

Construction and Validation of an Evaluation Index System for Assessing Clinical Nurses' Competence in Developing Age-Friendly Short Video-Based Health Education: A Mixed-Methods Study

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Abstract

Background: Promoting health knowledge is one of the most fundamental, cost-effective, and impactful strategies for improving population health. China has entered a moderately aging society, with over 60% of its elderly population suffering from chronic diseases and exhibiting generally low levels of health literacy. Short videos have become the primary source of health information for elderly internet users. However, current health science communication materials show significant shortcomings in age-friendliness. As key contributors to health education, clinical nurses lack standardized tools to evaluate their age-friendly science communication competence. Therefore, developing an evaluation index system is essential for enhancing the quality of age-friendly health communication.

Objective: This study aims to develop an evaluation index system for assessing clinical nurses' age-friendly science communication competence through short videos, providing a scientific basis for objective evaluation and targeted training.

Methods: A mixed-methods approach combining qualitative and quantitative techniques was employed. Guided by the Lasswell 5W communication model and informed by the digital media usage patterns of older adults, an initial evaluation framework was developed through theoretical analysis, literature review, and focus group discussions. Two rounds of Delphi expert consultation were conducted to refine the indicators, and the Analytic Hierarchy Process (AHP) was applied to determine the weights of each indicator level. The reliability and validity of the system were assessed using questionnaire data, and both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed.

Results: A total of 23 experts from five provinces participated, with a 100% response rate in both rounds of consultation. The expert authority coefficients were 0.952 and 0.960, respectively. Kendall's coefficient of concordance ranged from 0.182 to 0.289 and 0.194 to 0.329 ($P < .001$), and the consistency ratio (CR) remained below 0.1. A total of 706 valid questionnaires were collected, yielding a Cronbach's coefficient of 0.966. The final system consisted of 5 first-level indicators, 14 second-level indicators, and 51 third-level indicators. In the EFA, the KMO measure of sampling adequacy was 0.946, and Bartlett's test of sphericity yielded a chi-square value of 27,852.682 with 1,275 degrees of freedom ($P < .001$). The CFA demonstrated a good model fit ($\chi^2/df=1.924$, GFI=0.887, AGFI=0.868, RMSEA=0.036). All 14 dimensions showed composite reliability (CR) 0.888 and average variance extracted (AVE) 0.636, indicating strong reliability and construct validity.

Conclusions: The developed evaluation index system for clinical nurses' age-friendly short video science communication competence demonstrates strong scientific rigor and practical applicability. It provides a reliable tool for objectively assessing nurses' capabilities in delivering age-friendly health education through short videos and offers guidance for improving the

quality of age-appropriate health communication materials.

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Original Manuscript

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Conclusions: The developed evaluation index system for clinical nurses' age-friendly short video science communication competence demonstrates strong scientific rigor and practical applicability. It provides a reliable tool for objectively assessing nurses' capabilities in delivering age-friendly health education through short videos and offers guidance for improving the quality of age-appropriate health communication materials.

Key words: Health science popularization; Nurses; Age-friendly; Short videos; Evaluation index system; health communication; digital health; mobile health

1. Introduction

Health literacy refers to an individual's capacity to obtain, comprehend, and effectively apply health-related information and services in order to make informed health decisions¹. The World Health Organization (WHO) has long recognized health literacy as one of the three core pillars essential for achieving sustainable development and health equity and has actively encouraged member states to develop and implement national health literacy policies aimed at improving

population health outcomes². Within this strategic framework, enhancing health literacy has become a key public health objective for numerous countries worldwide and continues to be advanced through the systematic formulation and implementation of relevant policies^{3,4}.

With the rapid acceleration of global aging, health challenges faced by the elderly have increasingly become a focal point of concern across all sectors of society. In China, the population aged 60 and above has surpassed 310 million, accounting for 22.0% of the total population⁵, officially marking the country's transition into a moderately aging society. The prevalence of chronic diseases among older adults exceeds 60%, while their overall level of health literacy remains relatively low^{6,7}. The "14th Five-Year Plan for the Development of the National Aging Cause and the Elderly Care Service System" explicitly emphasizes the need to prioritize the improvement of elderly health literacy in order to better meet their growing demand for multi-level and high-quality health and elderly care services⁸. Health science knowledge dissemination, commonly referred to as health science communication, represents one of the most fundamental, cost-effective, and impactful strategies for enhancing public health literacy and improving the overall health status of the population. Medical professionals serve as the primary drivers of health science communication, and numerous countries and regions have introduced policies aimed at strengthening the health education competencies of healthcare workers and encouraging their active engagement in health promotion activities⁹⁻¹².

Currently, short videos have emerged as a critical medium for health science communication. Existing studies indicate that healthcare professionals, including physicians and nurses, utilizing short videos for health education have demonstrated significant positive impacts on enhancing public health literacy and promoting healthier behaviors¹³⁻¹⁵. In China, the number of elderly internet users has reached 157 million¹⁶, with short videos accounting for 35.1% of their mobile internet usage time, making it the primary channel through which the elderly access health-related information¹⁷⁻¹⁹. Nevertheless, the effectiveness of current health science communication targeting older adults

remains suboptimal²⁰⁻²², The primary limitation stems from inadequate consideration of the elderly's information processing habits and cognitive aging characteristics²³⁻²⁵, Particularly in the era of new media, older adults encounter substantial digital barriers in comprehension, engagement, and knowledge retention, which hinder the effectiveness of traditional communication formats in reaching this population. As primary providers of health education, clinical nurses possess professional advantages in delivering health science communication^{26,27}, and such activities have been integrated into the professional title evaluation system²⁸, however, nurses encounter challenges such as heavy workloads, limited proficiency in new media technologies, and insufficient awareness of age-friendly service design in their communication practices^{29,30}. Moreover, the quality of age-appropriate health communication materials varies significantly, resulting in limited effectiveness and impeding improvements in the scientific literacy of the elderly³¹⁻³³. Therefore, optimizing the age-friendliness of health science communication materials is essential to enhancing the effectiveness of health education for older adults³⁴.

Existing studies have explored the evaluation of science communication competencies among clinical healthcare professionals and medical students^{35,36}, yet current indicator systems exhibit gaps in key dimensions—particularly content, communication strategies, and audience adaptation. These systems fail to address the unique intersection of "age-friendly design" and "short video formats" and do not specifically target clinical nurses. As a result, nurses lack a standardized framework for assessing and enhancing their capabilities when developing age-friendly short video content for health science communication. The Lasswell 5W communication model, a foundational theoretical framework in communication studies, offers a comprehensive approach to understanding the core components of information dissemination: the communicator, message content, communication channel, audience, and communication effect, along with their interrelated mechanisms. Its relevance and applicability remain strong even in contemporary new media environments³⁷⁻³⁹. In alignment with the reform objectives outlined in the *Five-Year Work Plan of the 28th Council of the Chinese*

*Nursing Association*⁴⁰ which calls for the development of an evaluation mechanism for nursing science communication talents, this study aims to address the current absence of a competency assessment system for clinical nurses engaged in age-friendly short video production. By integrating the Lasswell 5W model with the media usage characteristics of older adults, this research seeks to construct a robust evaluation index system for clinical nurses' age-friendly short video science communication capabilities. This will fill a critical research gap and provide a theoretical foundation and practical tools to support nurse training, performance assessment, and the enhancement of health science communication quality for elderly populations.

