



FAST was applied 380 times in 12 months and 266 results were analysed (figure 2).

The researcher's paramedic service attended 8091 emergency calls during the year and applied FAST to approximately 5% of their work load. 4% of their workload are dispatched as stroke which is the 9th commonest cause for a 999 call (Crowe, 2016)

Section 2: Demographics

Table 2 Results demographics

	MALE	FEMALE	AGE (AVERAGE)	PMHS
FAST +VE	67	70	75	12
FAST -VE	58	71	76	10
PARAMEDIC STROKE	80	87	76	14
PARAMEDIC OTHER	56	54	75	8

Patients were classified and analysed in terms of FAST-positive/negative, paramedic stroke/other and working diagnosis at 4.5 hours. Of the 266 results analysed there was no significant differences between those who were FAST-positive (n=137) and those FAST-negative (n=129) in age or past medical history of stroke (PMHS). There was a slight difference in the male to female ratio. Within the paramedic diagnosis of stroke (n=167) and the paramedic diagnosis of other (n=99) group there were no differences between age and gender but there was a slight difference between past medical history of stroke (8 other diagnosis, 14 paramedic stroke) (Table 2).

All people with a past medical history of stroke were identified as FAST-positive and represented 9% of the FAST-positive group. 8% of those the paramedics identified as stroke had a past medical history of stroke but accounted for only 4% of those with a working diagnosis of stroke at 4.5 hours (Table 2). Of those who had a previous stroke and were FAST and paramedic positive only 3 (<10%) had a stroke diagnosis at 4.5 hours.

Table 3 Stroke Population Comparison

	Average age	No male	No female	Average age male	Average age female	% <60 years	% 60-69 years	% 70-79 years	% 80-89 years	% >90 years
Total Research population	74	47%	53%	72	78	15	13.5	26.5	30	15
IOM stroke population 2015-2016	74	57%	43%	71	80	10	23	30	28.5	8.5
People dx with stroke at 4.5 hrs	75	52%	48%	74	80	6	17	36	29	12

The research population was comparable to the local stroke population with some variation in the male to female ratio (Table 3). People assessed tended to be slightly older within the research population.

Section 3: Accuracy

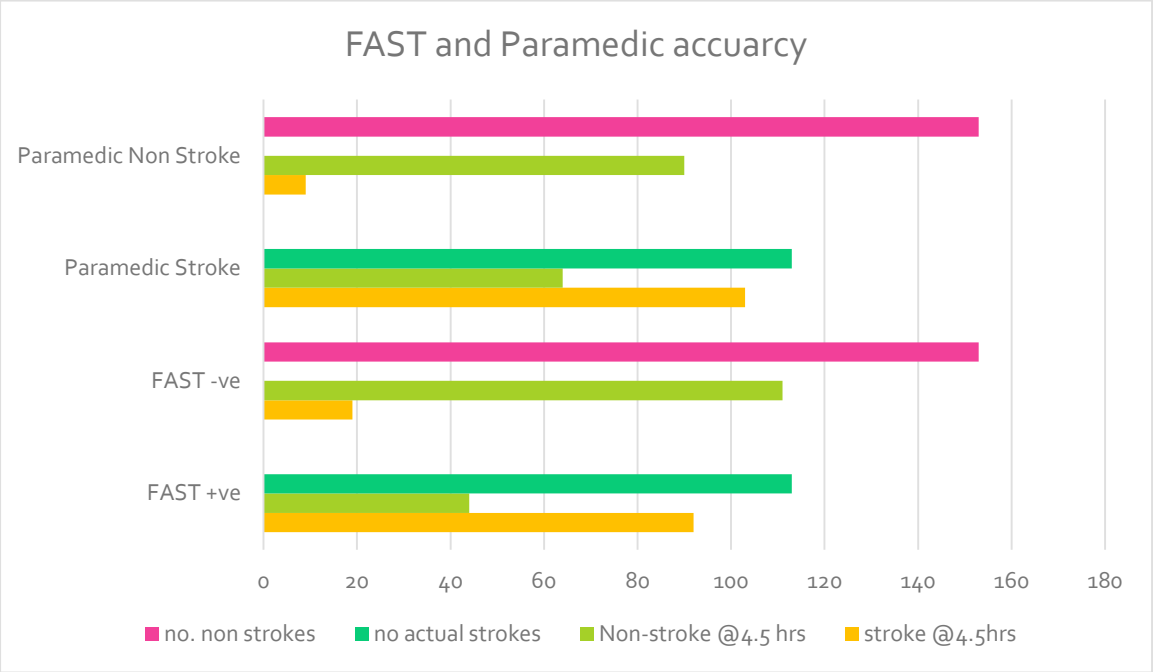
Table 4: Validation of FAST and Paramedic stroke recognition in an island setting:

Diagnostic Values	FAST	Paramedics
Sensitivity	67.6% (64.2-70.9)	61.6% (58.5-64.7)
Specificity	84.7% (80.4-88.9)	90% (85.5-94.5)
Positive Predictive Value	84.4% (80.2-88.6)	91% (86.4-95.5)
Negative Predictive Value	67.6% (64.2-71)	58% (55.1-60.9)

Values in parentheses are 95%CI (Confidence Interval)

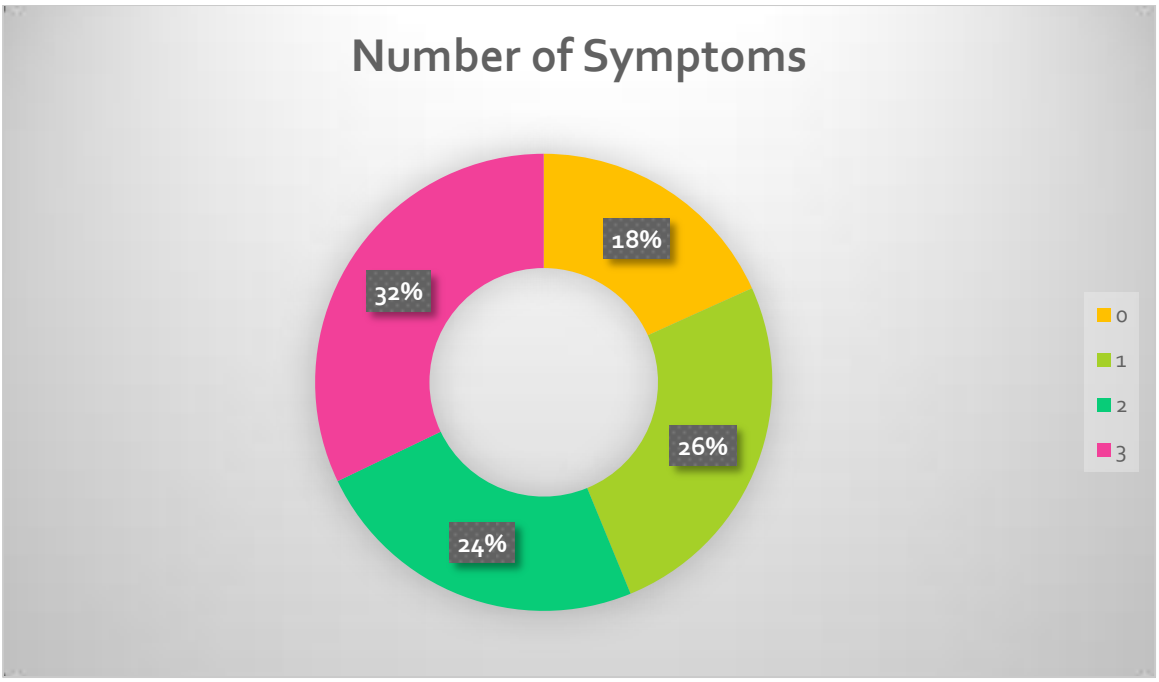
Of the 266 results analysed 111 people had a working diagnosis of stroke at 4.5 hours. The FAST test identified 83% (PPV 84.4%) of those with a working diagnosis of stroke at 4.5 hours but the paramedic service regardless of the FAST result identified 92% (PPV 91%). (Table 4 and 5)

Table 5: FAST and Paramedic Accuracy



The paramedic service diagnosed more false-positives n=64 (NPV 58%) than FAST n=44 (NPV 67.6%). Overall paramedics, regardless of the FAST result, had sensitivity of 61.6% and specificity of 90% and FAST alone had sensitivity 67.6% and specificity 84.7%. (Table 4 and Table 5).

Table 6: Number of Symptoms



People identified as FAST-positive were more likely to have all three symptoms present (n=44) compared to one symptom (n=35), two symptoms (n=33) or no symptoms (n=25) (Table 6).

Table 7: Case Detection: Face, Arm and Speech

		Face	Arm	Speech
Stroke dx @ 4.5 hours	Sensitivity	89%	88%	79%
	Specificity	78%	82%	78%
Paramedic dx @ 4.5 hours	Sensitivity	93%	96%	87%
	Specificity	64%	69%	62%

When analysed individually, face and arm symptoms had similar sensitivity (Face: 89% and Arm 88%) with speech achieving the lowest (79%). All had similar specificities (F=78%, A=82% and S=78%). If applied to the accuracy of paramedic diagnosis specificity reduced (F=64%, A=69% and S=62%) but sensitivity increased (F=93%, A=96% and S=87%). (Table 7)

Table 8: Number of symptoms in relation to working diagnosis at 4.5 hours

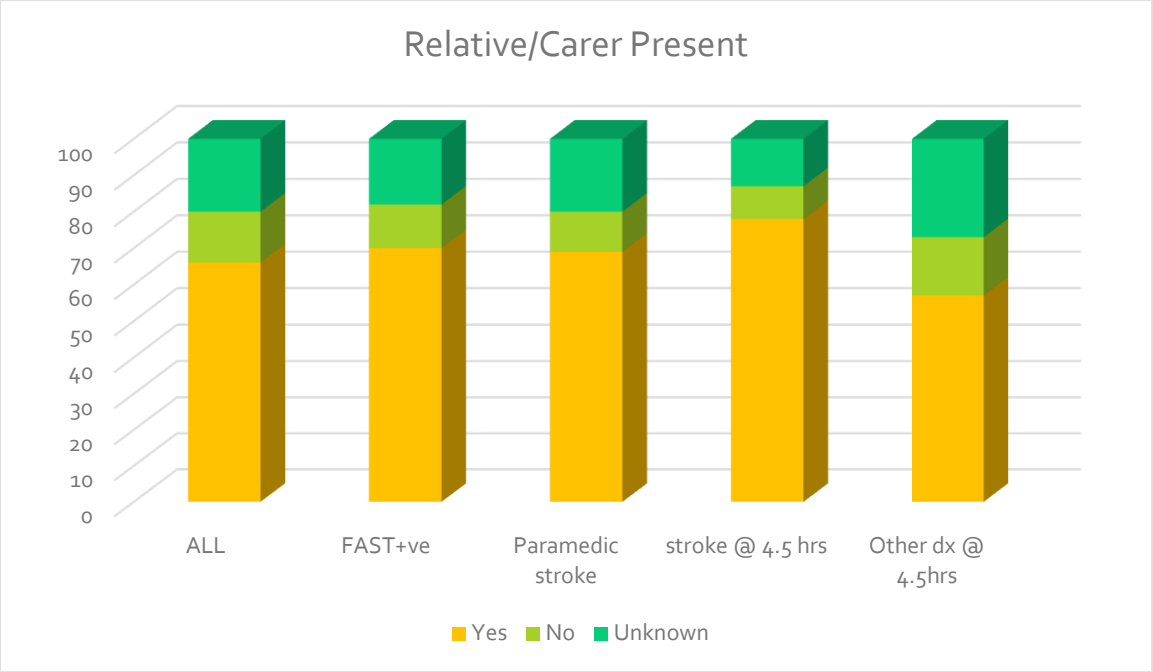
	0 symptom	1 symptoms	2 symptoms	3 symptoms
Stroke	7%	24%	28%	41%
Non-stroke	84%	12%	2%	2%

No symptoms of stroke had a PPV 91%, this in formation did include four people with a GCS <6 and would have been prohibitive to the accurate application of FAST.

