

Original Article

Contributing Factors Affecting the Counting Error in the Operating Room: A Qualitative Study

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Abstract

Background: The retained surgical items (RSIs) represent serious medical errors. The presence of an external item in the surgical site, particularly in body cavities, including the chest, abdomen, and pelvis, can cause life-threatening and financial risks for both patients and surgeons, although it is not a common occurrence. Therefore, to provide the perspective of operating room nurses for preventing counting errors during surgery, it is essential to investigate factors associated with counting errors from their point of view in this area. The purpose of the study was to investigate factors affecting the incidence of counting errors from the point of view of operating room nurses.

Methods: This qualitative study was conducted based on the content analysis approach, with a focus on the research objectives, in hospitals affiliated with Jahrom University of Medical Sciences. The participants were 10 operating room nurses selected through the snowball sampling method as non-probability sampling. Semi-structured interviews were used to collect the data. Sampling was started as purposive sampling and continued until reaching data saturation. Data were analyzed using the Graneheim and Lundman method approach.

Results: Based on the data analysis, three main categories were identified regarding the causes of counting errors in the operating room, including factors related to the operating room nurses, factors related to the surgical conditions, and factors related to the organization.

Conclusion: Factors contributing to counting errors in surgery were wide and multifactorial. Identifying factors contributing to errors is the first step to prevent errors. Considering individual and organizational factors effective in the occurrence of counting errors, as well as the special conditions of each surgery, effective measures can be taken to reduce the counting error.

Keywords: Counting error, Operating room nurses, Qualitative study, Nursing error



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Introduction

Annually, around 234 million surgical procedures are performed globally, and 3%-17% of cases experience complications according to the World Health Organization report. In addition, the mortality rate resulting from surgical procedures is between 0.4% and 0.8% (1). As the surgical room is considered a specialized environment in the hospital, and nurses and surgical technicians work alongside other healthcare teams, many errors that endanger patient safety occur during the care of patients undergoing surgical procedures (2). The retained surgical items (RSIs), including sponges, needles, and instruments, represent serious medical errors (3).

The presence of an external item in the surgical site, particularly in body cavities, including the chest, abdomen, and pelvis, can cause life-threatening and financial risks for both patients and surgeons, although it is not a widespread occurrence (4). Clinical manifestations of RSI are various and often a diagnostic dilemma. The consequences of RSI are undesirable and frustrating for the surgical team and can lead to medical-legal issues (5). Previous studies have shown that RSI occurs once in every 1000-18000 surgeries (6-9). Accuracy and correctness in counting are significantly important. Sponges and surgical instruments should be counted at the end of the procedure to ensure that nothing has been unintentionally left behind in the



patient's body. An accurate count is one in which there is no difference in the number of items before and after the procedure, or any difference has been accounted for by finding a missing item (10). The Association of Operation Nurses recommends that counts be performed before each procedure, before closing any cavity, before starting wound closure, at the end of the procedure, and at any time personnel changes occur in the operating room (11). However, performing an adequate surgical count does not eliminate the risk of lost surgical items, as approximately 88% of cases occur when the surgical count is considered correct (12). Although RSIs often occur in cavities (e.g., the abdomen and pelvis), RSIs can happen during any surgical procedure and have been reported during spinal, head, and neck surgeries, and procedures involving limbs. The discovery of an RSI can be immediate or it may occur minutes, hours, days, weeks, months, or years later (13). Negative consequences associated with this event include returning to the operating room, infection or sepsis, readmission or increased length of hospitalization, fistula formation or bowel obstruction, perforation of body cavities, and death (3). The mortality rate resulting from RSIs can range from 11% to 35%. The type of complication varies depending on the type of item, its location, and the duration it remains in the body (13). Complaints associated with these events can be considerable (3).

The medication costs and compensation for RSIs are high, even if there is a minor injury or no injury. Costs range from \$37 041 to \$2 350 000 (approximately £23 000 to £1 460 000) per event and are different in each case, with an average estimated cost of \$95 000 (£59 000) per case (14). Leaving instruments and tools inside the body will require additional surgery. The replacement of missing equipment will impose a heavy financial burden on the system (15). Therefore, to provide the perspective of operating room nurses for preventing counting errors during surgery, it is essential to investigate the factors associated with counting errors from their point of view in this area.

Materials and Methods

Study Setting

The current qualitative study was performed based on a content analysis approach focusing on research objectives in hospitals affiliated with Jahrom University of Medical Sciences.

