

Original Article

Standardized operating room nursing care is effective in preventing the occurrence of surgical wound infections

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Abstract: Objective: To analyze the clinical effectiveness of standardized operating room nursing care in preventing wound infections from orthopedic surgery. Methods: A total of 128 patients requiring orthopedic surgery were selected and divided into a control group and an observation group in accordance with the nursing care they received during surgery, with 64 patients in each group. Patients in the control group received conventional operating room nursing care, while those in the observation group received standardized operating room nursing care. The post-operative outcomes of patients in both groups, including wound healing rates, nursing management clinical indicators, incidence rates of wound infections and infection-associated complications, patients' mastery of infection-associated knowledge, patients' quality of life, and their satisfaction degree towards nursing care, were compared between groups. Results: Patients in the observation group showed a significantly higher wound healing rate compared to those in the control group ($P < 0.01$). The nursing management clinical indicators, such as the time to first eating and first ambulation after surgery, and the duration of hospital stay were all significantly shorter in the observation group than those in the control group (all $P < 0.01$). The incidence of postoperative wound infections in the observation group was 0.00%, which was significantly lower than the 21.88% observed in the control group ($P < 0.001$). After nursing care, the quality of life scores of patients in the observation group were significantly better than those in the control group ($P < 0.01$). The study also found that the overall satisfaction of patients in the observation group was 98.44%, significantly higher than 84.38% observed in the control group ($\chi^2 = 27.349$, $P < 0.001$). Conclusion: Standardized operating room nursing care is an effective way to prevent the occurrence of surgical wound infections. This kind of care helps patients establish healthy lifestyles and assists in improving relevant clinical indicators, which is worthy of being promoted in clinical settings.

Keywords: Standardized operating room nursing care, surgery, wound infection, clinical effectiveness

Introduction

The operating room (OR) is a facility designed for performing surgeries and providing emergency care to patients [1]. Every detail in surgical processes is highly important, especially in the nursing care process, where a minor mistake or negligence during the processes might become the prelude to severe consequences. A mistake or negligence is usually hidden beneath medical staff's careless operations, as invisible waves underneath a current, once triggered, could result in irreversible wound infections, and in severe cases, medical disputes [2].

Orthopedic surgery's complexities and invasive nature are undoubtedly primary factors leading

to the increase of post-operative infection risks. In most cases, surgeons typically make large incisions to directly access and operate on the bones, joints or soft tissues [3]. These extensive wounds not only complicate the surgical process but also make post-operative nursing care more challenging for patients. For instance, in hip replacement surgery, the surgeon must cut through skin and muscle on the upper leg to expose the hip's internal structure. While such an approach aims to achieve superior treatment outcomes, it also results in larger wounds and prolonged healing time, thereby increasing the risks of wound infections. Infections typically result from a variety of factors [4]. One critical factor is the surgical environment. Despite the use of state-of-the-art aseptic tech-

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niques and strict sterilization processes for medical devices, the risks of infection are still unavoidable in clinical practice. Additional factors, such as air quality in the operating room, the level of sterility of medical devices and procedural handling by the medical staff, also play significant roles in impacting the occurrence of infections [5].

Previous research has indicated that enhancing operating room nursing care is conducive to improving nursing efficacy and reducing the occurrence of infections. Nonetheless, these papers primarily focus on infection rates in clinical practice and a few focus on the comparison between hematologic inflammatory indicators and patients' quality of life [6]. Therefore, this study has investigated the impacts of standardized nursing room nursing care on the occurrence of infections in patients undergoing orthopedic surgery, with a purpose of offering more research targets for reducing wound infection rates.

Materials and methods

General data

A retrospective study was conducted on 128 patients requiring orthopedic surgery admitted to XD GROUP HOSPITAL between January 2020 and January 2021. Among them, patients receiving routine operating room nursing from January-December 2020 served as the control group, while patients receiving standardized operating room nursing from January-December 2021 were placed in the observation group. All patients met the surgical indications and gained approval from the XD GROUP HOSPITAL's ethics committee. Inclusion criteria: 1. Patients aged 18-70 years old; 2. All patients met the surgical indications; 3. Patient having orthopedic disease for the first time; 4. Patients who completed the whole treatment cycle in our hospital; Exclusion criteria: 1. Pregnant/lactating women; 2. Multiple fractures; 3. Other infected organs; 4. Incomplete hospitalization data; 5. People with communication difficulties; 6. Patients with other serious organic and blood diseases; 7. Patients with malignant tumors and serious abnormalities in cardiopulmonary, liver and kidney function.

