



Original Article

Development of a Dysphagia Nursing Quality Evaluation Index System for Neurosurgical Inpatients with Stroke: A Delphi Study Based on the Three-dimensional Quality Model



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Abstract

Background and objectives: Post-stroke dysphagia management research has primarily focused on screening, assessment, and intervention strategies, with limited objective indicators for evaluating nursing care quality. This study aimed to develop a dysphagia nursing quality evaluation index system for neurosurgical inpatients with stroke.

Methods: Using the “structure-process-outcome” three-dimensional quality model as the theoretical framework, a preliminary quality evaluation index system was constructed through literature analysis and group discussion. A two-round Delphi expert consultation was conducted among 25 purposively selected clinical experts from tertiary Class A hospitals, with inclusion criteria requiring a bachelor’s degree or higher, an intermediate professional title or above, and at least 10 years of clinical experience in stroke nursing or related fields. The analytic hierarchy process was used to determine indicator weights. Outcome measures included expert authority coefficients (Cr), Kendall’s W concordance coefficient, internal consistency reliability (Cronbach’s α), and the final indicator structure.

Results: The Cr values were 0.87 and 0.88 across the two rounds. Kendall’s W concordance coefficient increased from 0.207 to 0.235 ($P < 0.001$), indicating statistically significant expert agreement. The final index system comprised 3 first-level indicators, 11 second-level indicators, and 44 third-level indicators, with all indicator definitions and weights determined. The overall Cronbach’s α was 0.86, indicating preliminary internal consistency.

Conclusions: This study developed a dysphagia nursing quality evaluation index system for neurosurgical inpatients with stroke using the three-dimensional quality model and the Delphi method. The system showed acceptable expert authority, statistically significant expert agreement, and preliminary internal consistency, suggesting potential applicability for nursing quality monitoring in neurosurgical wards and Neurosurgery Intensive Care Units. Further clinical validation is needed before routine implementation.

Keywords: Stroke; Dysphagia; Quality evaluation; Index system; Three-dimensional quality model; Delphi method.

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Introduction

Stroke is characterized by a high incidence, high disability rate, high mortality, and high recurrence rate. It remains the second leading cause of death globally and the third leading cause of combined death and disability.^{1,2} In this study, stroke includes ischemic stroke, intracerebral hemorrhage, and subarachnoid hemorrhage. It has been reported that approximately two million new stroke cases occur annually in China,³ and post-stroke dysphagia is common, with reported prevalence varying widely across studies and pooled estimates of approximately 42% among acute stroke patients.^{4,5}

Malnutrition risk is also common after stroke and among hospitalized patients with neurological diseases, and dysphagia may further compromise nutritional intake. Reported prevalence varies according to patient populations and assessment tools.^{6,7} Meanwhile, dysphagia frequently triggers psychological disorders such as anxiety, fear, and depression, thereby reducing patients' quality of life.⁸ Evaluation of dysphagia nursing quality is an essential component of stroke prevention and management, and also a critical measure for improving patients' safety and quality of life.^{9,10} To date, substantial research has been conducted on the therapeutic and nursing management of post-stroke dysphagia worldwide.^{11,12} The primary focus has been on screening tools, risk assessment, and intervention protocol development. However, objective indicators remain limited for evaluating nursing care quality across the different stages of dysphagia management; therefore, there is a need to establish a comprehensive evaluation index system based on a systematic evaluation model.

In neurosurgical practice, dysphagia is frequently encountered in patients with impaired consciousness, brainstem injury, posterior fossa lesions, intracerebral hemorrhage, postoperative edema, tracheostomy, and those receiving mechanical ventilation. Previous studies have also shown that post-stroke or neurogenic dysphagia may be particularly complex in patients requiring mechanical ventilation and tracheostomy.¹³ These patients require more complex risk stratification and airway management than general stroke patients. Therefore, a nursing quality evaluation index system specifically tailored to neurosurgical inpatients with stroke (including intracerebral hemorrhage, large-area ischemic stroke requiring surgical intervention, and patients in the Neurosurgery Intensive Care Unit (NICU)) is urgently needed.

The three-dimensional quality model proposed by American scholar Donabedian in the late 1960s includes three dimensions—structure, process, and outcome—in medical and nursing quality evaluation systems, ensuring the integrity of the evaluation framework.¹⁴ This model has been widely applied and has become an internationally recognized and widely used foundation for constructing nursing quality evaluation index systems.¹⁵

This study used the three-dimensional quality model as the theoretical framework and combined expert consultation with the analytic hierarchy process to develop a dysphagia nursing quality evaluation index system for neurosurgical inpatients with stroke. The aim was to provide a structured reference for evaluating, monitoring, and improving dysphagia nursing quality in neurosurgical wards and Neurosurgery Intensive Care Units (NICUs).

Materials and methods

Establishment of a research group

The research group consisted of 8 nurses, including 1 nurse with a senior title, 5 with mid-level titles, and 2 primary-level nurses. The main tasks of this research team were as follows: determining the evaluation theme, reviewing relevant literature, formulating the index system, compiling an expert consultation form, organizing and coordinating expert consultation activities, conducting statistical analysis of the consultation results, and constructing an evaluation index system for dysphagia nursing quality in neurosurgical stroke patients based on a three-dimensional quality model combined with expert and group consensus.

Literature analysis

The following main search terms were used: “cerebrovascular ap-

oplexy/apoplexy/stroke/cerebral stroke/cerebrovascular accident/vascular accident/acute stroke/subacute stroke/cerebral infarction/ischemic stroke”, “dysphagia/deglutition disorder/swallowing disorder*/swallowing problem*/swallowing difficulty”, “nursing/care/manage*”, and “quality/standard*”. The search was conducted in databases including BMJ Best Practice, UpToDate, National Guideline Clearinghouse, JBI Evidence Summary, Registered Nurses' Association of Ontario, Guidelines International Network, China Clinical Guideline Network, Cochrane Library, CINAHL, PubMed, China National Knowledge Infrastructure, and China Biology Medicine. A snowballing method was also used to supplement retrieval of references cited in the literature. The search time range was set from database inception to July 2025. The literature search yielded 12 clinical practice guidelines, 8 systematic reviews, and 15 original studies, which were used to derive the initial indicators (Fig. 1).

