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Application and Effect Evaluation of the Integrated "5A and 3+3" Management Model in the Safe Medication Use for Chemotherapy Patients

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Abstract: *Objective:* To explore the application and effect evaluation of the integrated "5A and 3+3" management model in ensuring safe medication use for chemotherapy patients. *Methods:* A total of 100 intravenous chemotherapy patients admitted to the oncology department of Shaanxi Provincial People's Hospital were randomly divided into two groups using a random number list method. Both groups received conventional nursing management during chemotherapy, while the study group additionally received the integrated "5A and 3+3" safety management model. The nursing intervention effects between the two groups were compared. *Results:* After the intervention, the study group showed higher levels of self-management ability, compliance, and nursing satisfaction compared to the control group. The overall incidence of adverse events during hospitalization was lower in the study group, with statistically significant differences ($P < 0.05$). The knowledge scores of medical staff in the study group, related to the prevention and treatment of chemotherapy drug side effects, daily symptom management, and daily life management, were higher than those in the control group, with statistically significant differences ($P < 0.05$). *Conclusion:* Implementing the integrated "5A and 3+3" model in the safe medication management of intravenous chemotherapy patients can effectively enhance patients' self-management abilities and compliance, improve medical staff's ability to safely administer chemotherapy drugs, reduce adverse events caused by chemotherapy, and increase patient satisfaction.

Keywords: Intravenous chemotherapy; Safe medication; Adverse drug reactions; "5A" management; "3+3" management

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1. Introduction

Intravenous chemotherapy benefits a significant portion of cancer patients, but this treatment can also lead to adverse events such as drug extravasation and phlebitis [1], reducing patients' quality of life and impacting

treatment plans [2]. As safe medication is the foundation of medical safety, ensuring the safety of chemotherapy drug administration for cancer patients to minimize adverse events and related medical and nursing costs has become a key research focus for oncology nursing staff. Although clinical efforts, such as developing chemotherapy drug guidelines, enhancing staff training, and optimizing intravenous chemotherapy procedures, have shown some success in reducing adverse reactions [3-5], the long duration of chemotherapy treatment means that a systematic, evidence-based safe medication management model covering the entire pre-, intra-, and post-chemotherapy process is lacking. This leads to an inability to fully prevent adverse events like drug extravasation. Drug factors and improper nursing practices are the main contributors to adverse reactions in intravenous chemotherapy. Therefore, performing "three checks" before, during, and after drug preparation, dispensing, and administration, and "three observations" for up to three days post-infusion to monitor the puncture site, can help prevent and reduce adverse events during chemotherapy. However, due to heavy workloads and the lack of standardized procedures and management models, these "three checks" and "three observations" are often superficial, affecting the quality of nursing care.

The "5A" nursing model is a standardized nursing approach that emphasizes individual professional competence and nursing skills, implements nursing management protocols, and enhances the quality of nursing management. When applied to chemotherapy nursing services, it can effectively alleviate cancer-related fatigue and prevent and control complications [6]. To address the inconsistency and lack of standardization in adverse reaction prevention and management for intravenous chemotherapy, our research group integrated the conventional "three checks" and "three observations" into the "5A" nursing management model, creating an integrated "5A and 3+3" intravenous chemotherapy safety management model. This model was applied to the safe medication management of intravenous chemotherapy patients.

2. Materials and methods

2.1. General information

A total of 100 patients who received intravenous chemotherapy in the oncology department of Shaanxi Provincial People's Hospital from December 2021 to December 2023 were included in this study. The inclusion criteria were as follows: confirmed diagnosis of malignant tumors; good general condition with an Eastern Cooperative Oncology Group (ECOG) score [7] of 1–2; complete clinical data; normal intellectual and mental status with the ability to communicate; good compliance; voluntary participation in the study with signed informed consent. The exclusion criteria were: coexisting coagulation disorders or hemorrhagic diseases; coexisting hematological or immune system diseases; major diseases of the heart, brain, liver, kidneys, or other organs; local skin lesions or other injuries; history of drug allergies; pregnant or lactating women.

The patients were randomly divided into two groups (n = 50 per group) using a random number list method. In the control group, there were 22 males and 28 females, aged 46 to 77 years (mean 61.46 ± 7.60 years); 4 patients were overweight/obese; 7 had diabetes. Tumor types included colorectal cancer (13 cases), gastric cancer (8 cases), liver cancer (5 cases), esophageal cancer (3 cases), lung cancer (15 cases), and breast cancer (6 cases). In the study group, there were 25 males and 25 females, aged 48 to 79 years (mean 63.18 ± 7.41 years); 6 patients were overweight/obese; 5 had diabetes. Tumor types included colorectal cancer (11 cases), gastric cancer (10 cases), liver cancer (4 cases), esophageal cancer (2 cases), lung cancer (15 cases), and breast cancer (8 cases). There were no statistically significant differences in the distribution of these data between the

two groups ($P > 0.05$). The study adhered to the ethical standards of Shaanxi Provincial People's Hospital.