2 Methods

2.1 Definition of Age-Friendly Short-Video Health Science Communication Competence of Nurses.

The concept of age-friendliness originated in Canada in the late 1990s and has since gained increasing global traction. It has been widely promoted through policies and guidelines issued by the World Health Organization⁴¹. As a crucial element of the global sustainable development framework, age-friendly design is dedicated to creating accessible, inclusive, and user-centered experiences for older adults, with a focus on their distinct physical, cognitive, psychological, and social characteristics⁴². In this study, we define "age-friendly short-video health science communication competence of nurses" (ASHC-N) as the integrated capability that registered nurses must possess to systematically execute the full workflow of health science communication via short videos—encompassing topic selection, content development, platform dissemination, audience interaction, and outcome evaluation—tailored to the cognitive, sensory, and media usage traits of individuals aged 60 and above. The theoretical foundation of ASHC-N is grounded in Lasswell's 5W communication model. All measurement indicators are assessed using a 5-point Likert-type self-evaluation scale, where higher scores reflect stronger competence in age-friendly short-video health science communication.

2.2 Establishment of a Multidisciplinary Research Team.

The research team comprises nine members, including three clinical nursing experts, two geriatric head nurses, two specialists in geriatric health communication, and two master's degree candidates. The team was responsible for conducting a comprehensive literature review, screening preliminary indicators, formulating the initial evaluation index system, selecting expert panel members, designing and distributing Delphi questionnaires, compiling and analyzing expert feedback, and performing statistical validation. This study adheres to ethical standards in medical research and has been reviewed and approved by the hospital's ethics committee (YXLL-2025-161).

2.3 Preliminary Formulation of the Index System

2.3.1 Theoretical Foundation

Through a systematic review of existing literature, this study adopts Harold Lasswell's 5W communication model as the theoretical foundation for constructing the evaluation index system. The 5W communication model, a foundational framework in the field of communication studies, systematically identifies the core components of information dissemination and their interrelated mechanisms. The five key dimensions of the model are: who (the communicator), says what (the message content), in which channel (the communication medium), to whom (the target audience), and with what effect (the communication outcome). Based on these five dimensions, this study establishes the first-level indicators of the evaluation system as follows: communicator's professional competence, content design and quality, channel selection and communication strategy, audience analysis and interactive communication ability, and effect monitoring and optimization capability.

The Lasswell 5W model is selected as the core theoretical framework due to its strong alignment and guiding relevance to the key dimensions of "age-friendly short-video science communication." The model provides a systematic deconstruction of the entire communication process, offering a clear analytical pathway for addressing practical challenges in age-friendly science communication. Each component of the model offers concrete and actionable theoretical

guidance for implementing age-friendly design principles. By structuring the evaluation framework around these five dimensions, this study ensures that all indicators are both theoretically grounded and contextually applicable to the target scenario.

2.3.2 Literature Search

A comprehensive literature search was conducted to identify relevant studies and materials for the development of the evaluation indicator system. For Chinese literature, databases including CNKI, Wanfang, VIP, and the China Biology Medicine Database were searched using keywords such as "popular science, health education, health promotion, elderly-friendly, nurses, short videos, evaluation, evaluation indicators." For English literature, databases such as Embase, the Cochrane Library, and PubMed were searched using terms including "popular science, health education and popular science, health promotion education, clinical nurses, elderly-oriented, health education, short videos, ability."

To enhance the comprehensiveness of the indicator pool and minimize the risk of missing relevant materials, a grey literature search was also conducted. This included searching official websites such as the Chinese Government website, the National Health Commission of China, the China Association for Science and Technology, and the Chinese Nursing Association. The focus was on collecting policy documents, laws and regulations, as well as exemplary popular science cases and related materials concerning the development and evaluation of health science communication capabilities. The search period covered all available records from the inception of each database up to February 2025. All retrieved materials were compiled into an item pool, which served as the foundational basis for the subsequent screening and construction of the evaluation indicator system.

2.3.3 Semi-Structured Interviews

A purposive sampling method was employed to select interviewees based on the two key dimensions—"communicator" and "audience"—from Lasswell's 5W communication model. From the communicator perspective, participants included clinical nursing experts and geriatric head

nurses from three tertiary hospitals in Shanxi Province, communication scholars specializing in geriatric communication from two universities, and members of the provincial health science communication expert database in the fields of geriatric health and geriatric medicine. All communicators held at least a bachelor's degree, possessed intermediate or higher professional titles, and had over 10 years of relevant work experience. From the audience perspective, participants included elderly individuals aged 60 years or older from Shanxi Province who had viewed nurses' health science communication videos via short-video platforms within the past month.

The sample size was determined through the principle of information saturation, continuing until no new themes emerged from the interviews. A total of 6 clinical nursing experts, 2 geriatric head nurses, 2 communication experts, 6 provincial health science communication experts, and 7 elderly audience members were interviewed. These interviews were used to supplement and refine the findings from the initial literature review. The interview guide was developed based on the 5W communication model and structured into two sections: one for communicators and one for audience members.

(1) Interview Guide for Communicators: ①What age-friendly competencies should clinical nurses possess when creating health science communication content for the elderly using short videos? ②Considering the cognitive aging characteristics of older adults, how can health science short-video content be designed to be age-friendly? ③How should release strategies be developed for elderly audiences? What adjustments are necessary when implementing multi-platform coordinated communication strategies targeting older adults? ④How should nurses engage with elderly viewers through comment sections to address their questions? What communication strategies are essential for ensuring effective information delivery? ⑤How can nurses evaluate the actual effectiveness of their age-friendly science communication videos? What low-cost and easy-to-implement evaluation methods are available? What aspects should be optimized if the communication effectiveness is suboptimal? ⑥Do you have any additional comments or suggestions regarding this interview?

(2) Interview Guide for Audience Members: ①What motivated you to watch health science communication videos created by nurses? ②Please describe the nurse-created science communication videos you have watched. Why were some videos easy to understand while others were not? Where do you think the difficulties lay? ③Which short-video platforms do you typically use? ④Do you usually leave comments or engage in interactions in the comment sections? How would you like nurses to respond to your comments? ⑤After watching a science communication video, what factors would encourage you to follow the instructions provided? What kind of follow-up support would you expect from the nurses? ⑥Do you have any additional comments or suggestions regarding this interview?

All interviews were transcribed verbatim within 24 hours of completion and imported into Nvivo 15.0 for data organization and analysis. Qualitative data were analyzed using Colaizzi's seven-step phenomenological method. The research team synthesized, summarized, and interpreted the interview findings in conjunction with the literature review. Drawing upon validated instruments including the Chinese version of the Nurse Health Education Ability Scale⁴³, the Nurse Health Education Competence Scale⁴⁴, and the Health Education Ability Evaluation Scale for Nursing Staff^{45,46}, an initial evaluation index system was developed, comprising 5 first-level indicators, 14 second-level indicators, and 49 third-level indicators.

2.3.4 Quality Control

To ensure the scientific rigor and methodological validity of this study, a multi-faceted quality control strategy was implemented. During the interview phase, interviews were conducted by experienced researchers within the research team who possessed strong qualitative interviewing skills. A purposive sampling approach was employed to select representative participants. Following transcription of the interview recordings, two researchers with expertise in qualitative analysis independently performed coding and theme extraction. Regular consensus meetings were held to minimize subjective bias and enhance interpretive consistency. All analytical procedures adhered

strictly to established qualitative research guidelines to ensure the credibility, dependability, and confirmability of the findings.