Preliminary development of the initial evaluation index system

The relevant literature was reviewed and analyzed to serve as a theoretical basis for developing the nursing quality evaluation index system. After synthesis and summarization of the extracted data, the research team discussed, analyzed, and revised each indicator individually, focusing on importance, practicality, feasibility, and significance, and further categorized the indicator system. Based on the three-dimensional quality model, a preliminary nursing quality evaluation index system for dysphagia in neurosurgical stroke patients was developed, comprising 3 first-level indicators, 12 second-level indicators, and 35 third-level indicators.

Expert consultation

Selection of consultation experts

Using purposive sampling, we selected 25 of 32 initially contacted experts from tertiary Class A hospitals. Participants included clinical medical staff and managers. The inclusion criteria were: (1) a bachelor's degree or higher, (2) an intermediate title or above, (3) at least 10 years of experience in stroke clinical nursing, medical care, nursing management, or medical management, and (4) voluntary participation with informed consent. Of the 32 experts initially contacted, 7 did not participate (3 declined due to time constraints, 2 were unavailable during the study period, and 2 did not respond). The final 25 experts came from 5 tertiary Class A hospitals in Hubei Province, China. Their specialties included stroke neurology ($n = 8$), neurosurgery ($n = 5$), nursing management ($n = 7$), rehabilitation medicine ($n = 3$), and clinical nutrition ($n = 2$). No patients, speech-language therapists, registered dietitians, or intensive care unit (ICU) physicians were included (Fig. 2).

Development of the expert consultation questionnaire

The initial consultation questionnaire consisted of four parts: (1) Introduction, which described the research background, objectives, and instructions for completing the questionnaire; (2) Experts' basic information, including gender (based on biological sex), age, highest educational degree, years of work experience, administrative titles, professional titles, current positions, research field, and contact information; (3) The main consultation content, including each evaluation indicator and a scoring system for item importance (experts rated each item on a 5-point Likert scale from 1 [unimportant] to 5 [very important]), with an additional section for suggested revisions to capture divergent opinions; and (4) Expert authority self-assessment form, including self-assessment of familiarity with the subject matter and judgment basis.

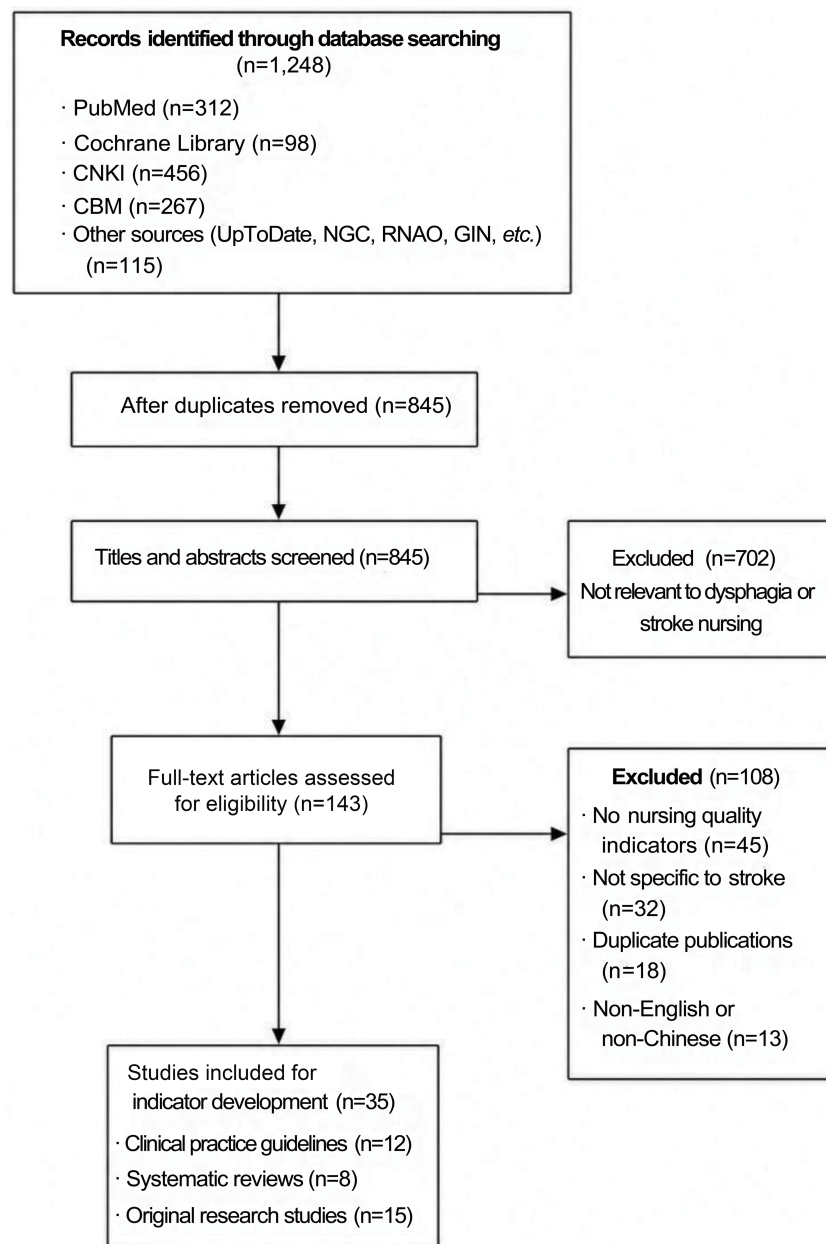


Fig. 1. Flowchart of the literature selection process. CBM, China Biology Medicine; CNKI, China National Knowledge Infrastructure; GIN, Guidelines International Network; NGC, National Guideline Clearinghouse; RNAO, Registered Nurses' Association of Ontario.

