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PDCA cycle and safety culture in nursing safety management of Day Ward chemotherapy

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Abstract

Objective The PDCA cycle, also known as the PDCA (Plan-Do-Check-Act) cycle, is a well-established continuous quality improvement framework. This study aimed to evaluate the impact of implementing a nursing safety management strategy grounded in the PDCA cycle and safety culture principles in the context of Day Ward chemotherapy.

Methods This a prospective group comparison study (cohort comparison) based on principles of randomization. A total of 120 patients receiving intravenous chemotherapy at the Day Ward of Nantong First People's Hospital from January 2023 to December 2023 were recruited as research participants. They were randomly assigned to either a control group or a study group, which were managed using the conventional nursing quality management approach and the PDCA cycle-based safety culture management method, respectively. The primary outcomes measured were nursing satisfaction, chemotherapy-related symptom burden, and the incidence of total implantable venous access port catheter (TIVAP)-related adverse events.

Results After three months, the study group showed significantly lower scores on all MSAS-SF subscales (GDI: 1.05 ± 0.33, PHYS: 0.69 ± 0.35, PSYCH: 1.15 ± 0.42, TMSAS: 2.62 ± 0.34) compared to the control group (GDI: 1.22 ± 0.47, PHYS: 0.85 ± 0.32, PSYCH: 1.43 ± 0.73, TMSAS: 2.81 ± 0.36) (all $P < 0.05$). Nursing satisfaction was higher in the study group (95.00%) than in the control group (78.33%) ($P < 0.05$). Quality of life scores improved more in the study group (74.9 ± 9.2) than in the control group (68.2 ± 10.5) ($P < 0.01$). The study group also had fewer TIVAP-related adverse events (6.67%) compared to the control group (24.67%) ($P < 0.05$).

Conclusion The adoption of a nursing safety management model rooted in the PDCA cycle and safety culture principles can effectively improve nursing quality and satisfaction, alleviate patient symptoms and enhance quality of life in the context of Day Ward chemotherapy. These findings underscore the merit of further disseminating and studying this management approach in nursing practice.

Keywords Oncology nursing, Health care category, Health care facilities workforce and services, Quality of life

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Introduction

Malignant neoplasms pose a significant threat to human health and are one of the major chronic non-communicable diseases and public health challenges in China and globally in the 21st century. Epidemiological data has shown a steady increase in the incidence of various malignant neoplasms in China in recent years [1]. The rising incidence and mortality of malignant neoplasms have led to an escalating demand for cancer treatment, and the judicious utilization of limited medical resources to serve cancer patients has become a pressing issue for healthcare institutions [2]. Furthermore, the rapid advancements in medicine have catalyzed profound changes in societal expectations for medical services. Patients now demand not only higher quality of care but also more convenient, expedient, and cost-effective diagnostic and treatment processes. Oncology day ward chemotherapy have emerged as a product of this evolving medical landscape [3, 4].

The oncology day ward chemotherapy, known colloquially as day chemotherapy, embodies a patient-centered healthcare model where individuals receive chemotherapy treatments in hospital settings or specialized treatment centers [5]. Following a series of pre-chemotherapy examinations, assessments, and preparatory measures, patients adhere to scheduled chemotherapy appointments to undergo treatment based on the prescribed chemotherapy plan [6]. Our day ward unit caters to patients falling within the realm suitable for day-based diagnostics and treatments, functioning as a communal platform accessible to all hospital departments. Its primary emphasis lies in providing integrated treatment for a spectrum of oncology patients, including conventional chemotherapy regimens, targeted therapies, immunotherapies, and biologic treatments. Operating under an inpatient framework, the facility ensures patient discharge within the same day or a maximum of 48 h.

The day chemotherapy unit is staffed with a specialized nursing team that delivers holistic care and follow-up services akin to those provided for inpatient individuals [7]. Oncology day ward chemotherapy embodies the transition from the traditional medical model to the modern "biopsychosocial" medical paradigm, realizing the ideal scenario of daytime hospital-based chemotherapy and nighttime home-based convalescence [8]. This approach can mitigate the discomfort and financial burden associated with hospitalization, enabling patients to maintain a relatively normal lifestyle and minimizing the impact on their family and social lives [9]. Patients receive treatment in designated hospital units, enabling prompt monitoring and support from the healthcare team. However, patients may experience various side effects following day hospital chemotherapy, such as nausea, vomiting, and fatigue [10]. Consequently, the nursing staff in the day hospital ward must receive comprehensive training and demonstrate competence in managing anti-neoplastic treatment-related adverse events, nursing care, and emergency interventions [11].

PDCA (Plan-Do-Check-Act) nursing can drive continuous quality improvement through iterative evaluation and adjustment, evidence-based decision-making to effectively identify and resolve issues, patient-centric focus on needs and feedback, enhanced nursing experience and satisfaction, improved team communication and collaboration, and overall elevation of nursing standards [12]. The PDCA cycle is a widely applied continuous improvement management tool in quality management and project management, and has been extensively utilized across various disease contexts [13]. Our healthcare institution has successfully integrated the PDCA cycle and a safety culture into the safety management of oncology day ward chemotherapy nursing, resulting in remarkable outcomes, which are reported herein.