2.4 Drafting the Expert Questionnaire

The expert questionnaire was structured into three distinct sections: ①The introductory section, which outlines the research purpose, methodology, significance, and instructions for completing the questionnaire, as well as the timeline and procedures for the Delphi rounds. ②The evaluation index consultation form, in which experts rate the importance of each indicator using a 5-point Likert scale ranging from "Not Important" (1) to "Very Important" (5). Additional columns were provided for experts to indicate whether an item should be deleted, revised, or supplemented, or to offer other suggestions. ③The expert profile form, which collects basic demographic information, assesses the expert's familiarity with the research topic, and identifies the basis for their professional judgment.

2.5 Selection of Delphi Experts

A total of 23 experts were selected for this study. Among them, 21 were affiliated with 11 tertiary-level hospitals across five provinces and municipalities in China—Shanxi, Shaanxi, Shandong, Hunan, and Shanghai—representing the fields of geriatric clinical nursing, nursing management, disease diagnosis and treatment, and public health. The remaining two experts were from higher education institutions in Shanxi Province and specialized in geriatric health communication. The inclusion criteria for expert selection were as follows: ①Active professional engagement in geriatric clinical nursing, nursing management, disease diagnosis and treatment, public health, or communication-related disciplines; ②At least 10 years of work experience in the relevant field; ③Holding a bachelor's degree or higher; ④Possessing an associate senior or full senior professional title; ⑤Demonstrating strong motivation and willingness to participate in the study and being available for the entire consultation process.

2.6 Implementation of Delphi Expert Consultation

The Delphi expert consultation was conducted between March and April 2025. Questionnaires were distributed to the selected experts using the most convenient methods available—WeChat, email, or face-to-face administration—and were collected within 10 days. Following the first round of data collection, the research team performed statistical analysis on the indicator scores and synthesized the qualitative feedback provided by the experts. Based on this feedback and the pre-established indicator screening criteria, a group discussion was held to refine and adjust the evaluation indicators. In the second round, the aggregated results from the first round were shared with the experts for re-evaluation. After two rounds of consultation, consensus among experts was achieved, as reflected by the convergence of their evaluations, and the Delphi process was terminated. A finalized evaluation index system was thereby established.

The criteria for indicator selection were based on established methodological standards^{47,48}: ① Mean importance score ≥ 3.50 ; ② Coefficient of variation < 0.25 ; ③ Full-score rate $> 20\%$. Indicators were revised according to expert suggestions and re-submitted for review until consensus was reached.

2.7 Statistical Analysis

Data entry was performed using Microsoft Excel, and statistical analysis of the Delphi survey results was conducted using SPSS 25.0 and YAAHP 12.2 software. Count data were summarized using frequencies and percentages, while measurement data were presented as means and standard deviations. The level of expert participation was assessed through the questionnaire recovery rate, and the concentration of expert opinions was evaluated using the mean and standard deviation of the importance scores assigned to each indicator. The expert authority coefficient (Cr) was calculated as the arithmetic mean of the judgment coefficient (Ca) and the familiarity coefficient (Cs), using the formula: $Cr = (Ca + Cs) / 2$. A Cr value greater than 0.7 indicated that the expert opinions were highly authoritative. The degree of consensus among experts was measured using the coefficient of

variation (CV) and Kendall's coefficient of concordance (W). The chi-square test was employed for significance testing, with statistical significance defined as $P < .05$. The Analytic Hierarchy Process (AHP) was applied to determine the relative weights of the evaluation indicators. Using YAAHP 12.2 software, a judgment matrix was constructed based on the mean differences of the importance scores provided by experts in the second Delphi round, following the Saaty scale⁴⁹. Hierarchical single sorting and consistency checks were performed to validate the matrix. The consistency ratio (CR) was calculated to assess whether the matrix demonstrated acceptable consistency; a CR value less than 0.10 was considered acceptable⁵⁰. Finally, the combined weights of the indicators were derived by integrating both subjective and objective weights. The significance level was set at $\alpha = .05$.

3 Results

3.1 Basic Information of the Consulted Experts

A total of 23 experts completed two rounds of Delphi consultation. These experts were affiliated with medical institutions and universities in five provinces (municipalities) of China: Shanxi Province, Shaanxi Province, Shandong Province, Hunan Province, and Shanghai Municipality. The experts' ages ranged from 30 to 59 years [mean 49.78, SD 6.82 years]. Their professional experience ranged from 10 to 40 years [mean 25.87, SD 9.24 years]. Among the participants, there were 10 clinical nursing experts (10/23, 43.48%), 11 clinical medical experts (11/23, 47.83%), and 2 experts specializing in geriatric health communication (2/23, 8.70%). The demographic and professional characteristics of the expert panel are summarized in Table 1.

Table 1 General information of experts (n=23)

Project	Classification	Quantity	Percentage [%]
Gender	Male	2	8.70
	Female	21	91.30
Age	30–39	2	8.70
	40–49	8	34.78
	50–59	13	56.52
Professional field	Nursing	10	43.48

Educational qualifications	Clinical Medicine	11	47.83
	Communication Studies	2	8.70
	Undergraduate degree	7	30.43
	Master's degree candidate	11	4.83
Professional title	Doctoral student	5	21.74
	Deputy senior	9	39.13
	Senior level	14	60.87
Years of professional experience	10□19	6	26.09
	20□29	8	34.78
	30□39	9	39.13

3.2 Expert Positive Coefficient and Authority Coefficient

This study conducted two rounds of expert consultation, with 23 questionnaires distributed in each round. The effective response rate for both rounds was 100%, indicating a high level of expert engagement. In the first round, 19 experts (19/23, 82.61%) provided revision suggestions, whereas in the second round, 5 experts (2/23, 21.74%) offered additional comments. This suggests that the experts were highly involved in refining the indicator system during the early stages of the study. The authority coefficient (Cr) was calculated based on the experts's familiarity degree (Cs) and judgment basis (Ca) using the formula: $Cr = (Cs + Ca) / 2$. A Cr value ≥ 0.70 indicates a high level of expert authority⁵¹. In the first round, Cs was 0.921, Ca was 0.982, and Cr was 0.952; in the second round, Cs was 0.930, Ca was 0.991, and Cr was 0.960. These results demonstrate that the participating experts possessed high authority, and the consultation outcomes were highly credible.

3.3 Degree of Consistency among Experts' Opinions

To evaluate the consistency of experts' opinions, this study utilized the coefficient of variation (CV), Kendall's W coefficient of concordance, and the chi-square test. In the first round of expert consultation, the CV values ranged from 0 to 0.24, Kendall's W ranged from 0.182 to 0.289, and χ^2_4 ranged from 20.00 to 291.62 ($P < .001$). In the second round, the CV values ranged from 0 to 0.22, Kendall's W ranged from 0.194 to 0.330, and χ^2_4 ranged from 33.54 to 104.93 ($P < .001$). These findings indicate that the experts' evaluations of each indicator were largely consistent, reflecting a relatively high level of agreement among participants. Detailed statistical results are presented in

Table 2.