Participants

The participants were 10 operating room nurses working at Jahrom University of Medical Sciences selected through the snowball sampling method as non-probability sampling. In this sampling method, the primary participants are asked to introduce people who have more experience in this field. The inclusion criterion for participation was having at least 1 year of working experience in the operating room, while the exclusion criterion included participants' unwillingness to continue

their participation in the study.

Data Collection

The study objectives were explained to participants, and written informed consent was obtained before conducting semi-structured interviews for data collection. The interviews continued from 17.03.2023 until reaching saturation on 27.04.2023. They were conducted individually at a time and place convenient for the participants and lasted for 30-90 minutes. Participants were asked for permission to record the interviews. To explore the mentioned phenomenon, the researcher used questions, including "What do you think causes counting errors during surgery?" and follow-up questions such as "Can you explain that further?" and "What do you mean?". The interviews were transcribed verbatim using Microsoft Word software and prepared for analysis. Participants were identified using numbers (P1, P2, P3, and so forth) instead of their names. Ten participants were interviewed until reaching data saturation. Data saturation is the point in coding where no new codes occur in the data. There are increasing examples of the same code, but no new code.

Data Analysis

The data analysis approach used in this study was based on questions and objectives and a contract content analysis approach. This approach was mainly used deductively in qualitative studies, aimed at providing a deep description of a phenomenon, where there are not enough existing theories or research studies on the subject. In this approach, data were extracted directly from the content using a deductive approach. The data analysis process was performed using the Graneheim and Lundman method, which proposes five stages for analyzing qualitative data as follows:

1. Transcribing the interviews and studying them repeatedly to obtain a general concept from them
2. Dividing the text into meaningful units
3. Summarizing meaningful units and extracting codes
4. Placing codes in subcategories and categories based on their similarities and differences
5. Organizing and extracting themes from the hidden content of interview text

Data were analyzed simultaneously and continuously with data collection. Therefore, in this study, the handwritten and typed text was immediately analyzed after the interview and read several times. Initial codes were extracted, then the codes were merged and classified based on similarities, and the hidden content and concepts in the data were extracted finally.

Rigor

Validity, validity, reliability, and transferability criteria were used for the accuracy of Lincoln and Goba's research. For the reliability of the research, the researcher employed the methods of triangulation, long-term data engagement, member checking, and continuous observation. For

credibility, the researcher attempted to ensure the validity of this research by keeping the documents related to the various stages of research and review by the supervisor. The validity of the research was provided by criteria such as the survey of the participants. For transferability, participants of different ages, both genders, and different levels of education and people with different work experiences participated in the study (16).

Results

Ten operating room nurses (6 women and 4 men) participated in this study. One person had a master's degree, and the other participants held bachelor's degrees. The age range of the participants was 23-42 years old. The minimum and maximum hospital work experiences were 4 years and 22 years, respectively. The demographic characteristics of the participants are presented in Table 1.

Based on the data analysis, three main categories, including factors related to the operating room nurses, factors related to the surgical conditions, and factors related to the organization, were identified regarding the causes of counting errors in the operating room. Table 2 summarizes the mentioned factors into categories and subcategories.

(A) Factors Contributing to Personnel-Related Counting Errors

The participants identified factors such as fatigue, disregard for counting protocols, and lack of awareness as causes of counting errors. From their perspective, individual factors are effective causes of inaccurate counting.

Fatigue

One of the reasons cited by participants for counting errors was fatigue. The surgical team experiences fatigue due to workload and environmental conditions in the operating room, as well as standing for long periods during surgery, which can increase the risk of incorrect counting. A participant with four years of experience in the operating room stated: "Sometimes I am so tired that I forget how many packs of gauze or how many needles have been opened on the surgical table, or sometimes the number

of patients is so high that we get tired and cannot accurately count all the items" (P2).

Disregarding the Counting Protocols

Another factor identified by the participants as a cause of counting errors was disregarding the counting protocols. For example, one participant mentioned "Sometimes some people are careless. For example, when we are counting, the surgeon says it's okay, let's finish it, and then we count several times but there is nothing left. Or sometimes the counting is not complete yet and the surgeon starts closing the wound, and the scrub nurse cooperates with him and does not emphasize the counting" (P4).