Methods

Control group: Patients in the control group received conventional operating room nursing

care. This approach mainly focused on basic assistance from nursing staff to perform the surgery and proper handover to ward nurses after surgery [7].

Observation group: On top of the treatments received by patients in the control group, patients in the observation group underwent additional standardized operating room nursing care [8].

(1) Standardized operating room nursing care skill training: Primary training content: technical nursing care operations tailored to orthopedic surgery, education of high-risk infection factors, infection prevention and control approaches, operation standards and management of medical instruments and equipment, job responsibilities of nursing staff, emergency plans, orthopedic surgery cooperation procedures, special equipment preparation and so on. By systematic training, nursing care staff could not only master professional skills for orthopedic surgery but also strengthen their ability to recognize high-risk wound infection factors and improve their response to the occurrence of infections. During the training, details on how to recognize risk factors triggering wound infections before and after surgery would be delivered, which include patient's underlying diseases, surgery type and post-operative care. This knowledge enables nursing staff to handle emergencies calmly in their work. In addition, nursing staff could also gain specific methods in relation to infection prevention and control. These methods encompass hand hygiene, aseptic techniques, and instrument disinfection. With the mastery of this knowledge, nursing staff will not only enhance their professional competence but also effectively reduce the incidence of hospital-acquired infections, improving patients' treatment outcomes. Moreover, the training content included case analysis study, allowing medical staff to understand the importance of infection prevention and control, and to gain measures in this regard as well in clinical practices. Besides, this kind of training enables nursing staff to understand the working nature of medical instruments and master their operation and management rules. Regular training not only helps nursing staff become familiar with the types and uses of medical instruments but also enables them to swiftly and precisely prepare and handle instruments in complex surgeries. The improvement of nursing staff's professional capabilities is in direct

association with the smooth progress of surgery and patients' safety. The training can be more effective and targeted if the nursing staff are stratified based on their working years and the mastery of professional skills. New nursing staff often lack practice, whereas experienced staff can help the newcomers quickly adapt to the hospital environment through one-on-one teaching of their own experiences and skills. Such types of apprentice-mentor training can not only enhance the effectiveness of their work but also build a harmonious and cooperative working environment. Lastly, emergency preparation training is also crucial. Nursing staff should be equipped with prompt response and handling abilities, as there are various emergent events occurring in hospitals. Only through regular training can they learn about the hospital's emergency plans and know what different strategies should be applied under different emergent circumstances. The accumulation of this knowledge can help nursing staff remain calm in the time of emergencies and lower the incidence of medical accidents, ensuring patients' safety [9].

(2) Standardized aseptic surgery: All moisture-resistant and high-temperature items in the orthopedic operating room should be subjected to high-temperature pressure sterilization, with a steam temperature of 121°C and a sterilization time of 30 minutes. Nursing staff should check the expiration dates of sterile items monthly, and those that are beyond their expiration dates should be replaced promptly. Scalpels, scissors, and other sharp instruments for wound cleaning should be put in high-pressure sterile packages for protection. Nursing staff should frequently change their masks and surgical clothing, especially when their gloves are damaged, they should be replaced immediately. Before surgery, nursing staff should carefully carry out disinfection procedures and strictly implement the principle of aseptic operations [10].

