Newcastle University

ePrints

McClelland G, Rodgers H, Flynn D, Price C. A survey of UK paramedics' views about their stroke training, current practice and the identification of stroke mimics. *British Paramedic Journal* 2017, **2**(1), 4-15.

A survey of UK paramedics' views about their stroke training, current practice and the identification of stroke mimics

Graham McClelland*
Institute of Neuroscience (Stroke Research Group), Newcastle University;
North East Ambulance Service NHS Foundation Trust
Graham.mcclelland@neas.nhs.uk

Darren Flynn
Institute of Health and Society, Newcastle University
Darren.flynn@newcastle.ac.uk

Helen Rodgers
Institute of Neuroscience (Stroke Research Group), Newcastle University; Northumbria Healthcare NHS Foundation Trust
Helen.rodgers@newcastle.ac.uk

Christopher Price
Institute of Neuroscience (Stroke Research Group), Newcastle University; Northumbria Healthcare NHS Foundation Trust
C.I.M.Price@newcastle.ac.uk

Abstract

Aims – Paramedics play a crucial role in identifying patients with suspected stroke and transporting them to appropriate acute care. Between 25% and 50% of suspected stroke patients are later diagnosed with a condition other than stroke known as a 'stroke mimic'. If stroke mimics could be identified in the pre-hospital setting, unnecessary admissions to stroke units could potentially be avoided. This survey describes UK paramedics' stroke training and practice, their knowledge about stroke mimic conditions and their thoughts about pre-hospital identification of these patients.

Methods – An online survey invitation was circulated to members within the UK College of Paramedics and promoted through social media (8 September 2016 and 23 October 2016). Topics included: stroke training; assessment of patients with suspected stroke; local practice; and knowledge about and identification of stroke mimics.

Results – There were 271 responses. Blank responses (39) and non-paramedic (1) responses were removed, leaving 231 responses from paramedics which equates to 2% of College of Paramedics membership and 1% of Health and Care Professions Council registered paramedics. The majority of respondents (78%) thought that they would benefit from more training on pre-hospital stroke care. Narrative comments focused on a desire to improve the assessment of suspected stroke patients and increase respondents' knowledge about atypical stroke presentations and current stroke research. The Face Arm Speech Test was used by 97% of respondents to assess suspected stroke patients, although other tools such as Recognition of Stroke in the

* **Corresponding author:**
  Graham McClelland, Stroke Research Group, Newcastle University, 3–4 Claremont Terrace, Newcastle upon Tyne
  NE2 4AE, UK.

Emergency Room (17%) and Miami Emergency Neurological Deficit (11%) were also used. According to those responding, 50% of stroke patients were taken to emergency departments, 35% went straight to a stroke ward and 8% were taken directly to CT scan. Most respondents (65%) were aware of the term 'stroke mimic'. Two-thirds of respondents (65%) thought a tool that predicted the likelihood of a suspected stroke being a stroke mimic would be useful in pre-hospital care.

Conclusion – This study reports a survey of UK paramedics' views about the stroke care they provide. Conclusions are limited by the low number of responses. Assessment of suspected stroke patients was recognised as an important skill by paramedics and an area where many would like further training. Respondents' current practice varied in terms of the stroke assessment tools used and whether suspected stroke patients were taken to the emergency department or direct to a stroke ward. A stroke mimic identification tool would be useful if it allowed stroke mimic patients to be directed to appropriate care, but it would need to have a high level of specificity and not adversely impact on time to treatment for true stroke patients.

Keywords
pre-hospital emergency care; stroke; surveys and questionnaires

Introduction

There are around 150,000 new cases of stroke each year in the UK (The Stroke Association, 2016). Paramedics provide the first direct healthcare contact for 79% of stroke patients admitted to hospital (Price et al., 2013). Pre-hospital stroke recognition and care is vital to delivering hyper-acute stroke care and treatment which gives stroke patients the best outcomes (Audebert, Saver, Starkman, Lees, & Endres, 2013; Puolakka, Strbian, Harve, Kuisma, & Lindsberg, 2016; Sheppard et al., 2015).

Stroke is a time-critical emergency due to the narrow time window for the current mainstay of treatment, thrombolysis, which has a 4.5-hour limit after stroke onset (Intercollegiate Stroke Working Party, 2016: 40–43). The paramedics' role in delivering the highest quality care to stroke patients is rapid identification of the suspected stroke patient and transport to a hyper-acute stroke unit (HASU) without delay (Intercollegiate Stroke Working Party, 2016: 35).

National clinical guidelines recommend pre-hospital stroke identification using a validated assessment tool (Intercollegiate Stroke Working Party, 2016: 34–35). Patients suspected by a paramedic of having a stroke, but who do not trigger on the validated tool, should also be treated as having a stroke until the diagnosis can be excluded (Intercollegiate Stroke Working Party, 2016: 34–35). Paramedics have access to a wide range of stroke identification instruments with variable evidence for their clinical performance in terms of sensitivity and specificity. The stroke assessment tool most commonly used in UK pre-hospital care is the Face Arm Speech Test (FAST) (Harbison et al., 2003) which correctly identifies approximately 75% of stroke presentations. However, in order to be sensitive to different possible combinations of stroke symptoms across a broad range of patients, pre-hospital identification instruments tend to over-diagnose stroke (Rudd, Buck, Ford, & Price, 2016). Consequently, their specificity is relatively low.

Stroke mimic conditions, such as seizures, infections and migraine, account for 25%–50% of emergency admissions to HASUs (Gibson & Whiteley, 2013; Whiteley, Wardlaw, Dennis, & Sandercock, 2011). While many patients with stroke mimic conditions still require urgent medical care, their status as false positive cases of stroke can lead to unnecessary transportation to distant stroke centres and inefficient use of ambulance and stroke service resources, as well as incurring substantial inconvenience for patients and families.

Stroke care is changing, with fewer hospitals providing acute stroke services (Morris et al., 2014), which means that it is more important than ever that paramedics direct stroke patients to the appropriate hospital. In light of this there is a pressing need to understand paramedics' knowledge and views about stroke, and stroke mimic conditions, to inform future research and practice.

A previous US survey reported on basic pre-hospital stroke knowledge and treatment in the US (Crocco, Kothari, Sayre, & Liu, 1999), but this is not directly relevant to current UK practice due to healthcare system and temporal differences. The current survey describes UK paramedics' views about their stroke training and practice, their knowledge about stroke mimic conditions and their thoughts about pre-hospital identification of these patients.

Methods

An online survey design was used to generate descriptive data from an opportunistic sample of UK paramedics. The content reflected contemporary literature regarding identification and treatment of patients with suspected stroke in

the pre-hospital setting. To ensure clarity and relevance, the survey was pre-tested within the north-east region of England with paramedics from North East Ambulance Service NHS Foundation Trust (NEAS). The final version of the survey questions can be found in Supplementary 1.

Sample and recruitment

A web link to the survey was sent by e-mail to members of the College of Paramedics (CoP), along with promotion of the survey in the CoP newsletter (28 September 2016 and 17 October 2016). The survey was open for six weeks between 8 September 2016 and 23 October 2016. CoP members were targeted as they work in pre-hospital care across a range of settings and geographical locations in the UK. We also targeted non-CoP members by advertising the survey on social media (Twitter and Facebook). Two NHS ambulance trusts (East of England Ambulance Service NHS Trust (EEAST) and NEAS) also promoted the survey through internal communications.