People with all three symptoms were more likely to have a working diagnosis of stroke at 4.5 hours than those with only one symptom, however of those who had an “other” diagnosis at 4.5

hours, 12% had one symptom (Table 8), mainly speech. Speech was a difficult diagnostic tool as 19 people identified as FAST-negative had a speech deficit, and 12 of those had a working diagnosis of stroke at 4.5 hours. Similarly, with paramedics, nine people were identified as non-stroke who had a speech deficit, but six of those had a working diagnosis of stroke at 4.5 hours.

Table 9: Relative/Carer Present



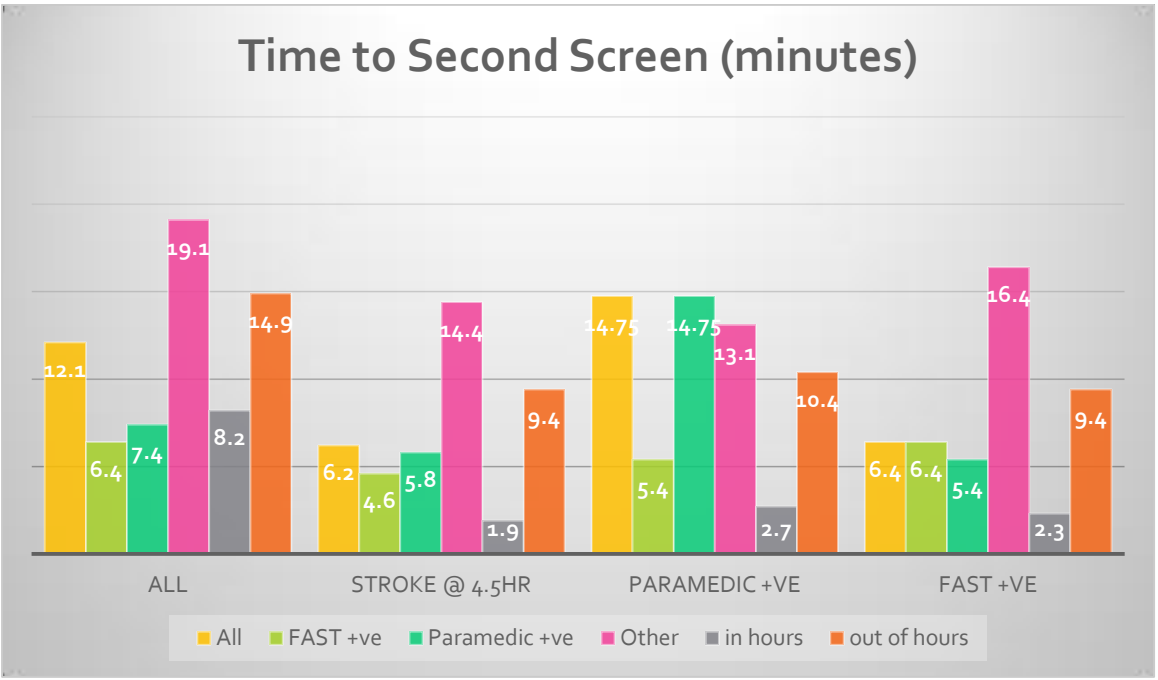
There is an association between the number of people who were FAST-positive (n=96) or paramedic diagnosis of stroke (n=115) who had a relative or carer present. The presence of a carer or relative was positively correlated to the likelihood of being diagnosed with stroke at 4.5 hours with 78% of those diagnosed having someone present and 57% other diagnosis having someone present (Table 9).

Those attending with relatives or carers tended to have a higher average age of 77, whilst those attending without a relative or carer tended to be of a younger average age of 69.

Section 4: Effects on Treatment

Time to second screen

Table 10: Time to second screen



The average time to second screen for all patients was 12.1 minutes. For those who had a working diagnosis of other at 4.5 hours, the average was 19.1 minutes, and those with a working diagnosis of stroke at 4.5 hours was 6.2 minutes.

The FAST tool had a positive effect on time to review with those who were FAST-positive and arrived in-hours being reviewed on average within 2.3 minutes and those arriving out-of-hours being reviewed on average within 9.4 minutes (Table 9).

If people were FAST-positive and paramedic positive the effect was enhanced. Those arriving in-hours had average time to second screen of 2.2 minutes, and those out-of-hours had an average time to second screen of 7.7 minutes.

Time to second screen was not affected by age (<70=12mins, >70=11.5mins) or sex (female= 12.5mins and male=13 mins). Those with a reduced GCS <13 were seen immediately.

People who arrived in-hours were assessed quicker regardless of being FAST-positive or paramedic stroke.

Scanning

Table 11: Access to scanning

		FAST +VE				FAST -VE			
		Paramedic +ve	Paramedic -ve	WDS @ 4.5hrs	Other dx @4.5hrs	Paramedic +ve	Paramedic -ve	WDS @ 4.5hrs	Other dx @ 4.5hrs
Scan	Y	65%	23%	83%	19%	30%	14%	63%	12%
	N	15%	15%	14%	5%	19%	2%	37%	3%
	NA	20%	62%	3%	76%	51%	84%	0%	85%

Those people who had a working diagnosis of stroke at 4.5 hours and were FAST-positive were 20% more likely to be scanned by 4.5 hours (Table 11). People FAST-positive with an "other" diagnosis had an increase in scanning at 4.5 hours than those FAST-negative and an "other" diagnosis (Table 11). This may be due to the result of the scan contributing to the "other" diagnosis.

Table 12: Acute stroke pathway

		FAST +VE				FAST -VE			
		Paramedic +ve	Paramedic -ve	WDS @ 4.5hrs	Other dx @4.5hrs	Paramedic +ve	Paramedic -ve	WDS @ 4.5hrs	Other dx @ 4.5hrs
Acute stroke	Y	66%	38%	91%	0%	37%	2%	95%	1%
	N	29%	24%	7%	100%	63%	96%	0%	99%
	NA	5%	38%	2%	0%	0%	2%	5%	0%

Those FAST-negative (18/19) with a working diagnosis of stroke at 4.5 hours were more likely to have accessed the ASP than those FAST-positive and a working diagnosis of stroke at 4.5 hours (84/92) (Table 12).

Table 13: Access to Stroke Unit

		FAST +VE				FAST -VE			
		Paramedic +ve	Paramedic -ve	WDS @ 4.5hrs	Other dx @4.5hrs	Paramedic +ve	Paramedic -ve	WDS @ 4.5hrs	Other dx @ 4.5hrs
Stroke unit	Y	61%	24%	83%	0%	33%	2%	79%	1%
	N	29%	38%	6%	0%	44%	98%	10.5%	99%
	NA	10%	38%	11%	100%	23%	0%	10.5%	0%

ASU access appeared to be affect by paramedic diagnosis. Those whom the paramedics did not identify as a possible stroke, regardless of FAST-positive or FAST-negative were less likely to have accessed the service by 4.5 hours (Table 13).

FAST/Paramedic Negative

Nineteen people were identified as FAST-negative whom had a working diagnosis of stroke at 4.5 hours. Of these the paramedics identified fifteen as stroke. Most had no symptoms with only one having a posterior circulation sign, two had speech problems and one had arm weakness.

Their treatment was comparable to others with a working diagnosis of stroke, most significant was that all were on the ASP but six did receive imaging. Four of the six arrived out-of-hours.

The paramedic service identified nine as non-stroke, who had a working diagnosis of stroke at 4.5 hours. Of the nine, six had a speech deficit. Three had all of the face, arm and speech symptoms and were identified as collapse query cause. All were on the ASP, only one was not on the ASU who required it and one was not scanned.

Only four people were both FAST and paramedic negative. Of the four, two had FAST symptoms.

1. Symptoms were attributed to a previous stroke
2. Treated for hypoglycaemia as a cause of their slurred speech.

The other two were transferred to ITU. All four were scanned and on the ASP if appropriate. They also (of those known) had relatives present. They had an increased door to second assessment time of 15 minutes, however the person arriving in-hours was seen immediately as was person presenting with a low GCS. Both of the others attended out-of-hours.

Discussion

FAST Accuracy

The sensitivity of FAST diagnosis of stroke was significantly reduced compared to other studies. FAST was found to have a PPV 84.4% and NPV 67.6% and a sensitivity 67.6% and specificity 84.7%. As FAST is an initial screen applied in a time-bound manner by non-stroke professionals, the researcher felt that specificity should be prioritised over sensitivity to support the identification of true negatives. This differs from other studies where hub and spoke service delivery models are used (Brandler et al. 2014; Rudd et al. 2015a). The focus for hub and spoke services is the identification of true positives hence the emphasis on sensitivity, which allows for the diversion of potential strokes to appropriate hyper-acute centres. Data relating to those who were FAST-negative and not treated within a stroke centre is incomplete; the studies included primarily FAST-positive results, increasing the sensitivity, and validation was not based on the total population to whom the tool was applied (Brandler et al. 2014; Rudd et al. 2015b). The research area has a single acute hospital which reviews all emergency patients, ensuring that all negative cases had their complete data included ensuring accurate sensitivity by capturing all to whom FAST was applied.

Sensitivity results are still subject to bias as no data was collected on the rationale for use of the FAST (999 call identified stroke, paramedic experience, dispatch code), nor did the research identify those to whom FAST was not applied but arrived by ambulance and had a working diagnosis of stroke at 4.5 hours. Whilst acknowledged in other studies this bias was also unable to be limited within them allowing for direct comparison.

Rudd et al. (2015a) discussed the falsely increased sensitivity in their systematic review and also suggested that the use of "sensitivity" as a measure is a limitation and that "case detection" would be more accurate. Case detection requires analysis based on the individual elements of the FAST.

Within this research the most common symptom which contributed to FAST (61%) or paramedic diagnosis (48%) was arm weakness. 71% of those with a working diagnosis of stroke at 4.5 hours had an arm weakness recorded (sensitivity 88%). Conversely, having a speech deficit (sensitivity 79%) made identification less likely despite 56% of those with a working diagnosis of stroke at 4.5 hours being affected by a speech deficit.

When developed in 1998, the FAST tool did not specify a set phrase to help identify speech problems, unlike the CPSS which asked people to repeat "the sky is blue in Cincinnati" (Studnek et al. 2013) but relied on conversation between those assessing and the assessed. It is a consideration to future application as to the use of set phrases as two of the people which were both FAST and paramedic negative, but had a working diagnosis of stroke, had slurred speech.

