

ORIGINAL RESEARCH

Dysphagia Characteristics of Patients Post SARS-CoV-2 During Inpatient Rehabilitation



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Abstract

Objective: To investigate dysphagia in patients recovering from SARS-CoV-2 admitted to acute inpatient rehabilitation by summarizing clinical swallow evaluation and videofluoroscopic swallow study findings.

Design: Retrospective cohort study.

Setting: Urban inpatient rehabilitation hospital.

Participants: The first inpatients admitted with SARS-CoV-2 (N=40) who participated in a videofluoroscopic swallow study.

Interventions: Not applicable.

Main Outcome Measures: Patient characteristics upon admission (duration of intubation, tracheostomy status, comorbidities, videofluoroscopic swallow study (VFSS) completion at previous level of care); admission International Dysphagia Diet level (IDDSI); Mann Assessment of Swallowing Ability (MASA), Functional Oral Intake Scale (FOIS), dysphagia severity rating; penetration aspiration scale (PAS) rated during VFSS; and IDDSI level recommended after completion of VFSS.

Results: Twenty percent of patients had been evaluated by videofluoroscopy in acute care. Nineteen of 37 (51%) individuals were upgraded to IDDSI level 7 regular diet with level 0 thin liquids and achieved a FOIS of 7 after the completion of the VFSS. Five individuals (13%) received a diet downgrade or remained on the same diet recommendations from their admission. Total numerical score (TNS) of less than 170 on the MASA predicted presence of aspiration in 27% of patients (6 of 22). Seventy-two percent of the sample (16 of 22) had a TNS less than 170 but did not demonstrate any instances of aspiration. The odds of patients having a PAS of 3 or greater increased by approximately 15% (odds ratio, 1.15; 95% confidence interval, 1.03-1.27; $P=.013$). Thus, with each additional day of intubation during acute care stay, there was a 15% greater likelihood of having airway invasion.

Conclusions: Instrumental swallow evaluations are imperative to diagnose and treat dysphagia in the post-coronavirus disease population. Because of the heterogeneity of this population, high incidence of prolonged intubation, and limitations of the clinical swallowing evaluation, instrumental assessments need to be performed on a more consistent basis as infection prevention protocols evolve.

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Patients recovering from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) reportedly present with

dysphagia or difficulty swallowing.¹ With the onset of the coronavirus disease 2019 (COVID-19) pandemic, the nature of dysphagia care shifted significantly, with multiple guidelines published to address the safe evaluation and treatment of patients with dysphagia in acute care.²⁻⁵ However, little has been published providing guidance for the evaluation and treatment of this patient population after they leave acute care and enter inpatient rehabilitation.

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The pandemic prompted reflection on infection prevention protocols as well as a designation by some groups that dysphagia assessment and treatment produce aerosolized droplets, resulting in recommendations to use noninvasive and noninstrumental means to evaluate dysphagia.^{2,3,5} However, instrumental examination via videofluoroscopy (VFSS) or via fiberoptic endoscopic evaluation of swallowing (FEES) is considered best practice in evaluating swallowing physiology, determining the presence or absence of aspiration, directing behavioral interventions to improve function, and guiding diet consistency recommendations.⁶ With more restricted use of instrumental assessments, a higher reliance was placed on the clinical swallow examination, with caveats limiting completion of a full oral mechanism examination, assessment of cough strength, and gag reflex.⁷

To date, specific information related to the etiology and nature of dysphagia has not yet been published for the inpatient rehabilitation setting after acute care hospitalization for COVID-19.³ Proposed mechanisms of dysphagia after COVID-19 include peripheral and central nervous system disruption, intubation, debility, and pulmonary dysfunction.¹

Confounding the effect of SARS-CoV-2 on swallowing function was an acute care management trend toward longer periods of endotracheal intubation.⁸ The Centers for Disease Control and Prevention identifies tracheostomy placement as a procedure that produces aerosolized droplets with greater risk for infection spread, and many infection prevention protocols initially discouraged tracheostomy placement with this population.⁸⁻¹⁰ As a result, increased durations of intubation were observed.¹¹ For example, during the first month of the pandemic, Hur et al report that 64% of patients in acute care were intubated for more than 14 days.¹²

