

# Systematic Risk Analysis and Mitigation Strategies for Near-Miss Events in Interventional Operating Room Nursing

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**Purpose:** The aim of this study is to examine the characteristics of intraoperative nursing near-miss events in interventional operating rooms, systematically identify and analyze associated risks, and propose effective mitigation strategies.

**Patients and Methods:** A retrospective study was conducted using a specially designed survey focused on nursing near-miss events in Interventional operating rooms. Records of intraoperative near-miss events voluntarily reported by medical and nursing staff between January 2023 and March 2024 were analyzed. Grey relational analysis was used to evaluate and identify the associated risk factors.

**Results:** A total of 81 near-miss events were reported, with the majority (50%) occurring after 8 PM. These events were categorized into 6 main types: medication errors (60.49%), issues with consumables (16.05%), tubing-related incidents (8.64%), specimen handling errors (7.4%), transfer handover issues (4.93%), and patient transport problems (2.46%). Grey relational analysis identified air embolism formation during pressurized fluid administration as the highest risk event ( $\xi_1 = 0.369$ ). The risk factors were ranked as follows: weak coordination ability and lack of responsibility among nurses > operational interruptions > inadequate professional capability > poor communication between medical staff and nurses > equipment malfunction > frequent emergency surgeries and a fast paced working environment.

**Conclusion:** Medication administration errors are frequently encountered, with air embolisms during pressurized fluid infusion representing the most significant risk. Operational interruptions are major contributors to these errors, often influenced by the coordination skills and professional competencies of nurses. Clinically, it is crucial to enhance the identification and management of near-miss events to reduce the incidence of adverse outcomes during surgical procedures.

**Keywords:** grey relational analysis, interventional surgery, near-miss, prevention and rectification, risk factors

## Introduction

Interventional surgery, a less invasive technique compared to laparoscopic procedures, employs imaging modalities such as X-ray, B-scan ultrasound, or CT to guide the maneuvering of guidewires or catheters within the vasculature, facilitating the precise placement of therapeutic devices.<sup>1</sup> Although categorized as minimally invasive, interventional surgery predominantly addresses critically ill emergency patients, rendering it inherently high-risk and technically demanding. This complexity elevates the risk associated with intraoperative nursing, thereby increasing the incidence of near-miss events.<sup>2</sup> In 2017, the Chinese Hospital Association mentioned near-miss events for the first time in the ten goals of patient safety and encouraged the medical and health system to actively learn from it.<sup>3</sup> A near-miss event is defined as an error or oversight in clinical nursing that is detected and rectified before any harm befalls the patient.<sup>4</sup> According to the safety pyramid model, for every serious injury, there are approximately 300 near-miss events, with an incidence rate 7 to 700 times greater than that of adverse events.<sup>5,6</sup> Therefore, focusing on the risk management of close error events and learning the valuable resources of errors can ensure the safety of patients. However, due to the absence of patient harm, near-miss events often receive insufficient attention from staff and have not been extensively studied.

Therefore, this study is focused on identifying and analyzing the characteristics and risks associated with near-miss events in interventional surgery, with the aim of providing evidence-based guidance to mitigate clinical risks in interventional nursing.

## Data and Methods

### General Data

A retrospective study was conducted using a questionnaire star survey method to collect 87 errors events reported by operating room nurses, surgeons, and technologists from January 2023 to March 2024; six adverse events were excluded, including three contrast allergies, two pressure injuries, and one error in the issuance of consumables; and 81 near-miss events were used as the study objects. This study was conducted in accordance with the declaration of Helsinki and approved by the ethical committee of Affiliated Hospital 2 of Nantong University (ethics number:2024KT344). Written informed consent was obtained from all participants.

### Methods

The research indicators include three sections: (i) General data: A self-designed questionnaire covering age, gender, professional title, education level, and duration of work in interventional procedures. (ii) Near-miss event data: Basic details of interventional surgery near-misses, including time of occurrence, surgical specialty, type of surgery, and the nature and causes of the error events. (iii) Use of Grey Relational Analysis (GRA) to conduct risk analysis, identification, and extraction of reports on interventional surgery near-miss events. The process of identification and extraction of information was carried out independently by two researchers, and discussions were held to resolve discrepancies. If a consensus could not be reached, a third researcher intervened to finalize the decision.