To improve the content validity, accuracy, and comprehensiveness of the questionnaire, the research team conducted a pilot survey among six nursing managers and four specialist nurses from high-risk departments for stroke-related dysphagia in our hospital. The structure, item order, content, and wording of the questionnaire were then repeatedly discussed and revised to develop the formal consultation questionnaire.

Indicator screening criteria

The criteria for retaining indicators were as follows: (1) mean importance score > 3.5; (2) coefficient of variation < 0.25; and (3) full-score rate > 20%.^{16,17} Indicators meeting all three criteria

were retained. For indicators meeting only one or two criteria but considered highly relevant to the study topic, the research team decided whether to remove them after discussion, combined with experts' written comments, and the final decision was reached through group consensus.

Implementation of expert consultation

Two rounds of expert consultation were conducted between August and September 2025. Questionnaires were distributed via email, and each round was completed within two weeks. Returned questionnaires were checked promptly to ensure completeness and an adequate response rate. The results of the first round were summarized

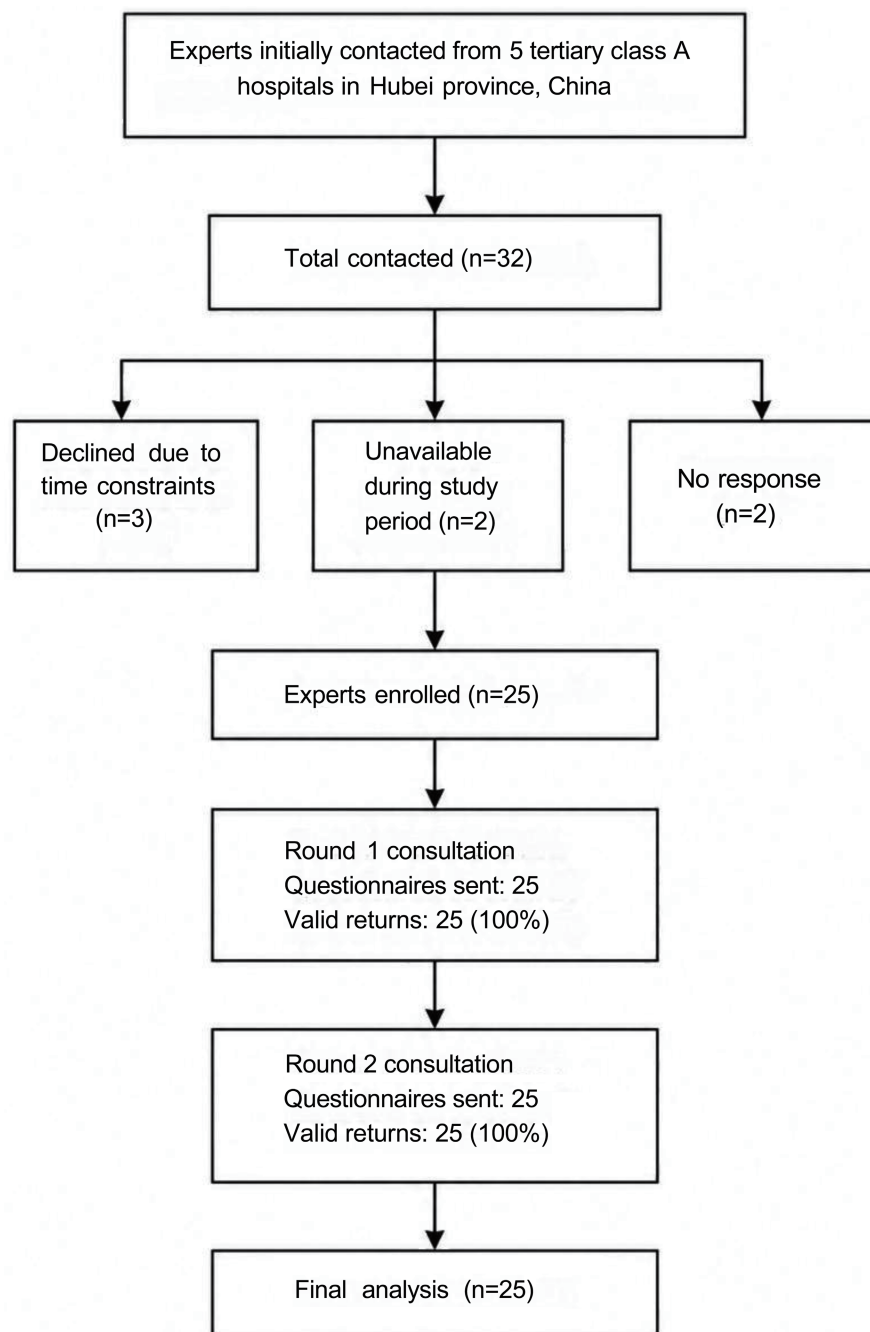


Fig. 2. Flowchart of the expert selection process.

and analyzed, and the indicators were revised (additions, deletions, or modifications) to form the second-round questionnaire. In the second round, modifications and rationales for rejected suggestions were provided to experts, who were then asked to re-evaluate the indicators and provide further feedback. The consultation process was terminated when expert opinions had converged. After two rounds, expert opinions showed acceptable consensus.

