



CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Acute Stroke Management **Seventh Edition, Update 2022** **Appendix 3: Tables of Tools**

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APPENDIX 3: TABLES OF TOOLS

Table 3a: Standardized Acute Prehospital Stroke Screening Tools

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results (validity & reliability)
Cincinnati Pre-Hospital Stroke Scale (CPSS) Kothari et al. 1999	3 items: presence/absence of facial palsy; unilateral arm weakness; and speech impairment. Items simplified versions from the NIHSS. Abnormality demonstrated on one or more items is indicative of suspected stroke	171 patients with suspected stroke recruited through ED and inpatient neurology units. Mean age was 57.8 years, 58% male. Stroke/TIA prevalence: 49 (28.7%) Patients were assessed by 24 prehospital care providers (17 paramedics and 7 EMTs) and 2 NIH certified physicians, resulting in 860 total assessments.	Final discharge diagnosis of stroke	Validity Physicians: Sensitivity 1 abnormality 66%, 95% CI 49-80% 2 abnormalities 26%, 95% CI 14-43% 3 abnormalities 11%, 95% CI 3-26% Physicians: Specificity 1 abnormality 87%, 95% CI 80-92% 2 abnormalities 95%, 95% CI 90-98% 3 abnormalities 99%, 95% CI 95-100% Prehospital care workers: Sensitivity 1 abnormality 59%, 95% CI 51-67% 2 abnormalities 27%, 95% CI 21-35% 3 abnormalities 13%, 95% CI 8-20% Prehospital care workers: Specificity 1 abnormality 88%, 95% CI 86-91% 2 abnormalities 96%, 95% CI 94-97% 3 abnormalities 98%, 95% CI 96-99% The validity of this scale has been evaluated further, by both the scale developers and independent researchers. Reliability ICC for total scores among all prehospital workers was 0.92, 95% CI 0.89-0.93 ICC for total scores between prehospital workers and physicians was 0.92, 95% CI 0.89-0.93
Face Arm Speech Test	3 items derived from the CPSS: facial palsy, arm weakness, speech	487 patients admitted by ambulance, primary	WHO criteria	Validity Sensitivity: Diagnostic sensitivity of FAST associated

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results (validity & reliability)
(FAST) Harbinson et al. 2003	disturbance. Assessment of speech is not dependent on the repetition of a stock phrase, as per CPSS, but assessed during by EMS during normal conversation with the patient. Abnormality demonstrated on one or more items is indicative of suspected stroke	care physicians and ED referrals with suspected stroke. Mean age was 72 years, 52% were female Stroke/TIA prevalence: 356 (73.1%). FAST was completed by paramedics over a 6-month period		with paramedic use was estimated to be 79%. PPV (arrival by ambulance): 78%, 95% CI 72-84% The validity of this scale has been evaluated further, by independent researchers. Reliability Not assessed in this publication, but has been subsequently evaluated .
Los Angeles Prehospital Stroke Screen (LAPSS) Kidwell et al. 2000 (Prospective validation study)	6 items: 4 screening/history items (age>45 years, no history of seizures, symptom duration <24 hours, ambulation status at baseline not bedridden or wheelchair bound), blood glucose (between 60 and 400) level, a clinical assessment (of 3 items to identify obvious asymmetry: facial palsy, grip, arm strength). If the patient has positive criteria, a blood glucose level within the specified range and unilateral weakness on the clinical exam items, they are a positive screen for stroke.	206 patients (of 1,298 total runs) with neurological symptoms, who were noncomatose, with nontraumatic cause, who had a LAPSS screen conducted. Mean age was 67 years, 52% were male. Stroke/TIA prevalence: 36 (17.5%) LAPSS was completed by 18 paramedics over a 7-month period.	Hospitalized patients with final diagnosis of stroke	Validity Sensitivity: 91%, 95% CI 76-98% Specificity: 97%, 95% CI 93-99% PPV: 86%, 95% CI 70-95% NPV: 98%, 95% CI 95-99% Accuracy: 96%, 95% CI 92-98% + LR: 31, 95% CI 16-147 - LR: 0.09, 95% CI 0-0.21 This validity of this scale has been evaluated further, by both the scale developers and independent researchers. Reliability Not assessed
Ontario Prehospital Stroke Screen (OPSS) Chenkin et al. 2009	At least one of the following symptoms must be present: unilateral leg/arm weakness or drift; slurred speech or muteness; unilateral facial droop), and the patient can be transported to arrive at a stroke centre within 3.5 hours of symptom onset.	325 patients transported to a stroke centre, who had been screened as positive by paramedics using the OPSS. Patients were identified through a National Stroke Registry. Mean age was 73.7 years, 47.4% were male. Stroke prevalence: 187	Final discharge diagnosis	Validity Since all patients included in the sample, were screened as positive, sensitivity and specificity could not be calculated. PPV for acute stroke (1,2, or 3 positive signs): 89.5%, 95% CI 85.7-92.7% No additional validation studies have been conducted on this scale. Reliability Not assessed