Methods

Study design

This a prospective group comparison study (cohort comparison) based on principles of randomization. Inclusion and Exclusion Criteria: The inclusion criteria for patient selection were as follows: (1) age between 18 and 75 years, with an expected survival time exceeding 1 year; (2) absence of severe comorbidities and preserved vital organ function; (3) Eastern Cooperative Oncology Group (ECOG) performance status score of 2 or less, indicating the ability to live independently; (4) receiving treatment using Total Implantable Venous Access Ports (TIVAP), with an expected infusion duration of 8 h or less; (5) no history of severe chemotherapy-related adverse reactions or well-controlled adverse reactions; (6) availability of accessible communication channels and emergency contact information; and (7) demonstration of good patient compliance, including the ability to attend scheduled visits and follow-up appointments.

The exclusion criteria were: (1) presence of comorbidities requiring surgical intervention or uncontrolled infectious fever; (2) assessed by the attending physician as requiring close observation; (3) existence of severe organ dysfunction; and (4) patients or their families requesting inpatient chemotherapy administration.

Sample size calculation

The sample size for the study was calculated by first determining the expected effect size, which indicated the minimum difference intended to be detected between groups. The desired statistical power was established, set at 80%, to minimize the risk of Type II errors. The alpha level was specified, set at 0.05, to control for Type I

errors. Statistical software G*Power was utilized to input these parameters and compute the necessary sample size for the study.

Assessing patient compliance in clinical practice

In clinical practice, the assessment of patient compliance was contributed to by both nurses and physicians through various methods. Nurses monitored and documented adherence to daily instructions, including medication intake and symptom management, while physicians evaluated the overall treatment response and adherence based on objective data and patient reports. Good patient compliance during chemotherapy was assessed by monitoring adherence to the prescribed treatment regimen, which encompassed the administration of chemotherapy, medication schedules, dietary recommendations, and other related instructions. The evaluation of compliance was based on several factors:

1. Medication Adherence: Compliance was assessed at regular intervals during each chemotherapy cycle, particularly during follow-up visits. Objective measures were employed to verify whether patients took prescribed medications on time and adhered to dosage instructions, while subjective measures involved inquiries about missed doses and any difficulties in following the treatment plan.
2. Treatment Attendance: Compliance was evaluated at each scheduled chemotherapy session, utilizing treatment logs and appointment records to confirm patient attendance.
3. Behavioral and Lifestyle Adherence: Adherence was monitored throughout the chemotherapy cycle during regular visits, with subjective measures assessing how well patients followed lifestyle recommendations, including diet and rest, through self-reports or discussions during consultations.
4. Side Effects Management: Compliance was evaluated during follow-up visits or after each chemotherapy cycle, with subjective measures assessing whether patients followed prescribed interventions for managing side effects and gathering insights from their reported experiences.
5. Patient-Reported Outcomes: These outcomes were assessed at every visit, particularly after each chemotherapy cycle, by employing questionnaires or self-reports to collect information on adherence to dietary guidelines, medication schedules, and coping strategies, enabling healthcare providers to evaluate overall compliance.

Study population

Double-blind method was applied to prevent bias in outcome evaluation. This prospective cohort study was conducted on a sample of 120 patients who underwent intravenous chemotherapy administration in the oncology day care unit of Nantong First People's Hospital between January 2023 and December 2023. Using a random number table, the participants were randomly assigned to either a control group or a study group, and were allocated to two distinct nursing units. The control group received conventional quality management nursing care, while the study group underwent PDCA cycle and safety culture management nursing care.

Intervention measures

The control group received conventional quality management nursing care. Upon admission, patients receive health education, which includes explanations of disease-related knowledge and reinforcement of skin care for the TIVAP, such as maintaining local skin cleanliness and dryness, observing for signs of redness, swelling, pain, or heat sensation. Patients are informed about precautions regarding TIVAP, such as avoiding heavy lifting and excessive activity on the side where the catheter is placed and preventing gravitational impacts on the catheter insertion site. The study group underwent a PDCA (Plan-Do-Check-Act) cycle and safety culture management, including four steps: plan, execute, check, and act.

Planning

Common antineoplastic drugs were categorized, and medication health education prescriptions with QR codes were created. Nursing quality was monitored, including tracking chemotherapy drug extravasation rates. Chemotherapy drugs were labeled, and reviews, along with enhanced training on new drug requirements, were conducted. Discharge medications, common dosages, and medication order guidelines were reviewed due to the department's complexity. Discharge education prescriptions for Baxter pumps were updated, and chemotherapy medication sequences were organized for easy reference. Emphasis was placed on discharge medication management, double-checking procedures, and medication education. Staff received training on chemotherapy drug preparation, and emergency drills for fire, CPR, and anaphylactic shock were held. Daily quality control was implemented based on hospital and department guidelines. The intravenous therapy and chemotherapy manuals were revised, and the updated content was applied in the department. The 2023 specialty project aimed to increase health education awareness for day care chemotherapy patients, and a nursing documentation template was established for chemotherapy admissions.