Before the SARS-CoV-2 outbreak, a relationship between prolonged intubation and dysphagia had been found in critically-ill patients requiring mechanical ventilation¹³ as well as those with acute respiratory distress syndrome.¹ Dysphagia was present in greater than 50% of patients who were intubated longer than 48 hours.¹⁴ Moderate to severe dysphagia was seen in patients who were intubated for longer than 7 days.¹⁵ Prolonged intubation may lead to reduced laryngeal sensation, which can result in silent aspiration.¹⁶

Although previous literature establishes a relationship between intubation and dysphagia, it is not clear how the swallowing mechanisms and physiology are affected by SARS-CoV-2. Given the limited information to date on dysphagia during inpatient rehabilitation in patients after COVID-19, our aims were: (1) to describe clinical and VFSS characteristics at admission to inpatient rehabilitation and (2) to explore the relationships between clinical swallow evaluation results, VFSS results, and prior intubation in patients admitted to an inpatient rehabilitation hospital after acute hospitalization for SARS-CoV-2.

List of abbreviations:

FEES	fiberoptic endoscopic evaluation of swallowing
FOIS	Functional Oral Intake Scale
IDDSI	International Dysphagia Diet Standardization Initiative
LAR	likelihood of aspiration ratio for stroke patients
MASA	Mann Assessment of Swallowing Ability
PAS	penetration aspiration scale
SLP	speech language pathologist
TNS	total numerical score
VFSS	videofluoroscopic swallow study

Methods

This retrospective study was conducted at a large urban acute rehabilitation hospital. Our institutional review board approved extraction of patient data from the electronic health record and granted a waiver of informed consent for use of deidentified, historical data. Objective measures were used to classify patient performance to avoid recall bias. We reviewed the electronic medical records of the first 40 patients with prior SARS-CoV-2 diagnoses who were referred for a VFSS between the months of April and August 2020. Referrals for VFSS were determined by the evaluating speech-language pathologist (SLP) after completion of a comprehensive speech, language, and swallowing evaluation that included a clinical swallow examination with administration of the Mann Assessment of Swallowing Ability (MASA)¹⁷ and the Functional Oral Intake Scale (FOIS).¹⁸ Demographic characteristics were extracted from the electronic medical record, including current medical comorbidities. Comorbidities were extracted based on admitting physicians *International Classification of Diseases*, 10th revision, codes.¹⁹ The first 40 patients who were referred for a VFSS were considered to be a representative sample of the 121 patients admitted to inpatient rehabilitation with COVID-19 acute respiratory disease, pneumonia owing to SARS-associated coronavirus and/or pneumonia owing to SARS-associated coronavirus diagnosis. An independent reviewer completed a reliability check on data extracted from 20% of the patients included in the sample determining reliability to be 97% with the electronic health record.

Measures

MASA

The MASA¹⁷ was administered at admission and discharge as a part of the standardized clinical swallow examination.²⁰ The MASA standardizes administration and scoring components of the clinical swallowing evaluation to determine the presence of dysphagia and severity of impairments. The MASA was initially validated in patients after acute stroke.¹⁷ It provides a score that ranges from 0 to 200, with a stroke-based risk cutoff score of 170 or greater indicating no abnormality.²¹ Furthermore, likelihood ratios were used to create 4 categories to define the risk for aspiration as follows: unlikely (≥ 170), possible (149-169), probable (141-148), and definite (≤ 140).²² Although not validated with the post-COVID population, research has shown application of the MASA with populations other than stroke^{23,24} and thus it is administered as a part of the hospital's usual care to standardize the clinical swallow evaluation.

FOIS

The FOIS¹⁸ was rated at admission and discharge by the treating SLP. The FOIS is a 7-point scale that documents the effect of dysphagia on oral intake of food and liquid, and includes both feeding tube dependence and consistency modifications. The FOIS has adequate reliability, validity, and sensitivity to change in functional oral intake over the course of rehabilitation.¹⁸

International Dysphagia Diet Standardization Initiative

The International Dysphagia Diet Standardization Initiative (IDDSI) framework consists of 8 food and liquid consistencies on a scale from 0 to 7.²⁵ Each patient's admission and discharge IDDSI diet as well as recommended IDDSI diet after VFSS were extracted from the electronic health record.

