



Evaluating a KAP-Based 4C Continuous Nursing Intervention on Self-Management and Glycemic Control in Patients with Type 2 Diabetes Mellitus

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Abstract: *Objective: To examine the effects of a 4C continuous nursing model, grounded in the knowledge-attitude-practice (KAP) framework, on glycated hemoglobin (HbA1c), self-management ability, quality of life, chronic disease resource utilization, and compliance behavior in patients with type 2 diabetes mellitus (T2DM). Methods: A total of 119 patients with T2DM admitted to the General Practice Department of Jingxi People's Hospital between January 2024 and March 2025 were enrolled. Participants were assigned to two groups according to nursing method: the control group (n=59) received routine discharge guidance and follow-up, while the intervention group (n=60) received a 6-month 4C continuous nursing intervention based on the KAP theoretical model. Differences in HbA1c, self-management ability, quality of life, chronic disease resource utilization, and compliance behavior were compared between the two groups. Results: At 3 and 6 months post-discharge, the intervention group demonstrated significantly lower HbA1c levels, higher scores in self-management ability, chronic disease resource utilization, and compliance behavior, and a lower quality of life score compared to the control group, with all differences being statistically significant ($P < 0.05$). Conclusion: The KAP theory-based 4C continuous nursing model can effectively improve glycemic control, enhance self-management ability and compliance behavior, promote efficient use of chronic disease resources, and contribute to quality of life in patients with T2DM, offering a valuable nursing strategy for long-term disease management.*

Keywords: Type 2 diabetes, Knowledge-attitude-practice theory, 4C continuous nursing, Blood glucose, Self-management.

1. Introduction

Type 2 diabetes (T2DM) is a common chronic metabolic disease, and its incidence is increasing annually, which seriously affects the quality of life of patients and increases the social medical burden [1]. Studies have shown that the self-management ability of T2DM patients is generally insufficient, the blood glucose control compliance rate is low, and the incidence of complications is high [2-3]. The traditional nursing model has difficulty meeting the long-term and continuous health needs of patients. The knowledge-attitude-practice (KAP) model is a theory of behavioral change that combines knowledge, beliefs and behaviors. By obtaining the information needed by patients and providing targeted knowledge replenishment and belief blessings, the patient's knowledge level can be improved, attitudes and concepts can be changed, and the corresponding behavior can be changed [4]. The 4C continuous

nursing model includes four core elements, namely, comprehensive, coordinated, continuous and collaborative, which can provide patients with full-course nursing services [5-6]. Through systematic health education, 4C continuous nursing based on the KAP theory model can improve patients' disease cognition, enhance their self-management beliefs, and ultimately promote behavioral changes, which is highly important for improving patients' blood glucose control and reducing the risk of complications. Therefore, this study uses 4C continuous nursing based on the KAP theory model for T2DM patients and explores the effects of this model on the blood glucose control level, self-management ability, quality of life, utilization of chronic disease resources and compliance behavior of T2DM patients.

2. Data and Methods

2.1 General Information

A total of 119 patients with T2DM who were hospitalized in the Department of Endocrinology of Jingxi People's Hospital from January 2024 to March 2025 were selected as the research objects. They were grouped according to different nursing methods. Among them, 59 patients in the control group received routine discharge guidance and follow-up care; 60 patients in the intervention group received a 4C continuous nursing intervention based on the KAP theory model for 6 months. This study was approved by the Ethics Committee of Jingxi People's Hospital (approval number: 2023001). In the control group, 37 males and 22 females, aged between 39 and 70 years, with an average age of 57.20 ± 7.36 years, were included; 30 people had junior high school or below, 22 people had high school or technical secondary school, and 7 people had college or above. The course of disease was ≤ 5 years for 22 people and >5 years for 37 people. In the intervention group, there were 36 males and 24 females aged between 38 and 69 years and aged between 38 and 69 years, with an average age of 57.25 ± 7.10 years. There were 24 people with junior high school education or below, 33 people with high school or technical secondary school education, and 3 people with college education or above. The course of disease was ≤ 5 years for 27 people and >5 years for 33 people. The baseline data of the two groups were comparable ($P > 0.05$).