Do

Medication safety measures were strengthened through expert-led training on intravenous infusion practices

and the standardization of antineoplastic drug administration sequences. Patients' profiles were thoroughly documented, encompassing demographics, chemotherapy regimens, treatment courses, allergic histories, and assessments of psychological status, dietary habits, excretory patterns, and sleep quality. Oncologists played a pivotal role in clinical decision-making, tailoring chemotherapy regimens based on the patient's cancer type, stage, health condition, and previous treatment responses, focusing on minimizing toxicity and maximizing efficacy. Pharmacists ensured the safe preparation and proper dosage of chemotherapy drugs, monitored for potential interactions or adverse reactions, and educated patients about medication management and side effects. Dietitians provided essential nutritional support to manage chemotherapy-induced appetite loss, nausea, and taste changes, ensuring that patients received adequate nutrition to support their immune systems and address issues such as weight management and deficiencies. The use of ultra-low-density infusion pumps was reviewed and implemented, alongside enhanced large-volume infusion management and thorough documentation of medication instructions. Infusions were avoided in limbs affected by breast removal, radiotherapy, or paralysis. Treatment room management was refined with clear zoning for discharge medications and refrigerator storage. Specialty-specific nursing quality standards and health education handbooks were updated.

Checking

(1) The chemotherapy manual was revised; (2) The specialty-specific nursing routines were revised; (3) The specialty-specific essential knowledge reading was revised; (4) The chemotherapy nursing quality evaluation indicators were learned; (5) Continuous optimization and enhancement of specialty-specific monitoring indicators were undertaken, with surveillance conducted every 15 min during chemotherapy drug infusion, followed by subsequent checks every 15 to 30 min. The local conditions of the intravenous line, connections, and peripheral venous puncture sites were observed to prevent disconnections, catheter misplacements, chemotherapy extravasation, venous inflammation, and adverse drug reactions. Changes in patient condition were monitored, vital signs were assessed, and efforts were made to advance specialty-specific nursing practices, introduce new high-quality nursing service initiatives, and continually elevate the quality of specialized nursing. Conditions for the peripheral administration of vesicant drugs included limiting infusion times to 30 to 60 min, prohibiting the use of infusion pumps, reassessing every 2 to 5 ml during intravenous push administration, and conducting evaluations every 5 to 10 min throughout infusion to ensure unobstructed blood return. Heparinoid ointment preparation was applied to individuals receiving peripheral venous medications.

Action

(1) Tiered training for nurses was provided, the departmental position training plan was improved, and personnel training and assessment were implemented as scheduled. (2) Timely hierarchical nursing rounds guidance was provided for patients with changing conditions; education was given on the importance of nutrition during chemotherapy, emphasizing a diet rich in high calories, high protein, high vitamins, and easily digestible foods, with meals preferably taken at least 2 h before medication to reduce reactions such as vomiting; encouragement of increased water intake to 2000-3000 ml daily; instruction on infection prevention practices: mouth rinsing after meals, proper hygiene after defecation, avoiding exposure to cold and contact with individuals with colds; close monitoring of changes in patient urination and defecation post-chemotherapy; guidance on injection procedures for oral chemotherapy drugs, leukocyte and platelet-raising injections; TIVAP maintenance every 28 days, with prompt medical attention in case of abnormalities. (3) Emphasis was placed on blood routine reexaminations according to medical orders, evaluating medication precautions, prevention and management of adverse reactions, and catheter maintenance at least twice a week; patient education effectiveness was assessed during hospitalization, and contact information for post-discharge follow-up was recorded; clinical skills assessments were implemented, focusing on strengthening nurses' emergency response abilities, condition assessment monitoring, nursing procedure complication prevention skills, and proficiency assessments. (4) Secondary training within the department on the content of theoretical and technical training, and emergency response drills organized by the nursing department and the major department were provided. (5) Emergency response skill training and assessment were emphasized, including grabbing rescue vehicle medications and using rescue equipment.

Measurement

(1) TIVAP-related adverse events: occurrences of TIVAP-related adverse events during daytime chemotherapy were documented, encompassing situations such as catheter occlusion, blood reflux absence, drug leakage, and skin swelling.

(2) Nursing Satisfaction: A self-developed nursing satisfaction survey was used to assess patient satisfaction with nursing care across 5 domains: nursing attitude, nursing procedures, health education, and basic nursing care. The total score was 100, with satisfaction levels classified as: very satisfied (90–100 points), satisfied (75–89

points), average (60–74 points), and dissatisfied (< 60 points). Nursing satisfaction rate was calculated as (number of very satisfied + number of satisfied) / total number of patients × 100%.

(3)Quality of Life (QOL): A validated QOL scale (EORTC QLQ-C30) [13] was used to assess changes in the patients' overall quality of life following the intervention.