### Statistical Analysis

The SPSS 24.0 software package was employed for statistical analysis, with categorical data presented as frequencies and composition ratios, and quantitative data reported as means  $\pm$  standard deviations. Grey relational analysis was conducted using SPSSAU software. Grey relational analysis is a multi-factor statistical method that assesses correlations between factors based on their development trends. It is particularly useful for describing relationships between factors or events, as it does not require a typical distribution pattern and is less stringent regarding sample size. In this analysis, the number of near-miss events served as the reference sequence, while the risk factors for near-misses were used as the comparison sequence. A lower correlation coefficient ( $\xi_i$ ) value indicates a greater impact of a factor, with a value of “1” signifying no impact. Conversely, a smaller degree of association ( $\gamma_i$ ) value reflects a higher risk level associated with the factors.<sup>7</sup>

## Results

### General Data

The study involved 26 individuals who experienced near-miss events in interventional surgery nursing, including 7 surgeons, 5 technicians, and 14 nurses. The average age of these participants was  $33.42 \pm 10.82$  years, with an average tenure of  $14.15 \pm 11.99$  years and an average duration of  $4.34 \pm 4.48$  years in interventional work, as shown in [Table 1](#).

### Basic Characteristics of Patients Who Underwent Interventional Surgery

During the study period, 5,571 patients underwent interventional surgery, with 81 near-miss events reported, reflecting an incidence rate of 1.45%. Among these cases, 46 were male (56.79%) and 35 were female (43.21%), with an average age of  $63.37 \pm 17.89$  years. The cases were categorized into 45 elective surgeries and 36 emergency surgeries. Regarding anesthesia, general anesthesia was administered in 40 cases, local anesthesia in 22 cases, and other forms in 19 cases. The surgical specialties were distributed as follows: neurointervention in 32 cases, peripheral vascular intervention in 24 cases, major vascular intervention in 8 cases, tumor intervention in 5 cases, digestive system intervention in 8 cases, and respiratory system intervention in 4 cases (see [Table 2](#)).

**Table 1** General Data Composition Ratio of Near-Miss Event Reporting Personnel (n = 26)

Item	Number	Proportion (%)
Gender		
Male	7	26.92
Female	19	73.08
Education level		
Technical secondary school	4	15.39
Junior college	8	30.77
Bachelor's degree	10	38.45
Graduate degree	4	15.39
Professional classification		
Nurse	9	34.62
Technician	5	19.23
Doctor	12	46.15
Professional title		
Junior	8	30.77
Intermediate	15	57.69
Senior	3	11.54
Reported cases		
Doctor	15	18.52
Technician	23	28.39
Nurse	43	53.09

**Table 2** Basic Characteristics of Surgical Patients Involved in the 81 Near-Miss Events

Item	Number	Proportion (%)
Gender		
Male	46	56.79
Female	35	43.21
Age		
$\leq 19$	1	1.23
20–34	6	7.41
35–49	10	12.35
50–64	19	23.46
$\geq 65$	45	55.56
Type of surgery		
Elective	45	55.56
Emergency	36	44.44
Anesthesia method		
General anesthesia	40	49.38
Local anesthesia	22	27.16
Other	19	23.46
Surgical specialty		
Neurointervention	32	39.51
Peripheral vascular intervention	24	29.63
Major vascular intervention	8	9.88
Tumor intervention	5	6.16
Digestive system intervention	8	9.88
Respiratory system intervention	4	4.94

## Basic Characteristics of Near-Miss Events

Of the 81 near-miss events, the majority occurred after 8 PM, representing 50% of the cases. The most common event was contrast media extravasation, accounting for 29.63% of the incidents, with an incidence rate of 0.43%. This was followed by medication-related near-miss events, which comprised 19.75% of the cases. The primary risk factors identified were frequent emergency surgeries and a rapid work pace (25.93%), inadequate professional capabilities of nurses (23.45%), and poor communication between medical and nursing staff (20.99%) (see [Tables 3 and 4](#)).

## Correlation Analysis of Near-Miss Events and Risk Factors

The distribution of the 6 categories of risk factors for the 81 near-miss events exhibited non-typical distribution characteristics. The event with the highest risk of occurrence was air embolism during intravenous infusion, attributed to operational interruptions ( $\xi_1 = 0.369$ ). The risk factors, ranked by correlation values ( $r$ ), were as follows: weak coordination ability and sense of responsibility among nurses > operational interruptions by nurses > nurses' insufficient professional capability > poor medical-nursing communication > equipment and instruments > frequent emergency surgeries and a fast-paced working environment (see [Table 5](#)).

