

ORIGINAL RESEARCH

The Effect of Intervention Program based on Interaction Model of Client Health Behavior on Patients of Pressure Injury

Xin Guan, BM; Xinyuan Li, BM; Manxia Yue, BM; Yufeng Wang, BM; Wei Zhao, BM; Min Shang, BM

ABSTRACT

Objective • To investigate the effect of the intervention program based on the Interaction Model of Client Health Behavior (IMCHB) in patients with pressure injury (PI).

Methods • The First Affiliated Hospital of Qiqihar Medical University received thirty patients suspected of having pressure injuries from June to December 2022. These patients were selected as the control group. Another thirty patients suspected of having pressure injuries were received by the hospital from January to June 2023 and were selected as the experimental group. The experimental group received a usual care protocol, while the trial group received the IMCHB model intervention for three months. The study compared the knowledge of pressure injuries, quality of life, incidence of pressure injuries, and patient satisfaction of high-risk patients between the two groups.

Results • After the intervention, the PI awareness score of caregivers in the experimental group was (31.90 ± 5.24) . It is higher than the control group (26.37 ± 6.85) . The point of social function, physical function and material function of experimental group were (57.03 ± 5.32) , (33.47 ± 3.52) and (58.53 ± 6.93) . Respectively, it was higher than the experimental group (48.63 ± 4.80) , (27.17 ± 3.04) , (46.13 ± 6.72) . The incidence of high-risk PI in the experimental group was 3.33%. The point of the control group was 26.67%. The total satisfaction of the experimental group was (8.27 ± 0.78) points, higher than the control group (7.30 ± 0.65) . The difference was of statistical significance ($P < .05$).

Conclusion • The intervention program based on IMCHB can significantly improve cognitive ability and thus promote health behavior. (*Altern Ther Health Med.* 2024;30(5):141-147)

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INTRODUCTION

Pressure injury (PI) is a localized injury to the skin and underlying subcutaneous soft tissue, usually in the bone protrusions or in skin contact with medical or other equipment, in the form of intact epidermis with local tissue damage or open ulceration, and can be accompanied by pain.¹ This study emphasizes that stress is a primary factor contributing to PI formation, influenced by factors such as movement, mobility, and sensory perception. In addition, tissue tolerance can also lead to PI occurrence.² Studies have shown that PI is characterized by chronic diseases, high

incidence, long course of disease, and difficult to cure. According to the investigation, PI patients are long-term bedridden and their sensory perception is impaired, resulting in malnutrition and cutaneous blood perfusion disorders. It seriously threatens the life and health of patients and increases their economic burden.³ Therefore, patients with PI need effective care. Routine nursing is often caused by the shortage of knowledge of PI prevention among caregivers, reducing their behavior due to negative emotions from the economic burden can affect the physical and mental health of patients, which is not conducive to improving their quality of life.⁴ The "interaction model of client health behavior" (IMCHB) was proposed by the American nursing specialist Cheryl. Cox based on the health belief pattern, Satchmann model, Anderson and Newman model, self-regulation model. The core is the dynamic interaction between and medical staff and patients. Medical staff can identify the factors affecting patients' health behavior from the perspective of patient characteristics and communication and interaction. Furthermore, the nursing intervention aims to stimulate patients' sense of responsibility and enthusiasm for their own health and enable patients to have maximum decision

control, effectively improving patients' self-efficacy. So as to promote the health behavior of patients.⁵

However, the application of this model has not been seen in PI. Based on this, this study aims to investigate the IMCHB model's intervention efficacy with PI patients, exploring its impact on patients' cognitive abilities and health behaviors.

MATERIALS AND METHOD

General Data

Thirty suspected PI patients admitted in The First Affiliated Hospital of Qiqihar Medical University from June 2022 to December 2022 were selected as the control group, and another 30 suspected PI patients admitted in the hospital from January 2023 to June 2023 were selected as the experimental group. There was no difference in the baseline data comparison between the two groups ($P > 0.05$), as shown in Table 1. The study was approved by the ethics committee of the hospital, and the patients and their family members were informed and signed a letter of consent.