VFSS and penetration aspiration scale

A VFSS was completed on each of the patients. If a patient had more than 1 VFSS for reassessment purposes during the study period, only the first was included in this study. A VFSS evaluates the “functional anatomy and physiology of the swallowing mechanism, swallowing efficiency, and airway protection.”²⁶ The SLP who completed the VFSS determined the presence or absence of aspiration using the penetration aspiration scale (PAS),²⁷ identified the need for compensatory strategies and provided diet recommendations. The PAS is an 8-point scale that rates the degree of airway invasion. Scores of 3 or greater indicate airway invasion, whereas a score of 6 or greater indicates aspiration. For this study, we extracted the highest (worst) PAS score, the IDDSI food or liquids bolus consistency on which it occurred, and the size of the bolus. This extracted score reflects the nature of the presenting dysphagia and is a common method for summarizing PAS scores.²⁸

Statistical analysis

Descriptive statistics were used to characterize patient demographic information and comorbidities, MASA and FOIS scores, and results of the VFSS. Correlation coefficients were used to determine the relationship between the MASA total numerical score (TNS) and the PAS determined from the VFSS. We used a logistic regression with a single continuous predictor (number of days of intubation) to estimate the odds of patients having a penetration aspiration score of 3 or greater (indicating airway invasion), compared with having a penetration aspiration score of less than 3. The presence of stroke and the presence of having a tracheostomy were assessed as independent predictors for PAS because strokes and tracheostomies may be associated with PAS impairments to a greater extent than intubation alone. Analyses were performed using SAS version 9.4.^{1,a}

Results

Patient characteristics

A total of 40 patients with confirmed diagnosis of SARS-COV-2 at the time of inpatient rehabilitation were included in data collection (age range, 32-86y; mean age, 65.9±13y; 29 identified as men, 11

Table 1 Patient characteristics (N=40)

Respiratory Information	n (%)
Days with endotracheal intubation (mean ± SD)	17±14
Tracheostomy placed	7 (18)
Acute medical complexities	
Type of medical complication	
Hematologic	14 (35)
Neurologic	12 (30)
Cardiac	9 (23)
Genitourinary and Hepatology	8 (20)
Infectious Disease	7 (18)
Medical complexities	
0	9 (23)
1	17 (43)
2	6 (15)
3	7 (18)

identified as women). Most (43%) individuals had at least 1 acute comorbidity, the most common of which were hematologic and neurologic (table 1). Five patients experienced an acute stroke. During the acute care stay, 34 of the 40 patients (85%) underwent endotracheal intubation (duration of intubation, 5-68d; median, 15d). Of these 34 patients, 10 (29%) had repeated intubation. Three of the 40 patients had an unknown history of intubation during their acute hospitalization for SARS-CoV-2 and 3 were not intubated. Seven patients from the entire sample (17%) had tracheostomies during the acute care stay.

Initial evaluation data

At the time of initial evaluation during inpatient rehabilitation, 37 patients (93%) had a FOIS score of 6 or less, indicating restriction of oral intake (table 2). Of the 40 patients, 3 (8%) were achieving nutrition by mouth with no modifications; 62% of patients achieved all nutrition by mouth but with modification to consistencies, 10% achieved some oral intake but required supplementation by gastrostomy tube, and 20% could consume nothing by mouth and were dependent on a gastrostomy tube for nutrition and hydration (table 3). Additionally, 18 (45%) achieved a likelihood of aspiration ratio (LAR) of unlikely (170-200) on the MASA. In our

Table 2 Dysphagia characteristics during inpatient rehabilitation (N=40)

Measures at Initial Evaluation	n (%)
MASA score on admission ≤170 (indicates potential aspiration risk)	22 (55)
FOIS score ≤6 upon admission (indicating modified diet)	37 (93)
PAS Scores on VFSS	
Degree of aspiration	
PAS score of 3 or 5 (penetration without ejection)	8 (20)
PAS score of ≥6 (aspiration)	12 (30)
PAS score of 8 (silent aspiration)	11 (28)
PAS score achieved with IDDSI consistency or volume	
PAS score of ≥3 on IDDSI liquids levels—thin, mildly thick, moderately thick	22 (55)
PAS score of ≥3 occurring on bolus of SS or STRS	12 (30)
PAS score of ≥3 occurring on bolus smaller than NS	13 (32.5)
Recommendations following VFSS information	
Upgraded to 0 from modified liquids or NPO	20 (67)
Upgraded or remained on 0 with swallow guidelines	11 of 28 (39)
Downgraded diet or remained ordered liquid modification or NPO	5 (13)
Upgraded to 7.0 - including with compensatory strategy use	19 of 37 (51.4)
Discharge diet and measures	
P upgraded to 7.0 at discharge from modified diet	25 of 37 (68)
MASA scores upon discharge ≤170 (indicating potential aspiration risk)	2 (6)
FOIS score ≤6 upon discharge (indicating modified diet)	9 of 37 (22)

