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Research Article

Prospective Investigation of Incidence and Co-occurrence of Dysphagia, Dysarthria, and Aphasia Following Ischemic Stroke

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Purpose: The high incidence of swallowing and communication disorders following stroke is well documented. However, many of these studies have used retrospective chart reviews to make estimates of incidence and co-occurrence. The current study prospectively examined the incidence and co-occurrence of dysphagia, dysarthria, and aphasia following a 1st occurrence of ischemic stroke at an academic medical center hospital.

Method: One hundred patients who experienced their 1st ischemic stroke were recruited for participation in this study. All participants received a clinical swallowing evaluation to assess for dysphagia, administration of the Frenchay Dysarthria Assessment–Second Edition (Enderby & Palmer, 2008) and Western Aphasia Battery–Revised (Kertesz, 2006) to screen for the presence of dysarthria and aphasia, respectively.

Results: Incidence rates of dysphagia, dysarthria, and aphasia were 32%, 26%, and 16%, respectively. Forty-seven percent of participants had at least 1 of these disorders, 28% had 2 of these disorders, and 4% had all 3. Although the incidence rates in this study were smaller in magnitude than incidence rates in previous research, the pattern of results is broadly similar (i.e., dysphagia had the highest incidence rate, followed by dysarthria and, lastly, aphasia).

Conclusions: This prospective study yielded slightly lower incidence rates than have been previously obtained from retrospective chart reviews. The high incidence and co-occurrence of devastating swallowing and communication disorders post–ischemic stroke provides clear motivation for speech-language pathology involvement in the early phase of stroke rehabilitation.

Cerebral ischemia, defined as the reduction or interruption of blood supply to various regions of the brain (Yorkston, Beukelman, Strand, & Hakel, 2010), is the leading cause of stroke and accounts for estimates of up to 87% of all strokes (American Stroke Association, 2012). Ischemic stroke often results in a variety of impairments, including, but not limited to, deficits in swallowing (Groher & Crary, 2010), speech (Yorkston et al., 2010), and language (Berthier, 2005). Each of these areas of deficit has the potential for massive implications on the health and overall well-being of survivors of stroke.

The incidence of *oropharyngeal dysphagia*, defined as a disorder of swallowing (Groher & Crary, 2010), following ischemic stroke has been estimated to range from 37% to 78% (Guyomard et al., 2009; Martino et al., 2005; Smithard, Smeeton, & Wolfe, 2007). Patients who have experienced a stroke are at significant risk for both overt and silent aspiration (Daniels et al., 1998) and subsequent pulmonary complications (Martino et al., 2005). Similarly, malnutrition and dehydration are potential calamitous outcomes of dysphagia (Crary et al., 2013). A study by Smithard et al. (2007) found dysphagia during the first 24 hr after stroke to be related to increased rates of mortality and dependency, including longer hospitalizations and nursing home admissions. Given the increased risk of dysphagia and associated complications in patients who have experienced a stroke, early identification is important for management and ultimate reduction of length of hospital stays and readmissions (Daniels et al., 1998; Martino et al., 2005; Smithard et al., 2007).

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The incidence of *dysarthria,* defined as a motor speech impairment characterized by slow, weak, and imprecise movements of the speech musculature (Yorkston et al., 2010), following ischemic stroke has been estimated to range from 25% (Lubart et al., 2005) to 58% (Vidovic, Sinanovic, Sabaskic, Haticic, & Brkic, 2011). Communication difficulties associated with poststroke dysarthria have been found to lead to changes in self-identity and relationships, social and emotional disruptions, and stigmatization or perceived stigmatization. Interestingly, these difficulties have been found to be equally significant for patients with a mild dysarthria as for patients with a moderate dysarthria (Dickson, Barbour, Brady, Clark, & Paton, 2008), emphasizing the need for identification and treatment of even mild impairments.

