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Analysis of the Impact of Proactive Nursing Measures on Enhancing Nursing Quality in Central Sterile Supply Departments

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Abstract: *Objective:* To investigate the role of anticipatory nursing measures in enhancing nursing quality within the Central Sterile Supply Department. *Methods:* Eighty sets of instruments processed by our hospital's Central Sterile Supply Department between January 2022 and December 2023 were selected as research subjects. Using random number tables, these were divided into a conventional care group and a proactive care group, each comprising 40 sets. Concurrently, 15 nursing staff members from the department were assigned to corresponding groups before and after implementing different care measures. The conventional care group received standard sterile supply care, while the proactive care group implemented proactive nursing interventions. The quality of instrument cleaning and disinfection, along with nursing quality scores, were compared between the two groups. *Results:* The predictive care group demonstrated higher compliance rates across all instrument cleaning and disinfection indicators compared to the routine care group, and nursing quality scores were also significantly higher ($P < 0.05$). *Conclusion:* Implementing predictive care measures in the Central Sterile Supply Department markedly improves the quality of instrument cleaning and disinfection, as well as nursing quality, and is worthy of wider adoption.

Keywords: Proactive nursing; Central Sterile Supply Department; Nursing quality; Instrument cleaning and disinfection

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1. Introduction

The Central Sterile Supply Department constitutes a highly specialised and critical unit within hospitals, responsible for the collection, cleaning, disinfection, sterilisation, storage, and distribution of all reusable medical instruments across the institution. It serves as the essential behind-the-scenes core ensuring the smooth operation of medical activities. The quality of this department's work is paramount, directly impacting patient safety during diagnosis and treatment. Any deficiencies in instrument processing may lead to nosocomial infections, which can exacerbate patient conditions, prolong treatment duration, increase healthcare costs, and in severe cases, threaten patient lives [1-2]. Concurrently, the efficiency and service quality of the Central Sterile Supply Department directly influence the workflow of clinical departments. Delays in instrument supply or substandard quality disrupt normal diagnostic and therapeutic procedures, thereby affecting the hospital's overall medical reputation. With the rapid advancement of modern medicine, the variety and complexity of medical devices continue to increase, presenting greater challenges for processing within the Central Sterile Supply

Department. Against this backdrop, anticipatory nursing—a proactive preventive care model—is gradually gaining recognition. This study compares the effectiveness of anticipatory nursing measures versus conventional nursing measures in enhancing care quality. It aims to provide more scientific and effective approaches for nursing practices within the Central Sterile Supply Department, thereby further safeguarding medical safety and promoting the overall improvement of nursing standards throughout the hospital.

2. Materials and Methods

2.1. General Information

A total of 80 sets of instruments processed by our hospital's Central Sterile Supply Department between January 2022 and December 2023 were selected as study subjects. Using a random number table, these were divided into a conventional care group and a proactive care group, each comprising 40 sets. Within the conventional care group, 22 sets comprised surgical instruments and 18 sets diagnostic instruments; within the proactive care group, 23 sets comprised surgical instruments and 17 sets diagnostic instruments. Concurrently, 15 nursing staff members aged 24–45 years (mean age 32.56 ± 4.12 years) with 3–20 years of experience (mean 10.23 ± 3.56 years) were selected. Comparisons of instrument types and nursing staff demographics between groups revealed no statistically significant differences ($P > 0.05$), establishing comparability.

Inclusion criteria: (1) Instruments were routine reusable sterilisable items used in the hospital; (2) Nursing staff were currently employed at the centre with at least one year's service; (3) No major equipment malfunctions affecting operations occurred during the study period.

Exclusion criteria: (1) Severely damaged instruments incapable of normal cleaning and disinfection; (2) Nursing staff who left employment or took extended leave during the study period; (3) Instruments contaminated with special infections.

2.2. Methodology

The conventional care group employed standard disinfection supply procedures, adhering to established protocols for recovery, classification, cleaning, and sterilisation. The anticipatory care group implemented anticipatory nursing measures alongside conventional care, specifically: (1) Establishing an anticipatory care team led by the Head Nurse of the Central Sterile Supply Department, comprising five experienced and conscientious nursing staff. Upon formation, the team comprehensively reviewed and analysed adverse nursing events and instances of substandard instrument cleaning and disinfection occurring within the centre over the preceding three years. This identified primary causes, such as inadequate cleaning of complex-structured instruments often stemming from improper cleaning techniques, and substandard sterilisation potentially linked to incorrect equipment parameter settings or non-compliant operational practices. Corresponding preventive measures were developed based on these causes, resulting in detailed operational guidelines distributed to all nursing staff. (2) Enhanced training for nursing staff was implemented through a systematic programme covering not only routine procedures but also the structural characteristics of various instruments, challenges and critical steps in cleaning and disinfection, and specific methods for implementing anticipatory care measures. Experts from the hospital's infection control department were invited to deliver lectures on the hazards and prevention of nosocomial infections, thereby heightening staff awareness of potential risks. Training combined theoretical instruction with practical exercises, including regular simulated procedure drills where team members provided on-site guidance and feedback. Conduct quarterly assessments covering both theoretical knowledge and practical skills, linking results to performance evaluations. Staff failing assessments must undergo retraining until competent. (3) Upon instrument receipt, designate personnel to conduct meticulous inspections using specialised tools. Examine all instrument components, particularly complex structures such as crevices, joints, and serrated edges, for residual bloodstains, soiling, or foreign matter. Mark instruments with visible contamination or intricate structures, documenting them in a dedicated register. Assign experienced nursing staff to focus on these during cleaning—e.g., using specialised brushes for crevices and high-pressure water jets for serrated edges. (4) Develop bespoke cleaning and disinfection protocols based on instrument material and