Diagnosis and inclusion criteria

(1) Comply with the diagnostic criteria⁶; (2) In-hospital and out-of-hospital PI patients should be reported by each department to nursing department (3) Pressure ulcer score (Braden)⁷ ≤ 12 ; (4) voluntarily participation in the study.

Exclusion criteria

(1) The patients are prohibited rolling over their body; (2) The patient died during the study; (3) Family abandoned the patient's treatment; (4) Family refused the participation of the experiment.

Nursing Method

Nursing method in the control group: The control group received routine care arrangements, including specifically:

(1) Before admission, all patients were evaluated in the Braden scale, and the family was informed when the score was 12, and signed for archiving.

(2) Patients with different scores are given different care. A. High-risk patients should be given the nursing care as follows: 1. Inform the patient and the family of the risk of PI; 2. Instruct family members to turn over to the patient regularly. To tell the family member to help the patient turn over with a soft pillow. To keep the sheets clean and dry as well as keep the skin clean and moisturizing properly. Cleaning the skin immediately after urinary and fecal incontinence. Avoiding using alkaline soap or detergent. Caregivers require using isolation products to protect the skin from moisture, using high absorption incontinence products, using the low friction coefficient of textiles such as; 3. To meet the nutritional needs of patients. 4. Patient should lie on the bed less than 30- degrees recumbent position and keep the patient's bed as flat as possible and protect the bone protrusion 5. Use high specification foam mattress, induction air mattress, alternating pressure gas mattress or use foam accessories and other preventive accessories, etc. B. Non-

high-risk patients: according to the wound position and wound exudation, the other care is the same as high-risk patients, which should be photographed and recorded.

(3) Patients should be given discharge guidance, and health publicity and education should be finished, such as: measures to prevent PI occurrence. Telling patients how to do home care, change a medical prescription, etc. Subsequently, nursing clinic visits for patients when necessary. In January and March of discharge, use WeChat video follow-up or home visit, observation and record, such as measures to prevent PI, tell patients how to do home care, dressing change, etc. And the patient need to go to the nursing clinic is the problem was not solved at home. The working staff can use WeChat video have a follow-up or home visit with patient after one month or two months after the hospital discharge. The patients' behavior was observed and recorded with the application of WeChat video follow-up or home visit after 1 month or 3 months after discharge

Care methods of the experimental group: The experimental group implemented the intervention program of IMCHB model on the basis of the control group, specifically as follows:

(1) **Establish the IMCHB model medical care team.** The group consists of PI team experts, including 2 PI team experts, 1 bone surgeon, 2 nurses in charge, 3 PI team nurses with an age of more than 5 years and 1 nursing undergraduate intern. Experts should have a great wealth of PI clinical experience, good organizational skills and interpersonal communication skills. Before the intervention, the wound and stoma experts provided systematic training to the medical team, so that the team members could master the content of the IMCHB model, PI treatment and care, prevention of home PI caregivers PI, skin care precautions, etc. Members can participate in this study after passing the theoretical knowledge and case simulation assessment.

(2) **Assess patients' characteristics.** Investigators and responsible nurses consult the clinical case data of patients to understand the age, educational background, personal history, patient awareness, current treatment, the family situation and the payment method. They actively interact with patients and/or caregivers, emotional status, social support, knowledge of caregivers' disease, previous health education, and the demand for the next interaction. Developing the interactive plan of the research process according to its uniqueness.

(3) **Health information guidance.** 1) Issue PI brochure. The brochure is compiled by the PI team based on the IMCHB model as well as the research purpose and content. The content of the manual is easy to acquire, including the definition of PI, incidence, mechanism, etiology and health guidance, and illustrate with pictures, so that patients can better understand the necessity of PI prevention. Therefore, the intrinsic motivation of patients and caregivers to increase disease- risk awareness and change behavior would be stimulated. 2) Personalized knowledge counseling: The researchers presented videos about the theory of turning over, skin care and wound healing. The fundamental nurse of the department will explain and introduce the relevant knowledge to the patients and/or caregivers in combination with the contents of the PI brochure.

