American Red Cross

Scientific Advisory Council

ARC SAC Scientific Review
Stroke Assessment Tools

Questions to be addressed:

Is the screening tool F.A.S.T. (face, arms, speech and time) an effective stroke assessment tool for first aid providers?

What is the most effective stroke assessment tool presently available to first aid providers?

Introduction/Overview:

Discourse on an ability to accurately evaluate neurological function following a cerebral vascular event is well established within the healthcare community [Scandinavian Stroke Study Group (1985), Cote et al. (1986), Goldstein et al. (1989), Brott et al. (1989), Hantson et al. (1994).] Efforts to develop an assessment scale to facilitate early recognition of stroke in the out-of-hospital setting with efforts to decrease the time to access healthcare resources, particularly initiation of thrombolytic therapy secondary to occlusive infarct, has been pursued utilizing this foundational research.

The development of a stroke scale which has clinical applicability and validity has transcended decades, with the mid 1980's being a focused effort. The development of multiple out-of-hospital scales occurred in the later 1990's into the twenty-first century (Kothari, 1997 & 1999; Kidwell, 1998; Harbison, 1999 & 2003; Nor, 2005; Hurwitz, 2005; Bray, 2005; Chenkin, 2009). This discourse focused on the early recognition of stroke symptoms by emergency medical care providers after being summoned by the individual, family or first aid providers/ general public.

A review of accessible literature to determine applicability of stroke assessment tools specific to the first aid provider/ general public was performed. Studies which evaluate the ability for recognition of stroke symptoms by first aid providers/ general public were obtained (Greenlund, 2003; Ferris, 2005; Handschu, 2006; Herlitz, 2010), with specific utilization of a validated out-of-hospital stroke scale items (Harbison, 2003; Liferidge, 2004; Hurwitz, 2005; Ferris, 2005). Only one prospective study was found which evaluated stroke signs and symptoms recognized by individuals who subsequently accessed health care resources (Bray, 2010). To address the question posed, a focus on stroke scales which utilized validated and reliable items included the Cincinnati Prehospital Stroke Scale (CPSS), LA Prehospital Stroke Scale (LAPSS) and the Face, Arm, Speech, Time (FAST).

Review Process and Literature Search Performed

Search criteria
Years 1985 - 2011

PubMed
1. Stroke and layperson (11)
2. Stroke identification by layperson (2)
3. Stroke identification by ems (14)
4. Cincinnati Prehospital stroke scale and laypersons (2 same to as in identification by laypersons)
5. LA Prehospital stroke scale and laypersons (0)
6. LA Prehospital stroke scale (5)
7. sNIHSS or sNIHSS stroke scale (3)

No information identified through Cochrane database and Medline utilizing above search terms

Additional resources reviewed from article references

Article Types Reviewed
1. Prospective
2. Retrospective
3. Descriptive and Survey Study
4. General Article
5. Case Study

Scientific Foundation:

The discourse on assessing the functional status following a stroke has a significant discourse. This review focuses on the development and implementation of stroke assessment tools for use in settings where access to definitive healthcare resources may be limited or delayed.

A precedence for stroke assessment from the National Health Institute Stroke Scale (NIHSS) was developed in 1989 (Brott, 1989) which provided the foundation of reliability and validity for 15 individual functional assessment items utilized in determining assessment of neurological deficits over time. Overall scale interrater agreement between the two NIH certified neurologists was good (mean κ, 0.69), test-retest mean (κ=0.66 – 0.77) and accuracy determined through CT at one week and a three month functional outcome assessment. Specific item agreement with perfect agreement = 1.00 and perfect disagreement = -1.00 was high ($\kappa \geq 0.80$) for pupillary response (0.95), best motor arm performance (0.85), best motor leg performance (0.83), best gaze (0.82), and level of consciousness (LOC) questions (0.80). Lowest agreement was for the qualitative assessment of level of consciousness (κ=0.49).

The NIHSS was able to be administered within 6.6±1.3 minutes meeting the suitability aspect of clinimetric validity. Accuracy was determined through use of CT for infarct volume at one week and patient functional outcome assessment at three (3) months.

The study evaluated an abbreviated scale to include level of consciousness questions, motor arm and leg) which provided an increased reliability, but was less valid. Additionally, the reduction of items, specifically the elimination of the visual fields assessment decreases the likelihood of detecting an occipital infarction.

As a basis for development of an abbreviated scale to identify and diagnose an acute stroke event, several of NIHSS stroke scale items have applied in various formats. Excellent (κ .85) for motor arm, moderate for dysarthria, facial palsy and best language (κ 0.64, 0.57 and 0.55 respectively) present as a consistent across the psychomotor function evaluation criteria.

A three-item Out-of-Hospital NIH Stroke Scale (Kothari, 1997) presented as a prospective, observational design which sought to modify the NIH 15-item for use as a diagnostic tool. A single physician administered and recorded data as normal or abnormal, with 12 of the 13 NIH stroke items utilized found to be significantly associated with the presence of stroke. The model utilizing facial palsy, arm difference and dysarthria presented as 100% sensitive in predicting stroke with 92% specificity. Due to dysarthria and aphasia being confusing, a single item was created and identified as abnormal speech. The presentation of an abnormality with facial palsy or motor arm and combined with abnormal speech presented a scale with 100% sensitivity and 88% specificity. It was identified a 1 in 9 non-stroke patients would have a false positive identification of stroke. The authors indicated this abbreviated scale may reduce the interval of symptom onset until treatment while not modifying the management of subtle stroke patients. The scale may have potential for use by other medical personnel and the general public to assist with recognition of a stroke.

Reproducibility and validity of the Out-of-Hospital NIH Stroke Scale, known as the Cincinnati Prehospital Stroke Scale (CPSS), occurred in 1999 through a prospective study (Kothari R. P., 1999) within a hospital environment. Two NIH Stroke Scale certified physicians performed 171 examinations while 24 prehospital personnel simultaneously scored the assessment findings. A 10 minute review of the CPSS was conducted between physician and paramedic and emergency medical technician prehospital personnel (EMS) prior to each evaluation. Reproducibility among EMS was (0.89) with correlation of excellent findings (0.92) between physician and EMS. The presence of abnormality in any one of the three stroke scale items resulted in a sensitivity of 66% and specificity of 87% for physician assessment and 59% and 89% respectively for prehospital providers. The ease of education, less than one minute to perform and presenting as reproducible and valid supports use as a rapid assessment stroke tool.

In 1998 a stroke evaluation tool for use by emergency medical services (Kidwell, 1998) was developed. This scale incorporated four historical questions, three motor function assessments and the evaluation of blood glucose. Historical questions included age, history of seizure or epilepsy, symptoms less than 12 hours and not bedridden or wheelchair bound. Motor function assessment included facial grimace, hand grip and arm strength, and blood glucose level.

