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ORIGINAL RESEARCH

Efficacy of an Aspiration Prevention Program That Utilizes the Gugging Swallowing Screen in Older Patients

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Purpose: Older patients have a higher risk of aspiration pneumonia and mortality if they are hospitalized. We aimed to assess the effectiveness of an aspiration prevention quality improvement (QI) program that utilizes the Gugging Swallowing Screen (GUSS) in older patients.

Patients and Methods: This retrospective cohort study was conducted in an acute medical care unit of a tertiary hospital in South Korea. The study used one-to-one propensity matching and included 96 patients who received the QI program and 96 who did not. All patients were aged 65 years or older and had risk factors for aspiration, including neurological and non-neurological disorders, neuromuscular disorders, impaired airway defenses, and dysphagia due to esophageal or gastrointestinal disorders. The primary outcomes included the duration of the fasting period during hospitalization, changes in nutritional status before admission and at discharge, in-hospital mortality, and readmission due to pneumonia within 90 days.

Results: Fasting period, changes in weight and albumin levels upon discharge after hospitalization, and length of stay did not differ significantly between patients in the GUSS and non-GUSS groups. However, the risk of readmission within 90 days was significantly lower in patients who underwent the GUSS than in those who did not (hazard ratio, 0.085; 95% confidence interval, 0.025–0.290; p = 0.001).

Conclusion: The GUSS aspiration prevention program effectively prevented readmission due to pneumonia within 90 days in older patients with acute illnesses. This implies that the adoption of efficient aspiration prevention methods in older patients with acute illnesses could play a pivotal role by enhancing patient outcomes and potentially mitigating the healthcare costs linked to readmissions.

Keywords: aspiration pneumonia, older patients, gugging swallowing screen, prevention, quality improvement

Introduction

Pneumonia is the fourth leading cause of death worldwide, with most deaths occurring in patients older than 65 years.[1,2] Aspiration is the main pathophysiology of pneumonia in older patients; hence, it is reasonable to primarily consider aspiration pneumonia when it occurs in older patients.[3] Indeed, a study reported that 75% of hospitalized patients with pneumonia were older than 70 years, and 80% of them had aspiration pneumonia.[4] It is also known that when aspiration pneumonia occurs in older adults, the length of hospital stay is prolonged, and the in-hospital and 1-year mortality rates nearly double.[5–9] Many developed countries are experiencing unprecedented social aging, and the number of older people is expected to reach approximately 1.5 billion by 2050.[10] Therefore, aspiration pneumonia is increasingly important in clinical practice.

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Dysphagia is an important cause of aspiration, and deterioration of swallowing and cough reflexes are the major mechanisms for developing aspiration pneumonia.[11–13] As age increases, degeneration and complex comorbidities occur, and approximately 13−81% of older patients experience oropharyngeal dysphagia.[10,14–16] Older patients with aspiration pneumonia often exhibit non-specific symptoms, such as general malaise, impaired consciousness, and loss of appetite, and because pneumonia is often detected late, patients are usually in serious condition.[13] Additionally, repeat aspiration pneumonia often occurs owing to inadequate knowledge of the risk factors for aspiration and administration of antibiotic therapy without assessing whether there is a problem with oral administration.[13] Therefore, to mitigate the risk of aspiration pneumonia in older individuals, it is imperative to ascertain the occurrence of aspiration and provide appropriate dietary education.[17]

Fibreoptic endoscopic evaluation of swallowing (FEES) and videofluoroscopic swallowing study (VFSS) are the clinical gold standards for objectively evaluating oropharyngeal dysphagia.[18–21] VFSS is widely used because it is non-invasive, can directly confirm anatomical and functional problems by visualizing them through radiography, and can reliably evaluate the presence or absence of aspiration. However, VFSS requires access to the radiology room and cannot be performed if the patient is unable to sit or cooperate for >30 min.[22] Additionally, it requires a fluoroscopy device, which exposes the patient to individual radiation. Finally, scheduling challenges and wait times in radiology often prolong the patient's fasting periods and lead to unnecessary extension of hospital stay.[18] The Gugging Swallowing Screen (GUSS) is a typical bedside screening tool for dysphagia.[23,24] The GUSS has a relatively high sensitivity and specificity compared with other tools; therefore, it is widely used to identify dysphagia after stroke and shows results comparable to VFSS.[25] A recent study on healthy older adults reported that the GUSS test was valid and reliable for identifying the risk of oropharyngeal dysphagia and was highly correlated with the FEES test.[25] However, studies validating the utility of the GUSS in older patients with acute illnesses are scarce.