In order to make patients to master the essentials of nursing as soon as feasible, the primary nurse is supposed to assess patient skin, nutritional status, the risk of PI occurrence and health needs and to give patients and change the dressing presentation, and ask caregivers to present a simulation of topical application of drug. 3) PI knowledge lecture: The lectures will be held within 1 month or within 2 or 3 months after intervention, each time lasting 60-90 minutes, in the form of combining teaching and interaction. Promoting the extended learning of patients' knowledge related to PI, providing patients with home care skills, encouraging patients and/or caregivers to face the disease bravely, strengthen their belief in PI rehabilitation, and enhance the self-efficacy of PI. 4) Online education: researchers upload PI relevant knowledge in PPT or video through WeChat group, so that patients and/or caregivers can repeat reading and learning. Relevant links of PI successful PI cases are often presented to stimulate them to change their psychology, make patients establish confidence in self-management, and improve their enthusiasm for knowledge learning and active participation in treatment.

(4) **Professional skills support.** Team members develop individualized skills training plans based on patients' conditions. 1) One-to-one guidance and demonstration for changing the medical prescription of PI wound according to the moist healing theory. Meanwhile, illustrating the key point of moist healing and the usage of surgical dressings. 2) To guide the patients and their families to master the relevant knowledge of PI prevention, including determining the time of repositioning and the observation points of the skin according to the skin compression. 3) To Guide the patients and their families to record the wound diary, guide the wound photo taking, record the replacement date, interval time, experience and the problems encountered in skill training. The group members require helping the patients to analyze the reasons, and jointly formulate measures to deal with the problems. Adjusting the treatment plan timely according to the actual situation to ensure the rationalization of the use of topical application of drug. To recognize and praise those patients who implement the competence training plan carefully. And the health care provider need to inform the patients and caregivers that when the skin changes, seek medical treatment if the wound did not get well for two weeks. Or the patients can consult team members, avoiding blindly deal with it by the patient themselves. The team conducted a skin examination once a month to evaluate the effect of short-term intervention, and timely corrected the patients' insufficient skills to ensure the effectiveness of PI care.

(5) **Emotional support.** Team members closely observe the patients' emotional reactions during the interaction, and evaluate the psychological state of the patients and their caregivers, and timely give corresponding emotional support based on their uniqueness. 1) Team members can instruct patients with a one-on-one mental relaxation method, and encourage patients and caregivers to keep in a good mood for the day. 2) Encourage patients to express their emotions, speak out their inner worries, confusion and needs, and actively help patients to analyze specific reasons and adjust their mentality. When patients and

caregivers worry about the disease prognosis or show a negative attitude, team members can tell them the disease-related knowledge, the current clinical treatment level and its own condition and outcome. Meanwhile, team members can emphasize the importance of positive attitude and the necessity of health recovery, encourage families to work together to alleviate the bad mood, help patients to eliminate bad psychological state, actively face the disease. 3) Hold the rehabilitation exchange meeting. The team members invite patient caregivers with good self-management behavior to share their experience. Thus, to enhance the sense of benefit from home management and the rehabilitation confidence of patients and caregivers. For older patients with poor learning ability, the treatment effect of patients should be fully affirmed, and step-by-step theoretical knowledge and skill guidance should be adopted to encourage patients and caregivers to persist, so as to reduce the powerlessness and anxiety of patients and caregivers.

(6) **The decision making control.** Team members give correct guidance and suggestions to patients, enable each patient caregiver correctly identifies their own skin-related problems in interactive communication with patients. Besides, encourage patients to actively participate in the PI plan, and jointly formulate the goal of home PI. Patients are supposed to send the wound diary to the team every week to jointly evaluate the patient's behavior goals and plan completion. Moreover, affirming and praising the patients with high completion and caregivers. During the communication, team members ask the reasons for the patients with low completion, timely help them to remove the barriers of behavior change, and timely adjust the goals of the next stage.