Lack of Awareness

Lack of awareness was another factor identified as a cause of counting errors. This issue is mostly reported by new employees. One participant indicated "Sometimes it's due to lack of awareness. For example, a new employee who went to the ENT surgery didn't know that they had to count the mesh fragments and report them to the circulator. At the end of the surgery, I asked him how many mesh fragments he had, and he said he didn't count them at all!" (P1).

(B) Factors Contributing to Counting Errors Associated With Surgical Conditions

Some of the causes of counting errors are the surgical conditions and unique characteristics of each patient during surgery. This category includes emergency surgeries, complicated and lengthy surgeries, and surgeries on body cavities. Participants acknowledged that the conditions related to the surgical procedure were a highly effective factor in the occurrence of counting errors and the retention of surgical items in the patient's body. The simultaneous occurrence of this factor with individual factors can increase the risk of error.

Emergency Surgeries

Emergency surgeries are performed when the patient's life is in danger. In these conditions, the priority of the surgical team is to save the patient's life and the surgery may deviate from its natural course. As a result, counting procedures may be subject to change. One participant with 15 years of experience stated "When there is emergency surgery, especially if the patient is in critical condition, we

Table 1. Demographic Information of Participants

Participants' Number	Age (y)	Gender	Work Experience (y)	Education Level
P1	41	Male	20	Bachelor's degree
P2	24	Female	2	Bachelor's degree
P3	35	Female	11	Bachelor's degree
P4	40	Female	18	Bachelor's degree
P5	28	Female	4	Bachelor's degree
P6	30	Male	5	Bachelor's degree
P7	36	Male	14	Bachelor's degree
P8	39	Female	17	Bachelor's degree
P9	30	Female	6	Bachelor's degree
P10	33	Male	7	Masters

Table 2. Summary of Categories and Subcategories

Category	Subcategory
Factors contributing to counting errors related to the operating room nurse	Fatigue
	Simplicity
	Lack of awareness
Factors causing counting errors related to surgical operating conditions	Emergency surgery procedures
	Long surgical procedures
	Surgery on large body cavities
Factors causing organizational counting errors	Employing inexperienced personnel
	Labor shortage
	Lack of basic training upon entry

open everything so quickly that there may not be time for counting, or sometimes we wait for the patient's condition to improve before counting. That's why there is no standard counting process anymore, and the risk of error is very high" (P7). Another participant mentioned "When an emergency patient arrives, we are so stressed that counting may be incorrect" (P2).

Complicated and Lengthy Surgeries

A change in the routine of a surgical operation and its complexity or a prolonged operation are some of the cases expressed by participants as contributing to counting errors in the operating room. Prolonged surgery or complexity in the surgical stages can cause fatigue in the operating room staff and consequently result in counting errors. A participant with 5 years of experience indicated that "When the surgery is long and difficult, and many tools need to be opened, counting becomes more difficult and we may not be able to count accurately and diligently" (P8). Another participant stated, "When there is a very difficult operation or a lot of bleeding or the surgeon changes the method during the surgery, including changing from laparoscopy to open surgery, the new gases or needles may not be counted properly or combined accurately with the previous ones" (P10).

Surgery on Body Cavities

It is one of the subcategories that contributes to counting errors associated with surgical conditions. Surgery on the abdominal cavity carries a higher risk of RSI in the body, and participants have repeatedly mentioned this issue. A participant with 11 years of working experience declared "When surgery is performed on the abdomen or pelvis, the conditions become more sensitive, and the likelihood that gases and needles are left in the abdomen or lost is higher" (P3).

(C) Organizational Factors Contributing to Counting Errors

Organizational factors contributing to counting errors were identified as another category of causes of errors in counting. These organizational factors included subcategories such as the employment of inexperienced staff, staff shortages, and inadequate pre-employment training.

Employment of Inexperienced Staff

One of the factors contributing to errors associated with the organization was the employment of inexperienced staff. One participant in this regard stated "When inexperienced staff, including students, are present in the room, the likelihood of error increases because they have not yet fully learned the sensitivity of counting or the extent to which counting mistakes can cause trouble. Essentially, they are inexperienced" (P9).

Staff Shortages

Another organizational factor that could lead to errors was the mismatched ratio of the number of surgeries to the number of OR nurses and staff shortages. As one participant pointed out "If we have the right number of staff in each OR and no staff shortage, errors will be reduced. For example, when you are the only circulating nurse in the OR, you are assigned a thousand tasks, including documenting, performing tasks during surgery, preparing for the next patient, etc. For each task, you may have to leave the OR ten times, so it is possible to perform the counting process incorrectly or make mistakes during counting" (P10).