Statistical methods

Data were analyzed using Statistical Package for the Social Sci-

ences (SPSS) version 23.0 (IBM Corp., Chicago, IL, United States) and Microsoft Excel 2019. The Kolmogorov–Smirnov test was used to assess normality. Continuous variables with a normal distribution were expressed as means $\pm$ standard deviations. Categorical variables were reported as frequencies and percentages (%). Expert engagement was measured by the effective response rate and the proportion of experts providing comments. The expert authority coefficient (Cr) was determined by familiarity (Cs) and judgment basis (Ca).¹⁸ The degree of expert consensus was assessed using Kendall's coefficient of concordance (W). In addi-

Table 1. Kendall's concordance coefficients in two rounds of expert consultation

Items	Number	W	χ^2	P
Round 1				
Overall	–	0.207	294.481	<0.001
First-level indicators	3	0.203	10.133	0.006
Second-level indicators	12	0.161	40.127	<0.001
Third-level indicators	35	0.220	236.654	<0.001
Round 2				
Overall	–	0.235	253.118	<0.001
First-level indicators	3	0.245	12.250	0.002
Second-level indicators	11	0.181	45.361	<0.001
Third-level indicators	44	0.228	245.281	<0.001

The number of third-level indicators in Round 2 refers to those included in the second-round Delphi consultation before final revision. After final discussion and adjustment by the research group, the final index system contained 44 third-level indicators, as shown in Table 2. W, Kendall's coefficient of concordance; χ^2 , chi-square statistic.

tion, the analytic hierarchy process was used to calculate indicator weights. Internal consistency reliability was assessed using Cronbach's α coefficient, calculated based on the importance ratings assigned by experts in the second-round questionnaire. This approach followed established Delphi study methodology, in which Cronbach's α was used as a measure of homogeneity and consensus among panelists.¹⁹ All tests were conducted at a significance level of $\alpha = 0.05$.

Results

Basic information of experts

The expert consultation involved 25 participants, with a mean age of 42.08 ± 5.36 years, and the mean working experience in related fields was 19.84 ± 6.09 years. Regarding educational background, 10 had a bachelor's degree, 11 had a master's degree, and 4 had a doctoral degree. Regarding professional titles, 8 had intermediate titles, 11 had associate senior titles, and 6 had senior titles. The reasons for non-participation of the 7 initially contacted experts are shown in Figure 2.

Expert enthusiasm and authority

In both rounds of expert consultation, 25 questionnaires were distributed, and the effective response rate was 100%. In the first round, Ca was 0.92, Cs was 0.81, and Cr was 0.87. In the second round, Ca was 0.93, Cs was 0.84, and Cr was 0.88.

Concentration and coordination of expert opinions

In the first round of expert consultation, the mean importance scores for each indicator ranged from 4.08 to 5.00, with a full-score rate of 81.72% and a coefficient of variation ranging from 0.000 to 0.111. In the second round, the mean importance scores ranged from 4.00 to 5.00, with a full-score rate of 81.66% and a coefficient of variation ranging from 0.00 to 0.109. Kendall's concordance coefficient tests in both rounds of expert consultation were statistically significant ($P < 0.001$), as shown in Table 1. The internal consistency reliability (Cronbach's α) for the overall index system was 0.86 (calculated based on experts' importance ratings from the second-round questionnaire); for first-level indicators, 0.81; for second-level indicators, 0.84; and for third-level

indicators, 0.88.

Revision of indicators

Deletion

The secondary indicator "Nurse Behavior" in the outcome quality dimension was removed, as experts considered it to be feedback evaluating the quality of the nursing practice process rather than an outcome indicator.

Merger

The secondary structural indicators "Human Resources", "Equipment Management", and "Assessment Tools" were merged into "I-2 Resource Allocation and Management". The secondary process indicators "Aspiration Management" and "Malnutrition Management" were merged into "II-3 Complication Management".

Revision

The tertiary structural indicator "The completeness rate of risk assessment facilities" was revised to "I-2-1 Completeness rate of risk assessment tools". "Accuracy rate of dysphagia assessment" was subdivided into "II-1-1 Accuracy rate of timing for bedside dysphagia assessment", "II-1-2 Accuracy rate of use of dysphagia screening tools", and "II-1-3 Accuracy rate of implementation of the dysphagia assessment process". The secondary outcome indicator "Adverse events caused by dysphagia" was revised to "III-1 Patient Outcomes", and "Service Outcomes" was revised to "III-2 Service Quality".

Addition

Two tertiary structural indicators, four tertiary process indicators, and two tertiary outcome indicators were added: "I-1-4 Completeness rate of multidisciplinary team management system", "I-3-2 Completion rate of specialist nurse training programs", "II-1-6 Accuracy rate of risk assessment outcome disposition", "II-2-7 Accuracy rate of oral care implementation", "II-2-8 Accuracy rate of nursing documentation", "II-4-3 Standardized implementation rate of collaborative management with support departments", "III-3-1 Patient awareness rate of the risks and consequences associated with dysphagia", and "III-3-4 Patient

compliance rate with risk prevention and control measures for dysphagia”.

Special handling

The full-score rate of the tertiary structural indicator “I-1-4 Completeness rate of multidisciplinary team management system” was less than 20% in the expert consultation. Although this indicator did not meet the predefined retention criteria, both its importance score and coefficient of variation were within the acceptable range. After discussion by the research team, it was concluded that this indicator provides important guidance for multidisciplinary collaboration in the nursing management of stroke patients with swallowing disorders; therefore, it was retained.

After the second-round expert consultation and final discussion by the research team, the index system was further refined, resulting in a final system consisting of 3 first-level indicators, 11 second-level indicators, and 44 third-level indicators.