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results (validity & reliability)
		(58%) An unknown number of EMS workers conducted OPSS over a one-year period		
Melbourne Ambulance Stroke Screen (MASS) Bray et al. 2005	Combination of items from CPSS and LAPSS. The presence of any physical assessment item + a response of “yes” to all history items indicates a positive screen	100 MASS assessments were conducted on patients with suspected stroke (total of 5,957 paramedic calls during the study period) Stroke/TIA prevalence: 73 (73%) 18 paramedics conducted MASS assessments over a one-year period	Final discharge diagnosis	Validity Sensitivity: 90%, 95% CI 81-96% Specificity: 74%, 95% CI 53-88% PPV: 90%, 95% CI 81-96% NPV: 74%, 95% CI 53-88% +LR: 3.49, 95% CI 1.83-6.63 -LR: 0.13, 95% CI 0.06-0.27 Accuracy: 86% (Validity of LAPSS and CPSS was also assessed. CPSS had highest sensitivity at 95%, LAPSS had highest specificity at 85%) This validity of this scale has been evaluated further, by the scale developers. Reliability Not assessed
Recognition of Stroke in the Emergency Room Scale (ROSIER) Nor et al. 2005	7-items: 2 clinical history items (loss of consciousness, convulsive fits/syncope) and 5 neurological signs of stroke (facial palsy/weakness, arm weakness, leg weakness, speech disturbance and visual field defect). A -1 is awarded for each clinical history item present and a +1 for each neurological sign. Total scores range from -2 to +5. A score >0 is associated with possible stroke.	160 consecutive patients with suspected stroke presenting to the Emergency Department (ED) Stroke/TIA prevalence: 101 (63.1%) Assessments were conducted by ED physicians during a one-year period	Final diagnosis made by stroke consultant after review of symptoms and imaging findings	Validity (Prospective validation study) Sensitivity: 93%, 95% CI 89-97% Specificity: 83%, 95% CI 77-89% PPV: 90%, 95% CI 85-98% NPV: 88%, 95% CI 83-93% (Validity of LAPSS, FAST and CPSS was also assessed. CPSS had highest sensitivity at 85%, LAPSS had highest specificity at 85%). The validity of this scale has been evaluated further by independent researchers. Reliability Not assessed
Medic Prehospital	The scale was developed by combining the strongest elements	416 patients with suspected stroke,	Final discharge diagnosis	Validity Sensitivity: 74.2%, 95% CI 67.2-80.2%

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results (validity & reliability)
Assessment for Code Stroke (MedPACS) Studneck et al. 2013	of CPSS and LAPSS and included: eligibility criteria-no prior history of seizure; onset of symptoms ≤25 hours, blood glucose 60-400 mg/mL and a physical exam (facial droop, arm/leg weakness; speech difficulty; and gaze preference) The presence of any physical assessment item + a response of “yes” to at least one eligibility criterion item indicates a positive screen	transported to one of 7 hospitals. Mean age was 66.8 years, 45.7% were male. Stroke prevalence: 186 (44.7%) EMS reports and stroke GWTG-S registries were reviewed over a 6-month period		Specificity: 732.6%, 95% CI 26.7-39.1% PPV: 47.1%, 95% CI 41.3-53.0% NPV: 61.0, 95% CI 51.8-69.6% + LR: 1.10, 95% CI 0.973-1.24 - LR: 0.791, 95% CI 0.582-1.07 The validity of the CPSS was also assessed (SN: 79%, SP: 24%) No additional validation studies have been conducted on this scale. Reliability Not assessed

PPV: Positive Predictive Value; NPV: Negative Predictive Value; LR Likelihood Ratio

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Table 3b: Additional Tools

Assessment Tool	Number and description of Items	Time to Administer	Reliability/validity	Interpretation of Scores	Sensitivity and Specificity	Training Required
Glasgow Coma Scale (GCS) Teasdale & Jennett 1974¹	15 items in 3 categories: motor response (6 items), verbal response (5 items), and eye opening (4 items). Points are awarded for the best response in each category. Categories are summed to provide a total score.	Approximately 1 minute.	Interobserver reliability: Scale authors reported low rates of disagreement, but noted variations in motor responses based on stimulus used ². Reported agreements ranged 0.48 (verbal) to 0.72 (eye opening)³ and from 0.39 – 0.79.⁴ Percentage agreements have been reported as 90% overall, and as ranging from 83.8% (eye opening, right) to 98.7% (best motor response – left).⁵ In addition, similar rates of between observer agreement have been reported in groups of experienced nurses (98.6% - 100%), newly graduated nurses (94.3%-96.2%) and student nurses (77.3% - 100%).⁶ Construct Validity: In review of GCS, evidence supports association between extent of brain damage and depth of coma as assessed on GCS. GCS scores significantly associated with length	GCS scores range from 3 – 15, where 3 represents total unresponsiveness and 15 represents alert and fully responsive. Scores may be divided into categories by severity: 13-15 = mild; 9-12 = moderate and ≤8 represents severe injury. ²¹	Not reported	Yes.