The incidence of *aphasia,* defined as an acquired language impairment, characterized by anomia (Helm-Estabrooks & Albert, 1991) and/or other deficits in any of the four language modalities (i.e., speaking, listening, reading, and writing; Hallowell & Chapey, 2008), following ischemic stroke has been estimated to range from 21% to 38% (Berthier, 2005; Engelter et al., 2006; Flowers, Silver, Fang, Rochon, & Martino, 2013). Aphasia has been described as a large cause of disability following stroke, with poststroke aphasia being associated with high rates of mortality and morbidity (Berthier, 2005). Dickey et al. (2010) found that patients who had experienced a stroke and acquired aphasia were more likely than their counterparts who were nonaphasic to be discharged to long-term care facilities and rehabilitation facilities. In addition, length of hospital stay and in-hospital service use was higher for those patients with aphasia than for those without (Dickey et al., 2010). Increased length of stay and likelihood of further health care needs (i.e., rehabilitation) contributes to increased health care expenditures for patients with poststroke aphasia (Ellis, Simpson, Bonilha, Mauldin, & Simpson, 2012).

Although the three aforementioned consequences of ischemic stroke have been estimated to occur in large proportions of survivors of stroke, their co-occurrence following acute stroke has only begun to be investigated. Lapointe and McFarland (2004) reported that 79% of patients with acute stroke with dysphagia had a co-occurring communication deficit, with the term *communication impairment* encompassing both dysarthria and aphasia, as well as voice and cognitive communication deficits. A retrospective study by Flowers et al. (2013) found dysphagia, dysarthria, and aphasia to co-occur in 10% of 221 patients who had experienced a first-ever acute ischemic stroke. In addition, these authors found dysphagia and dysarthria to co-occur in 28% of patients, dysarthria and aphasia to co-occur in 15% of patients, and dysphagia and aphasia to co-occur in 17% of patients. Given the adverse effects of dysphagia, dysarthria, and aphasia poststroke, current estimates of incidence, and the potential of confounding effects due to comorbidity, further investigation is warranted to explore their relationship in the ischemic stroke population.

Although retrospective research executed in this population has been thorough and has established necessary estimates of poststroke consequences, a prospective investigation utilizing standardized screening and evaluation methods is valuable. Flowers et al. (2013) stated the limitations of their own retrospective chart review including the use of "broad defining terms" to capture participants with impairments. These authors postulated that, perhaps, this only captured "global impressions of the assessing health professionals" (p. 246). In particular, relying on data from physicians and nurses diagnosing communication and swallowing disorders, which may not be within their scope of practice or expertise, likely leads to overestimation or underestimation of symptoms poststroke (Sherman et al., 2018). In a study by Flowers et al. (2013), only 56% of patients were assessed by speech-language pathologists (SLPs) for dysphagia and 48% of patients for communication impairments, with other clinical information taken from notes in patient medical records that had been written by physicians, nurses, or other therapists. As an example, in this study, the definition of *absence of dysarthria or aphasia* included "omission of their reported presence during all clinical assessments…" (pp. 240–241). This suggests that some patients were not screened/evaluated for communication impairments by an SLP and that other medical professions did not note their presence. In addition, in a subsequent article, the same group of authors noted the suboptimal performance of informal dysphagia screening in identifying dysphagia (Sherman et al., 2018). A clinical, evaluation-driven approach, completed prospectively by SLPs, within whose scope of practice is the evaluation of these impairments, has the potential to enhance our understanding of poststroke consequences. In fact, authors who have used chart reviews in their investigations have highlighted the need for prospective evaluation of incidence estimates (Flowers et al., 2013). A standardized protocol for operationalizing the diagnosis of impairments in a prospective study would uniquely contribute to the literature to verify results of retrospective work.

The current study prospectively examined the incidence and co-occurrence of dysphagia, dysarthria, and aphasia following a first ischemic stroke as assessed by SLPs—the first, to our knowledge, to prospectively investigate these three disorders concurrently. The purpose of the current work was to compare the results found by Flowers et al. (2013) with a prospective and standardized design in order to better control variables and measurements, as well as to rely on the role of the SLP in expertly evaluating for these impairments in patients who have experienced an ischemic stroke. We hypothesized that the incidence and co-occurrence of the three disorders would be slightly lower than those found in previous literature, such as those by Flowers et al. (2013), due to the more precise measurement of these disorders in the current study.