(4) Chemotherapy-related Symptoms: The Chinese version of the Memorial Symptom Assessment Scale-Short Form (MSAS-SF) [14] was employed to evaluate cancer patients' symptom burden and quality of life during chemotherapy. The MSAS-SF encompasses 5 components: Global Distress Index (GDI), Physical Symptom Distress Score (PHYS), Psychological Symptom Distress Score (PSYCH), Total MSAS (TMSAS), and Number of Symptoms (NS). The GDI includes 4 psychological symptoms (feeling sad, worried, irritable, and nervous) and 6 physical symptoms (lack of energy, pain, poor appetite, drowsiness, constipation, and dry mouth); the PHYS includes 12 physical symptoms (lack of energy, pain, poor appetite, drowsiness, constipation, dry mouth, nausea, vomiting, taste changes, weight loss, bloating, and dizziness); the PSYCH includes 6 psychological symptoms (anxiety, sadness, nervousness, difficulty sleeping, restlessness, and lack of concentration). TMSAS represents the mean score of the 32 symptom items, and NS denotes the number of symptoms experienced. The flowchart is shown in Fig. 1.

Statistical analysis

Statistical analyses were conducted using SPSS 22.0 software, and figures were generated with GraphPad Prism 9.0 software. Continuous variables are presented as mean ± standard deviation ($\bar{x} \pm s$) and analyzed using t-tests, while categorical variables are expressed as rates (n, %) and analyzed using chi-square tests. All statistical tests were two-tailed, with a significance level of $\alpha = 0.05$.

Results

Patient characteristics

The mean age of the control group was 59.36 ± 11.81 years, with 36 male patients. The tumor types included 22 cases of respiratory system tumors, 19 cases of digestive system tumors, 12 cases of gynecological tumors, and 7 other tumor cases. There were 36 patients with an Eastern Cooperative Oncology Group (ECOG) performance status of 0 and 24 patients with a score of 1–2. The study group had a mean age of 63.07 ± 13.42 years, with 41 male patients. The tumor types included 20 cases of respiratory system tumors, 24 cases of digestive system tumors, 8 cases of gynecological tumors, and 8 other

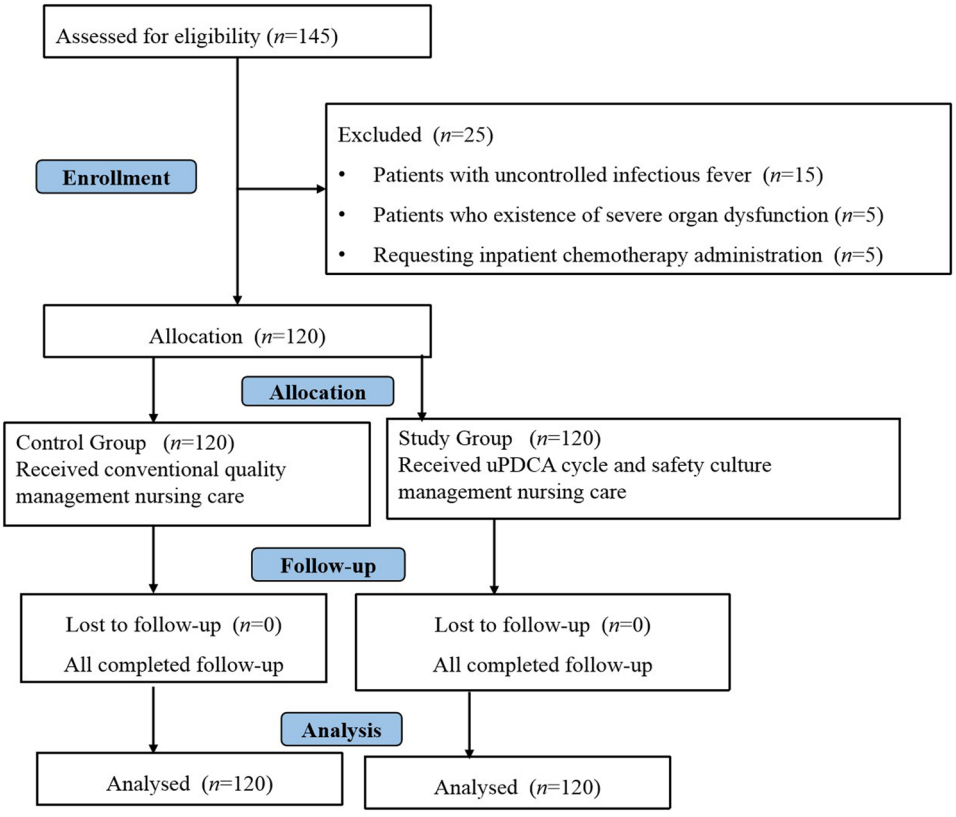

Fig. 1 The flowchart

Table 1 Patient characteristics

	Control	Study	t/χ2	*P*
n	60	60		
Age (Mean±SD, years)	59.36±11.81	63.07±13.42	1.608	0.111
Gender (male/female)	36/24	41/19	0.906	0.341
Tumor types			1543	0.672
Respiratory system	22	20		
Digestive system	19	24		
Gynecological tumors	12	8		
Others	7	8		
ECOG (points)			1.319	0.251
0	36	42		
1-2	24	18		

Note: ECOG=Eastern Cooperative Oncology Group

tumor cases. There were 42 patients with an ECOG performance status of 0 and 18 patients with a score of 1–2. Baseline characteristics were balanced between the two groups in terms of age, gender, tumor type, and ECOG performance status, indicating comparable (Table 1).

