

## ORIGINAL RESEARCH ARTICLE

## Development and application of a nursing management decision system for patients undergoing endoscopy in cancer care: A multi-phase study

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## Abstract

Digestive endoscopy is a vital minimally invasive procedure for the diagnosis and treatment of gastrointestinal diseases, including pre-cancerous lesions and early-stage cancers. In the era of value- and quality-based healthcare, increasing attention is being paid to endoscopy quality improvement. This study aimed to develop and validate a nursing management decision system instrument for patients undergoing endoscopy. This study was conducted in three stages: development, initial assessment, and evaluation. An initial pool of items was created from clinical practice guidelines, literature reviews, and patient interviews, followed by refinement based on expert input. The final instrument, the endoscopic nursing management system questionnaire (Endo-NMSQ), consists of 25 items across five domains rated on a 4-point Likert scale. Thirty endoscopy nurses participated in the pilot testing. This tool demonstrated excellent internal consistency (Cronbach's  $\alpha = 0.97$ ) and strong content validity. Overall, endoscopy nurses performed well in the patient assessment and competency domains, although some variability was noted across the five categories. The Endo-NMSQ proved to be a reliable and valid instrument that can complement existing patient safety frameworks throughout the endoscopy care continuum, from initial cancer screening and lesion detection to post-procedure evaluation. By facilitating structured nursing assessments, this tool may improve oncological endoscopy outcomes.

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## 1. Introduction

Gastrointestinal endoscopy has become an essential tool for diagnosing and treating precancerous diseases and early-stage cancers with minimal invasiveness.<sup>1</sup> Its appropriate use can decrease healthcare costs and improve patient survival. The prevalence of digestive disorders and associated malignancies continues to rise globally, increasing the need

for high-quality gastrointestinal endoscopic procedures.<sup>2-4</sup> In the age of value- and quality-based healthcare, the quality of endoscopy has drawn increasing attention. Recent studies have shown that quality improvement programs can improve endoscopic procedures, including esophagogastroduodenoscopy and colonoscopy.<sup>5,6</sup> Developing a comprehensive framework of quality metrics is considered the most effective way to measure and improve endoscopy performance.<sup>7</sup> Nationwide surveys and assessments further support quality control, inform clinical practice, and guide health policy; however, only some countries have reported comprehensive national endoscopy census data.<sup>8</sup>

Over the past few decades, China has witnessed a remarkable improvement in endoscopy services, paralleling its economic development.<sup>8</sup> In 2015, China developed the national digestive endoscopy improvement system, incorporating quality indicators tailored to local needs.<sup>9</sup> Digestive cancers remain a major health burden in China, accounting for approximately 1.89 million new cases and 1.47 million deaths annually.<sup>10</sup> Therefore, fostering a strong patient safety culture in endoscopy units is critical.

An organization's values, beliefs, and attitudes toward safety reflect its safety culture,<sup>9</sup> and a positive safety culture is intrinsically related to improved patient outcomes.<sup>3</sup> Notably, healthcare staff with low safety-attitude scores have been associated with higher readmission rates, prolonged hospital stays, and increased adverse events.<sup>11</sup> Endoscopy units are high-volume, fast-paced environments, and endoscopy nurses have indeed reported elevated levels of stress and burnout compared to those in other settings.<sup>12</sup> Such stressors, if unaddressed, can compromise patient management and safety, underscoring the need for improved support and standardized protocols.

Technological advances have also improved the quality of endoscopic procedures and patient care. Modern endoscopy systems enable high-resolution image capture, storage, and retrieval, facilitating more thorough examinations and documentation.<sup>13</sup> In addition, the physical design of endoscopy units plays a crucial role in infection control and patient safety. Guidelines recommend that endoscopy facilities have well-structured layouts—including patient waiting, preparation, procedure, recovery, and equipment reprocessing—to ensure infection control and patient comfort.<sup>14</sup>