(7) **Follow-up.** 1) Telephone follow-up: It can be completed by the investigator and the responsible nurse within one week after the lecture. Researchers and nurses need to understand patients' acquirement of disease-related knowledge and professional skills so as to urge patients and (or) caregivers to actively implement self-management plan. In addition, they need to listen to the question of patients and (or) caregivers about PI and answer various questions of patients and propose targeted and focused suggestions. Evaluating the patients' current emotional response and providing the individualized emotional support is indispensable. The team members would guide patients to relieve emotions and release inner pressure through music therapy. The routine telephone WeChat video between the caregivers and patients would be connected once a month. Nevertheless, the number of telephone interactions of individual patients can be increased according to the actual situation of patients' skill mastery, mood fluctuations and compliance. 2) WeChat follow-up: Team members check the PI wound diary every week. Firstly, understanding the implementation of self-management plans for patients and/or caregivers. If the patient is not found to record or upload a diary, team members will send a message of inquiry by WeChat or have a call with patients once a week. The team members would present knowledge of PI disease to WeChat group regularly. Secondly, the timely summary of the patients during telephone follow-up. Then they transmit the relevant

knowledge relatively. Helping patients to solve problems. Patients can exchange their experience online through the WeChat group. Otherwise, the patients can consult team members about problems they still have. The group members then respond positively and answer the patients' questions in time. It is beneficial to improve the enthusiasm of patients in injury management under home pressure.

Observational indicators

Caregiver awareness of the PI: The caregivers' awareness of PI was assessed through the questionnaire prepared by research group experts, including the knowledge of PI prevention, treatment and nursing, with a total of 0 to 45 points, and the higher the score, the higher the cognition.

Life ability of patients: The quality of patients' lives can be assessed by the table of Generic Quality of Life Inventory-74 (GQOLI-74). Three dimensions of social function, body function and material function were selected, and the total score was total 0 to100 points. The higher the score, the higher the quality.

The incidence of high-risk PI: Post-intervention Braden scores were recorded in 2 groups, if the score is lower or equal to12 points, it will mean that the recurrence of high-risk PI. The incidence of high-risk PI=The number of people with PI/Total high-risk number×100%.

Satisfaction of patient: Patient satisfaction was assessed by the CST questionnaire,⁹ including service accessibility, emotional support, decision control, health information, professional skills, and overall satisfaction. Each full score is 2 to 10 points. Subsequently, the higher the score, the higher the satisfaction.

Statistical analysis

Data were processed in Statistic Package for Social Science (SPSS) 26.0 (IBM, Armonk, NY, USA). Measurement data were tested by Shapiro-Wilk normal test. Measurement data consistent with normal distribution marked as " $\bar{x} \pm s$ ". Within-group comparisons were performed as paired sample *t* test. The data were counted using n (%). The χ^2 test was used. Rank data were tested with rank sum test. When *P* < .05, is considered to be statistically significant differences.

RESULTS

General information

There was no difference in the baseline data comparison between the 2 groups, (*P* > .05) which was presented in table 1

Caregiver awareness of the PI

After intervention, the awareness level of both groups was improved, and the experimental group was better (*P* < .05). The data were in Table 2 and Figure 1.

Living ability of the patients

After the intervention, the social, physical and physical functions were improved in the two groups, and more significantly in the experimental group (*P* < .05). Look at Table 3 and Figure 2.

Table 1. Baseline data comparison [$\bar{x} \pm s$, n (%)]

Group	experimental group (n=30)	control group (n=30)	Inspection value	P value	
Age (years old)	70.80±7.74	71.13±8.07	<i>t</i> =0.162	.872	
Gender(male/female)	18/12	16/14	$\chi^2=0.272$.602	
Body mass index (Kg/m ²)	21.19±3.17	20.86±3.20	<i>t</i> =0.401	.690	
Degree of education	Primary school and below	12(40.00%)	13(43.33%)	<i>Z</i> =0.346	.729
	Middle school	13(43.33%)	13(43.33%)		
	Bachelor School and above	5(16.67%)	4(13.33%)		
Marital status	No spouse	4(13.33%)	5(16.67%)	$\chi^2=0.359$.720
	Have Spouse	26(86.67%)	25(83.33%)		
Mode of payment	Medical insurance payment	27(90.00%)	28(93.33%)	$\chi^2=0.463$.643
	At one's own expense	3(3.00%)	2(6.67%)		