One stroke neurology investigator certified in the NIHSS and the LAPSS performed the data abstraction. With the absence of grip motor function, items 4 (facial weakness) and 5 (arm weakness) from the NIHSS were applied to the LAPSS criteria. To demonstrate early

recognition by EMS, additional data extraction related to time of symptom onset, method of arrival to ED, CT and medication administration and compared to patients arriving by private vehicle or already admitted to the hospital.

A total of 83 patients were enrolled over a period of three years, with 50 arriving by ambulance, 27 by private vehicle and six were already hospitalized. Those arriving by ambulance 44 of 48 were correctly identified by LAPSS (92% sensitivity) and 38 of 41 (93% sensitivity) were identified as ischemic strokes. Four patients were missed utilizing the LAPSS criterion. The LAPSS was sensitive at 77% for patients arriving by private vehicle.

While the authors identify this scale is appropriate for use by non-healthcare individuals, the exclusion criteria may present as cumbersome, an inability to screen blood glucose and the variance in sensitivity between EMS and private vehicle arrivals indicates the screening instrument is more reliable when utilized healthcare personnel.

A new rapid stroke identification assessment was evaluated through a prospective study which compared the characteristics and accuracy of diagnosis by ambulance personnel, primary care physicians and emergency medicine physicians (Harbison, 2003). The instrument combined the CPSS and LAPSS into the Face Arm Speech Test (FAST) by replacing the sentence repeat with an assessment of language and deleted the blood glucose level assessment. The primary assessment designed for administration to seated individuals to detect unilateral motor weakness and included facial weakness, arm weakness and speech disturbances. The sensitivity presented as 79% with ambulance personnel and a positive predictive value of 78%. Physician predictive values were 71%, with sensitivity unable to be determined due to the inability for obtaining the false-negative diagnoses. As with other abbreviated stroke assessment tools, the items utilized do not permit for the direct assessment of posterior circulation stroke.

In 2005 a study was completed utilizing the Face Arm Speech Test (FAST) to evaluate agreement between ambulance paramedic and physician recorded neurological signs in acute stroke patients (Nor, 2005). Over the period of one year, a stroke neurologist evaluated 95% of 278 suspected stroke cases transported by paramedics, of which 217 were confirmed to have experienced a stroke event (n=189) or TIA (n=28). Paramedics recorded FAST findings for 100% of the 278 patients transported. Complete agreement between paramedic and physician existed for facial weakness (78%), arm weakness (98%) and speech disturbance (89%). Arm weakness was present in 95% of patients and demonstrated near-excellent agreement, suggesting this item may be the most appropriate clinical finding. Approximately two-thirds of patients presenting with posterior circulation events were positive for the FAST criteria.

The recognition of stroke symptoms by the general public remains less than optimal (Greenlund, 2003) (Liferidge, 2004) (Ferris, 2005) (Hurwitz, 2005) (Handschu, 2006) to include a meta-analysis evaluating the actions of patients, bystanders and healthcare providers during the acute phase of stroke, with an emphasis in the pre-hospital setting (Herlitz, 2010). Several studies attempted to identify the prevalence of recognizing stroke symptoms (Greenlund, 2003) (Ferris, 2005), however only two studies utilizing stroke symptom items identified as valid and reliable (Hurwitz, 2005) (Liferidge, 2004) were found which utilized the CPSS by laypersons.

A study by (Liferidge, 2004) utilized laypersons to interpret stroke symptoms displayed by a mock stroke patient. An investigator simulating a 9-1-1 operator guided participants through the administration of facial droop, arm drift and speech impairment. The accuracy in administration of the stroke items were 100% for facial droop and speech impairment and 98.6% for arm drift. Interpretation of results for facial droop and arm droop of 92.9% and speech impairment of 97.1%. Sensitivity and specificity for facial droop 90%, 94%; speech impairment 100%, 96% and arm drift 95%, 92%. Overall sensitivity and specificity of detection for CPSS items was 94.3% and 82.9% respectively. A post study questionnaire indicated 95.7% of the participants reported extreme or very easy in response to the CPSS questions.

The second was a prospective observational study evaluating untrained adults to follow CPSS phone instructions provided by an investigator (Hurwitz, 2005). This study sought to determine the ability of individuals to identify deficits and accurately report their findings to an investigator. Utilizing the stroke items of facial weakness, arm weakness and speech deficits portrayed by stroke survivors possessing unresolved symptoms, participants correctly administered the CPSS directions in an average of 94 seconds 96%, 99% and 98% respectively with an overall ability of adults to correctly administer the CPSS being 98%. Facial weakness specificity was 74% with a sensitivity of 94%, arm weakness sensitivity was 92% and specificity 72% and speech deficit specificity and sensitivity were 96%. Findings concluded the ability to expedite prehospital triage of stroke symptoms by untrained laypersons in a timely manner.

Overall Recommendation:

An accurate, concise and rapidly deployable method to evaluate individuals experiencing stroke-like signs and symptoms is desired and has been attempted through the use of various stroke assessment tools since the mid 1980's.

Both the CPSS and LAPSS stroke tools utilized assessment items which the reliability and validity were previously established. As the FAST stroke tool incorporates criteria from both the CPSS and LAPSS, provided near-excellent agreement between healthcare personnel and physicians, required less than two minutes to complete and was easily utilized by laypersons when guided through administration, the tool presents as a reliable and effective triage resource for healthcare and non-healthcare/ laypersons.

Recommendations and Strength (using table below):

Standard:	None
Guideline:	Utilizing a stroke scale is effective in identifying stroke.
Option:	Utilization of F.A.S.T. is appropriate by the first aid provider and general public. No evidence that one scale is clearly better than another.

Summary of Key Articles/Literature Found and Level of Evidence/Bibliography:

AUTHOR (Name, year, country)	INSTRUMENT (Title, abbreviation)	POPULATIONS (Developed for, used with)	CONTENT (# items, categories, specific items)	SCORING (Concepts rated, rating scale)	MISC.
Brott, T., Adams, H.P., Olinger, C.P., Marler, J.R., Barsan, W.G., Biller, J., Spilker, J., Holleran, R., Eberle, R., Hertzberg, V., Rorick, M., Moomaw, C.J., Walker, M. 1989 Stroke, 20(7); 864-870 Published: USA Research: USA	Measurement of Acute Cerebral Infarction: A Clinical Examination Scale	Design of a 15-item neurologic examination stroke scale for use in acute stroke therapy trials. Acute Care Setting for Physicians and Nurses	Compilation of previous neurologic assessment scales and assessment criteria (2a) Final format being an un-weighted, 15-item, sequential examination Stroke Scale Screening Criteria: In a pilot study of 10 patients was conducted utilizing previous stroke assessment tools to establish the examination scale Consultation with National Institute of Neurological Disorders and Stroke (NINDS) resulted in the addition of three categories and two additional from the Edinburgh-2 Coma scale Final stroke scale included 15 items with a grading	Screening Criteria: Initial exam scale utilized in the pilot study on 10 patients was derived by combining the Toronto Stroke Scale, Oxbury Initial Severity Scale and the Cincinnati Stroke Scale. Modification to the initial scale included the addition of sensory function, papillary response, and plantar response from NINDS and supplementing the Mental status assessment with two items from the Edinburgh-2 Coma Scale Final fifteen-item examination included: • Level of Consciousness	Used as a measurement of neurologic deficit, not as a diagnostic tool Foundational reliability and validity established for items in scale