Endoscopy serves as a vital diagnostic tool across various organ systems. It allows direct visualization for the diagnosis, staging, and minimally invasive treatment of lesions in the gastrointestinal, respiratory, and urological systems. It is instrumental in identifying esophageal, gastric, and colorectal cancers, which are among the

leading causes of cancer-related mortality worldwide.<sup>15</sup> Technological advancements, such as high-resolution endoscopic endosonography, have significantly improved the accuracy of locoregional cancer staging. Early detection through endoscopy allows the identification of early-stage cancers that may be suitable for organ-preserving, minimally invasive therapies.<sup>16</sup> For instance, early-stage esophageal cancer detected through endoscopy has a 5-year survival rate exceeding 80%, whereas late-stage diagnosis drops below 20%.<sup>15</sup>

Endoscopy nursing has emerged as a specialized field, with highly skilled nurses playing critical roles before, during, and after procedures. These nurses prepare the endoscopy suite and necessary equipment, ensure adherence to infection control practices, and provide pre-procedure patient education to reduce anxiety. During the procedure, they also assist endoscopists and anesthesiologists, manage instruments, and maintain a sterile environment. After the procedure, nurses are responsible for patient monitoring and reprocessing the endoscopic equipment. Proper nursing interventions across all phases—pre-, intra-, and post-procedure—are vital to minimizing risks and preventing complications.<sup>17-19</sup>

Despite these advancements, there remains a lack of structured tools specifically designed to guide nursing management during endoscopy. To address this gap, we developed the endoscopic nursing management system questionnaire (Endo-NMSQ) and evaluated its reliability and validity among endoscopy nursing staff in China. This instrument is intended to provide a comprehensive checklist covering the entire endoscopic process—from initial patient assessment to post-procedure care—thus supporting nurses in delivering safe, high-quality care, particularly in the context of cancer diagnosis and treatment.

## 2. Methodology

### 2.1. Instrument design and evaluation

The study was completed in three phases: (1) construction of the nursing management decision system; (2) development and description of the instrument; and (3) validation of the instrument among the target population of nurses working in the gastrointestinal endoscopy unit.

#### 2.1.1. Phase 1: Instrument development

In Phase 1, we constructed the initial version of the Endo-NMSQ. A comprehensive literature review was conducted using Boolean operators across databases such as CINAHL, MEDLINE, PubMed, and Google Scholar, covering the period from 2000 to 2024.<sup>20</sup> Clinical

experience, existing clinical practice guidelines, and input from patient interviews were also incorporated to generate a broad pool of items. An expert panel comprising three senior endoscopy nurses reviewed the collected articles for relevance and clarity. Initially, nine conceptual domains of endoscopy nursing management were proposed. Through iterative discussions, four domains were found to be extraneous or overlapping, resulting in a streamlined instrument comprising five core domains. Key guidance was drawn from the work of Abd Elgaphar *et al.* (2019), who outlined eight areas of nurse compliance. Three prominent components—hand hygiene, use of personal protective equipment, and equipment decontamination—were included under the domain of “Compliance and Examination.”<sup>21</sup> For procedural assessments, literature on physical examination practices was reviewed, leading to the inclusion of three items: Vital signs, physical assessment, and procedural risk stratification.<sup>22</sup> To address patient psychological preparedness, six items were drawn from studies on anxiety and stress management by nurses.<sup>23</sup> Additional items covered nurse-led patient education, intra- and post-procedure monitoring, and evaluation of patient status.<sup>24</sup> The final domain emphasized safety culture, incorporating seven items informed by the endoscopy safety attitudes questionnaire (Endo-SAQ), developed in 2023.<sup>25</sup>

An initial draft containing 33 items across the five domains was developed. Two rounds of pre-investigation were conducted. In the first round, 10 endoscopy nurses from a single center reviewed the instrument for face validity and feasibility. Based on their feedback, several items were reworded for clarity, and two items deemed redundant were removed. In the second round, the revised instrument was further evaluated for clarity of wording and formatting. The outcome of Phase 1 was a refined instrument with five domains and 25 items. Each item is rated on a 4-point Likert scale (1 = “never” to 4 = “always”), reflecting how consistently the nurse performs or observes the described practice.

### 2.1.2. Phase 2: Description of the instrument

The Endo-NMSQ instrument consists of two parts. Part A collects demographic information about the nurse respondents, including gender, age, marital status, education level, years of experience, monthly income, and work shift. Part B contains a 25-item scale organized into five dimensions, as identified in Phase 1. A higher score in each domain indicates better adherence to standards and performance in that aspect of endoscopic nursing management.