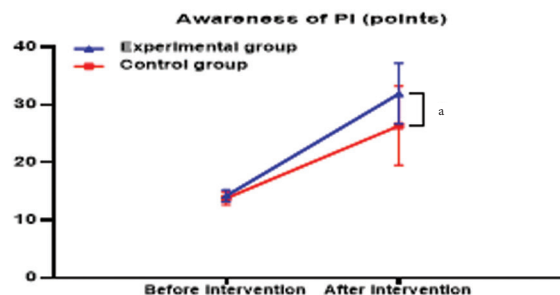
Table 2. Caregiver awareness of the PI ($\bar{x} \pm s$, points)

Group	Experimental group (n=30)	Control group (n=30)	<i>t</i>	P value	
PI awareness situation	Before the intervention	14.23±1.04	13.80±1.10	1.556	.125
	After the intervention	31.90±5.24 ^{a,b}	26.37±6.85 ^b	3.512	.001
	<i>t</i>	17.325	10.228	-	-
	P value	.000	.000	-	-

^aCompared with the control group, *P* < .05

^bContrast with pre-intervention, *P* < .05

Figure 1. Knowledge of PI among caregivers in both groups



^a*P* < .01

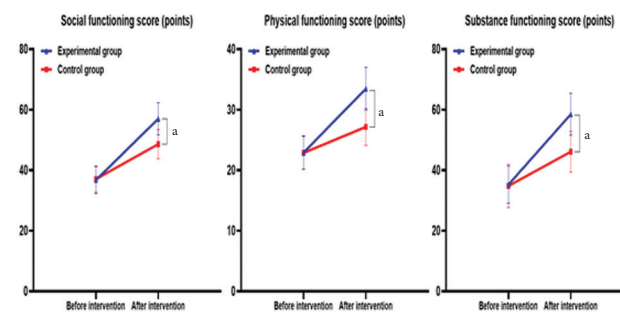
Table 3. Comparison of patients' living ability ($\bar{x} \pm s$, points)

group	Experimental group (n=30)	Control group (n=30)	<i>t</i>	P value	
Social function	Before the intervention	36.77±4.51	37.13±4.36	0.314	.754
	After the intervention	57.03±5.32 ^{a,b}	48.63±4.80 ^a	6.421	.000
Somatic function	Before the intervention	22.93±2.75	22.87±2.69	0.085	.932
	After the intervention	33.47±3.52 ^{a,b}	27.17±3.04 ^a	7.419	.000
Material function	Before the intervention	35.27±6.13	34.83±7.10	0.257	.798
	After the intervention	58.53±6.93 ^{a,b}	46.13±6.72 ^a	7.036	.000

^aCompared with that before the intervention, *P* < .05

^bCompared with the control group, *P* < .05.

Figure 2. Comparison of patients' living ability between the two groups



^a*P* < .001

The incidence of high-risk PI

After the intervention, the incidence of high-risk PI was lower in the experimental group ($P < .05$). Look at Table 4 and Figure 3.

The satisfaction of patients

After the intervention, the experimental group exhibited higher overall satisfaction the overall satisfaction rate in the experimental group was higher ($P < .05$). Look at Table 5 and Figure 4.

DISCUSSION

According to the survey, PI of patients is mostly seen in the elderly, long-term bedridden or people with long-term pressure in a certain place, the incidence of PI in individuals not receiving home treatment is as high as 50%, and it shows an increasing trend. It not only brings great pain to patients, but also increases the care burden of patients' families.^{10,11} At present, the prevention and management of PI have been gradually improved. However, from a global perspective, the incidence of PI has not significantly decreased compared with the past. In recent years, with the further deepening of PI related research, it is basically agreed that most PI can be prevented through effective nursing interventions and measures.¹² IMCHB model mainly includes patient uniqueness, the interaction between patients and medical staff and health outcome three main elements, expounds the patient uniqueness and patient and staff interaction on health behavior and the relationship between health outcomes. The main idea of this model is to promote the health outcomes of patients by stimulating their health responsibilities, emphasizing the positive role of the dynamic interaction between patients and medical staff in the formation and promotion of health behaviors.¹³ However, there is no detailed report of this model applied in PI. International studies use the IMCHB model to guide patients with mental illness in home drug management, not only to meet the needs of patients for drug-related knowledge, but also pay attention to their emotional response in treatment, encourage patients to actively participate in disease management. It effectively improves medication compliance, reduces the corresponding symptoms of the disease, and improves the quality of life.¹⁴ Chinese scholars have also applied the IMCHB model to the field of chronic diseases such as diabetes, coronary heart disease, female puerperia period management and AIDS. It emphasized stimulating patient's responsibilities, motivating patients to participate in disease or health management, and promoting positive health outcomes.¹⁵ Based on this, the IMCHB model has a clear theoretical framework so far.