			scale for each item and comprehensive glossary 24 stroke patients provided findings of interrater reliability mean (κ=0.69) Test-retest reliability was mean (κ=0.66 – 0.77) Scale validity determined prospectively on 65 acute stroke patients utilizing computerized tomography at 1 week and three independent functional outcome measures of performance class, placement class and location in the community Effectiveness: Examination completed in 6.6±1.3 minutes Clinimetric validity provided through reliability, accuracy and suitability	• LOC Questions • LOC Commands • Pupillary Response • Best Gaze • Best Visual • Facial Palsy • Best Motor Arm • Best Motor Leg • Plantar Reflex • Limb Ataxia • Sensory • Neglect • Dysarthria • Best Language • Change from Previous Exam • Change from Baseline Item assessment and rating without independent weighting or individual parameters of each item occurred Effectiveness: Good inter-rater reliability for all 15 items of the NIHSS (mean	

			Implementation: Examination and scale completed on 24 stroke patients and 65 naloxone study patients Independent evaluation of scale completed Applicability to Layperson: None	kappa, .69) among neurologists, emergency physicians, residents and nurses Inter-rater reliability ranged from excellent for motor arm (κ .85), to moderate for dysarthria and best language (kappa, .64 and .55 respectively), to poor for facial palsy (kappa, .39). Test-retest was mean (κ=0.66 – 0.77) establishing reliability Accuracy was determined through use of CT for infarct volume and patient outcome at three (3) months Suitability is identified as: • Brief • Able to be administered by physician	

				and nurses • Easily repeatable • May be performed on mute and paralyzed patients and at any time • Requires little training An independent evaluation of the authors scale was completed following the study Implementation: Patient assessments were completed by one of two physicians certified in the use of the NIH Stroke Scale Patient assessment completed by staff neurologist while three person examination team observed (neurology house officer, neurology nurse-clinician, emergency	

				department nurse-clinician) Applicability to Layperson: None in present form, designed for use by healthcare professionals	
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Kothari, R., Hall, K., Brott, T., Broderick, J. 1997 Academic Emergency Medicine, 4(10);986-990 Published: USA Research: USA	Early Stroke Recognition: Developing and Out-of-hospital NIH Stroke Scale	To develop an abbreviated and practical neurologic scale that could assist emergency medical services or triage personnel in identifying patients with stroke	Prospective, observational design (2a) 299 subjects; 74 acute ischemic stroke and 225 non-stroke Evaluation performed by physician Utilized Abbreviated NIH Stroke Scale Screening Criteria: Facial Palsy Motor arm Abnormal Speech Effectiveness: Sensitivity 100% Specificity of 88% Posterior circulation stroke may be missed	Screening Criteria: NIHSS items modified to reflect binomial findings and ranked for predictive value in presence of stroke Facial palsy, motor arm and dysarthria identified as present in 100% of stroke patients Effectiveness: An abbreviated stroke scale presented with sensitivity of 100% and specificity of 92% Combining the items of dysarthria and	

			with scale Implementation: Baseline NIHSS scores obtained from database of previous study Patient evaluation completed by single board-certified emergency physician 74 of the 299 subjects evaluated were positive for stroke and 225 non-stroke Applicability to Layperson: Other medical personnel and potentially the general public	aphasia to abnormal speech created a scale of 100% sensitivity and specificity 88% Implementation: Scoring items unable to be determined by physician scored as normal Applicability to Layperson: In addition to medical personnel utilization the scale may be applicable to assist family, friends and the general public in recognition of stroke symptoms	
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Kidwell, C.S., Saver, J.L., Schubert, G.B., Eckstein, M., Starkman, S. 1998 Prehospital Emergency Care, October/ December, 2(4);267-273	Design and Retrospective Analysis of the Los Angeles Prehospital Stroke Screen (LAPSS)	Demonstrate new Prehospital screening instrument (LAPSS) sensitively identifies acute stroke patients For use with Emergency Medical	Retrospective Cohort Study (Stroke) (2b) 83 patients enrolled over a three-year period 50 by ambulance, 27 by private vehicle and 6 already hospitalized	Data extraction performed by a single stroke neurology investigator (CSK) Physician review of charts and extracted data with retrospective scoring utilizing	Instrument designed for health personnel not trained in neurology NIHSS criteria for greatest sensitivity to stroke are abnormal

Published: USA Research: USA		Services (EMS) Providers (EMT & Paramedic)	One stroke neurology investigator (CSK) and physician chart review Screening Criteria: History/Motor Age > 45 Duration of Symptom History of Epilepsy Wheelchair / Bedridden Motor Function Facial Smile/ Grimace Grip Strength Arm Strength Blood Glucose (additional assessment criteria item) Effectiveness: Specificity Not Assessed (no control group) Sensitivity Ambulance 93% Private Vehicle 77% Hospitalized – not reported Implementation: Knowledge Base Health Care Provider	the NIHSS items 4 (facial weakness) and 5 (arm weakness) to assess LAPSS for identifying an acute stroke Screening Criteria: The LAPSS incorporates four (4) historical questions, three (3) motor function assessments and the evaluation of blood glucose Age of less than 45 assumes younger more likely to have non-stroke etiologies related to weakness History of Epilepsy excludes patients with postictal Todd's paralysis As motor weakness is a major long-term disability determinant, a person in a	speech, facial palsy and arm weakness Applicability for laypersons to assess blood glucose questionable Variance in LAPSS criteria between EMS and private vehicle arrivals indicates the LAPSS does not serve as a reliable screening instrument for the lay person

			Time Three (3) minutes to implement Applicability to Layperson: Patients arriving by private vehicle and positive for stroke findings (96%) presented 77% sensitive to the LAPSS criteria Not as constructed due to inability to assess blood glucose and significant number of items assessed	wheelchair or bedridden may not present with functional motor baseline status Motor function focuses on ability to identify deficits in unilateral face, measured by equal, right weak and left weak; grip strength measured weak or no grip, right or left; and arm strength drifting down or falls rapidly, right or left Blood Glucose <50 or > 400 excluded due to possibility of exhibiting stroke-like symptoms Effectiveness: Overall enrolled patients by EMS (n=50) 48 were identified as having an ischemic or hemorrhagic stroke (96%), with 38 of the 41 ischemic stroke cases	