An acute medical care unit (AMU) led by internal medicine specialists has been maintained at our facility since 2015. In April 2021, we introduced an aspiration prevention and education quality improvement (QI) program using the GUSS aimed at reducing the risk of aspiration pneumonia in older patients admitted to the AMU due to acute illnesses. This initiative was prompted by the common presence of aspiration risk factors in this patient population. Therefore, this study aimed to assess the clinical effectiveness of aspiration prevention QI using the GUSS before discharge following the stabilization of acute diseases.

Materials and Methods

Study Design and Patients

This retrospective cohort study enrolled patients ≥65 years admitted to the AMU at a tertiary referral hospital, from 1 April 2021 to 31 March 2023, who participated in the aspiration QI program (GUSS group). The AMU is a general ward managed by a team of 10 internists, each with >10 years of experience, and two advanced practice nurses (APNs), providing round-The-clock patient care. Adult patients with acute medical illnesses requiring hospitalization were predominantly admitted to the emergency room of this ward. To confirm the effectiveness of the QI program, older hospitalized patients with aspiration risk factors who did not undergo the QI program between January 2017 and March 2021 were retrospectively reviewed, and 290 were selected as the control group (non-GUSS group).

Patients aged ≥65 years with the following risk factors for aspiration were encouraged to participate in the aspiration prevention program using the GUSS: dysphagia due to neurological disorders such as dementia, parkinsonism, and stroke; non-neurological disorders such as chronic obstructive pulmonary disease and sarcopenic dysphagia; neuromuscular diseases such as scleroderma; compromised airway defense such as vocal cord palsy; or esophageal or gastrointestinal disorders. The exclusion criteria included patients with pre-existing confirmed dysphagia, severe hypercapnia (pH<7.25), respiratory or cardiac arrest, acute coronary syndrome, life-threatening arrhythmias, dysfunction of two or more organs, dysphagia due to anatomical diseases, such as head and neck cancer, previously undergone surgery or radiation therapy, or required therapeutic fasting due to intestinal obstruction, and those who were unable to cooperate with the instructions or were already receiving nutrition through feeding tubes.

Demographic data, including age, sex, comorbidities, and laboratory data, were systematically reviewed, and collected for each patient. Nutritional status at admission was assessed using the Mini Nutritional Assessment – Short Form (MNA-SF), a validated nutritional screening tool for geriatric patients.[26] This study was approved by the Institutional Review Board and Ethics Committee of Seoul National University Bundang Hospital (IRB No. B-2305-826-103). The requirement for informed consent was waived because the study was retrospective in nature, analyzing pre-existing medical records. To protect patient privacy, all data were anonymized and handled with strict confidentiality. This research was conducted in compliance with the Declaration of Helsinki.

Aspiration Prevention Program Using the GUSS

For patients at risk of aspiration but on an oral diet, we used the GUSS to assess for eating disorders, evaluated their nutritional status to make improvements, and recommended appropriate physical properties of meals, eating habits, and postures. Additionally, we implemented non-pharmacologic interventions, such as oral care and swallowing rehabilitation, when necessary.[13]

Patients with aspiration risk factors were screened within 48 h of admission. If the patient satisfied the clinical stability criteria, the APNs performed the GUSS test at the bedside after confirmation by the attending hospitalist. Speech-language pathologists (SLPs) are typically responsible for evaluating patients for dysphagia and conducting VFSS and FEES.[27] However, at our institution, these tests are scheduled and performed by the Department of Rehabilitation Medicine, which often leads to delays and staffing constraints. To address this issue, trained APNs with more than 3 years of experience in GUSS implementation were tasked with performing GUSS assessments.[28] Clinical safety criteria, which all had to be met on the same day, included temperature ≤37.8°C, heart rate ≤100 beats/min, respiratory rate ≤24 breaths/min, systolic blood pressure ≥90 mmHg, arterial oxygen saturation ≥90% or partial pressure of oxygen ≥60 mmHg on room air, and normal mental status.[29]

Before initiating the GUSS screening, patients were positioned upright on the bed at a minimum angle of 60°, and the investigator assessed their ability to recognize the tester's face, a spoon, and various textures placed in front of them. Throughout the GUSS assessment, a caregiver was required to be present, and vital signs, including oxygen saturation, were continuously monitored. If any changes in vital signs, alterations in voice, or instances of coughing were observed, the test was promptly halted.

