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Research on the Construction of an Evaluation Index System for Nursing Quality in Patients with Diabetes Mellitus Complicated by Coronary Heart Disease Based on the Structure-Process-Outcome Three-Dimensional Quality Evaluation Model

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Abstract: *Objective*: To construct an evaluation index system for nursing quality in patients with diabetes mellitus complicated by coronary heart disease based on the structure-process-outcome three-dimensional quality evaluation model. *Methods*: Using Donabedian's three-dimensional quality evaluation model as the theoretical foundation, an initial index system was formed through literature analysis and interviews. The Delphi method was employed to solicit opinions from 24 experts over two rounds of correspondence to screen the indicators. Subsequently, the Analytic Hierarchy Process (AHP) was used to determine the weights of indicators at all levels, establishing an evaluation index system for nursing quality in patients with diabetes mellitus complicated by coronary heart disease. *Results*: The response rates for both rounds of expert correspondence were 100.00%. The expert authority coefficients were 0.873 and 0.892, respectively, with Kendall's coefficients of concordance being 0.231 and 0.318 ($p < 0.05$). The final nursing quality evaluation system comprised 3 primary indicators, 11 secondary indicators, and 32 tertiary indicators. Among the primary indicators, process quality had the highest weight (0.467), followed by structural quality (0.284) and outcome quality (0.249). Within the secondary indicators, blood glucose management and cardiovascular risk management had relatively high weights. *Conclusion*: The constructed evaluation index system for nursing quality in patients with diabetes mellitus complicated by coronary heart disease demonstrates good scientific validity and systematicness, providing a reference basis for evaluating and continuously improving nursing quality in these patients.

Keywords: Diabetes mellitus; Coronary heart disease; Nursing quality; Structure-process-outcome; Index system

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1.Introduction

Diabetes mellitus and coronary heart disease are both prevalent chronic non-communicable diseases in clinical practice today, with a relatively close association in terms of pathogenesis and pathological progression [1]. When patients are in a state of prolonged hyperglycemia, symptoms such as endothelial dysfunction, enhanced oxidative stress, and activated inflammatory responses accelerate atherosclerosis, thereby significantly increasing the risk of coronary heart disease [2]. Previous epidemiological studies have shown that the risk of coronary heart disease in diabetic patients is significantly higher than that in non-diabetic populations, while the proportion of patients with confirmed coronary heart disease who also have abnormal glucose metabolism continues to rise [3,4]. These patients often exhibit characteristics such as significant blood glucose fluctuations, decreased cardiac functional reserve, and multisystem metabolic disorders. The disease progresses insidiously with a high incidence of adverse cardiovascular events, imposing higher demands on clinical treatment and nursing management [5]. Typically, clinical nursing for patients with diabetes mellitus complicated by coronary heart disease is complex, requiring long-term management of blood glucose control and lifestyle interventions. The combined use of multiple treatment regimens, including insulin, antiplatelet drugs, and statins, necessitates regular risk assessments and medication management. Therefore, any inadequate nursing in any aspect may affect the overall treatment outcome [6]. Nursing quality evaluation is an important component of nursing management, and a scientific and objective evaluation index system is the foundation for quantifying nursing quality and achieving continuous improvement. The “structure-process-outcome” three-dimensional quality evaluation model proposed by American scholar Donabedian reflects the quality of medical and nursing services from three perspectives: resource allocation, nursing behaviors, and outcome indicators. This model has been widely applied in nursing quality evaluations across multiple disciplines [7,8]. However, for patients with diabetes mellitus complicated by coronary heart disease, a common chronic disease comorbidity, existing research lacks a specialized nursing quality evaluation index system constructed based on this theoretical framework. Therefore, this study established a nursing quality evaluation index system suitable for patients with diabetes mellitus complicated by coronary heart disease using Donabedian’s structure-process-outcome three-dimensional quality evaluation model as the theoretical framework, providing a scientific basis for objective evaluation and refined management of nursing quality in these patients.