Chemotherapy-related symptoms

After 3 months of Day Ward chemotherapy, the control group, the GDI score was 1.22 ± 0.47, the PHYS was 0.85 ± 0.32, the PSYCH was 1.43 ± 0.73, the TMSAS score was 2.81 ± 0.36, and the NS was 8.71 ± 2.31. In the study group, the GDI score was 1.05 ± 0.33, the PHYS score was 0.69 ± 0.35, the PSYCH score was 1.15 ± 0.42, the TMSAS score was 2.62 ± 0.34, and the NS was 7.26 ± 2.29. All MSAS-SF subscale scores were significantly lower in the study group versus the control group (all $P < 0.05$, Table 2).

Nursing satisfaction

After 3 months of Day Ward chemotherapy, the control group, 25 patients were very satisfied, 22 were satisfied, 10 were average, and 3 were dissatisfied, resulting in a satisfaction rate of 78.33% (47/60). In the study group, 32 patients were very satisfied, 25 were satisfied, 2 were average, and 1 was dissatisfied, resulting in a satisfaction rate of 95.00% (57/60). The nursing satisfaction rate was significantly higher in the study group versus the control group ($P < 0.05$, Table 3).

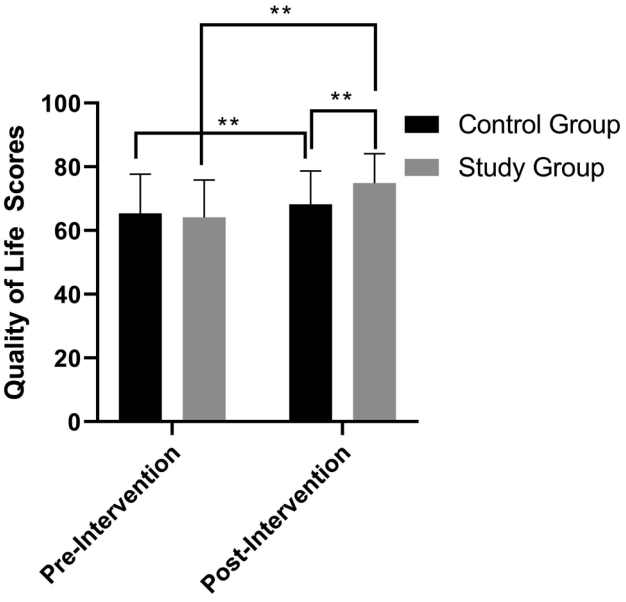

Fig. 2 Comparison of quality of life scores pre and post intervention

Quality of life

Pre-intervention, there was no significant difference in the quality of life score between the control group (65.4 ± 12.3) and the study group (64.1 ± 11.8) ($P > 0.05$); Post-intervention, the quality of life scores of both groups of patients improved compared to before the intervention; The quality of life score of the study group (74.9 ± 9.2) was higher than that of the control group (68.2 ± 10.5) ($P < 0.01$), as shown in Fig. 2.

Table 2 Chemotherapy-related symptoms

	n	GDI	PHYS	PSYCH	TMSAS	NS
Control	60	1.22±0.47	0.85±0.32	1.43±0.53	2.81±0.36	8.71±2.31
Study	60	1.05±0.33	0.69±0.35	1.15±0.42	2.42±0.34	7.26±2.29
t		2.293	2.613	3.207	4.746	3.453
P		0.024	0.010	0.002	0.000	0.001

Note: Global Distress Index=GDI; Physical Symptom Distress Score=PHYS; Psychological Symptom Distress Score=PSYCH; Total Memorial Symptom Assessment Scale=TMSAS; NS=Number of Symptoms

Table 3 Nursing satisfaction

	n	Very satisfied	Satisfied	Average	Dissatisfied	Satisfaction rate
Control	60	25	22	10	3	47
Study	60	32	25	2	1	57
χ2						7.212
P						0.007

Table 4 TIVAP -related adverse events

	n	Drug leakage	Blood reflux absence	Catheter occlusion	Skin swelling	Total
Control	60	3	2	3	5	13
Study	60	1	0	1	2	4
χ2						5.551
P						0.019

Table 5 Quality of life scores pre and post intervention for 58 satisfied and very satisfied patients

Quality of Life Scores	Very satisfied subgroup (*n*=32)	Satisfied subgroup (*n*=25)	t	*p*
Pre	67.1±8.6	66.9±8.2	1.254	0.245
Post	77.9±6.7	71.8±5.9	3.254	<0.01
t	2.365	4.254		
P	<0.01	<0.01		

TIVAP-related adverse events

In the control group, there were 3 cases of drug leakage, 2 cases of blood reflux absence, 3 cases of catheter occlusion, and 5 cases of skin swelling, with a total adverse event rate of 24.67% (13/60). In the study group, there was 1 case of drug leakage, 1 case of blood reflux absence, and 2 cases of catheter occlusion, with a total adverse event rate of 6.67% (4/60). The incidence of PICC-related adverse events was significantly lower in the study group versus the control group ($P < 0.05$, Table 4).