The development and details of the GUSS are available from Trapl et al.[30] The Korean version of the GUSS was used.[31] The difference between the Korean version and the original GUSS lies primarily in the language of administration, with the test methodology and ingredients remaining consistent. Diet recommendations were provided to attending physicians and nurses depending on the score reached on the GUSS. After discussing the GUSS results with the patient or caregiver, the APN provided a detailed booklet titled 'Guidelines for Patients with Swallowing Disorders' and thoroughly explained its contents. This booklet provides comprehensive guidelines and education on understanding dysphagia, including the anatomy and physiology of swallowing and the major symptoms that may indicate dysphagia. It also outlines assessment methods such as the VFSS and details various treatment options, including postural adjustments, sensory stimulation, swallowing techniques, dietary modifications, swallowing exercises, and tube feeding for patients unable to intake orally due to severe dysphagia.

The GUSS, utilizing a 14-point scale, typically shows normal results in the indirect swallowing and semisolid tests but may reveal some abnormalities in the liquid tests. Patients who score 14 or lower are classified as at risk for aspiration.[30] For these patients, further evaluation through VFSS is recommended, and, if appropriate, swallowing rehabilitation is provided in collaboration with the Department of Rehabilitation Medicine. The results of the VFSS were graded using the Penetration Aspiration Scale (PAS), which sequentially classifies the severity of dysphagia and the degree of airway obstruction.[32] Patients with a PAS score of 5 or higher on the semi-solid or liquid diet during the examination were classified as being at risk for aspiration.[18,30] The nurse in charge continuously monitored the patient for aspiration during meals.[30] Education was provided again when the patient was discharged.

Clinical Outcomes

Primary outcomes included changes in fasting duration during hospitalization and changes in nutritional status before admission and at discharge, including body weight and albumin levels. Secondary outcomes were readmission rates due to pneumonia within 90 days and in-hospital mortality. Furthermore, a subgroup analysis was conducted based on the implementation of the VFSS and considering aspiration risk factors, age, and comorbidities.

Statistical Analysis

Data are reported as the number and percentage for categorical variables and mean and standard deviation for continuous variables with a normal distribution. Paired t-tests or Wilcoxon signed-rank tests were used to compare continuous outcomes, and McNemar's test was used to compare categorical outcomes.

To minimize the effects of potential confounding variables, propensity score matching (PSM) was performed using a nearest-neighbor matching algorithm without replacement.[33] Each patient who underwent GUSS assessment was matched 1:1 to a non-GUSS patient based on the logit of the propensity score with 0.2-SDa caliper width.[34] The propensity score was estimated using logistic regression analysis with 14 covariates, including demographic and nutritional status variables, aspiration pneumonia history or diagnosis, aspiration symptoms, and Eastern Cooperative Oncology Group status.[35] All demographic and clinical information before and after PSM were compared using absolute standardized mean difference and considering <0.2 as a good balance.[36] The proportional hazards assumption of all Cox proportional hazard models was examined using the Grambsch and Therneau test based on Schoenfeld residuals.[37] An interaction term was added to test whether there was a difference in the effect of the GUSS depending on age, sex, and cause of dysphagia. All statistical analyses were performed using R 4.4.1 (R Foundation for Statistical Computing, Vienna, Austria) with the "MatchIt" package,[38] and p-values < 0.05 (two-tailed) were considered significant.

Results

Patient Characteristics

Between 1 April 2021 and 31 March 2023, 132 patients participated in the GUSS aspiration prevention QI program (Figure 1). On average, QI using the GUSS was administered on the 4.6th day of hospitalization.

