

Research Progress on Nursing Interruptions in the Operating Room

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Abstract: In recent years, research on nursing interruptions has been conducted at various levels in emergency departments, intensive care units, hemodialysis centers, operating rooms, and sterilization and supply centers. Nursing interruptions are closely related to adverse nursing events, and interruptions in operating room nursing can significantly impact the success of a patient's surgery. However, there is a lack of in-depth theoretical research on safety risk assessment and response decision-making by operating room nurses when faced with nursing interruptions. This article reviews the concept, current status, and impact of nursing interruptions in the operating room, analyzes the cognitive level, coping strategies, and negative emotions of operating room nurses, and elaborates on management strategies to provide references for research and management of nursing interruptions in the operating room.

Keywords: Operating room nursing; Nursing interruptions; Safety management

Online publication: Oct 16, 2025

1. Introduction

The operating room is a complex work environment with interconnected departments and dynamically changing patient conditions. Operating room nurses are easily disrupted by external environmental factors, colleagues, patients, and other uncertainties, leading to frequent interruptions in ongoing nursing tasks ^[1]. An observational study found that the incidence of nursing interruptions during surgical item counting was 63.4%, and the presence of high-frequency nursing interruptions is prone to causing nursing errors ^[2,3]. According to the "Action Plan for Improving Surgical Quality and Safety (2023–2025)" issued by the General Office of the National Health Commission, it emphasizes the need to further improve the surgical quality and safety management system ^[4]. Therefore, this article aims to develop practical and effective prevention strategies for interruptions in the operating room by elaborating on the concept, current status, and management strategies of nursing interruptions in the operating room, thereby controlling and reducing the occurrence of nursing interruptions in the operating room.

2. Core concepts of nursing interruption events

2.1. Definition

Previous study defines nursing interruption events (NI) as a sudden external behavior that occur unexpectedly, interrupt, or delay ongoing tasks, and distract nurses' attention during the provision of ethically appropriate nursing services within a specified time, role, and environment ^[5]. Interruption events primarily disrupt work continuity by interfering with personal attention and undermining prospective memory, leading to work errors or repetitive tasks ^[6].

2.2. Sources and related factors

Operating rooms are characterized by a fast-paced work environment, rapid technological and equipment updates, frequent interdisciplinary collaboration, and nurses often performing multiple tasks simultaneously, which increases the risk of current tasks being interrupted during surgical procedures ^[7]. Bretonnier et al. summarized that team cohesion, equipment technology, professional expertise, and high workloads are the primary causes of NI ^[8]. Some scholars have found that case-irrelevant verbal communication and smartphone use are major sources of distraction during surgical procedures ^[9].

Wang Xiaomei et al. categorized the sources of interruptions as below

- (1) Operating room perspective: Environmental factors and equipment factors;
- (2) Surgical team perspective: Technical factors, education and training factors, and teamwork factors; and
- (3) Patient perspective: Patient-related factors.

These source issues must be addressed by or in collaboration with operating room nurses, inevitably leading to NI in the operating room ^[10]. Guo Dong et al. collected and analyzed data on NI during surgical item counting, indicating that the number of surgeons, surgical duration, multi-specialty surgeries, emergency surgeries, the working experience of circulating nurses, and the educational background of scrub nurses are risk factors for NI occurring during critical surgical stages ^[3]. Han Xiaoyun et al. found that surgeons, anesthesiologists, the environment, colleagues, and patients are all major sources of NI during surgeries ^[11]. Foreign scholars primarily analyze NI in operating rooms from external factors related to nurses, while Chinese scholars have noted that internal factors within nurses or mutual interference among nurses are also significant sources of NI in operating rooms.

The smooth execution of a surgical procedure requires coordination among operating room nurses and multiple related departments, such as the anesthesia department, surgical ward, intensive care unit, blood transfusion department, pathology department, and equipment department. Additionally, adjustments must be continuously made to address unpredictable surgical needs, including medication, equipment, and consumables, based on the progress of the surgery ^[7]. The operating room nursing environment and tasks are complex and diverse, leading to various sources of mutual interference.