The five dimensions of the Endo-NMSQ are as follows:

- **Compliance and physical examination (6 items):** This domain assesses the nurse’s role in ensuring compliance and conducting examinations during endoscopic procedures for cancer diagnosis. Their responsibilities include adhering to infection control practices, preparing and sterilizing equipment, and providing patient support, all of which collectively enhance the quality and safety of endoscopic care
- **Stress recognition (4 items):** This domain evaluates the nurse’s ability to identify and respond to patient stress during endoscopic procedures. Nurses should pay close attention to nonverbal signals, including body language, facial expressions, and vocal tone, which may reveal a patient’s level of stress. By recognizing these indicators, nurses can take timely action to offer reassurance and support. Nurses also foster open conversations with patients, inviting them to share their worries and apprehensions about the procedure
- **Teaching and communication (5 items):** This dimension captures the nurse’s role in educating patients about endoscopic procedures. Comprehensive instruction can reduce anxiety, improve understanding of the process, and encourage adherence to pre- and post-procedural guidelines. Nurses are responsible for explaining the procedure’s purpose, steps, and significance, as well as providing detailed instructions on preparation (e.g., dietary restrictions, medication adjustments, and bowel preparation). Effective communication helps reduce patient anxiety and improve compliance, thereby enhancing procedural outcomes
- **Safety environment (4 items):** This domain focuses on the nurse’s role in maintaining a safe procedural environment. Key tasks include the implementation of safety protocols, continuous monitoring of patients, and provision of a secure environment throughout the procedure. Nurses perform comprehensive assessments of the patient’s medical histories, current medications, allergies, and any existing comorbidities. This information is vital for identifying the potential risks and contraindications associated with the procedure. Nurses are also responsible for ensuring informed consent is obtained from patients following a thorough explanation of the procedure and its associated risks, benefits, and available alternatives. This approach empowers patients to make informed decisions. Trained to identify and address emergencies, nurses respond to emergencies such as allergic reactions, respiratory distress, or cardiac events. Furthermore, nurses play a critical role in ensuring safe discharge practices, which include verifying that

a responsible adult is available to accompany them, particularly following sedation

- Perception of management and monitoring (6 items): This domain explored nurses' perceptions of leadership support, team dynamics, and quality assurance within the endoscopy unit. It includes items evaluating whether management prioritizes patient safety, offers constructive feedback, promotes teamwork, and continuously updates clinical protocols. A positive perception in this area indicates that nurses feel supported and empowered to deliver safe, high-quality care, which is especially crucial in cancer diagnostic settings.

### 2.1.3. Phase 3: Validation of the instrument

A pilot study was conducted to validate the Endo-NMSQ. A stratified sampling technique was adopted to ensure representation from diverse hospital settings. Ten endoscopy units from both public and private hospitals across China were selected as strata. From each unit, three nurses involved in gastrointestinal endoscopy procedures were randomly chosen, yielding a sample of 30 nurses. These participants had experience with upper gastrointestinal endoscopy, specifically esophagogastroduodenoscopy, which was the initial focus of our study. Each participant completed the Endo-NMSQ based on their routine practice and perceptions.

### 2.2. Data collection and analysis

Data were collected using the Endo-NMSQ questionnaire and summarized in Microsoft Excel. Participant characteristics were analyzed using descriptive statistics, including frequencies and percentages. To evaluate the instrument's construct validity, we performed an exploratory factor analysis (EFA) using the Statistical Package for the Social Sciences, version 22.0 (IBM Corp., USA). The internal consistency of the instrument, both overall and across individual domains, was assessed using Cronbach's alpha. The contribution of each item to its corresponding domain's reliability was also evaluated.

Content validity was established through a rigorous instrument development process. The items were adapted and refined from previously validated instruments where applicable. Test-retest reliability (stability) was examined by calculating Spearman's correlation coefficients between responses at 2 time points (Time 1 and 2), using data from repeated administrations of the scale.