				(93%) correctly identified by the LAPSS. 38 of 50 patients enrolled by EMS identified ischemic stroke (76%) 25 of the 27 patients arriving by private vehicle, 26 were identified to have experienced an ischemic or hemorrhagic stroke, with the LAPSS sensitivity being 77% Implementation : Health Care Provider with basic understanding of neurology were able to complete the LAPSS instrument in three (3) minutes Applicability: Layperson identification of a stroke were outside of the	

				LAPSS criteria (77% sensitivity) indicating alternative criteria was utilized (not defined) to identify abnormal medical presentation of the patient	
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Kothari, R., Pancioli, A., Liu, T., Brott, T., Broderick, J. 1999 Annals of Emergency Medicine, 33(4) Published: USA Research: USA	Cincinnati Prehospital Stroke Scale: Reproducibility and Validity (CPSS)	Validate and verify the reproducibility of the CPSS when used by Prehospital providers	Prospective Study – (2a) Convenience Sample Two NIH Stroke Scale certified physicians and 24 Prehospital personnel (17 paramedics and 7 EMT's) engaged in 23 separate patient evaluation sessions 171 patients identified within the ED or inpatient neurology service Total of 860 scales were completed (171 physician and 689 Prehospital personnel) Screening Criteria:	Patient assessments were completed by one of two physicians certified in the use of the NIH Stroke Scale Physician led patient evaluation with concurrent scoring of patient response by Prehospital personnel Prior to patient contact a ten-minute verbal review of CPSS with Prehospital personnel by the physician conducting the patient examination Screening Criteria:	Sensitivity and specificity excellent with physician and Prehospital personnel Correlation of findings between physician and Prehospital personnel excellent Brott (1989) reported the Cincinnati Stroke Scale originally comprised of Speech, Arm & Leg Drift (affected side) and Grip Strength

			Motor Function Facial Droop Arm Drift Use of language (Speech) Effectiveness: Sensitivity and Specificity Physician Prehospital personnel Prehospital personnel Scoring Excellent reproducibility Physician / Prehospital provider correlation of total score Excellent correlation Specific item scoring between physician and Prehospital personnel Excellent Implementation: Physician review session with prehospital personnel. Physician examination performed. Applicability to	Facial Droop measured as "one side of face does not move as well as the other." Arm Drift measured as "one arm either does not move, or one arm drifts down compared to the other", and Speech measured as "the patient slurs words, says the wrong words, or is unable to speak Effectiveness: Sensitivity and Specificity For the presence of single abnormality on CPSS Physician scored sensitivity of 66% and specificity of 87% with the CPSS Prehospital providers scored 59% sensitivity and 89% specificity Prehospital personnel Scoring	Biased subject population for stroke-like symptoms Environment and implementation not viable to out-of-hospital setting

			Layperson: Not addressed	Prehospital personnel demonstrated excellent reproducibility for each scale item (facial droop .89, arm drift .91, speech .84) and total score (.89) Physician / Prehospital provider correlation of total score 0.92 with no difference related Prehospital level of training Specific item scoring between physician and Prehospital personnel was excellent (facial droop .78, arm drift .91 and speech .87) Implementation : Prior to evaluation session a 10-minute verbal review of performance and scoring conducted by physician with prehospital	

				personnel. Physician administered scale performed with prehospital personnel scoring responses. Applicability: Not addressed	
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Harbison, J., Hossain, O., Jenkinson, D., Davis, J., Louw, S.J., Ford, G.A. 2003 Stroke, Volume 34:71-76 Published: USA Research: UK	Diagnostic Accuracy of Stroke Referrals from Primary Care, Emergency Room Physicians, and Ambulance Staff Using the Face Arm Speech Test	Compared characteristics and accuracy of diagnosis of stroke by ambulance staff using a rapid ambulance protocol incorporating the Newcastle Face Arm Speech Test (FAST) assessment with PCDs and ER doctors	Prospective Study – (2a) Convenience sample via referral pattern from February 1 through July 31, 2000) 529 individuals evaluated with 487 subjects enrolled; 37% by ambulance (Rapid Ambulance Protocol), 44% primary care doctor (PCD) and 19% by the emergency department (ER) Average subject age of 72 years; 52% female. Screening criteria : FAST assessment Effectiveness:	FAST developed from CPSS and LAPSS; replaced sentence repeat with assessment of language by paramedic and deleted BGL assessment. Not designed to detect posterior cerebral circulation lesions. Screening Criteria: All patients referred to Freeman Hospital Stroke Services were prospectively studied for a period of six months.	

			Sensitivity and Specificity Rapid Ambulance Protocol – Estimated diagnostic sensitivity – 79%; Positive Predictive Value (PPV) 78% Primary Care Doctor PPV 71% - unable to determine diagnostic sensitivity Emergency Department – PPV 78% - unable to determine diagnostic sensitivity Implementation: Complement existing assessments (e.g. GCS) for prehospital personnel Training packet developed and implemented Diversion to an acute stroke unit (ASU). Failure to implement	One hundred thirty one (131) patients determined not to meet stroke/TIA criteria; exclusion of subarachnoid hemorrhage, seizures, infection, delirium or other/ non-neurological. Of the 131 patients excluded; 52% of misdiagnosed subjects (68) presented with other neurological diagnoses (peripheral neuropathy, migraine); 18 patients (14%) presented with residual neurological deficits from previous stroke. No difference between referral methods in proportion of non-stroke patients received. Effectiveness:	

			protocol due to non-recognized stroke-like symptoms. Applicability to Layperson: Not addressed	Admission within three (3) hours: Ambulance – 68%; PCD – 34%; ER – 23% Diagnostic accuracy comparable to but less than reported by LAPSS Implementation: Training packet of lecture notes, slides, handouts and multiple choice questionnaires delivered in 1998-1999 and to all new hires. Patients identified as having stroke-like symptoms were administered the FAST examination, consulted with hospital personnel for diversion to an acute stroke unit (ASU). 25% of subjects diverted to ED against protocol	

				had a FAST assessment – indicating stroke not considered by ambulance personnel. Applicability to Laypersons: Not addressed	
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Greenlund, K.J., Neff, L.J., Zheng, Z., Keenan, N.L., Giles, W.H., Ayala, C.A., Croft, J.B., Mensah, G.A. 2003 American Journal of Preventive Medicine, Volume 25:4; 315-318 2003 Published: USA Research: US	Low Public Recognition of Major Stroke Symptoms	Recognition of stroke symptoms and awareness of the need to call 911 for acute stroke events were examined among the general population	2001 Phone survey (3a) 17 states and U.S. Virgin Islands; 53.3% respondent rate (calculated.) 62,632 contacts with analysis of 61,019 participants; ≥ 18 years of age Screening Criteria: Six questions administered via phone Effectiveness: Sudden confusion or trouble speaking (88%), numbness or weakness of the face, arm or leg (94%), and sudden trouble	Screening Criteria: Six questions were asked of respondents to include: 1) Sudden confusion or trouble speaking 2) Numbness or weakness of face, arm, or leg 3) Sudden trouble seeing in one or both eyes 4) Sudden chest pain 5) Sudden trouble walking, dizziness, or loss of balance 6) Severe headache with no known cause Effectiveness: Results based	