NOTES. Number is out of 40 patients unless indicated otherwise. MASA score ≤170 indicates potential aspiration risk, FOIS score ≤6 indicates diet modification, and PAS ≥6 indicates aspiration and PAS ≥3 indicates airway invasion.

Abbreviations: NPO, nothing by mouth; NS, natural sip; SS, serial swallows; STRS, straw sip.

Table 3 VFSS information

Patient No.	Preadmission		Admission				VFSS		Diet Recommendation After VFSS
	VFSS at OSH	No. of Days Intubated	IDDSI	MASA	FOIS	PAS	IDDSI Level	Bolus Size	IDDSI Level Recommendation
1	No	27	NPO	155	1	3	0	3 mL	NPO
2	U	86	6.0	186	5	5	0	SS, STRS	Upgrade to 7, remain *0
3	Yes	10	NPO	156	1	8	0	3 mL	Upgrade to 4, 3
4	No	U	7, 2	170	6	1	0	All	Upgrade to 7.0
5	No	7	6.2	163	5	1	0.4, 7	All	upgrade to 7, 0
6	No	30	6.0	186	5	8	0	3 mL	Upgrade to 7, remain 0
7	U	11	6.0	167	5	2	0	All 0	Upgrade to 7, remain 0
8	No	24	NPO	165	1	8	0	SS	Upgrade to level 7, *0
9	No	U	5.2	182	5	5	0	NS, SS	Remain on 5.2
10	No	7	4.3	136	4	5	0.2, 3	5 mL, SS	Trial 5.3
11	No	16	4.4	168	4	6	0	NS	Upgrade to 6.0
12	No	24	5.0	175	3	8	0	SS	Upgrade to 7, remain on 0
13	Yes	11	7.0	167	7	2	0	All 0	Remain on 7.0
14	No	N/A	4.3	157	3	1	0.4	All trials Trials of 0	Trial of 5.0
15	Yes	15	6.3	184	5	8	0	NS, SS	Upgrade to 7, *0
16	No	21	NPO	162	1	1	0.4, 7	All	Upgrade to level 5.0
17	No	24	4.2	157	4	8	0.2	NS 2	Downgrade to level 3, Upgrade to level 5
18	No	9	NPO	167	1	2	0	SS	Upgrade to 7, remain *0
19	No	25	NPO	160	1	5	0	3 mL, 5 mL	Upgrade to level 7, 2
20	Yes	22	4.2	183	4	3	0	5 mL, 10 mL, NS, SS	Upgrade to 7, *0
21	U	U	4.0	180	4	2	0	All 0	Upgrade to level 5, remain 0
22	No	9	6.2	165	5	8	0	SS	Upgrade to level 7, *0
23	No	23	NPO	167	1	3	0	NS	Upgrade to 4.2
24	U	16	4.2	176	4	8	0	5 mL, 10 mL, NS	Upgrade to 6, remain on 2
25	No	10	7.0	192	7	1	0	All	Remain on 7.0
26	No	13	5.2	165	5	1	0.4, 7	All	Upgrade to level 7.0
27	Yes	25	7.2	181	6	2	0	SS	Upgrade to level 7, 0
28	No	14	5.2	181	3	3	0	5 mL, 10 mL, NS, SS	Upgrade to *6.0
29	Yes	21	4.2	164	4	1	0.4, 7	All	Upgrade 6.0
30	U	N/A	4.2	167	4	1	0	NS	Upgrade to *7.0
31	U	15	5.2	162	5	8	0	NS	Remain on 5, 2
32	Yes	19	7.3	171	6	2	0	NS, SS	Upgrade to 7.0
33	U	28	4.0	196	4	8	0	SS	Upgrade to 7, *0
34	No	5	6.2	181	5	1	0.4, 7	All	Upgrade to 7.0
35	Yes	13	6.3	171	5	8	0	SS	Upgrade to *7.0
36	No	6	5.0	156	3	1	0.4, 7	All	Upgrade to 6, Remain 0
37	No	16	7.2	181	6	1	0.4, 7	All	Upgrade to 7.0
38	No	10	7.0	154	7	5	0	STRS	Remain on 7, *0
39	No	0	5.3	124	5	2	0	NS, SS	Upgrade to 5.0
40	No	14	NPO	173	1	5	0	3ML, 5ML	Upgrade to level 7.2