(3) Preoperative care: ① Assessment of Patient Conditions: Nurses offer prompt explanations of relevant treatment methods and medical information to patients, actively delivering supportive guidance; ② Development of Personalized Nursing Plans: Led by senior management, nurses collaboratively analyze and discuss existing issues and challenges in current nursing practices. This approach facilitates mu-

tual dialogue and deliberation regarding patients' rehabilitation, fostering a deeper comprehension of patients' knowledge and proficiency in self-care. On this basis, nurses were able to provide more refined care, closely monitor the patients' symptoms, and actively engage with patients to understand their feelings during treatment process. This process helped identify deficiencies in the treatment approach, enabling collaborative development of a more effective nursing plan [9]. Intraoperative Care: Nursing staff interacted directly with patients, and the first impression they conveyed significantly shaped patients' subsequent perceptions and attitudes. Consequently, nursing staff upheld a warm and amiable presence when carrying out treatment, employing a smile and affable, compassionate language to foster effective communication with patients. They approached patients with the utmost kindness and a soothing tone, and closely monitored all the indicators of patients, ensuring that their blood pressure was maintained within the range of 120-150 mmHg/80-90 mmHg. When adverse events did emerge, nursing staff promptly communicated with clinical physicians to implement appropriate treatment measures [10]. Postoperative Care: Nurses provided a personalized and balanced diet that aligned with patients' therapeutic regimen and unique conditions, strictly controlling dietary indicators. It was also important to ensure that patients maintained good sleeping habits, ideally going to bed and getting up early, to facilitate a quicker recovery. Throughout treatment, many patients encountered negative emotions due to their health condition or family dynamics. Therefore, nurses engaged in regular and empathetic communication with patients to minimize these negative psychological impacts. During interactions, nurses actively sought to understand patients' feelings about treatment process to identify any deficiencies. Additionally, it is essential to involve specialized staff in providing rehabilitation guidance. Healthcare professionals can use platforms like WeChat to conduct offline peer education and specialized seminars, offering timely explanations of treatment methods and medical information. This allows for systematic responses to patient inquiries and encourages patients to engage in regular exercise, helping them manage relevant indicators and reduce the occurrence of complications.

Evaluation measures

Primary outcome measures: ① The degree of postoperative wound healing was recorded, categorized into three levels: Grade A, Grade B, and Grade C healing. Grade A healing indicates excellent healing without adverse reactions. Grade B healing refers to healing with mild inflammatory reactions, such as induration, redness, swelling, hematoma, or seroma, but without suppuration, which can achieve primary healing through active management. Grade C healing indicates the presence of suppuration at the incision site, requiring incision and drainage for complete healing, commonly seen in purulent diseases. Meanwhile, the incidence of infection complications, such as organ, nerve or vascular damages, deep infections, adjacent segment injuries, pulmonary embolism, wound dehiscence, as well as patients' mastery of infection-related knowledge (through questionnaires designed for this study, finished by patients upon discharge, with total score of 50, and a score no less than 40 suggesting complete mastery of the knowledge) were compared between the control group and the observation group. ② Comparison of the time to first postoperative eating and ambulation, the duration of hospital stays, and inflammatory response indicators were compared between the two groups. ③ The incidence of postoperative wound infections, calculated as: postoperative wound infection rate = (the number of postoperative wound infection cases/the total number of cases) × 100.00%.

Secondary outcome measures: ① The quality of life of patients were recorded upon discharge using the SF-36 Quality of Life Scale developed by the American Medical Research Group [11]. This scale evaluates various aspects, including physical function, psychological function, social function, material life, and treatment conditions, with higher scores indicating a better quality of life of patients. ② Upon discharge, the satisfactory degrees of patients were evaluated between the two groups, by a questionnaire designed specifically for this study purpose. The assessment focuses on aspects such as the attitude of nursing staff, their professional competence, the level of concern towards patients, treatment environment, and diagnostic and treatment skills. Satisfaction was classified into three categories: satisfied, basically satisfied, and dissatisfied. The satisfactory rate towards nursing care was calculated

as: (the number of satisfied patients + the number of basically satisfied patients)/the total number of patients × 100%.

Statistical analysis

All research data were analyzed using SPSS 22.0 statistical software. Measurement data underwent normality testing and were presented as mean ± standard deviation ($\bar{x} \pm s$) if they conformed to a normal distribution. An independent sample t-test was used for comparisons between groups, while a paired t-test was used for within-group comparisons before and after interventions. Counting data were expressed as frequency/percentage (n/%) and analyzed using the chi-square test. A *P*-value of less than 0.05 was considered statistically significant.