There are phrases in use but there is no evidence as to their usage, as speech deficit in stroke is normally a result of dysarthria or dysphasia. By repeating a sentence, a person may demonstrate dysarthria but not dysphasia. This is more likely to be obtained through conversation however standardised tasks do improve reproducibility (Kothari et al. 1997). The NIHSS scale uses a series of phrases and pictures to assess both dysarthria and dysphasia and this demonstrated reproducibility and high sensitivity to speech deficits (ver Hage, 2011).

However, time of delivery would be increased and a low threshold for having people with speech problems assessed for stroke may be more appropriate.

Unfortunately, case detection comparison is limited as few studies within the last 10 years have reported specific neurological deficits outside of severity scores other than as a combined total. It is outside the remit of the research to apply a stroke severity scale to each data set for comparison but may be beneficial for future evaluation.

A study in 2005 identified that having more than one face, arm or speech symptom gave an increased likelihood of stroke (Goldstein, 2005). The value of multiple symptoms in improving stroke detection is well documented and reinforced by this research (Goldstein, 2005; Kaps et al. 2014). The CPSS (Kothari et al. 1997) has a specificity of 98% for three items compared to 88% for one item. This research has lower specificity for number of items (3=73% AND 1=62%) however specificity and sensitivity both increased in relation to number of symptoms present. Tools such as LAPSS require multiple symptoms to be present for stroke diagnosis, significantly increasing their sensitivity and lowering specificities.

Within this study, FAST definition required either the identification of all FAST symptoms (either positive or negative) or the inclusion of the words “FAST-positive” or “FAST-negative”. Some of the data collected identified FAST symptoms but documented “FAST-negative” (n=18) in the records. These were analysed as FAST-negative due to the research focus of paramedic accuracy of FAST.

The FAST tool missed 17% (n=18) of those with a working diagnosis of stroke at 4.5 hours which is comparable to other research where it varies between 9-40% (Brandler et al. 2014; Huwez,

2015; Purrucker et al. 2015). It is worth considering tools yet to be validated such as BE-FAST (Aroor et al. 2017) which include POCS signs to increase accuracy. Within this research accuracy would not have been increased as the four people who did not have either FAST or paramedic identification had either FAST symptoms or no symptoms.

Paramedic Accuracy

The paramedic service, regardless of FAST, had a specificity 91% and sensitivity 61.6%. Specificity was higher than FAST (84.7%) suggesting that paramedic experience and knowledge has an effect on stroke recognition.

Paramedic education on stroke, treatment available and their role in the pathway has been shown to improve stroke outcomes such as door to needle times and time to CT (Bray et al. 2005a; Lee Gordon et al. 2005) whereas education relating to the application of stroke recognition tools only, had no impact on diagnosis (Frendl et al. 2009). The biggest benefits were seen when education was combined with a clear protocol and a standardised tool being used in clinical practice (Crocco et al. 2003; Quain et al. 2008).

The paramedic service being researched does not currently have regular stroke education but there is a clear stroke protocol in place and FAST is used as the standardised tool. Paramedics are also an integral part of the stroke service, with active membership on the stroke project group and thrombolysis review group. This provides access to regular feedback, involvement in developments and updates relating to people and the service, a factor shown to improve stroke recognition (Hodell et al. 2016). This may be why the paramedic service has higher specificity than the FAST alone. It may be useful to re-evaluate this after delivery of a formal training plan.

The paramedic service was more likely to diagnose people as stroke than previous studies (PPV 91% and NPV 58%) however a direct comparison is not possible due the lack of information relating to true false-negatives within the other studies (Rudd et al. 2015a). On the surface, it appears to be higher which may relate to the service environment, specifically, high population exposure in relation to the number of ambulance calls. In urban areas, suspected stroke calls account for approximately 2.3% of paramedic workload (Hunter et al. 2013) where the research paramedic service had a 4% exposure (Crowe, 2016). The service is delivered by a small team whose individual exposure is likely to be greater than someone operating within a larger team, a barrier to stroke recognition identified by paramedics (Hodel et al. 2016).

The effect of over diagnosis within a hub and spoke service model may have a negative effect on patient outcomes. This is assumed and based on several factors:

- transfer to incorrect specialist centre
- delay in accessing correct treatment
- increased false-positives increasing workload in specialist centres.

There is a lack of evidence as to the true effect of the impact of focussing on specificity. In a Canadian centre using OPSS they found that while the number of people receiving rtPA had increased, they could not manage demand and a state-wide service reorganisation was required (Gladstone et al. 2009). Concern with "flooding" a service has been expressed in other research but with a caveat that if in doubt treat as stroke (Purrucker et al. 2015).

Within this single centre, the researcher has been able to identify that there was no obvious negative effect on treatment and care for those identified as stroke but had an "other"

diagnosis at 4.5 hours. This information is limited to 4.5 hours as the study's outcome parameter but at this point they had all been either transferred or discharged, and had a treatment plan in place. Comparison to non-stroke paramedic attendees is outside the parameters of this research.

Population/Demographic Impact

The research population is similar with regards to age and gender to the other research populations (Brandler et al. 2014, Fothergill et al. 2013, Rudd et al. 2016). Sensitivity and specificity are assumed not to alter with prevalence but can be affected by population (Brandler and Sharma 2014). The research population is predominately white British (Economic Affairs Division, 2011). Other research on stroke recognition tools were conducted within large urban populations which are more ethnically diverse, causing an effect on the results (Kidwell et al. 2000, Chenkin et al. 2009, Bray et al. 2005b, Chen et al. 2013) and preventing direct comparison.

Relative/Carer Present

The most significant impact was the presence of a carer or relative. The ASP identifies that a relative or carer should be transported with the patient if possible. The OPSS, CPSS and ROSIER all demonstrated lower specificity when applied to people with pre-existing disability and no relative or carer present (Purrucker et al. 2015). This is due to neurological deficits caused by stroke being, not only physical, but also cognitive. Capacity is often affected by difficulties with memory, thinking and speaking (Prabhakaran, 2015). The benefit of having someone present to describe pre-morbid health aids rapid diagnosis and supports treatment decisions. This

research supports this action, with 78% of people with a working diagnosis of stroke at 4.5 hours having someone present.

Past Medical History of Stroke Impact

The number of people with a previous stroke were <7% which is significantly lower than UK data 16-32% (Mohan et al. 2011) and not representative of the researchers practice area 17-20% (SSNAP, 2016). While this does not accurately effect the stroke population, it aims to, and does, reflect the information available to the paramedics when applying FAST as it was taken from their information sheets. It suggests that pre-existing stroke symptoms are taken at face value which may increase the specificity of diagnosis by paramedics. Whilst several other recognition tools excluded people with pre-existing disabilities, FAST does not (Kidwell et al. 2000, Bray et al. 2005b), perhaps due to other tools focussing on who is suitable for treatment rather than exclusively who is a stroke. This is not a focus proposed by the researcher's service area, who has a preference for the stroke team making suitability for treatment decisions and the paramedics focussing on rapid transfer and screening. It is also an ethical concern to exclude people on the grounds of disability, and benefit from rtPA should be assessed on effect on individual quality of life rather than perceived quality of life, as despite slightly increased mortality 1 in 3 return to pre-stroke level (Foell et al. 2003; Karlinski et al. 2014).

Presentation In-Hours/Out-of-Hours Effect

The researchers service provides an "in-hours" hyper-acute pathway which includes:

- stroke team ED attendance

- rapid transfer to ASU
- rapid access to CT by stroke team.

Out-of-hours care is provided by an "on-call" general medical team who may or may not have stroke experience and no hyper-acute pathway is available.

Arrival "in-hours" improved time to review by 6.7 minutes (14.9 – 8.2 minutes) with suspected stroke diagnosis being seen within an average 2.5 minutes.

CT access was similar. In-hours CT has a rapid access process for suspected strokes whereas out-of-hours it requires a consultant to consultant referral. This is reflected in the research as 15% of those with a working diagnosis of stroke at 4.5 hours arriving in-hours were not scanned by 4.5 hours compared to 31% of those arriving out-of-hours. This suggests that access to CT/time to review is affected more by systems rather than by recognition tools.

If the service area provided a 24/7 service then the recognition tools and paramedic diagnosis could be assumed to have a greater effect, as those who were FAST or paramedic positive had the quickest response times. Despite the research showing that of those arriving in-hours who did not receive a scan within 4.5 hours, 50% were FAST-positive, all were on the ASP and seen immediately and all had a paramedic diagnosis of stroke. This implies that the FAST tool and paramedic diagnosis has no obvious effect on access to CT, and that barriers are attributable to other phenomena post-admission; this requires further exploration.

Access to Stroke Unit

Whilst it appears that paramedic diagnosis affects access to the ASU, the researcher cannot clearly establish a link. The research service area does not have a direct admission process and all people must pass through the ED, therefore decisions relating to admission are not part of the paramedic or tool direct influence. Indirectly, delays in review, diagnosis and scanning may have an effect but so far this has not been demonstrated. Only seven out of 111 with a working diagnosis of stroke did not have access, or planned access to the ASU at 4.5 hours. This information requires further analysis investigating other barriers or delays to accessing the ASU, including:

- Bed availability
- Time of day
- Knowledge of pathways and process by team on duty
- Referral process

This additional information is outside the scope of this research but may add further information as why those not diagnosed as stroke by paramedics did not access appropriate treatment within the same time frames.

Acute Stroke Pathway

Use of the ASP varied with FAST and paramedic diagnosis. Paramedic positive diagnosis should trigger the use of the pathway within the community, but barriers such as time constraints, availability of the pathway, and continuation of pathway on arrival may be a factor as to the low usage. However, at 4.5 hours of all patients who required the pathway, only two did not have it.

As with access to other elements of treatment, it is difficult to attribute the impact or effect to a single element such as FAST diagnosis, and further information regarding post-admission processes and barriers need to be considered before a definite effect can be established.

Clinical Significance

The research distinguishes clinical significance to the population who had a false-negative diagnosis. Of the 111 with a working diagnosis of stroke at 4.5 hours:

- 19 were FAST-negative.
- Of the 15, the paramedic service placed a stroke diagnosis on 15.
- Significantly three of the 15 had FAST symptoms but were classified as FAST-negative (two arm, one speech).
- All 19 had an ASP but only six were scanned (two in-hours, four out-of-hours) and only one had not accessed or planned to access the ASU.

Comparatively the false-negative diagnosis did not appear to affect care, and factors not relating to FAST were more likely to be the cause of not achieving appropriate care as per other factors.

The paramedic service did not identify nine out of 111 with a working diagnosis of stroke at 4.5 hours.

- six of the nine had a speech deficit highlighting the complexity and difficult diagnostic value of this element.

- three out of the six had face, arm and speech symptoms and were classified as “collapse unknown cause” which suggests that information regarding their presentation may not be complete.
- All nine had an ASP in use.
- All except one were not scanned or in the ASU.

Suggesting that there is no clinical significance to paramedic false-negative diagnosis and that diagnosis does not always reflect the treatment provided.