Patient baseline characteristics before and after PSM are summarized in Table 1. The mean age was 81.1±7.83 years, with a male predominance of approximately 65%. The albumin level was 3.21±0.55 g/dL in the GUSS group and 3.07±0.63 g/dL in the non-GUSS group, revealing no significant difference between the two groups (p=0.119). The average body mass index (BMI) was approximately 20, and the mean total MNA-SF score was approximately 5. Notably, only 1% of patients

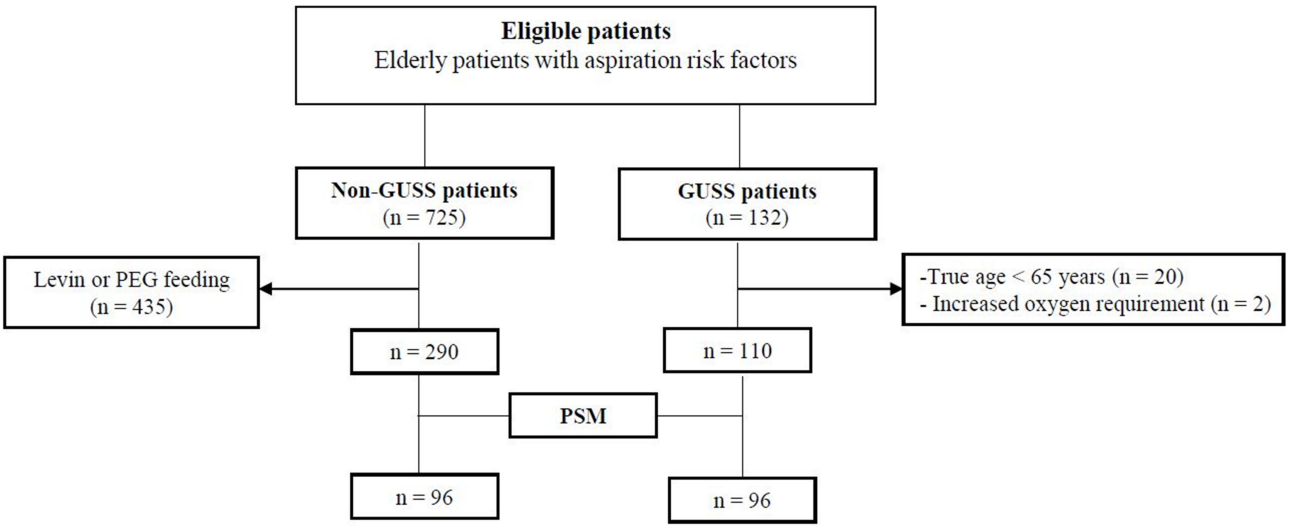

Figure 1 Patient enrolment.

Table 1 Baseline Characteristics of Patients Before and After Propensity Score Matching