## 3. Results

### 3.1. Participant characteristics

A total of 30 endoscopy nurses participated in the pilot study. The majority of participants were male (56.7%) and between

20 and 30 years of age (70%). Most nurses were single (70%) and held at least a Bachelor of Science in Nursing (46.7%), whereas 33.3% had post-registered nurse qualifications, and 20% had diploma-level education. Approximately half of the nurses (53.3%) worked in government hospitals, whereas the remainder were employed in private facilities. In terms of experience, 43.3% had 1 year or fewer of endoscopy nursing experience, 26.7% had 1 – 2 years, and 30.0% had 6 or more years of experience. Approximately half (46.7%) of the nurses had previously assisted patients in endoscopic procedures; the others were relatively new to the role. The demographic details of the participants are summarized in [Table 1](#).

### 3.2. Instrument structure

EFA of the 25-item Endo-NMSQ supported a five-factor solution consistent with the predefined domains. Together, these five factors explained approximately 96.6% of the total variance in nurses' responses. The compliance and physical examination (Factor 1) was the most dominant domain, accounting for 64.3% of the variance, reflecting the strong clustering of items related to infection control and patient assessment. Stress recognition (Factor 2) contributed 15.8% of the variance; teaching and communication (Factor 3) contributed 7.6%; safety environment (Factor 4) contributed 4.8%; and perception of management and monitoring (Factor 5) contributed 4.1%. Each item was primarily loaded onto its corresponding domain, with factor loadings above 0.5, indicating good construct validity. Spearman correlation test analysis further supported the strength and direction of relationships between items and their respective domains ([Table 2](#)).

### 3.3. Test-retest reliability

The internal reliability of the study instrument was calculated using Cronbach's alpha. The alpha coefficients were as follows: Factor 1, 0.92; Factor 2, 0.70; Factor 3, 0.92; Factor 4, 0.86; and Factor 5, 0.92. The overall Cronbach's alpha of the instrument was 0.97, indicating significantly strong internal consistency ([Table 2](#)).

The factor structure confirmed that the instrument's items were appropriately grouped into conceptual categories established during development. Notably, items related to Factor 1 showed strong intercorrelation, indicating a well-defined domain. Items in Factor 2 also clustered appropriately, albeit with slightly lower loadings—likely reflecting the subtle nature of assessing patient anxiety. Similarly, Factor 3 emerged as a distinct and reliable component in the factor analysis.

### 3.4. Reliability and validity testing

The Endo-NMSQ demonstrated strong reliability in this pilot study. The overall Cronbach's alpha for the 25-item



**Table 1. Demographic data of the participants**

Characteristics	<i>n</i>	%
Gender		
Male	17	56.7
Female	13	43.3
Age		
20 – 30	21	70.0
31 – 40	9	30.0
Marital status		
Single	21	70.0
Married	9	30.0
Educational qualification		
Diploma	6	20.0
BSN	14	46.7
Post-RN	10	33.3
Years of experience		
1 and below	13	43.3
1 – 2	8	26.7
3 – 5	0	0
6 and above	9	30.0
Type of hospital		
Private	14	46.7
Government	16	53.3
Prior experience in assisting with the procedure		
Yes	14	46.7
No	16	53.3

Note: Total number of participants=30.

Abbreviations: BSN: Bachelor of science in nursing; RN: Registered nurse.

scale was 0.97, indicating excellent internal consistency. Cronbach's alpha values for the individual domains were 0.92 (Factor 1), 0.70 (Factor 2), 0.92 (Factor 3), 0.86 (Factor 4), and 0.92 (Factor 5). These results show high internal consistency in four of the five domains. The lower (but acceptable) alpha of 0.70 for Factor 2 may reflect the smaller number of items and variability in how nurses interpret and respond to patient stress.

The test-retest reliability was also confirmed. The Spearman correlation coefficients between initial and 2-week follow-up responses ranged from 0.78 to 0.90 across domains, all statistically significant ( $p < 0.001$ ). These findings indicate that the Endo-NMSQ produces stable and consistent results over time.