The most clinically significant affect was time to second screen, and this was within the median parameter (11.3 minutes). As a time is brain approach is key to the delivery of rtPA, this time period is longer than the target. The aim of the stroke team being in attendance on arrival may have been achieved if the appropriate service had been in place as these patients all had an ASP in use.

Four people were both FAST and paramedic negative:

- Time to second screen was the most clinically significant element at an average of 15 minutes
- Two of the four were seen immediately and two at 30 minutes.
- Both people who were 30 minutes to second review arrived out-of-hours; this is likely to have had more of an impact than FAST or paramedic diagnosis.
- Of the two seen at 30 minutes:
    - one required acute intervention and ITU admission but had no stroke symptoms.
    - the other was younger in age (55).

Of the four, one had face and arm symptoms and one had slurred speech. Had a case detection approach been taken towards the application of the FAST, then diagnostic accuracy may have been improved reducing the number to two (remaining two had no stroke symptoms).

The person with slurred speech was also hypoglycaemic. The treatment and exclusion of hyperglycaemia is a normal part of stroke pathways and reversal of it is important to enable an accurate diagnosis as it is a common stroke mimic (Fernandes et al. 2013).

The two people who were transferred to ITU were both diagnosed with Sub-Arachnoid Haemorrhage (SAH), an atypical type of stroke which presents differently and does not always have any or persistent neurological symptoms. Due to the difference in presentation, the stroke recognition tools are not designed to capture these (Jiang et al. 2014) and diagnosis is via investigation.

Clinical significance is difficult to justify when the effect is on a person. Significance could be reduced to two people with no symptoms, whom it would have been difficult to assess as stroke without access to imaging had the FAST been applied literally. Whether this would have increased the number of false-positives has not been assessed, but clinical effect for stroke would have been improved. The main clinical effect is time to second review, which appears to be affected by service organisation as well as FAST/paramedic accuracy.

Conclusion

Paramedic services are the first medical contact for the majority of acute stroke patients. They play a vital role in the identification and treatment of acute stroke as a result. The benefits of thrombolysis and other interventional therapies for acute ischemic stroke are highly time dependent, making rapid and effective paramedic response a necessity.

Reliable stroke identification pre-hospital enables appropriate treatment pathways to be initiated and potentially inappropriate treatment or treatment delays avoided. The activation of a pre-alert and the availability of the stroke team on a patient's arrival can make significant differences to patient outcomes (Mosley et al. 2007b).

This research has established that whilst there are significant differences between this and previously published research, the information is specific and useful to the local service taking into account its location and service delivery model. The alternative focus onto specificity rather than sensitivity is designed to enable second stage assessment by a team whose primary focus is stroke care. It removes the expectation that non-specialists are responsible for treatment pathways and aims to capture the maximum number of strokes to enable rtPA to be accessible to the highest number of stroke patients.

Previous research identified that FAST missed between 9-40% of strokes (Brandler et al. 2014; Huwez, 2015; Purrucker et al. 2015). Within this research, if related to FAST alone it missed 17% of strokes, however when combined with paramedic identification this reduced to 8% (n=9) and could be a result of the level of exposure the researcher's paramedics have to stroke and their

involvement with the service (Karlinski et al. 2014). It also reflects that the service has an established stroke pathway and that there is a standardised tool in use, both elements shown to significantly improve access to stroke care (Quain et al. 2008; Hunter et al. 2013; Camerlingo et al. 2014).

Further improvements can be achieved by providing regular structured education and training. It would be beneficial within training to identify the value of FAST as individual elements and not just as a whole. Case detection demonstrated that the individual elements increased stroke recognition, and if combined with education on the subtle or unusual types and presentations of stroke (Bray et al. 2005a) recognition could be further improved. There is no suggestion that other tools which are more complex would provide any benefit to stroke recognition by island paramedics.

The most significant influence on diagnosis was the presence of a relative or carer with 78% of stroke diagnosis having someone present. This is part of the pathway but its importance could be reinforced within education sessions and within public education events.

Findings indicate that other variables did not have significant effect on diagnosis or outcomes but age may have contributed to pre-ambulance stroke recognition and therefore the use of 999 for younger stroke patients. Combined approaches which not only educate pre-hospital providers but also the public have been shown to increase the number of people accurately accessing hyper-acute stroke care (Baldereschi et al. 2012). The need for regular public campaigns highlighting recognition and the public role within the pathway could increase access to hyper-acute stroke care and therefore reduce future disability from stroke.

Clinical significance was relatively minimal with two people having reduced access to the treatment required; this was affected by service structure and access to services out-of-hours. To monitor true effect on access to treatment, services would need to be equal over the 24-hour period. This would potentially alter time to review for the four false-negatives. Long-term effect on clinical outcomes of these delays was not assessed as the research was looking at paramedic influence rather than service design influence.

The main limitation of this study relates to those to whom the FAST was not applied. It would be important to establish the number who did not have FAST applied, but had a working diagnosis of stroke at 4.5 hours. This would establish a complete picture of paramedic identification of stroke and the influence of FAST on this.

The findings identify that FAST combined with paramedic knowledge is appropriate to meet the needs of an island population, and that future actions should include education, specifically in relation to the value of carers, the individual elements of FAST and the more complex signs of stroke (vision, balance, headache). Further assessment should be undertaken to improve post-admission pathways along with the identification of those to whom FAST was not applied.

APPENDICES

Appendix 1 - Literature Review Search Terms

Search Strategy

Step 1: Topic

- Investigation into the accuracy of the FAST test when delivered by an island paramedic service and the impact on treatment of FAST test result

Step 2: Related Topics

- Validation of:
- Pre-hospital stroke assessment/recognition tools
- TIA/CVA/Stroke
- Post admission outcomes
- rtPA treatment access
- rural/urban environments

Step 3: Expanded search terms

Study these search terms. Using the boxes below, put related terms into groups or concepts.

Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6
Stroke	FAST	Pre-hospital	Paramedics	Island	Accuracy
TIA	Assessment tools	Community	Ambulance	"Rural v urban"	Diagnosis
Cerebral Vascular Accident	Recognition tools	Non-hospital	EMS	Rural	Outcomes
Transient Ischaemic Attack	Scales	General practitioner	Emergency medical services	"Rural and urban"	Validation
CVA	Diagnostic pathways	Non-specialist		Geographically isolated	Analysis
	Protocols				Systematic review
	"code stroke"				

Step 4: Search statement

Linked using the Boolean Operators (AND, OR, NOT)

Search 1: pre-hospital **AND** stroke assessment **AND** paramedics

Search 2: pre-hospital **AND** (stroke **OR** TIA) **AND** (assessment **OR** recognition)

Search 3: community **OR** pre-hospital **AND** stroke recognition **AND** (EMS **OR** paramedics)

Search 4: rtPA rates **AND** (Code stroke **OR** stroke recognition) **AND** (EMS **OR** paramedics **OR** ambulance)

Search 5: stroke outcomes **AND** rural v urban areas **AND** pre-hospital **AND** (assessment **OR** alert)

Search 6: validation **AND** stroke **OR** TIA **AND** recognition **AND** (tools **OR** assessment)

Search 7: systematic review **AND** stroke **AND** assessment **AND** (pre-hospital **OR** community)

Search 8: (stroke **OR** TIA) **AND** (assessment **OR** scales) **AND** (outcomes **OR** diagnosis)

Step 5:

Date range: since introduction of “time is brain”, agreement of rtPA as therapy

Source: Newspaper articles, scholarly journals, multimedia, national guidelines/reports

Text coverage: Full text/citation and abstracts only

Acceptable sources: Peer‐Reviewed / Evidence‐based/factual

Geographical coverage: International

Appendix 2 - Caldicott Agreement

Department of Health and Social Care

This is a request for a specific person ('the requestor'), to be granted access to Medway EPR for the specific purpose of downloading anonymised and/or patient identifiable data. Note that by default the requestor will not have access to download any data unless this permission is explicitly granted by the Caldicott Guardian.

The requestor must fully understand and accept their responsibilities under the Data Protection Act 2002 and all other relevant legislation to securely protect patient identifiable data that is accessed using Medway EPR for patient data management.

The Caldicott Guardian must provide explicit permission using this form for each and every requestor who wishes to access Medway EPR for projects that require information sharing.

Person making request (Requestor):

Name [redacted] Title/Role [redacted]

Purpose: Research proposal as previously sent regarding accuracy of pre-hospital stroke assessment tool.

Indicate which data items you require access to:

Forename: [redacted] Surname: [redacted] DoB: [redacted] Age: [redacted] Sex: [redacted]

Address: ☐ Postcode: ☐ NHS no: ☐ Other (Please state below)

Other: ...diagnosis at 4.5 hours post stroke admission and effects on care (within that time period)

Purpose of Data Request

To identify the accuracy of the FAST tool when used by the ambulance service. This will hopefully ensure that we are appropriately screening all potential stroke patients and that diagnosis in the first screening is as accurate as possible.

How will the data be transferred/extracted? (Note – patient/user identifiable data must not be transferred via e-mail unless anonymised, encrypted or using secure NHS network i.e.@nhs.net)

Data will be extracted by hand and patient identifiable information used only to locate records this will be stored in a password protected, network file. Other data collected will be anonymised.

Ambulance Service > manual extraction from Medway PAS > collate data > data released anonymized

How and with whom will the information be shared?

Information will be shared via the research dissertation as well as a presentation to relevant stake holders when complete. There will also be scope for it to be published in a peer reviewed journal is accepted.

Who else will have access to the data? (If data recipients are not employed by the Department please state whether Department contracts are in place. If not detail confidentiality agreements)

Data access will be restricted to second reviewer if required.

How will the service users be contacted?

NA

How will service users consent be obtained?

Consent is not required as it within the hospitals patient information that data and information may be used for service review and improvement and therefore consent will be implied.

Where will the data be stored?

Password protected file stored within a networked computer.

How will the data be protected? (Please detail security measures to be taken)

Network only computer, password protection on file.

The data will be 'locked down' on the Government System (I can also advise that the research data is not downloaded to USB etc.)

If the data is on a computer is there access via a network?

Yes government system.

How long will the data be stored?

Data will be stored until results of dissertation are known.

At the end of this period, how will the data be disposed of?

File deletion from both folder and recycling.

Who will be responsible for ensuring that the data is disposed of in a confidential manner?

[redacted]

When the records are deleted [redacted] (Information Governance officer) will attend to witness and will providing a statement to the effect.

I confirm that the data will be held and used according to the condition and information given as described within this access request form.

Name..... [redacted] ..... Title [redacted] .....

Signature.....

Date.....07/09/2016.....

Please return form to:

Information Governance Team
Department of Health & Social Care
Chief Executive's Office,

3
n for projects signatory Caldicott Guardian

For Office Use Only

The release and use of data as described above: **Approved / Not Approved**

Caldicott Guardian signature .....  .....

Name .....[redacted].....

Date: .....13th Sept 2016.....