PDCA cycle's impact on patient satisfaction and QoL

Among the 60 patients in the study group, 32 patients were very satisfied with the PCDA intervention measures and were classified as the "Very Satisfied Subgroup," while 25 patients were satisfied and were classified as the "Satisfied Subgroup."Pre-intervention, there was no significant difference in the quality of life score between the very satisfied subgroup (67.1 ± 8.6) and the satisfied subgroup (66.9 ± 8.2) ($P > 0.05$); Post-intervention, the quality of life scores of both subgroups of patients improved compared to before the intervention; The quality of life score of the very satisfied subgroup (77.9 ± 6.7) was higher than that of the satisfied subgroup (71.8 ± 5.9) ($P < 0.01$), as shown in Table 5.

Discussion

The present investigation represents the first application of the PDCA cycle model for nursing safety management in the Day Ward chemotherapy setting, yielding remarkably positive outcomes. The study findings substantiate that PDCA-based nursing can significantly ameliorate chemotherapy-related symptoms, enhance nursing quality and satisfaction, and reduce TIVAP -associated adverse events, thereby supporting the necessity of introducing this PDCA nursing strategy. The PDCA management approach is a quality control model originating from the American management domain, which delineates quality management into four iterative phases: plan, do, check, and act [15]. The nursing management model grounded in PDCA integrates this management methodology with nursing practice, aiming to improve nursing quality and clinical treatment efficacy.

The application of the PDCA-based nursing management model in mitigating the incidence of complications has been widely recognized [16, 17]. Intravenous chemotherapy constitutes a principal therapeutic modality for malignant neoplasms, yet the cytotoxic agents can also inflict damage upon normal cells [18, 19]. Medication errors are prevalent in Day Ward settings, accounting for 23–92% of prescriptions, with prescription errors being the most commonly reported type, particularly dosage errors, largely attributed to insufficient knowledge [20]. In the United States, medication negligence or errors have been implicated in 7% of medical harm experienced by hospitalized patients [21]. Therefore, attenuating medical errors in the Day Ward chemotherapy context is of paramount importance. By effectively implementing the PDCA management model, nurses' perceptions can be transformed, transitioning from the previous mindset that merely required notifying the physician when patients experienced adverse reactions without the need to ascertain appropriate counteractive measures, thereby enhancing medication safety awareness.

The Planning phase focused on creating a robust framework for nursing interventions. Key strategies included medication health education through QR codes linking patients to personalized medication instructions. This improved patient understanding and adherence, reducing confusion and errors. Zonal management of medications, which categorized and labeled chemotherapy drugs, minimized medication errors and cross-contamination, ensuring safer drug administration. Additionally, emergency response drills (fire, CPR, anaphylactic shock) were conducted to prepare nursing staff for unexpected situations, further enhancing patient safety. The Execution phase focused on ensuring consistent implementation of these strategies. Medication safety was prioritized through the standardization of chemotherapy drug administration and the use of ultra-low-density infusion pumps to control infusion rates, reducing the risk of drug-related complications. Zonal management of treatment areas organized chemotherapy drugs and treatment spaces to prevent mistakes and ensure proper

medication storage. Moreover, Comprehensive Patient Monitoring, including psychological and physiological assessments, allowed for a more personalized approach to care, promoting better patient outcomes [22]. Regular 15-minute infusion checks helped detect complications such as extravasation early, further reducing side effects. The Checking Phase emphasized continuous monitoring to assess the effectiveness of the implemented strategies. Regular assessments of chemotherapy infusion and nursing quality indicators ensured high standards of care were maintained. The early detection of complications, like extravasation, and continuous feedback allowed for timely interventions, which likely contributed to a reduction in chemotherapy-related symptoms. The feedback loop ensured that interventions were adjusted as needed to meet patient needs. The Action phase focused on refining care based on feedback. Ongoing education and training for nursing staff was critical in maintaining high standards. Regularly scheduled training kept nurses updated on clinical skills and emergency response protocols. This continuous professional development reinforced a culture of quality improvement and better patient management [23]. Additionally, patient education and follow-up empowered patients to manage their health more effectively, improving their adherence to treatment regimens and contributing to higher nursing satisfaction and better outcomes.

The structured implementation of these interventions resulted in significant improvements. Patient education helped reduce symptom burden and improved quality of life, while medication safety and zonal management reduced TIVAP-related adverse events. Nursing satisfaction was higher in the study group, likely due to the enhanced training and the structured support systems. Nurses reported greater confidence in managing patients, particularly in emergency situations, leading to improved morale and satisfaction with their work environment.

Day Ward cancer patients may encounter a broad spectrum of psychosocial health needs, encompassing psychological, emotional, social, and spiritual domains, culminating in a deterioration of quality of life over time. Consequently, comprehensive psychosocial interventions are necessitated in the cancer patient population to mitigate the psychological impact of the disease and bolster patients' coping capacities with treatment demands and disease outcome uncertainty [22, 23]. These elements are often lacking in conventional nursing care. Caminiti et al. have demonstrated that the PDCA-based nursing management model can improve quality of life and reduce the incidence of complications [24]. In the present study, the MSAS-SF was employed to assess the physical symptoms and quality of life of the two cohorts. The results indicated that the study group exhibited significantly higher scores versus the control group across physical symptoms, psychological distress, and quality of life domains. Additionally, the incidence of complications in the study group was lower versus the control group, which may be attributed to the implementation of the PDCA-based nursing management model. The PDCA framework assists in managing the risks of PICC-related complications and adverse events by addressing the conditions of catheter use, puncture sites, and puncture veins [25]. In summary, through the PDCA cycle and safety culture management, healthcare professionals and patients have gained confidence in the management of Day Ward chemotherapy, improving work efficiency, shortening consultation time, enhancing intra-team coordination, and overall work efficiency.