In order to increase the survey response rate, incentives (£50 gift vouchers) were offered to a random selection of 10 CoP members who participated.

Data collection and analysis

The data were collected via the web-based service SurveyMonkey and were reported descriptively (frequencies and percentage frequencies). Free text comments were subjected to a functional content analysis to generate mutually exclusive categories.

Ethics

This survey was completed voluntarily by CoP members and did not include any sensitive topics. Ethics committee approval for the survey was not required based on the NHS Health Research Authority criteria.

Results

A total of 271 people started the survey. Of these, 39 responses were removed as they were blank and one was removed as the respondent was not a paramedic. The 231 respondents included are described in Table 1. The 12 respondents currently in non-paramedic roles include 10 qualified paramedics and two student paramedics. All participants included from this point will be referred to as paramedics. The included 231 paramedics equate to 2% of CoP members (College of Paramedics, 2016) and 1% of paramedics registered with the Health and Care Professions Council (HCPC) (HCPC, 2016).

Demographics

The characteristics of respondents included in the study are shown in Table 1.

Thirty-six respondents (16%) indicated that their main role did not involve working for an NHS ambulance trust.

These respondents were distributed across the UK and worked in roles including Helicopter Emergency Medical Services (HEMS), private ambulance services and universities.

Table 1. Characteristics of survey respondents included in the study.

Gender	N (%)
Male	165 (71)
Female	66 (29)
Age	
18–20	2 (1)
21–29	61 (27)
30–39	76 (33)
40–49	65 (28)
50–59	26 (11)
60+	1 (< 1)
Length of service in pre-hospital care (years)	
< 2	27 (12)
3–5	40 (17)
6–10	55 (24)
11–20	76 (33)
> 20	33 (14)
Current role	
Paramedic	134 (58)
Specialist paramedic	30 (13)
Advanced paramedic	15 (6)
Consultant paramedic	6 (3)
Other paramedic	34 (15)
Non-paramedic	12 (5)
Highest level of education relevant to role	
IHCD paramedic	53 (23)
FdSc	56 (24)
BSc	63 (27)
Postgraduate (PGCert, PGDip, Masters)	57 (25)
Doctorate	2 (1)
NHS ambulance employer	
East Midlands Ambulance Service NHS Trust (EMAS)	18 (9)
East of England Ambulance Service NHS Trust (EEAST)	38 (19)
London Ambulance Service NHS Trust (LAS)	8 (4)
National Ambulance Service (Ireland)	1 (< 1)
North East Ambulance Service NHS Foundation Trust (NEAS)	32 (16)
North West Ambulance Service NHS Trust (NWAS)	10 (5)
Northern Ireland Ambulance Service Health & Social Care Trust	6 (3)
Scottish Ambulance Service (SAS)	13 (7)
South Central Ambulance Service NHS Foundation Trust (SCAS)	7 (4)
South East Coast Ambulance Service NHS Foundation Trust (SECAMB)	18 (9)
South West Ambulance Service NHS Foundation Trust (SWAST)	15 (8)
Welsh Ambulance Service NHS Trust (WAST)	4 (2)
West Midlands Ambulance Service NHS Foundation Trust (WMAS)	13 (7)
Yorkshire Ambulance Service NHS Trust (YAS)	12 (6)

Stroke training and continuing professional development

Of the respondents, 83 (36%) rated their initial pre-registration stroke training as inadequate, 144 (62%) as adequate and four (2%) rated it as excessive.

One hundred and eighty-two (82% from 223 answers) respondents indicated they would like more training on pre-hospital stroke care, 26 (12%) thought they did not need more training and 15 (7%) were unsure. When asked whether paramedics as a group needed more stroke training, 174 (78% from 223 answers) replied yes, 26 (12%) replied no and 23 (10%) were unsure.

One hundred and twenty-eight (55%) respondents supplied comments when asked about what type of stroke training they would like to receive in the future. The main themes within the responses were improved assessment of suspected stroke patients, delivery of training by experts who can expand on later stages of acute stroke care, updates on pre-hospital stroke research and recognition of patients with atypical strokes such as FAST-ve and posterior circulation stroke.

One hundred and forty-three (64% from 223 answers) respondents indicated they had completed some stroke continuing professional development (CPD) since qualifying (Figure 1). The majority of the 'other' CPD related to research study-based training. The median stroke-related CPD completed in the previous 12 months was three hours (IQR 1–7).

Stroke assessment tools

The tools used to assess patients with suspected stroke are displayed in Figure 2. Most (n = 209/216, 97%) respondents indicated they used FAST. Other stroke assessment tools were used infrequently (Cincinnati Pre-hospital Stroke Scale (CPSS) (Kothari, Pancioli, Liu, Brott, & Broderick, 1999), Los Angeles Pre-hospital Stroke Screen (LAPSS) (Kidwell, Saver, Schubert, Eckstein, & Starkman, 1998), Melbourne Ambulance Stroke Screen (MASS) (Bray et al., 2005), Miami Emergency Neurological Deficit (MEND) (Brotons et al., 2012), National Institutes of Health Stroke Scale (NIHSS) (Brott et al., 1989) and Recognition of Stroke in the Emergency Room (ROSIER) (Fothergill, Williams, Edwards, Russell, & Gompertz, 2013)) or not at all (Los Angeles Motor Scale (LAMS) (Llanes et al., 2004) and Rapid Arterial oCclusion Evaluation (RACE) (Pérez de la Ossa et al., 2014)).