Assessment Tool	Number and description of Items	Time to Administer	Reliability/validity	Interpretation of Scores	Sensitivity and Specificity	Training Required
			of coma ($p < 0.0001$).⁷ Predictive Validity: GCS score is a significant predictor of death following stroke⁸,⁹ or traumatic brain injury (modified by age and mechanism of injury)¹⁰, though eye-opening may be less strongly associated than either the motor or verbal score components.¹¹ GCS scores are also predictive of survival (AUC=0.89), though eye-opening may not add to predictive accuracy.¹² GCS scores have been demonstrated to be predictive of Glasgow Outcome scores at 6 months to 1 year post injury^{7, 13-16}, Disability Rating Scale scores at discharge¹⁷ and at 6 months¹⁸, FIM scores at discharge^{17, 19} and employment status at one year.²⁰			

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Table 3c Prehospital Stroke Screening Scales to Identify Large Vessel Occlusions (LVO)

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results
Wasyliw et al. 2022 Face, Arm, Speech, Time-Vision Aphasia Neglect (FAST VAN)	3 components 1. Vision: Is there a gaze preference to either side (usually away from the hemiparesis)? 2. Aphasia: Ask the patient to name simple objects (ie: watch, pen). 3. Neglect: With eyes closed, touch each arm independently and ask which side is being touched. Then touch both simultaneously. If neglect is present the patient will only report one side being touched, almost always neglecting the left side. Any single positive response was considered to be positive for LVO.	1,080 consecutive acute stroke patients attended to by EMS personnel between April 2017 and Jan 2021.	CTA	Of 440 patients who were FAST-VAN +ve, 236 (53.6%) had LVO. Of 640 patients who were FAST-VAN -ve, 40 (6.25%) had LVO. Sensitivity was 86%; specificity was 75%. Overall accuracy was 77%. Among the 240 false positives (+ve FAST VAN, no LVO), 69 patients were stroke with no LVO, 47 were ICH, 30 had delirium/encephalopathy, 23 had seizures, 14 had TIA, and 21 had other conditions
Okuno et al. 2020 Field Assessment of Critical Stroke by Emergency Services for Acute Delivery (FACE₂AD)	6 items 1. Facial palsy (0-1) 2. Arm palsy (0-1) 3. Consciousness impairment (0-1) 4. Eye deviation (0 or 2) 5. Atrial fibrillation (0-1) 6. Diastolic blood pressure ≤ 85 mmHg (0-1) Total possible score: 7	1157 patients were included in the derivation cohort. They were patients taken to hospital by EMS because of suspected stroke or consciousness disturbance in the first 24 hours of symptom onset, from 2012 and 2015. 502 patients were included in the validation cohort, using same criteria. Patients were recruited from 4 hospitals during a 5-month period. All the items except eye	MRA, CTA, digital subtraction angiography (DSA)	In the derivation cohort, 416 patients had ischemic stroke of which 149 (13%) patients had LVO. In the validation cohort, at a cut point of ≥3, the sensitivity and specific were 0.85 and 0.80, respectively. PPV and NPV were 0.39 and 0.97, respectively. AUC was 0.88 (95% CI 0.87–0.90). In the validation cohort, 216 patients (43%) had an ischemic stroke, of which 86 (17%) patients had an LVO. In the validation cohort, at a cut point of ≥3, the sensitivity and specific were 0.80 and 0.74, respectively. PPV and NPV were 0.39 and 0.95, respectively. AUC was 0.83 (95% CI 0.81–0.86).

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results
		deviation were evaluated by EMS providers, while eye deviation was evaluated by physicians or nurses.		
Gong et al. 2020 The Conveniently-Grasped Field Assessment Stroke Triage (CG-FAST) scale	5 items based on NIHSS 1. Level of Consciousness questions (0-1) 2. Gaze deviation (0-1) 3. Facial palsy (0-1) 4. Arm weakness (0-1) 5. Speech changes (0-1) Total possible score: 5	1,355 patients, admitted to a single centre from 2009 to 2018 with confirmed acute ischemic stroke with symptom onset within the previous 8 hours. Median NIHSS on admission was 8 (IQR 3–15). NIHSS data was abstracted from patient records by an experienced neurologist	CTA or MRA	664 patients (49.0%) were found to have LVO At a cut-point of ≥ 4 Sensitivity: 61.7% Specificity: 81.0% Positive predictive value: 78.5% Negative predictive value: 69.2% AUC was 0.758 Youden Index: 0.428 At a cut-point of ≥ 4 , the performance of the CG-FAST was better than FAST-ED ≥ 3 , 3-ISS ≥ 3 , CPSS ≥ 2 , PASS ≥ 2 , RACE ≥ 5 , LAMS ≥ 3 , and G-FAST ≥ 3
Vidale et al. 2019 The Large ARtery Occlusion (LARIO) stroke scale	5 items, based on LAMS 1. Facial palsy (0-1) 2. Arm weakness (0-1) 3. Grip strength (0-1) 4. Language (0-1) 5. Neglect (0-1) Total possible score: 5	145 patients with suspected ischemic stroke presenting to an emergency department of one hospital between April and October 2017. The scale was developed and tested on the same cohort of patients. Both a neurologist and a nurse performed all assessments.	CT/CTA	54 patients (37.2%) were found to have LVO. At a cut point of >3 on The LARIO scale: Sensitivity: 100% Specificity: 83% + LR: 0.77 - LR: 1.0 AUC: 0.951 (95% CI 0.902-0.980) Compared with other scales, NIHSS had the best performance (AUC 0.915). AUC for CPSS (0.896), LAMS (0.832) and VAN (0.884). There was excellent agreement between raters (Cohen's k: 0.963).
Gropen et al. 2018 The Emergency Medical Stroke	5 items, based on NIHSS 1. Eye movement (0-1) 2. Facial weakness (0-1) 3. Arm weakness (0-1) 4. Leg weakness (0-1)	1,663 consecutive adult stroke patients enrolled in the Tulane Comprehensive Stroke Center (CSC) registry from 2008 to 2013.	CTA or MRA	LVO was present in 171 patients (10.3%) A cut-point of ≥ 3 on EMSA had the best performance to identify LVO Sensitivity: 74.5% (95% CI 68.7-80.5)

