The Recognition of Stroke in the Emergency Room (ROSIER) scale: development and validation of a stroke recognition instrument

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Summary

Background In patients with acute stroke, rapid intervention is crucial to maximise early treatment benefits. Stroke patients commonly have their first contact with medical staff in the emergency room (ER). We designed and validated a stroke recognition tool—the Recognition of Stroke in the Emergency Room (ROSIER) scale—for use by ER physicians.

Methods We prospectively collected data for 1 year (development phase) on the clinical characteristics of patients with suspected acute stroke who were admitted to hospital from the ER. We used logistic regression analysis and clinical reasoning to develop a stroke recognition instrument for application in this setting. Patients with suspected transient ischaemic attack (TIA) with no symptoms or signs when assessed in the ER were excluded from the analysis. The instrument was assessed using the baseline 1-year dataset and then prospectively validated in a new cohort of ER patients admitted over a 9-month period.

Findings In the development phase, 343 suspected stroke patients were assessed (159 stroke, 167 non-stroke, 32 with TIA [17 with symptoms when seen in ER]). Common stroke mimics were seizures (23%), syncope (23%) and sepsis (10%). A seven-item (total score from −2 to +5) stroke recognition instrument was constructed on the basis of clinical history (loss of consciousness, convulsive fits) and neurological signs (face, arm, or leg weakness, speech disturbance, visual field defect). When internally validated at a cut-off score greater than zero, the instrument showed a diagnostic sensitivity of 92%, specificity of 86%, positive predictive value (PPV) of 88%, and negative predictive value (NPV) of 91%. Prospective validation in 173 consecutive suspected stroke referrals (88 stroke, 59 non-stroke, 26 with TIA [13 with symptoms]) showed sensitivity of 93% (95% CI 89–97), specificity 83% (77–89), PPV 90% (85–95), and NPV 88% (83–93). The ROSIER scale had greater sensitivity than existing stroke recognition instruments in this population.

Interpretation The ROSIER scale was effective in the initial differentiation of acute stroke from stroke mimics in the ER. Introduction of the instrument improved the appropriateness of referrals to the stroke team.

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Introduction

The benefits of early assessment and hyperacute treatment of stroke patients with thrombolysis within the first 3 h is well known.[1,2] Additional reasons to achieve rapid early diagnosis of suspected stroke in the emergency room (ER) are to facilitate early transfer of stroke patients to organised acute stroke care, and to initiate appropriate treatment for events that mimic stroke, such as seizure, acute confusional states due to sepsis, syncope, and hypoglycaemia. The efficacy of treatment with thrombolysis is highly time dependent, which increases the importance of a prompt diagnosis. Since patients commonly first present to the ER, ER physicians have a critical and potentially expanding role at the forefront of stroke management. One of the challenges in this setting lies in expediting rapid triage while achieving good diagnostic accuracy.[3–5] Delayed early assessment and ineffective triage may deny timely administration of thrombolytic therapy in up to two-thirds of patients.[6] Diagnostic accuracy of ER physicians varies from 22% to 96%.[7–11] In the study that reported a very high diagnostic accuracy,[11] all referrals had received prior CT brain scanning in a large urban teaching hospital in which a comprehensive stroke intervention programme was in place. The differentiation of common stroke mimics presenting to the ER can be a challenge to physicians who do not specialise in stroke care.[12]

Substantial progress has been made with the development of stroke diagnostic tools for ambulance paramedics. Rapid assessment and triage by paramedics has achieved a consistent diagnostic accuracy of between 80% and 95%, with stroke assessment instruments such as the Cincinnati Pre-hospital Stroke Scale (CPSS) and the Los Angeles Pre-hospital Stroke Screen (LAPSS) in the USA, and the Face Arm Speech Test (FAST) in the UK.[7,13–15] In the light of this experience, we hypothesised that the development of a similar stroke recognition instrument for the ER would be a means of increasing diagnostic accuracy and improving rapid triage of stroke patients. In the UK, clinical assessment and brain imaging of patients admitted with suspected acute stroke to the ER is often delayed.[16] Therefore, our aim was to develop and validate a simple and practical clinical stroke recognition instrument for ER physicians.

Methods

This study was divided into two phases. First, a development phase, in which data were prospectively

collected over a 1-year period for the purpose of designing the Recognition of Stroke in the Emergency Room (ROSIER) scale. Second, a prospective validation phase, during which independent validation of the ER physicians' use of ROSIER was undertaken over a 9-month period. The study was reviewed by the Newcastle Joint Ethics committee who decided that written informed consent was not required from the participants.