			walking, dizziness, or loss of balance (86%) were identified as signs of a stroke. 86% indicated would activate 911 if thought a stroke or heart attack. Overall 92% correctly recognized at least three stroke symptoms; 19.6% correctly identified all symptoms; 17.2% identified all symptoms and would activate 911. Implementation: Based on the Healthy People 2010 objective for recognition of early warning signs of stroke The Behavioral Risk Factor Surveillance System (BRFSS) utilized – state-based survey. Random-digit-dialed telephone contact Applicability to	on closed-ended questions (Yes/No) Results indicated three of five questions were identified as potential stroke symptoms. Implementation: Large sample size, lower than expected participatory rate and closed-ended questions may have influenced outcomes of symptom recognition. Applicability to Laypersons: Previous literature indicates an increased recognition alone does not lead to action (no decrease in access time to ED with/ without recognition of stroke symptoms), a result reproduced by	

			Laypersons: Higher symptom recognition does not lead to action/ earlier health care intervention. Increased awareness needed.	this study. Promotes targeted messages to specific at-risk groups to complement public awareness campaigns.	
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Herlitz, J. WireklintSundstrom, B., Bang, A., Berglund, A., Sevensson, L., Blomstrand, C. 2010 Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine; Volume 18:48. http:www.sjtrem.com/content/18/1/48 Published: Online Open Access Research: Sweden	Early identification and delay to treatment in myocardial infarction and stroke: differences and similarities	Describe differences and similarities with regard to the way patients, bystanders and health care providers act in the acute phase of the two diseases with the emphasis on the pre-hospital phase.	Meta Analysis (1a) Screening Criteria: Database search with 433 articles identified related to AMI and 186 for stroke. Utilized 66 and 58 articles respectively. Conducted February and June 2010 on PubMed, EMBASE and Cochrane databases. Limited to English published only articles. Effectiveness: One study identified FAST is utilized by EMS and the	Loss of consciousness and difficulty speaking shortened access to physician and diagnostic testing More frequent use of checklist by paramedics to identify stroke than AMI (37% versus 28%)	Advocated use of telemedicine with tertiary care Increasing layperson access to medical resources via telemedicine may facilitate early identification and reduce time to treatment

			prevalence of checklists for thrombolytic are greater than for AMI, 37% vs. 28% respectively by one study. Implementation: To include a large population this study constructed a scale adjusted for use by non-neurologists Ratings were coordinated and practiced in meetings with participants from all centers Raters blinded to treated versus non-treated Applicability to Laypersons: Reduction in patient decision time, early identification with improved logistics may reduce time to treatment		
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**

Scandinavian Stroke Study Group, 1985 Stroke, Volume 16:885-890 Published: USA Research: Scandinavia	Multicenter Trial of Hemodilution in Ischemic Stroke – Background and Study Protocol	Evaluate the effects of early hemodilution treatiment by a combination of vensection and dextran 40 administration on the clinical outcome.	Multicenter controlled stratified randomization (1a) Screening Criteria: Fifteen participating hospital centers 604 screened with 193 subjects enrolled as a subset of a larger clinical trial Constructed an initial prognostic score for use by non-neurologists to include level of consciousness, eye movement and severity of paresis Effectiveness: Unknown as trials were ongoing at the time of publication Implementation: April 1983 with conclusion on November 30, 1984 Analysis of single-center study enrollment	Screening Criteria: Prognostic Scoring maximum total of 22 Consciousness; Fully conscious Somnolent, able to awaken Reacts to verbal command, not fully conscious Eye Movements; No gaze palsy Gaze palsy present Conjugate eye deviation Arm, motor power; Raises arm with normal strength Raises arm with reduced strength Raises arm with flexion in elbow Can move, but not against gravity Paralysis Leg, motor power;	Due to contraindications associated with hemodilution and pre-existing conditions, only 32% of the screened individuals were enrolled into the study Components of prognostic scoring utilized as foundational components in future short evaluation tools Study results not reported

			showed a total of 400 patients were needed to demonstrate statistical significance Applicability to Layperson: Not indicated	Normal strength Raises straight leg with reduced strength Raises leg with flexion of knee Can move, but not against gravity Paralysis Long-term scoring included components of Hand, motor power; Orientation, Speech, Facial palsy and Gait – total scoring of 48	
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Côté, R., Hachinski, V.C., Shurvell, B.L., Norris, J.W., Wolfson, C. 1986 Stroke, Volume 17(4):731-737 Published: USA Research: London, Ontario, Canada	The Canadian Neurological Scale: A Preliminary Study in Acute Stroke	Presentation of a simple clinical monitoring scale for acute stroke	Prospective Observational (2a) Screening Criteria: University Hospital and St. Joseph's Hospital in London, Ontario. 34 patients evaluated from a convenience sample available on neurology	Scale included 10 clinical modalities beginning with mentation: level of consciousness, orientation and speech Remaining items grouped into presence or absence of comprehension deficit with separate sections	Significance of dichotomous item differentiation versus multiple category items which may have increased the kappa values Omission of gaze paresis from scale due to redundant

			wards Four raters: neurologist, resident neurologist and two nurses Scale consists of 10 clinical modalities Implementation: Most scoring completed within first two to three days Each patient scored by raters within a short time interval (2-4 hours) Completion of scoring took 5 to 10 minutes per rater Raters blinded to each other's assessment Evaluation: Interrater reliability good to excellent ranging from 0.535 to 1.000 Presented as reliable scale when performed in this study	dependent upon findings	item scoring Validity of scale not evaluated

			Applicability to Layperson: None		
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Goldstein, L.B., Bertels, C., Davis, J.N. 1989 Archives of Neurology 46, June; 660-662 Published: USA Research: US	Interrater Reliability of the NIH Stroke Scale	Determine the interobserve reliability of the NIH Stroke Scale	Prospective observational (2a) Screening Criteria: 20 patients served as subjects for the study Convenience sample from patients admitted to Duke University Hospital with neurologic deficits secondary to a recent stroke Effectiveness: Calculated values for κ significantly different for 11 of the 13 items Neglect most coded as "untestable" Implementation: Scale administered by four clinical stroke fellows	Utilizing kappa (κ) 11 of 13 items scored significantly different: 5 indicated substantial, 4 moderate and 2 fair 0 - .20 slight agreement; .21 - .40 fair agreement; .41 - .60 moderate agreement; .61 - .80 substantial agreement; .81 – 1.00 almost perfect agreement Substantial difference: Language, Motor leg, Motor arm, LOC questions, Neglect Moderate difference: Visual fields, Sensory, LOC, LOC commands Fair difference:	Study determined present scale more reliable in assessing language, proximal leg strength, proximal arm strength, visual fields, level of consciousnes s and sensory disturbances Reliability of the NIH Stroke scale has moderate interrater reliability for 9 of 13 items assessed