	Before matching			After matching		
	GUSS (n = 110)	**Non-GUSS (n = 290)**	**SMD**	**GUSS (n = 96)**	**Non-GUSS (n = 96)**	**SMD**
Sex, male	71 (64.5)	189 (65.2)	0.006	63 (65.6)	66 (68.8)	0.031
Age (years)	80.34 ± 8.10	81.81 ± 7.56	0.181	79.85 ± 8.07	80.79 ± 7.11	0.116
Body weight (kg)	54.46 ± 10.74	51.27 ± 11.33	0.296	54.01 ± 10.64	53.05 ± 10.78	0.089
BMI (kg/m^2)	21.25 ± 4.08	19.82 ± 3.82	0.349	20.97 ± 3.70	20.66 ± 3.89	0.077
Age-adjusted CCI	8.24 ± 2.53	6.53 ± 1.98	0.673	7.85 ± 2.30	7.48 ± 2.30	0.148
Diabetes mellitus	46 (41.8)	89 (30.7)	0.111	36 (37.5)	37 (38.5)	0.010
Hypertension	72 (65.5)	137 (47.2)	0.182	60 (62.5)	42 (43.8)	0.188
CVD	36 (32.7)	68 (23.4)	0.093	30 (31.2)	19 (19.8)	0.115
COPD	22 (20.0)	39 (13.4)	0.066	17 (17.7)	18 (18.8)	0.010
CVA	34 (30.9)	84 (29.0)	0.019	31 (32.3)	29 (30.2)	0.021
Solid cancer	50 (45.5)	71 (24.5)	0.210	41 (42.7)	37 (38.5)	0.042
Dementia	51 (46.4)	145 (50.0)	0.036	46 (47.9)	36 (37.5)	0.104
MNA-SF total score	5.12 ± 2.96	4.97 ± 3.09	0.050	5.09 ± 2.86	5.08 ± 2.71	0.004
NST consultation	44 (40.0)	120 (41.4)	0.014	40 (41.7)	38 (39.6)	0.021
Oral feeding at home	110 (100.0)	288 (99.3)	0.007	96 (100.0)	96 (100.0)	0.000
Feeding at admission			0.168			0.083
NPO	38 (34.5)	145 (50.0)		36 (37.5)	34 (35.4)	
Oral diet	61 (55.5)	112 (38.6)		49 (51.0)	57 (59.4)	
Tube feeding	11 (10.0)	33 (11.4)		11 (11.5)	5 (5.2)	
Aspiration pneumonia history	8 (7.3)	18 (6.2)	0.011	6 (6.2)	8 (8.3)	0.021
Aspiration pneumonia at admission	27 (24.5)	174 (60.0)	0.355	27 (28.1)	28 (29.2)	0.010
Aspiration symptom	63 (57.3)	222 (76.6)	0.193	58 (60.4)	61 (63.5)	0.031
ECOG scale			0.056			0.056
1	0 (0.0)	5 (1.7)		0 (0.0)	0 (0.0)	
2	6 (5.5)	22 (7.6)		6 (6.2)	7 (7.3)	
3	21 (19.1)	39 (13.4)		17 (17.7)	16 (16.7)	
4	83 (75.5)	224 (77.2)		73 (76.0)	73 (76.0)	

Notes: Values are presented as n (%) or mean ± standard deviation.

Abbreviations: BMI, body mass index; CCI, Charlson Comorbidity Index; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; CVD, coronary vascular disease; ECOG, Eastern Cooperative Oncology Group; GUSS, Gugging Swallowing Screen; MNA-SF, Mini Nutritional Assessment – Short Form; NPO, nil per os; NST, nutritional support team; SMD, standardized mean difference.

exhibited normal nutritional status, with approximately 80% diagnosed with malnutrition (78.2% and 79.2% in the GUSS and non-GUSS groups, respectively). Neurological disorders were the most prevalent cause of dysphagia, accounting for 72.9% and 62.8% of patients in the GUSS and non-GUSS groups, respectively. The primary reason for hospitalization was respiratory disease, followed by cancer-related conditions. PSM was well balanced regarding patients' demographic variables, comorbidities, presence and symptoms of aspiration pneumonia, and nutritional status (Supplementary Figure 1).

Among the 60 patients who underwent VFSS 34 were in the GUSS group and 26 were in the non-GUSS group. For the 34 patients who underwent both GUSS and VFSS, tube feeding was recommended for 7 patients (20.6%), while an oral diet was recommended for 15 patients (44.1%). According to the GUSS test, 20 patients (58.8%) were identified as being at high risk for aspiration, while the VFSS test identified 24 patients (70.6%) as high-risk. Notably, 14 patients (41.2%) were classified as high-risk for aspiration by both tests (Table 2).

Primary Outcomes

To assess potential nutritional differences between the GUSS and non-GUSS groups, body weight, albumin levels, and fasting time were analyzed at admission and discharge (Supplementary Table 1). The observed difference in albumin

Table 2 The Results of GUSS and VFSS 2A. Risk of Aspiration

	VFSS results	
	PAS (5–8)	**PAS (1–4)**
GUSS results		
0–14	14 (41.2)	6 (17.6)
15–20	10 (29.4)	4 (11.8)

Note: Values are presented as n (%).
Abbreviations: GUSS, Gugging Swallowing Screen; PAS, Penetration Aspiration Scale; VFSS, Videofluoroscopic swallowing study.