Stroke compared to other time-critical conditions

Three questions compared stroke with other time-critical conditions (sepsis, ST segment elevation myocardial infarction (STEMI) and major trauma), with answers in the form of 5-point Likert scales. Answers were scored with 1 being the least confident/influence/change and 5 being the most. Responses to these three questions have been ordered using weighted averages.
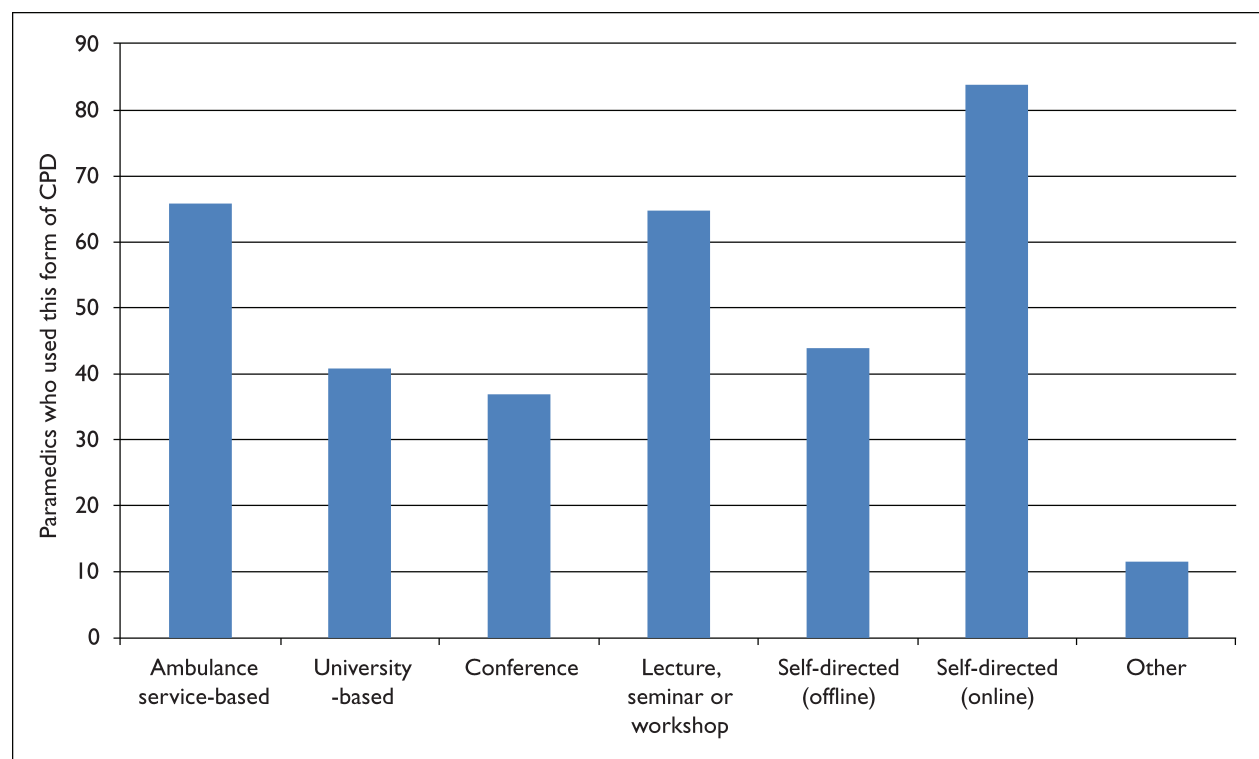
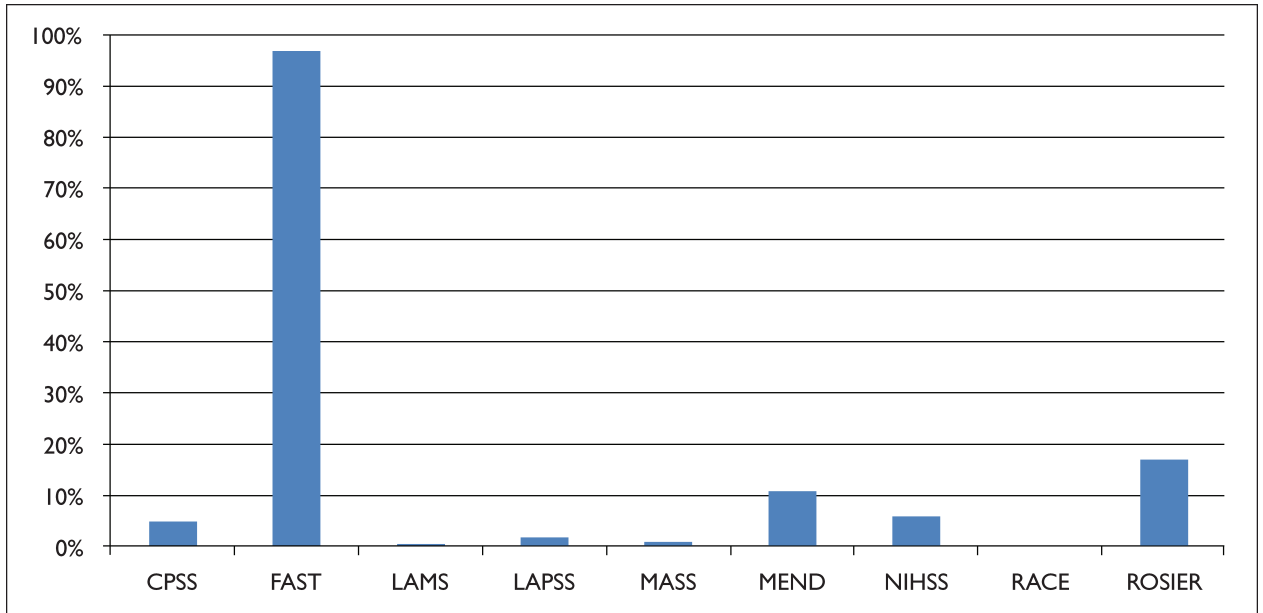**Figure 1.** Paramedics' stroke continuing professional development source.

Figure 2. Stroke assessment tools used by paramedics.

Response ■ Very little confidence ■ Little confidence ■ Neutral ■ Confident ■ Very confident
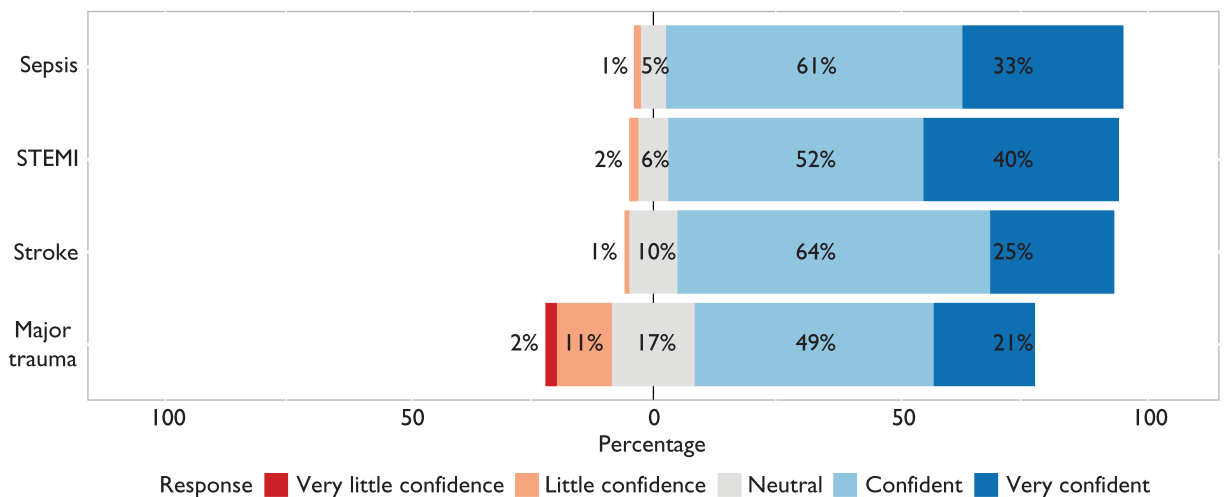
Figure 3. How respondents rated their confidence dealing with time-critical conditions.

Compared with stroke, respondents were asked to rate how confident they felt dealing with patients with the other time-critical conditions. In ascending order of confidence, the average responses were: major trauma (3.74), stroke (4.14), sepsis (4.25) and STEMI (4.30) (see Figure 3).

Respondents were asked to what extent they thought pre-hospital actions influenced patient outcomes for the conditions. In ascending order of influence, the average responses were: stroke (4.37), sepsis (4.49), major trauma (4.69) and STEMI (4.81) (see Figure 4).