Table 2 Degree of Consistency of Expert Opinions

Round of rounds	Indicators	Kendall's W	Chi-square (df)→ (4)	<i>P value</i>
First round	First-level indicators	0.182	20.00	□0.001
	Secondary indicators	0.289	89.14	□0.001
	Third-level indicators	0.271	291.62	□0.001
Second round	First-level indicators	0.330	36.17	□0.001
	Secondary indicators	0.110	33.54	□0.001
	Third-level indicators	0.194	104.9.3	□0.001

3.4 Results of Expert Consultation

Following the first round of expert consultation, the following modifications were made according to the item screening criteria, expert feedback, and team discussions: ① Nine indicators were revised, including five first-level indicators and four third-level indicators. For example, the descriptions of the first-level indicators were refined; the original phrase "Possessing the ability to operate new media platforms, such as account authentication, management, and interaction skills, etc." was revised to "Possessing the ability to operate new media platforms and being familiar with the operational rules and elderly-friendly features of short-video platforms commonly used by older adults (e.g., WeChat Video Account and Douyin Lite Edition)." ② Six new third-level indicators were added, including "Empathy and Affinity," "Analysis of Target Users' Active Time Periods," and "Appropriate Use of AI Tools for Support." ③ Five third-level indicators were removed, such as "Cross-Platform Promotion to Increase Exposure," "Using Short Videos for Live Science Communication and Interaction with Elderly Viewers," and "Conducting Offline Surveys with Elderly Viewers." ④ Four third-level indicators were consolidated, for instance, the item "Understanding the rules and characteristics of short-video platforms and being able to optimize video release settings based on platform requirements and user preferences to increase video

exposure" was integrated into C1 Platform Selection and Application.

In the second round of consultation, no new deletions, modifications, or additions were proposed by the experts. Their feedback primarily focused on refining the wording of certain indicators. For example, "Media Literacy" was revised to "Elderly-Friendly Media Literacy"; "Content Needs to Be Targeted" became "Targeting Elderly Health Needs"; "Platform Selection and Application" was updated to "Elderly-Friendly Platform Selection and Application" to highlight the elderly-centered design; and "Application of AI Tools and Declaration" was revised to "Appropriate Use of AI and Other Artificial Intelligence-Generated Content with Human Review and Video Annotation."

Based on the two rounds of Delphi expert consultation, the research team conducted comprehensive discussions and revisions, ultimately finalizing the evaluation index system for clinical nurses' elderly-friendly short-video science communication competence. The system comprises five first-level indicators, 14 second-level indicators, and 51 third-level indicators. The weights of each level of indicators were calculated using the Analytic Hierarchy Process (AHP), followed by consistency checks. All *CR* values were below 0.10, indicating acceptable consistency. Detailed results are presented in Table 3.

Table 3 The feedback results of the evaluation index system for the clinical nurses' ability to conduct elderly-friendly science popularization through short videos

Indicator	$\bar{x} \pm s$	CV	Weight	Overall weight	CR
A	5.00	0	0.249	0.249	0.013
A1	5.00	0	0.231	0.231	0.001
A1-1	4.61±0.72	0.157	0.313	0.018	
A1-2	4.00±0.74	0.185	0.084	0.005	0.030
A1-3	4.22±0.74	0.174	0.128	0.007	

4	A1-	4.48±0.99	0.222	0.475	0.027	
	A2	5.00	0	0.231	0.231	□0.001
	A2-	4.61±0.84	0.182	0.625	0.036	
	1					
2	A2-	4.35±0.83	0.191	0.137	0.008	0.018
	A2-	4.35±0.88	0.203	0.239	0.014	
	3					
	A3	4.48±0.51	0.110	0.077	0.077	□0.001
1	A3-	4.78±0.52	0.108	0.661	0.013	
	A3-	4.26±0.62	0.145	0.208	0.004	0.051
	2					
	A3-	4.22±0.67	0.159	0.131	0.003	
3	A4	5.00	0	0.231	0.231	□0.001
	A4-	4.91±0.29	0.059	0.420	0.024	
	1					
	A4-	4.87±0.34	0.071	0.297	0.017	
2	A4-	4.70±0.47	0.100	0.210	0.012	0.045
	3					
	A4-	4.22±0.60	0.142	0.074	0.004	
	4					
A5	A5	5.00	0	0.231	0.231	□0.001
	A5-	4.70±0.47	0.100	0.163	0.009	
	1					
	A5-	4.91±0.29	0.059	0.350	0.020	
2	A5-	4.26±0.54	0.127	0.089	0.005	0.046
	3					
	A5-	4.96±0.21	0.042	0.350	0.020	
	4					
A5-	A5-	4.00±0.60	0.151	0.049	0.003	

5					
B	5.00	0	0.249	0.249	0.013
B1	5.00	0	0.333	0.333	□0.001
B1-					
	5.00	0	0.400	0.033	
1					
B1-					
	5.00	0	0.400	0.033	□0.001
2					
B1-					
	4.70±0.63	0.135	0.200	0.017	
3					
B2	5.00	0	0.333	0.333	□0.001
B2-					
	4.52±0.51	0.113	0.225	0.019	
1					
B2-					
	4.43±0.79	0.178	0.148	0.012	
2					
B2-					
	4.78±0.42	0.088	0.429	0.036	0.038
3					
B2-					
	4.04±0.77	0.190	0.051	0.004	
4					
B2-					
	4.43±0.51	0.114	0.148	0.012	
5					
B3	5.00	0	0.333	0.333	□0.001
B3-					
	4.87±0.34	0.071	0.212	0.018	
1					
B3-					
	4.91±0.29	0.059	0.357	0.030	
2					
B3-					0.023
	4.96±0.21	0.042	0.357	0.030	
3					
B3-					
	4.09±0.42	0.102	0.075	0.006	
4					
C	5.00	0	0.249	0.249	0.013
C1	4.87±0.34	0.070	0.667	0.667	□0.001
C1-					
	4.96±0.21	0.042	0.448	0.075	
1					
C1-					0.037
	3.78±0.60	0.159	0.051	0.008	
2					
C1-	4.09±0.42	0.102	0.113	0.019	

3	C1-	3.83±0.65	0.170	0.075	0.013	
4	C1-	4.52±0.67	0.147	0.313	0.052	
5	C2	4.65±0.50	0.112	0.333	0.333	□0.001
	C2-	4.39±0.72	0.164	0.131	0.011	
1	C2-	4.83±0.39	0.080	0.661	0.055	0.052
2	C2-	4.30±0.47	0.109	0.208	0.017	
3	D	4.91±0.29	0.080	0.109	0.109	0.013
	D1	4.83±0.39	0.094	0.333	0.333	□0.001
	D1-	3.83±0.65	0.170	0.239	0.009	
1	D1-	3.61±0.58	0.162	0.137	0.005	0.018
2	D1-	4.61±0.78	0.170	0.625	0.023	
3	D2	4.96±0.20	0.070	0.667	0.667	□0.001
	D2-	4.48±0.67	0.149	0.280	0.020	
1	D2-	5.00	0	0.627	0.045	0.082
2	D2-	3.83±0.58	0.151	0.094	0.007	
3	E	4.91±0.29	0.060	0.143	0.143	0.013
	E1	4.78±0.42	0.104	0.333	0.333	□0.001
	E1-1	4.61±0.50	0.108	0.342	0.016	
	E1-2	3.74±0.75	0.201	0.081	0.004	0.028
	E1-3	4.57±0.79	0.173	0.577	0.028	
	E2	4.96±0.20	0.058	0.667	0.667	□0.001
	E2-1	4.26±0.45	0.105	0.140	0.013	
	E2-2	4.61±0.58	0.127	0.333	0.032	0.052
	E2-3	4.65±0.57	0.123	0.528	0.050	