No ceiling or floor effects were observed in the total or subscale scores, as the response distributions did not cluster at the extremes. This suggests that the Endo-NMSQ effectively differentiates between varying levels of

performance and perception among endoscopy nurses. Overall, the evidence from the factor analysis, internal consistency, and test-retest reliability supports the Endo-NMSQ as a psychometrically sound tool for assessing nursing management practices in endoscopy settings.

It is noteworthy that although the overall scores were high, some variation in domain performance was observed. In particular, nurses scored slightly lower on average in Factor 2, indicating a potential area for targeted training or development. However, no statistical comparisons were made between the domain scores because of the limited sample size. Similarly, no significant differences were observed between nurses from different hospital types (public versus private) or across experience levels, although the study was not powered to detect such differences.

#### 4. Discussion

Endoscopy plays an indispensable role in the diagnosis and management of cancer.<sup>26</sup> Endoscopy nurses are integral to ensuring that these procedures are conducted safely and efficiently. Nurses can enhance the overall efficacy of cancer detection and endoscopic care by educating patients, managing equipment, and monitoring patient status. Their contributions—such as optimizing patient preparation and positioning—support direct visualization for physicians and allow endoscopists to focus on the technical aspects of the procedure. Nurse-led patient education before endoscopy, including explanations of the purpose of the procedure, expectations, and preparation requirements, has been shown to reduce patient anxiety and improve cooperation. During the procedure, collaborative nursing efforts in instrument handling and patient monitoring are vital to promptly address any issues that arise. Thus, strong partnerships between endoscopists and skilled endoscopy nurses contribute to a more timely and accurate cancer diagnosis.

This study describes the development and validation of a comprehensive tool, the Endo-NMSQ, to assess endoscopy nursing management practices. The instrument was developed using a rigorous multistep process to ensure content validity and clinical relevance. A small but experienced group of endoscopy nurses contributed to refining item clarity and eliminating redundancies. Expert reviews and a standardized content validation process, including the content validity index,<sup>27</sup> ensured adequate domain coverage. The final instrument consisted of 25 items and could be used as a checklist or audit tool by the endoscopy nursing staff. Our pilot test indicated that the Endo-NMSQ has excellent internal consistency and reliability, suggesting that it is a stable nursing practice within endoscopy units. This tool enables systematic

Table 2. Rotated factor loadings and internal consistency of the Endo-NMSQ

Factor/item	Factor loading	Communality
<b>Factor 1: Compliance and physical examination (Cronbach <math>\alpha</math> = 0.92)</b>		
C1. Perform hand hygiene	0.67	0.980
C2. Use of personal protective equipment	0.72	0.890
C3. Decontaminate endoscope, accessories, and equipment; dispose of waste	0.74	0.968
C4. Assess patient ID, vital signs, and informed consent	0.65	0.977
C5. Take patient history and perform physical examinations	0.70	0.957
C6. Explain risk stratification and sedation planning	0.73	0.976
<b>Factor 2: Stress recognition (Cronbach <math>\alpha</math> = 0.70)</b>		
SR1. Assess if the patient feels nervous before the procedure	0.95	0.994
SR2. Assess symptoms like sweating, dizziness, or palpitations	0.93	0.997
SR3. Assess whether fatigue affects work performance	0.26	0.966
SR4. Performance is impaired under excessive workload	0.44	0.943
<b>Factor 3: Teaching and communication (Cronbach <math>\alpha</math> = 0.92)</b>		
T1. Provide sufficient information about the procedure	0.88	0.998
T2. Provide fasting instructions	0.72	0.985
T3. Explain the potential side effects of sedation	0.95	0.921
T4. Explain the purpose of informed consent	0.79	0.997
T5. Clarify patient concerns	0.79	0.981
<b>Factor 4: Safety environment (Cronbach <math>\alpha</math> = 0.86)</b>		
SE1. The environment is safe for the patient	0.73	0.977
SE2. Patient safety issues are handled appropriately	0.73	0.977
SE3. Nurses are free to report safety concerns	0.70	0.958
SE4. Patient-related concerns are addressed and discussed for improvement	0.76	0.998
<b>Factor 5: Perception of management and monitoring (Cronbach <math>\alpha</math> = 0.92)</b>		
PM1. Management does not knowingly compromise patient safety	0.84	0.880
PM2. Management supports staff efforts	0.77	0.977
PM3. Staff in difficulty are supported constructively	0.92	0.960
PM4. Timely and adequate information sharing about patient safety events	0.88	0.989
PM5. Team-based patient evaluations	0.78	0.978
PM6. Unit guidelines and care processes are regularly updated	0.92	0.987
Overall internal consistency (25 items)		0.97