Respondents were asked how they thought pre-hospital care for the conditions had changed over their careers. In ascending order of improvement, the average responses

were: stroke (3.97), STEMI (4.43), major trauma (4.47) and sepsis (4.60) (see Figure 5).

Stroke transport

The responses to where most stroke patients were conveyed in their region are shown in Figure 6. Emergency departments were the most common destination for suspected stroke patients.

Of the respondents, 59 (29% of 213 answers) reported their destination could change depending on the time or day of the week.

Sixteen (8%) respondents reported access to telemedicine for stroke patients. Those who expanded upon this
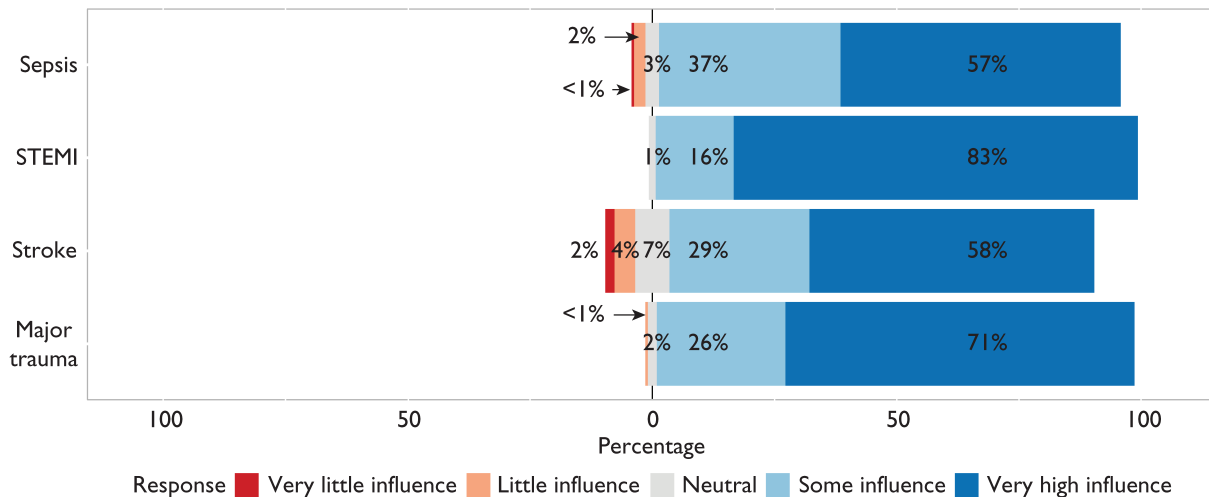
Figure 4. Respondents were asked to what extent they thought that pre-hospital actions influence patient outcome.
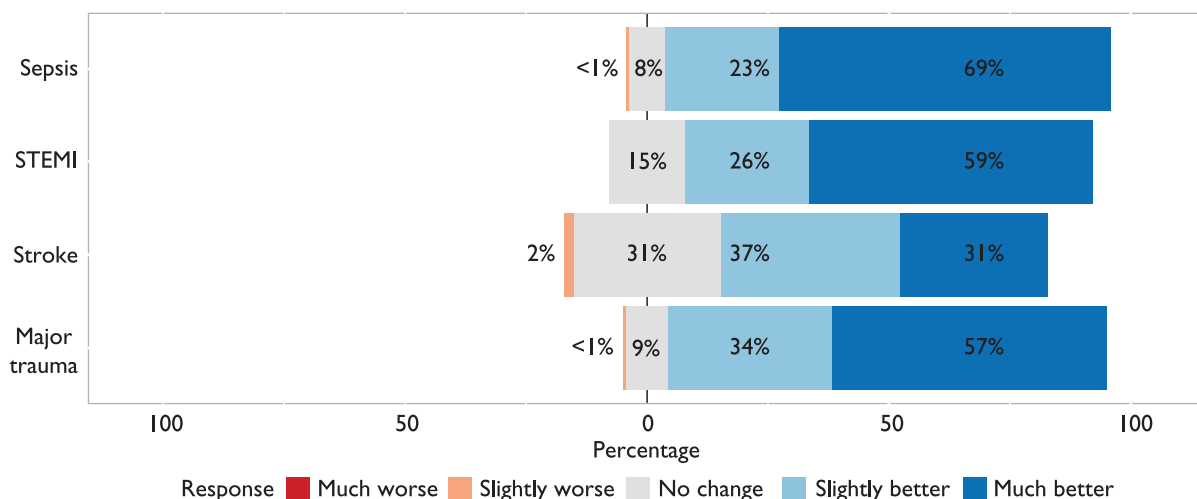

Figure 5. Respondents were asked how they thought pre-hospital care has changed over the course of their career.

answer defined their access as being able to telephone either stroke teams at hospital or senior paramedics for advice.

The majority (n = 197, 92%) of respondents thought that feedback on suspected stroke patients would be useful, but most (n = 158, 74%) reported that they did not receive any. Forty-nine (23%) respondents indicated they received informal feedback. Only six (3%) reported they received feedback in a formal manner.

One hundred and forty-four (68%) respondents routinely performed an ECG on suspected stroke patients, 16 (8%) reported only if the patient had chest pain and 53 (25%) reported that they would not routinely perform an ECG.

Transient ischemic attacks

When asked whether they had transient ischemic attacks (TIA) referral pathways in their region, 94 (45% from 208

respondents) said yes. Fifty-two (25%) had access to TIA clinics in their region. Fifty-eight (28%) reported providing aspirin, and six (3%) used other antiplatelet agents to treat patients with suspected TIA. Ninety-eight (47%) respondents reported using the ABCD2 (Johnston et al., 2007) score for TIA risk stratification. ABCD2 was the only TIA risk tool used.

Stroke general questions

Respondents were asked about the current timeframe for thrombolysis in stroke patients, which is a maximum of 4.5 hours. Twelve (6%) thought < 2.5 hours, 28 (13%) < 3.5 hours, 126 (61%) < 4.5 hours and 42 (20%) < 5.5 hours. One hundred and six (51%) respondents indicated they had heard of intra-arterial thrombectomy. Respondents thought stroke accounted for 5% (IQR 3–10) of their workload.
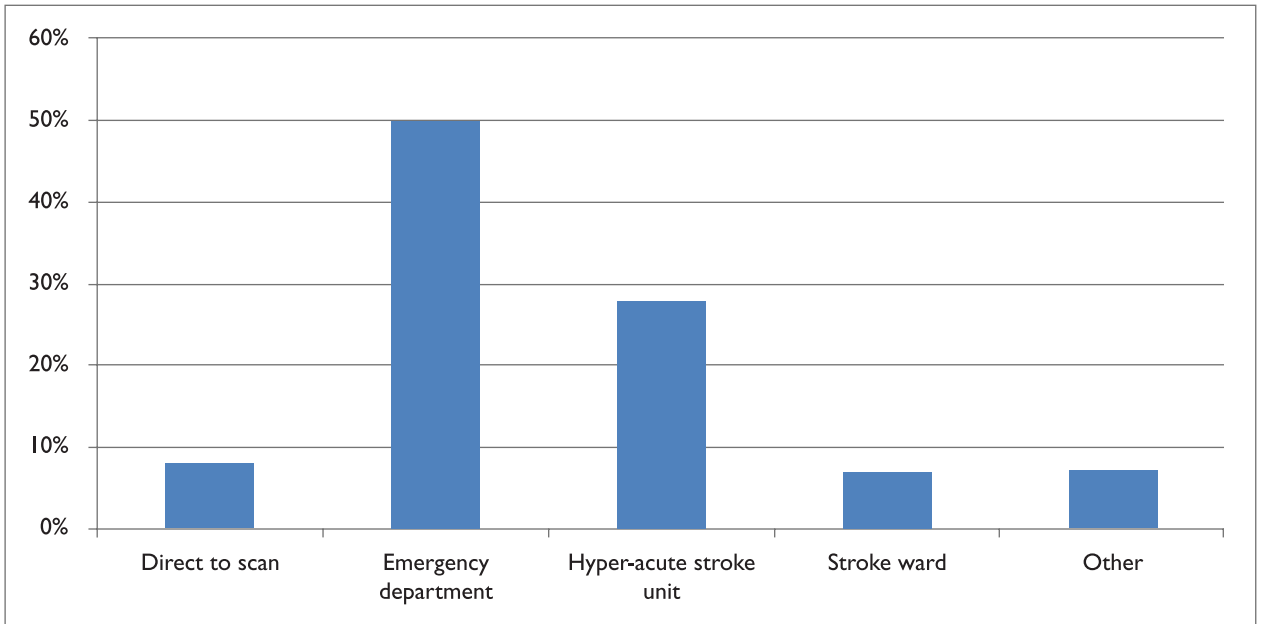
Figure 6. Stroke patient destinations.