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results
Assessment Tool (EMSA)	5. Slurred speech or aphasia (0-2) Total possible score: 6	Acute stroke cohort: Used to develop the EMSA. 218 stroke patients in 2010, based on chart review.		Specificity: 50.3% (95% CI 44.4-56.2) + LR: 1.517 (95% CI 1.356-1.659) - LR: .489 (95% CI .366-0.637) Performance of EMSA was also compared with 3I-SS, C-STAT, RACE, FAST-ED, and NIHSS (3 different cut points). An EMSA ≥ 3 had a significantly higher sensitivity for prediction of LVO compared with the other scales at their published cut-points but had lower specificity. The area under the curves for the scales were similar across scales EMSA 0.688 (95% CI .736-0.640) 3I-SS 0.647 (95% CI 0.696-0.597) C-STAT 0.646 (95% CI 0.693-0.598) RACE 0.666 (95% CI 0.716-0.616) FAST-ED 0.641 (95% CI 0.690-0.591) NIHSS 0.678 (95% CI 0.723-0.633) A cut point of ≥ 1 on a variety of scales resulted in sensitivities and specificities (95% CI) of: EMSA 93.3% (86.9-96.7), 46.9% (38.0-56.1) 3I-SS 74.3% (65.2-81.7) 54.0% (44.8-62.9) C-STAT 36.2% (27.6-45.7), 74.3% (65.6-81.5) RACE 84.8% (76.7-90.4), 55.8% (46.6-64.6) FAST-ED 78.1% (69.3-84.9), 54.9% (45.7-63.7)
Field Assessment Stroke Triage for Emergency Destination (FAST-ED) Lima et al. 2016	6-items, 5 based on NIHSS 1. Facial palsy (0-1) 2. Arm weakness (0-2) 3. Speech changes (0-2) 4. Eye deviation (0-2) 5. Denial/neglect (0-2) 6. Time (documentation for decision-making) not scored Total possible score: 9	741 consecutive patients enrolled in the STOP Stroke study, who were admitted to 2 university-based hospitals with unilateral, complete occlusion of the M1 and M2 segments of the MCA or basilar artery, with onset of symptoms within 24 hours. Prevalence of LVO: 240	CTA	A cut-point of ≥ 4 on FAST-ED had best performance Sensitivity: 0.61 Specificity: 0.83 PPV: 0.72 NPV: 0.82 Accuracy: 0.79 AUC:0.813 Performance of FAST-ED was also compared with NIHSS, RACE and CPSS scale

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results
		(33%)		
Vision, Aphasia, and Neglect (VAN) Teleb et al. 2016	Patients are asked to raise both arms up and hold them up for 10 s. If the patient demonstrates any level of drift, weakness or paralysis, the assessment continues. Otherwise, patient is VAN -ve and screen ends. Items Visual disturbances: field cut, double vision, new-onset blindness (present/absent) Aphasia: Expressive, receptive, mixed (present/absent) Neglect: Forced gaze, unable to feel both sides at same time or doesn't recognize arm, ignoring one side (present/absent) Scoring: None If weakness present + ≥1 positive finding =VAN +ve	62 acute stroke codes at a single facility Prevalence of LVO: 19 (30.6%)	CTA	Performance of VAN was also compared with NIHSS ≥6 For VAN +ve patients Sensitivity: 1.00 Specificity: 0.90 PPV: 0.74 NPV: 1.00 Accuracy: 0.92 NIHSS≥6 Sensitivity: 1.00 Specificity: 0.79 PPV: 0.58 NPV: 1.00 Accuracy: 0.84
Prehospital Acute Stroke Severity Scale (PASS) Hastrup et al. 2016	3 NIHSS items: 1. Incorrect month and/or age? (Level of consciousness (NIHSS item >0) 1 point 2. Gaze palsy and/or deviation (NIHSS item gaze>0) 1 point 3. Arm weakness (NIHSS item arm weakness >0) 1 point Total possible score: 3	3,127 patients included in the Danish Stroke Registry (2010-2015) who were treated with t-PA. 2/3 of sample was used for scale development and 1/3 for validation Prevalence of LVO: 35%	CTA/MRA	A cut-point of ≥2 on the PASS had the best predictive value: Using the Derivation cohort Sensitivity 0.66, 95% CI 0.62-0.66 Specificity: 0.83, 95% CI 0.81-0.85 AUC: 0.74, 95% CI 0.72-0.76 OR=9.22, 95% CI 7.5-11.40 PPV/NPV: 0.68/0.81 +LR/-LR: 3.84/0.42 The values were similar when using the validation cohort
Cincinnati Prehospital Stroke	3 NIHSS items:	Derivation cohort-624 patients with mild to severe stroke from 2	CTA	Severe stroke AUC: 0.89 A cut point of ≥2 had the best predictive value for

