ONLINE SUPPLEMENT

Swallowing Screens after Acute Stroke: A Systematic Review

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Search Strategy

The primary search was conducted through MEDLINE using the terms (swallow* OR dysphagia) AND (screening OR evaluation OR assessment) AND (stroke OR cerebrovascular accident) with no limits through August 12, 2011. Only publications in English were considered. Additional papers were identified through (1) search of CINAHL and EMBASE databases over the same time period using the same search terms, (2) review of relevant papers' references, (3) manual search of the tables of contents for the Journals *Stroke* and *Dysphagia* from January 2005 to August 2011, (4) search of reference lists for guidelines publications, and (5) search of the Cochrane Library.

Supplemental Table 1: Criteria used to evaluate swallowing-screening protocols

	Criterion
1	Must describe a swallowing-screening protocol where screening is defined as a preliminary assessment by a healthcare worker as to whether or not a patient appears safe for oral intake at that moment in time.
2	Must not require specialized skills or training in dysphagia, other than some basic training to carry out the screening protocol.
3	Must include reliability data.
4	Must specify a gold standard measure of dysphagia or aspiration against which the protocol's validity could be evaluated. Only formal swallowing evaluations, as performed by a specially trained therapist, are considered a suitable gold standard, including formal bedside evaluation, video-fluoroscopy, fiberoptic endoscopy, or some combination of these assessments.
5	Must describe the screening protocol in sufficient detail to be replicated.
6	Must have been evaluated in patients with acute stroke.

Relevant papers that were excluded (see Figure 1)

Excluded due to need for specialized training or expertise for administration (n=3)

1. Kagaya H, Okada S, Saitoh E, Baba M, Yokoyama M, Takahashi H. Simple swallowing provocation test has limited applicability as a screening tool for detecting aspiration, silent aspiration, or penetration. *Dysphagia*. 2010;25:6-10
2. Trapl M, Enderle P, Nowotny M, Teuschl Y, Matz K, Dachenhausen A, et al. Dysphagia bedside screening for acute-stroke patients: the Gugging Swallowing Screen. *Stroke*. 2007;38:2948-2952
3. Warnecke T, Teismann I, Meimann W, Olenberg S, Zimmermann J, Kramer C, et al. Assessment of aspiration risk in acute ischaemic stroke--evaluation of the simple swallowing provocation test. *J Neurol Neurosurg Psychiatry*. 2008;79:312-314

Excluded due to unclear description of gold standard criterion, validation against something other than a swallowing assessment, or insufficient reporting of validation (n= 11)

1. Courtney BA, Flier LA. RN dysphagia screening, a stepwise approach. *J Neurosci Nurs*. 2009;41:28-38
2. Dangerfield L, Sullivan R. Screening for and managing dysphagia after stroke. *Nurs Times*. 1999;95:44-45
3. Gottlieb D, Kipnis M, Sister E, Vardi Y, Brill S. Validation of the 50 ml3 drinking test for evaluation of post-stroke dysphagia. *Disabil Rehabil*. 1996;18:529-532
4. Massey R, Jedlicka D. The Massey Bedside Swallowing Screen. *J Neurosci Nurs*. 2002;34:252-253, 257-260
5. Perry L. Screening swallowing function of patients with acute stroke. Part two: Detailed evaluation of the tool used by nurses. *J Clin Nurs*. 2001;10:474-481
6. Perry L. Screening swallowing function of patients with acute stroke. Part one: Identification, implementation and initial evaluation of a screening tool for use by nurses. *J Clin Nurs*. 2001;10:463-473
7. Schrock JW, Bernstein J, Glasenapp M, Drogell K, Hanna J. A novel emergency department dysphagia screen for patients presenting with acute stroke. *Acad Emerg Med*. 2011;18:584-589
   We could not be sure that all patients received formal swallowing evaluation against which validity could be determined. Nevertheless, this swallowing screen, conducted by emergency department nurses, had many merits. It was simple, consisted of five items, and was evaluated in a sample of 283 patients with acute stroke. Inter-rater reliability was substantial with kappa = 0.69 (95% CI 0.55-0.83). For the heterogeneous gold standard that was used, sensitivity was 95% (95% CI 88-98), specificity was 55% (95% CI 48-62), positive predictive value was 50% and negative predictive value was 95%.
8. Smithard DG, O'Neill PA, Parks C, Morris J. Complications and outcome after acute stroke. Does dysphagia matter? *Stroke*. 1996;27:1200-1204
9. Tanton M. Developing a screening tool and training package to identify dysphagia in all settings. *Nurs Times*. 2010;106:18-20
10. Westergren A, Hallberg IR, Ohlsson O. Nursing assessment of dysphagia among patients with stroke. *Scand J Caring Sci*. 1999;13:274-282