Results

Comparison of basic information between the two groups

In this study, no statistically significant differences were found in patients' basic information, such as age, gender, the presence of underlying diseases including hypertension, diabetes, surgical classification, BMI, between the two groups (all *P* > 0.05). The specific details are shown in **Table 1**.

Comparison of postoperative wound healing between the two groups

The rate of Grade A healing in the observation group was significantly higher than that in the control group (*P* < 0.01). The specific results are shown in **Table 2**.

Comparison of clinical indicators related to nursing management between the two groups

The observation group had significantly shorter times for first postoperative eating and ambulation, as well as shorter hospital stay compared to the control group (all *P* < 0.01). The specific results are shown in **Table 3**.

Comparison of postoperative wound infection rates between the two groups

The incidence of postoperative wound infections in the observation group was 3.13%, significantly lower than 21.88% observed in the control group (*P* = 0.003), as shown in **Table 4**.

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Table 1. Comparison of basic information between the two groups (n, $\bar{x} \pm s$)

Variable	Control group (n = 64)	Observation group (n = 64)	t/X ²	P
Age (y)	44.7±5.7	45.2±5.4	-0.509	0.611
Average weight (kg)	58.26±3.74	58.63±3.69	-0.563	0.574
Gender			0.281	0.596
Male	30	33		
Female	34	31		
Hypertension			0.031	0.860
Yes	33	32		
No	31	32		
Diabetes			0.127	0.722
Yes	29	27		
No	35	37		
Grading of orthopedic surgery			0.041	0.840
Grade 1 healing	12	13		
Grade 2 healing	24	25		
Grade 3 healing	17	16		
Grade 4 healing	11	10		
Prophylactic antibiotic			0.031	0.860
Yes	32	33		
No	32	31		
Operation Duration (h)	2.85±1.22	2.93±1.18	-0.377	0.707
Intraoperative blood loss (mL)	61.53±4.15	61.77±4.09	-0.314	0.754
BIM	62.15±5.65	61.89±5.61	0.261	0.794

Note: BMI: Body mass index.

Table 2. Comparison of postoperative wound healing between the two groups [n (%)]

Group	Healing condition		
	Class A	Class B	Class C
Control group (n = 64)	53 (82.81)	7 (10.94)	4 (6.25)
Observation group (n = 64)	64 (100.00)	0 (0.00)	0 (0.00)
X ²		12.034	
P		0.001	

Table 3. Comparison of clinical indicators related to nursing management between the two groups ($\bar{x} \pm s$)

Group	Time to start eating after surgery (h)	Time to get out of bed (h)	Length of stay (d)
Control group (n = 64)	28.09±5.25	28.09±2.86	29.43±4.09
Observation group (n = 64)	25.54±4.14	23.73±2.19	25.71±3.47
T	3.051	9.683	5.548
P	0.003	< 0.001	< 0.001

Comparison of inflammatory response factors before and after intervention between the two groups

The study results showed that the postoperative levels of WBC, serum CRP, and IL-6 in-

creased in both groups compared to their pre-operative levels (all P < 0.05). However, the increase in these indicators was less pronounced in the observation group compared to the control group. Details are shown in **Figure 1**.

Table 4. Comparison of incision infection rate between the two groups

Group	Cases	Infected/Non-infected
Observation group	64	2/62
Control group	64	14/50
χ^2		12.286
P		0.003