NOTES. MASA score ≤170 indicates potential aspiration risk.

FOIS score ≤6 indicates diet modification. Level 1: nothing by mouth. Level 2: tube dependent with minimal attempts of food or liquid. Level 3: tube dependent with consistent oral intake of food or liquid. Level 4: total oral diet of a single consistency. Level 5: total oral diet with multiple consistencies, but requiring special preparation or compensations. Level 6: total oral diet with multiple consistencies without special preparation, but with specific food limitations. Level 7: total oral diet with no restrictions.

IDDSI: Level 7: regular diet. Level 6: soft and bite-size. Level 5: moist and minced. Level 4: puree, liquids—extremely thick liquids. Level 3: moderately thick liquids. Level 2: mildly thick liquids. Level 0: thin liquids.

PAS: 1 indicates no penetration or aspiration; 2 indicates penetration, contrast remains above the vocal folds and subsequently ejected; 3 indicates penetration, contrast remains above the vocal fold and not ejected; 4 indicates penetration, contrast contacts vocal folds and subsequently ejected; 5 indicates penetration, contrast contacts vocal folds and not ejected; 6 indicates aspiration, contrast below vocal folds and subsequently ejected; 7 indicates aspiration not ejected despite effort; and 8 indicates aspiration, no effort made to eject.

Abbreviations: OSH, outside hospital; N/A, not available; NPO, nothing by mouth; NS, natural sip; SS, serial swallows; STRS, straw sip U, unknown.

sample, only 20% of patients had been evaluated previously by videofluoroscopy in acute care. FEES was not conducted at the previous level of care for any of the patients in our sample.

Data from VFSS

After their VFSS during inpatient rehabilitation, 30% (12 of 40) of patients demonstrated a PAS score of 6 or greater, indicating aspiration on a least 1 trial during VFSS. An additional 25% (10 patients) demonstrated penetration without ejection on VFSS. Nineteen individuals (51%) were upgraded to IDDSI level 7 regular diet with level 0 thin liquids and achieved a FOIS of 7, indicating that no food or liquid modifications were needed for safe intake. Of the 30 patients admitted on modified liquids or who were allowed nothing by mouth, 20 (67%) were upgraded to level 0, thin liquids, with 11 patients being restricted from straws and consecutive swallows to achieve safety with upgrade to level 0 liquids. After the VFSS, 5 individuals (13%) received a downgrade of liquids or remained on the same modified liquid recommendations from their admission to inpatient rehabilitation.

Relationship between clinical swallow examination and VFSS

We compared the MASA score from the clinical swallowing evaluation with results obtained during the VFSS. We calculated the TNS and LAR achieved on the MASA. A TNS of less than 170 predicted the presence of aspiration with 27% (6/22) accuracy; 72% of the patients (16/22) had a TNS less than 170 but did not demonstrate any instances of aspiration. Fifty percent of patients who aspirated (6 of 12) achieved an LAR of “unlikely to aspirate” on the MASA; 7% (2 of 27) achieved a “definite” LAR but did not aspirate.

Relationship between intubation and dysphagia

Results of the logistic regression indicated that for each additional day of intubation, the odds of patients having a PAS of 3 or greater increased by approximately 15% (odds ratio, 1.15; 95% confidence interval, 1.03-1.27; $P=.013$). Thus, with each additional day of intubation, there was a 15% greater likelihood of having airway invasion. Stroke and tracheostomy placement were not significant predictors of PAS alone or in combination with days intubated.