Although the results of this study have demonstrated the remarkable advantages of the PDCA framework and safety culture in nursing management of Day Ward chemotherapy, certain limitations warrant further investigation. First, this research was conducted at a single healthcare institution with a relatively small sample size. Larger-scale, multi-center validation studies are needed to further establish the generalizability and scalability of the PDCA approach in this domain. Moreover, the current study had a relatively short follow-up period, precluding the assessment of the long-term impact of this management model on nursing quality improvement and patient outcomes. Future research should expand the follow-up duration to analyze the long-term effects of PDCA-guided nursing practice on patient quality of life, treatment adherence, and clinical prognosis. Secondly, while the PDCA framework significantly enhanced nursing quality, its implementation process still faced certain challenges. For instance, additional training resources were required to ensure nursing staff's proficiency in the PDCA methodology, and further strengthening of interdepartmental collaboration and information sharing was necessary. Future studies should delve deeper into the specific implementation strategies of PDCA in Day Ward chemotherapy management, in order to provide more actionable guidance for clinical translation. Furthermore, this study focused solely on the impact of PDCA on nursing quality and patient outcomes, without examining its effects on the overall efficiency and cost-effectiveness of the healthcare service. Subsequent research should comprehensively evaluate the system-wide impacts of the PDCA approach from an organizational management perspective, to provide more robust evidence for clinical decision-making.

Limitations

The study has several limitations that may affect the generalizability of its findings. (1) Demographic differences: one of the key limitations is the demographic variability between the control and study groups. The

mean age in the control group was 59.36 years, while in the study group, it was 63.07 years, indicating that the population predominantly consists of middle-aged to elderly adults. This age distribution may limit the applicability of the findings to younger populations, as age-related factors could influence chemotherapy outcomes and nursing care needs. (2) Gender disparity: the cohort was male-dominated, with 36 males in the control group and 41 in the study group. This gender imbalance introduces potential gender-related biases, making the results less applicable to female patients. Future studies should aim for more gender-balanced recruitment to enhance the generalizability of findings to both male and female patients. (3) Tumor type variety: the study included a variety of tumor types, but respiratory and digestive system tumors were most prevalent, while other types, such as gynecological cancers, were underrepresented (only 8 cases in each group). This could limit the conclusions drawn for patients with different cancer types, highlighting the need for a more diverse range of tumor types in future studies to improve applicability across various oncology patient populations. (4) Functional status (ECOG Scores): the study found that the distribution of ECOG scores was relatively similar between groups, but the study group had a higher number of patients with ECOG 0, indicating better baseline functional status. This disparity may have influenced the outcomes, as patients with better functional status are likely to have better recovery and fewer complications. This limitation may reduce the applicability of the results to patients with more severe functional impairments or worse baseline health.

Selection bias could be mitigated in future studies through several strategies: (1) Matching or stratification: matching participants in the control and study groups based on key variables—such as age, gender, tumor type, and ECOG score—could help ensure more balanced distributions and reduce the impact of demographic differences on the outcomes. Alternatively, stratified randomization could be employed to control for these variables, ensuring that both groups are comparable on these important factors. (2) Adjustment in statistical analysis: to further reduce the potential influence of selection bias, future studies could use statistical methods such as regression analysis to adjust for confounders (e.g., age, gender, tumor type, and functional status). This would help account for differences between groups and provide a clearer picture of the true effect of the intervention. (3) Further discussion of recruitment process: a more detailed explanation of the recruitment and randomization process in this study would also be beneficial. This could clarify any steps taken to minimize bias, such as random allocation and stratification by key factors, and highlight how these processes might have affected the study results. Additionally, any biases introduced during recruitment, such as patient self-selection or incomplete randomization, should be acknowledged and discussed.

Conclusion

Overall, while the study provides valuable insights into the impact of the PDCA cycle-based nursing safety management strategy in Day Ward chemotherapy, the demographic and clinical differences between the control and study groups may limit the generalizability of the results. Future studies should aim for more balanced group distributions, consider matching participants on key variables, and incorporate a broader range of tumor types. Moreover, further exploration of the long-term sustainability of these interventions and their impact on patient outcomes would provide a deeper understanding of their efficacy.

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Author contributions

Xia Chen conceived the idea, conceptualised the study, collected the data, analysed the data, drafted the manuscript, then reviewed the manuscript. Xia Chen read and approved the final draft.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was conducted with approval from the Ethics Committee of Nantong First People's Hospital. This study was conducted in accordance with the declaration of Helsinki. Written informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

1. Han B, Zheng R, Zeng H, Wang S, Sun K, Chen R, et al. Cancer incidence and mortality in China, 2022. J Natl Cancer Cent. 2024;4:47–53.
2. Soerjomataram I, Bray F. Planning for tomorrow: global cancer incidence and the role of prevention 2020–2070. Nat Rev Clin Oncol. 2021;18:663–72.
3. Shao H, Jin C, Xu J, Zhong Y, Xu B. Supply-demand matching of medical services at a City level under the background of hierarchical diagnosis and treatment - based on Didi Chuxing data in Haikou, China. BMC Health Serv Res. 2022;22:354.
4. Iijima K, Arai H, Akishita M, Endo T, Ogasawara K, Kashihara N, et al. Toward the development of a vibrant, super-aged society: the future of medicine and society in Japan. Geriatr Gerontol Int. 2021;21:601–13.