Appendix 3 - Ethics Agreement

Submission No 54 /2016 from LREC
to Department of Health and Social Care

LREC Project application

Applicant	Name	Gillian Horsey
	e-mail	jhmillstream@gmail.com
Title of Project		Investigate accuracy and impact of paramedic delivered FAST
Date considered by Committee		14 September 2016
Recommendation		approval
Conditions (if any)		
Comment		
Documents attached		Full application and extra document

Submitted by Derek M Legg, Secretary to LREC dated 14 September 2016

DHSC Decision

Approved

Comments: none

Signed: Date: 23 September 2016
Dr Malcolm Couch, Chief Executive Officer
Department of Health and Social Care

Appendix 4 - Raw Data

Patient Id	Age	FAST used?	FAST+ve	FAST-ve	Working Dx	Sex	In/Out of Hours
a001	57	y	y	n	fall	f	out
a002	85	y	n	y	unknown	f	out
a003	79	y	y	n	stroke	f	in
a004	64	y	n	y	collapse?cause	m	out
a005	76	y	n	y	fall	m	out
a006	35	y	n	y	seizure	m	out
a007	53	y	n	y	tia	f	out
a008	95	y	n	y	collapse?cause	m	out
a009	86	y	n	y	head injury	f	in
a010	41	y	n	y	stroke	f	out
a011	67	y	n	y	tia	m	out
a012	76	y	n	y	collapse ? Cause	m	out
a013	83	y	n	y	stroke	f	out
a014	53	y	y	n	collapse ? Cause	m	out
a015	45	y	n	y	dizzy	m	out
a016	85	y	n	y	fall	m	in
a017	52	y	y	n	stroke	m	out
a018	50	y	y	n	stroke	m	in
a019	85	y	y	n	hypoglycaemia	m	out
a020	91	y	n	y	collapse ? Cause	m	out
a021	67	y	n	y	fall	m	out
a022	86	y	n	y	generally unwell	f	out
a023	71	y	n	y	collapse ? Cause	m	out
a024	92	y	n	y	stroke	f	out
a025	93	y	n	y	#hip	f	out
a026	89	y	n	y	hyperglycaemia	f	in
a027	98	y	n	y	#nof	f	out
a028	47	y	n	y	headache	m	out
a029	76	y	n	y	anaemia	f	out
a030	67	y	y	n	stroke	m	in
a031	79	y	n	y	stroke	m	out
a032	87	y	n	y	back pain	m	out
a033	74	y	n	y	collapse ? Cause	m	on
a034	80	y	y	n	stroke	m	out
a035	70	y	n	y	collapse ? Cause	f	in
a036	58	y	n	y	fall	m	in
a037	80	y	n	y	fall	f	out
a038	75	y	n	y	ex parkinsons	m	in
a039	69	y	y	n	collapse	f	out
a040	100	y	n	y	dizzy	m	out
a041	85	y	n	y	chest infection	f	in

Patient Id	Age	FAST used?	FAST+ve	FAST-ve	Working Dx	Sex	In/Out of Hours
a042	93	y	n	y	stroke	f	out
a043	81	y	n	y	headache	m	in
a044	35	y	y	n	stroke	f	in
a045	31	y	y	n	stroke	f	in
a046	82	y	n	y	head pain	m	in
a047	82	y	y	n	stroke	f	in
a048	68	y	y	n	stroke	m	out
a049	53	y	n	y	?overdose	f	out
a050	40	y	y	n	stroke	f	out
a051	55	y	y	n	stroke	m	out
a052	74	y	n	y	af/dizzy	m	in
a053	84	y	n	y	#hip	m	out
a054	87	y	y	n	stroke	m	out
a055	63	y	y	n	stroke	m	in
a056	73	y	y	n	stroke	m	out
a057	96	y	y	n	stroke	f	out
a058	96	y	y	n	stroke	f	out
a059	81	y	n	y	dizzy	f	ou
a060	55	y	n	y	tia	m	out
a061	91	y	n	y	tia	f	in
a062	83	y	n	y	tia	f	out
a063	76	y	n	y	tia	m	out
a064	95	y	n	y	?UTI	f	out
a065	90	y	y	n	tia	f	out
a066	77	y	n	y	tia	m	out
a067	81	y	n	y	falls	f	out
a068	77	y	n	y	fall	f	in
a069	89	y	y	n	stroke	m	out
a070	71	y	n	y	stroke	f	out
a071	89	y	n	y	uti	m	in
a072	89	y	y	n	confused	f	out
a073	87	y	n	y	tia / confusion	m	
a074	92	y	y	n	tia	f	in
a075	87	y	n	y	tia	m	in
a076	92	y	n	y	reduced mobility	m	out
a077	65	y	n	y	unwell	m	in
a078	82	y	n	y	UTI	f	in
a079	71	y	n	y	seizure	f	out
a080	78	y	n	y	seizure	f	in
a081	88	y	y	n	stroke	f	out
a082	81	y	n	y	unwell	f	in
a083	92	y	n	y	uti	m	in
a084	93	y	y	n	stroke	m	in

Patient Id	Age	FAST used?	FAST+ve	FAST-ve	Working Dx	Sex	In/Out of Hours
a085	70	y	n	y	stroke	f	in
a086	68	y	y	n	seizure/stroke	f	in
a087	84	y	n	y	stroke	f	out
a088	52	y	n	y	depression	m	out
a089	65	y	n	y	unwell	f	out
a090	43	y	n	y	unwell	f	out
a091	55	y	n	y	collapse ? Cause	f	in
a092	90	y	n	y	fall	f	out
a093	56	y	n	y	fall	f	out
a094	71	y	y	n	infection	f	out
a095	87	y	n	y	mfall	f	out
a096	94	y	n	y	stroke	f	out
a097	68	y	n	y	stroke??	m	out
a098	79	y	n	y	tia	f	out
a099	72	y	y	n	stroke	m	out
a100	80	y	y	n	stroke	f	in
a101	48	y	y	n	stroke	f	out
a102	67	y	y	n	stroke	m	out
a103	86	y	n	y	stroke	m	in
a104	77	y	y	n	stroke	f	ou
a105	87	y	y	n	tia	m	out
a106	30	y	y	n	stroke/migraine	m	out
a107	19	y	y	n	stroke	m	in
a108	73	y	n	y	panic attack	m	out
a109	85	y	n	y	tia	f	in
a110	84	y	n	y	sepsis	f	out
a111	75	y	n	y	tia	f	in
a112	91	y	n	y	mechanical fall	m	in
a113	87	y	n	y	tia	f	out
a114	90	y	n	y	dizziness	f	in
a115	87	y	n	y	dizzy	f	out
a116	96	y	n	y	fall	f	in
a117	94	y	n	y	stroke	f	out
a118	53	y	n	y	collapse?cause	m	in
a119	57	y	n	y	faint	f	in
a120	52	y	n	y	chest pain	m	in
a121	95	y	n	y	mfall	f	in
a122	50	y	n	y	migraine	f	out
a123	86	y	n	y	stroke	f	out
a124	52	y	n	y	tia	f	in
a125	43	y	n	y	neck injury	f	in
a126	88	y	n	y	weakness	f	out
a127	89	y	y	n	collapse	m	in

Patient Id	Age	FAST used?	FAST+ve	FAST-ve	Working Dx	Sex	In/Out of Hours
a128	78	y	n	y	collapse	f	out
a129	55	y	n	y	collapse ? Cause	m	out
a130	89	y	y	n	confused	m	out
a131	90	y	y	n	dehydration	m	in
a132	75	y	n	y	head wound	m	out
a133	87	y	n	y	hyperglycaemia	f	in
a134	69	y	y	n	hypertension	f	out
a135	101	y	y	n	stroke	f	in
a136	98	y	y	n	stroke	f	in
a137	97	y	y	n	stroke	f	in
a138	91	y	y	n	stroke	f	in
a139	90	y	y	n	stroke	f	in
a140	89	y	y	n	stroke	f	in
a141	86	y	y	n	stroke	f	in
a142	86	y	y	n	stroke	f	in
a143	86	y	y	n	stroke	f	in
a144	85	y	y	n	stroke	f	in
a145	81	y	y	n	stroke	f	in
a146	81	y	y	n	stroke	f	in
a147	76	y	y	n	stroke	f	in
a148	76	y	y	n	stroke	f	in
a149	75	y	y	n	stroke	f	in
a150	75	y	y	n	stroke	f	in
a151	71	y	y	n	stroke	f	in
a152	68	y	y	n	stroke	f	in
a153	63	y	y	n	stroke	f	in
a154	56	y	y	n	stroke	f	in
a155	87	y	y	n	stroke	m	in
a156	78	y	y	n	stroke	m	in
a157	76	y	y	n	stroke	m	in
a158	76	y	y	n	stroke	m	in
a159	76	y	y	n	stroke	m	in
a160	75	y	y	n	stroke	m	in
a161	75	y	y	n	stroke	m	in
a162	74	y	y	n	stroke	m	in
a163	72	y	y	n	stroke	m	in
a164	69	y	y	n	stroke	m	in
a165	69	y	y	n	stroke	m	in
a166	68	y	y	n	stroke	m	in
a167	67	y	y	n	stroke	m	in
a168	66	y	y	n	stroke	m	in
a169	64	y	y	n	stroke	m	in
a170	74	y	y	n	stroke	m	ou

Patient Id	Age	FAST used?	FAST+ve	FAST-ve	Working Dx	Sex	In/Out of Hours
a171	78	y	y	n	stroke	f	our
a172	97	y	y	n	stroke	f	out
a173	93	y	y	n	stroke	f	out
a174	93	y	y	n	stroke	f	out
a175	89	y	y	n	stroke	f	out
a176	88	y	y	n	stroke	f	out
a177	87	y	y	n	stroke	f	out
a178	87	y	y	n	stroke	f	out
a179	86	y	y	n	stroke	f	out
a180	86	y	y	n	stroke	f	out
a181	83	y	y	n	stroke	f	out
a182	80	y	y	n	stroke	f	out
a183	77	y	y	n	stroke	f	out
a184	75	y	y	n	stroke	f	out
a185	74	y	y	n	stroke	f	out
a186	72	y	y	n	stroke	f	out
a187	70	y	y	n	stroke	f	out
a188	65	y	y	n	stroke	f	out
a189	58	y	y	n	stroke	f	out
a190	52	y	y	n	stroke	f	out
a191	94	y	y	n	stroke	m	out
a192	91	y	y	n	stroke	m	out
a193	87	y	y	n	stroke	m	out
a194	86	y	y	n	stroke	m	out
a195	84	y	y	n	stroke	m	out
a196	78	y	y	n	stroke	m	out
a197	76	y	y	n	stroke	m	out
a198	74	y	y	n	stroke	m	out
a199	73	y	y	n	stroke	m	out
a200	72	y	y	n	stroke	m	out
a201	72	y	y	n	stroke	m	out
a202	71	y	y	n	stroke	m	out
a203	71	y	y	n	stroke	m	out
a204	71	y	y	n	stroke	m	out
a205	70	y	y	n	stroke	m	out
a206	69	y	y	n	stroke	m	out
a207	68	y	y	n	stroke	m	out
a208	68	y	y	n	stroke	m	out
a209	67	y	y	n	stroke	m	out
a210	66	y	y	n	stroke	m	out
a211	62	y	y	n	stroke	m	out
a212	59	y	y	n	stroke	m	out
a213	58	y	y	n	stroke	m	out