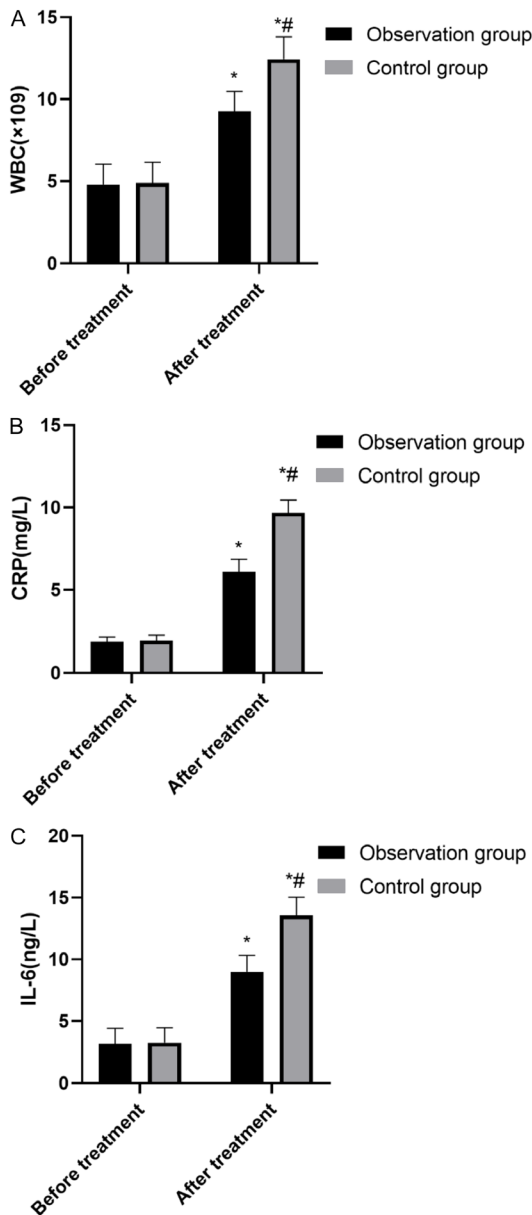


Figure 1. Serum inflammatory markers WBC, CRP, and IL-6 levels in both groups. A: Comparison of white blood cell count before and after treatment in both groups; B: Comparison of CRP levels before and after treatment in both groups; C: Comparison of IL-6 levels before and after treatment in both groups. Note: Compared with before treatment, *P < 0.05; Compared with observation group after treatment, #P < 0.05.

Comparison of the incidence rate of infection complications and the mastery of infection-related knowledge between the two groups

The results of this study indicated that the incidence rate of wound infection complications was lower and the mastery of infection-related knowledge higher in the observation group than those in the control group (all P < 0.05). See **Table 5**.

Comparison of quality of life between the two groups

Before intervention, there was no statistically significant difference in the quality of life scores between the observation group and the control group (P > 0.05). After intervention, the prognostic quality of life scores for both groups were significantly better than before nursing care, with the observation group showing higher scores than the control group (P < 0.01). The specific results are shown in **Table 6**.

Comparison of patient satisfaction between the two groups

The study found that the overall patient satisfaction in the observation group (98.44%) was significantly higher than that in the control group (84.38%) ($\chi^2 = 27.349$, P < 0.001). The specific results are shown in **Table 7**.

Discussion

Orthopedic surgery, as an important surgical category, has been constantly giving health back to human beings. However, underlying this type of surgery there are various risks and challenges, particularly the risk of infections due to open wounds. Infections are not conducive to the recovery of patients' health. Which could result in severe consequences for patients undergoing orthopedic surgery, hence lowering the incidence rate of infections has become the goal of sterile operations in the operating room. This goal will not only determine the success or failure of the surgery, more importantly, it is a crucial factor that influences patients' post-operative recovery and quality of life. In addition, whether the wounds of patients will be infected or whether they will gain their health back successfully also determines the relationship between patients and doctors [11, 12]. The management mode in operating rooms is a critical component for nursing care as well, which can significantly improve patients' physi-

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Table 5. Comparison of the incidence rates of wound infections, complications and the mastery of infection-related knowledge between the two groups

Group	Complication cases	The mastery rate of infection-related knowledge
Observation group (n = 64)	2	63%
Control group (n = 64)	10	56%
χ^2	5.889	4.303
P	0.015	0.016

Table 6. Comparison of quality of life scores before and after intervention between the two groups ($\bar{x} \pm s$, points)

Project	Observation group (n = 64)		Control group (n = 64)	
	Pre-care	After care	Pre-care	After care
Quality of Life	95.62±12.33	100.56±9.14 ^{**##}	95.45±12.33	97.85±12.89 ^{**}
Psychological Function	46.87±6.85	52.63±8.56 ^{**##}	46.52±7.02	49.99±8.45 ^{**}
Physical Function	22.56±4.59	30.47±6.56 ^{**##}	22.75±4.69	25.89±5.03 ^{**}
Social Relationships	15.11±2.58	19.87±3.65 ^{**##}	14.23±3.66	16.21±2.87 ^{**}
Treatment Condition	11.08±3.21	16.99±3.78 ^{**##}	11.15±1.26	13.17±1.23 ^{**}

Note: Compared with before nursing care, ^{**}P < 0.05; compared with the control group, ^{##}P < 0.05.