11. Wood P, Emick-Herring B. Dysphagia: a screening tool for stroke patients. *J Neurosci Nurs*. 1997;29:325-329

Excluded due to lack of reliability data (n=16)

1. Bravata DM, Daggett VS, Woodward-Hagg H, Damush T, Plue L, Russell S, et al. Comparison of two approaches to screen for dysphagia among acute ischemic stroke patients: Nursing admission screening tool versus National Institutes of Health Stroke Scale. *J Rehabil Res Dev*. 2009;46:1127-1134
2. Caviedes IR, Lavados PM, Hoppe AJ, Lopez MA. Nasolaryngoscopic validation of a set of clinical predictors of aspiration in a critical care setting. *J Bronchol Intervent Pulmonol*. 2010;17:33-38
3. Cichero JA, Heaton S, Bassett L. Triaging dysphagia: nurse screening for dysphagia in an acute hospital. *J Clin Nurs*. 2009;18:1649-1659
4. DePippo KL, Holas MA, Reding MJ. Validation of the 3-oz water swallow test for aspiration following stroke. *Arch Neurol*. 1992;49:1259-1261
5. DePippo KL, Holas MA, Reding MJ. The Burke dysphagia screening test: validation of its use in patients with stroke. *Arch Phys Med Rehabil*. 1994;75:1284-1286
6. Hinds NP, Wiles CM. Assessment of swallowing and referral to speech and language therapists in acute stroke. *QJM*. 1998;91:829-835
7. Huhmann M, Decker RT, Byham-Gray L, Maillet JO, VonHagen S. Comparison of dysphagia screening by a registered dietitian in acute stroke patients to speech language pathologist's evaluation. *Top Clin Nutr*. 2004;19:239-249
8. Kidd D, Lawson J, Nesbitt R, MacMahon J. Aspiration in acute stroke: a clinical study with videofluoroscopy. *Q J Med*. 1993;86:825-829
9. Kopey SA, Chae J, Vargo MM. Does a 3-sip test detect dysphagia in acute stroke rehabilitation patients? *PM R*. 2010;2:822-828
10. Lees L, Sharpe L, Edwards A. Nurse-led dysphagia screening in acute stroke patients. *Nurs Stand*. 2006;21:35-42
11. Odderson IR, Keaton JC, McKenna BS. Swallow management in patients on an acute stroke pathway: quality is cost effective. *Arch Phys Med Rehabil*. 1995;76:1130-1133
12. Suiter DM, Leder SB. Clinical utility of the 3-ounce water swallow test. *Dysphagia*. 2008;23:244-250
13. Wakasugi Y, Tohara H, Hattori F, Motohashi Y, Nakane A, Goto S, et al. Screening test for silent aspiration at the bedside. *Dysphagia*. 2008;23:364-370
14. Weinhardt J, Hazelett S, Barrett D, Lada R, Enos T, Keleman R. Accuracy of a bedside dysphagia screening: a comparison of registered nurses and speech therapists. *Rehabil Nurs*. 2008;33:247-252
15. Zhou Z, Salle JY, Daviet JC, Stuit A, Nguyen CL. Combined approach in bedside assessment of aspiration risk post stroke: PASS. *Eur J Phys Rehabil Med*. 2011;47:1-6
16. Brody RA, Touger-Decker R, VonHagen S, Maillet JO. Role of registered dietitians in dysphagia screening. *J Am Diet Assoc*. 2000;100:1029-1037

Details on how to perform swallowing screens, extracted from the references

Acute Stroke Dysphagia Screen (subsequently re-titled the SWALLOW-3D)

Edmiaston J, Connor LT, Ford AL. SWALLOW-3D, a simple 2-minute bedside screening test, detects dysphagia in acute stroke patients with high sensitivity when validated against video-fluoroscopy (abstract). Stroke. 2011;42:e352

Edmiaston J, Connor LT, Loehr L, Nassief A. Validation of a dysphagia screening tool in acute stroke patients. Am J Crit Care. 2010;19:357-364

To be completed on all patients upon admission with diagnosis of stroke.
If any of the following questions are answered with a yes, stop and refer to speech pathology.