Weight analysis of indicators

Indicator weights at each level were analyzed using the analytic hierarchy process. The weights of first-level indicators ranged from 0.24 to 0.50, the weights of second-level indicators ranged from 0.11 to 0.42, and the combined weights ranged from 0.05 to 0.16. The weights of third-level indicators ranged from 0.09 to 0.53, with composite weights ranging from 0.01 to 0.04. The consistency ratio of each judgment matrix was <0.10 , indicating reasonable weight distribution and good consistency.²⁰ A representative judgment matrix for first-level indicators is provided in [Supplementary Table 1](#), with a note stating that the weights were derived from the geometric mean of experts’ pairwise comparisons, and that minor discrepancies between the matrix and final weights are due to rounding of aggregated expert judgments. The details of indicator weights are shown in [Table 2](#). Operational definitions and data collection methods for each third-level indicator are provided in [Supplementary Table 2](#).

Discussion

This study developed a dysphagia nursing quality evaluation index system for neurosurgical inpatients with stroke based on the Donabedian structure–process–outcome model and the Delphi method. The final system comprised 3 first-level indicators, 11 second-level indicators, and 44 third-level indicators. The two rounds of expert consultation demonstrated high response rates, acceptable expert authority coefficients (Cr), and statistically significant Kendall’s concordance coefficients, indicating acceptable expert authority and a certain degree of consensus among experts. In addition, the Cronbach’s α coefficient of 0.86 suggested preliminary internal consistency of the index system. These findings support the scientific rigor and preliminary reliability of the proposed evaluation framework.^{14,18,19}

Structural indicators in this study included education and training management, system and process management, and resource allocation and management. Although structural indicators accounted for a smaller proportion of the overall weight than process indicators, education and training management received the highest weight among them. This finding highlights the importance of nurses’ professional competence in dysphagia assessment, prevention, and management. Dysphagia care requires nurses to possess adequate knowledge and practical skills related to screening, nutritional support, aspiration prevention, oral care, and emergency management. As the primary practi-

tioners of nursing care, nurses’ mastery of theoretical knowledge and proficiency in nursing practice regarding swallowing disorders associated with stroke are critical factors influencing nursing quality.²¹ Therefore, healthcare institutions should establish standardized training systems and continuous competency assessment mechanisms to ensure the effective implementation of dysphagia nursing practices. In addition, system and process management indicators were also highly valued, emphasizing the importance of standardized protocols, risk assessment pathways, and multidisciplinary management systems in supporting high-quality nursing care.^{22–24}

The weight analysis showed that process indicators accounted for the largest proportion of the overall weight, suggesting that experts considered nursing practice to be the most direct determinant of dysphagia care quality. Accurate risk assessment, timely identification of aspiration and malnutrition risks, standardized nursing interventions, multidisciplinary collaboration, and effective health education are essential components of dysphagia management. Previous evidence has highlighted the importance of evidence-based stroke nursing care, early dysphagia screening, and aspiration risk assessment for reducing aspiration-related risks and improving patient outcomes.^{25,26} Therefore, strengthening the implementation and monitoring of key nursing processes may contribute substantially to improving dysphagia care quality in stroke patients.

Outcome indicators focused on both clinical effectiveness and patient-centered quality assessment. Monitoring patient outcomes and complications is an important component of stroke nursing care.²⁵ Aspiration, aspiration pneumonia, asphyxia, and malnutrition were identified as key outcome indicators because they are clinically relevant complications or consequences in dysphagia care and are associated with patient prognosis. These indicators received a high level of recognition from experts, consistent with previous evidence highlighting the importance of dysphagia-related aspiration risk screening.²⁶ Furthermore, patient satisfaction, awareness, and compliance indicators were included to evaluate nursing quality from the patient perspective. These indicators may encourage greater patient and caregiver participation in dysphagia prevention, rehabilitation, and self-management, thereby contributing to improved care outcomes and quality of life.

A notable strength of this study is its focus on neurosurgical inpatients with stroke. Compared with general stroke populations, patients in neurosurgical wards and NICUs frequently present with impaired consciousness, brainstem injury, postoperative edema, tracheostomy, mechanical ventilation, and other conditions that increase the complexity of dysphagia management.¹³ Consequently, indicators related to multidisciplinary team management, specialist nurse training, aspiration risk assessment, oral care implementation, and collaboration with rehabilitation and nutrition services were emphasized in the final index system. These indicators reflect the unique clinical characteristics and nursing requirements of neurosurgical patients and may enhance the applicability of the system in neurosurgical settings.

The proposed index system may provide a structured framework for nursing managers and healthcare institutions to evaluate, monitor, and improve dysphagia nursing quality in neurosurgical wards and NICUs. By integrating structure, process, and outcome indicators, the system facilitates comprehensive quality assessment and may support the development of standardized quality improvement programs. Future implementation should also include ongoing education and competency support for nurs-