Note: CV is the coefficient of variation and CR is the coefficient of agreement

4. Reliability and Validity Testing of the Evaluation Index System

A convenience sampling method was employed to select 40 clinical nurses from Hospital A, a tertiary grade A hospital located in Taiyuan City, Shanxi Province, as pre-survey participants. The purpose of the pre-survey was to assess the content accuracy, logical clarity, and potential ambiguity of the questionnaire items. Based on the feedback received, necessary revisions and adjustments were made to the questionnaire, resulting in the finalized version for formal administration. In July 2025, clinical nurses from Hospital B, another tertiary grade A hospital in Taiyuan City, were selected as participants for the formal survey. Prior to data collection, approval was obtained from the hospital's nursing department, after which the questionnaires were distributed to eligible participants. The inclusion and exclusion criteria for the survey participants were as follows: (1) Inclusion criteria: ① Registered nurses with at least one year of clinical work experience currently serving in clinical nursing roles; ② Willingness to participate and provision of informed consent. (2) Exclusion criteria: ① Intern nurses or those undergoing training from other hospitals. (3) Removal criteria: ① Questionnaires completed in an unreasonably short time; ② Responses exhibiting clear patterns indicative of invalid or careless answering behavior.

According to psychometric principles, the required sample size should be 5 to 10 times the number of questionnaire items, with an additional 20% allowance for potential attrition⁵². This evaluation index system comprises 51 items. Applying the formula: $51 \times (5-10) \times (1+20\%)$, the calculated sample size should range between 306 and 612 participants. The questionnaire is structured into three sections: (1) Instructions: providing an overview and detailed guidance on how to complete the questionnaire; (2) Basic Information Collection: gathering sociodemographic data of the participating nurses; (3) Self-Assessment Questionnaire: evaluating the participants' competence in elderly-friendly science communication using a 5-point Likert scale. The response options are: "Completely Unfit" (1), "Slightly Fit" (2), "Moderately Fit" (3), "Fairly Fit" (4), and "Completely

Fit" (5). Higher scores indicate a higher level of competence in elderly-friendly science communication. Data collection was conducted through both an online platform (Wenjuanxing) and paper-based questionnaires, resulting in a total of 706 valid responses.

4.1 Reliability Analysis of the Questionnaire

Reliability serves as a key indicator for assessing the stability and internal consistency of a questionnaire. In this study, Cronbach α coefficient and corrected item-total correlation (CITC) were employed to evaluate internal consistency. The results demonstrated that both the overall reliability and the reliability of each subscale met the established psychometric criteria, indicating strong internal consistency. The overall Cronbach α coefficient was 0.966, surpassing the widely accepted threshold of 0.8⁵³, which suggests high inter-item consistency and that the questionnaire yields stable and reliable measurements. These findings support the instrument's ability to accurately reflect the actual level of clinical nurses' competence in delivering age-friendly short-video science communication.

4.2 Validity Analysis of the Questionnaire

Validity refers to the extent to which a questionnaire accurately measures the construct it is intended to assess. In this study, structural validity was evaluated using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The results indicated that the questionnaire exhibited strong structural validity, effectively capturing the core dimensions of clinical nurses' competence in age-friendly short-video science communication. This supports the instrument's suitability for measuring the intended theoretical construct.

4.2.1 Exploratory Factor Analysis (EFA)

Prior to conducting the factor analysis, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were performed to evaluate whether the dataset was appropriate for factor analysis. The KMO value was 0.946, substantially exceeding the threshold of 0.7, indicating a high degree of common variance among the items and that the data structure was

well-suited for factor analysis. Bartlett's test of sphericity yielded an approximate χ^2_4 of 27,852.682 with 1,275 degrees of freedom, and a significance level of $P < .001$. This result led to the rejection of the null hypothesis that the correlation matrix was an identity matrix, confirming the presence of significant inter-item correlations. These findings further support the suitability of the data for exploratory factor analysis. Detailed results are presented in Table 4.

Table 4. Results of the KMO Measure and Bartlett's Test of Sphericity

Index	Result
KMO Measure of Sampling Adequacy	0.946
Bartlett's Test of Sphericity	χ^2 27852.682 Degrees of Freedom 1275 Significance (P-value) $\square .001$

Factor Extraction and Structural Validation. Principal component analysis was employed to extract factors, using the eigenvalue ≥ 1 criterion. A total of 14 common factors were identified, aligning precisely with the 14 predefined secondary dimensions (A1–A5, B1–B3, C1–C2, D1–D2, E1–E2) of the questionnaire. The cumulative variance explained reached 79.456%, exceeding the minimum acceptable threshold of 50%. This indicates that the 14 extracted factors collectively accounted for 79.456% of the total variance in the questionnaire. The measurement dimensions comprehensively covered the core components of clinical nurses' competence in producing age-friendly short videos, with no critical dimensions omitted.

Rotated Component Matrix. Factor rotation was conducted using the Kaiser normalization Varimax method. The results revealed that all item loadings on their respective common factors were ≥ 0.673 , with no evidence of cross-loadings (i.e., each item loaded highly only on its designated factor and minimally on others). This confirms that the items were clearly assigned to their respective dimensions, with distinct and non-overlapping factor structures. For instance, the four items under A1 (Professional Knowledge Reserve) (A1-1 to A1-4) exhibited high loadings exclusively on the fourth common factor (0.812–0.880); the five items under B2 (Targeted Health

Needs of the Elderly) (B2-1 to B2-5) showed high loadings solely on the first common factor (0.689–0.785); and the three items under E2 (Behavioral Change and Feedback from Elderly Viewers) (E2-1 to E2-3) demonstrated high loadings only on the fourteenth common factor (0.742–0.806). These findings provide strong evidence for the structural validity and rationality of the questionnaire.

4.2.4 Confirmatory Factor Analysis (CFA)

To further validate the structural integrity of the questionnaire, confirmatory factor analysis (CFA) was performed to assess the goodness-of-fit of the theoretical model comprising the 14 dimensions. Additionally, model quality was evaluated using key indicators including standardized factor loadings, average variance extracted (AVE), composite reliability (CR), and discriminant validity.

Standardized factor loadings. All manifest variables (third-level items) demonstrated standardized factor loadings ≥ 0.766 on their corresponding latent constructs. Moreover, the z-values (critical ratios) of all unstandardized factor loadings were ≥ 22.401 , with $P < .001$, indicating statistically significant and robust relationships between items and their respective dimensions. This confirms the strong measurement properties of each item. For instance, within the A1 dimension (Professional Knowledge Reserve), item A1-2 exhibited the highest loading (0.892), while A1-1, A1-3, and A1-4 showed loadings of 0.833, 0.885, and 0.835, respectively. For the C2 dimension (Multi-platform Collaborative Communication), C2-2 had the highest loading (0.904), with C2-1 and C2-3 showing loadings of 0.870 and 0.885, respectively. The squared multiple correlation (SMC) values for all items were ≥ 0.602 , indicating that each item effectively captures a substantial portion of the variance in its latent variable, thereby demonstrating strong measurement validity.