5. Sabbagh Dit Hawasli R, Barton S, Nabhani-Gebara S. Ambulatory chemotherapy: past, present, and future. J Oncol Pharm Pract. 2021;27:962–73.
6. Goh I, Lai O, Chew L. Prevalence and risk of polypharmacy among elderly Cancer patients receiving chemotherapy in ambulatory oncology setting. Curr Oncol Rep. 2018;20:38.
7. Moore C, Strong D, Childress J, Fougere B, Gotthardt S. Ambulatory infusional cancer chemotherapy: nursing role in patient management. Cancer Cent Boston J Infus Chemother. 1996;6:164–70.
8. McBride A, Campen CJ, Camamo J, Maloney M, Persky D, Kurtin SE, et al. Implementation of a pharmacy-managed program for the transition of chemotherapy to the outpatient setting. Am J Health Syst Pharm. 2018;75:e246–58.
9. Moore C, Herbst S, Lawson M. Application of ambulatory infusion devices in infusional cancer chemotherapy: a model for nursing management. J Infus Chemother. 1996;6:181–5.
10. Considine J, Livingston P, Bucknall T, Botti M. A review of the role of emergency nurses in management of chemotherapy-related complications. J Clin Nurs. 2009;18:2649–55.
11. Karius DL, Colvin CM. Managing chemotherapy extravasation across transitions of care: A clinical nurse specialist initiative. J Infus Nurs. 2021;44:14–20.
12. Santana MJ, Ahmed S, Lorenzetti D, Jolley RJ, Manalili K, Zelinsky S, et al. Measuring patient-centred system performance: a scoping review of patient-centred care quality indicators. BMJ Open. 2019;9:e023596.
13. Aaronson NK, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez NJ, et al. The European organization for research and treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. J Natl Cancer Inst. 1993;85:365–76.
14. Chang VT, Hwang SS, Thaler HT, Kasimis BS, Portenoy RK. Memorial symptom assessment scale. Expert Rev Pharmacoecon Outcomes Res. 2004;4:171–8.
15. Zhou J, Xu H, Jiang M, Cao H, Jiang L, Xu T, et al. Effect of PDCA-based nursing management model on the quality of life and complications of patients with acute leukemia undergoing chemotherapy. Am J Transl Res. 2021;13:3246–53.
16. Niu Y, Zhang L, Sun X. Efficacy of seamless care management under FOCUS-PDCA for patients with acute cerebral infarction complicated with dysphagia and its influence on nutritional status and neurological functions. Altern Ther Health Med; 2023.
17. Xu Y, Shi C, Liu Y. Application effect of PDCA circulation on nursing quality management and risk control in digestive endoscopy room. Med (Baltim). 2023;102:e35885.
18. Anand U, Dey A, Chandel AKS, Sanyal R, Mishra A, Pandey DK, et al. Cancer chemotherapy and beyond: current status, drug candidates, associated risks and progress in targeted therapeutics. Genes Dis. 2023;10:1367–401.
19. Pérez-Herrero E, Fernández-Medarde A. Advanced targeted therapies in cancer: drug nanocarriers, the future of chemotherapy. Eur J Pharm Biopharm. 2015;93:52–79.
20. Naseralallah L, Stewart D, Price M, Paudyal V. Prevalence, contributing factors, and interventions to reduce medication errors in outpatient and ambulatory settings: a systematic review. Int J Clin Pharm. 2023;45:1359–77.
21. Schwappach DL, Wernli M. Medication errors in chemotherapy: incidence, types and involvement of patients in prevention. A review of the literature. Eur J Cancer Care (Engl). 2010;19:285–92.
22. Institute of Medicine Committee on Psychosocial Services to Cancer Patients/Families in a Community S. The National Academies Collection: Reports funded by National Institutes of Health. In: Adler NE, Page AEK, editors. Cancer Care for the Whole Patient: Meeting Psychosocial Health Needs. Washington (DC): National Academies Press (US) Copyright © 2008, National Academy of Sciences.; 2008.
23. Piazza MF, Galletta M, Portoghese I, Pilia I, Ionta MT, Contu P, et al. Meeting psychosocial and health information needs to ensure quality of cancer care in outpatients. Eur J Oncol Nurs. 2017;29:98–105.
24. Caminiti C, Iezzi E, Passalacqua R. Effectiveness of the HuCare quality improvement strategy on health-related quality of life in patients with cancer: study protocol of a stepped-wedge cluster randomised controlled trial (HuCare2 study). BMJ Open. 2017;7:e016347.
25. Moore C, Strong D. Administrative and technical support of ambulatory infusional cancer chemotherapy (ICC). J Infus Chemother. 1996;6:161–3.

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