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results
Severity Scale (CPSSS) Katz et al. 2015	1. Conjugate gaze deviation (≥ 1 on NIHSS item for gaze) 2 points 2. Incorrectly answers to at least 1 of 2 LOC questions (NIHSS age or current month) and does not follow at least 1 of 2 commands (close eyes, open and close hand) ≥ 1 NIHSS items LOC 1b and 1c. 1 point 3. Cannot hold arm (left, right or both) up for 10 seconds (≥ 2 NIHSS motor arm). 1 point Total possible score 4	NINDS t-PA trials. Validation cohort-650 patients from the IMS-III trial Prevalence of LVO: 34% (validation cohort)		severe stroke Using the derivation cohort Sensitivity: 89% Specificity: 73% + LR/-LR: 3.30/0.15 Using the validation cohort: Sensitivity: 92% Specificity: 51% + LR/-LR: 1.89/0.1
Pérez de la Ossa et al. 2014 Rapid Arterial occlusion Evaluation Scale (RACE)	5 NIHSS items: 1. Facial palsy (absent=0, mild=1, mod/severe=2) 2. Arm motor function (normal/mild=0, moderate=1, severe=2) 3. Leg motor function (normal/mild=0, moderate=1, severe=2) 4. Head and gaze deviation (absent=0, present=1) 5. Aphasia (R hemiparesis: performs both tasks correctly=0, performs 1 task correctly=1, performs neither tasks=2); Agnosia (Left hemiparesis: patient recognizes arm/impairment=0, does not recognize arm or impairment=1, does not recognize arm and impairment=2) Total possible score 9	Derivation cohort-654 patients with acute stroke or stroke mimic for whom a stroke code had been activated by EMS or a community hospital. Validation cohort-357 patients transferred by EMS to a stroke centre Prevalence of LVO: 178 patients (27%) had a LVO in derivation cohort vs. 76 (21.3%) in the validation cohort.	Transcranial Doppler, CT or MRA	In the derivation cohort, there was a strong correlation between RACE and NIHSS ($r=0.76$, $p<0.01$) In the validation cohort, a cut point of ≥ 5 had the best predictive value for detecting LVO Sensitivity: 85% Specificity: 68% PPV: 42% NPV: 94% The AUC for the RACE scale was 0.82, 95% CI 0.77-0.87 for the detection of LVO
The Los	3 items:	119 patients included in	MRA/CTA, or	AUC: 0.854

Assessment Tool Author	Items/Scoring	Sample	Reference Standard	Results
Angeles Motor Scale (LAMS) Nazliel et al. 2008	1. Facial droop (absent=0, present=1) 2. Arm drift (absent=0, drifts down=1, falls rapidly=2) 3. Grip strength (normal=0, weak=1, no grip=2) Total possible score 5	a clinical trials registry at a stroke centre from 1996-2003, and patients included in the Get with the Guidelines Registry in 2005. Patients were included if they were last known well within 12 hours of presentation to the ED and had a final diagnosis of ischemic stroke in the anterior circulation Prevalence of LVO: 74 (62%)	catheter angiography	A cut point of ≥ 4 had the best predictive value for detecting LVO Sensitivity: 81% Specificity: 89% Accuracy: 85% +LR: 7.36 -LR: 0.21
3-Item Stroke Scale (3ISS) Singer et al. 2005	3 items: Disturbance of consciousness (no=0, mild=1, severe=2) Gaze and head deviation (absent=0, incomplete gaze/head deviation=1, forced gaze/head deviation=2) Hemiparesis (absent=0, moderate=1, severe=2) Total possible score 6	180 patients presenting to a stroke unit in 2002 with symptoms of stroke within ≤ 6 hours (28 patients had ICH). Prevalence of LVO: 27 (15%)	MRI/MRA/CT	A cut point of ≥ 4 had the best predictive value for detecting MCA occlusions Sensitivity: 67% Specificity: 92% PPV: 74% NPV: 89% Accuracy: 86% Inter-rater reliability: Intraclass correlation co-efficient was 0.947; K for individual items were 0.77, 0.77 and 0.84