	YES	NO
1) Is the Glascow Coma Scale LESS than 13?	☐	☐
2) Is there Facial Asymmetry/Weakness?	☐	☐
3) Is there Tongue Asymmetry/Weakness?	☐	☐
4) Is there Palatal Asymmetry/Weakness?	☐	☐
5) Are there signs of aspiration during the 3 oz water	☐	☐

- If all findings for the first 4 questions are **NO**, proceed to the 3 oz water test.
- Administer 3 oz of water for sequential drinks, note any throat clearing, cough or change in vocal quality immediately after and 1 minute following the swallow. If clearing, coughing or change in vocal quality is noted, refer to speech therapy.
- If all of the answers to the above questions are **NO**, then start the patient on a regular diet.

Modified Mann Assessment of Swallowing Ability (MMASA)

Antonios N, Carnaby-Mann G, Crary M, Miller L, Hubbard H, Hood K, et al. Analysis of a physician tool for evaluating dysphagia on an inpatient stroke unit: the Modified Mann Assessment of Swallowing Ability. J Stroke Cerebrovasc Dis. 2010;19:49-57

Appendix: Dysphagia Screen

Modified Mann Assessment of Swallowing Ability (MMASA)
INSTRUCTIONS:
Circle the most appropriate clinical findings for each indicator.
Calculate the total score by adding the points for each indicator.
Patient Name_____
Date
_____

1. Alertness	
Task: Observe and evaluate the patient's response to speech, limb movement, or painful stimulation	Grade: 10 = Alert 8 = Drowsy-fluctuating awareness/alert level 5 = Difficult to arouse by speech or movement 2 = Coma or nonresponsive
2. Cooperation	
Task: Gain patient's attention and attempt to initiate communication or activity	Grade: 10 = Cooperative–engages in some form of verbal or nonverbal exchange 8 = Fluctuating co-operation 5 = Reluctant co-operation 2 = No co-operation/response
3. Respiration	
Task: Assess status of patient's Task: Assess status of patient's	Grade: 10 = Chest clear, no clinical or radiographic evidence of abnormality 8 = Sputum in the upper airway or other respiratory condition (e.g., asthma/bronchospasm, chronic obstructive pulmonary disease) 6 = Fine basal crepitations/self-clearing 4 = Coarse basal crepitations 2 = Suspected infection/frequent suctioning/respirator dependent
4. Expressive Dysphasia	
Task: Assess for disturbances expression	Grade: 5 = No abnormality 4 = Mild difficulty finding words/expressing ideas 3 = Expresses self in a limited manner/short phrases or words 2 = No functional speech sounds or undecipherable single words 1 = Unable to assess
5. Auditory Comprehension	
Task: Ability to understand basic verbal communication	Grade: 10 = No abnormality 8 = Follows ordinary conversation with little difficulty 6 = Follows simple conversation/instructions with repetition 4 = Occasional response if cued 1 = No response
6. Dysarthria	
Task: Assess articulation	Grade: 5 = No abnormality 4 = Slow with occasional hesitation and slurring 3 = Speech intelligible but obviously defective rate/range/strength/coordination 2 = Speech unintelligible 1 = Unable to assess

7. Saliva

Task: Observe patient's control of of saliva; note any escape of secretions from the side of the mouth

Grade:
5 = No abnormality
4 = Frothy/expectorated into cup
3 = Drooling at times, during speech, while side lying or fatigued
2 = Some drool consistently
1 = Gross drooling, unable to control drooling

8. Tongue Movement

Task: Assess tongue movement
Protrusion: Have patient extend tongue as forward as possible, and then retract
Lateralization: Have patient touch each corner of the mouth, then repeat alternating lateral movements
Elevation: With mouth wide open, have patient raise tongue up to palate; alternate elevation and depression in this way

Grade:
10 = Full range of movements/no abnormality detected
8 = Mild impairment in range
6 = Incomplete movement
4 = Minimal movement
2 = No movement or unable to perform

9. Tongue Strength

Task: Assess bilateral tongue strength
Have patient push laterally and anteriorly against tongue blade

Grade:
10 = No abnormality
8 = Minimal weakness
5 = Obvious unilateral weakness
2 = Gross weakness or unable to perform

10. Gag

Task: Contact posterior pharyngeal wall on either side separately

Grade:
5 = No abnormality
4 = Diminished bilaterally
3 = Diminished unilaterally
2 = Absent unilaterally
1 = No gag response

11. Cough Reflex

Task: Ask patient to cough as strong as possible
Observe strength and clarity of cough

Grade:
10 = No abnormality
8 = Cough attempted, but hoarse in quality
5 = Attempt inadequate
2 = No attempt or unable to perform