**Table 3** Basic Characteristics of Near-Miss Events

Item	Number	Proportion (%)
Time period of occurrence		
8:00–12:00	2	7.69
12:00–16:00	4	15.38
16:00–20:00	7	26.93
After 8 pm	13	50.00
Categories of near-miss events		
Infusion and medication related (60.49%)		
Incorrect choice of venipuncture site	6	7.41
Failure to timely replace fluid during pressurized infusion	3	3.70
Contrast media extravasation	24	29.63
Errors in medication timing, dosage, and concentration	16	19.75
Consumable related (16.05%)		
Consumable packaging damaged or expired	5	6.17
Incorrect distribution of consumables	8	9.88
Tubing management (8.64%)		
Tubing disconnection during patient transport	1	1.23
Urinary catheter drainage obstruction	4	4.94
Tubing fixation method	2	2.47
Errors in patient transport (2.47%)		
Patient sent to the wrong operating room	1	1.23
Non-operated patients intercepted when returned to ward	1	1.23
Transfer handover (4.94%)		
Critical patient not escorted	1	1.23
Inadequate handover of critical patients	3	3.70
Specimen management (7.41%)		
Specimen barcode printing not done on time	3	3.70
Specimens not secured on time	2	2.47
Barcode information error	1	1.23

**Table 4** Distribution and Risk Factors Associated With the 81 Near-Miss Events

	Venipuncture Site Choice	Specimen Management	Air Embolism	Contrast Media Extravasation	Medication Errors	Consumable Use	Tubing Management	Patient Transport	Transfer Handover	Composition Ratio (%)
Fast pace/ multiple emergencies	0	3			8	8		2		25.93
Equipment malfunction				10			3			16.05
Poor medical-nursing communication	2	1	1		4	5	4			20.99
Weak professional capability	4			14					1	23.45
Operation interruption		2	2							4.94
Weak coordination ability					4				3	8.64

**Table 5** Association and Ranking of Risk Factors in Relation to Different Types of Near-Miss Events

Risk Factors	Intravenous Infusion Air Embolism	Medication Events (Timing, Dosage, Concentration)	Consumables Quality	Consumables Distribution	Tubing Management	Patient Transport	Specimen Information, Securing, and Testing	R-value	Ranking
Factor 1: Weak professional capability of nurses	0.559	0.507	0.555	0.814	0.679	0.630	1.000	0.678	4
Factor 2: Fast work pace, frequent emergency surgeries	0.480	0.601	0.640	0.803	1.000	0.799	0.676	0.714	1
Factor 3: Operation interruption	0.369	1.000	0.952	0.418	0.540	0.875	0.397	0.650	5
Factor 4: Equipment malfunction	0.513	0.554	0.598	1.000	0.821	0.711	0.796	0.713	2
Factor 5: Weak coordination ability, lack of responsibility among nurses	0.726	0.415	0.468	0.505	0.467	0.484	0.595	0.523	6
Factor 6: Poor medical-nursing communication	0.435	0.697	0.721	0.610	0.844	1.000	0.544	0.693	3

## Discussion

A near-miss event refers to an incident that could potentially harm a patient but does not result in actual harm due to chance or timely intervention. It serves as a warning sign that can provide valuable safety information to the medical system promptly.<sup>8</sup> The primary distinction between a near-miss and an adverse event is the outcome, with the former representing an incident that is prevented from causing harm by various factors. By actively identifying and analyzing the risk factors associated with near-miss events, it is possible to address and prevent the underlying causes of adverse events. Therefore, nursing administrators should strengthen the attention and management of near-miss events, and conduct multidisciplinary cooperation with medical and information departments to reduce nursing deficiencies by analyzing the structural characteristics and influencing factors of near miss events, making joint improvements, and targeting feed-forward control.

## System Construction and Management of Near-Miss Events Reporting

Nursing personnel are the primary group involved in experiencing and reporting near-miss events, with existing research predominantly addressing issues such as medication administration, operating room item counts, and intensive care management.<sup>9,10</sup> Given the relatively recent development of interventional specialties in clinical settings in China, the interventional nursing unit has evolved from catheterization rooms to a platform management model within interventional operating rooms. This evolution involves nursing staff from various departments, including CT, MRI, radiology, cardiology, neurology, and operating rooms. Due to the diverse professional levels among interventional operating room nursing staff, a thorough analysis of near-miss events in this context is essential for enhancing care quality. In this study, a total of 81 near-miss events were reported, with nurses contributing 43 cases (53.09%), doctors 15 cases (18.52%), and technicians 23 cases (28.40%). The reporting personnel had an average work tenure of  $4.34 \pm 4.48$  years.

