

SUPPLEMENTAL MATERIAL

METHODS

Data Collection.

A trained abstractor collected data from the EMR using standard Centers for Disease Control and Prevention data definitions and entered the data into the MSR web-based data collection tool.¹

Outcomes.

Screening time and results had to be documented in the medical record by a healthcare professional. Results were coded as not done if there was no documentation of a swallow screen being done, and were coded as missing if the results of the screen were not documented. Contraindications to the swallow screen must be documented in the EMR to be abstracted.

Intervention.

An EMR based CDS embedded in the stroke admission order set with the following 4 key components:

1. **Dysphagia evaluation protocol (Figure 1):** A flow chart accessible through a hyperlink in the order set providing guidance on screening for dysphagia. The flow chart was created by speech and language pathologists at the study hospital based on the practice followed by them to screen stroke patients for dysphagia. Currently, there is no optimal bedside swallow screen recommended by the guidelines. However, a recent review identified valid elements for screening for dysphagia risk and also identified a

water swallow test as being an important part of the screen.² The protocol as shown in the CDS flow chart includes a water swallow test and also many non-swallow elements (e.g. dysarthria) identified in the review as valid screening items.

2. Pre-checked hard stop *Dysphagia Screening* order: To be completed before the admission order set could be signed and released. Completion entailed a mandatory selection of 1 of the following 4 options: i) Failed screening; Strict NPO pending SLP (speech language pathology) evaluation; ii) Passed screening; No dysarthria; Regular diet with thin liquids; iii) Passed screening; Dysarthria present; Dysphagia 2 diet with thin liquids; Refer to SLP; iv) Refer to SLP.

3. Default NPO diet: There were 3 diet options and the NPO diet was the default. A different diet could be selected after unselecting the NPO diet and allowed combinations of diet consistencies (e.g. dysphagia Level 2, thick liquids).

4. Prompt for documentation of dysphagia screening time and results of screening in the stroke history and physical EMR template. To be completed before the admission note could be signed.

Design of the dysphagia screening protocol. The dysphagia screening protocol was put together by institutional Speech and Language Pathology (SLP) therapists in order to facilitate dysphagia screening by trainee resident physicians in the emergency department (ED). After much deliberation, a decision was made to use material (water) which was readily available in the ED. The protocol was only intended to be the preliminary screen; a more definitive evaluation involving material of multiple

consistencies was to be done by the SLP therapists. The rationale for using water in the protocol is described below.

Most dysphagia screens start with liquids and studies of dysphagic patients with fluoroscopy has found that laryngeal penetration was more likely with liquids rather than semisolid textures.³ This is true on clinical observation as well.⁴ One screen⁴ that starts with semisolids rather than liquids does so in order to minimize patients placed NPO (nothing by mouth). Our motivation was different: we wanted to minimize patients ordered oral intake incorrectly by resident physicians before the SLP therapists could perform a more comprehensive assessment. Hence, our goal with the screen was to achieve a high sensitivity in terms of identifying those at risk for aspiration. Currently, there is no single tool that has been designated as a standard screen by consensus.² Furthermore, while most stroke patients do worse with liquids than with semi-solid food, there are occasional brainstem strokes where the patient may do better with water rather than semi-solids. Our SLP therapists were aware of this and took this into account by screening for brainstem signs prior to swallow evaluation and making them NPO until further detailed evaluation. (Figure 1 exclusion criteria). Our SLP therapists then use more advanced food consistencies as needed.

We wish to point out however that the flowchart algorithm is specific to our institution and has not been proven to be the optimal way to triage patients.

RESULTS.

Online table compares baseline characteristics of patients before and after the intervention. While the proportion of patients presenting with aphasia and altered

consciousness was similar, the proportion of patients with weakness or paresis was lower post-intervention.

Additional References

1. Data Elements Paul Coverdell National Acute Stroke Registry. Centers for Disease Control and Prevention website.

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3. Doggett DL, Tappe KA, Mitchell MD, Chapell R, Coates V, Turkelson CM. Prevention of pneumonia in elderly stroke patients by systematic diagnosis and treatment of dysphagia: an evidence-based comprehensive analysis of the literature. *Dysphagia*. 2001; 16: 279-295.

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5. Lakshminarayan K, Peacock JM, Luepker RV, Krier B, Tsai AW. Does Dysphagia Screening Prevent Aspiration Pneumonia After Stroke. *Stroke*. 2009; 40: e117.

6. Hinchey JA, Shephard T, Furie K, Smith D, Wang D, Tonn S, et al. Formal dysphagia screening protocols prevent pneumonia. *Stroke*. 2005; 36: 1972-1976.

7. Lakshminarayan K, Borbas C, McLaughlin B, Morris NE, Vazquez G, Luepker RV, et al. A cluster-randomized trial to improve stroke care in hospitals. *Neurology*. 2010; 74: 1634-1642.

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Online Table. Patient demographics and clinical features pre and post implementation of the EMR-based dysphagia screening Clinical Decision Support (CDS) tool.

Variables	N (%) Pre and Post CDS Intervention		P-value
	Pre-CDS (N=369)	Post-CDS (N=583)	
Mean age ± standard deviation, years	64±16	64±16	0.6
Male, N (%)	203 (55)	309 (53)	0.5
Race			
White	255 (66)	362 (62)	0.09
African American	74 (20)	143 (25)	
Other	40 (14)	78 (13)	
Stroke subtype & severity			
Ischemic	278 (75)	428 (73)	0.5
Hemorrhagic	91 (24)	155 (27)	0.5
Admission NIHSS			
NIHSS<10	299 (81)	307 (53)	0.001
NIHSS ≥10	68 (18.5)	116 (20)	
Missing	2 (0.5)	194 (27)	
GCS (Hemorrhagic strokes only)			
GCS <9	17 (19)	34 (22)	0.7
GCS 9-12	6 (7)	17 (11)	
GCS ≥13	65 (71)	101 (65)	
Missing	3 (3)	3 (2)	
Clinical Features			
Aphasia	115 (31)	162 (28)	0.1

Altered level of consciousness	72 (20)	155 (27)	0.9
Weakness	263 (71)	352 (60)	0.001