2. Materials and methods

2.1. Study subjects

2.1.1. Interviewed experts

A total of 9 experts from the endocrinology department, cardiovascular department, and nursing management-related fields in our hospital were selected for interviews using purposive sampling from March to April 2024. This included 3 endocrinologists, 2 cardiovascular physicians, 2 nursing administrators, and 2 specialist nurses. The experts’ ages ranged from 32 to 56 years, with an average age of (43.78 ± 7.21) years. Their work experience ranged from 10 to 31 years, with an average of (19.56 ± 6.84) years. Six held associate senior or higher titles, and 3 held intermediate titles.

2.1.2. Inclusion criteria

(1) Possession of medical or nursing practitioner qualifications;
(2) Engagement in clinical diagnosis and treatment, specialist nursing, or nursing management related to diabetes mellitus or coronary heart disease for ≥ 5 years;
(3) Holding an intermediate or higher title;
(4) Informed consent and voluntary participation in this study.

2.1.3. Exclusion criteria

(1) Failure to fully participate in the interviews;
(2) Incomplete interview data.

2.1.4. Correspondence experts

In May 2024, 24 experts from relevant fields were selected for correspondence using the Delphi method, coming from our hospital, six surrounding tertiary hospitals, and one institution of higher education. This included 6 clinical medical experts, 10 nursing management experts, 6 clinical nursing experts, and 2 nursing education experts.

2.1.5. Inclusion criteria

(1) Bachelor's degree or higher;
(2) Intermediate or higher title;
(3) Engagement in work related to endocrinology, cardiovascular disease, nursing management, or clinical nursing for ≥ 8 years;
(4) Familiarity with nursing management content for patients with diabetes mellitus complicated by coronary heart disease;
(5) Voluntary participation in this study and completion of questionnaires on time.

2.1.6. Exclusion criteria

(1) Failure to complete questionnaires within the specified time;
(2) Withdrawal from the study midway.

2.2. Research methods

2.2.1. Drafting evaluation indicators

Based on Donabedian's "structure-process-outcome" three-dimensional quality evaluation model as the theoretical foundation, literature searches were conducted in databases including CNKI, Wanfang Data, VIP Database, and the Chinese Biomedical Literature Database, with the search period extending from database establishment to February 2024. Chinese search terms included "diabetes mellitus", "coronary heart disease", "nursing quality", "evaluation index", "sensitive indicator", "structure-process-outcome", and "Delphi method", while English search terms included "diabetes mellitus", "coronary heart disease", "nursing quality", "evaluation index", "sensitive indicator", "structure-process-outcome", and "Delphi". Relevant guidelines, expert consensus, systematic reviews, evidence summaries, and studies on index system construction were included, while duplicate publications, unavailable full texts, incomplete data, and literature with low relevance to the research topic were excluded. The indicator items, evaluation dimensions,

and indicator expressions in the included literature were summarized and organized. Simultaneously, based on literature analysis, interviews were conducted with 9 experts from relevant fields. The interview content included the core content covered by nursing quality evaluation for patients with diabetes mellitus complicated by coronary heart disease; key aspects of blood glucose management, cardiovascular risk management, and medication management during hospitalization; deficiencies in existing single-disease nursing quality indicators for comorbid patients; and outcome indicators that should be prioritized in nursing outcome evaluation. The interviews were conducted face-to-face by two uniformly trained researchers, lasting 30–45 minutes each. The interview data were transcribed into text within 24 hours, with coding and theme extraction performed separately by two researchers. Consensus was reached through discussion within the research team.

Ultimately, combining literature analysis and interview results, a preliminary evaluation index system for nursing quality in patients with diabetes mellitus complicated by coronary heart disease was established, including 3 primary indicators, 11 secondary indicators, and 35 tertiary indicators. An expert correspondence questionnaire was further drafted.

2.2.2. Expert selection and consultation

Subsequently, the Delphi method was employed to solicit opinions from 24 correspondence experts. The expert consultation questionnaire consisted of three parts: the first part included general information about the experts, such as age, educational background, title, work experience, and professional field; the second part was an indicator scoring table; and the third part was an expert opinion section, which included suggestions for indicator modification, additions or deletions, and indicator classification opinions. The importance of indicators was evaluated using a Likert 5-point scale, with 1–5 points representing “very unimportant”, “unimportant”, “average”, “important” and “very important”, respectively. The expert judgment basis coefficient (Ca) was primarily assigned based on literature review, theoretical analysis, and work experience; the expert familiarity coefficient (Cs) was assigned based on the level of familiarity with the research content. The first round of expert correspondence was conducted in June 2024. After the first round, the research team deleted, merged, modified, or supplemented relevant indicators based on the mean importance, full score rate, coefficient of variation, and written opinions of the experts. The second round of expert correspondence was conducted in July 2024, and the final index system was determined.