Method

Participants

One hundred inpatients at the university hospital at the University of Wisconsin–Madison who were admitted

for ischemic stroke were recruited for this study. Participants were identified by study team SLPs on the university hospital's swallow service. Per standard protocol, all patients admitted to the hospital with a stroke diagnosis, or with "stroke-like symptoms" but without a diagnosis of stroke, are required to have a clinical dysphagia evaluation administered by an SLP on the swallow service within 24 hr of admission. Potential participants were screened for eligibility by reviewing their medical charts to determine if patients met eligibility requirements. Patients without a diagnosis of ischemic stroke at admission were followed by a study team member via medical chart to track official diagnosis by a neurologist. Patients who were unable to consent due to cognitive and/or language deficits had family members or other legally defined surrogate decision makers provide written informed consent prior to completing all study procedures.

Inclusionary criteria for participants included the following: experienced a first-time ischemic stroke, 18 years of age or older, and alert and responsive enough to participate in the three evaluations as determined by the National Institutes of Health Stroke Scale (National Institute of Neurological Disorders and Stroke, 2011). To be included in this study, patients were required to score a 0 (*alert and keenly responsive*) or a 1 (*not alert, but arousable by minor stimulation*) on this scale. Exclusionary criteria for participants included patients with a history of oropharyngeal dysphagia; patients with neurological disorders associated with dysphagia, dysarthria, and aphasia, including but not limited to dementia, Parkinson's disease, multiple sclerosis, prior stroke, and amyotrophic lateral sclerosis; patients with a history of head and neck cancer or laryngeal surgery; non–English speakers; and patients who had been recently intubated. This study was approved by the Health Sciences Institutional Review Board at the University of Wisconsin–Madison.

Study Procedures

All study procedures were administered during the participants' hospitalization. Participants received all three evaluations/screens (i.e., dysphagia, dysarthria, and aphasia) within a 72-hr period of admission to the hospital. Procedures on standardized assessments for dysarthria and aphasia were adapted if necessary. For example, if a participant demonstrated paresis/paralysis of the upper extremities, writing tasks were either excluded or adapted so the patient could respond verbally, and pointing/gestural tasks were adapted to involve limbs other than the affected ones. Clinicians used clinical judgment regarding when to provide adaptations. Three SLPs were trained to administer the dysarthria assessment and aphasia screens, and any member of the highly specialized swallow service completed the dysphagia evaluation.

Demographic Information

Age, sex, and date of birth, as well as clinical information including medical history, medical diagnosis, admitting diagnosis (site/size of stroke lesion), handedness, and comorbidities, were collected from the electronic medical record.

Dysphagia Evaluation

Dysphagia was evaluated primarily using a clinical swallow evaluation. A standardized protocol was utilized; however, clinical judgment in deviation from this protocol was permitted. The standard protocol included an oral mechanism examination to appraise the anatomy and physiology of the swallowing mechanism, including subjective evaluation of strength and range of motion of the lips, tongue, jaw, and palate, as well as cough and swallow strength, and liquid/solid food trials of ice chips, thin water via spoon, straw, and sequential sipping via straw or cup, nectar and honey-thick liquids if needed, two ounces of puree (i.e., apple sauce or pudding), and solids (i.e., graham cracker or saltine cracker). If dysphagia was suspected, the SLP used skilled judgment in determining the need for compensatory maneuvers, deviation from the protocol, and/or appropriate time to terminate the evaluation. Participants who had signs and/or symptoms of dysphagia during the clinical evaluation also completed a videofluoroscopic swallowing study or fiberoptic endoscopic evaluation of swallowing also administered by a swallow team member. If the clinical evaluation indicated dysphagia and an instrumental evaluation was performed but did not indicate dysphagia, results from the imaging study were considered the gold standard. *Dysphagia* was defined as impairment in any of the phases of the swallow, including oral, oropharyngeal, pharyngeal, or pharyngoesophageal (Logemann, 1995; Tanner, 2006), identified by either clinical or instrumental evaluation.

Dysarthria Assessment

Dysarthria was evaluated using the Frenchay Dysarthria Assessment–Second Edition (Enderby & Palmer, 2008), which is a validated and standardized diagnostic tool that is widely used to evaluate the presence and type of dysarthria (Duffy, 2013). Participants were rated on a number of simple performance tasks related to speech function (i.e., reflexes, respiration, lips, palate, laryngeal, tongue). The assessment was used to identify the presence or absence of "dysarthria," defined as any disturbance in muscular control of the speech mechanism resulting in abnormal execution of speech (Duffy, 2013; Yorkston et al., 2010). Scores on the Frenchay Dysarthria Assessment–Second Edition corresponding to the types of dysarthria were used for identifying participants as having dysarthria (Enderby & Palmer, 2008).