Nurses, in particular, may sometimes overlook the significance of near-miss events due to insufficient awareness and attention, making it challenging for nursing managers to promptly identify deficiencies in risk perception and critical thinking. To address this, nursing managers should implement targeted training programs for nurses at various experience levels. Such training could include scenario simulations, workshops, and other educational methods. Establishing a “no-penalty” reporting system and fostering a supportive leadership style can contribute to a positive hospital safety culture, encouraging nurses to recognize and report near-miss events. Additionally, promoting a shared understanding of near-miss events within the nursing team and encouraging peer participation in reporting through diverse perspectives can enhance the comprehensiveness and accuracy of data collected, supporting effective risk management.<sup>11</sup>

## Basic Characteristics and Risk Management of Interventional Operation Near-Miss Events in Interventional Surgery

The study reveals that 50% of near-miss events occurred after 8 PM, a time predominantly characterized by neurointervention surgeries during nighttime emergency operations. The Interventional operating room environment, marked by factors such as radiation exposure and a high-paced work setting, places considerable demands on nurses in terms of physical and mental health, resulting in relative human resource shortages. The study highlights that nighttime emergency surgeries primarily involve cerebral infarction thrombectomy, a procedure that is both technically complex and time-sensitive. The optimal window for performing mechanical thrombectomy for cerebral infarction is within 90 minutes from patient arrival to femoral artery puncture, with vascular recanalization being ideally achieved within 120 minutes.<sup>12</sup> Consequently, Interventional operating room staff must rapidly prepare consumables, manage medications to stabilize blood pressure, and oversee intraoperative pressurized perfusion. The study also indicates that nurse fatigue can impair the perception of potential clinical adverse events, thereby increasing the incidence of near-miss events. To address these challenges, nursing managers should undertake comprehensive assessments based on surgery type and workload, allocate nursing staff more effectively, and develop emergency human resource deployment plans to mitigate nurse fatigue. Enhancing nursing safety perception and ensuring specialization and standardization in interventional operating room nursing are essential for fostering the sustainable, high-quality development of the interventional nursing specialty through scientific management.

The proportion of near-error events of infusion and medication was the highest, up to 60.49%. However, this study identified that the incidence of iodinated contrast extravasation error events was as high as 29.63%, with an overall incidence rate of 0.43%, consistent with findings from previous research. Iodinated contrast agents, characterized by high concentration, high osmolarity, and high viscosity, pose a significant risk of extravasation during high-pressure injections, with reported incidence rates ranging from 0.3% to 0.9%. When extravasation occurs, the potential toxicity of iodinated contrast agents can adversely affect surrounding tissues, particularly the skin, and in severe cases, may lead to compartment syndrome.<sup>13</sup> Therefore, prior to administering iodinated contrast agents via high-pressure injectors in digital subtraction angiography (DSA), it is essential to identify high-risk individuals and areas. After successful venipuncture, blood should be withdrawn to confirm that the needle is within the vessel, followed by a pre-flush with 20 mL of 0.9% saline solution. During this process, the patient should be queried about any pain or swelling at the puncture site. High-pressure injection of the iodinated contrast agent should only proceed once it is confirmed that no extravasation has occurred. If excessive pressure, patient-reported pain, or localized swelling at the injection site is observed during the injection, re-venipuncture may be required. Technicians and nurses should monitor patient limb movements closely and be vigilant for any local or systemic symptoms during the administration of iodinated contrast agents.<sup>14</sup> Additionally, careful observation of dynamic changes in enhanced images following the contrast agent administration and monitoring pressure curves on the high-pressure display are crucial to minimize the occurrence of venous extravasation.<sup>15</sup>