contamination level. Stainless steel instruments may undergo high-temperature cleaning and sterilisation; heat-sensitive materials like plastic and rubber require low-temperature methods. Adjust detergent concentration and soaking duration according to contamination severity, increasing strength and time for heavily soiled items. Team members shall conduct circulating supervision during cleaning to verify compliance with protocols and promptly correct non-standard practices. (5) Regularly monitor cleaning and disinfection efficacy by randomly sampling a specified quantity of instruments daily. Employ visual inspection and residual protein testing: visually assess surfaces for smoothness and absence of stains; use specialised test strips for residual protein detection to ensure compliance with standards. Conduct weekly biological monitoring of steriliser efficacy, documenting results promptly. Cease use immediately if issues arise and contact maintenance; resume operation only after equipment is functioning correctly and monitoring passes. Additionally, perform monthly environmental monitoring of sterile storage areas, including air and surface bacterial colony counts, to ensure compliance with hygiene standards. (6) Establish an adverse event reporting and analysis system, encouraging nursing staff to promptly report any incidents encountered during work, regardless of scale, without concealment. Reported adverse events shall be investigated and analysed by the Proactive Care Team within 24 hours to identify root causes. Corrective measures shall be formulated and communicated department-wide to serve as a cautionary example for all nursing staff. Quarterly adverse event analysis meetings shall be convened to collate and review incidents from the preceding quarter, summarising lessons learned to continuously optimise nursing procedures. Effective corrective measures shall be incorporated into operational guidelines.

2.3. Observation Indicators

Compare the pass rates for instrument cleaning, disinfection, and sterilisation between the two groups; Compare the nursing quality scores of the two groups of nursing staff, including procedural compliance, timeliness of service, and completeness of documentation, with a maximum score of 100 points. Higher scores indicate better nursing quality.

2.4. Statistical Methods

Data were analysed using SPSS 24.0. T-tests were performed for continuous data, while χ^2 tests were conducted for categorical data. A p-value < 0.05 was considered indicative of a statistically significant difference.

3. Results

3.1. Comparison of the Pass Rates for Cleaning, Disinfection and Sterilisation Between Two Sets of Equipment

The predictive care group demonstrated higher rates of satisfactory instrument cleaning, disinfection, and sterilisation compared to the conventional care group ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of Pass Rates for Cleaning, Disinfection and Sterilisation of Two Sets of Instruments

Group	Cleaning approved	Sterilisation approved	Sterilisation approved
Routine Care Group	32(80.00)	31(77.50)	30(75.00)
Proactive Care Group	39(97.50)	39(97.50)	38(95.00)
χ^2	4.507	7.314	6.275
P	0.034	0.007	0.012

3.2. Comparison of Nursing Quality Scores Between Two Groups of Nursing Staff

The predictive care group demonstrated higher scores than the conventional care group in terms of nursing staff compliance with operational standards, timeliness of service provision, and completeness of documentation ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of Nursing Quality Scores Between Two Groups of Nursing Staff ($\bar{x}$±s, points)

Group	Operational Standardisation	Timeliness of service	Record integrity
Conventional Care Group (40)	75.32±4.25	73.18±3.96	72.56±4.10
Proactive Care Group (40)	89.65±3.82	87.23±3.54	88.12±3.68
t	15.860	16.729	17.863
P	0.000	0.000	0.000

3.3. Comparison of Adverse Nursing Events Between the Two Groups

The incidence of adverse nursing events was lower in the anticipatory care group than in the conventional care group ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of Adverse Events Occurring in the Two Nursing Groups

Group	Equipment damage	Packaging non-compliant	Incorrect distribution	Occur frequently
Conventional Care Group (40)	3(7.50)	3(7.50)	2(5.00)	8(20.00)
Proactive Care Group (40)	0(0.00)	1(2.50)	0(0.00)	1(2.50)
χ^2				4.507
P				0.034

4. Discussion

As a pivotal department in hospital infection control, the quality of care delivered by the Central Sterile Supply Department is intrinsically linked to patient safety and clinical outcomes [3-4]. Within the current healthcare environment, heightened patient awareness of medical safety underscores the critical importance of hospital infection control. The Central Sterile Supply Department serves as the primary defence line in this endeavour. Any breach in this line could facilitate pathogen transmission and trigger nosocomial infections, inflicting additional suffering and financial burden upon patients while damaging the hospital's reputation and credibility. Consequently, the continuous enhancement of nursing quality within the Central Sterile Supply Department is an imperative requirement for the hospital's sustained development.