2.2 Inclusion and Exclusion Criteria

2.2.1 Inclusion criteria:

1) Conform to the diagnostic criteria of T2DM [7]. 2) Age between 18 and 70 years. 3) The time of diagnosis of T2DM was more than 6 months. 4) Patients had basic reading, understanding and communication skills. 5) Patients provided informed consent for this study and volunteered to participate.

2.2.2 Exclusion criteria:

1) Patients with severe major organ system diseases or an expected survival period of less than 6 months. 2) Patients with a history of mental illness, cognitive impairment, or severe audio-visual impairment who were unable to complete the research requirements of the behavior and questionnaire survey. 3) Pregnant or lactating women. 4) Patients who had participated in other research projects that may affect blood glucose control or self-management before enrollment. The researcher judged that it was not suitable to participate in this study.

2.3 Intervention Methods

2.3.1 Control group. Routine nursing intervention was performed for 6 months. The contents included the following: (1) patients with T2DM received unified DM health education during hospitalization, including collective teaching, distribution of publicity materials, discharge guidance, etc. (2) After the patient was discharged, the doctor issued a discharge certificate and was informed of the patient's return visit time (once every 3 months). After the patient was discharged from the hospital, the nurse regularly followed up by telephone to understand the patient's current situation and provided education according to the patient's situation. The patient can also consult the department doctor by telephone. The intervention content focused mainly on the popularization of T2DM knowledge.

2.3.2 Intervention group. On the basis of routine nursing, 4C continuous nursing based on the knowledge-attitude-practice theory model was implemented for 6 months.

(1) Connect. Within 24 hours after admission, the patient's disease health records were established, and the patient's diabetes knowledge level, self-management ability, quality of life, and utilization of chronic disease resources were initially evaluated. 2 Before discharge, a personalized discharge plan was developed with the patients and their families to clarify the blood glucose control target and monitoring frequency after discharge, such as fasting blood glucose control at 6.1–7.8 mmol/L, 2-hour post-prandial blood glucose control at 8.0–10.0 mmol/L, and the first week, 4 times a day (fasting + three meals). Stable communication channels with patients and their families should be established, WeChat groups should be established, patients and their families should be invited to join, and patients should be able to easily contact medical staff after discharge. 3 After discharge, patients were followed up by telephone or WeChat video every two times.

(2) Coordination. 1 Hospital coordination. During the hospitalization of patients, multidisciplinary consultations are organized for patients, and multidisciplinary team resources such as medical, nursing, nutritional and rehabilitation resources are coordinated to ensure the consistency and synergy of interventions in various disciplines. 2 Coordination outside the hospital. After the patient is discharged from the hospital, the community doctor or family doctor and the patient's family members are coordinated to form a management synergy to help the patient return visits on time to ensure the continuity of medical services. According to the patient feedback and evaluation results, the management plan should be coordinated and adjusted.

(3) Communicate. 1 Knowledge transfer. On the basis of KAP theory, a variety of educational media (including educational manuals, popular science, and personalized one-on-one guidance) were used to systematically impart T2DM knowledge, covering core content such as disease cognition, diet regulation, exercise prescription, drug treatment, and T2DM complication prevention, and emphasizing the importance of updating disease knowledge in a timely manner with patients. For example, a short video is made, and a two-dimensional code of the promotional video is posted in the ward. The patient can scan and watch the video, including 'how to inject insulin correctly' and 'how to do hypoglycemia'. The food model display area (such as rice or fruit models) is set up in the department for teaching, and the number of 'one copy' is visually displayed. During the hospitalization of the patient, the responsible nurse uses 10–15 minutes to educate and demonstrate the patient every morning to help the patient improve disease knowledge. 2 Belief reinforcement. Through successful clinical case analysis, group interactive discussions and psychological support interventions, patients' positive understanding of disease management was strengthened, and their self-efficacy was improved so that patients could fully realize the clinical benefits of standardized management. 3 Behavior guidance. Patients should be provided with precise and operable behavioral guidance programs, including the development of individualized nutrition plans, the design of scientific exercise programs, the training of blood glucose monitoring techniques and recording methods, and the strengthening of regular medication compliance.