2.3. Types and outcomes

Sociologists Jett and George categorized interruptions into four types: intrusive, distractive, conflicting, and destructive ^[12]. Intrusive interruptions are unexpected and unpredictable disturbances that hinder work continuity, such as damage to surgical instruments during a procedure, errors in counting supplies, or alarms from the anesthesia machine ^[13]. Distractive interruptions involve behaviors that prevent individuals from concentrating on current tasks or fully shifting their attention to external activities, such as poor communication within the surgical team, inefficient coordination among nurses, or sounds from operating room equipment ^[14]. Conflicting

interruptions occur when personal theories or expectations contradict or oppose current tasks, such as sudden changes in surgical methods or positive results from intraoperative frozen pathology. Destructive interruptions completely disrupt work continuity or damage the main workflow, such as contamination of the surgical instrument table.

Research indicates that intrusive and distractive interruptions (referred to as NIs) are the most common types. Additionally, the outcomes of NIs are classified as positive or negative ^[15]. Positive outcomes have a positive impact on nursing work by promptly terminating and/or avoiding adverse consequences ^[16]. For example, a surgeon alerting the instrument nurse to an incorrect joint prosthesis size or conducting a surgical safety check. Negative outcomes refer to interruptions in nursing procedures that meet any of the following criteria, including pausing the nurse's current tasks, failing to resume the current task after handling the interruption, increasing the nurse's workload, or causing adverse nursing events ^[17]. Studies have shown that nearly 90% of the outcomes of nursing interruptions (NI) were negative ^[6]. This is primarily because NI can interfere with nurses' attention and prospective memory, leading to information delays or forgetfulness, increasing the likelihood of decision-making errors and repetition, and ultimately raising the risk of human errors ^[18]. Cohen et al. argued that frequent NI can deplete the compensatory resources of surgical teams, increasing the likelihood of errors or adverse events during surgery ^[19]. For example, a scrub nurse may become distracted and mistakenly pass endoscopic scissors instead of endoscopic vascular forceps to the surgeon, be interrupted during item counting leading to omissions or recounts, or experience communication breakdowns during surgical safety checks among the surgical team, causing information interruptions. As a treatment venue for the rescue of critically ill patients, the operating room has a heavy nursing workload and a higher risk of NI ^[6]. Once negative outcomes occur, they can lead to prolonged surgery times, increased workloads for surgical personnel, and heightened surgical risks, easily resulting in adverse nursing events ^[20].

2.4. Coping strategies

Most operating room nurses were not adapting for identifying and responding to NI in the operating room, and some even consider NI to be an inherent part of their nursing duties ^[21]. When dealing with NI, they primarily adopt immediate coping strategies, such as task switching, followed by multitasking, and rarely employ delaying or refusing strategies ^[22]. Studies have indicated that compared to immediate coping, delaying or refusing strategies have a lesser negative impact on nursing work ^[23]. Senior and highly qualified operating room nurses are more proficient in workflow, possess more nursing experience, and have higher risk assessment capabilities. During NI, they can prioritize current and interrupted events, adopting more appropriate coping strategies ^[24].

3. Current status of NI in operating rooms

3.1. Nurses' cognitive levels and training status

In recent years, many scholars have conducted extensive and in-depth investigations into nursing interruptions (NI), yet nurses still lack awareness of NI, and the level of management practice remains inadequate ^[25]. Nurses fail to recognize that NI disrupts the workflow of current tasks and lack an understanding of the potential negative outcomes that may arise ^[26]. The cognitive level of nurses determines their coping strategies, thereby influencing the final patient outcomes ^[27]. Therefore, how to effectively manage NI is a crucial issue concerning patient safety. However, over 50% of nurses are unclear about the coping measures for NI and their impact on patients and

themselves^[25]. Currently, domestic school education has not yet incorporated education on NI, and the avenues for nurses to acquire relevant knowledge are limited^[28]. Research by Wu Chengcheng et al. revealed that only 28.16% of operating room nurses have received NI training, all of which were training courses organized by their departments or hospitals, and 87.37% of operating room nurses believed that systematic NI training was necessary^[24]. It can be seen that operating room nurses have insufficient awareness of NI, a strong desire for training, but limited training channels, indicating a concerning training status.

3.2. Incidence of NI in operating rooms

Research by Bretonnier et al. showed that surgical interruptions occur on average 2.4–114 times per hour^[8]. Catchpole et al. found that robotic surgeries experience an average of 48 interruptions per procedure^[29]. Jung et al. discovered that 45% of surgeries involve interruptions^[30]. Guo Dong et al. found that the overall incidence rate of NI during surgical item counting reached as high as 63.4%, and high-frequency interruptions are prone to causing nursing errors^[2]. Currently, there is limited research on the current state of NI in operating rooms in China. Therefore, there is an urgent need to investigate NI in operating rooms, explore its risk factors, and implement effective preventive measures.