PPV: Positive Predictive Value; NPV: Negative Predictive Value; LR Likelihood Ratio; AUC Area under curve

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Table 4 Canadian Stroke Best Practices Screening and Assessment Tools for Acute Stroke Severity

Assessment Tool	Purpose	Items and Administration	Interpretation of Scores	Availability
Neurological status/stroke severity				
Canadian Neurological Scale (CNS) Cote et al. 1986	Evaluate and monitor the neurological status (cognitive and motor function) of patients who are conscious (alert or drowsy) in the acute phase of stroke	Items assess mentation (level of consciousness, orientation, and speech) and motor function (face, arm, and leg). Motor function evaluations are separated into sections A1 and A2. A1 is administered if the patient is able to understand and follow instructions (5 items). A2 is administered if there are comprehension deficits (3 items). Takes approximately 5-10 minutes to administer.	Motor items are rated in terms of severity. Ratings are weighted and summed to provide a total score out of 11.5. Lower scores indicate increased stroke severity.	Free download at several sites (e.g., https://strokengine.ca/wp-content/uploads/2020/07/canadian-neurological-scale_strokecenter.pdf)
National Institutes of Health Stroke Scale (NIHSS) Lynden et al. 1994	Evaluate neurologic outcome and degree of recovery for stroke patients.	15 items: Impairment in level of consciousness (LOC), ability to respond to questions/ obey simple commands, papillary response, gaze deviation, hemianopsia, facial palsy, resistance to gravity (weaker limb), plantar reflexes, limb ataxia, sensory loss, visual neglect, dysarthria, and aphasia. Each item is graded on an ordinal scale from 0-3 or 0-4 where 0=no impairment. Takes approximately 6 minutes to administer	Total scale score = 0-42. Higher scores reflect greater severity. Stroke severity may be stratified as follows: >25 = very severe, 15–24 = severe, 5–14 = mild to moderately severe and 1–5 = mild	Free download at: https://www.stroke.nih.gov/documents/NIH_Stroke_Scale_508C.pdf
Glasgow Coma Scale (GCS) Teasdale & Bennett 1974	Describe the depth and duration of impaired consciousness or coma. Typically used following traumatic brain injury	15 items in 3 categories: motor response (6 items), verbal response (5 items), and eye opening (4 items). Points are awarded for the best response in each category. Categories are summed to provide a total score. Takes approximately 1 minute to administer.	GCS scores range from 3–15, where 3 represents total unresponsiveness and 15 represents alert and fully responsive. Scores may be divided into categories by severity: 13–15 = mild; 9–12 = moderate, and ≤8 represents severe injury.	Free download at: http://www.strokecenter.org/wp-content/uploads/2011/08/glasgow_coma.pdf
Glasgow Outcome Scale (GOS) Jennett & Bond 1975	A global outcome scale which categorizes the outcomes of patients after traumatic brain	5 categories: 1 Death	It has become common practice in clinical trial administration to use a modified version that places the scores in reverse order (i.e., "good recovery" =	Free download at: http://www.strokecenter.org/wp-content/uploads/2011/08/

Assessment Tool	Purpose	Items and Administration	Interpretation of Scores	Availability
	injury (TBI). Can also be used for long-term prediction of rehabilitation after TBI.	2 Persistent vegetative state. Patient exhibits no obvious cortical function. 3 Severe disability (conscious but disabled). Patient depends upon others for daily support due to mental or physical disability or both. 4 Moderate disability (disabled but independent). Patient is independent as far as daily life is concerned. The disabilities found include varying degrees of dysphasia, hemiparesis, or ataxia, as well as intellectual and memory deficits and personality changes. 5 Good recovery. Resumption of normal activities even though there may be minor neurological or psychological deficits.	1, "moderate disability" = 2, etc.). The Extended GOS (GOSE) provides more detailed categorization into 8 categories by subdividing the categories of severe disability, moderate disability, and good recovery into a lower and upper category. (Teasdale et al., 1988).	glasgow_outcome.pdf
Assessment of function				
Modified Rankin Scale (mRS) van Swieten et al. 1988	The mRS is an assessment tool for rating global outcome following stroke.	Individuals are assigned a subjective grade or rank ranging from 0 (no symptoms) to 5 (severe disability) based on level of independence with reference to pre-stroke activities rather than observation of task-based performance. Takes approximately 15 minutes to administer.	mRS scores range from 0–5 such that 0 is indicative of no symptoms, while a rank of 5 is indicative of the most severe disability (described as bedridden, incontinent, requiring constant nursing care).	Free download at: http://www.strokecenter.org/wp-content/uploads/2011/08/modified_rankin.pdf
AlphaFIM® Instrument Stillman et al. 2009	An assessment tool designed to assess caregiver burden during acute care.	6 items assessing motor (eating, grooming, bowel management, and toilet transfers) and cognitive (expression and memory) function, which can be reliably collected in acute care. For patients who are able to walk 150 feet or more, eating and grooming items are replaced by items evaluating walking and bed transfer.	Alpha-FIM® scores are transformed to a projected FIM® scores and an estimate of patient burden of care hours using an online proprietary algorithm	Available for purchase at: www.udsmr.org/WebModules/Alpha/Alp_About.aspx