Discussion

Our study shows that instrumental swallow evaluation provides important information for the diagnosis and treatment of dysphagia in patients who have had SARS-CoV-2 and are admitted to inpatient rehabilitation. The retrospective analysis also demonstrates a high correlation between acute care intubation and ongoing dysphagia during inpatient rehabilitation for patients with SARS-CoV-2 diagnoses. Specifically, the likelihood of airway invasion, as identified on videofluoroscopy, increases with each day of intubation and persists into the subacute rehabilitation period of recovery. This finding is consistent with prior evidence that prolonged intubation decreased laryngeal sensation and puts patients at risk for silent aspiration or airway invasion.^{15,16}

In addition to increased duration of intubation, other underlying factors likely affected dysphagia. Many of the patients in this

sample experienced multiple acute comorbidities. Critical illness contributes to deconditioning and debility, impaired cognition, neuromyopathy, and decreased coordination of swallow and breathing.^{13,15,16} The presence of airway invasion and silent aspiration in our sample may indicate a common pathophysiology of dysphagia in patients after SARS-CoV-2 intubation. The incidence of aspiration after an acute stroke varies, but can be as high as 33%.²⁹ A high number of patients in this study experienced a neurologic comorbidity, yet our analysis found that the presence of stroke was a noncontributing factor for airway invasion in this population. Furthermore, previous literature supports a high incidence rate of aspiration in patients with tracheostomies, citing rates as high as 30% to 50%.^{30,31} Again, our analysis found that the presence of a tracheostomy alone was a noncontributing factor for airway invasion in this population.

Silent aspiration occurred in 27% of the patients sampled. An instrumental swallow study would be imperative for identification and intervention. VFSS was important for identifying strategies that were appropriate for helping patients return to intake of unmodified liquids. Although 11 patients were able to upgrade or remain on level 0 thin liquids, they required modifications for safe liquid intake, including taking single cup sips, restriction from using straws, and drinking a small volume, which could only have been determined with the completion of the VFSS.

Furthermore, our analysis underscores the need for conducting instrumental swallowing evaluations in this patient population. In our sample, MASA TNS and LAR were poor predictors of aspiration; 56% of patients achieved a TNS of less than 170 but did not aspirate, and 50% of patients who aspirated achieved a LAR of “unlikely” on the MASA. Only 20% of patients in our sample had a VFSS conducted during their acute care hospitalization, yet 93% were receiving modified diets as rated on the FOIS, indicating conservative management in acute care. This management trend may reflect early decision-making during the pandemic to hold or defer VFSS and FEES given infection prevention concerns with aerosol generating procedures.

Collaboration with the hospital infection preventionist allowed early implementation of measures to allow completion of VFSS with the SARS-CoV-2 population at our rehabilitation hospital. Our guidelines limited exposure during patient transport, reduced the number of personnel during the examination, and placed a time restriction on room use after the completion of the aerosol generating procedure. Later in the pandemic, guidelines such as these were suggested for the medical community.³² Our study supports recent efforts of many hospital systems to revisit their protocols for instrumental dysphagia evaluations with COVID-positive patients.²

Study limitations

There are several limitations related to the retrospective nature of this study. Compared with prospective dysphagia research, we report fewer objective measures of swallowing physiology, because the VFSS were documented using standard clinical rather than research practices. The timing of the completion of the VFSS was not extracted as part of this data analysis. One limitation of using FOIS is that it can be influenced by nondysphagia-related factors such as poor dentition or consistency preference, which we did not track owing to their low frequency of occurrence in this sample. Our patient sample was taken early in the pandemic and may not represent current patients discharged from acute care given evolving practices in acute care management.

Conclusion

Instrumental swallow evaluations are imperative to diagnose and treat dysphagia in the post-COVID population. Because of the heterogeneity of this population, the potential for multiple medical comorbidities, and the lack of sensitive screening tools, instrumental assessments need to be performed on a more consistent basis. Infection prevention protocols need to evolve to prioritize the completion of instrumental swallow studies such as videofluoroscopy for this patient population. This population, which has a high incidence of prolonged intubation, is at greater risk for aspiration, and clinical swallow evaluations are limited in their sensitivity in identifying aspiration. Further research is warranted to specify the pathophysiology of dysphagia in this population through more precise measurement.

Supplier

a. SAS, version 9.4; SAS Institute.

Keywords

COVID-19; Rehabilitation; Speech-language pathology

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