Air embolism, particularly arterial air embolism, often occurs during arterial catheterization or other invasive procedures.<sup>16</sup> The clinical manifestations and consequences of an air embolism are influenced by the volume of air entering the circulation, the speed of its entry, and the location within the body. Symptoms of air embolism typically manifest immediately when a substantial volume of air is introduced into the vasculature. When air enters cerebral vessels, it can lead to cerebral air embolism (CAE), which, although rare, can be fatal. CAE may result in focal neurological deficits, seizures, coma, and in severe cases, cardiac arrest or acute respiratory failure.<sup>17,18</sup> The risk of air embolism is a concern during pressurized drug infusion, particularly in mechanical cerebral thrombectomy. This study identified three near-miss events involving mild air embolism during pressurized infusion: one occurred when medical staff temporarily left the operating room during a CT scan, another was due to the absence of an air detector, and the third resulted from inadequate medical-nursing communication that failed to adjust the drip rate promptly. All incidents were managed effectively before causing any patient harm. Consequently, clinical vigilance and preventive measures are crucial. Emphasis should be placed on effective medical-nursing communication and collaboration. Prior to pressurized infusion, it is essential to expel all air from the infusion tube, promptly replace fluids, and utilize an air detector to prevent air embolism formation, thereby mitigating its occurrence during procedures.

In this study, medication near-miss events constituted 19.75% of all incidents, encompassing errors related to medication timing, dosage, route, and concentration, which were identified and corrected through post-medication double-checks. These errors are likely attributed to the high degree of specialization and complexity inherent in interventional surgeries, particularly neurointervention surgeries. The specialized nature of these procedures and the variety of medications used place significant demands on nursing staff. During such surgeries, nurses are required to don lead protective clothing and perform multiple tasks, including administering anticoagulant and vasoconstriction medications. The use of these high-risk medications exacerbates the potential for medication errors. To address these challenges, nursing managers should prioritize risk management strategies in neurointervention settings. It is advisable to deploy at least two experienced nurses for these procedures to ensure precision and safety in medication administration. In situations of limited staffing, especially during nighttime emergencies, enhancing joint verification practices within the medical-nursing team is essential to mitigate errors caused by fatigue or staffing shortages. Additionally, to further improve medication safety, it is recommended to implement standardized prompt cards or signage for commonly used medications and procedures, thereby aiding nurses in effective medication verification and reducing the likelihood of near-miss events.

This study found that 16.05% of error events were related to the distribution and management of medical supplies, which may be attributed to the extensive variety of consumables used in interventional surgery. The management of these consumables presents a significant challenge within interventional operating room environments. Consumable usage is typically determined by the surgeon based on intraoperative requirements, with nurses executing verbal medical orders. Errors can arise if there is a lack of re-verification with the surgeon regarding the specifications and models of consumables during distribution or if the integrity of consumable packaging is not



checked, especially during emergency resuscitations. To address these issues, interventional operating room managers should focus on standardizing the use of consumables and implementing comprehensive management practices. Prior to utilizing consumables, nurses should confirm the manufacturer, model, specifications, and expiration date, ensuring all details are accurate before distribution to minimize the risk of errors.

Other near-miss events identified in this study included improper fixation of tubing, incomplete or inadequate critical patient handovers, and delays in fixing or sending specimens for examination. Consequently, nursing managers should focus on improving the professional skills of interventional operating room nurses. This can be achieved through ongoing education, stringent process control, and timely risk management, which can effectively reduce the incidence of errors and enhance the overall quality of nursing care in the interventional operating room.

## Analysis of the Degree of Correlation Between Near-Miss Events and Risk Factors in Interventional Surgery

This study employed Grey relational analysis to quantitatively assess the correlation between identified risk factors and near-miss events in interventional surgery. The findings indicate that the primary risk factors, ranked from highest to lowest, are: the weak coordination ability and sense of responsibility among nurses, operational interruptions, weak professional capability of nurses, poor medical-nursing communication, equipment malfunction, frequent emergency surgeries, and a fast-paced work environment. Among these, the top three risk factors contributing to near-miss events in the interventional operating room are weak coordination ability of nurses, interruptions during operations, and weak professional capability.