Table 3 Suggested Meal Properties Based on GUSS or VFSS Results (n = 34)

	Suggested diet based on GUSS results					χ^2	P-value
Suggested diet based on VFSS results	**Tube feeding**	**DD step 1**	**DD step 2**	**DD step 3**	**Tolerable diet**	**9.20**	**0.42**
Tube feeding	7 (20.6)	2 (5.9)	6 (15.2)	0 (0.0)	0 (0.0)		
DD step 1	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)		
DD step 2	1 (2.9)	1 (2.9)	0 (0.0)	0 (0.0)	0 (0.0)		
DD step 3	1 (2.9)	1 (2.9)	3 (8.8)	0 (0.0)	0 (0.0)		
Tolerable diet	2 (5.9)	4 (11.8)	4 (11.8)	2 (5.9)	0 (0.0)		

Note: Values are presented as n (%).
Abbreviations: DD, dysphagia diet; GUSS, Gugging Swallowing Screen; VFSS, Videofluoroscopic swallowing study.

levels before and after hospitalization was approximately 0.2, the variance in BMI was 0.4, and the average difference in the fasting period was approximately 1.6 days. These differences were not statistically significant between the groups.

The mean waiting times for VFSS were 10.2 and 11.8 days in the GUSS and non-GUSS groups, respectively, with no statistically significant difference observed (p=0.499). Furthermore, the mean length of stay was comparable between the groups (GUSS group, 14.7 days; non-GUSS group, 15.3 days), with p=0.631. Even after conducting an additional subgroup analysis based on VFSS implementation, no statistically significant differences in primary outcomes were observed between the two groups (Table 3).

Secondary Outcomes

Twenty-nine patients were readmitted for aspiration pneumonia within 90 days. Among them, 25 patients were from the non-GUSS group, while 4 patients were from the GUSS group. Results regarding the risk of readmission within 90 days in the two groups are presented in Table 4. The hazard ratio (HR) for the non-GUSS group relative to the GUSS group was 11.7, indicating that the risk of readmission in the non-GUSS group was 11.7 times higher than that in the GUSS group. This distinction was visually evident in the Kaplan–Meier curve (Figure 2). Eight (8.3%) and nine (9.4%) patients in the non-GUSS and GUSS groups, respectively, died during their hospital stay. Analysis using McNemar's test revealed no statistically significant difference between the two groups (p=1.000).

When subgroup analysis was conducted based on the performance of VFSS, the HR for readmission within 90 days in the non-GUSS group, compared with the GUSS group, was 7.99 in patients who did not undergo VFSS and 20.3 in those who underwent VFSS (Table 5). This analysis revealed a substantial increase in the risk of readmission within 90 days due to pneumonia when the aspiration prevention QI was not implemented, particularly in patients who did not undergo VFSS. An interaction term was added to check whether there was a difference in the effect of the GUSS depending on age, sex, and cause of dysphagia; however, no significant difference was found (Supplementary Figure 2), and there was no difference depending on whether VFSS was implemented (Supplementary Table 2 and Supplementary Figure 2).

Table 4 Mean Difference in Primary Clinical Outcomes Between the GUSS and Non-GUSS Groups Based on VFSS

	Outcomes	Mean difference	95% CI	p-value
Full data	LOS	–0.625	–3.201 to 1.951	0.631*
	Body weight changes	–0.089	–0.874 to 0.696	0.822*
	Albumin changes	–0.005	–0.150 to 0.139	0.941*
	NPO days	0.000	–0.725 to 0.725	1.000*
Without VFSS (n = 132)	LOS	–0.010	–3.506 to 3.486	0.416†
	Body weight changes	–0.124	–1.083 to 0.835	0.901†
	Albumin changes	–0.026	–0.193 to 0.141	0.432†
	NPO days	–0.458	–1.380 to 0.464	0.295†
With VFSS (n = 60)	LOS	–2.330	–6.648 to 1.988	0.073†
	Body weight changes	0.354	–1.110 to 1.819	0.629*
	Albumin changes	0.015	–0.237 to 0.267	0.906*
	NPO days	0.910	–0.630 to 2.449	0.492†
	Time to VFSS	–1.585	–6.262 to 3.091	0.082†

Notes: *Paired *t*-test. †Wilcoxon signed-rank test.
Abbreviations: CI, confidence interval; GUSS, Gugging Swallowing Screen; LOS, length of stay; NPO, nil per os; VFSS, videofluoroscopic swallowing study.