Patient Id	Age	FAST used?	FAST+ve	FAST-ve	Working Dx	Sex	In/Out of Hours
a214	41	y	y	n	stroke	m	out
a215	100	y	n	y	stroke	f	in
a216	84	y	n	y	stroke	f	in
a217	81	y	n	y	stroke	f	in
a218	69	y	n	y	stroke	f	out
a219	77	y	n	y	stroke	m	out
a220	74	y	n	y	stroke	m	out
a221	74	y	n	y	stroke	m	out
a222	82	y	n	y	stroke signs	f	in
a223	81	y	y	n	tia	f	in
a224	66	y	y	n	tia	m	in
a225	87	y	y	n	tia	m	out
a226	82	y	y	n	tia	m	out
a227	81	y	n	y	tia	f	in
a228	87	y	n	y	tia	f	out
a229	93	y	n	y	tia	m	out
a230	74	y	n	y	tia	m	out
a231	74	y	n	y	tia	m	out
a232	71	y	n	y	tia	m	out
a233	87	y	y	n	tia/infection	f	in
a234	76	y	y	n	unwell	f	in
a235	86	y	y	n	stroke	f	out
a236	60	y	n	y	stroke	m	out
a237	78	y	y	n	stroke	m	out
a238	66	y	y	n	stroke	f	out
a239	60	y	n	y	leg pain	f	out
a240	91	y	n	y	unwell	f	in
a241	87	y	y	n	tia	f	in
a242	69	y	n	y	seizure	f	out
a243	18	y	n	y	seizure	m	out
a244	87	y	n	y	infection	f	out
a245	71	y	y	n	nil	f	out
a246	78	y	n	y	sepsis	m	out
a247	96	y	n	y	unwell	m	out
a248	91	y	n	y	unsteady	f	out
a249	66	y	n	y	dizziness	m	out
a250	87	y	n	y	seizure	m	in
a251	85	y	y	n	stroke	f	in
a252	50	y	y	n	stroke	m	out
a253	81	y	y	n	stroke	f	in
a254	67	y	n	y	tia	m	in
a255	88	y	n	y	unwell	f	out
a256	85	y	n	y	fall	f	our

Patient Id	Age	FAST used?	FAST+ve	FAST-ve	Working Dx	Sex	In/Out of Hours
a257	90	y	n	y	sepsis	f	in
a258	87	y	y	n	stroke	f	in
a259	83	y	y	n	stroke	m	out
a260	76	y	n	y	UTI	f	in
a261	96	y	n	y	UTI	m	out
a262	71	y	n	y	uti	m	out
a263	80	y	y	n	stroke	f	out
a264	45	y	n	y	faint	f	out
a265	86	y	n	y	faint	m	out
a266	72	y	n	y	unwell	m	in

Patient Id	Face	Arm	Speech	Vision	Coordination	GCS
a001	n	n	n	n	n	
a002	n	n	n	n	n	
a003	n	y	y	n	n	
a004	n	n	n	n	n	
a005	n	n	n	n	n	
a006	n	n	n	n	n	
a007	n	n	n	n	n	
a008	n	n	n	n	n	
a009	n	n	n	n	n	
a010	n	n	n	n	n	
a011	n	n	n	n	n	
a012	n	n	n	n	n	
a013	n	n	n	n	n	
a014	n	n	y	n	n	
a015	n	n	n	y	y	
a016	n	n	y	n	n	
a017	n	n	y	n	n	
a018	y	y	y	n	n	
a019	y	?	y	n	Y	
a020	n	n	n	n	n	
a021	n	n	n	n	n	
a022	n	n	n	n	n	
a023	n	n	n	n	n	
a024	n	n	n	n	n	
a025	n	n	n	n	n	
a026	n	n	n	n	n	
a027	n	n	n	n	n	
a028	n	n	n	n	n	
a029	n	n	n	n	n	
a030	n	n	n	n	n	
a031	n	n	n	n	n	
a032	n	n	n	n	n	
a033	n	n	n	n	n	
a034	n	y	n	n	n	
a035	n	n	n	n	n	
a036	n	n	n	n	n	
a037	n	n	n	n	n	
a038	n	n	n	n	n	
a039	n	n	n	n	n	
a040	n	n	n	n	n	
a041	n	n	n	n	n	
a042	n	n	n	n	n	
a043	n	n	n	n	n	
a044	y	n	n	n	n	

Patient Id	Face	Arm	Speech	Vision	Coordination	GCS
a045	y	y	y	n	n	
a046	n	n	n	n	n	
a047	n	n	n	n	n	
a048	y	n	y	n	n	
a049	n	n	n	n	n	
a050	n	n	y	n	n	
a051	n	y	n	n	n	
a052	n	n	n	n	n	
a053	n	n	n	n	n	
a054	n	y	n	n	n	
a055	n	y	n	n	y	
a056	n	n	n	n	n	
a057	y	y	y	n	n	
a058	n	n	n	n	n	
a059	n	n	n	n	n	
a060	n	n	n	n	n	
a061	n	n	n	n	n	
a062	n	n	n	n	n	
a063	n	n	n	n	y	
a064	n	n	n	n	n	
a065	n	n	y	n	n	
a066	n	n	n	n	n	
a067	n	n	n	n	n	
a068	n	n	n	n	n	
a069	n	n	y	n	n	
a070	n	n	n	n	n	
a071	n	n	n	n	n	
a072	n	n	n	n	n	
a073	?	?	?	?	?	
a074	n	n	n	n	n	
a075	n	n	n	n	n	
a076	n	n	n	n	n	
a077	n	n	n	n	n	
a078	n	n	n	n	n	
a079	n	n	n	n	n	
a080	n	n	n	n	n	
a081	n	n	n	n	n	
a082	n	n	n	n	n	
a083	n	n	n	n	n	
a084	n	n	y	n	n	
a085	n	n	n	n	n	
a086	n	n	n	n	n	
a087	n	n	n	n	n	
a088	n	n	n	n	n	

Patient Id	Face	Arm	Speech	Vision	Coordination	GCS
a089	n	n	n	n	n	
a090	n	n	n	n	n	
a091	n	n	n	n	n	
a092	n	n	n	n	n	
a093	n	n	n	n	n	
a094	n	n	n	n	n	
a095	n	n	n	n	n	
a096	n	n	n	n	n	
a097	n	n	y	n	n	
a098	n	n	n	n	n	
a099	n	n	n	n	n	
a100	n	n	n	n	n	
a101	n	y	y	n	n	
a102	n	n	n	n	n	
a103	n	n	n	n	n	E1V1M1
a104	n	n	n	n	n	E4V2M2
a105	n	n	n	n	n	
a106	n	n	n	n	n	
a107	n	n	n	n	n	
a108	n	n	n	n	n	
a109	n	n	n	n	n	
a110	n	n	n	n	n	
a111	n	n	n	n	n	E4V5M6
a112	n	n	n	n	n	
a113	n	n	n	n	n	
a114	n	n	n	n	y	
a115	n	n	n	n	n	
a116	n	n	n	n	n	
a117	n	n	y	n	n	
a118	n	n	n	n	n	e2m3v1
a119	n	n	n	n	n	
a120	n	n	n	n	n	
a121	n	n	n	n	n	
a122	n	n	n	n	n	
a123	n	n	n	n	n	
a124	n	n	n	n	n	
a125	n	n	n	n	n	
a126	n	n	n	n	n	
a127	y	y	y	n	n	
a128	n	n	n	n	n	E2V2M3
a129	y	n	y	n	n	
a130	n	n	y	n	n	
a131	n	n	y	n	n	
a132	n	n	n	n	n	

Patient Id	Face	Arm	Speech	Vision	Coordination	GCS
a133	n	n	y	n	n	
a134	n	n	n	n	n	
a135	y	y	y	uk	uk	
a136	n	y	n	n	n	
a137	y	y	n	n	n	
a138	y	y	y	n	n	
a139	n	n	n	n	n	e1v1m1
a140	y	y	y	y	y	
a141	y	y	y	n	n	E1V1M1
a142	y	y	y	n	n	
a143	y	y	n	y	n	
a144	n	y	y	n	n	
a145	n	n	n	n	n	E4V1M1
a146	y	y	y	n	n	
a147	n	y	n	n	n	
a148	n	y	y	n	n	
a149	y	y	y	y	y	
a150	n	y	y	n	n	
a151	y	y	y	n	n	
a152	y	y	n	n	n	
a153	n	n	y	y	y	E3V4M6
a154	n	n	y	n	n	
a155	y	y	y	n	n	
a156	y	y	y	n	n	E4V3M6
a157	y	y	y	y	y	E2V1M3
a158	n	y	n	n	n	
a159	y	y	n	n	n	
a160	n	y	y	n	y	
a161	n	n	y	n	n	
a162	y	y	y	n	n	
a163	y	y	y	n	n	
a164	y	y	y	n	n	
a165	y	y	y	n	n	
a166	y	n	y	n	n	
a167	y	y	y	y	y	
a168	y	y	n	n	n	
a169	n	n	y	n	n	
a170	n	y	n	n	n	
a171	y	y	y	n	n	
a172	y	y	n	n	n	
a173	y	y	y	n	n	
a174	y	n	y	n	n	
a175	y	n	n	n	n	
a176	y	y	y	n	n	

Patient Id	Face	Arm	Speech	Vision	Coordination	GCS
a177	y	n	n	n	n	
a178	n	y	n	n	n	
a179	y	y	y	n	n	
a180	y	y	y	n	n	
a181	y	y	n	n	y	
a182	y	y	y	y	y	
a183	n	y	y	n	n	
a184	n	y	n	n	n	
a185	y	y	n	n	n	
a186	y	y	y	n	n	
a187	y	y	y	uk	uk	E4V5M6
a188	y	n	y	n	n	
a189	n	n	y	n	n	
a190	y	y	y	y	n	
a191	y	y	y	n	n	
a192	y	y	n	n	n	
a193	y	y	y	n	n	
a194	y	y	y	uk	uk	E4V1M3
a195	n	y	n	n	y	
a196	y	n	n	n	n	
a197	y	n	y	n	y	
a198	y	y	y	n	n	
a199	n	n	n	y	n	
a200	y	y	y	n	n	
a201	y	y	n	n	n	
a202	y	y	y	n	n	E3V2M6
a203	y	y	y	n	n	
a204	y	y	y	n	n	
a205	y	y	y	y	y	
a206	y	y	n	n	n	
a207	n	n	y	n	n	
a208	n	y	n	n	n	
a209	n	n	n	n	n	E2V1M1
a210	n	y	y	n	n	
a211	y	y	n	n	n	
a212	y	y	n	n	n	
a213	y	n	y	n	y	
a214	y	y	y	y	y	
a215	n	n	n	y	n	
a216	n	n	y	n	y	
a217	y	y	y	y	y	E1V1M1
a218	y	y	y	n	n	
a219	y	y	y	n	n	
a220	y	n	y	n	n	