Assessment Tool	Purpose	Items and Administration	Interpretation of Scores	Availability
		Takes approximately 5 minutes to complete.		
Barthel Index of Activities of Daily Living (BI) Mahoney & Barthel 1965	An assessment tool for evaluating independence in self-care activities.	The BI consists of 10 common activities of daily living (ADLs), 8 related to personal care and 2 related to mobility. Administration: Self-report (<5 minutes) or direct observation (up to 20 minutes).	The index yields a total score out of 100, with higher scores indicating greater functional independence.	Free download at: http://www.strokecenter.org/wp-content/uploads/2011/08/barthel.pdf
Scales to assess severity following intracranial hemorrhage				
Hunt & Hess Classification of Subarachnoid Hemorrhage (SAH) Hunt & Hess 1968	Designed to gauge surgical risk and aid neurosurgeons in deciding on the appropriate time after SAH at which the neurosurgeon should operate.	The grades are based on the opinion of its authors, who judged that the most important clinical signs of SAH were: (a) the intensity of meningeal inflammatory reaction, (b) the severity of neurological deficit, (c) the level of arousal, and (d) the presence of associated disease. Individuals are assigned a subjective grade of I to V.	I – asymptomatic or mild headache II – moderate-severe headache, meningism and no weakness III – mild alteration in mental status IV – depressed LOC and/or hemiparesis V – posturing or comatose	Free download at: http://www.strokecenter.org/wp-content/uploads/2011/08/hunt_hess.pdf
World Federation of Neurological Surgeons Grading Scale Drake et al. 1988	Designed to assess the severity of SAH and to predict outcome.	The scale combines the results of the GCS plus the presence or absence of motor deficits. GCS 15 + absence of motor deficits = Grade 1 GCS13-14 + absence of motor deficits = Grade 2 GCS13-14 + motor deficits present = Grade 3 GCS 7-12 + motor deficits present/absent = Grade 4 GCS 3-6 + motor deficits present/absent = Grade 5	Maximum score of 15 has the best prognosis Minimum score of 3 has the worst prognosis Scores of 8 or above have a good chance for recovery Scores of 3 to 5 are potentially fatal, especially if accompanied by fixed pupils or absent oculovestibular responses	Free download at: http://www.strokecenter.org/wp-content/uploads/2011/08/WWF_scale.pdf
Fisher Grading Scale for Subarachnoid Hemorrhage (SAH) Fisher et al. 1980	Used to predict cerebral vasospasm after SAH.	Grade 1 - No subarachnoid blood seen on CT scan Grade 2: Diffuse or vertical layers of SAH <1 mm thick Grade 3: Diffuse clot and/or vertical layer > 1 mm thick	Risk of vasospasm Grade 1: Low (0-21%) Grade 2: Low (0-25%) Grade 3: Low to high (23% to 96%) Grade 4: Low to moderate (range 0-35%)	Free download at: http://www.strokecenter.org/wp-content/uploads/2011/08/WWF_scale.pdf

Assessment Tool	Purpose	Items and Administration	Interpretation of Scores	Availability
Intracerebral Hemorrhage (ICH) Score Hemphill et al. 2001	Used to grade ICH severity and subsequent 30-day mortality, based on age and CT findings.	Grade 4: Intracerebral or intraventricular clot with diffuse or no subarachnoid blood Components for ICH score include: GCS score 3-4: 2 points 5-12: 1 point 13-15: 0 points <i>ICH volume</i> ≥30 cm³: 1 point < 30 cm³: 0 points <i>IVH (intraventricular hemorrhage)</i> Yes: 1 point No: 0 points <i>Infratentorial origin of ICH</i> Yes: 1 point No: 0 points <i>Age</i> Age ≥80 years: 1 point < 80 years: 0 points	ICH scores with corresponding mortality risk are as follows: 0 points: 0% 1 point: 13% 2 points: 26% 3 points: 72% 4 points: 97% 5 points: 100% 6 points: 100% (estimated)	Free calculator at: https://qxmd.com/calculator/calculator_118/ich-score

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Useful Links

1. Additional information regarding the CNS, NIHSS, mRS, and FIM is available at www.ebrsr.com and at www.strokingengine.ca
2. There is a site for international users of the NIHSS scale – it may be found here: <http://www.nihstrokescale.org/> It provides links to the scale in English, as well as lots of good training information – but it also provides links to the scale in quite a number of other languages as well.
3. An online calculator for many of the scales listed above: <https://www.mdcalc.com/>
4. The Rankin scale has its own website: <http://www.rankinscale.org/>
5. The FIM is also reviewed at: <http://www.rehabmeasures.org/lists/rehabmeasures/disppform.aspx?id=889>

Table 5 Canadian Stroke Best Practices: Selection of Validated Swallowing Screening Tools