Table 5 Readmission Rate Due to Pneumonia Within 90 Days Between the GUSS and Non-GUSS Groups

	HR	95% CI	p-value
Full data	11.749	3.450–40.008	0.0001
Without VFSS (n = 132)	20.297	2.597–158.640	0.0041
With VFSS (n = 60)	7.989	1.697–37.606	0.0086

Abbreviations: CI, confidence interval; GUSS, Gugging Swallowing Screen; HR, hazard ratio; VFSS, videofluoroscopic swallow study.

Discussion

This study confirms the positive impact of implementing an aspiration prevention program using the GUSS in older patients admitted with acute disease following stabilization of their conditions. Our findings revealed that the aspiration prevention QI did not cause significant differences in various parameters, including body weight, albumin levels, fasting periods, and in-hospital mortality during hospitalization. The average length of hospitalization was approximately 15 days, making it challenging to discern nutritional differences over a relatively short period. Furthermore, given that the in-hospital mortality rate is likely to be influenced by the patient's underlying disease, the impact of the QI program itself on mortality rates may be limited. However, a noteworthy and intriguing result emerged, indicating a nearly 12-fold reduction in the risk of hospitalization for pneumonia within 90 days of implementing the aspiration prevention QI. The observed preventive effects can be attributed to several pivotal components. First, pre-emptive screening of vulnerable older patients with risk factors for aspiration was performed within 48 h after admission. Second, swift bedside screening for dysphagia was conducted using the GUSS. Notably, the waiting time for the VFSS by SLP exceeded an average of 10 days, whereas the GUSS was expeditiously administered within 5 days of hospitalization. Third, active communication with healthcare professionals regarding dietary patterns based on GUSS results was undertaken. Finally, personalized dietary education was provided to both patients and their caregivers. Comparing the risk of readmission due to pneumonia within 90 days based on VFSS, the impact of QI using the GUSS was more pronounced. The odds of readmission within 90 days were approximately eight times higher in patients who did not undergo aspiration prevention QI than in those who received QI. Notably, the odds of readmission due to pneumonia within 90 days were increased by approximately 20 times in patients who did not undergo VFSS (Table 4). This might be attributed to the practical constraints associated with VFSS, which typically require patients to maintain a seated position for an extended duration and be mobile.[18,22] Additionally, the time-consuming nature of the test and the interpretation of results pose challenges for its implementation during hospitalization.[18] The findings of our study indicate that although the GUSS may not serve as a direct substitute for VFSS, its