Regular follow-up should be established, a systematic review of behavior implementation should be conducted, and targeted feedback should be provided. For example, the patient's 'food exchange portion' method is taught so that the patient can learn to replace similar food, and the palm rule can also be used for food quantification. The patient was provided with a designed recording form, and the patient was taught to record the monitored blood glucose value. During the follow-up, specific praise was given to the patients where they did well; they did not obtain their position, and the patients were asked to analyze the reasons.

(4) Care. 1 Personalized attention. The nursing team regularly assessed patients' blood glucose control, self-management behavior and life changes. At each follow-up, in addition to asking the patient's blood glucose, it is also necessary to ask, 'Has anything happened at home recently? How is the recent sleep? To provide targeted care and support. 2 Emotional support. Attention should be given to the emotional changes experienced by patients, psychological counseling should be provided, and family members should be encouraged to participate in supporting emotional support. An online/offline patient exchange meeting is organized every month to create an atmosphere of mutual support. 3 Resource links. Patients should be informed and assisted in the use of available chronic disease management resources, such as community health lectures, online support platforms, and medical insurance policies. Patients should be actively informed of the latest medical insurance reimbursement policy, reimbursement process, proportion, etc., such as handling chronic disease cards, and assisting in preparing the required materials. Some comparative disease knowledge public numbers or software should be recommended to patients or their families.

2.4 Evaluation Indicators

The evaluation indices of the patients were collected at the time of admission and 3 and 6 months after discharge.

(1) Glycated hemoglobin (HbA1c).

(2) Self-management behavior. The self-management behavior of patients was evaluated by the Chinese and foreign diabetes self-management behavior scale translated by Wan et al. [8]. The scale has 5 dimensions and 13 items, including diet control and regular exercise, with a total score of 0--91 points. The higher the score is, the stronger the patient's self-management behavior. The Cronbach's coefficient of the scale was 0.88.

(3) Utilization of chronic disease resources. The Chinese version of the chronic disease resource questionnaire translated and revised by Zhong Huiqin et al. [9] was used to evaluate the utilization of chronic disease resources in patients with T2 DM. The questionnaire consists of 6 dimensions and 19 items, including medical team, family and friends, individual coping, etc. A 5-point Likert scale was used, with a total score ranging from 19--95 points. The higher the score is, the greater the resource utilization of T2DM patients. The Cronbach's coefficient of the scale was 0.86.

(4) Quality of life. The quality of life of patients with T2DM was evaluated by the type 2 diabetes quality of life scale [10] from five aspects, namely, psychology, physiology, disease, society and satisfaction, which includes 39 items. The Likert 5-level scoring method was used, with a total score of 39--195 points. The score of the scale was negatively correlated with quality of life. The lower the score is, the greater the quality of life of the patients.

(5) Compliance behavior. The compliance of patients was evaluated according to five aspects: diet, exercise, medicine, reexamination and emotion [11]. Patients can consider 5 items as complete compliance behavior, 2-4 items as partial compliance behavior, 0-1 items as noncompliance behavior, and the proportion of complete + partial compliance behavior = compliance rate of compliance behavior.

2.5 Statistical Methods

SPSS 26.0 statistical software was used for data analysis. Two independent samples t tests, repeated measures analysis of variance and chi-square tests were used for data analysis. $P < 0.05$ was considered statistically significant.

3. Results

3.1 Comparison of Blood Glucose between the Two Groups of Patients

The results revealed that the HbA1c level in the intervention group was significantly lower than that in the control group at 3 months and 6 months after discharge ($P < 0.05$).