Patient Id	Face	Arm	Speech	Vision	Coordination	GCS
a221	n	y	n	n	n	
a222	y	n	n	n	n	
a223	y	y	n	n	n	
a224	y	y	n	n	n	
a225	y	y	y	n	n	
a226	y	y	y	n	n	
a227	y	n	n	n	n	
a228	y	y	y	n	n	
a229	y	y	y	y	y	
a230	n	n	n	n	n	
a231	n	n	y	n	n	
a232	n	y	y	n	n	
a233	n	y	n	n	n	
a234	y	y	y	n	n	
a235	y	y	y	y	n	E3V1M5
a236	y	y	y	n	n	
a237	y	y	y	n	n	
a238	y	y	n	n	n	
a239	n	n	n	n	n	
a240	n	n	n	n	n	
a241	n	n	n	n	n	E2V2M2
a242	n	n	n	n	n	
a243	n	n	n	n	n	
a244	n	n	n	n	n	
a245	n	n	y	n	n	
a246	n	n	n	n	n	
a247	n	n	n	n	n	
a248	n	n	n	y	n	
a249	y	n	n	n	n	
a250	n	n	n	n	n	
a251	n	n	n	n	n	E3V1M5
a252	n	y	n	n	n	
a253	n	n	n	n	n	
a254	n	n	n	n	n	
a255	n	n	n	n	n	
a256	n	n	n	n	n	
a257	n	n	n	n	n	
a258	n	n	y	n	n	
a259	y	n	y	n	n	
a260	n	n	n	n	n	
a261	n	n	n	n	n	
a262	n	n	n	n	n	
a263	y	n	n	n	n	
a264	n	n	n	n	n	

Patient Id	Face	Arm	Speech	Vision	Coordination	GCS
a265	n	n	n	n	n	
a266	n	y	n	n	y	

Patient Id	Dx at 4.5 hours	Treatment	Scan < 4.5 hours	Pathway	rtPA
a001	#elbow	#clinic	na	n	n
a002	back pain	AMU	na	n	n
a003	collapse	AMU, discharge	na	n	n
a004	ETOH	discharged	na	n	n
a005	ETOH	AMU	na	n	n
a006	ETOH	AMU	na	n	n
a007	ETOH	discharged	na	n	n
a008	fall	AMU	na	n	n
a009	head injury	dx	y	n	n
a010	headache	AMU	n	n	n
a011	headache	discharge	y	n	n
a012	heart failure/syncope	AMU	na	n	n
a013	hypertension	discharge	na	n	n
a014	hypoglycaemia	discharged	na	n	n
a015	labyrinthitus	discharge	na	n	n
a016	LRTI	AMU	na	n	n
a017	medication side effect	discharged	na	n	n
a018	mets/tumour	AMU	y	n	n
a019	movement issues	discharged	na	n	n
a020	postural hypotension	AMU	na	n	n
a021	ruptured spleen	surgeons	na	n	n
a022	sepsis	discharged	na	n	n
a023	sick sinus syndrome	AMU	na	n	n
a024	UTI	discharged	na	n	n
a025	#LNOF	ortho admission	na	n	n
a026	#nof	surgical admission	na	n	n
a027	#NOF / seizure	ITU	na	n	n
a028	ACS	AMU	na	n	n
a029	anaemia	AMU	na	n	n
a030	anxiety	discharge	na	n	n
a031	arrhythmia	CCU	na	n	n
a032	back pain	discharged	na	n	n
a033	bradycardia	ccu	na	n	n
a034	chest infection	AMU	na	n	n
a035	confusion?cause	AMU	na	n	n
a036	fall	discharged	na	n	n
a037	head injury	surgical admission	y	n	n
a038	headache	discharge	na	n	n
a039	hypoglycaemia	discharged	na	n	n
a040	hypotension	amu	na	n	n
a041	LRTI	AMU	na	n	n
a042	MI	AMU	na	n	n
a043	migraine	discharged	n	n	n
a044	migraine	AMU	y	n	n
a045	migraine	AMU	y	n	n

Patient Id	Dx at 4.5 hours	Treatment	Scan < 4.5 hours	Pathway	rtPA
a046	neck pain	discharged	na	n	n
a047	not stroke	discharged	na	n	n
a048	old stroke	discharged	n	n	n
a049	overdose	discharged	na	n	n
a050	overdose	AMU	na	n	n
a051	peripheral neurology	discharged	na	n	n
a052	postural dizziness	discharged	na	n	n
a053	postural hypotension	AMU	na	n	n
a054	seizure	AMU	na	n	n
a055	sepsis	AMU	y	n	n
a056	sepsis	AMU	na	n	n
a057	sepsis old stroke	AMU	na	n	n
a058	shoulder injury	discharged	na	n	n
a059	syncope	AMU	na	n	n
a060	unwell	discharged	na	n	n
a061	UTI	discharged	na	n	n
a062	UTI	AMU	na	n	n
a063	UTI	discharge	na	n	n
a064	vasovagal	discharged	na	n	n
a065	vasovagal	AMU	na	n	n
a066	vasovagal	stroke unit	na	y	n
a067	#NOF	AMU	na	n	n
a068	acopia	AMU	na	n	n
a069	ACS	AMU	na	n	n
a070	ACS	AMU	na	n	n
a071	ACS	CCU	na	n	n
a072	acute confusion	AMU	na	n	n
a073	acute confusion	AMU direc	na	n	n
a074	bowel obstruction		na	n	n
a075	bradycardia	CCU	na	n	n
a076	chest infection	ED	na	n	n
a077	chest infection	discharged	na	n	n
a078	chest infection	AMU	na	n	n
a079	collapse	discharge	na	n	n
a080	collapse?cause	AMU	na	n	n
a081	collapse?cause	AMU, #shoulder	n	n	n
a082	collapse?cause	AMU	na	n	n
a083	collapse?cause	AMU	na	n	n
a084	collaspse	discharge	na	n	n
a085	confusion	AMU	y	n	n
a086	dehydrated	AMU	na	n	n
a087	dehydration	AMU	na	n	n
a088	depression	discharge	na	n	n
a089	diarrhoea	surgical	na	n	n
a090	ETOH seizure	discharged	na	n	n

Patient Id	Dx at 4.5 hours	Treatment	Scan < 4.5 hours	Pathway	rtPA
a091	faint	AMU	na	n	n
a092	fall	surgical admission	na	n	n
a093	fall	AMU	na	n	n
a094	fall	discharged	na	n	n
a095	fall	discharged	na	n	n
a096	fall	AMU	na	n	n
a097	fall	AMU	na	n	n
a098	fall	AMU	na	n	n
a099	fast AF	discharged	na	n	n
a100	fentanyl OD	ITU	y	n	n
a101	functional weakness	AMU	y	n	n
a102	gastroenteritus	AMU	na	n	n
a103	gastroenteritus	AMU	y	n	n
a104	head injury	surgical	y	n	n
a105	heart block	CCU, PPM	na	n	n
a106	hemiplegic migraine	discharged	na	n	n
a107	hoax	discharged	na	n	n
a108	hypoglycaemia and CCF	dex, AMU	na	n	n
a109	hypotension	AMU	na	n	n
a110	hypothermia	ED	na	n	n
a111	Infect ex COPD	IVABs, AMU	na	n	n
a112	infection	AMU	na	n	n
a113	labrythnitus	discharge	na	n	n
a114	labyrhinthitus	discharged	na	n	n
a115	labyrinthitus	discharge	na	n	n
a116	mechanical fall	discharged	na	n	n
a117	medication side effect	AMU	na	n	n
a118	metabolic acidosis		y	n	n
a119	mets/tumour	AMU	y	n	n
a120	mfall	discharge	na	n	n
a121	mfall	discharged	y	n	n
a122	migraine	AMU	y	n	n
a123	migraine	AMU	y	n	n
a124	migraine	discharged	na	n	n
a125	neck injury	discharge	na	n	n
a126	nil	discharged	na	n	n
a127	stroke	stroke unit	y	y	n
a128	stroke	ITU	y	nb	n
a129	stroke	stroke unit	y	y	n
a130	stroke	stroke unit	n	y	n
a131	stroke	stroke unit	y	y	n
a132	stroke	ITU	y	y	n
a133	stroke	stroke unit	y	y	n
a134	stroke	AMU	n	y	n

Patient Id	Dx at 4.5 hours	Treatment	Scan < 4.5 hours	Pathway	rtPA
a135	stroke	stroke unit	n	y	n
a136	stroke	stroke unit	n	y	n
a137	stroke	stroke unit	y	y	n
a138	stroke	stroke unit	y	y	n
a139	stroke	AMU	y	n	n
a140	stroke	stroke unit	y	y	n
a141	stroke	stoke unit	y	y	n
a142	stroke	stroke unit	y	y	n
a143	stroke	stroke unit	y	y	n
a144	stroke	stroke unit	n	y	n
a145	stroke	stoke unit	y	y	n
a146	stroke	stroke unit	y	y	n
a147	stroke	stroke unit	y	y	n
a148	stroke	stroke unit	n	y	n
a149	stroke	stroke unit	y	y	n
a150	stroke	Stroke unit	y	y	n
a151	stroke	stroke unit	y	y	n
a152	stroke	stroke unit	y	y	n
a153	stroke	stroke unit	y	y	n
a154	stroke	AMU	y	y	n
a155	stroke	stroke unit	y	y	n
a156	stroke	stroke unit	y	y	n
a157	stroke	RIP, stroke unit	y	nb	n
a158	stroke	stroke unit	y	y	n
a159	stroke	stroke unit	y	y	n
a160	stroke	stroke unit	y	y	n
a161	stroke	stroke unit	y	y	n
a162	stroke	surgical admission	y	n	n
a163	stroke	stroke unit	y	y	n
a164	stroke	ITU	y	nb	n
a165	stroke	stroke unit	y	y	n
a166	stroke	Stroke unit	y	y	n
a167	stroke	stroke unit	y	y	n
a168	stroke	stroke unit	y	y	n
a169	stroke	stroke unit	y	y	n
a170	stroke	stroke unit	y	y	n
a171	stroke	stroke unit	y	y	n
a172	stroke	stroke unit	n	y	n
a173	stroke	stroke unit	y	y	n
a174	stroke	SP, stroke unit	y	y	n
a175	stroke	stroke unit	y	y	n
a176	stroke	stroke unit	y	y	n
a177	stroke	stroke unit	y	y	n
a178	stroke	stroke unit	y	y	n
a179	stroke	stroke unit	y	y	n