Aphasia Screen

Aphasia was evaluated using the Bedside Western Aphasia Battery–Revised (Kertesz, 2006). This validated and standardized tool is commonly used in acute care settings due to its ability to generate an aphasia diagnosis and a quantitative measure of severity in a short time (i.e., approximately 15 min; Bland et al., 2013; Vallila-Rohter, Kasparian, Kaminski, Schliep, & Koymen, 2018).

Participants were rated on a number of simple performance tasks related to language function (i.e., content, fluency, auditory comprehension, following commands). The assessment was used to identify the presence or absence of "aphasia," defined as any impairment in receptive, expressive, or global language abilities (Chapey, 1981; McNeil, 1982; Rosenbek, LaPointe, & Wertz, 1989). Scores on the Bedside Western Aphasia Battery–Revised corresponding to the types of aphasia were used for identifying participants as having aphasia (Kertesz, 2006).

Data Analysis

The outcomes of interest included estimates for the incidence and co-occurrence of dysphagia, dysarthria, and aphasia. Incidence was calculated using frequency estimates and their 95% confidence intervals (CIs) for the incidence and co-occurrence of dysphagia, dysarthria, and aphasia. The CIs were computed using the following formula: incidence $\pm$ z value for the 95% CI * $\sqrt{(\text{incidence}(1 - \text{incidence})/N)}$.

Results

Participants

Demographic information for the participants in the study can be found in Table 1. Participants ranged from 32 to 91 years of age (M = 72.33, SD = 14.40), and 63% of participants were men.

Table 1. Demographics, stroke, and clinical characteristics of sample population.

Variable	Total participants, N = 100
Demographics	
Age in years, M (SD)	72.33 (14.40)
Male, n	63
Right-handed, n	91
Previous medical history, n	
Hypertension	58
Hyperlipidemia	21
Heart disease/myocardial infarction	19
Diabetes	15
Cancer	11
Atrial fibrillation	9
Side/site of lesion, n	
Right	49
Left	41
Bilateral	9
Brainstem	10
Procedure, n	
Thrombectomy	17
tPA	19
Type of imaging used to confirm stroke, n	
CT	20
CT angiography	8
MRA	17
MRI	51
MRI/MRA	4

Note. tPA = tissue plasminogen activator; CT = computed tomography; MRA = magnetic resonance angiogram; MRI = magnetic resonance imaging.

Administration of Evaluations

The time of dysphagia evaluations ranged from during the patient's time in the emergency department just prior to hospital admission to up to 57.5 hr after admission (M = 17.77, SD = 12.92). Dysarthria evaluations were administered between 2 and 67 hr after admission (M = 25.61, SD = 13.51). Aphasia screens were administered between 2.25 and 67 hr after admission (M = 25.64, SD = 13.52). Dysphagia evaluations always occurred first, followed by the dysarthria assessment and aphasia screen administered in a single session. The average amount of time between dysphagia evaluations and the other two assessments was 7.47 hr (SD = 12). Twenty-four of our participants received instrumental (i.e., videofluoroscopic swallowing study or fiberoptic endoscopic evaluation of swallowing) dysphagia evaluations following the clinical dysphagia evaluation. In summary, the majority of evaluations occurred within the first 36 hr of admission, and the three evaluations were administered within several hours of each other.

Incidence and Co-occurrence

Incidence and co-occurrence rates are displayed in Table 2. The highest incidence of all of the impairments was dysphagia with 32% of participants experiencing this following a first ischemic stroke (95% CI [23, 41]), followed by dysarthria with 26% of participants (95% CI [17, 34]), and aphasia with 16% of participants (95% CI [9, 23]). Of those participants with dysphagia, 69% also had a concomitant communication disorder (95% CI [61, 76]). Participants with all three impairments (n = 4) had a mean age of 77 years (SD = 8.05, range: 68–84 years), and two out of the four were men (50%). Participants with any two

Table 2. Incidence and co-occurrence of three disorders found in the current study compared to the retrospective study by Flowers et al. (2013).