Forty-three individuals (20%) reported being involved in the following pre-hospital stroke studies: Rapid Intervention with Glyceryl Trinitrate in Hypertensive Stroke Trial 2 (RIGHT2) (Bath, 2015) (n = 30, 70%), Paramedic Acute Stroke Treatment Assessment (PASTA) (PASTA, 2016) (n = 11, 26%), Transient Ischaemic Attack 999 Emergency Referral (TIER) (TIER, 2016) (n = 3, 7%) and others (n = 5, 12%).

At the end of the survey, respondents were given the chance to comment on any aspect of pre-hospital stroke care. The main themes that emerged from 46 respondents' comments were a desire to improve the care they provided, concern over geographical variability and recognition of the time-critical nature of pre-hospital stroke care.

Stroke mimics

The majority (n = 138, 65%) had heard of the term 'stroke mimics'. Overall, 183 (86%) identified the correct definition which we stated as: *Where a patient appears to be having a stroke but their symptoms are due to a different condition*.

Respondents tended to give a conservative estimate of the proportion of suspected stroke patients admitted to hospital by ambulance that were later given a stroke mimic diagnosis (Figure 7).

Respondents were asked which three conditions, out of 10 suggestions, were the most common pre-hospital stroke mimics (Figure 8). The most common responses were migraine and metabolic disorders.
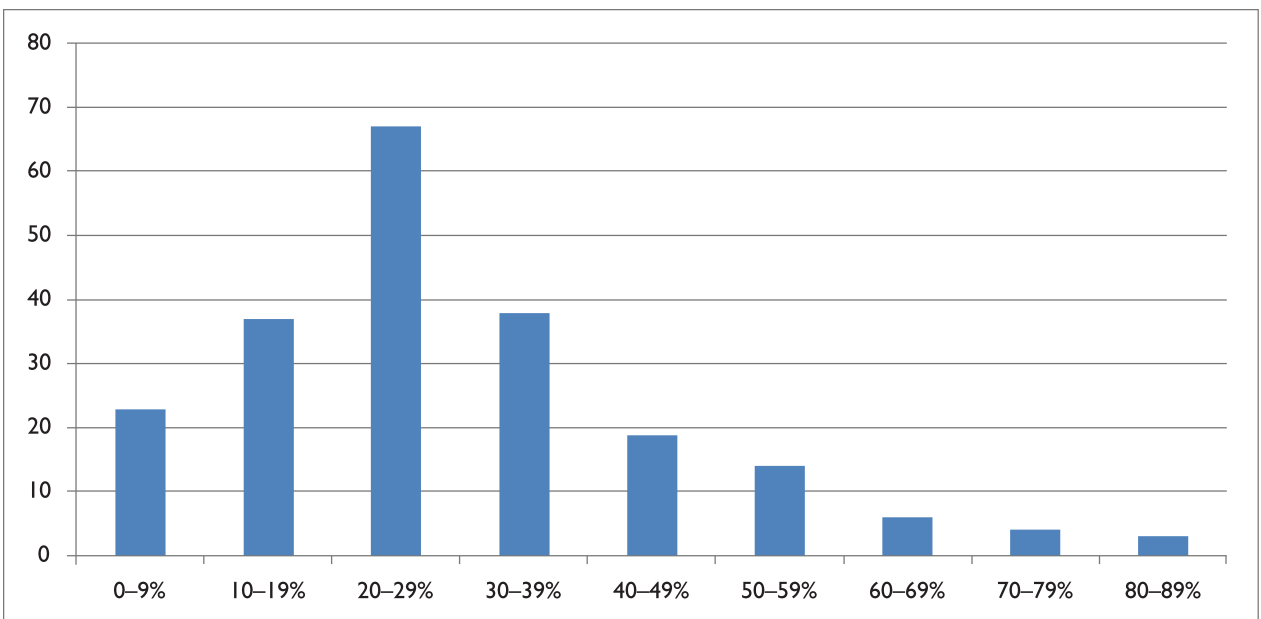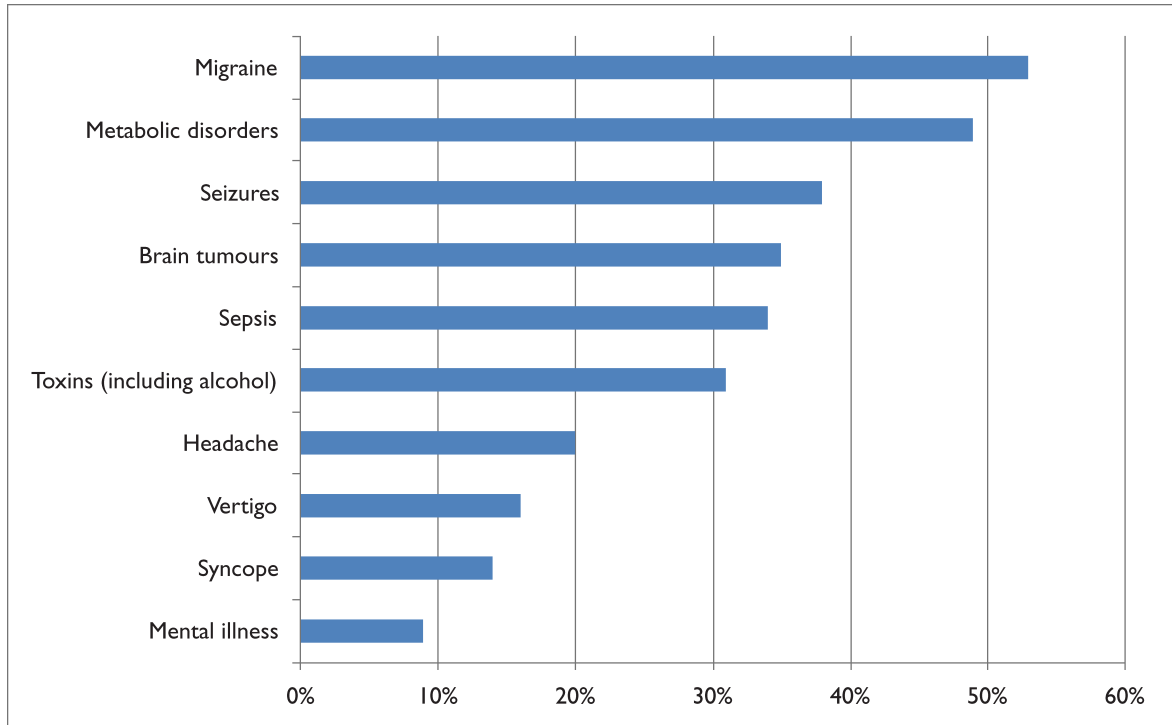

Figure 7. Paramedics' estimates of the proportion of pre-hospital suspected stroke patients with a stroke mimic diagnosis.