Author/ Name of test	Components of test Details of validation study	Results of original validation study
Daniels et al. 1997¹ “Any Two”	Items included 6 clinical features. Dysphonia, dysarthria, abnormal volitional cough (includes water-swallowing test), abnormal gag reflex, cough after swallow, and voice change after swallow were assessed. Scoring: Presence of any 2 of the items distinguished patients with/without dysphagia. Sample: 59 acute stroke survivors were studied within 5 days of hospital admission.	Diagnostic standard: VMBS exam Prevalence of dysphagia: 74.6% The sensitivities and specificities of individual items ranged from 31%-76.9% and 61%-88%, respectively. Overall: Sensitivity: 92% Specificity: 67%
Trapl et al. 2007⁴ The Gugging Swallowing Screen (GUSS)	Preliminary Assessment (vigilance, throat clearing, saliva swallow) Direct swallow (semisolid, liquid, solid swallow trials) Scoring: Total scores ranged from 0 (worst) - 20 (no dysphagia). A cut-off score of 14 was selected. Sample: 50 first-ever acute stroke patients with suspected dysphagia.	Diagnostic standard: Fiberoptic endoscopic evaluation using the Penetration Aspiration Scale to interpret the results. Prevalence of dysphagia: 73% First group of 19 patients using the GUSS to identify subjects at risk of aspiration: Sensitivity: 100% Specificity: 50% Second group of 30 patients Sensitivity: 100% Specificity: 69% Interrater reliability: Kappa=0.835
Martino et al. 2009⁵ The Toronto Bedside Swallowing Screening Test (TOR-BSST)	Items included presence of dysphonia before/after water swallowing test, impaired pharyngeal sensation, and abnormal tongue movement. Scoring: pass=4/4 items; fail ≥1/4 items Sample: 311 stroke patients (103 acute, 208 rehabilitation)	Diagnostic standard: VMBS exam. Prevalence of dysphagia: 39% Sensitivity: 91% Specificity: 67% Interrater reliability (based on observations from 50 subjects) ICC =0.92 (95% CI: 0.85-0.96)
Edmiaston et al. 2009 USA⁶ Acute Stroke Dysphagia Screen	Items included Glasgow Coma Scale score <13, presence of facial, tongue or palatal asymmetry/weakness. If no to all 3 items, then proceed to 3 oz water swallowing test. Scoring: If there is evidence of change in voice quality, cough, or	Diagnostic standard: Mann Assessment of Swallowing Ability (MASA), performed by a SPL. Prevalence of dysphagia: 29% Sensitivity (Dysphagia): 91% Specificity: 74%

Author/ Name of test	Components of test Details of validation study	Results of original validation study
	change in vocal quality 1 minute after water swallowing test = fail. Sample: 300 acute stroke patients screened by nurses within 8 to 32 hours following admission.	Sensitivity (Aspiration risk): 95% Specificity: 68% Interrater reliability: Kappa=94%
Turner-Lawrence et al. 2009⁷ Emergency Physician Dysphagia Screen	The two-tiered bedside tool was developed by SLPs. Tier 1 items included voice quality, swallowing complaints, facial asymmetry, and aphasia. Tier 2 items included a water swallow test, with evaluation for swallowing difficulty, voice quality compromise, and pulse oximetry desaturation ($\geq 2\%$). Patients failing tier 1 did not move forward to tier 2. Scoring: Patients who passed both tiers were considered to be low-risk. Sample: A convenience sample of 84 stroke patients (ischemic/hemorrhagic) screened by 45 ER MDs.	Diagnostic standard: formal assessment conducted by an SLP Prevalence of dysphagia: 57% Sensitivity: 96% Specificity: 56% Interrater reliability: Kappa=0.90
Antonios et al. 2010⁸ Modified Mann Assessment of Swallowing Ability (MMASA)	12 of the 24 MASA items were retained including alertness, co-operation, respiration, expressive dysphasia, auditory comprehension, dysarthria, saliva, tongue movement, tongue strength, gag, volitional cough, and palate movement. Scoring: Maximum score is 100 (no dysphagia). A cut-off score of 94 was used to identify patients at risk of dysphagia. Sample: 150 consecutive patients with acute ischemic stroke were assessed by 2 neurologists shortly after admission to hospital.	Diagnostic standard: MASA conducted by SLP Prevalence of dysphagia: 36.2% Sensitivity: 87% & 93% Specificity: 86% & 84% Interrater reliability: Kappa=0.76
Schrock et al. 2011⁹ MetroHealth Dysphagia Screen	5 Items included alert and able to sit upright for 10 minutes; weak, wet, or abnormal voice; drooling; slurred speech; and weak or inaudible cough. Scoring: ≥ 1 items answered yes=failed screen. Sample: 283 patients admitted to the Emergency department with acute stroke and screened for the presence of dysphagia by nurses	Diagnostic standard: VMBS Prevalence of dysphagia at 30 days: 32% Sensitivity: 95% Specificity: 55% Interrater reliability: Kappa=0.69

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