Patient Id	Dx at 4.5 hours	Treatment	Scan < 4.5 hours	Pathway	rtPA
a180	stroke	stroke unit	n	y	n
a181	stroke	stroke unit	n	y	n
a182	stroke	stroke unit	n	y	n
a183	stroke	SP, stroke unit	n	y	n
a184	stroke	stroke unit	y	y	n
a185	stroke	ED a/w stroke unit	y	y	n
a186	stroke	stroke unit	y	y	n
a187	stroke	SP, stroke unit	y	y	n
a188	stroke	stroke unit	y	y	n
a189	stroke	AMU	n	y	n
a190	stroke	ITU	y	nb	n
a191	stroke	stroke unit	n	y	n
a192	stroke	stroke unit	n	y	n
a193	stroke	stroke unit	n	y	n
a194	stroke	DNACPR, stroke unit	y	nb	n
a195	stroke	stroke unit	y	y	n
a196	stroke	AMU stroke unit full	y	y	n
a197	stroke	stroke unit	y	y	n
a198	stroke	RTPA	y	y	y
a199	stroke	stroke unit	y	y	n
a200	stroke	stroke unit	y	y	n
a201	stroke	stroke unit	n	y	n
a202	stroke	stroke unit	y	y	n
a203	stroke	stroke unit	y	y	n
a204	stroke	stroke unit	n	y	n
a205	stroke	stroke unit	y	y	n
a206	stroke	stroke unit	y	y	n
a207	stroke	ED / ASU	n	y	n
a208	stroke	stroke unit	y	y	n
a209	stroke	ITU	y	nb	n
a210	stroke	stroke unit	y	y	n
a211	stroke	stroke unit	y	y	n
a212	stroke	old stroke	n	y	n
a213	stroke	stroke unit	y	y	n
a214	stroke	ITU	y	y	n
a215	stroke	stroke unit	n	y	n
a216	stroke	stroke unit	n	y	n
a217	stroke	stroke unit	y	y	n
a218	stroke	AMU stroke unit full	no scan	y	n
a219	stroke	stroke unit	y	y	n
a220	stroke	stroke unit	y	y	n
a221	stroke	RTPA	y	y	y

Patient Id	Dx at 4.5 hours	Treatment	Scan < 4.5 hours	Pathway	rtPA
a222	stroke	stroke unit	n	y	n
a223	stroke	ED aw stroke bed	y	y	n
a224	stroke	stroke unit	y	y	n
a225	stroke	stroke unit	n	y	n
a226	stroke	stroke unit	y	y	n
a227	stroke	AMU	y	y	n
a228	stroke	stroke unit	n	y	n
a229	stroke	stroke unit	n	y	n
a230	stroke	stroke unit	y	y	n
a231	stroke	stroke unit	n	y	n
a232	stroke	stroke unit	y	y	n
a233	stroke	stroke unit	y	y	n
a234	stroke	ED	y	y	n
a235	stroke / heart block	CCU	y	nb	n
a236	stroke / HT	stroke unit	y	y	n
a237	stroke / slow AF	CCU	y	y	n
a238	stroke/ETOH	AMU	n	y	n
a239	OA	discharged	na	n	n
a240	opiod toxicity	ED	na	n	n
a241	pancreatitus	surgical	na	n	n
a242	seizure	AMU	na	n	n
a243	seizure	AMU	na	n	n
a244	sepsis	AMU	na	n	n
a245	sepsis	AMU	na	n	n
a246	sepsis	AMU	na	n	n
a247	sepsis	AMU	na	n	n
a248	subdural	trauma	y	n	n
a249	subdural haemorrhage	AMU	y	n	n
a250	syncope	ED	n	n	n
a251	unknown	AMU	y	n	n
a252	unknown	AMU	na	n	n
a253	unwell	AMU	na	n	n
a254	unwell	AMU	y	n	n
a255	unwell	ED	na	n	n
a256	UTI	discharged	na	n	n
a257	UTI	AMU	na	n	n
a258	UTI	discharged	na	n	n
a259	UTI	AMU	na	n	n
a260	UTI	surgical admission	na	n	n
a261	UTI	AMU	na	n	n
a262	UTI	AMU IVABS	na	n	n
a263	UTI / old stroke		y	y	n
a264	vasovagal	discharged	na	n	n
a265	vasovagal	AMU	na	n	n
a266	viral labyrinthintus	AMU	na	n	n

Patient Id	Previous Stroke	Relative/NOK present	Time to Second Screen (minutes)	Category
a001	n	n	13	1
a002	n	n	11	1
a003	n	n	8	1
a004	n	n	22	1
a005	n	n	33	1
a006	n	n	7	1
a007	n	n	22	1
a008	n	n	20	1
a009	n	n	5	1
a010	n	n	4	1
a011	n	n	31	1
a012	n	n	22	1
a013	n	n	16	1
a014	y	n	10	1
a015	n	n	44	1
a016	n	n	22	1
a017	n	n	13	1
a018	n	n	15	1
a019	y	n	12	1
a020	n	n	13	1
a021	n	n	3	1
a022	y	n	22	1
a023	n	n	31	1
a024	n	n	22	1
a025	n	uk	20	1
a026	n	uk	12	1
a027	n	uk	10	1
a028	n	uk	13	1
a029	n	uk	45	1
a030	n	uk	5	1
a031	n	uk	9	1
a032	n	uk	70	1
a033	n	uk	0	1
a034	n	uk	6	1
a035	n	uk	11	1
a036	n	uk	35	1
a037	n	uk	22	1
a038	n	uk	16	1
a039	n	uk	7	1
a040	n	uk	23	1
a041	y	uk	56	1
a042	n	uk	0	1
a043	n	uk	62	1

Patient Id	Previous Stroke	Relative/NOK present	Time to Second Screen (minutes)	Category
a044	n	uk	0	1
a045	n	uk	0	1
a046	n	uk	34	1
a047	n	uk	0	1
a048	y	uk	24	1
a049	n	uk	11	1
a050	n	uk	22	1
a051	n	uk	12	1
a052	n	uk	16	1
a053	y	uk	30	1
a054	y	uk	0	1
a055	n	uk	0	1
a056	n	uk	0	1
a057	y	uk	0	1
a058	n	uk	0	1
a059	n	uk	22	1
a060	n	uk	33	1
a061	n	uk	0	1
a062	n	uk	22	1
a063	y	uk	21	1
a064	n	uk	45	1
a065	n	uk	15	1
a066	y	uk	15	1
a067	y	y	23	1
a068	n	y	13	1
a069	n	y	5	1
a070	n	y	5	1
a071	n	y	11	1
a072	n	y	44	1
a073	n	y	12	1
a074	n	y	15	1
a075	n	y	17	1
a076	n	y	62	1
a077	n	y	15	1
a078	n	y	15	1
a079	n	y	5	1
a080	n	y	5	1
a081	n	y	8	1
a082	n	y	15	1
a083	n	y	15	1
a084	y	y	0	1
a085	y	y	0	1
a086	n	y	0	1
a087	n	y	0	1
a088	n	y	45	1

Patient Id	Previous Stroke	Relative/NOK present	Time to Second Screen (minutes)	Category
a089	n	y	17	1
a090	n	y	2	1
a091	n	y	17	1
a092	n	y	19	1
a093	n	y	11	1
a094	n	y	33	1
a095	y	y	50	1
a096	n	y	3	1
a097	y	y	23	1
a098	n	y	0	1
a099	n	y	0	1
a100	y	y	0	1
a101	n	y	3	1
a102	n	y	15	1
a103	n	y	0	1
a104	n	y	0	1
a105	n	y	11	1
a106	y	y	0	1
a107	n	y	23	1
a108	n	y	45	1
a109	n	y	15	1
a110	n	y	8	1
a111	n	y	17	1
a112	n	y	45	1
a113	n	y	55	1
a114	n	y	22	1
a115	n	y	44	1
a116	n	y	46	1
a117	n	y	11	1
a118	n	y	0	1
a119	n	y	14	1
a120	n	y	23	1
a121	n	y	50	1
a122	n	y	15	1
a123	n	y	3	1
a124	n	y	0	1
a125	n	y	34	1
a126	n	y	0	1
a127	n	uk	0	1
a128	n	y	0	1
a129	y	uk	31	1
a130	n	y	11	1
a131	n	y	13	1
a132	n	y	31	1
a133	n	y	0	1

Patient Id	Previous Stroke	Relative/NOK present	Time to Second Screen (minutes)	Category
a134	n	n	16	1
a135	n	y	0	1
a136	n	y	0	1
a137	n	y	0	1
a138	n	y	0	1
a139	n	y	0	1
a140	n	y	0	1
a141	n	y	0	1
a142	n	y	12	1
a143	n	y	0	1
a144	n	y	0	1
a145	n	y	0	1
a146	n	y	0	1
a147	n	y	0	1
a148	n	n	0	1
a149	n	n	0	1
a150	n	n	0	1
a151	n	uk	0	1
a152	n	n	0	1
a153	n	uk	0	1
a154	n	y	17	1
a155	n	y	0	1
a156	n	y	0	1
a157	n	y	0	1
a158	n	y	0	1
a159	n	y	0	1
a160	n	uk	1	1
a161	n	y	4	1
a162	n	y	0	1
a163	n	y	0	1
a164	n	y	0	1
a165	n	y	5	1
a166	n	y	0	1
a167	n	y	5	1
a168	n	y	0	1
a169	n	y	0	1
a170	n	y	14	1
a171	n	y	0	1
a172	n	y	2	1
a173	n	y	0	1
a174	n	y	11	1
a175	n	y	0	1
a176	n	y	4	1
a177	y	y	5	1
a178	n	y	6	1

Patient Id	Previous Stroke	Relative/NOK present	Time to Second Screen (minutes)	Category
a179	n	y	5	1
a180	n	y	0	1
a181	n	y	3	1
a182	n	y	32	1
a183	n	y	3	1
a184	n	n	0	1
a185	n	uk	22	1
a186	n	uk	10	1
a187	n	uk	11	1
a188	n	n	7	1
a189	n	n	11	1
a190	n	y	0	1
a191	n	y	12	1
a192	n	y	0	1
a193	n	y	12	1
a194	n	y	0	1
a195	y	y	11	1
a196	n	y	23	1
a197	n	y	0	1
a198	n	n	0	1
a199	n	y	0	1
a200	n	y	0	1
a201	n	y	0	1
a202	n	y	0	1
a203	n	y	23	1
a204	n	y	11	1
a205	n	y	10	1
a206	n	y	13	1
a207	n	y	5	1
a208	n	y	5	1
a209	n	y	0	1
a210	n	y	10	1
a211	n	y	0	1
a212	n	uk	15	1
a213	y	uk	15	1
a214	n	y	0	1
a215	n	n	0	1
a216	n	uk	0	1
a217	n	n	0	1
a218	n	uk	22	1
a219	n	y	17	1
a220	n	uk	23	1
a221	n	y	0	1
a222	n	y	0	1
a223	n	y	0	1

Patient Id	Previous Stroke	Relative/NOK present	Time to Second Screen (minutes)	Category
a224	n	y	0	1
a225	n	y	3	1
a226	n	y	5	1
a227	n	y	12	1
a228	n	y	12	1
a229	n	y	33	1
a230	n	y	45	1
a231	n	y	27	1
a232	n	y	10	1
a233	n	y	10	1
a234	n	y	0	1
a235	n	uk	0	1
a236	n	y	10	1
a237	n	y	0	1
a238	n	y	13	1
a239	n	y	46	1
a240	n	y	0	1
a241	n	y	0	1
a242	n	y	0	1
a243	n	y	2	1
a244	n	y	36	1
a245	n	y	55	1
a246	n	y	2	1
a247	n	y	0	1
a248	n	y	6	1
a249	n	y	9	1
a250	n	y	0	1
a251	n	y	0	1
a252	n	y	45	1
a253	n	y	0	1
a254	n	y	0	1
a255	n	y	10	1
a256	n	y	5	1
a257	n	y	16	1
a258	n	y	0	1
a259	n	y	21	1
a260	n	y	15	1
a261	n	y	16	1
a262	n	y	5	1
a263	y	y	20	1
a264	n	y	21	1
a265	n	y	22	1
a266	n	y	10	1

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