Notes: Extraction method: Principal component analysis; Rotation method: Oblimin with Kaiser normalization; Rotation converged in 22 iterations.  
Abbreviation: Endo-NMSQ: Endoscopic nursing management system questionnaire.

assessment of areas such as infection control compliance, patient education, and safety culture—areas that are novel to endoscopy quality management.

The Endo-NMSQ offers remarkable advantages over previously available tools. Many existing instruments or protocols focus on a single aspect of endoscopy care; some emphasize only pre-procedure assessment, while others focus exclusively on the during the procedure. In contrast, the Endo-NMSQ adopts a holistic approach, encompassing all critical steps from patient preparation to post-procedure evaluation and unit management. For instance,

infection control compliance is a major component of this tool, which is justified by prior studies showing that this factor is essential for preventing procedure-related infections. A study from Egypt, for instance, highlighted the importance of compliance with infection control measures, including proper instrument decontamination and waste management, in minimizing the risk of microbial transmission.<sup>28</sup> By including compliance items, the Endo-NMSQ directly targets these quality measures. Similarly, thorough patient assessment before endoscopy is critical. A step-by-step protocol from South Korea

emphasized the need for identifying patients, recording history, and performing risk assessment to ensure smooth procedural flow.<sup>22</sup> These recommendations are mirrored in our compliance and physical examination domain, which includes vital signs checks, risk stratification, and informed consent. Stress recognition, safety environment, and management perception were also included as independent domains in the Endo-NMSQ. Recognizing patient anxiety is especially important, as it can significantly affect both patient tolerance and procedural outcomes. Evidence indicates that endoscopy nurses frequently encounter patients with high levels of anxiety or misconceptions about procedures.<sup>12</sup> Addressing these issues enhances patient satisfaction and cooperation.

In addition, the teaching and communication domain ensures that the nurses' educational interventions are formally evaluated. The expanded role of endoscopy nurses as care coordinators who provide pre- and post-procedure education and counseling has been previously described.<sup>24</sup> In our study, this domain exhibited high internal consistency, suggesting it is well-defined within nursing practice.

The Endo-NMSQ also builds upon Endo-SAQ, which was proposed in 2023 in response to the lack of a dedicated safety culture tool for endoscopy settings.<sup>25</sup> While the Endo-SAQ emphasizes attitudes, the Endo-NMSQ goes further by evaluating concrete behaviors related to compliance and patient monitoring. It could serve as a complementary tool to existing quality frameworks such as the global rating system and endoscopy service accreditation initiatives.<sup>29</sup>

The Endo-NMSQ is a short and easy-to-administer scale, making it suitable for integration into routine audits or quality improvement programs in endoscopy units. It consists of concise questions with straightforward response options, allowing quick completion by nursing staff. Scoring provides quantifiable metrics for unit leaders to monitor progress over time. Since the scale was derived from literature reviews, patient inputs, and expert feedback, it has strong content and face validity. In practical terms, units could use the Endo-NMSQ to identify domains in which nurses might require additional training or resources. For example, if stress recognition scores are consistently lower than other domains, targeted interventions, such as patient communication workshops or anxiety reduction training, can be implemented. Evidence suggests that providing standardized education to endoscopy nurses improves their preparedness and confidence. A recent initiative reported that a standardized training program significantly improved endoscopy nurses' knowledge and readiness to manage

high-risk patients and reduced stress levels.<sup>12</sup> These findings underscore the importance of investing in nurse training and support to enhance patient safety. Global efforts to standardize endoscopy nursing practices are increasing. A recent study by Fang *et al.*<sup>30</sup> developed a competency index for nurse endoscopists in China using a Delphi process, resulting in a framework encompassing cognitive, technical, and professional domains. Our study complements such initiatives by focusing on practical nursing management behaviors and safety measures during endoscopy. Together, these tools help raise standards, provide performance benchmarks, and inform educators and administrative decisions.<sup>30</sup>