			Raters assigned in random pairing with assessments performed independently Assessments were performed one after the other Applicability to Layperson: None	Extraocular movements, Dysarthria No substantial difference was found for limb ataxia or facial palsy	
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Hantson, L., De Weerdt, W., De Keyser, J., Diener, H.C., Franke, C., Palm, R., Van Orshoven, M., Schoonderwalt, H., De Klippel, N., Herroelen, L., Feys, H. 1994 Stroke 25:2215-2219 Published: USA Research: Belgium, Germany, Netherlands, Sweden	The European Stroke Scale	Developed to detect therapeutic effect and matching treatment groups in stroke trials	Prospective Observational (2b) Five participating centers Convenience sample of patients diagnosed with middle cerebral artery stroke 74 patients assessed utilizing the scale Screening Criteria: Scale designed for patients with middle cerebral artery stroke Consists of 14 items selected for	14 items include: Level of consciousness, comprehension, speech, visual field, gaze, facial movement, maintenance of arm position, arm raising, wrist extension, finger strength, maintenance of leg position, leg flexing, foot dorsiflexion and gait Interrater reliability reported as 0.62 to 0.85 Internal consistency of	Study determined scale met clinimetric criteria of good

			their specificity and prognostic value Effectiveness: Identified scale to be reliable, sensitive, easy to utilize with prognostic value Implementation: Assessments completed independently by two neurologists with experience in stroke trials Average 12.5 days before assessment made (0 – 68 days) Forms filled out during or immediately following assessment 38 patients utilized to determine interrater reliability Validity and sensitivity of scale utilized in 20 patients Concurrent and prognostic validities and the	the scale reported at Cronbach's α 0.92	

			sensitivity of scale assessed in 44 patients Average evaluation time per assessment 8.2 minutes Applicability to Layperson: None		
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Nor, Mohd A., McAllister, C., Louw, S.J., Dyker, A.G., Davis, M., Jenkinson, D., Ford, G.A. 2005 Stroke 35:1355-1359 Published: USA Research: UK	Agreement Between Ambulance Paramedic- and Physician-Recorded Neurological Signs With Face Arm Speech Test (FAST) in Acute Stroke Patients	Paramedic accuracy in detecting acute stroke signs	Prospective Observational (2b) Patients received from ambulance crews referred to the acute stroke unit were examined by a trainee stroke neurologist or admitting stroke physician over the period of one (1) year 278 patients referred with 189 confirmed stroke and 28 transient ischemic attack (217 – 78%) Screening Criteria: FAST consists of three items: facial	Screening Criteria: FAST was performed and recorded for 100% of referrals to ASU Incorporated into the patient care report Effectiveness: FAST signs absent upon physician assessment for 3.6% (11/305) Findings upon confirmation of stroke indicated presence of arm weakness 87% (266/305), facial weakness	Initial study implementing comparison of physician and paramedic assessment of stroke No additional education beyond foundational education and mentorship period occurred with this study Less sensitive in detecting posterior circulation syndrome unless accompanied

			weakness, arm weakness; speech disturbances Language and clarity assessed during conversation for speech disturbances Effectiveness: Most prevalent sign in confirmed acute stroke was arm weakness (96%) FAST signs present in 79% of patients admitted with transient ischemic attack Implementation: In 1998 the FAST screening tool implemented into rapid ambulance protocol Ambulance crews performed FAST exam and triaged patients to acute stroke units Applicability to Layperson: Study did not address use by layperson	62% (189) and speech disturbances 72% (220) Twenty-five posterior circulation infarcts presented with 21 having completed the FAST Positive for detecting 62% of posterior circulation syndromes (13/21) Near-excellent agreement between physician and paramedic included presence of arm weakness (95%) Fast signs present in patients presenting with TIA 79% (22/28) Non-stroke diagnoses (49) included seizure (17), sepsis (9), Syncope (7), metabolic (7), brain tumor (4), deteriorating dementia (2),	by FAST scale items Excellent interobserver reliability when utilized in clinical settings by paramedics Simple, brief, reliable tool which may be utilized in the prehospital setting

				subarachnoid hemorrhage (2), labyrinthisis (1), subdural hematoma (1), parkinsonism (1), neuropathy/radiculopathy (1), medicated-related (1), alcohol-related (1), paraneoplastic syndrome (1) and extradural hematoma (1) Implementation: Trainee stroke neurologist evaluated 95% of patients presented and 98% of stroke cases (185/189) Median time between paramedic and physician assessment 18 hours (8 – 24) Agreement between paramedic and physician facial weakness 68% versus 70% (κ = 0.49, 95%), arm weakness 96% versus 95%, (κ = 0.77, 95%)	

				and speech disturbance 79% versus 77% (κ = 0.69, 95%) Interrater agreement was complete for arm weakness in 98% of cases Applicability to Layperson: Based on simplicity, expediency and reliability, may be able to extrapolate for layperson population	
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Hurwitz, A.S., Brice, J.H., Overby, B.A., Everson, K.R. 2005 Prehospital Emergency Care 9:292-296 Published: USA Research: US	Directed Use of the Cincinnati Prehospital Stroke Scale by Laypersons	Ability for untrained adults to follow CPSS instructions provided by a 9-1-1 telecommunicator, identify deficits and accurately report finding to an investigator	Prospective Observational (2a) CPSS utilizes a three item neurological examination to evaluate facial palsy, arm weakness and speech abnormalities 100/111 individuals approached agreed to participate Study utilized	Participants correctly administered CPSS directions as follows: • Facial weakness 96% • Arm weakness 99% • Speech deficits 98% The sensitivity and specificity of the assessment for the three items: • Facial palsy	Previous studies have identified approximately 83 % of persons activating EMS were self (4.3%), related to the patient, neighbor, colleague, healthcare provider or friend (Handschu et al., 2003; Wein et al., 2000)

			seven stroke survivors with various unresolved symptoms in each domain as mock patients Screening Criteria: Non-patient visitors to the emergency department Visitors of critically ill patients were not approached Exclusion of minors and non-English speaking Effectiveness: Ability of adults to correctly administer the CPSS was 98% Implementation: Mean duration of each trial 94 seconds Applicability to Layperson: Laypersons can accurately relay CPSS instructions when directed over the phone	74% and 94% • Arm weakness 97% and 72% • Speech deficits 96% and 96%	Decreased time to access healthcare facilitated by motor, language or consciousnes s impairment (Palomeras et al., 2008) Data suggests it would be reasonable to expect a 9-1-1 caller be familiar with a person's pre-stroke behavior (as baseline) A high prevalence of deficits in the mock patients may affect sensitivity and specificity unassisted stroke recognition may be plausible utilizing CPSS with appropriate education/ guidance