Composite reliability (CR) and average variance extracted (AVE). Composite reliability values for all 14 dimensions exceeded 0.888, surpassing the recommended threshold of 0.7. This indicates high internal consistency and reliability among items within each dimension. The average variance

extracted (AVE) values were all ≥ 0.636 , exceeding the minimum criterion of 0.5, which supports strong convergent validity across all dimensions. Specifically, the C2 dimension (Multi-platform Collaborative Communication) achieved the highest CR (0.917) and AVE (0.785), whereas the C1 dimension (Selection and Application of Age-friendly Platforms) had the lowest AVE value (0.636), which still meets the acceptable standard. Overall, these findings confirm that the questionnaire demonstrates satisfactory convergent validity. Detailed results are presented in Table 5.

Table 5. The results of the average variance extracted (AVE) and composite reliability (CR) values for the 14 dimensions.

Factor	Average Variance Extracted	Composite Reliability
	(AVE)	(CR)
A1 Professional knowledge reserve	0.743	0.920
A2: Expression and communication skills for aging	0.761	0.905
A3: Video production ability	0.727	0.889
A4: Spreading awareness and attitudes	0.687	0.898
A5: Aging media literacy	0.690	0.918
B1: Content Accuracy	0.737	0.894
B2: Targeted health needs of the elderly	0.653	0.904
B3: Content suitable for aging design	0.665	0.888
C1: Selection and application of aging platform	0.636	0.897
C2: Multi-platform collaborative transmission	0.785	0.917
D1: Understanding of the older audience	0.740	0.895
D2: Effective interaction and feedback	0.770	0.910
Y1: Video playback data	0.749	0.900
Y2: Behavior change and feedback of elderly audience	0.753	0.901

Discriminant Validity. Discriminant validity was assessed by comparing the square root of each dimension's average variance extracted (AVE) with the Pearson correlation coefficients between that dimension and all others. The results indicated that the square roots of the AVE values for the 14 dimensions ranged from 0.797 to 0.886. Meanwhile, all inter-dimensional Pearson correlation coefficients were ≤ 0.671 , with the highest observed between B1 and B2 (0.671). These correlation coefficients were consistently lower than the corresponding square roots of the AVE values (e.g., B1:

$\sqrt{AVE} = 0.859$; B2: $\sqrt{AVE} = 0.808$). This pattern suggests that while the dimensions exhibit meaningful and theoretically plausible correlations (e.g., between content accuracy and relevance to

elderly needs), they also maintain sufficient statistical independence. There is no evidence of dimension overlap or conceptual confusion, indicating satisfactory discriminant validity.

Model Fit Assessment. To evaluate the overall fit of the confirmatory factor model, multiple fit indices were employed. The results revealed a chi-square to degrees of freedom ratio (χ^2/df) of 1.924, which is below the acceptable threshold of 3.0, indicating an acceptable model fit. The root mean square error of approximation (RMSEA) was 0.036, with a 90% confidence interval ranging from 0.034 to 0.038. The upper bound of this interval was below the criterion of 0.05, suggesting excellent model fit accuracy. The comparative fit index (CFI), non-normed fit index (NNFI/TLI), and incremental fit index (IFI) were 0.962, 0.957, and 0.962, respectively, all exceeding the recommended cutoff of 0.95. These values indicate a high degree of fit when compared to the baseline model. Additionally, the standardized root mean square residual (SRMR) was 0.028, which is below the 0.05 threshold, further supporting the model's good fit as it reflects minimal unexplained variance. Although the goodness-of-fit index (GFI) and adjusted goodness-of-fit index (AGFI) were 0.887 and 0.868, respectively—slightly below the conventional cutoff of 0.90—this minor deviation is considered acceptable given the large number of items in the questionnaire (51 items). Importantly, all core fit indices (RMSEA, CFI, TLI) demonstrated excellent performance. Taken together, these findings support the conclusion that the model demonstrates a good overall fit and strong compatibility with the data. Detailed results are presented in Table 6.

Table 6. The model fitting index was used to analyze the results.

Model fitting indicators										
Indicator	χ^2	df	P value	χ^2/df	GFI	RMSEA	RMR	CFI	NFI	NNFI
Judgment criteria	-	-	>0.05	<3	>0.9	<0.10	<0.05	>0.9	>0.9	>0.9
Numerical value	2180.098	1133	0.000	1.924	0.887	0.036	0.039	0.962	0.924	0.957
Other indicators	TLI	AGFI	IFI	PGFI	PNFI	PCFI	SRMR	RMSEA 90% CI		
Criteria for judgment	>0.9	>0.9	>0.9	>0.5	>0.5	>0.5	<0.1	-		
Value	0.957	0.868	0.962	0.758	0.821	0.855	0.028	0.034 ~ 0.038		

Note: Default Model $\chi^2(1275) = 28616.048$, $P \leq .99$

AIC = 379.824, BIC = 1259.830

The statistical analysis results indicate that the model demonstrates a satisfactory fit. The corresponding confirmatory factor analysis model is illustrated in Figure 1.