The establishment of a nursing management decision system tailored to endoscopy, particularly in cancer diagnosis, is key to enhancing patient care.<sup>31</sup> Such standardized systems can refine decision-making, optimize documentation, and ensure thorough, consistent management of patients throughout their endoscopic journey. This system aligns with safety standards and professional guidelines for endoscopy care. It emphasizes evidence-based clinical protocols, patient education, and teamwork across healthcare roles. Educated and well-prepared patients experience smoother procedures and better recovery. The system also supports data tracking through digital records and audits. Together with regular reviews and team feedback, the system promotes accountability, fosters a culture of safety, reduces complications, and helps endoscopy units maintain high standards of care.

Despite its strengths, this study has several limitations. First, validation was conducted in a specific cultural and linguistic context (Chinese endoscopy units). Therefore, adaptation and re-validation are necessary before applying the tool in other languages or healthcare settings. Second, our sample was limited to nurses working in upper gastrointestinal endoscopy units. Endoscopic procedures, such as colonoscopy, endoscopic retrograde cholangiopancreatography, or bronchoscopy, were not directly represented in this pilot study. The instrument's relevance to these contexts and multidisciplinary teams needs further evaluation. Third, the sample size was relatively small for psychometric analyses. While the results were encouraging, a larger study would provide more robust estimates of the factor structure, allow the use of confirmatory factor analysis, and enable the examination of how instrument scores correlate with various clinical outcomes. Finally, as this is a new instrument, iterative refinement is expected. Feedback from the wider application of the Endo-NMSQ can inform future revisions to enhance clarity, relevance, and cross-context applicability.

## 5. Conclusion

This study highlights the critical role of oncology nurses in managing cancer-related endoscopic procedures by identifying five essential domains: patient compliance and assessment, stress response management, therapeutic education, environmental safety, and perception of clinical leadership. The newly developed Endo-NMSQ has emerged as a robust and validated instrument capable of systematically evaluating nursing performance in these areas. The pilot study demonstrated the tool's effectiveness in capturing practice variations and ensuring consistency in nursing care. Given the increasing reliance on endoscopic techniques for both diagnosis and intervention in cancer care, such as early tumor detection, staging, biopsy, and palliation, ensuring optimal nursing involvement is vital. The Endo-NMSQ offers a practical framework for nurses and oncology teams to comprehensively assess each phase of the endoscopy process, from pre-procedure preparation to post-procedure recovery. This structured approach supports the early identification of procedural gaps, enables timely corrective actions, and fosters a safer environment for immunocompromised or high-risk cancer patients. Furthermore, the tool supports personalized oncology nursing by addressing individual patient needs, such as enhanced psychological support for newly diagnosed patients or stricter infection control measures for those undergoing chemotherapy. Integrating this system into routine oncology practice can facilitate the development of tailored care strategies, improve interdisciplinary communication, and enhance adherence to evolving quality standards in cancer treatment. We recommend broader clinical application and multicenter evaluation of the Endo-NMSQ to validate its utility across diverse oncology care environments. Such expansion could yield significant insights into its adaptability, reinforce evidence-based nursing practices, and ultimately contribute to improved clinical outcomes for patients undergoing cancer-related endoscopic interventions. In conclusion, structured nursing decision-making systems such as the Endo-NMSQ can significantly elevate the standard of endoscopic care in oncology. By empowering nurses with validated tools and protocols, this model promotes safer, more effective, and patient-centered care—aligning with the overarching goals of precision oncology and integrative cancer management.

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## Conflict of interest

The authors declare that they have no competing interest.

## Author contributions

*Conceptualization:* All authors

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## Ethics approval and consent to participate

The research received approval from the ethics committee of Shanxi Bethune Hospital (approval No. YXLL-2023-89). All participants in the study provided their written informed consent prior to their participation. The study was conducted in accordance with the Declaration of Helsinki.

## Consent for publication

All the participants gave consent to publish their data.

## Availability of data

Data are available from the corresponding author upon reasonable request.

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