Table 7. Comparison of satisfaction towards nursing care between the two groups

Group	Satisfied	Basically satisfied	Dissatisfied	Total satisfaction
Observation group (n = 64)	33	30	1	63/64
Control group (n = 64)	30	26	8	56/64
χ^2		27.349		
P		< 0.001		

cal conditions and help mitigate their negative psychological impact. It also facilitates efficient dialogue between doctors and patients, promoting better recovery. This approach has garnered considerable attention and has been widely adopted by many healthcare professionals [13].

Studies have suggested that surgical duration, the use of antibiotics, operating room environment, the control of operating room visitors as well as the selections of surgical materials are all essential factors affecting hospital-acquired infections in patients undergoing orthopedic surgery [14]. Therefore, through effectively controlling these high-risk factors, medical facilities will not only lower the incidence rate of infections but also improve the overall quality of operating room nursing care management, ensuring patients' health and life safety. It has been reported that surgical duration is closely related to hospital-acquired infections [15]. Longer surgical duration suggests prolonged expose of wounds to the air, resulting in in-

creased risks of infections. Moreover, factors, such as the temperature, humidity and ventilation in the operating room, all have impacts on the incubation of bacteria [16]. It has been demonstrated that a suitable temperature and humidity can effectively inhibit the growth of bacteria, and good ventilation is conducive to expelling the bacteria in the air [17]. The number of visitors in the operating room also plays a significant role, each one of them could become a potential source of infection. In particular, the presence of outsiders in the operating room can not only impact the efficacy of operation but also bring in bacteria from outside. Therefore, hospitals should limit the number of visitors staying in the operating room when establishing operating room management standards and enhance the cleaning and disinfection of the operating rooms to minimize the risk of wound infections [18].

The study's findings indicated that patients in the observation group exhibited lower incidence and higher healing rates of wound infec-

tions, and lower peripheral blood inflammatory blood indicators compared to those in the control group. The underlying mechanisms might be that standardized operating room nursing care and professional skill training can effectively improve nursing staff's understanding of professional skills and awareness of operating room management, fundamentally changing adverse working procedures and maximizing their initiatives in work, which allows them to carry out their operating room nursing work with a positive attitude and well-prepared professional skills. In comparison to other surgeries, nursing care in orthopedic surgery has unusual complexity and professionalism [19]. It is largely involved with the repair and reconstruction of bones, joints and soft tissues, which typically require exquisite operational skills and prolonged surgical duration. Hence, nursing staff must possess solid professional knowledge and proficient operational skills during surgical process. Training is not only a way of delivering related knowledge, but also a grindstone that polishes one's professional skills and a way of accumulating knowledge for real-world practices [20]. Therefore, professional skill training has become critical. It will not only help nursing staff master basic nursing theories, but also enable them to flexibly handle all kinds of emergencies in practices, thereby reducing surgical duration, lowering the risk of infection and promoting the recovery of patients' health, which conforms to previous reports [21, 22].

Additionally, it was found in this study that standardized operating room nursing care significantly enhanced patients' quality of life. This might be associated with the fact that operating room nursing care poses impacts on patients' mental health. Many patients feel anxious, depressed, even lost towards the future after surgery. When dealing with this situation, nursing staff can help patients release negative feelings and strengthen their confidence for a full recovery through the application of professional psychological counselling skills. Such kind of psychological support can not only facilitate a healthy recovery of patients but also improve their quality of life, conforming to the results from previous studies [23, 24]. Lastly, the comparison of nursing satisfaction between the two groups revealed that the satisfactory degree of patients in the observation group was higher than that in the control group. This might be related to nursing staff's explanation

of surgical procedures and precautions as well as post-operative recovery related education for patients to reduce their anxiety. Research has suggested that sufficient explanations to patients about surgery will soothe their anxiety, which is a key to improving their satisfaction. Meanwhile, prompt post-operative recovery and the attitude of nursing staff as well as their emotional support can markedly elevate the satisfactory degree of patients, which is in line with previous studies [25-29]. Once again, it was confirmed that the popularization of nurses' empowered expertise can improve patient care satisfaction.