The indicator screening criteria were set as follows: mean importance ≥ 3.50, full score rate ≥ 0.20, and coefficient of variation ≤ 0.25. For indicators that did not fully meet the screening criteria but were identified by multiple experts as having significant clinical value, the research team discussed whether to retain them.

2.3. Statistical methods

Data organization and statistical analysis were performed using Excel 2021 and SPSS 26.0 software. Expert enthusiasm was represented by the questionnaire response rate; indicator importance was described using the mean, standard deviation, full score rate, and coefficient of variation; expert authority was represented by the authority coefficient (Cr), calculated as Cr = (Ca + Cs)/2; expert opinion coordination was tested using Kendall’s coefficient of concordance (W), with a higher W value indicating better consistency of expert opinions and $p < 0.05$ representing a statistically significant difference. The Analytic Hierarchy Process (AHP) was used to calculate the weights of indicators at all levels and perform a consistency test. When the consistency ratio (CR) < 0.10, the judgment matrix was considered to have satisfactory consistency, and the

weight results were acceptable.

3. Results

3.1. General information of experts

A total of 24 experts were included in the study for correspondence consultation, among whom 3 held full professor titles (12.50%), 9 held associate professor titles (37.50%), and 12 held intermediate titles (50.00%). In terms of educational background, 1 had a doctoral degree (4.17%), 8 had master's degrees (33.33%), and 15 had bachelor's degrees (62.50%). The experts' ages ranged from 33 to 57 years, with an average age of (44.38 ± 5.94) years. Their work experience in relevant fields ranged from 9 to 30 years, with an average of (18.72 ± 6.15) years.

3.2. Expert enthusiasm, authority, and coordination

In the first round of expert correspondence consultation, 24 questionnaires were distributed and 24 were returned, resulting in an effective response rate of 100.00%. In the second round, 24 questionnaires were distributed and 24 were returned, also yielding an effective response rate of 100.00%.

The expert authority coefficients were 0.873 in the first round and 0.892 in the second round, both exceeding 0.70. The expert judgment basis coefficient (Ca) was 0.89 and the familiarity coefficient (Cs) was 0.86 in the first round; in the second round, they were 0.91 and 0.87, respectively. Meanwhile, in the first round of correspondence consultation, the coordination coefficients for primary, secondary, and tertiary indicators were 0.214, 0.226, and 0.231, respectively. In the second round, they were 0.297, 0.305, and 0.318, respectively, with statistically significant differences ($p < 0.05$).

3.3. Results of indicator screening

The initial indicator system comprised 3 primary indicators, 10 secondary indicators, and 35 tertiary indicators. After the first round of expert correspondence consultation, indicator revisions included: deleting 2 tertiary indicators, merging 3 indicators with similar content, revising 10 indicators with unclear expressions or insufficient operability, and adding 2 new tertiary indicators.

The revised indicator system formed the questionnaire for the second round of correspondence consultation. In the second round, the importance scores for each indicator stabilized, with no further deletions or additions of indicators. The final evaluation indicator system for nursing quality in patients with diabetes mellitus complicated by coronary heart disease was established, including 3 primary indicators, 11 secondary indicators, and 32 tertiary indicators. See **Table 1**.

Table 1. Evaluation indicator system for nursing quality in patients with diabetes mellitus complicated by coronary heart disease

First-level indicator	Second-level indicator	Third-level indicator
Structural quality	Human resource allocation	Specialty nurse staffing rate
		Nurse-to-patient ratio compliance rate
		Specialty training coverage rate
	Professional competence	Diabetes management knowledge test pass rate
		Cardiovascular emergency identification competence rate