3.3. Impact of NI in operating rooms

3.3.1. Increasing surgical costs and risks for patients

The study by Willett et al. revealed that interruptions extended the average surgical duration by 6.12 minutes^[31]. Van Winkle et al. proposed a formula for calculating the cost of surgical delays, indicating that each additional minute results in an extra \$20 in medical expenses^[32]. Kalisch et al. found that nursing interruptions (NI) led to 1.5 nursing errors per hour^[33]. Frequent interruptions result in higher mental workload, thereby increasing the likelihood of task errors. NI often leads to multitasking and cognitive overload, posing a threat to patient safety^[34]. During NI in the operating room (OR), current tasks include nursing documentation, inventory checks, patient care, sterile procedures, and specimen management, all of which directly impact patient safety^[35]. Given the high costs and consequences of NI, minimizing OR interruptions and enhancing OR efficiency are crucial for reducing costs, improving quality, and ensuring patient safety.

3.3.2. Inducing negative emotions in nurses

As the proportion of multidisciplinary surgeries rises, along with an increase in uncertain factors in emergency surgeries, surgical volume, and complexity, the workload of OR nurses have also increased^[36]. Göras in observing surgical teams, noted that OR nurses spend nearly half of their working hours multitasking, such as passing surgical instruments during team communication or documenting care while answering work calls^[34]. When cognitive capacity is overwhelmed by intense workloads, a “bottleneck effect” occurs^[37]. According to cognitive resource theory, human cognitive resources are limited^[38]. Frequent NI causes nurses to continuously shift their attention, leading to omissions or repetitions in current tasks, increasing their workload and the risk of nursing errors, and fostering self-doubt and negative emotions^[39]. The emotional experiences of respondents in Chen Huimin et al.’s study included negative emotions, decreased professional identity, and feelings of helplessness^[26]. In summary, the occurrence of NI in the OR undoubtedly increases the mental workload and emotional stress of nurses, potentially affecting their careers and negatively impacting patient safety.

4. Management of nursing interruptions (NI) in the operating room

4.1. Enhancing cognitive awareness, strengthening self-efficacy, and stimulating positive experiences

Willett et al. pointed out that when operating room nursing staff receive training on knowledge and management related to NI in the operating room, they can distinguish between negative NI and positive NI, and enhance their ability to identify and handle them^[31]. This can maximize the efficiency of the operating room and ensure patient safety. Research has found that the cognitive level and vigilance of operating room nurses towards NI are not high. Improving the cognitive level and risk identification ability of nursing staff regarding NI can help anticipate the occurrence of adverse nursing events^[24]. Therefore, it is essential to strengthen training on NI-related knowledge in the operating room, including theoretical instruction, analysis and sharing of typical NI cases in the operating room, and scenario-based simulation exercises^[40]. Simultaneously, standardized emergency response plans should be developed for frequently occurring NI in the operating room to enhance the cognitive level, risk identification, and response capabilities of operating room nurses^[24].

Knowledge, skills, and situational awareness are crucial for high-quality practice and the development of self-efficacy^[41]. In critical aspects of surgical collaboration, such as patient identification, surgical safety checks, surgical counts, positioning, handovers, blood transfusion verification, specimen management, and rescue operations, nurses should be able to make quick judgments and prioritize multiple tasks. Targeted specialized training should be conducted to gain richer experience in handling NI, and even transform it into positive factors that promote work and personal development^[42]. Through learning, nurses can reduce psychological exhaustion caused by NI, strengthen self-efficacy, and improve work efficiency and professional identity.

4.2. Optimizing organizational management processes to reduce sources of risk factors

4.2.1. Scientific allocation of human resources

Guo Dong et al. found that the working years of circulating nurses are an influencing factor for nursing incidents (NI) during the surgical item counting process^[2]. Nursing managers should comprehensively consider differences in task allocation, skill sets, and nurse training^[43]. Senior nurses possess cognitive abilities to predict risks, plan for both expected and unexpected events, and are mentally and practically prepared for the surgical process^[44]. When allocating nursing staff in operating rooms, managers should fully assess factors such as professional titles, years of experience, specialty areas, surgical durations, and work intensity^[45]. Scientific and rational allocation of human resources should not only consider the actual workload and nurses' professional competencies but also ensure a balanced mix in terms of professional titles and years of experience, thereby implementing a mentorship mechanism for nurses^[46]. Therefore, rational allocation of human resources can not only reduce NIs caused by factors related to operating room nurses themselves but also accelerate the growth of junior nurses to some extent, promoting a virtuous cycle.