In summary, standardized operating room nursing care could reduce the incidence of infections after orthopedic surgery, promote post-operative recovery and in the meantime improve patients' quality of life as well as their nursing care satisfaction, and it is worthy of clinical applications. However, this study has its limitations, it only investigated a narrow scope of aspects. Therefore, the exploration of the application value of individualized nutritional nursing care remains insufficient. Additionally, the study had a small sample size and a short follow-up period. Further research will be conducted in the future to address these limitations.

Disclosure of conflict of interest

None.

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References

- [1] Ruetzler K, Bustamante S, Schmidt MT, Almonacid-Cardenas F, Duncan A, Bauer A, Turan A, Skubas NJ and Sessler DI; Collaborative VLS Trial Group. Video laryngoscopy vs direct laryngoscopy for endotracheal intubation in the operating room: a cluster randomized clinical trial. *JAMA* 2024; 331: 1279-1286.
- [2] Bolten A, Kringos DS, Spijkerman IJB and Sperna Weiland NH. The carbon footprint of the operating room related to infection prevention measures: a scoping review. *J Hosp Infect* 2022; 128: 64-73.
- [3] Montiel V, Pérez-Prieto D, Perelli S and Monllau JC. Fellows and observers are not a problem

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- for infection in the operating rooms of teaching centers. *Trop Med Infect Dis* 2021; 6: 43.
- [4] He Y, Chen J, Chen Y and Qian H. Effect of operating room nursing management on nosocomial infection in orthopedic surgery: a meta-analysis. *J Healthc Eng* 2022; 2022: 4193932.
- [5] Chellam Singh B and Arulappan J. Operating room nurses' understanding of their roles and responsibilities for patient care and safety measures in intraoperative practice. *SAGE Open Nurs* 2023; 9: 23779608231186247.
- [6] Liu Q, Wang J, Han J and Zhang D. Effect of combining operating room nursing based on clinical quantitative assessment with WeChat health education on postoperative complications and quality of life of femoral fracture patients undergoing internal fixation. *J Healthc Eng* 2022; 2022: 2452820.
- [7] Sadrizadeh S, Pantelic J, Sherman M, Clark J and Abouali O. Airborne particle dispersion to an operating room environment during sliding and hinged door opening. *J Infect Public Health* 2018; 11: 631-635.
- [8] Liu X, Wei Y, Pei J and Wu X. Construction and application of standardized training effect evaluation system for new nurses in operating room. *Health Care Sci* 2023; 2: 392-399.
- [9] Sha J, Zhu X, Xu Y, Hong D, Hu H, Yan Y and Jiang Y. Nursing team training and standardized management in hybrid OR. *Altern Ther Health Med* 2024; 30: 498-503.
- [10] Davies BM, Jones A and Patel HC. Implementation of a care bundle and evaluation of risk factors for surgical site infection in cranial neurosurgery. *Clin Neurol Neurosurg* 2016; 144: 121-125.
- [11] Lukaszewski RA, Jones HE, Gersuk VH, Russell P, Simpson A, Brealey D, Walker J, Thomas M, Whitehouse T, Ostermann M, Koch A, Zacharowski K, Kruhoffer M, Chaussabel D and Singer M. Presymptomatic diagnosis of postoperative infection and sepsis using gene expression signatures. *Intensive Care Med* 2022; 48: 1133-1143.
- [12] Li N, Wei S, Qi Y and Wei W. The effects of enhanced recovery after surgery on wound infection, complications, and postoperative hospital stay in patients undergoing colorectal surgery: a systematic review and meta-analysis. *Int Wound J* 2023; 20: 3990-3998.
- [13] Wukich DK, Crim BE, Frykberg RG and Rosario BL. Neuropathy and poorly controlled diabetes increase the rate of surgical site infection after foot and ankle surgery. *J Bone Joint Surg Am* 2014; 96: 832-839.