First-level indicator	Second-level indicator	Third-level indicator
Process quality	Nursing system and support	Nursing quality management system perfection rate
		Blood glucose management protocol compliance rate
		Medication safety management system implementation rate
	Admission assessment and risk stratification	Blood glucose risk assessment completion rate
		Cardiovascular risk stratification assessment rate
	Blood glucose management and monitoring	Blood glucose monitoring protocol compliance rate
		HbA1c testing implementation rate
		Hypoglycemia identification and management timeliness rate
	Cardiovascular risk management	ECG monitoring protocol compliance rate
		Blood pressure monitoring protocol compliance rate
		Angina Pectoris identification and management timeliness rate
	Medication management	Insulin use protocol compliance rate
		Antiplatelet medication management protocol compliance rate
		Statin medication adherence assessment rate
	Health education and behavioral intervention	Dietary guidance implementation rate
		Exercise intervention implementation rate
		Self-monitoring education compliance rate
	Discharge and follow-up management	Discharge guidance completion rate
		Follow-up implementation rate
Outcome quality	Clinical outcome indicators	Blood glucose target rate
		HbA1c target rate
		Cardiovascular adverse event rate
		Rehospitalization rate
		Hypoglycemia incidence rate
	Behavioral and perceptual outcomes	Medication adherence score
		Self-management ability score
		Patient satisfaction

3.4. Results of indicator weights

Meanwhile, the weights of indicators at all levels were calculated using the Analytic Hierarchy Process (AHP), and the results indicated that all consistency test results for the judgment matrices met the criterion of CR < 0.10. Among the primary indicators, process quality had the highest weight (0.467), followed by structural quality (0.284) and outcome quality (0.249). The weight distribution of secondary indicators is shown in **Table 2**:

Table 2. Weight distribution of secondary indicators

First-level indicator	Second-level indicator	Weight
Structural quality	Human resource allocation	0.102
	Professional competence	0.098

First-level indicator	Second-level indicator	Weight
	System development	0.084
Process quality	Admission assessment and risk stratification	0.080
	Blood glucose management and monitoring	0.121
	Cardiovascular risk management	0.115
	Medication management	0.098
	Health education and behavioral intervention	0.073
	Discharge and follow-up management	0.060
Outcome quality	Clinical outcome indicators	0.143
	Behavioral and perceptual outcomes	0.106

4. Discussion

Patients with diabetes mellitus complicated by coronary heart disease (CHD) often experience a state of impaired vascular endothelial function and persistent activation of inflammatory responses due to the interaction between long-term hyperglycemia and the atherosclerotic process. Patients in this stage are characterized by high volatility and risk in disease progression and adverse cardiovascular events [9]. Faced with this situation, nursing management for these patients must concurrently address glycemic control and cardiovascular risk prevention and control throughout the entire process of assessment, intervention, and follow-up. Constructing an indicator system based on the structure-process-outcome three-dimensional quality evaluation model represents a comprehensive indicator system that integrates three levels: resource allocation, nursing implementation, and outcome evaluation. Its application facilitates the systematic evaluation of nursing quality [10].

The results of this study indicate that process quality holds the highest weight among primary indicators, followed by structural quality and outcome quality. This implies that variations in nursing quality primarily stem from the implementation process of nursing measures. Given that both blood glucose levels and cardiovascular status in patients with diabetes mellitus complicated by CHD exhibit dynamic changes, the effectiveness of nursing interventions depends more on the timeliness of monitoring and the degree of implementation of intervention measures. Additionally, the results show that blood glucose management and cardiovascular risk management have relatively high weights, indicating their central roles in nursing quality. Typically, persistent hyperglycemia can exacerbate vascular endothelial damage and promote plaque formation, while hypoglycemia can induce sympathetic nervous system excitation, increasing the risk of arrhythmias and cardiovascular events. Therefore, maintaining stable blood glucose levels and reducing fluctuations are of great significance for patients' health.

Through the Delphi method, this study screened and revised indicators, achieving a high expert authority coefficient and a gradually increasing coordination coefficient over two rounds, demonstrating good consistency in expert opinions regarding this nursing quality evaluation indicator system. However, it should be noted that the experts consulted in this study were primarily from tertiary medical institutions, and the applicability at the primary care level still requires further validation.

5. Conclusion

In summary, the nursing quality evaluation indicator system for diabetes mellitus complicated by CHD

constructed in this study demonstrates good systematicness and pertinence, providing a reference basis for nursing quality evaluation and continuous improvement.

Disclosure statement

The authors declare no conflict of interest.

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