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Bray, J.E., Martin, J., Cooper, G., Barger, B., Bernard, S., Bladin, C. 2005 Cerebrovascular Diseases 20:28-33 Published: Switzerland Research: Australia	Paramedic Identification of Stroke: Community Validation of the Melbourne Ambulance Stroke Screen	Validation of the LAPPS and CPSS tools and to evaluate a combination of the two tools – Melbourne Ambulance Stroke Screen (MASS)	Prospective Observational (2a) Screening Criteria: Paramedics responded to 5,957 emergency calls over the period of 12 month (Sept 2002-Sept 2003) 3,327 patients were transported to Box Hill Hospital Effectiveness: Of the 100 participants 73% obtained a final discharge diagnosis of stroke or TIA; 27% stroke mimics For the 27 incomplete MASS assessment sheets 10 (37%) were identified as stroke and 17 (63%) were stroke mimic MASS sensitivity and specificity were significant	MASS assessment as performed presented with a 73% Motor component findings: • 60% unilateral arm drift • 73% weak hand grasp • 64% facial droop • 84% speech disturbance Abnormal speech present in 9/73 as the only deficit identified Retrospective application to the 27 patients excluded due to incomplete assessment sheets, all three stroke scale tools identified 100% of stroke patients and 95% of stroke mimics	Sought for MASS to obtain equivalence with CPSS sensitivity and LAPSS specificity MASS tool combined all items of both tools Paramedic initiation of completing the MASS sheet based on identifying neurological deficits (limb weakness, speech disturbance) MASS presented as statistically equivalent to CPSS for sensitivity and superior to the LAPSS. MASS was superior to CPSS and statistically equivalent to LAPSS

			between the LAPSS and CPSS 13 ischemic stroke patients demonstrated 100% sensitivity for detection 14 patients were misidentified by MASS, 7 did not meet criteria (false negative) and 7 mimics met criteria (false positive) Implementation: 18 paramedics were selected to participate with the study A one-hour education session on the pathogenesis and management of acute stroke and instruction in the assessment and documentation provided Completion required for all dispatches for 'stroke' that were symptomatic, conscious and to be transported to Box Hill Hospital or identified neurological		Strong support for the use of a prehospital stroke scale by paramedics

			deficit upon examination 127 patients were identified as study eligible, with an additional 19 patients excluded due to incomplete diagnosis prior to discharge or transfer 100 MASS assessment sheets were completed (79%) for analysis Applicability to Layperson: Not as constructed due to inability to assess blood glucose and significant number of items assessed		
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Chenkin, J., Gladstone, D.J., Verbeek, P.R., Lindsay, P., Fang, J., Black, S.E., Morrison, L. 2009 Prehospital Emergency Care 13:153-159 Published: USA	Predictive Value of the Ontario Prehospital Stroke Screening Tool for the Identification of Patients with Acute Stroke	To determine the positive predictive value of the Ontario Prehospital Stroke Screening Tool implemented by paramedics in the out-of-hospital environment	Retrospective analysis (2b) Utilized inclusion criteria of unilateral weakness, slurred speech or muteness and facial droop, onset within two (2) hours and exclusions to identify stroke	291/ 325 patients screened positive by paramedics were diagnosed as: • 187 ischemic stroke (58%) • 67 hemorrhagic	Speech abnormality most common isolated symptom No patient with isolated facial droop diagnosed as acute stroke Requires

Research: Canada			mimics Implementation of study coincided with Toronto prehospital stroke initiative 554 patient records reviewed Paramedic completion of stroke screening tool or chart documentation used to screen candidates Stroke Screening Instrument Assessed: Screening Criteria Effectiveness Implementation Applicability to Layperson Screening Criteria: Patients transported to Sunnybrook Health Sciences Centre between March 1, 2005 and February 28, 2006 Patients identified with diagnosis of stroke through Registry of the Canadian Stroke	stroke (21%) • 37 TIA (11%) An 81% positive predictive value (PPV) with one criterion present, increasing to95.3% if all three screening criteria were positive 27/ 229 (11.8%) not triaged to the protocol and diagnosed with acute stroke produced a negative predictive value (NPV) of 88.2% with sensitivity of 89.1% (95% CI 84.4-92.6%) and specificity 79.5% (95% CI 73.9-84.2%) Overall tool sensitivity of 89.1% and specificity of 79.5%	assessment of blood glucose Requires use of Glasgow Coma Score assessment scale Motor criteria difference between this tool and the CPSS to include Arm or Leg weakness Decreased onset time to two (2) hours An increase of tPA administration from 5.9% to 10.1% when compared to the previous year period

			Network database Suspected stroke patients not identified by ambulance for a positive screening included in review Effectiveness: Of patients identified by stroke scale tool by paramedics, positive predictive value of 89.5% Patients identified as not appropriate to utilize stroke scale tool, negative predictive value of 88.2% Implementation: Paramedics received a 90 minute training session on the stroke screening tool prior to implementation Stroke tool was applied to any patient with symptoms suggesting acute neurologic problem		

			554 suspected acute stroke patients arrived by ambulance • 325 triaged under the acute stroke protocol (59%) • An additional 229 did not meet the protocol according to paramedic assessment (41%) Applicability to Layperson: Continued support of specific motor function criteria as assessment items		
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Liferidge, AT, Brice, J.H., Overby, B.A., Everson, K.R., 2004 Prehospital Emergency Care, 8:384-387 Published: USA	Ability of laypersons to use the Cincinnati Prehospital Stroke Scale (CPSS)	Directed layperson use of the CPSS with accurate interpretation of results	Prospective observational study (2a) Screening Criteria: 70 of 74 English-speaking visitors to the ED agreed to participate Less than 18	Screening Criteria: Individuals were enrolled as a convenience sample while visiting the ED 63% female and 40% no college Effectiveness:	Limitations included a convenience sample of participants already in contact with the healthcare system. Potential for bias by

Research: US			years of age and non-English speaking excluded. Effectiveness: Interpretation by participants indicated accuracy of 93% for facial droop and arm drift, and 97% for speech. Implementation: Initial pilot study conducted to optimize logistics and efficiency of trial Conducted October through November 2001 Applicability to Layperson: Participants correctly applied the CPSS and interpreted stroke symptom when directed by a trained investigator.	Interpretation by participants indicated accuracy of 93% for facial droop and arm drift, and 97% for speech. Overall layperson interpretation was 89% with 94% sensitivity and specificity of 83% Implementation: Study administered over a two month period of time (Oct –Nov 2001) Following a pilot study of six participants to optimize logistics and scripts, 70 recruited individuals were randomly exposed to either normal or abnormal patient-types (n=35 per type). Single individual portrayed mock	observer for inaccurate/ inconsistent role-play by the actor of patient-type. Nnon-emergent out-of-hospital setting utilized. Independent application of the CPSS with recognition of stroke symptoms by layperson was not evaluated.