Disorder(s)	Current study	Flowers et al. (2013)
Incidence		
Dysphagia	32% [23, 41]	44% [38, 51]
Dysarthria	26% [17, 35]	42% [35, 48]
Aphasia	16% [9, 23]	30% [25, 37]
At least 1	48% [38, 58]	66%
None	52% [42, 62]	34%
Co-occurrence		
Dysphagia + dysarthria	19% [11, 27]	28% [23, 34]
Dysarthria + aphasia	4% [0, 8]	15% [11, 21]
Aphasia + dysphagia	7% [2, 12]	17% [12, 22]
Any 2 of the impairments	18% [11,26]	Not reported
All 3	4% [0, 8]	10% [6, 14]

Note. 95% Confidence intervals are in brackets. Confidence intervals for rows titled "at least 1" and "none" under incidence were not reported by Flowers et al. (2013).

of the impairments (n = 18) had a mean age of 68 years (SD = 15.2, range: 39–91 years), and 12 were men (67%). Participants with none of the three impairments (n = 52) had a mean age of 66 years (SD = 15.33, range: 32–91 years), and 32 were men (61.5%). Participants with at least one of the three impairments (n = 48) had a mean age of 68 years (SD = 13.34, range: 39–91 years), and 31 were men (64.58%).

Discussion

This study is the first, to our knowledge, to prospectively estimate incidence and co-occurrence of dysphagia, dysarthria, and aphasia following an initial ischemic stroke using standardized evaluation procedures. Following the lead of Flowers et al. (2013), we calculated the incidence and co-occurrence of these disorders based on clinical evaluations by trained SLPs in an acute care hospital setting. Although our results demonstrate lower incidence rates than the results found by Flowers et al. (2013), as well as by other authors (Guyomard et al., 2009; Lapointe & McFarland, 2004; Lubart et al., 2005; Martino et al., 2005; Smithard et al., 2007; Vidovic et al., 2011), incidence estimates are still high and, as such, have implications for both patients and clinicians.

Studies that examined other poststroke consequences have found lower incidence estimates than in the current study. For example, seizure activity has been estimated to occur in 6.3% of patients who have experienced a stroke (Beghi et al., 2011), visual–spatial and/or personal neglect in 23% patients who have experienced a stroke (Appelros, Karlsson, Seiger, & Nydevik, 2002), and cognitive impairment in approximately 30% of patients (del Ser et al., 2005). Comparing the incidence proportions found in the current study to the incidence proportions of these other devastating poststroke consequences demonstrates that communication and swallowing impairments occur just as often, if not more often, than these other impairments. Thus, poststroke dysphagia, dysarthria, and aphasia should be assessed for and managed just as aggressively as other poststroke consequences.

The lower incidence rates found in the current study as compared to some previous research (i.e., Flowers et al., 2013) may be due to the fact that some previous work did not limit assessment to first-time strokes (Dickey et al., 2010; Smithard et al., 1997; Teasell, Foley, Fisher, & Finestone, 2002; Vidovic et al., 2011). Considering second or later strokes may inflate the incidence estimates of communication and swallowing disorders following stroke. Another possibility for the higher incidence rates in the current work is that medical records may contain diagnoses/mention of communication and swallowing disorders that occur at any point following a stroke. Given that some of the participants included in our study were not evaluated until more than 36 hr following admission, we may have failed to evaluate/screen for a disorder that had resolved by the time they were evaluated, whereas retrospective chart reviews would count these participants as having the impairment. Our results, therefore, reflect poststroke outcomes that are sustained for longer than a few hours. Given that patients with prolonged symptoms are the ones who would most benefit from continued management of swallowing, speech, and language disorders, we anticipate that these results demonstrate the incidence of patients who are poststroke who may be well-served by ongoing SLP involvement in their care. In addition, the lower incidence rates in the current study are likely due to the differences in the rigor of the data collection in the current prospective study in comparison to previous retrospective studies. As discussed in detail in the Introduction, previous retrospective work has used somewhat imprecise descriptions of dysphagia, dysarthria, and aphasia with the presence of these disorders sometimes assumed from a single mention of, for example, "slurred speech" in a medical record (Flowers et al., 2013). Using imprecise operational definitions may have led to the higher, potentially overestimations of the incidence and co-occurrence rates of these disorders in retrospective research. The explicit definitions of these three disorders in the current study, along with clear criteria from standardized assessment tools, may have resulted in the lower, potentially more conservative estimates of incidence and co-occurrence.