Development phase

All patients aged older than 18 years who were referred from the ER to the stroke team with suspected stroke or transient ischaemic attack (TIA) were consecutively assessed during a 1-year period (August, 2001, to July, 2002). Stroke was defined as a focal or global neurological deficit with symptoms lasting for 24 h or resulting in death before 24 h, which was thought to be due to a vascular cause after investigation. TIAs were defined as clinical syndromes characterised by an acute loss of focal cerebral or monocular function with symptoms lasting less than 24 h and thought to be caused by inadequate blood supply as a result of thrombosis or embolism. Referrals to our acute stroke unit were made from the paramedic ambulance staff, ER physicians, and primary-care physicians. The paramedics referred suspected stroke patients directly to our unit, bypassing the local ER by using a rapid ambulance protocol for suspected stroke that incorporated FAST. The stroke referral structure associated with our unit has been previously described in detail elsewhere.[7] The acute stroke unit and stroke service is located at a separate hospital 2 miles from the ER. Patients identified as having a possible acute stroke are transferred to the acute stroke unit and assessed by the stroke team at this site. The acute stroke team have had a stroke thrombolysis protocol in place since 1998, which is delivered at the acute stroke unit site but not at the ER.

All patients referred with suspected stroke or TIA to our unit from the ER were examined by a research neurologist certified in the use of the US National Institutes of Health Stroke Scale (NIHSS) in 95% of cases or by senior clinicians of the stroke team (registrar or consultant). The research neurologist was unaware of imaging results or stroke team diagnoses at the time of clinical examination. In addition to the clinical assessment, the following data were prospectively collected during this study period: demographics, stroke referrals, onset and admission time, assessment time, clinical symptoms and signs, risk factor profile, NIHSS score, blood pressure, blood glucose concentration, imaging findings, and final diagnosis. Ischaemic strokes were subclassified using the Oxford Community Stroke Project classification of total anterior circulation infarction, partial anterior circulation infarction, lacunar infarction, posterior circulation infarction, and primary intracerebral haemorrhage.[17] All patients with confirmed stroke or TIA who had symptoms and signs when assessed were incorporated into the derivation dataset. Although we collected prospective data on all cases of subarachnoid haemorrhage during this period, these patients were excluded from the derivation dataset because of the difference in symptoms and signs between subarachnoid haemorrhage and a typical stroke. All patients underwent brain CT or MRI, or both, during the index admission. The final diagnosis made by the consultant stroke physician, after assessment and review of clinical symptomatology and brain imaging findings, was used as the reference standard for diagnosis in the study.

Our dataset was unique in that we collected and compared all suspected stroke referrals exclusively from the ER. This allowed examination of the typical characteristics of stroke patients and stroke mimics presenting to the ER. The latter group are hereafter referred to as non-stroke cases.

We pre-selected 30 variables comprising 18 clinical symptoms and 12 signs for use in the derivation dataset. These variables were common clinical features in stroke patients identified in previous studies.[18,19] We analysed these variables to identify which were predictive for stroke occurrence. Univariate analyses were initially used to select variables that had the highest discriminatory value between stroke and non-stroke in our cohort of suspected stroke referrals. Significant variables from univariate analyses were subsequently entered into a logistic regression analysis, and models were constructed to select significant variables. To capture the characteristics of all types of stroke would require a large number of data variables. We aimed to develop an instrument that combined high, but not perfect, diagnostic sensitivity with good specificity. Equally importantly, the instrument needed to have logical clinical meaning to ER physicians (ie, face validity).[20]

Variables in the models were initially selected from those that showed good discriminatory power with high odds ratios (ORs) for stroke and non-stroke occurrence. After this initial screening phase, we used logistic regression analyses and clinical judgment to select items on the basis of ease of use in the ER environment, coverage of both anterior and posterior circulation stroke symptoms, and evidence of good inter-observer agreement from previous studies.[21–24] If items were discriminatory for a symptom and a sign (eg, arm weakness), then the item relating to the clinical sign was favoured due to the objective nature of clinical signs.

We then assigned a scoring system to these variables: +1 for a positive stroke symptom or sign (OR >1·0), and −1 for a negative stroke symptom or sign (OR <1·0). A combination of these variables was put onto a one-page proforma on which a total score could be easily calculated. Basic demographic details, blood pressure, and blood glucose concentrations were added, the latter to ensure that hypoglycaemia (a potential stroke mimic) was identified early.