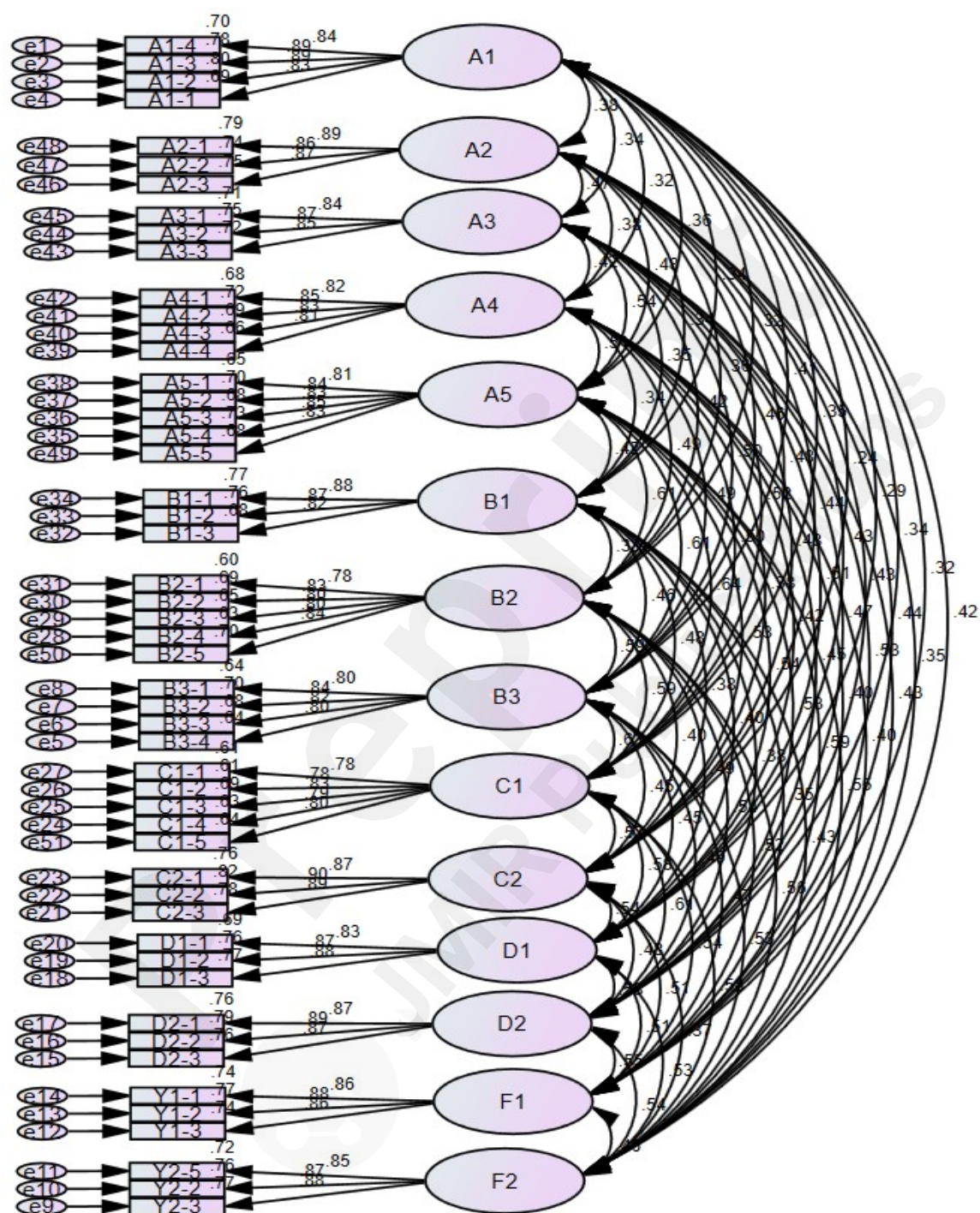


Figure 1. Confirmatory Factor Analysis Model

5 Discussion

5.1 The Necessity and Significance of Developing an Evaluation Index System for Clinical Nurses'

Ability to Produce Age-Friendly Short Video Science Popularization Content

The global aging of the population has emerged as a major challenge confronting the international community. In this context, improving the health literacy of older adults is widely recognized as a crucial strategy for achieving healthy aging. Although health science popularization is highly prioritized globally and healthcare professionals are actively encouraged to participate, effectively reaching the elderly through digital media remains a persistent challenge. The "digital divide," particularly in terms of the elderly's comprehension and engagement capabilities, hinders the effectiveness of traditional science communication methods. Currently, there is a notable absence of internationally recognized, standardized tools capable of scientifically evaluating the competence of science communicators in producing age-friendly digital content. While China has been actively advancing health science popularization initiatives, this gap is not unique to China—it also constrains the global enhancement of elderly health education quality and the development of specialized talent in this domain. To address this issue, this study developed an evaluation system designed specifically for clinical nurses to assess their competence in creating age-friendly short video science popularization content. This system aims to provide a structured reference framework and empirical foundation for standardizing relevant training programs and enhancing the overall quality of age-appropriate science communication materials on a global scale.

5.2 Characteristics of the Evaluation Index System for Clinical Nurses' Ability to Produce Age-Friendly Short Video Science Popularization

The evaluation index system developed in this study demonstrates scientific rigor and reliability. Grounded in the Lasswell 5W communication model, the system exhibits strong theoretical applicability by systematically analyzing the key components involved in the dissemination of age-friendly science popularization short videos. Throughout the development process, the research team conducted a comprehensive review of relevant policy documents and

academic literature, and engaged in in-depth discussions with interdisciplinary experts from multiple provinces, ensuring a robust integration of theory and practice.

A convenience sampling method was employed to recruit 23 Delphi experts from five provinces across China, representing diverse fields including nursing, communication (with a focus on geriatric communication), clinical medicine, and public health. Specifically, six experts were members of the Shanxi Provincial Health Science Popularization Expert Database, and two were communication scholars specializing in geriatric health communication from local universities. The expert panel demonstrated broad representativeness, and the involvement of a multidisciplinary team enhanced the credibility and authority of the study.

Two rounds of Delphi expert consultation achieved full consensus, with a 100% questionnaire response rate in both rounds, reflecting high levels of expert engagement. Following the two rounds, the coefficient of variation for the indicators was less than 0.25, while Kendall's coefficient of concordance ranged from 0.182 to 0.289 in the first round and from 0.194 to 0.330 in the second, with all P -values $< .001$. These results indicate a high degree of consistency among expert opinions and suggest that the consultation outcomes are reliable.

To determine the weights of the indicators and quantitatively assess expert input, the Analytic Hierarchy Process (AHP) was applied. The consistency ratio (CR) for all hierarchical indicators was below 0.1 and passed the consistency test, demonstrating that the weight allocation within the index system is reasonable⁵⁴. The integration of the Delphi method with the Analytic Hierarchy Process further strengthens the scientific validity and practical applicability of the evaluation index system.

5.3 Analysis of the Content and Weights of the Evaluation Index System for the Elderly-friendly Popular Science Ability of Clinical Nurses' Short Videos

5.3.1 Analysis of the Content of the First-level Indicators

The combined weights of "Professional Competence of Communicators", "Elder-friendly

Content Design and Quality", and "Channel Selection and Communication Strategies" are equal (0.249) and are ranked first in terms of weight. The average importance score for each is 5.00, indicating that experts unanimously believe that these three indicators have the highest priority in the elderly-friendly short video popular science ability. This is consistent with the research results of Wang Xueqing et al. on the impact of short video popular science on the public's willingness to perform cardiopulmonary resuscitation, which also emphasizes the importance of authoritative communication subjects, reliable content quality, and high-penetration short video platforms⁵⁵.

In terms of communication channel research, the results of this study are in line with those of Li Rongzong⁵⁶ and Wang Dapeng²⁵ et al., highlighting that the effectiveness of popular science not only depends on content quality but also requires consideration of the diversity of communication channels, as the elderly have a higher demand for diversified popular science channels than for the content itself. However, there are differences from the research results of Mi Yu⁵⁷ et al. on the construction of the evaluation index system for the health education competence of nursing staff, reflecting that in the new media era, clinical nurses need to possess stronger composite abilities, including establishing professional authority, producing elderly-friendly content, and accurately reaching channels, all of which are indispensable for achieving the best popular science effect. Additionally, the research results of Deng Ying⁵⁸ et al. on the evaluation index system for the health education competence of clinical doctors show that "Health Education Skills" have the highest weight, followed by "Knowledge", which is significantly different from the results of this study. This may be related to the different role positioning, work focus, and required abilities of clinical nurses and clinical doctors in health popular science. Clinical doctors are the decision-makers and leaders in disease diagnosis and treatment, with high specificity and authority, focusing on diagnostic health guidance. Their core goal of popular science is to enhance patients' understanding and compliance with diseases and promote shared decision-making between doctors and patients. In contrast, clinical nurses, leveraging their advantage of in-depth contact with patients, act as disease caregivers and

promoters of healthy behaviors, focusing on continuous and life-oriented health guidance.