2.2. Research methods

2.2.1. Control group

Patients in the control group received routine nursing management during chemotherapy:

(1) Family members were encouraged to pay attention to the patient's psychological changes, communicate more with the patients, offer love and encouragement, and help patients build confidence and courage to overcome the disease, while also assisting with daily living activities.

(2) Patients' temperature, blood pressure, and pulse were measured and recorded daily. If the temperature exceeded 37.5°C, physical cooling measures were implemented. Body weight was measured once a week to monitor physical changes and adjust the dosage of chemotherapy drugs accordingly.

(3) During chemotherapy, nurses observed patients for toxic reactions such as fever, vomiting, nausea, rash, allergies, and bleeding. Any such occurrences were immediately reported to the attending physician for timely intervention. Patients were reminded to drink 2–3 liters of water per day to accelerate the excretion of toxins produced by chemotherapy. Before and after chemotherapy, patients and their families were reminded to maintain oral hygiene by rinsing after meals and using a soft-bristle toothbrush to prevent oral ulcers and infections.

(4) Patients were guided on proper dietary habits, such as eating light, easily digestible foods in small, frequent meals. The diet was adjusted within available resources to stimulate appetite, with an emphasis on high-protein foods and those rich in vitamins and fiber to ensure nutrition and prevent constipation.

2.2.2. Study group

On the basis of routine nursing management, patients in the study group received integrated "5A" and "3+3" chemotherapy-safe medication management nursing interventions. The specific measures were as follows:

(1) Formation of a medication safety management team: The team was led by the head nurse and department director and included 2 attending physicians (with senior titles), 2 charge nurses (with senior titles), 1 laboratory doctor, 1 nutritionist, 1 psychological counselor, and 1 rehabilitation therapist.

(2) Literature review: Team members conducted a literature review using the hospital information management system, nursing management system, and smart nursing system to retrospectively analyze adverse chemotherapy drug events in the department over the past three years (from September 2018 to September 2021). They discussed, analyzed, and summarized the types of adverse drug events:

(a) High-risk events: drug allergies, falls/bed falls, chemotherapy drug extravasation;

(b) High-risk periods: allergic reactions during chemotherapy and drug extravasation during intravenous catheterization;

(c) High-risk populations: people with allergic constitutions, elderly patients, those with multiple comorbidities, those without family support, those with low education levels, and those with poor social support;

(d) High-risk drugs: cisplatin, paclitaxel, oxaliplatin, doxorubicin, fluorouracil, etc.

(3) Health education:

(a) Staff training: Monthly safety management training sessions were held for healthcare staff using morning classes, case analysis, simulation exercises, etc., covering safety management protocols,

procedures, emergency plans, and risk assessment tools. Based on the characteristics of oncology chemotherapy, high-risk emergency scripts were developed, and emergency drills were conducted. Staff competency was assessed after training through written exams and practical exercises, with only those scoring above 85% allowed to participate in care.

(b) Patients and families: Health education was provided to patients and families using brochures, videos, and live demonstrations. Patients and families were invited to participate in the safety management process.

(c) Cleaning staff: Quarterly fall prevention management training was provided to cleaning staff, with case studies highlighting preventive measures.

(4) Implementation of the integrated "5A and 3+3" management model:

(a) Ask stage: When patients sought treatment, attending physicians assessed their condition. Those eligible for chemotherapy hospitalization were issued admission certificates and bed reservations. One day before admission, patients or their families were notified to prepare for hospitalization, and the primary nurse contacted patients to inquire about their general condition and reminded them to bring necessary items and documents.

(b) Assess stage: Upon admission, the charge nurse introduced themselves, confirmed patient information, explained the ward environment, and inquired about medical history, allergies, medications, and tube conditions. The nurse and attending physician then collaborated on a comprehensive medical-nursing evaluation.

(c) Advice + "Three Checks" stage:

(i) The 1st check was when the attending physician issued chemotherapy orders based on the patient's condition. The primary nurse and medication nurse verified the treatment sheet before preparing the drugs.

(ii) The 2nd check involved the charge nurse and attending physician verifying the treatment sheet before administering the medication.