4.2.2. Establishing subspecialty systems to enhance professional skills

With the continuous refinement of modern medical specializations, surgical instruments and equipment are constantly being updated and diversified, leading to increasing dependence and demands on operating room nurses by surgeons^[47]. Studies have shown that nursing experts outperform novices in terms of execution rate and accuracy in handling NIs^[7]. Tan Shufen et al. found that the coordination of emergency surgeries and multidisciplinary collaborative surgeries was unsatisfactory and demonstrated through practice that adopting a management approach combining

absolute and relative specialization can effectively enhance nurses' professional core competencies, predictive thinking, and emergency response capabilities ^[45]. Therefore, establishing subspecialty systems can specialize the coordination of operating room nursing, improve the quality of surgical coordination, and reduce NIs caused by nurses. Additionally, members of specialty teams should undergo intensive training in the use and maintenance of specialized instruments and equipment, particularly in handling common malfunctions of specialized equipment, to minimize NIs caused by issues with specialized instruments and equipment ^[48].

4.2.3. Building surgical teams

Bretonnier et al. discovered that enhancing teamwork and increasing team familiarity could reduce the occurrence of nursing interruptions (NI) in the operating room ^[8]. Allers et al. found that in robotic surgery, surgical teams with high cohesion and familiarity could predict and prepare for the next steps, thereby reducing interruptions and distractions ^[49]. Some scholars advocate for adding team and organizational culture perspectives to the existing professional skill perspective, as interactions among teams enable each other to play a resilient role in both predictable and unpredictable situations ^[9]. Managers should strive to promote surgical team building, propose practical team training plans, enhance communication among surgical teams, and cultivate tacit understanding among team members to improve team performance ^[22]. Operating room nurses should understand the needs and surgical habits of each surgeon regarding surgical supplies, confirm with the surgeon the special supplies required for the surgery the day before, and proactively prepare the necessary supplies before the operation. During the surgery, nurses should work in harmony with surgeons and anesthesiologists to form a good collaborative relationship and ensure the quality of medical-nursing cooperation. As doctors and nurses, themselves are significant sources of NI, they can easily interfere with each other during the surgical process ^[2]. During critical nursing operations directly related to surgical safety, unnecessary interruptions should be avoided or controlled. Therefore, hospital administrators must establish relevant management systems and provide training to doctors on NI-related knowledge in the operating room to enhance safety awareness and reduce NI caused by surgical team members.

4.3. Other practices

The Association of perioperative Registered Nurses (AORN) recommends establishing the concept of a "sterile cockpit" during critical phases of the perioperative period, which involves team members avoiding unnecessary conversations during critical surgical phases to reduce noise interference ^[50,51]. However, the operating room environment is complex, and it is impossible to establish comprehensive safety zones. Moreover, communication among surgical teams is crucial for the success of the surgery ^[52]. The equipment briefing tool is a communication tool that supplements the surgical safety checklist, and its implementation can also reduce surgical interruptions ^[48]. Domestic scholars such as Xie Jianfei et al. conducted observations and practices in terms of the sources, types, and current affairs of nosocomial infections (NI), including implementing standardized warning alerts, adopting standardized communication models, and using standardized workflow review forms, while integrating standardized operational procedures and multimedia education ^[41]. Lou Chenyan et al. utilized feedforward control management to prevent negative outcomes of NI in operating rooms, providing new insights for operating room management ^[20].

5. Conclusion

As a critical location for the emergency treatment of critically ill patients, the operating room faces significant risks

of adverse nursing events caused by NI. However, currently, only a limited number of scholars have conducted survey analyses on the current status and needs of NI training in operating rooms, with insufficient sample representativeness. There is observer bias in the analysis of NI risk factors for the crucial process of item counting in operating rooms. The sources of NI in operating rooms are diverse, and an effective response mechanism has not yet been established. In the future, scholars could conduct multi-center, large-sample investigations into NI in various surgical specialties and different stages of surgery to identify the risk factors for NI in each surgical specialty and stage, and develop effective preventive measures.

Funding

Analysis of Lung Compliance Measurement and its Guided Therapeutic Effects in Patients with ARDS Secondary to Severe Multiple Trauma (Project No.: XSD-2023-002)

Disclosure statement

The authors declare no conflict of interest.

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