Figure 8. Conditions paramedics thought were the three most common pre-hospital stroke mimics.

Respondents were asked if they thought a score to calculate the probability of a stroke mimic causing suspected stroke symptoms would be useful in pre-hospital care. Of the respondents, 137 (65% from 211 answers) thought that this would be useful, 30 (14%) thought it would not be useful and 44 (21%) were unsure. If a score was developed, the majority (n = 154, 73%) preferred an electronic tool which could be built into an existing electronic patient record system as opposed to a stand-alone application.

We asked how acceptable it would be for paramedics to treat a suspected stroke (FAST+ve) patient differently, based on a test indicating a high probability that the patient's symptoms were due to a stroke mimic condition, for example transport to the emergency department (ED) as opposed to a HASU: 24% thought that this was unacceptable, 27% (n = 57) were neutral and 49% thought this was acceptable.

Figure 9 shows that most respondents would need to be 90%–99% certain that a patient was a stroke mimic in order to deviate from their normal stroke protocol.

Respondents were asked for comments about pre-hospital identification and treatment of stroke mimics.
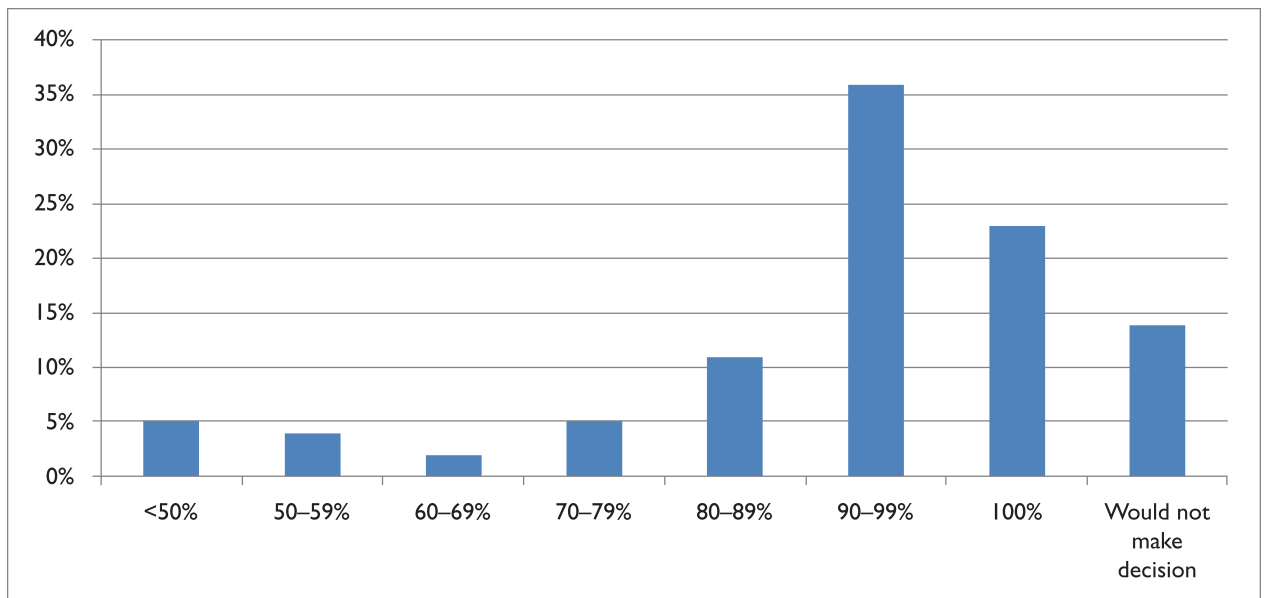
Figure 9. Certainty in stroke mimic diagnosis needed by paramedics to deviate from normal stroke protocol.

The main themes were the potential risks for both patients and the staff making the stroke mimic diagnosis, and the need for organisational support if this type of decision was to be made.

Discussion

The results of this survey have provided a snapshot of paramedics' views about pre-hospital stroke care and stroke mimics. This is the first time a UK national survey of this type has been reported.

Pre-hospital workforce

Data were collected from paramedics with a range of roles, lengths of service, training and geographical locations in the UK. The respondents' demographics were similar to the HCPC register data, although the current sample was slightly younger. There were large numbers of respondents from two NHS ambulance trusts (EEAST and NEAS), which may have influenced the results based on their local practices. Half of respondents had qualified through a university. Based on these findings, and the low response rate, it is impossible to claim these results are representative of all paramedics and findings and conclusions should be interpreted accordingly.

Stroke training and continuing professional development

Although a small percentage (11%) had completed no stroke-related CPD in the past year, the majority of respondents were in favour of more stroke-related training. Stroke could be added to mandatory paramedic refresher training but it would have to compete with multiple other training needs for the limited time available. Online learning was frequently used and has benefits for a geographically dispersed workforce such as paramedics. Providing opportunities for paramedics to undertake CPD which focuses on identified areas of interest such as assessment of suspected stroke patients and atypical strokes, or uses multidisciplinary teams to deliver training, could encourage people to complete more stroke-related training. Courses delivering this type of content report positive feedback (Haran, Bhalla, Cluckie, & Birns, 2016).

Stroke assessment, treatment and transport

FAST was the most commonly used stroke assessment tool and continues to be supported by national recommendations (Intercollegiate Stroke Working Party, 2016: 34). A recent review (Rudd et al., 2016) reported that FAST is supported by the most clinical evidence and has the best balance of characteristics, in terms of sensitivity and simplicity, for NHS stroke services. Despite being developed for ED use, and a clinical trial showing no additional value (Fothergill et al., 2013), ROSIER was the second most frequently used stroke assessment tool. MEND (Brotons et al., 2012) was the third most frequently used assessment, due to high reporting from one locality (SWAST).

For suspected stroke patients transported to hospital there are differences in pathways across the UK which are further complicated by variations based upon day and/or time. In addition there is variation in the destination within the hospital.

There is little evidence that any standard pre-hospital interventions, beyond identification and rapid transport with pre-alert, positively affect stroke patient outcomes (Fassbender et al., 2013; Puolakka et al., 2016). Even standard observations such as routine ECGs, which 68% of respondents reported routinely performing on all stroke patients, have been questioned as they may delay transport (Munro, Cooke, Kiln-Barfoot, & Quinn, 2015).