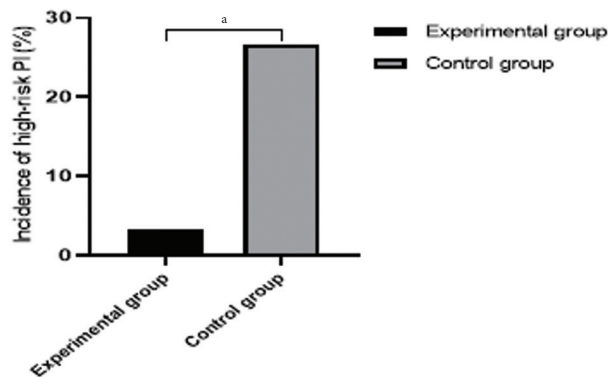
This observation showed that the test group had a higher level of PI cognition after the intervention. The PI awareness score was (31.90 ± 5.24) , higher than the control group (26.37 ± 6.85) . The intervention method under the IMCHB model broke the single mission form of routine care management by analyzing these reasons. This model includes face-to-face guidance, multimedia education, such as

Table 4. The incidence of high-risk PI [n (%)]

Group	Experimental group (n=30)	Control group (n=30)	χ^2	P value
High-risk PI occurrence	1(3.33%) ^a	8(26.67%)	4.706	.030

^a $P < .05$ versus the control group

Figure 3. Comparison of the incidence of high-risk PI in the two groups

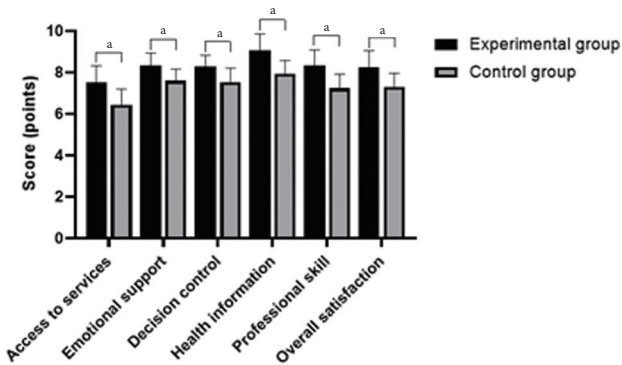


^a $P < .05$

Table 5. Comparison of Patient satisfaction ($\bar{x} \pm s$, Example)

Group	Experimental group (n=30)	Control group (n=30)	t	P value
Service accessibility	7.50±0.82	6.43±0.77	5.210	.000
Emotional support	8.33±0.61	7.60±0.56	4.829	.000
Decision making control	8.30±0.54	7.53±0.68	4.857	.000
Health information	9.07±0.78	7.93±0.64	6.189	.000
Specialized skill	8.33±0.76	7.23±0.68	5.908	.000
Overall satisfaction	8.27±0.78	7.30±0.65	5.233	.000

Figure 4. Comparison of patient satisfaction in the two groups



^a $P < .001$

illustrating PI complications, watching a great number of PI videos and pictures. It not only can better meet the needs of different levels of patients and caregivers' demand for health knowledge as well as reduce the impact of poor health knowledge mastery on nursing quality and rehabilitation effect, but also can strengthen the caregivers' cognition of the severity of PI, enhance the vigilance of PI risk, fully understand the relevant knowledge about PI. At the same time, it can promote the caregivers' awareness of the importance of correct care behavior, so as to reduces the

occurrence of PI.⁴ This study found that the quality of life was higher in the experimental group after the intervention. The social function, physical function and substance function scores were (57.03±5.32), (33.47±3.52) and (58.53±6.93), which were higher than the control group (48.63±4.80), (27.17±3.04) and (46.13±6.72).