(iii) The 3rd check involved the charge nurse and medication nurse verifying the treatment sheet and drug preparation before administering the medication. During medication administration, drugs for gastric protection, acid suppression, and antiemetics were administered first, followed by chemotherapy drugs after confirming no leakage. The nurse closely monitored the puncture site and informed the patient or family about the drug's effects, possible adverse reactions, and the risks of extravasation, while advising on the proper use of chemotherapy pumps.

(d) Assist + "Three Observations" stage: During chemotherapy drug infusion, nurses performed frequent rounds to monitor infusion conditions, ensuring proper restraint for restless patients, and placing essential items like call bells within easy reach. Patients were assisted with comfortable positioning, toileting, water, and warmth. Nurses also provided psychological support and behavioral guidance. After chemotherapy, skin conditions at the puncture site and chemotherapy-related adverse reactions such as delayed responses, gastrointestinal symptoms, and general fatigue were observed for three consecutive days.

(e) Attend stage: Post-discharge, follow-up was conducted within 24 hours via WeChat, phone, or text to inquire about adverse reactions, puncture site conditions, and catheter status. Further follow-ups were conducted weekly or adjusted based on the patient's condition to ensure home safety.

2.3. Observation indicators

(1) Before and after nursing interventions, the patients' self-management abilities were assessed using the Cancer Behavior Inventory scale brief (CBI-B) (Cronbach's α = 0.959) [8], evaluating four dimensions (maintaining independence and a positive attitude, emotional care, stress management, and involvement in medical care) with a total of 14 items scored on a 9-point scale (total score 14-126 points), with higher scores indicating better self-management.

(2) The medical staff's knowledge of chemotherapy drug safety was assessed using a self-designed "Chemotherapy Drug Safety Prevention Knowledge Questionnaire," covering adverse reaction prevention and treatment (60 questions), daily symptom management (10 questions), and daily life management (10 questions). Each correct answer was scored 2 points (total score: 140 points), with a Cronbach's α of 0.869.

(3) Patient compliance was assessed during chemotherapy: adherence to treatment and care plans with active cooperation = good compliance; occasional non-adherence = moderate compliance; resistance to treatment and care plans = poor compliance [9].

(4) The incidence of adverse reactions such as drug extravasation, phlebitis, and deep vein thrombosis was recorded.

(5) Patient satisfaction was evaluated using a standardized hospital satisfaction questionnaire, covering hardware conditions, staff service attitude, health education, and subjective feelings (14 items). Scores of 100 = very satisfied, 80–99 = satisfied, 50–79 = moderately satisfied, < 50 = unsatisfied.

2.4. Statistical analysis

A database was created using Epidata 3.0 with double data entry. Statistical analysis was performed using SPSS 22.0. Descriptive statistics (mean ± standard deviation), frequency, and composition ratio were used to describe general data and evaluation indicators. Chi-squared tests, Wilcoxon rank-sum tests, and *t*-tests were used to analyze variables. A *P*-value of < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of self-management ability scores between the two groups

As shown in **Table 1**, before the intervention, there was no statistically significant difference in the self-management ability scores between the two groups ($P > 0.05$). After the intervention, the self-management ability scores of both groups improved, and the scores in the study group were higher than those in the control group. The differences were statistically significant ($P < 0.05$).

Table 1. Comparison of self-management ability scores between the two groups (mean ± SD, points)

Groups	Pre-intervention	Post-intervention	*t*	*P*
Control group (*n* = 50)	82.18 ± 6.09	90.52 ± 5.81	8.613	< 0.001
Study group (*n* = 50)	80.50 ± 6.90	98.42 ± 6.93	15.942	< 0.001
t	1.291	6.176		
P	0.200	< 0.001		

3.2. Comparison of knowledge mastery regarding chemotherapy drug safety prevention among medical staff between the two groups

Before the intervention, there was no statistically significant difference in the scores for knowledge mastery in various aspects between the two groups of medical staff ($P > 0.05$). After the intervention, the knowledge mastery scores of medical staff in both groups improved, and the scores in the study group were higher than those in the control group. The differences were statistically significant ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of knowledge mastery regarding chemotherapy drug safety prevention among medical staff between the two groups (mean ± SD, points)

Groups	Time	Adverse reaction prevention and treatment	Daily symptom management	Daily life management
Control group (n = 50)	Pre-intervention	84.19 ± 6.40	14.66 ± 2.76	13.36 ± 2.52
	Post-intervention	89.40 ± 8.10*	16.48 ± 2.39*	14.96 ± 2.86*
Study group (n = 50)	Pre-intervention	84.10 ± 8.19	14.54 ± 3.27	13.14 ± 2.86
	Post-intervention	108.98 ± 5.88*	19.00 ± 1.01*	18.52 ± 1.23*
Post-intervention t value for both groups		11.530	6.861	8.090
Post-intervention P value for both groups		< 0.001	< 0.001	< 0.001

Note: Compared with pre-intervention, *$P < 0.05$.