5.3.2 Analysis of Secondary Indicators

Among the secondary indicators, "Selection and Application of Age-Friendly Platforms," "Effective Interaction and Feedback," and "Behavioral Changes and Feedback of Elderly Viewers" carry the highest combined weight (0.666). The essence of age-friendly health science popularization lies in achieving precise outreach through appropriate "media channels," rather than merely pursuing broad reach. This represents a critical strategy for bridging the digital divide among older adults in health communication. Effective interaction and feedback are essential for building long-term trust between elderly audiences and both the nurses and their content. Furthermore, "Behavioral Changes and Feedback of Elderly Viewers" highlights that the ultimate objective of science popularization should center on behavioral improvement, rather than mere view counts. Therefore, the effectiveness of nurses's science communication efforts should be evaluated based on measurable changes in audience behavior, rather than superficial traffic metrics. In contrast, "Video Production Skills" holds the lowest weight, suggesting that in the new media era, age-friendly science popularization should prioritize content understandability, acceptability, and practicality over technical production capabilities. Older adults are primarily concerned with whether the content is clear, comprehensible, and applicable to their daily lives. Thus, limited video production skills are not the primary barrier preventing nurses from engaging in effective science communication⁵⁹.

Moreover, the three indicators of content accuracy, targeting, and age-friendliness (B1–B3) are assigned equal weights, a finding consistent with the research of Wang Dapeng et al.²⁵. This indicates that all three components are equally essential, and the absence of any one can significantly compromise the effectiveness of science popularization. In the context of an aging society, health science communication requires nurses to develop non-traditional competencies, including demand analysis, media adaptation for older audiences, and evaluation of behavioral feedback. In conclusion, this study reveals through weight distribution two core principles: "precise outreach" is more

valuable than "broad coverage," and "behavioral change" is a more meaningful outcome than "traffic data." It is therefore recommended that medical institutions, while ensuring content quality, prioritize training in communication channel utilization and audience interaction skills for nurses to enhance the real-world impact of age-friendly science popularization.

5.4 Practicality of the Constructed Evaluation Index System for Clinical Nurses' Ability to Produce Age-Friendly Science Popularization Content

The evaluation index system developed in this study aligns closely with the national health science popularization strategy. Research findings indicate that nurses should possess key competencies such as "age-friendly expression and communication," "age-appropriate content design," and "selection and application of age-friendly platforms." These capabilities ensure that science popularization short videos are tailored to the audiovisual habits and cognitive characteristics of older adults, thereby enhancing the quality of age-friendly science communication materials and improving both audience reach and behavioral conversion rates.

From the perspective of hospital management, this evaluation index system transforms the abstract concept of "age-friendly science popularization ability" into a quantifiable, actionable, and improvable training and assessment framework. This enables hospitals to develop stratified training programs and promote standardized management and quality improvement in science popularization initiatives. The inclusion of "behavioral change and feedback of elderly viewers" as an indicator encourages nurses to focus on the actual health outcomes of science communication rather than merely on view counts. This approach helps bridge the digital divide and supports improvements in health behaviors and health literacy among older adults. Clinical nurses can utilize this system for self-assessment, identifying areas of professional weakness and implementing targeted improvements. This process optimizes science popularization practices and provides a scientifically grounded and systematic model for elderly health communication.

5.5 Challenges and Limitations

Despite offering a solid theoretical foundation and practical tools for training clinical nurses in age-friendly short video science popularization, the implementation of this index system faces several real-world challenges. First, clinical nurses often have heavy workloads and irregular schedules, making it difficult to allocate time for structured training. Second, many hospitals lack dedicated science popularization training resources and qualified instructors, particularly those with expertise in short video production and geriatric communication. Third, the current performance evaluation system provides limited incentives for science popularization activities, which may result in low motivation among nurses to engage in content creation and ongoing updates. This could lead to issues such as "learning without application" or short-lived enthusiasm.

To improve the feasibility of implementing this index system, the following strategies are recommended: First, modularize and fragment training content into 15–20-minute micro-courses, delivered through online platforms (e.g., DingTalk, Learning Pass) to enable flexible and repeated learning, thereby reducing time constraints. Second, establish a "science popularization mentor team" comprising nurses with video production experience, hospital publicity staff, and external communication scholars to provide one-on-one script guidance and technical support, addressing the shortage of internal expertise. Third, Integrate science popularization competence into performance evaluations and promotion criteria. For example, introduce an "Annual Outstanding Age-Friendly Science Popularization Video" award linked to excellence recognition and career advancement, fostering a sustainable incentive mechanism. Fourth, Prioritize pilot implementation in specialized outpatient departments or chronic disease management centers, where nurses have frequent interactions with elderly patients and face concentrated health education demands. This facilitates the formation of a "content–audience–feedback" closed-loop system. Once successful models are established, they can be scaled up across the hospital. In conclusion, while the index system

demonstrates both scientific rigor and operational feasibility in its design, its applicability across diverse hospital settings requires a phased implementation approach involving small-scale pilots, evaluation, and iterative refinement. Future research should include multi-center studies and longitudinal tracking to further validate its effectiveness and long-term sustainability.

6 Limitations

This study has several limitations. First, due to constraints in time, resources, and personnel, the constructed evaluation index system may not fully capture all dimensions of clinical nurses' capabilities in producing age-friendly short video science popularization content. Second, the study employed purposive sampling to select Delphi experts from five provinces (municipalities) in China, with a relatively high proportion of experts from Shanxi Province. This may compromise the representativeness and regional generalizability of the findings. Future studies should aim to diversify the expert pool by including participants from more geographic regions and disciplinary backgrounds to further refine the evaluation system. Additionally, although the Delphi method is a widely recognized approach for achieving expert consensus, variations in individual experience, professional background, and disciplinary perspectives may still influence the objectivity of expert judgments. Particular attention should be paid to methodological rigor during interdisciplinary collaboration to minimize bias. Finally, while the index system was designed with both scientific validity and operational feasibility in mind, its applicability across diverse hospital settings requires further validation through a phased implementation approach involving small-scale pilot testing, evaluation, and iterative optimization. Future research should include multi-center and longitudinal studies to comprehensively assess the system's effectiveness and long-term sustainability.

7 Conclusion

This study represents the first application of Lasswell's 5W communication model to the

evaluation of clinical nurses' ability to produce age-friendly health science popularization content. It has developed a comprehensive evaluation index system comprising five first-level indicators, 14 second-level indicators, and 51 third-level indicators. The system demonstrates strong scientific validity, practical applicability, and relevance, thereby extending the utility of the 5W communication model to the field of nursing and health communication. The findings provide a theoretical foundation and practical guidance for science popularization training programs for nurses. Specifically, the study highlights the importance of enhancing nurses' professional image and communication skills, improving the quality and age-appropriate design of health content, and systematically cultivating their competence in utilizing new media platforms and strategic communication. These efforts are expected to significantly enhance the effectiveness and societal impact of age-friendly health science communication.

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- Conflicts of Interest

The authors declare no conflicts of interest.

- Data availability statement

All data generated or analyzed during this study are included in this published article and its supplementary information files.

- Author Contributions

(1) Wang Y: Conceptualization□Methodology□Writing—original draft

- (2) Xu Y: Data curation□Formal analysis□Software
- (3) Guo F: Investigation□Visualization□Validation
- (4)Gao P: Conceptualization□Formal analysis
- (5) Feng X: Methodology□Software□Project administration
- (6) Li Y: Supervision□Data curation□Writing–review & editing
- (7) Cui L: Methodology□Supervision

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Supplementary Files

Figures

Confirmatory Factor Analysis Model.