Table 2. Details of indicator weights

Evaluation indicators	Importance score (mean $\pm$ SD)	CV	Weight
I. Structure indicators	4.56 $\pm$ 0.51	0.111	0.240
I-1. System and process management	4.80 $\pm$ 0.41	0.085	0.357
I-1-1. Completeness rate of dysphagia nursing management system and process	4.76 $\pm$ 0.44	0.092	0.257
I-1-2. Completeness rate of risk assessment system and process	4.76 $\pm$ 0.44	0.092	0.257
I-1-3. Completeness rate of risk management systems and process	4.76 $\pm$ 0.44	0.092	0.257
I-1-4. Completeness rate of multidisciplinary team management system	4.00 $\pm$ 0.00	0.000	0.229
I-2. Resource allocation and management	4.64 $\pm$ 0.49	0.106	0.233
I-2-1. Completeness rate of risk assessment tools	4.76 $\pm$ 0.44	0.092	0.333
I-2-2. Completeness rate of multidisciplinary resource allocation	4.76 $\pm$ 0.44	0.092	0.333
I-2-3. Completeness rate of equipment availability	4.76 $\pm$ 0.44	0.092	0.333
I-3. Education and training management	5.00 $\pm$ 0.00	0.000	0.410
I-3-1. Completion rate of dysphagia nursing training	4.80 $\pm$ 0.41	0.085	0.203
I-3-2. Completion rate of specialist nurse training programs	4.72 $\pm$ 0.46	0.097	0.171
I-3-3. Implementation rate of dysphagia nursing theory training	5.00 $\pm$ 0.00	0.000	0.218
I-3-4. Implementation rate of practical dysphagia nursing skills training	5.00 $\pm$ 0.00	0.000	0.218
I-3-5. Implementation rate of emergency plan drill training	4.76 $\pm$ 0.44	0.092	0.189
II. Process indicators	4.88 $\pm$ 0.33	0.068	0.500
II-1. Risk assessment management	5.00 $\pm$ 0.00	0.00	0.325
II-1-1. Accuracy rate of timing for bedside dysphagia assessment	5.00 $\pm$ 0.00	0.00	0.180
II-1-2. Accuracy rate of using dysphagia screening tools	5.00 $\pm$ 0.00	0.000	0.180
II-1-3. Accuracy rate of dysphagia assessment process implementation	5.00 $\pm$ 0.00	0.000	0.180
II-1-4. Accuracy rate of malnutrition risk assessment implementation	4.84 $\pm$ 0.37	0.077	0.141
II-1-5. Accuracy rate of aspiration risk assessment implementation	4.88 $\pm$ 0.33	0.068	0.160
II-1-6. Accuracy rate of risk assessment outcome disposition	4.88 $\pm$ 0.33	0.068	0.160
II-2. Nursing practice management	4.96 $\pm$ 0.20	0.040	0.257
II-2-1. Accuracy rate of dysphagia nursing plan formulation	5.00 $\pm$ 0.00	0.000	0.161
II-2-2. Accuracy rate of nutrition support timing implementation	4.76 $\pm$ 0.44	0.092	0.128
II-2-3. Accuracy rate of nutrition support pathway establishment	4.76 $\pm$ 0.44	0.092	0.128
II-2-4. Accuracy rate of feeding method management	4.80 $\pm$ 0.41	0.085	0.140
II-2-5. Accuracy rate of dietary nursing management	4.80 $\pm$ 0.41	0.085	0.140
II-2-6. Accuracy rate of oral administration implementation	4.64 $\pm$ 0.49	0.106	0.104
II-2-7. Accuracy rate of oral care implementation	4.64 $\pm$ 0.49	0.106	0.104
II-2-8. Accuracy rate of dysphagia nursing documentation	4.60 $\pm$ 0.50	0.109	0.093
II-3. Complication management	4.92 $\pm$ 0.28	0.056	0.162
II-3-1. Accuracy rate of aspiration risk prevention measures implementation	5.00 $\pm$ 0.00	0.000	0.529
II-3-2. Accuracy rate of malnutrition risk prevention measures implementation	4.96 $\pm$ 0.20	0.040	0.471
II-4. Multidisciplinary collaboration management	4.88 $\pm$ 0.33	0.068	0.143
II-4-1. Standardized implementation rate of rehabilitation nursing collaboration	5.00 $\pm$ 0.00	0.000	0.375
II-4-2. Standardized implementation rate of nutrition nursing collaboration	4.92 $\pm$ 0.28	0.056	0.332

(continued)

Table 2. (continued)

Evaluation indicators	Importance score (mean $\pm$ SD)	CV	Weight
II-4-3. Standardized implementation rate of collaboration with support departments	4.68 $\pm$ 0.48	0.102	0.293
II-5. Health education management	4.60 $\pm$ 0.50	0.109	0.113
II-5-1. Implementation rate of health education on risk prevention and control for patients	4.80 $\pm$ 0.41	0.085	0.500
II-5-2. Implementation rate of health education on swallowing training for patients	4.80 $\pm$ 0.41	0.085	0.500
III. Outcome indicators	4.68 $\pm$ 0.48	0.102	0.260
III-1. Patient outcomes	5.00 $\pm$ 0.00	0.000	0.416
III-1-1. Incidence of aspiration	5.00 $\pm$ 0.00	0.000	0.281
III-1-2. Incidence of aspiration pneumonia	4.80 $\pm$ 0.41	0.085	0.249
III-1-3. Incidence of asphyxia	4.80 $\pm$ 0.41	0.085	0.249
III-1-4. Incidence of malnutrition	4.72 $\pm$ 0.46	0.097	0.221
III-2. Service quality	4.72 $\pm$ 0.46	0.097	0.200
III-2-1. Patient satisfaction with nursing operations	5.00 $\pm$ 0.00	0.000	0.374
III-2-2. Patient satisfaction with health education	4.80 $\pm$ 0.41	0.085	0.346
III-2-3. Patient satisfaction with multidisciplinary collaboration	4.72 $\pm$ 0.46	0.097	0.280
III-3. Patient behavior	4.76 $\pm$ 0.44	0.092	0.384
III-3-1. Patient awareness rate of the risks and consequences associated with dysphagia	4.76 $\pm$ 0.44	0.092	0.235
III-3-2. Patient awareness of nursing related knowledge associated with dysphagia	4.76 $\pm$ 0.44	0.092	0.235
III-3-3. Patient compliance rate with rehabilitation nursing measures for dysphagia	5.00 $\pm$ 0.00	0.000	0.265
III-3-4. Patient compliance rate with risk prevention and control measures for dysphagia	5.00 $\pm$ 0.00	0.000	0.265

CV, coefficient of variation; SD, standard deviation.

es caring for patients with stroke.²⁷ However, further multicenter studies are needed to evaluate its feasibility, reliability, and applicability in routine clinical practice and to establish benchmark values for quality evaluation.