Lack of Pre-employment Training

In addition, another organizational factor that contributed to errors was the lack of pre-employment training. Training plays a crucial role in preventing errors. As one participant noted, "One of the things that can lead to counting not being given importance or an error occurring is that no training has been provided for proper counting before entering the OR, and the importance of this issue has not been taught" (P9).

Discussion

This study sought to identify factors contributing to counting errors in the operating room. The findings indicated that individual, surgical, and organizational factors play a role in creating errors in the counting of surgical items. It is impossible to attribute counting errors to a single factor, but rather a combination of factors that lead to these errors. One important factor related to the operating room nurse is fatigue. Nurses in the operating room become tired due to long work shifts and the challenging work conditions, which can affect their performance. In a study, Oosting et al found that 48.5% of nursing students made medication errors, with forgetting to administer medication being the most common type, which may be due to their exhaustion from working long hours in the department (17). Additionally, Hashemi et al showed that more than 70% of adverse events for patients were due to negligence and fatigue of healthcare providers, including nurses, and that more than 90% of these events were possibly preventable (18). Operating room nurses are extensively involved in patient care. Night shifts, long shifts, and the unpredictable nature of their activities increase the risk of fatigue, which can reduce physical performance and capacity while increasing the likelihood of work-related errors (16).

Another factor that contributes to counting errors is negligence. In any organization, some personnel may neglect their job duties, which can be particularly costly in hospital environments, especially in operating rooms. In an empirical study conducted by Madani et al, nearly 50% of all adverse events in hospital operating rooms in developed countries occurred for patients undergoing surgery (19). Several case studies have been conducted on negligence in the process of counting surgical instruments

and gases during surgery, suggesting that gases and instruments are often left at the surgical site. In a study reported by Kiernan et al, a laparotomy pad was found in a patient's abdomen 11 months after surgery, which led to further surgery on the patient (20). In a study by Sankpal et al, a 40-year-old woman who underwent a cholecystectomy was reported to have had surgical gas entered into her duodenum (21). The results of a study by Trehan et al demonstrated that the most common causes of RSIs in patients' bodies after surgery are unplanned changes and negligence in the counting of surgical gases and instruments during all stages of preparation and after surgery (22). Moreover, a study conducted by Meng et al revealed that 10% of patients suffer from physical harm due to nursing negligence (23).

Another contributing factor to the occurrence of counting errors by operating room nurses was a lack of awareness, which was particularly evident in newly hired staff. In a study by Aghamohammadi et al, a lack of awareness of ethical codes was reported as the main agent causing surgical errors (24). Additionally, in a study performed by DeWane and Kaafarani in Japan, the most effective factor in causing medication errors in newly trained nurses was found to be a lack of knowledge (25). To reduce this factor, educational informative classes can be utilized to increase awareness of the correct procedures for counting items and the consequences of inaccurate counting, as well as the importance of RSI in the patient's body.

Another significant factor affecting the occurrence of counting errors in the operating room was related to surgical conditions. In this study, emergency surgeries, lengthy and complicated surgeries, and surgeries on body cavities played a role in the occurrence of errors. One factor relating to surgical conditions was emergency surgeries. Due to the nature of these surgeries, high levels of stress, and short decision-making times, the likelihood of counting errors increases because preserving the patient's life takes priority over counting surgical items. Additionally, performing surgery with a higher sense of urgency and in the shortest possible time can lead to more errors compared to pre-planned surgeries. Fencil identified emergency conditions, excessive bleeding, and lengthy procedures as risk factors for RSIs in the patient's body (13). In a study conducted by DeWane and Kaafarani, emergency surgeries were considered a factor contributing to the retention of surgical items in the patient's body. Moreover, this study identified unexpected changes in the surgical procedure as another factor contributing to the occurrence of RSI (25).

Several studies reported the occurrence of RSI in high-risk procedures, including emergency abdominal surgery, at a rate of 1 in 700 cases (26-29). Complex and lengthy surgical procedures were also identified as a contributing factor to the occurrence of RSI. Prolonged operative time and significant blood loss were cited as underlying risk factors for RSI in the body (13). When surgery is prolonged

or complex, the need for increased numbers of surgical instruments and gases complicates the counting process and increases the likelihood of counting errors. Difficult surgical procedures can be a common cause of inaccurate counting (30). The study by Stawicki et al confirmed that the length of the surgical procedure is directly related to the risk of RSI. This study also demonstrated that high body mass index and unexpected events during surgery can increase the risk of RSI (7). Judson et al (31) also approved the association of prolonged surgical duration with an increased risk of counting errors, possibly due to fatigue and increased usage of sponges and tools.