Most respondents received no feedback on stroke patients, but the majority would like feedback. Feedback on diagnosis would aid paramedics in reflecting on their decision making and actions. Feedback to paramedics about stroke patients has been shown to be beneficial (Choi et al., 2014; Pollard & Black, 2015) in terms of promoting reflection and improving practice.

Stroke compared to other time-critical conditions

When stroke was compared with a selection of other time-critical conditions, people felt more confident dealing with sepsis or STEMI than stroke, and less confident dealing with major trauma. This may be due to low exposure to major trauma compared to the other conditions.

Of the four conditions included in the study, respondents thought that pre-hospital stroke care had the least influence on outcome, and had improved the least over their careers. The recent interest in sepsis, developments in regional trauma and STEMI care and the ability of paramedics to provide interventions perceived as beneficial in trauma, sepsis and STEMI may all contribute to the lack of perceived pre-hospital development of, and influence on patient outcomes within stroke care.

Transient ischemic attacks

The latest stroke guidelines (Intercollegiate Stroke Working Party, 2016: 15) recommend giving aspirin to patients with suspected TIAs and referral to a specialist clinic within 24 hours irrespective of risk stratification. Nearly half of respondents reported access to TIA referral pathways. Only a quarter of respondents reported access to TIA clinics. From the results of this survey it is clear that practice would need to change in large parts of the country if ambulance services are to treat TIAs as recommended in these guidelines.

Research and developing treatments

Stroke consistently appears in priority-setting exercises for pre-hospital research (Evans et al., 2009; National Ambulance Service Medical Directors, 2014: 3). Previous research has shown that paramedics are keen to be involved in stroke-related studies (Ankolekar, Parry, Sprigg, Siriwardena, & Bath, 2014). Despite the fact that there are large pre-hospital stroke studies currently recruiting (PASTA, RIGHT2), only 20% of respondents reported involvement in pre-hospital stroke research. This could be due to lack of opportunity, lack of desire to participate, lack of incentives, the perception of research being an additional responsibility or other factors (Burges Watson et al., 2012).

Just over half (51%) of respondents were aware of intra-arterial thrombectomy. This is an emerging treatment for large vessel occlusion strokes (Flynn, Ford, McMeekin, & White, 2016; Goyal et al., 2016). Pre-hospital input will be important, in terms of patient identification and bypass to specialist centres, for this treatment (Pérez de la Ossa, Ribó, Jiménez, & Abilleira, 2016).

Stroke mimics

As stroke services start to centralise, similar to STEMI care and regional trauma centres, awareness of, and potential paramedic identification of stroke mimics becomes more relevant due to the importance of pre-hospital redirection. A third of respondents had not heard of stroke mimics, which highlights a potential need for further education.

A review by Gibson and Whiteley (2013) reported that 26% of patients with suspected stroke are stroke mimics. The most frequently reported stroke mimic diagnoses were seizure, syncope, sepsis, migraine and brain tumours (Gibson & Whiteley, 2013). Data from our survey show that most people's perception of the frequency of stroke mimics was correct and that respondents were aware of the common stroke mimics.

Two thirds of respondents thought a stroke mimic prediction tool could be useful, but when asked about how acceptable this would be in practice respondents were less sure. If a tool was to be used in practice then it would need to instil a high degree of confidence in the results – that is, have high specificity. Narrative data around stroke mimic identification show concern over the risks to patients and the possible consequences for staff making clinical decisions based upon a stroke mimic tool.

The findings of this survey will be used to inform work the authors are currently undertaking around pre-hospital identification of stroke mimics.

Limitations

Despite communications from the CoP, regular promotion through social media and the incentive of a prize draw, the number of completed surveys was low. Due to the diverse paramedic population it is impossible to calculate an exact response rate, which is a potential source of bias in this study. It is difficult to judge the representativeness of the sample due to the lack of national paramedic demographic data but the survey does include responses from the majority of trusts, roles and locations where paramedics work. Two trusts are disproportionately represented in the study, which may bias the results based on their local practices. The proportion of respondents with postgraduate qualifications may not be representative of the wider population of paramedics. This study relies on voluntary participation, self-reported data and respondents' perceptions, which all have inherent limitations.

Conclusion

This study reports a survey of UK paramedics' views about the stroke care that they provide. Conclusions are limited by the low number of responses. Assessment of suspected stroke patients is recognised as an important skill by paramedics and an area where many would like further training. Respondents' current practice varied in terms of the stroke assessment tools used and where suspected stroke patients were admitted. A stroke mimic identification tool would be useful if it allowed stroke mimic patients to be directed to appropriate care, but it would need to have a high level of specificity and not adversely impact on time to treatment for true stroke patients.

Acknowledgements

Conflict of interest

Graham McClelland is on the editorial board of the *British Paramedic Journal*. No conflicts of interest are declared for other authors.

Funding

References

Ankolekar, S., Parry, R., Sprigg, N., Siriwardena, A. N., & Bath, P. M. (2014). Views of paramedics on their role in an out-of-hospital ambulance-based trial in ultra-acute stroke: Qualitative data from the Rapid Intervention with Glyceryl Trinitrate in Hypertensive Stroke Trial (RIGHT). *Annals of Emergency Medicine, 64*, 640–648.

Audebert, H. J., Saver, J. L., Starkman, S., Lees, K. R., & Endres, M. (2013). Prehospital stroke care: New prospects for treatment and clinical research. *Neurology, 81*, 501–508.

Bath, P. (2015). Rapid Intervention with Glyceryl Trinitrate in Hypertensive Stroke Trial 2: RIGHT-2. Information for paramedics and medical staff. Retrieved from

http://right-2.ac.uk/ (accessed 21 November 2016).

Bray, J. E., Martin, J., Cooper, G., Barger, B., Bernard, S., & Bladin, C. (2005). Paramedic identification of stroke: Community validation of the Melbourne ambulance stroke screen. *Cerebrovascular Diseases, 20*, 28–33.

Brotons, A. A., Motola, I., Rivera, H. F., Soto, R. E., Schwemmer, S., & Issenberg, B. (2012). Abstract 3468: Correlation of the Miami Emergency Neurologic Deficit (MEND) exam performed in the field by paramedics with an abnormal NIHSS and final diagnosis of stroke for patients airlifted from the scene. *Stroke, 43*, S1, A3468.

Brott, T., Adams, H. P. Jr., Olinger, C. P., Marler, J. R., Barsan, W. G., Biller, J., … Walker, M. (1989). Measurements of acute cerebral infarction: A clinical examination scale. *Stroke, 20*, 864–870.

Burges Watson, D. L., Sanoff, R., Mackintosh, J. E., Saver, J. L., Ford, G. A., Price, C., … Murtagh, M. J. (2012). Evidence from the scene: Paramedic perspectives on involvement in out-of-hospital research. *Annals of Emergency Medicine, 60*, 641–650.

Choi, B., Tsai, D., McGillivray, C. G., Amedee, C., Sarafin, J., & Silver, B. (2014). Hospital-directed feedback to emergency medical services improves prehospital performance. *Stroke, 45*, 2137–2140.