In their prospective examination of patients who had experienced a stroke, Gordon, Langton Hewer, and Wade (1987) found that the most prevalent co-occurring impairment of dysphagia following stroke was dysarthria. In addition, many dysphagia screening tools include dysarthria as a potential risk factor for dysphagia following a stroke (Edmiaston, Tabor Connor, Loehr, & Nassief, 2010). In fact, many authors have found dysarthria to be a significant predictor of dysphagia (Daniels, Ballo, Mahoney, & Foundas, 2000; Horner, Buoyer, Alberts, & Helms, 1991; Logemann, Veis, & Colengelo, 1999), and a recent systematic review highlighted that "dysarthria is a strong clinical clue to the presence of dysphagia" (Wang, Carter, & Altman, 2018, p. E1). In the current study, we found that 73% of our participants who had dysarthria also had co-occurring dysphagia. Because adequate articulator (i.e., tongue, lips, and jaw) function is necessary both for intelligible speech and for safe and efficient swallowing, there is a clear rationale for evaluating patients who have experienced a stroke for speech and swallowing impairments in tandem, as the presence of dysarthria may help to inform dysphagia evaluations and vice versa.

Flowers et al. (2013) provided exceptional arguments outlining the need for assessment of dysphagia, dysarthria, and aphasia early after occurrence of ischemic stroke. The current results also provide justification for this objective. Considering the large proportion of stroke patients who demonstrated symptoms of these impairments, it may be advantageous to implement standard referral processes to SLPs for all patients who have experienced a stroke. Early detection and management of swallowing and communication impairments may reduce the harmful impact of their presence on these patients. In other acute care settings, swallowing is often assessed prior to communication due

to the potential sequelae of the impairment (i.e., malnutrition, dehydration, aspiration pneumonia) and a general sense of immediacy so that patients can take oral medications and drink and eat safely. Our results demonstrated that almost 70% of participants diagnosed with dysphagia also had a co-occurring communication impairment. The need for a comprehensive swallowing and communication evaluation promptly following stroke occurrence is highlighted by this high co-occurrence rate. It is well known that untreated communication impairments are associated with increased length of hospital stay and mortality (Dickey et al., 2010; Ellis et al., 2012; Laska, Hellblom, Murray, Kahan, & Von Arbin, 2001), as well as with reduced ability to make decisions, which has obvious implications on involving patients with communication impairments in health care decision making (Carling-Rowland & Wahl, 2010; Suleman & Kim, 2015). In addition, the previous discussion of dysarthria as a clinical clue to the presence of dysphagia (Wang et al., 2018) emphasizes the potential advantages of jointly assessing swallowing and communication early in patients who have experienced stroke, rather than focusing on swallowing as is often the case.

One of the limitations of this work was that we did not quantify stroke severity, which may confound the incidence and co-occurrence estimates, given that previous work has shown that stroke severity was correlated with the presence of these disorders (Dickey et al., 2010). Because stroke was not diagnosed with the same imaging technique in each participant and reporting of these imaging results was not standardized, we do not have a lesion size available for each subject. In addition, we did not seek to quantify severity of dysphagia, dysarthria, or aphasia and, as such, do not have associations between stroke severity/lesion size and severity of these disorders. This is an important question that could be examined in future research. A measure of stroke severity, such as the National Institutes of Health Stroke Scale, is a critical complement to be used in future work on this topic.

Conclusions

In conclusion, this prospective study had slightly lower incidence rates than those found in previous retrospective studies that have relied on chart review. Despite this, the results follow similar patterns of incidence and co-occurrence and, therefore, validate the high incidence rates of these common poststroke consequences found in previous studies. Along with the high incidence rates found in the current work, the known, potentially devastating consequences of swallowing and communication impairments poststroke provide a rationale to advocate for greater SLP involvement in the care of patients who have experienced a stroke. The current work fills a necessary gap in the literature by prospectively examining the incidence and co-occurrence rates of dysphagia, dysarthria, and aphasia following a first ischemic stroke with standardized evaluation and screening methods. The ecological validity of collecting data within the context of a fast-paced, acute care medical setting is a notable strength of this study and also demonstrates the feasibility of using a comprehensive screening tool(s) for communication and swallowing disorders in the acute phase poststroke.

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