				patient for all patient-types. Independent observation determined accuracy of administration of instructions. Facial droop and speech instruments were administered with 100% and arm drift instructions 99% accuracy. Investigator not blinded to patient-type for evaluation of how accurate the scale was administered by participant and interpretation of their results. Applicability to Layperson: Participants correctly applied the CPSS and interpreted stroke symptom when directed by a trained investigator.	
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**

Ferris, A., Robertson, R. Fabunmi, R., Mosca, L. 2005 Circulation, 111:1321-1326 Published: USA Research: US	American Heart Association and American Stroke Association National Survey of Stroke Risk Awareness Among Women	Assess current level of awareness and knowledge about stroke among women in the United States Evaluate differences in perception of stroke based on race/ ethnicity and age	Prospective Telephone Observational Study (3a) Screening Criteria: English-speaking women greater than 25 years old Screening between June 26 – July 14, 2003 32 questionnaire divided into four sections: • General awareness of general health issues • Communications and behaviors related to cardiovascular disease prevention • Specific understanding of cardiovascular disease and behaviors associated with prevention • Demographic characteristics Effectiveness: Low level of knowledge and	Screening Criteria: Sampling discontinued after 1024 households agreed to participate Racial/ethnic distribution of 68% white, 12% black, 12% Hispanic and 8% other Effectiveness: 89% indicated some form of heart disease may result in a stroke (true/false question) Identification of sudden weakness/ numbness of face or a limb on one side most prevalent response warning sign for women [white 39%, black 32%, Hispanic 29%] Difficulty talking for understanding speech was identified as a	Disorientation added as a stroke warning sign question Sudden weakness/ numbness as most prevalent warning sign unchanged from 2000 and 1997 survey data *JAMA*. 2006;296:2939-2946

			awareness about stroke among US women 20% of women overall stated worried a lot about stroke Fewer than 50% reported they did not worry about stroke at all Implementation: Utilized random-digit dialing to obtain national sample Targeted random-digit database sample created to ensure adequate numbers of black and Hispanic women 2025 households contacted with 1024 agreeing to participate Professional interviewers conducted phone screenings Stroke warning signs utilized were: • Sudden weakness/numbness of face or limb	warning sign of stroke by 26% of women Awareness to disorientation as a warning sign less than 10% for all women (white 8%, black 2% and Hispanic 4%) Implementation: Average of 10 minutes to complete the survey Applicability to Layperson: Identified the importance of continued efforts to increase public awareness of stroke risks Targeted educational initiatives should be directed at those at highest risk, specifically racial/ethnic minorities and the elderly	

			on one side • Sudden severe headache • Difficulty talking or understanding speech • Unexplained dizziness • Sudden dimness/loss of vision, often in one eye • Disorientation Disorientation added as stroke warning sign question Applicability to Layperson: Increased public awareness needed More black women reported easy access to accurate information (48%) compared to white women (32%)		
AUTHOR (Name, year, country)	**INSTRUMENT (Title, abbreviation)**	**POPULATIONS (Developed for, used with)**	**CONTENT (# items, categories, specific items)**	**SCORING (Concepts rated, rating scale)**	**MISC.**
Handschu, R., Reitmayer, M., Raschick, M., Erbjuth, F, Neundorfer, B., Babjar, E.	First aid in acute stroke	Investigation if first aid training may be useful for enhancing stroke awareness	Prospective Observational (2a) Offered by St. John Ambulance across Bavaria	Screening Criteria: 79% indicated a having prior information about stroke	Increased awareness and understandin g of stroke with only 3.6% not

2006 Journal of Neurology 253:1342-1346 Published: UK Research: Germany			Integrated within First Aid educational programs Analysis of 532/ 614 participants attending training (87%) Screening Criteria: Warning signs presented included: • Sudden uni- or bilateral weakness or numbness • Facial paresis • Speech disturbance • Blurred vision • Trouble in walking • Vertigo/ dizziness • Diplopia Effectiveness: Positive effect following intervention up from 28% to 70% Implementation: 15 – 20 minute focused audiovisual presentation on stroke was integrated into the	Baseline and post questions evaluated include: Stroke signs Definition of stroke Brain effected organ Explanation of stroke Specific data collected No/incorrect explanation Greater than 4 symptoms listed Effectiveness: Following the course 70% were able to correctly provide a description of stroke; up from the initial 28% of participants An increase from 1.52 to 3.35 stroke symptoms were identified post course Implementation: Pre-intervention a free text assessment of participant	able to list a symptom of stroke post course Question as to frequency of exposure for repetition of training needed Exposure to training in combination with existing requirement (e.g. driver license) may greatly enhance information disseminatio n

			8 to 16 hour first aid course First aid instructors were provided a booklet with more detailed information about stroke Applicability to Layperson: Mean number of stroke symptoms and number of participants giving correct descriptions of stroke more than doubled	knowledge explaining what is a stroke, name signs and symptoms and to describe how they would act in case of witnessing stroke Post course requested definition of stroke and to list symptoms of stroke Individual associated with any healthcare profession were excluded from analysis Applicability to Layperson: Upon completion of the intervention a difference in number of symptoms and portion of participants describes stroke symptoms correctly was highly significant	

Level of Evidence	Definitions (See manuscript for full details)
Level 1a	**Experimental and Population based studies** - population based, randomized prospective studies or meta-analyses of multiple higher evidence studies with substantial effects
Level 1b	**Smaller Experimental and Epidemiological studies** - Large non-population based epidemiological studies or randomized prospective studies with smaller or less significant effects
Level 2a	**Prospective Observational Analytical** - Controlled, non-randomized, cohort studies
Level 2b	**Retrospective/Historical Observational Analytical** - non-randomized, cohort or case-control studies
Level 3a	**Large Descriptive studies** – Cross-section, Ecological, Case series, Case reports
Level 3b	**Small Descriptive studies** – Cross-section, Ecological, Case series, Case reports
Level 4	**Animal studies or mechanical model studies**
Level 5	**Peer-reviewed Articles** - state of the art articles, review articles, organizational statements or guidelines, editorials, or consensus statements
Level 6	**Non-peer reviewed published opinions -** such as textbook statements, official organizational publications, guidelines and policy statements which are not peer reviewed and consensus statements
Level 7	**Rational conjecture** (common sense); common practices accepted before evidence-based guidelines
Level 1-6E	**Extrapolations** from existing data collected for other purposes, theoretical analyses which is on-point with question being asked. Modifier E applied because extrapolated but ranked based on type of study.