Limitations

This study has several limitations that should be acknowledged. (1) The Delphi method relies on experts' subjective evaluations and personal judgment, which may introduce bias. (2) The index system lacks external validation and has not been tested in real-world clinical settings. Future clinical empirical studies are needed to validate its applicability in neurosurgical populations. (3) We did not distinguish between stroke subtypes (ischemic vs. hemorrhagic) or treatment phases (acute vs. rehabilitation), which may affect the relevance of certain indicators. (4) The feasibility of collecting data for all 44 tertiary indicators in routine clinical practice has not been assessed. In particular, indicators relying on patient interviews or satisfaction surveys, such as patients' awareness rates (III-3-1, III-3-2), satisfaction with nursing operations (III-2-1), health education (III-2-2), multidisciplinary collaboration (III-2-3), and compliance rates (III-3-3, III-3-4), may be difficult to obtain from patients with impaired consciousness, tracheostomy, or severe neurological deficits. For these populations, proxy assessments or alternative data collection methods may be required. (5) The expert panel was predominantly composed of nursing professionals and neurologists,

with only five neurosurgeons and no speech-language therapists, registered dietitians, ICU physicians, or patient representatives. Ideally, future studies should include a broader range of specialists to enhance the multidisciplinary perspective of the index system. (6) The inclusion of experts with intermediate professional titles may have somewhat reduced the authority of the index system. Despite these limitations, our study provides a foundational framework for nursing quality evaluation in neurosurgical stroke patients with dysphagia.

Conclusions

Based on the three-dimensional quality model and the Delphi method, this study developed a preliminary dysphagia nursing quality evaluation index system for neurosurgical inpatients with stroke. The system evaluates dysphagia nursing quality across structure, process, and outcome dimensions and demonstrated potential reliability and applicability based on expert consultation. It may provide a structured reference for nursing quality monitoring in neurosurgical wards and NICUs. Further clinical validation is needed to assess its feasibility, reliability, and applicability in real-world neurosurgical settings.

Supporting information

Supplementary material for this article is available at <https://doi.org/10.14218/NSS.2026.00009>.

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Conflict of interest

YZ has been an Executive Associate Editor of *Neurosurgical Subspecialties* since January 2026. The authors declare that they have no other conflict of interest..

Author contributions

Study conception and design (TD, WX, PW, LX, HZ, HL, YW, LC, YZ, BL), material preparation and data collection (TD, WX, PW, LX, HZ, HL), data analysis and interpretation (YW, LC), the first draft of the manuscript (YW, LC), and supervision (YZ, BL). All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethical statement

The study was conducted in compliance with the principles of the Declaration of Helsinki (as revised in 2024) and was approved by the Ethics Committee of Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, Hubei Province, China (No. 0045, 2025). All participating experts provided written informed consent and agreed to the use of their anonymized data for this research.

Data sharing statement

The datasets generated for this study are available from the corresponding author upon reasonable request.