3.3. Comparison of chemotherapy compliance between the two groups

Table 3 shows that the chemotherapy compliance of patients in the study group was better than that in the control group, and the difference was statistically significant ($P < 0.05$).

Table 3. Comparison of chemotherapy compliance between the two groups [n (%)]

Groups	Good compliance	Moderate compliance	Poor compliance
Control group (n = 50)	35 (70.00)	9 (18.00)	6 (12.00)
Study group (n = 50)	45 (94.00)	4 (8.00)	1 (2.00)
Z		2.548	
P		0.011	

3.4. Comparison of adverse events during hospitalization between the two groups

During hospitalization, the overall incidence of adverse events in the study group was significantly lower than in the control group, and the difference was statistically significant ($P < 0.05$), as shown in **Table 4**.

Table 4. Comparison of adverse events during hospitalization between the two groups [n (%)]

Groups	Chemotherapy drug extravasation	Phlebitis	Deep vein thrombosis	Total adverse event rate
Control group (n = 50)	1 (2.00)	5 (10.00)	2 (4.00)	8 (16.00)
Study group (n = 50)	0 (0.00)	0 (0.00)	1 (2.00)	1 (2.00)
χ^2				5.983
P				0.014

3.5. Comparison of patient satisfaction with nursing care between the two groups

Table 5 shows that the overall satisfaction of patients in the study group with the nursing services was higher than that in the control group, and the difference between the groups was statistically significant ($P < 0.05$).

Table 5. Comparison of patient satisfaction with nursing care between the two groups [*n* (%)]

Groups	Very satisfied	Satisfied	Moderately satisfied	Not satisfied
Control group ($n = 50$)	11 (22.0)	14 (28.00)	15 (30.00)	10 (20.00)
Study group ($n = 50$)	26 (52.00)	17 (34.00)	5 (10.00)	2 (4.00)
Z		3.964		
P		< 0.001		

4. Discussion

4.1. Impact of the integrated "5A combined with 3+3" management model on self-management ability and compliance

The self-management ability of intravenous chemotherapy patients refers to their ability to acquire relevant knowledge through their own actions, strictly follow medical advice to monitor and manage infusion catheters, promptly identify abnormalities and take effective measures, manage their emotions, and enhance self-confidence in self-management [10]. Compliance refers to the degree of consistency between a patient's behavior and medical advice, influenced by factors such as the patient's educational level, age, economic status, treatment plan, and adverse drug reactions [11]. Intravenous chemotherapy is a painful and prolonged process for patients, and medical staff cannot accompany them throughout the treatment. Therefore, it is crucial for patients to have strong self-management ability and compliance.

The results of this study show that after the intervention, the self-management ability scores in the study group were higher than those in the control group, and compliance was better in the study group, with statistically significant differences ($P < 0.05$). This suggests that the integrated "5A combined with 3+3" management model for intravenous chemotherapy patients can effectively improve self-management ability and enhance compliance. The reasons for this may be that improved self-management ability and compliance require patients to have a rich knowledge of self-protection against chemotherapy side effects, a strong sense of responsibility for self-care, and a clear self-concept.

Cancer chemotherapy patients often experience fear and anxiety due to cancer-related pain, fatigue, uncertainty about the outcome of chemotherapy, and various side effects, leading them to resist participating in self-management during treatment. Furthermore, limitations such as age and educational level can prevent patients from fully understanding the mechanical presentation of health information by medical staff, thereby affecting their self-management ability and compliance. To address these issues, the study group used multiple methods, such as distributing brochures, playing educational videos, and combining on-site explanations and demonstrations. This effectively mitigated the impact of age and educational level on health education outcomes, enhanced patients' mastery of self-protection knowledge and skills, and encouraged patient participation in their own care management, thereby improving their self-concept and sense of responsibility for self-care.

Additionally, the study group established a professional drug safety management team, including expert psychologists, to guide patients in maintaining a healthy mindset throughout chemotherapy. This helped patients

manage catheter care, recognize and handle side effects, and ultimately led to significant improvements in self-management ability and compliance.