Table 1: Comparison of HbA1c between the two groups of patients ($\bar{x} \pm s$)

peer group	Number of cases	Before intervention	Discharge for 3 months	Discharged for 6 months
Control group	59	9.83±2.28	7.93±1.69	8.61±2.89
Intervention group	60	9.90±2.44	7.16±1.81	7.39±1.47
<i>t</i>		-0.161	2.417	2.911
<i>P</i>		0.873	0.017	0.005

Note: $F_{time} = 119.255$, $P = 0.000$; $F_{group} = 3.145$, $P = 0.067$; $F_{interaction} = 8.578$, $P = 0.083$.

3.2 Comparison of Self-management Ability Scores Between the Two Groups of Patients

The results revealed that the self-management ability of the intervention group was greater than that of the control group at 3 months and 6 months after discharge, and the difference was statistically significant ($P < 0.05$).

Table 2: Comparison of self-management ability scores between the two groups of patients ($\bar{x} \pm s$)

peer group	Number of cases	Before intervention	Discharge for 3 months	Discharged for 6 months
Control group	59	55.07±4.43	64.98±4.38	74.73±4.50
Intervention group	60	54.43±4.87	67.03±5.98	79.10±4.66
<i>t</i>		0.744	-2.136	-5.203
<i>P</i>		0.459	0.035	<0.001

Note: $F_{time} = 2844.723$, $P = 0.000$; $F_{group} = 5.541$, $P = 0.020$; $F_{interaction} = 36.336$, $P = 0.000$

3.3 Comparison of Quality of Life Scores Between the Two Groups of Patients

The results revealed that the quality of life scores of the intervention group were significantly lower than those of the control group at 3 months and 6 months after discharge ($P < 0.05$).

Table 3: Comparison of quality of life scores between the two groups of patients ($\bar{x} \pm s$)

peer group	Number of cases	Before intervention	Discharge for 3 months	Discharged for 6 months
Control group	59	60.28±4.22	69.48±5.13	77.58±5.44
Intervention group	60	60.00±3.31	67.31±3.95	74.90±3.79

<i>t</i>	-0.408	-2.593	-3.131
<i>P</i>	0.684	0.011	0.002

Note: $F_{time}=240.49$, $P=0.000$; $F_{group}=5.133$, $P=0.025$; $F_{interaction}=15.396$, $P=0.000$

3.4 Comparison of Chronic Disease Resource Utilization Between the Two Groups of Patients

The results revealed that the scores of chronic disease resource utilization in the intervention group were significantly greater than those in the control group at 3 months and 6 months after discharge ($P < 0.05$).

Table 4: Comparison of chronic disease resource utilization scores between the two groups of patients ($\bar{x} \pm s$)

peer group	Number of cases	Before intervention	Discharge for 3 months	Discharged for 6 months
Control group	59	56.02±4.30	66.59±4.07	74.27±4.20
Intervention group	60	57.30±3.57	69.88±4.83	78.42±5.24
<i>t</i>		-1.770	-4.019	-4.756
<i>P</i>		0.079	<0.001	<0.001

Note: $F_{time}=7640.384$, $P=0.000$; $F_{group}=13.687$, $P=0.020$; $F_{interaction}=42.128$, $P=0.000$

3.5 Comparison of Compliance Behavior between the Two Groups of Patients

The results revealed that the compliance behavior of patients in the intervention group was significantly greater than that of patients in the control group ($P < 0.05$).

Table 5: Comparison of compliance behavior scores between the two groups of patients (n, %)

peer group	Number of cases	Complete compliance behavior	Partial compliance behavior	bad compliance behavior	Compliance rate of compliance behavior (%)
Control group	59	17	29	13	77.97
Intervention group	60	27	28	5	91.67
χ^2					4.349
<i>P</i>					0.037

4. Discussions

4.1 Effect of 4C Continuous Nursing Based on KAP Theory on HbA1c in Patients with T2DM

The results revealed that the level of HbA1c in the intervention group was lower than that in the control group, indicating that 4C continuous nursing based on the KAP theory could effectively promote long-term stable control of blood glucose in patients with T2DM. These findings suggest that clinical medical staff should pay attention to the application value of continuous nursing in T2DM management and help patients realize the process from knowledge acquisition to behavior transformation through systematic and standardized nursing interventions to achieve the goal of long-term blood glucose control.