References

- [1] Feigin VL, Brainin M, Norrving B, Martins SO, Pandian J, Lindsay P, *et al*. World Stroke Organization: Global Stroke Fact Sheet 2025. *Int J Stroke* 2025;20(2):132–144. doi:10.1177/17474930241308142, PMID:39635884.
- [2] Parry-Jones AR, Krishnamurthi R, Ziai WC, Shoamanesh A, Wu S, Martins SO, *et al*. World Stroke Organization (WSO): Global intracerebral hemorrhage factsheet 2025. *Int J Stroke* 2025;20(2):145–150. doi:10.1177/17474930241307876, PMID:39629687.
- [3] Zhang T, Zhao J, Li X, Bai Y, Wang B, Qu Y, *et al*. Chinese Stroke Association guidelines for clinical management of cerebrovascular disorders: executive summary and 2019 update of clinical management of stroke rehabilitation. *Stroke Vasc Neurol* 2020;5(3):250–259. doi:10.1136/svn-2019-000321, PMID:32595138.
- [4] Gu H, Ren D. Prevalence and Risk Factors of Poststroke Dysphagia: A Meta-Analysis. *Cerebrovasc Dis* 2025;54(2):236–259. doi:10.1159/000538218, PMID:38643757.
- [5] Banda KJ, Chu H, Kang XL, Liu D, Pien LC, Jen HJ, *et al*. Prevalence of dysphagia and risk of pneumonia and mortality in acute stroke patients: a meta-analysis. *BMC Geriatr* 2022;22(1):420. doi:10.1186/s12877-022-02960-5, PMID:35562660.
- [6] Zhang G, Pan Y, Zhang R, Wang M, Meng X, Li Z, *et al*. Prevalence and Prognostic Significance of Malnutrition Risk in Patients With Acute Ischemic Stroke: Results From the Third China National Stroke Registry. *Stroke* 2022;53(1):111–119. doi:10.1161/STROKEAHA.121.034366, PMID:34645284.
- [7] Wan Y, Zhan Y, Wu Y, Yao P, Chen Y, Xiong Z, *et al*. Nutritional Status and Support in Hospitalized Patients with Neurological Diseases: A Cross-sectional Survey. *Neurosurg Subspec* 2025;1(1):20–27. doi:10.14218/NSSS.2024.00005.
- [8] Karisik A, Dejakum B, Moelgg K, Komarek S, Toell T, Mayer-Suess L, *et al*. Association between dysphagia and symptoms of depression and anxiety after ischemic stroke. *Eur J Neurol* 2024;31(5):e16224. doi:10.1111/ene.16224, PMID:38308469.
- [9] Koirala E, Greely C, Fitzpatrick S. Swallow evaluation tool to reduce aspiration among acute stroke patients: A quality improvement project. *J Vasc Nurs* 2025;43(1):1–9. doi:10.1016/j.jvn.2024.11.001, PMID:40057346.
- [10] Xu C, Zhan T. Study on rehabilitation effect of continuous nursing on patients with dysphagia in acute cerebral infarction. *Medicine (Baltimore)* 2025;104(28):e43141. doi:10.1097/MD.00000000000043141, PMID:40660601.
- [11] Jiang L, Zhang W, Qian L, Wang C. Clinical practice guideline appraisal and algorithm development to identify recommendations related to nursing practice for post-stroke dysphagia. *J Clin Nurs* 2023;32(17-18):6089–6100. doi:10.1111/jocn.16737, PMID:37095612.
- [12] Selg J, Holmlund T, Jäghagen EL, McGreevy J, Svanberg S, Wester P, *et al*. Validity and Reliability of the Swedish Version of the Gugging Swallowing Screen for use in Acute Stroke Care. *Dysphagia* 2025;40(1):176–186. doi:10.1007/s00455-024-10717-y, PMID:38753206.
- [13] Cheng I, Bath PM, Hamdy S, Muhle P, Mistry S, Dziewas R, *et al*. Clinical predictors of outcome after pharyngeal electrical stimulation (PES) in non-stroke related neurogenic dysphagia after mechanical ventilation and tracheotomy: results from subgroup analysis of PHADER study. *Neurol Res Pract* 2025;7(1):23. doi:10.1186/s42466-025-00380-5, PMID:40189593.
- [14] Donabedian A. Evaluating the quality of medical care. *Milbank Mem Fund Q* 1966;44(3):Suppl:166–206. doi:10.2307/3348969, PMID:5338568.
- [15] Correia P, Bernardes RA, Caldeira S. Instruments for Assessing Nursing Care Quality: A Scoping Review. *Nurs Rep* 2025;15(9):342. doi:10.3390/nursrep15090342, PMID:41003298.
- [16] Bai X, Gan X, Yang R, Zhang C, Luo X, Luo C, *et al*. Construction of a competency evaluation index system for front-line nurses during the outbreak of major infectious diseases: A Delphi study. *PLoS One* 2022;17(7):e0270902. doi:10.1371/journal.pone.0270902, PMID:35776753.
- [17] Nie S, Wang L. Constructing an evaluation index system for clinical nursing practice teaching quality using a Delphi method and analytic hierarchy process-based approach. *BMC Med Educ* 2024;24(1):772. doi:10.1186/s12909-024-05770-y, PMID:39030603.
- [18] Hohmann E, Beaufils P, Beiderbeck D, Chahla J, Geeslin A, Hasan S, *et al*. Guidelines for Designing and Conducting Delphi Consensus Studies: An Expert Consensus Delphi Study. *Arthroscopy* 2025;41(10):4208–4224.e10. doi:10.1016/j.arthro.2025.03.038, PMID:40157555.
- [19] Ma LL, Zhang YJ, Rong S, Yao JX, Zhuang HR, Zhang WY. The construction of the index system for nurses' innovation competence evaluation in China: A Delphi study. *Heliyon* 2024;10(20):e38530. doi:10.1016/j.heliyon.2024.e38530, PMID:39449709.
- [20] Lukinskiy V, Lukinskiy V, Sokolov B, Bazhina D. An empirical examination of the consistency ratio in the analytic hierarchy process (AHP). In: Dolgui A, Bernard A, Lemoine D, von Cieminski G, Romero D (eds). *Advances in Production Management Systems. Artificial Intelligence for Sustainable and Resilient Production Systems: IFIP WG 5.7 International Conference, APMS 2021, Nantes, France, September 5–9, 2021, Proceedings, Part V*. Cham: Springer; 2021:477–485. doi:10.1007/978-3-030-85914-5_51.
- [21] Pumsopa N, Jirapongsuwan A, Kalampakorn S, Siri S, Klainin-Yobas P. The Effectiveness of Community Nurse Training Programs to Improve Nurses' Competency in Community Settings: a Systematic Review and Meta-Analysis. *Int J Nurs Pract* 2025;31(6):e70090. doi:10.1111/ijn.70090, PMID:41399271.
- [22] Lu QY, Bu MR, Zhu Y, Huang ZY, Gao SH, Yuan C. The Practices of Public Hospital Registered Nurses Regarding Post-Stroke Dysphagia, in China. *J Multidiscip Healthc* 2025;18:4629–4641. doi:10.2147/JMDH.

- S531891, PMID:40787148.
- [23] Karisik A, Labeit B, Schiefecker AJ, Sollereder S, Galvan O, Graf S, *et al*. Gaps in Guidelines on Long-Term Management Strategies for Post-Stroke Dysphagia. *Eur J Neurol* 2025;32(8):e70307. doi:10.1111/ene.70307, PMID:40708460.
- [24] Serber SL, Wachtel N, Fox M, Petrushonis C. A Multidisciplinary Approach to Increase Dysphagia Compliance in Stroke Patients. *J Neurosci Nurs* 2024;56(5):180–185. doi:10.1097/JNN.0000000000000778, PMID:38968388.
- [25] Rodgers ML, Fox E, Abdelhak T, Franker LM, Johnson BJ, Kirchner-Sullivan C, *et al*. Care of the Patient with Acute Ischemic Stroke (Endovascular/Intensive Care Unit-Postinterventional Therapy): Update to 2009 Comprehensive Nursing Care Scientific Statement: A Scientific Statement from the American Heart Association. *Stroke* 2021;52(5):e198–e210. doi:10.1161/STR.0000000000000358, PMID:33691467.
- [26] Boaden E, Burnell J, Hives L, Dey P, Clegg A, Lyons MW, *et al*. Screening for aspiration risk associated with dysphagia in acute stroke. *Cochrane Database Syst Rev* 2021;10(10):CD012679. doi:10.1002/14651858.CD012679.pub2, PMID:34661279.
- [27] Zhao Y, Xu Y, Ma D, Fang S, Zhi S, He M, *et al*. The impact of education/training on nurses caring for patients with stroke: a scoping review. *BMC Nurs* 2024;23(1):90. doi:10.1186/s12912-024-01754-x, PMID:38308293.