College of Paramedics. (2016). College of Paramedics: News. College membership reaches 10,000 members. Retrieved from https://www.collegeofparamedics.co.uk/news/college-membership-reaches-10000-members (accessed 7 November 2016).

Crocco, T. J., Kothari, R. U., Sayre, M. R., & Liu, T. (1999). A nationwide prehospital stroke survey. *Prehospital Emergency Care, 3*, 201–206.

Evans, A., Snooks, H., Wells, B., Thomas, M., Peconi, J., Turner, J., & Woollard, M. (2009). What are the highest priorities for research in pre-hospital care? Results of a review and consultation exercise. *Emergency Medicine Journal, 26*, 1.

Fassbender, K., Balucani, C., Walter, S., Levine, S. R., Haass, A., & Grotta, J. (2013). Streamlining of prehospital stroke management: The golden hour. *Lancet Neurology, 12*, 585–596.

Flynn, D., Ford, G. A., McMeekin, P. J., & White, P. (2016). Characteristics of intra-arterial thrombectomy service provision in England. *International Journal of Stroke, 11*, NP83–NP85.

Fothergill, R. T., Williams, J., Edwards, M. J., Russell, I. T., & Gompertz, P. (2013). Does use of the recognition of stroke in the emergency room stroke assessment tool enhance stroke recognition by ambulance clinicians? *Stroke, 44*, 3007–3012.

Gibson, L. M., & Whiteley, W. (2013). The differential diagnosis of suspected stroke: A systematic review. *Journal of the Royal College of Physicians of Edinburgh, 43*, 114–118.

Goyal, M., Menon, B. K., Van Zwam, W. H., Dippel, D. W. J., Mitchell, P. J., Demchuk, A. M., … Jovin, T. G. (2016). Endovascular thrombectomy after large-vessel ischaemic stroke: A meta-analysis of individual patient data from five randomised trials. *Lancet, 387*, 1723–1731.

Haran, H., Bhalla, A., Cluckie, G., & Birns, J. (2016). Hyperacute stroke unit training for paramedics. *Journal of Paramedic Practice, 8*, 494–498.

Harbison, J., Hossain, O., Jenkinson, D., Davis, J., Louw, S. J., & Ford, G. A. (2003). Diagnostic accuracy of stroke referrals from primary care, emergency room physicians, and ambulance staff using the face arm speech test. *Stroke, 34*, 71–76.

HCPC. (2016). About regulation: Professions: Paramedics. Retrieved from http://www.hcpc-uk.co.uk/aboutregistration/professions/index.asp?id=10 (accessed 7 November 2016).

Intercollegiate Stroke Working Party. (2016). *National Clinical Guideline for Stroke* (5th ed.). London: Royal College of Physicians. Retrieved from https://www.rcplondon.ac.uk/guidelines-policy/stroke-guidelines.

Johnston, S. C., Rothwell, P. M., Nguyen-Huynh, M. N., Giles, M. F., Elkins, J. S., Bernstein, A. L., & Sidney, S. (2007). Validation and refinement of scores to predict very early stroke risk after transient ischaemic attack. *Lancet, 369*, 283–292.

Kidwell, C. S., Saver, J. L., Schubert, G. B., Eckstein, M., & Starkman, S. (1998). Design and retrospective analysis of the Los Angeles Prehospital Stroke Screen (LAPSS). *Prehospital Emergency Care, 2*, 267–273.

Kothari, R. U., Pancioli, A., Liu, T., Brott, T., & Broderick, J. (1999). Cincinnati prehospital stroke scale: Reproducibility and validity. *Annals of Emergency Medicine, 33*, 373–378.

Llanes, J. N., Kidwell, C. S., Starkman, S., Leary, M. C., Eckstein, M., & Saver, J. L. (2004). The Los Angeles Motor Scale (LAMS): A new measure to characterize stroke severity in the field. *Prehospital Emergency Care, 8*, 46–50.

Morris, S., Hunter, R. M., Ramsay, A. I., Boaden, R., McKevitt, C., Perry, C., … Fulop, N. J. (2014). Impact of centralising acute stroke services in English metropolitan areas on mortality and length of hospital stay: Difference-in-differences analysis. *BMJ, 349*, g4757.

Munro, S. F., Cooke, D., Kiln-Barfoot, V., & Quinn, T. (2015). The use and impact of 12-lead electrocardiograms in acute stroke patients: A systematic review. *European Heart Journal: Acute Cardiovascular Care*. Advance online publication. doi:10.1177/2048872615620893.

National Ambulance Service Medical Directors (NASMeD). (2014). Future national clinical priorities for ambulance services in England. Retrieved from http://aace.org.uk/wp-content/uploads/2014/05/Future-national-clinical-priorities-for-ambulance-services-in-England-FINAL-2.pdf (accessed 7 December 2016).

PASTA. (2016). The PASTA trial. Retrieved from https://research.ncl.ac.uk/pasta/ (accessed 21 November 2016).

Pérez de la Ossa, N., Carrera, D., Gorchs, M., Querol, M., Millán, M., Gomis, M., … Dávalos, A. (2014). Design and validation of a prehospital stroke scale to predict large arterial occlusion: The rapid arterial occlusion evaluation scale. *Stroke, 45*, 87–91.

Pérez de la Ossa, N., Ribó, M., Jiménez, X., & Abilleira, S. (2016). Prehospital scales to identify patients with large vessel occlusion: It is time for action. *Stroke, 47*, 2877–2878.

Pollard, J., & Black, S. (2015). Do paramedics find it beneficial to learn the diagnosis given to their patients in the emergency department? *Emergency Medicine Journal, 32*, 421.

Price, C. I., Rae, V., Duckett, J., Wood, R., Gray, J., McMeekin, P., … Ford, G. A. (2013). An observational study of patient characteristics associated with the mode of admission to acute stroke services in north east England. *PLoS One, 8*, e76997.

Puolakka, T., Strbian, D., Harve, H., Kuisma, M., & Lindsberg, P. J. (2016). Prehospital phase of the stroke chain of survival: A prospective observational study. *Journal of the American Heart Association, 5*, e002808.

Rudd, M., Buck, D., Ford, G. A., & Price, C. I. (2016). A systematic review of stroke recognition instruments in hospital and prehospital settings. *Emergency Medicine Journal, 33*, 818–822.

Sheppard, J. P., Mellor, R. M., Greenfield, S., Mant, J., Quinn,

T., Sandler, D., … McManus, R. J. (2015). The association between prehospital care and in-hospital treatment decisions in acute stroke: A cohort study. *Emergency Medicine Journal, 32*, 93–99.

The Stroke Association. (2016). State of the nation: Stroke statistics. Retrieved from https://www.stroke.org.uk/resources/state-nation-stroke-statistics (accessed 7 December 2016).

TIER. (2016) Transient Ischaemic Attack 999 Emergency Referral (TIER). Retrieved from http://www.primecentre.wales/tier.php (accessed 21 November 2016).

Whiteley, W. N., Wardlaw, J. M., Dennis, M. S., & Sandercock, P. A. G. (2011). Clinical scores for the identification of stroke and transient ischaemic attack in the emergency department: A cross-sectional study. *Journal of Neurology, Neurosurgery, and Psychiatry, 82*, 1006–1010.