4.2 Effect of 4C Continuous Nursing Based on KAP Theory on the Self-management Ability of T2DM Patients

The results revealed that the self-management ability of the intervention group was greater than that of the control group, indicating the effectiveness of the 4C continuous nursing model based on KAP theory in improving the self-management of T2DM patients. The intervention group helped patients acquire

scientific knowledge of disease management, strengthened patients' beliefs and confidence in disease management through regular follow-up and feedback, and finally transformed into patients' daily self-management behavior. Although the control group also received routine health education, it was often fragmented and lacked individualization and continuity. The structured, individualized and whole-process support provided by 4C continuous nursing can compensate for the deficiency of routine nursing and promote improvements in patients' self-management ability. A number of studies have confirmed that [12-13], through follow-up, peer support, etc., can improve patients' self-management behaviors, such as diet management, exercise participation, and blood glucose monitoring.

4.3 Effect of 4C Continuous Nursing Based on KAP Theory on the Quality of Life of Patients with T2DM

The results revealed that the quality of life score of the intervention group was lower than that of the control group, which further verified the clinical value of the intervention strategy combining the KAP theory with the 4C model in improving the quality of life of diabetic patients. Previous studies have shown that [14-15] effective diabetes management programs can improve the quality of life of patients. The 4C continuous nursing model based on KAP theory not only focuses on monitoring patients' physiological indicators but also improves the overall quality of life of patients. As a chronic disease, T2DM has a multidimensional negative impact on the quality of life of patients. The 4C continuous nursing model intervenes at multiple levels through its systematic intervention mechanism to optimize the quality of life of patients.

4.4 Effect of 4C Continuous Nursing Based on KAP Theory on the Utilization of Chronic Disease Resources in Patients with T2DM

The results revealed that the score of chronic disease resource utilization in the intervention group was greater than that in the control group, indicating that the 4C continuous nursing model based on KAP theory was helpful in guiding patients to make more rational and effective use of existing chronic disease management resources. T2DM patients need long-term and regular use of various resources for management. However, many patients fail to make full use of these resources because of insufficient knowledge, weak beliefs or behavioral barriers, resulting in poor management. Studies have shown that [16] an effective continuous care model can help patients obtain more levels of social resources and improve the utilization of chronic disease resources. The 4C continuous nursing model directly affects patients' resource utilization behavior through systematic intervention and better realizes the rational allocation of medical resources.

4.5 Effect of 4C Continuous Nursing Based on KAP Theory on the Compliance Behavior of T2DM Patients

Good compliance behavior is the basic guarantee for the effectiveness of diabetes management. The results of this study revealed that the compliance behavior of the intervention group was better than that of the control group, indicating that 4C continuous nursing, according to the KAP theory model, had a positive effect on promoting the compliance behavior of diabetic patients. Studies have shown that [17-18] the use of a 4C continuous nursing model to intervene in patients can improve patients' compliance behavior and treatment compliance. The management of T2DM involves diet control, regular exercise, and regular monitoring of blood glucose. The absence of any link may lead to poor blood glucose control or an increased risk of complications. The goal of the 4C continuous nursing model is to intervene in multiple obstacles to compliance behavior. This continuous and personalized

attention and support can effectively reduce patients' forgetting, slackness and resistance and enhance their internal motivation to adhere to treatment.

In summary, the 4C continuous nursing model based on the KAP theory can improve the blood glucose control status of T2DM patients; improve their self-management ability, quality of life, utilization efficiency of chronic disease resources and compliance behavior; and provide a useful nursing strategy for the long-term management of T2DM patients.

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