4.2. Impact of the integrated "5A combined with 3+3" management model on the personal abilities of medical staff

Nurses are primarily responsible for the safety of medication administration during cancer patients' hospitalization. The duty nurse is responsible for administering the correct medication to the correct patient at the correct time. Safe medication management is a basic ability that clinical medical staff should possess, which involves patient-centered, meticulous management of the medication process and safety factors, as well as providing timely responses to crisis events. Many studies have shown that insufficient medication safety skills are one of the main causes of clinical medication errors [12].

Previous studies have found that factors such as years of nursing experience, educational background, hospital level, daily workload, attitude toward medication safety, and problem-solving abilities influence the medication safety abilities of clinical nursing staff, which tend to be at a moderately high level but with room for improvement [13,14]. Additionally, research by Yu *et al.* indicated that patient safety culture perception and medication environment perception are also key factors affecting the medication safety abilities of nursing staff [15].

The 5A nursing management model is an evidence-based approach aimed at changing behavior and improving self-management skills, widely used in nursing management for patients undergoing hemodialysis [16], children with type 1 diabetes [17], and cancer patients [6]. The results of this study show that the knowledge mastery scores of medical staff in the study group regarding the prevention and treatment of chemotherapy drug side effects, daily symptom management, and daily life management were significantly higher than those in the control group ($P < 0.05$), suggesting that the integrated "5A combined with 3+3" management model can improve the professional skills of medical staff.

The reasons for this improvement may include the establishment of a professional drug safety team in the study group, with team members possessing solid professional knowledge and skills. Through literature reviews, they gained a clear understanding of high-risk factors and periods for adverse practices in intravenous chemotherapy safety, and based on this, they provided drug safety management training to medical staff, improving their knowledge of chemotherapy drug side effect prevention and treatment. Furthermore, the study group divided nursing management during chemotherapy into five stages: inquiry, assessment, notification, assistance, and follow-up. They integrated the conventional "three checks" and "three observations" into the "5A" nursing management model, systematizing, specifying, and standardizing the daily nursing procedures for patients. This not only improved the efficiency of nursing management but also enabled medical staff to have a more comprehensive understanding of the physical and psychological symptoms and life needs exhibited by patients at different stages of chemotherapy. As a result, the medical staff in the study group had a better grasp of intravenous chemotherapy management knowledge compared to the control group.

4.3. Impact of the integrated "5A combined with 3+3" management model on patient adverse events and nursing satisfaction

Preventing and reducing adverse drug events, such as drug extravasation and phlebitis, and improving patients' treatment experiences are the ultimate goals of nursing management. The results of this study show that the

incidence of adverse events in the study group was lower than in the control group, and patient satisfaction with nursing care was higher in the study group, with statistically significant differences ($P < 0.05$). This indicates that implementing the integrated "5A combined with 3+3" management model for intravenous chemotherapy patients can effectively improve clinical medication safety and nursing quality.

The reasons for this are as follows: First, the occurrence of adverse events during chemotherapy is the result of a combination of internal and external factors. Before implementing the integrated "5A combined with 3+3" model, the study group established a professional drug safety management team. The involvement of professionals from various departments improved the efficiency and accuracy of analyzing and summarizing chemotherapy-related adverse events. Second, using diversified methods to conduct chemotherapy drug safety training helped improve the medical staff's sense of responsibility for safety, their knowledge and skills in safe medication, and enhanced patients' self-protection awareness, self-care ability, and compliance. Additionally, based on the retrospective analysis of chemotherapy drug adverse events and the strengthening of training on medication safety for relevant personnel, the integrated "5A combined with 3+3" management model provided a scientific basis for subsequent integrated medical and nursing care through the inquiry stage. Combining the conventional "three checks" with the notification stage of nursing management improved patients' intuitive understanding of drug side effects, and implementing "three observations" during the assistance stage enhanced patients' ability to recognize side effects, thereby preventing and reducing the incidence of chemotherapy drug adverse reactions. This led to a relatively better chemotherapy experience for patients and higher nursing satisfaction.

5. Conclusion

In conclusion, implementing the integrated "5A combined with 3+3" drug safety management model for intravenous chemotherapy patients can effectively enhance self-management ability and treatment compliance, improve the chemotherapy drug safety skills of medical staff, reduce the incidence of chemotherapy-related adverse events, and increase patient satisfaction. However, this study has some limitations: First, the sample size was small, which may introduce some bias in the results. Second, the wide age range of patients means that the effectiveness of nursing management methods across different age groups requires further analysis with a larger sample size in future studies.

Disclosure statement

The authors declare no conflict of interest.

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