Another factor that led to an increased risk of counting errors was surgery on large body cavities. Some studies represented that most instances of RSI occur in abdominal and pelvic surgeries (30,32-33). Reports suggest that RSI occurs in up to 50% of abdominal surgeries, with the complexity of the abdominal cavity cited as a contributing factor (34). The results of the study by Susmallian et al showed that the majority of RSI cases in large body cavities occurred in bariatric, abdominal hernia and navel surgeries, gynecological operations, orthopedics, ENT, and heart surgeries. However, this side effect was less common in ophthalmic surgery (12).

Another category that played a role in the occurrence of errors was organizational factors. These factors included the use of inexperienced personnel, lack of staff, and inadequate training upon entry. Seki and Yamazaki stated that working conditions lead to the creation of clinical errors, but little attention has been paid to these conditions (35). Sheu et al reported a significant relation between nursing experience and the occurrence of errors in their study (36). In this study, participants also pointed to the occurrence of counting errors by inexperienced personnel. Reason also indicated that a shortage of human resources and inexperience can lead to an increase in unsafe clinical activities and errors (37). Additionally, Jachan et al confirmed the relation between nursing errors and work experience (38).

One of the organizational factors contributing to the occurrence of counting errors is the shortage of personnel in the operating room. The shortage of personnel leads to an increase in workload, increasing the likelihood of errors in counting. In this regard, Bagheri and Ghaderi Zamharir identified a shortage of staff as one of the causes of error in the operating room in their study (39). Nemati et al also found that the low ratio of personnel to the number of performed surgeries is one of the effective managerial factors in the occurrence of errors in the operating room (40). Furthermore, Cramer et al demonstrated that from the perspective of nurses, high workloads and staff shortages can lead to errors (41).

A lack of initial training is also an effective factor in the occurrence of errors, which, when combined with low-risk work experience, increases the likelihood of error. Bagaei et al cited the hospital management's reluctance to train and educate staff as an effective factor in error occurrence

(42). In addition, in a study conducted by Hajibabae et al, attending training courses was significantly associated with the occurrence of errors (43). Therefore, nurses should receive the necessary training when they first enter the operating room, facilitated by the organization.

The healthcare system is shifting toward a proactive rather than reactive approach to medical errors. Reducing residual surgical items is an important part of any patient safety effort in the operating room. A surgical count procedure (counting surgical instruments, sponges, and sharps) is recommended in all surgeries to ensure that surgical items are not left in the intraoperative period.

Surgical counting is a manual process for counting materials used in a sterile field during surgery, with the aim of preventing unwanted retention in patients. However, even when the final count is recorded as correct, surgical cases may remain unwanted.

Counting errors during surgery in the operating room is always a key issue for surgeons and nurses, and if it occurs, it can lead to serious harm to the patient and impose costs on the healthcare system. A continued reduction in the incidence of all RSI events requires improved preventive and recovery strategies. RSI events are classified as “never events”, indicating that they are completely preventable. However, their continued occurrence, despite the development of many new protocols and regulations, shows the complexity and multifactorial nature of the problem. However, RSI event prevention requires a system-based solution that relies on the entire surgical team.

To avoid counting errors, it is necessary to pay attention to their causes and then provide a solution to improve patient care. In the current study, a set of factors related to nurses, the special conditions of each surgery, and the organization played a role in causing errors. According to Kattdegan Company, only one factor does not play a role in the occurrence of counting error, but a set of factors causes the occurrence of an error in counting and the result of surgical items being left in the patient’s body. Therefore, according to the causes of errors, by providing solutions such as reducing the workload of operating room nurses, holding training classes, and increasing the awareness of employees, steps can be taken to prevent errors. It is also necessary to pay attention to the specific conditions of each surgery and standard counting.

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Authors’ Contribution

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Competing Interests

The authors declare that they have no conflict of interests.

Ethical Approval

All experimental procedures were performed in strict accordance with ethical standards, including maintaining the confidentiality of the information of the involved society. Furthermore, the study was approved by the Ethics Committee of the Jahrom University of Medical Sciences (Ethics code number: IR.JUMS.REC.1401.102).

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