The findings of this study indicate that the instrument cleaning, disinfection, and sterilisation pass rates in the anticipatory care group were significantly higher than those in the conventional care group. This demonstrates that anticipatory care measures can effectively enhance the quality of instrument cleaning and disinfection. This may be attributed to the anticipatory nursing approach proactively analysing potential operational issues—such as stubborn stains on instruments being difficult to remove or suboptimal disinfection parameter settings—and subsequently implementing targeted preventative measures. Instruments were meticulously inspected and specialised items marked upon receipt, receiving focused attention during cleaning. Furthermore, appropriate cleaning and disinfection methods and parameters were selected based on actual conditions. This multi-faceted approach minimised potential problems at every stage,

ensuring effective instrument processing. For instance, with complex surgical instruments, routine care may adhere strictly to standard cleaning protocols, often failing to thoroughly remove debris from crevices. Proactive nursing, however, employs pre-marking and targeted handling, utilising specialised tools to significantly enhance cleaning thoroughness. During sterilisation, proactive nursing adjusts parameters according to instrument material and contamination level, preventing inadequate sterilisation or instrument damage caused by improper settings, thereby improving sterilisation pass rates. Regarding nursing staff quality assessments, the predictive care group consistently achieved significantly higher scores across all metrics. This stems from the establishment of dedicated teams within predictive care systems, which intensify training and evaluation of nursing personnel. This approach enhances operational proficiency and heightens risk awareness. Furthermore, the implementation of adverse event reporting and analysis systems enables staff to learn from past issues, continuously standardise procedures, and improve service timeliness and documentation integrity [5-6]. Concurrently, regular monitoring and rectification measures fostered more standardised and orderly nursing practices, further elevating overall care quality. Under conventional nursing models, staff training was often fragmented, lacking systematic structure and targeted focus, resulting in inadequate proficiency with operational procedures and diminished risk awareness among some personnel. Proactive nursing, through structured training programmes and rigorous assessment systems, ensured comprehensive mastery of instrument handling protocols and risk prevention knowledge, markedly improving procedural compliance. Regarding service timeliness, anticipatory nursing optimises processes and strengthens oversight, enabling staff to complete tasks more efficiently and ensuring timely instrument delivery to clinical departments. Enhanced record integrity stems from anticipatory nursing's emphasis on documentation. By clarifying recording requirements and conducting regular checks, it encourages staff to meticulously complete each entry, providing reliable evidence for work traceability. Furthermore, the incidence of adverse nursing events was lower in the proactive nursing group compared to the conventional nursing group, further demonstrating the advantages of proactive nursing. By implementing advance prevention, it reduced adverse events such as instrument damage, substandard packaging, and dispensing errors. This not only minimised the hospital's financial losses but also ensured the accuracy and safety of instrument supply, providing robust support for the smooth progression of clinical diagnostic and therapeutic work. Damaged instruments increase hospital procurement costs, substandard packaging risks recontamination of sterilised instruments, and dispensing errors may compromise the timeliness and accuracy of clinical care, potentially leading to medical disputes. By anticipating and intervening in these latent risks, predictive nursing reduces adverse events at source, yielding cost savings for hospitals while safeguarding the orderly progression of medical operations [7-8].

From a hospital management perspective, the implementation of anticipatory nursing measures has not only enhanced the quality of care within the Central Sterile Supply Department but also elevated the hospital's overall management standards. This approach embodies the principle of proactive management, shifting the focus from reactive post-event handling to pre-emptive prevention. By establishing comprehensive preventive and oversight mechanisms, it has fostered a closed-loop quality management system. This management model can be extended to other hospital departments, driving improvements in overall quality management standards. Concurrently, the implementation of anticipatory nursing measures has strengthened nursing staff's teamwork ethos and sense of responsibility. Under group leadership, colleagues engage in mutual learning and oversight, fostering a positive working environment that enhances efficiency and job satisfaction. Compared to other nursing models, anticipatory nursing places greater emphasis on risk anticipation and control. It transcends rigid adherence to fixed procedures, instead continuously adapting and optimising methodologies based on actual circumstances, thereby demonstrating superior flexibility and precision. This adaptability proves particularly crucial when confronting increasingly complex medical devices and escalating nursing demands. It enables the Central Sterile Supply Department to better accommodate diverse changes while consistently maintaining high standards of care [9-10].

In summary, anticipatory nursing measures enhance the quality of instrument cleaning and disinfection, as well as the standard of care delivered by nursing staff, by proactively identifying and intervening in potential issues within the workflow of the Central Sterile Supply Department. This approach addresses all stages of instrument processing and staff

management, thereby reducing the occurrence of adverse events.

Disclosure statement

The author declares no conflict of interest.

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