- [14] Scigliano NM, Carender CN, Glass NA, Deberg J and Bedard NA. Operative time and risk of surgical site infection and periprosthetic joint infection: a systematic review and meta-analysis. *Iowa Orthop J* 2022; 42: 155-161.
- [15] Muilwijk J, van den Hof S and Wille JC. Associations between surgical site infection risk and hospital operation volume and surgeon operation volume among hospitals in the Dutch nosocomial infection surveillance network. *Infect Control Hosp Epidemiol* 2007; 28: 557-563.
- [16] Boonrattanakij N, Yomchinda S, Lin FJ, Belotindos LM and Lu MC. Investigation and disinfection of bacteria and fungi in sports fitness center. *Environ Sci Pollut Res Int* 2021; 28: 52576-52586.
- [17] Xu C, Chen H, Liu Z, Sui G, Li D, Kan H, Zhao Z, Hu W and Chen J. The decay of airborne bacteria and fungi in a constant temperature and humidity test chamber. *Environ Int* 2021; 157: 106816.
- [18] Rosoff PM. In defense of (some) altered standards of care for Ebola infections in developed countries. *HEC Forum* 2015; 27: 1-9.
- [19] Park KW and Dickerson C. Can efficient supply management in the operating room save millions? *Curr Opin Anaesthesiol* 2009; 22: 242-248.
- [20] Koivunen M and Saranto K. Nursing professionals' experiences of the facilitators and barriers to the use of telehealth applications: a systematic review of qualitative studies. *Scand J Caring Sci* 2018; 32: 24-44.
- [21] Wang P, Chen H and Ji Q. Application of operating room nursing intervention to incision infection of patients undergoing gastrointestinal surgery can reduce complications and improve gastrointestinal function. *Front Surg* 2022; 9: 842309.
- [22] Miller N, Frankenfield D, Lehman E, Maguire M and Schirm V. Predicting pressure ulcer development in clinical practice: evaluation of braden scale scores and nutrition parameters. *J Wound Ostomy Continence Nurs* 2016; 43: 133-139.
- [23] Ahtiala MH, Soppi E and Kivimäki R. Critical evaluation of the Jackson/Cubbin pressure ulcer risk scale - a secondary analysis of a retrospective cohort study population of intensive care patients. *Ostomy Wound Manage* 2016; 62: 24-33.
- [24] Setoguchi Y, Ghaibeh AA, Mitani K, Abe Y, Hashimoto I and Moriguchi H. Predictability of pressure ulcers based on operation duration, transfer activity, and body mass index through the use of an alternating decision tree. *J Med Invest* 2016; 63: 248-255.
- [25] Ness SJ, Hickling DF, Bell JJ and Collins PF. The pressures of obesity: the relationship between obesity, malnutrition and pressure injuries in hospital inpatients. *Clin Nutr* 2018; 37: 1569-1574.

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- [26] Montalcini T, Moraca M, Ferro Y, Romeo S, Serra S, Raso MG, Rossi F, Sannita WG, Dolce G and Pujia A. Nutritional parameters predicting pressure ulcers and short-term mortality in patients with minimal conscious state as a result of traumatic and non-traumatic acquired brain injury. *J Transl Med* 2015; 13: 305.
- [27] Lussi C, Frotzler A, Jenny A, Schaefer DJ, Kreszig RW and Scheel-Sailer A. Nutritional blood parameters and nutritional risk screening in patients with spinal cord injury and deep pressure ulcer-a retrospective chart analysis. *Spinal Cord* 2018; 56: 168-175.
- [28] Li Q, Wu X, Xu L, Chen K and Yao L; Alzheimer's Disease Neuroimaging Initiative. Classification of Alzheimer's disease, mild cognitive impairment, and cognitively unimpaired individuals using multi-feature kernel discriminant dictionary learning. *Front Comput Neurosci* 2018; 11: 117.
- [29] Otero TMN, Canales C, Yeh DD, Elsayes A, Belcher DM and Quraishi SA. Vitamin D status is associated with development of hospital-acquired pressure injuries in critically ill surgical patients. *Nutr Clin Pract* 2019; 34: 142-147.