12. Palate

Task: Ask patient to produce a strong "AH" several times and sustain each one for several seconds
Observe for hypernasality and note action of palate elevation

Grade:
10 = No abnormality
8 = Slight asymmetry noted; mobile palate
6 = Unilaterally weak and inconsistently maintained
4 = Minimal movement, nasal regurgitation, nasal air escape
2 = No elevation of palate or unable to perform

MMASA SCORE = _____

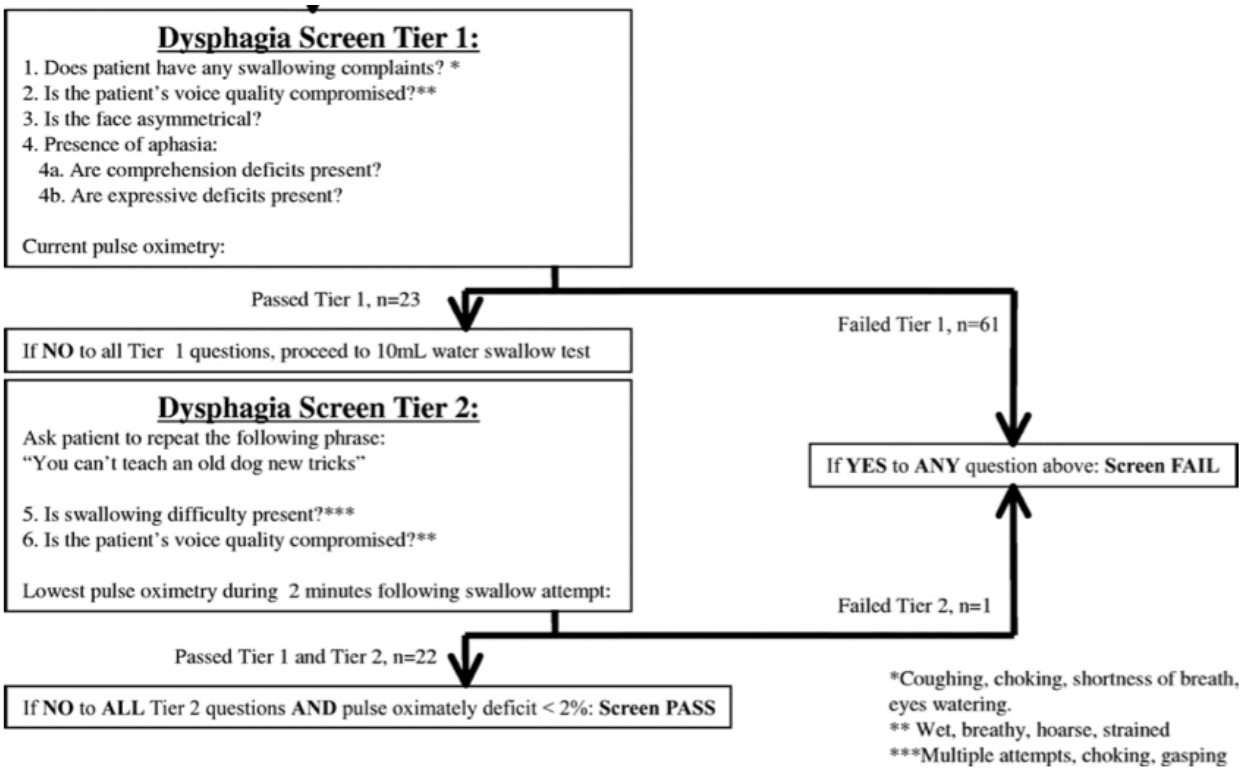
Interpretation

Score ≥ 95: Start oral diet and progress as tolerated. Monitor first oral intake and consult SPEECH PATHOLOGY if patient has difficulty eating or drinking.

Score ≤ 94: Nothing by mouth and consult SPEECH PATHOLOGY for a formal swallow evaluation.

A swallowing screen conducted by emergency physicians

Turner-Lawrence DE, Peebles M, Price MF, Singh SJ, Asimos AW. A feasibility study of the sensitivity of emergency physician dysphagia screening in acute stroke patients. Ann Emerg Med. 2009;54:344-348



Toronto Bedside Swallowing Screening Test (TOR-BSST)

Martino R, Silver F, Teasell R, Bayley M, Nicholson G, Streiner DL, et al. The Toronto Bedside Swallowing Screening Test (TOR-BSST): development and validation of a dysphagia screening tool for patients with stroke. Stroke. 2009;40:555-561

Proprietary but items assess vocal quality, tongue movement, water swallow.