The reasons are as follows, under the IMCHB model, first of all, caregivers can master the correct nursing skills, correctly turn over patients and help patients with physical activities. They also assist patients with bedside activities, etc. Nurses and family members will also listen to their patients' concerns and anxieties. There is one more point, with the establishment of the WeChat platform and the return visit of the outpatient service, patients can get more social support and emotional needs, and to some extent can reduce the pain caused by the wound to the body. It is helpful for patients to establish the correct treatment effect objective and gradually improve their quality of life.¹⁶ In addition, the intervention methods of the experimental group were more multidisciplinary. Researchers not only guided and corrected level of PI care for their caregivers, but also help the caregivers learn and master the PI care during their hospitalization. Different types of wound dressings will be selected according to the different wound of patients, and the dressing will be changed irregularly. Caregivers will be required to pay attention to the dressing process to understand the relevant matters needing attention. At the same time, nursing staff in the hospital will change the diet through the wound record diary accordingly, pay attention to the patient's emotional state, and give timely psychological counseling. For example, measures like peer education and the introduction of successful cases would be taken to increase the confidence of patients to continue the treatment. It aims at ensuring a considerable prognosis with the help of patients with the wound recovery in all aspects.¹⁷

Furthermore, the current study also recorded the incidence of high-risk PI in 2 groups, the results showed that the incidence in the experimental group was 3.33%, which was lower than 26.67%, which showed that the incidence was lower in the experimental group. The reason is that patients can quickly master the correct nursing methods for the intervention method under the IMCHB model can develop a personalized care plan for the different care demand of patients, and inform the caregivers of the program content in a simple and understandable form. Meanwhile, the patient's condition change was recorded in detail with the assistance of the researcher so as to facilitate researchers to timely update relevant nursing measures, help patients recover faster and reduce the incidence of high-risk PI in patients.¹⁸

Finally, this study also discussed the satisfaction of 2 groups, where the overall satisfaction was higher in the experimental group. The overall satisfaction score of the experimental group was (8.27±0.78), which was higher than that of the control group (7.30±0.65). Because the intervention method under IMCHB model can give patients and their families a high sense of security. The collaboration of

researchers, the practical ability and PI prevention knowledge level of caregivers can be significantly improved. It is helpful to improve the overall quality of care and it will be of significance for patients to change their thinking and form healthy behaviors and then improve their compliance, and promote rehabilitation. Therefore, patients' demands and needs can be met in time, so patient satisfaction is high.¹⁹

In addition, this study has some limitations, such as the small sample size and limited to one hospital. At the same time, due to time, manpower and other reasons, the intervention time is relatively short, and the sample size can be expanded in the later stage, the intervention time can be increased, and the patient follow-up time can be extended, so as to further verify the effectiveness of this model in PI patients.

In conclusion, the intervention program based on the IMCHB model can improve the cognitive ability of PCI patients and promote the change of their health behavior. It is helpful for them to improve the awareness of PI among caregivers and the quality of life of patients. Meanwhile, the PI improvement rate is increased, too. For they have a low high-risk PI rate and increase patients' satisfaction with this model. Moreover, it has a low high-risk PI rate, so patients are more satisfied with this model. In the future, it is conceivable to incorporate various stage-specific pressure-related losses and additional biochemical markers into research endeavors, aiming to advance the stratified diagnosis and treatment. Furthermore, integrating nursing and medical practices, advocating for the application of the IMCHB model in the management and reference of a broader spectrum of patients with chronic wounds, could be considered.

ETHICAL COMPLIANCE

This study was approved by the ethics committee of The First Affiliated Hospital of Qiqihar Medical University. Signed written informed consents were obtained from the patients and/or guardians.

CONFLICT OF INTEREST

The authors have no potential conflicts of interest to report relevant to this article.

AUTHOR CONTRIBUTIONS

MS and XG designed the study and performed the experiments, XL and MY collected the data, YW and WZ analyzed the data, MS and XG prepared the manuscript. All authors read and approved the final manuscript.

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