We initially validated the instrument against the 1-year derivation dataset comprising all ER referrals with

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suspected stroke. The optimum cut-point for the total scores that best distinguished between stroke and non-stroke was determined by internal validation. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for each cut-point and plotted on a receiver operating characteristic curve.

Prospective validation phase

Having developed the instrument, we then did a 9-month prospective validation study for ROSIER in the ER on a new cohort of patients. All patients aged older than 18 years with suspected stroke or TIA with symptoms or signs seen by ER physicians in the ER were included. The ROSIER proforma was completed by ER physicians on these patients during the clinical assessment and before CT or MRI brain investigations, with no prior knowledge of the final diagnosis. All patients to whom the ROSIER instrument was applied were referred to the acute stroke unit, irrespective of the ROSIER score that was recorded.

The Newcastle Hospital ER assesses approximately 70 000 patients per year. An additional 40 000 patients per year are seen in a separate minor injuries unit. At the time of the study, usual ER staffing during the day consisted of a consultant (attending), two specialist registrars (senior residents), and three or four senior house officers (junior residents) who would be from a mix of specialty backgrounds, some with little experience or formal ER training. Night staff included three senior house officers, one specialist registrar, and cover (non-resident) from an attending consultant. Most patients with suspected stroke were seen by a senior house officer, and approximately 50% of cases would have been discussed with, and sometimes seen by, the specialist registrar or consultant. Patients with suspected stroke, irrespective of the ROSIER score, were then transferred by ambulance to the acute stroke unit at the Freeman Hospital, Newcastle, 2 miles away from the ER. The introduction of the ROSIER scale was accompanied by a regular educational programme on how to use the instrument, with twice monthly updates, given to small groups of ER staff. During these informal sessions, we also received regular feedback and comments from ER physicians about the use of the ROSIER scale. On average the instrument took 2–3 min to administer. During the prospective validation period, ER physicians were not informed of the final diagnosis.

Statistical analysis

Data were entered into a Microsoft Access database, and statistical analyses were done using SPSS version 11. The prevalence of symptoms and signs was calculated. Univariate analysis was initially used on all variables, and results were presented as ORs with 95% confidence intervals. Significance levels were taken at $p<0\cdot05$. Variables that were identified as significant from the univariate analyses were then entered into logistic regression models to identify independent predictors of either stroke or non-stroke occurrence.

We used forward stepwise regression analyses to construct the models. Significant predictive variables generated in the first model were selected for the final model, with additional use of clinical reasoning (as discussed above and summarised later in Results). These variables were then removed and the regression analysis was repeated with the remaining variables. These steps were repeated until there were no longer any clinically relevant variables available. The cut-point of the developed scale that best differentiated between stroke and stroke mimics (ie, optimum value for both sensitivity and specificity) was determined by an internal validity study. Differences in continuous variables were compared using unpaired *t*-tests, whereas differences in categorical variables between groups were compared with χ^2 analyses. We calculated sensitivity, specificity, PPV, and NPV.

Role of the funding source

The funding source had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

343 patients were assessed between Aug 1, 2001, and July 31, 2002, with similar numbers of stroke and non-stroke cases (table 1). Age and sex were similar between

	Stroke or TIA (n=176)	Non-stroke (n=167)
Demographics		
Women	89 (51%)	89 (53%)
Mean (SD) age (years)	70 (14)	71 (16)
Stroke classification		
Total anterior circulation stroke	27 (15%)	..
Partial anterior circulation stroke	35 (20%)	..
Lacunar stroke	53 (30%)	..
Posterior circulation stroke	20 (11%)	..
Primary intracerebral haemorrhage	24 (14%)	..
TIA	17 (10%)	..
Non-stroke diagnoses		
Seizure	..	40 (24%)
Syncope	..	38 (23%)
Sepsis	..	17 (10%)
Migraine	..	10 (6%)
Somatisation	..	9 (5%)
Labyrinthitis	..	7 (4%)
Metabolic disorder	..	7 (4%)
Brain tumour	..	6 (3%)
Dementia	..	4 (2%)
Encephalopathy	..	4 (2%)
Neuropathy or radiculopathy	..	3 (2%)
Transient global amnesia	..	2 (1%)
Other*	..	20 (12%)

Data are numbers (%) unless otherwise stated. *Orthostatic hypotension (n=9), arthropathy/arthritis (n=2), social breakdown (n=2), and one each of subdural haematoma, cervical myelopathy, motor neuron disease, cerebral venous sinus thrombosis, medication side-effect, parkinsonism, and vasculitis. TIA=transient ischaemic attack.