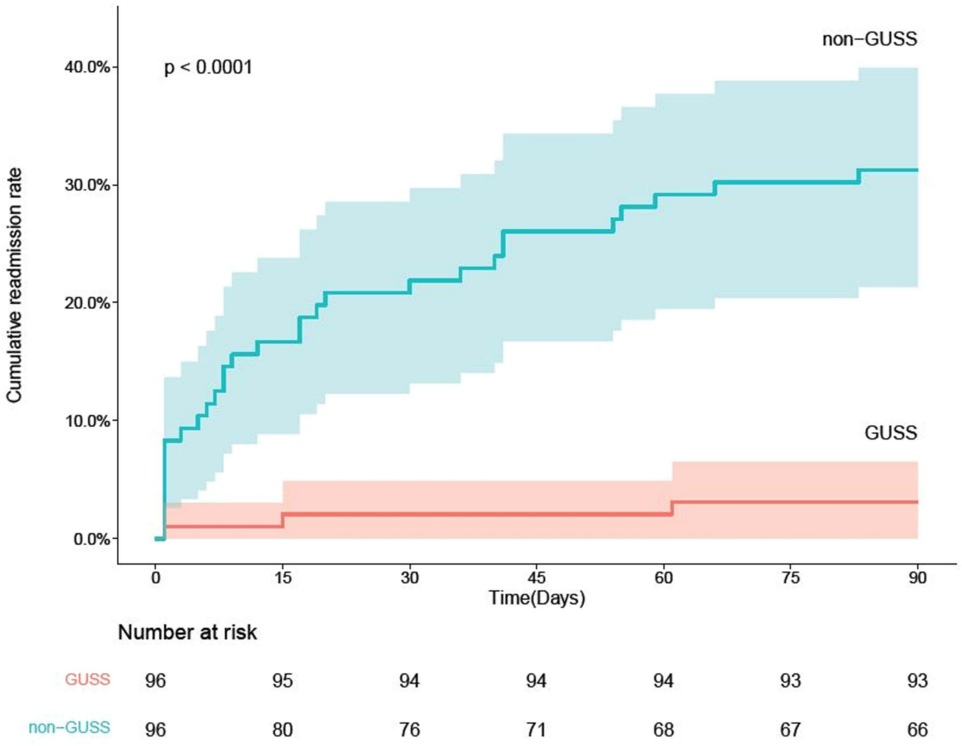

Figure 2 Kaplan–Meier curve of readmission rate within 90 days due to pneumonia.

utilization for dysphagia screening and dietary education remains beneficial, particularly for patients who are not suitable candidates for VFSS. Notably, the provision of tailored dietary education based on GUSS outcomes amplified the aspiration prevention effect by 2.5 times compared with VFSS (Table 4). This observation adds an intriguing dimension to the study's findings and underscores the potential utility of the GUSS in broadening the scope of dysphagia evaluation and prevention strategies.

Although the GUSS has been validated as a screening test to assess dysphagia in older patients, this study found a moderate degree of agreement (44.1%) between GUSS and VFSS recommendations for oral feeding. Dysphagia was confirmed in 41.2% of cases upon actual VFSS (Table 2). This discrepancy may be due to the approximately 5-day difference in the timing of the GUSS and VFSS administration. It should be noted that the GUSS was not administered to patients presenting with dysphagia but rather as a screening test for those with risk factors for aspiration. This targeted approach may have contributed to the relatively low level of agreement between the GUSS results and other assessments. The VFSS can assess macroscopic aspiration in more advanced conditions, as indicated by discernible physiological changes at each stage of actual swallowing, whereas the GUSS was designed as a screening tool to identify aspiration;[25] therefore, the agreement between the results of the two methods may be limited. Hence, as evidenced by our findings, it is reasonable to consider broadening the application of the GUSS beyond using it as a tool solely for identifying dysphagia to implement its role in the aspiration pneumonia prevention QI program.

Hospitalists and APN teams within the AMU collaboratively executed aspiration prevention QI initiatives. Notably, APNs assume a primary role in overseeing and providing educational interventions concerning patient dietary practices. The relatively successful implementation of this QI initiative within a bustling AMU, characterized by the admission and discharge of numerous emergency internal medicine patients, can be interpreted as an indirect affirmation of the utility and effectiveness of collaborative teamwork between hospitalists and APNs.

This study had several limitations. First, owing to resource constraints, aspiration prevention QI initiatives were not implemented on weekends or holidays. Second, there was a limitation in evaluating patient nutritional status, which was primarily assessed through changes in body weight and blood albumin levels. Both parameters can be substantially influenced by underlying conditions such as liver cirrhosis and heart failure, making it challenging to assert that they directly reflect the patient's nutritional

status. Third, the study utilized a PSM design to retrospectively validate the clinical effectiveness of a quality improvement program, and unmeasured variables could have influenced the results, limiting interpretation. Additionally, our study did not include pharmacologic assessments, such as angiotensin-converting enzyme inhibitors (ACEIs) usage, which have been shown to help prevent aspiration.[13] Our program focused exclusively on non-pharmacologic strategies, identifying patients at risk for aspiration and providing education on appropriate diets and daily care practices. When reviewing patient histories, we found that only one participant in the GUSS group was taking an ACEI. This limited sample size constrains our ability to evaluate the effectiveness of ACEIs within our study population. Consequently, a prospective randomized controlled trial should be conducted to further elucidate and confirm our findings.

Conclusion

In older patients hospitalized with acute medical conditions, using the GUSS to assess the risk of aspiration, coupled with appropriate dietary education, plays a crucial role in preventing aspiration pneumonia.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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