Table 1: **Demographic and diagnosis profile of development phase**

	Number (%) of patients		Odds ratio (95% CI)
	Stroke or TIA (n=176)	Non-stroke (n=167)	
Acute onset	169 (96%)	78 (47%)	27·6 (12·2–62·2)
Arm weakness	110 (63%)	40 (24%)	5·3 (3·3–8·5)
Leg weakness	95 (54%)	37 (22%)	4·1 (2·6–6·6)
Face weakness	41 (23%)	10 (6%)	4·8 (2·3–9·9)
Limb incoordination	9 (5%)	4 (2%)	2·2 (0·7–7·3)
Speech disturbance	94 (53%)	37 (22%)	4·0 (2·5–6·5)
Visual disturbance	20 (11%)	12 (7%)	1·7 (0·8–3·5)
Face parasthesia	16 (9%)	12 (7%)	1·3 (0·6–2·8)
Arm parasthesia	36 (20%)	26 (16%)	1·4 (0·8–2·4)
Leg parasthesia	30 (17%)	19 (11%)	1·6 (0·9–3·0)
Vertigo	10 (6%)	8 (5%)	1·2 (0·5–3·1)
Dizziness	22 (13%)	55 (33%)	0·3 (0·2–0·5)
Nausea	17 (10%)	29 (17%)	0·5 (0·3–1·0)
Vomiting	14 (8%)	21 (13%)	0·6 (0·3–1·2)
Headache	24 (14%)	29 (17%)	0·8 (0·4–1·4)
Confusion	9 (5%)	41 (25%)	0·2 (0·1–0·4)
Loss of consciousness	10 (6%)	69 (41%)	0·1 (0·0–0·2)
Convulsive fits	1 (1%)	16 (10%)	0·1 (0·0–0·4)

TIA=transient ischaemic attack.

Table 2: **Clinical symptoms in derivation phase dataset**

stroke and non-stroke cases. The median time from admission to assessment by the research neurologist (95% of cases) and senior physicians of the stroke team was 300 mins (IQR 150–480). The most common stroke mimics were seizure, syncope, and sepsis, which together composed 56% of the total non-stroke cases (table 1). Prevalence and univariate analyses of clinical symptoms and signs for stroke and non-stroke patients are shown in tables 2 and 3. As expected, the item on acute onset for stroke cases registered the highest prevalence (table 2), followed by arm and leg weakness, speech disturbance, and facial weakness. Sensory symptoms, vertigo, dizziness, and headache were non-discriminatory between stroke and non-stroke cases. By contrast, convulsive seizures, confusion, and loss of consciousness were noted to be discriminatory items in identifying non-stroke cases.

	Number (%) of patients		Odds ratio (95% CI)
	Stroke or TIA (n=176)	Non-stroke (n=167)	
Face paresis	80 (45%)	5 (3%)	27·0 (10·6–68·9)
Arm paresis	122 (69%)	20 (12%)	16·6 (9·4–29·3)
Leg paresis	108 (61%)	18 (11%)	13·1 (7·4–23·4)
Visual field defect	42 (24%)	4 (2%)	12·8 (4·5–36·5)
Eye movement abnormality*	48 (27%)	1 (1%)	62·2 (8·5–457·1)
Dysphasia/dysarthria	100 (57%)	13 (8%)	15·6 (8·2–29·6)
Visuospatial neglect	40 (23%)	8 (5%)	5·8 (2·6–12·9)
Limb ataxia	7 (4%)	3 (2%)	2·3 (0·6–8·9)
Hemiparetic/ataxic gait	93 (53%)	12 (7%)	14·5 (7·5–27·9)
Sensory deficits			
Face	5 (3%)	2 (1%)	2·4 (0·5–12·6)
Arm	40 (23%)	6 (4%)	7·9 (3·2–19·2)
Leg	37 (21%)	4 (2%)	10·8 (3·8–31·2)

*Gaze palsy or ophthalmoplegia. TIA=transient ischaemic attack.

Table 3: **Clinical signs in derivation phase dataset**

In the stroke subgroup, neurological signs with the highest prevalence were arm and leg paresis, dysphasia or dysarthria, gait abnormality, and facial paresis (table 3). The item with the highest OR for discriminating stroke from non-stroke was eye movement abnormality (defined as gaze palsy or ophthalmoplegia). Visual field defect also recorded a high OR. The lowest ORs were for facial sensory deficits, visuospatial neglect, and limb ataxia.

The seven-item scoring system for ROSIER was constructed by applying the principles described in Methods (figure 1). Internal validation of ROSIER was undertaken using the derivation dataset for all suspected stroke referrals from the ER. By validating ROSIER on the 343 suspected stroke cases, the optimum cut-point for stroke diagnosis was determined to be a total score of +1 or above (figure 2). At this cut-point, the corresponding diagnostic performance was as follows: sensitivity 92% (95% CI 89–95), specificity 86% (95% CI 82–90), PPV 88% (95% CI 85–91%), and NPV 91% (95% CI 88–94; figure 3).

Characteristics of stroke and non-stroke patients in the prospective validation study are shown in table 4. The total validation was analysed in 160 patients (88 stroke, 13 of 26 TIA with symptoms or signs, 59 non-stroke) between Nov 1, 2002, and July 31, 2003. In the prospective validation at the cut-point of +1 or above for stroke, the ROSIER scale had a sensitivity of 93% (figure 4, table 5). This performance was similar to that shown in the internal validation phase.

Assessment Date ☐☐☐☐☐☐ Time ☐☐☐☐

Symptom onset Date ☐☐☐☐☐☐ Time ☐☐☐☐

GGS E=☐ M=☐ V=☐ BP ☐☐☐ *BM ☐☐☐

***If BM <3·5 mmol/l treat urgently and reassess once blood glucose normal**

Has there been loss of consciousness or syncope? Y (−1) ☐ N (0) ☐

Has there been seizure activity? Y (−1) ☐ N (0) ☐

Is there a NEW ACUTE onset (or on awakening from sleep)

I. Asymmetric facial weakness Y (+1) ☐ N (0) ☐

II. Asymmetric arm weakness Y (+1) ☐ N (0) ☐

III. Asymmetric leg weakness Y (+1) ☐ N (0) ☐

IV. Speech disturbance Y (+1) ☐ N (0) ☐

V. Visual field defect Y (+1) ☐ N (0) ☐

*Total Score_____(−2 to +5)

Provisional diagnosis

☐Stroke ☐ Non-stroke (specify) _____

*Stroke is likely if total scores are > 0. Scores of </= 0 have a low possibility of stroke but not completely excluded

Figure 1: **ROSIER scale proforma**
BM=blood glucose; BP=blood pressure (mm Hg); GCS=Glasgow Coma Scale; E=eye; M=motor; V=verbal component

	ROSIER	CPSS	FAST	LAPSS
Sensitivity	93% (89–97)	85% (80–90)	82% (76–88)	59% (52–66)
Specificity	83% (77–89)	79% (73–85)	83% (77–89)	85% (80–90)
Positive predictive value	90% (85–95)	88% (83–93)	89% (84–94)	87% (82–92)
Negative predictive value	88% (83–93)	75% (68–82)	73% (66–80)	55% (48–62)

Data are percentages (95% CI). ROSIER=Recognition of Stroke in the Emergency Room scale; CPSS=Cincinnati Pre-Hospital Stroke Scale; FAST=Face Arm Speech Test; LAPSS=Los Angeles Pre-Hospital Stroke Screen.

Table 5: **Diagnostic performance of ROSIER, CPSS, FAST, and LAPSS instruments in prospective validation of our patients (n=160)**

weakness, or speech deficits were present and Glasgow Coma Score was more than 6. LAPSS was defined as positive if arm weakness, grip weakness, or facial weakness was present, and blood glucose was within the range 2·8–22·2 mmol/L, age greater than 45 years, no seizure activity, symptoms present for less than 24 h, and the patient not wheelchair bound or bedridden (pre-stroke modified Rankin score <5). Sensitivity, specificity, PPV, and NPV for each instrument are shown in table 5. FAST scores were completed for 49 of 91 (54%) stroke patients taken to the ER by ambulance paramedics during the prospective validation phase. When real-time performance between FAST and ROSIER was compared in these 49 patients, ROSIER was superior to FAST (sensitivity 92% *vs* 54%, specificity 96% *vs* 91%, PPV 96% *vs* 88%, NPV 92% *vs* 64%).

The total ROSIER scores were related to stroke severity and subtype. Patients with total anterior circulation infarction had the highest median score of +4 (IQR 2·25–4), and posterior circulation infarction showed the lowest median score of +1 (IQR 0–2). The median scores for primary intracerebral haemorrhage, partial anterior circulation infarction, and lacunar infarction were +2·5 (1·25–3·75), +1 (1–3), and +2 (2–3), respectively. The seven patients with confirmed subarachnoid haemorrhage had total scores of zero or less (−2 in four, −1 in three).

Discussion

The ROSIER scale is a clinical diagnostic stroke scale that is simple, sensitive, specific, and suitable for use in the ER. The early distinction between stroke and non-stroke is becoming more important with the increasing use of thrombolytic therapy. Whereas developments in stroke imaging, such as diffusion-weighted MRI, may be able to exclude stroke mimics, assessment of a patient with suspected stroke usually starts with a non-specialist clinical assessment and often ends with an expert clinical assessment after further investigations.[25]

Effective management of stroke in the ER is essential to achieve good treatment outcomes. As public awareness of the signs and symptoms of stroke increases and pre-hospital emergency medical service identification of stroke improves, more patients with suspected stroke are likely to arrive earlier at the ER.[26,27] The first key step in the ER is to make a rapid and accurate assessment as to whether a patient is likely to have had a stroke. The ROSIER scale has been valuable in our setting in achieving this goal and reducing the referral of non-stroke cases. The value of introducing the ROSIER scale in other ER settings will depend on the skills and expertise of the ER staff, with fewer benefits seen in settings where the ER team has a high level of expertise in assessing suspected stroke patients.

Our study underscores the value of clinical assessment in stroke and the high diagnostic accuracy achievable by a simple but structured assessment. This aspect of stroke care could potentially become inadvertently neglected with the increasing reliance on high technology imaging. Notwithstanding technological advances in recent years, clinical diagnostic instruments such as ours may assume an even greater importance in communities lacking easy access to CT or MRI. Scoring systems based on clinical data from inpatient stroke assessment have been explored previously, but none have been widely adopted in clinical use. The Allen and Siriraj scores were devised to differentiate clinically between haemorrhagic and ischaemic stroke.[28,29] Despite initial reports of favourable accuracy, their clinical use has proved limited and the routine use of brain CT has rendered the scales obsolete in high-income countries.[30] In retrospect, that these developments were not used to develop instruments to distinguish stroke from non-stroke rather than between stroke subtypes is surprising.

Our instrument used clinical history items to exclude stroke mimics, a similar approach to that used in LAPSS, which used age, seizures, and blood glucose to exclude non-stroke cases. The most commonly used assessment scale in stroke, NIHSS, is an impairment scale, designed to grade stroke severity in patients already diagnosed with stroke; it therefore has limited application in differentiating stroke from stroke mimics. In Newcastle, UK, because a rapid ambulance protocol that uses FAST diverts substantial numbers of patients away from the ER and directly to our acute stroke unit, the performance of the ROSIER scale may be greater than in other ER settings, since inclusion of this group of patients diagnosed by ambulance paramedics and possibly having more obvious strokes would improve the overall accuracy of ROSIER.

Stroke has protean manifestations and differentiation of stroke mimics in the hyperacute setting can be challenging even for experienced vascular neurologists and stroke physicians. In developing the ROSIER scale, we endeavoured to identify clinical items that were capable of differentiating between stroke and non-stroke, and were useful in both anterior and posterior circulation stroke. We avoided selecting items that are difficult to assess in the ER setting, such as confusion and gait or limb ataxia. Due attention to the instrument's clinical use by ER staff was one of our primary concerns.[20] We actively engaged ER staff during both phases for comments on its use and potential problems that might

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In summary, we have designed and prospectively validated the ROSIER scale, which is a new stroke recognition instrument for specific use in the ER that has good diagnostic accuracy and is simple to administer. Increasing involvement of ER staff in the early treatment of stroke patients requires their increased understanding of stroke and appropriate early management, which may be facilitated by the use of simple diagnostic instruments.

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Authors' contributions

GAF was responsible for protocol design, study coordination, and writing of the paper. AMN was responsible for data collection, statistical analysis, and writing of the paper. JD assisted with data collection and analysis. BS assisted with study coordination in the Newcastle Accident and Emergency department. DS assisted with data collection, training of emergency room staff, and writing of the paper. SJL, AGD, and MD provided final diagnoses in patients referred to the acute stroke service, and contributed to writing of the paper.

Conflicts of interest

We have no conflicts of interest.

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