Nursing interruptions (NI) are defined as disruptions that occur during the provision of standardized care services, which delay tasks and distract attention.<sup>19</sup> The interventional operating room's unique environment-characterized by sudden demands from surgeons and anesthesiologists, phone interruptions, and equipment malfunctions-results in a high incidence of such interruptions. Limited emergency coordination skills and insufficient awareness of near-miss events further diminish nurses' alertness to these interruptions, thereby increasing the risk of adverse outcomes. Additionally, the heavy reliance on instruments and equipment, coupled with the prevalence of emergency surgeries and a fast-paced work environment, can overwhelm nurses, decreasing their sensitivity to potential hazards and increasing the likelihood of near-miss events. Therefore, nursing managers should emphasize training to improve nurse coordination, professional skills, and risk anticipation. Given the frequent emergency surgeries and the fast-paced nature of the work environment, it is essential to strategically schedule surgical staff and enhance communication with surgeons and anesthesiologists. Additionally, educational sessions focused on awareness of interruptions, boosting sensitivity to potential disruptions, and encouraging proactive reporting of near-miss events can effectively reduce adverse event rates, thereby improving patient safety and the quality of nursing care in interventional surgeries.

## Conclusion

This study collected reports of near-miss events from medical and nursing staff involved in interventional surgery, conducted a risk analysis, and employed Grey relational analysis for identification. Based on these findings, preventive measures were proposed to aid in the early detection of near-miss events in the interventional operating room, thereby preventing their escalation into adverse events or medical malpractice. However, the study's focus on a specific cardiac catheterization room as an independent interventional treatment unit, which was excluded from the analysis of cardiac interventional surgery near-miss events, and its single-center design, limit the generalizability of the results. Therefore, it is recommended that each interventional operating room develop an early warning model tailored to the types of surgeries performed and the specific characteristics of their working environment. Implementing effective interventions based on this model can help ensure patient safety during surgery and improve the overall quality of nursing services.

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## Disclosure

The authors report no conflicts of interest in this work.

## References

1. Jiansong J, Shiji F, Minjiang C, et al. Precision interventional radiology. *J Int Med.* 2021;4(4):155–158. doi:10.1016/j.jimed.2021.09.002
2. Feng TT, Zhang X, Tan LL, et al. Research progress of nursing approach error management. *Chin J Nurs.* 2020;55(1):153–157.
3. Chinese Hospital Association. Patient Safety Objective. *Health Quality Manag China.* 2017;(2):13,23,36,55,67,126.
4. Thomas Angela D, Chinmay P, Krevat Seth A. Race differences in reported “near miss” patient safety events in health care system high reliability organizations. *J Patient Saf.* 2021;17(8):e1605–e1608. doi:10.1097/PTS.0000000000000864
5. Taylor Jennifer A, Lacovara Alicia V, Smith Gordon S, et al. Near-miss narratives from the fire service: a bayesian analysis.. *Accid Anal Prev.* 2014;62:119–129. doi:10.1016/j.aap.2013.09.012
6. Tanaka K, Otsubo T, Tanaka M, et al. Similarity in predictors between near miss and adverse event among Japanese nurses working at teaching hospitals. *Ind Health.* 2010;48(6):775–782. doi:10.2486/indhealth.MS1151
7. Huang C-Y, Lin Y-C, Lu Y-C, Chen C-I, et al. application of grey relational analysis to predict dementia tendency by cognitive function, sleep disturbances, and health conditions of diabetic patients. *Brain Sci.* 2022;12(12):1642. doi:10.3390/brainsci12121642
8. Noor NHM, Joibe KF, Hasan MN, et al. prevalence of near-miss events of transfusion practice and its associated factors amongst house officers in a teaching hospital. *Oman Med J.* 2021;36(2):e249. doi:10.5001/omj.2021.55
9. Tingting F, Xin Z, Lingling T, et al. Near-miss organizational learning in nursing within a tertiary hospital: a mixed methods study. *BMC Nurs.* 2022;21(1):315. doi:10.1186/s12912-022-01071-1
10. Samuel W, Fabio C, Dielle M, et al. Risk factors and preventive strategies for unintentionally retained surgical sharps: a systematic review. *Patient Saf Surg.* 2021;15(1):24. doi:10.1186/s13037-021-00297-3
11. Yang Y, Liu H. The effect of patient safety culture on nurses’ near-miss reporting intention: the moderating role of perceived severity of near misses. *J Res Nurs.* 2021;26(1–2):6–16. doi:10.1177/1744987120979344
12. Hassan K, Sherief G, Gautam A, et al. Endovascular therapy for stroke presenting beyond 24 hours: a systematic review and meta-analysis. *JAMA Netw Open.* 2023;6(5):e2311768. doi:10.1001/jamanetworkopen.2023.11768
13. Liu W, Wang P, Zhu H, Contrast media extravasation injury: a prospective observational cohort study. *Eur J Med Res.* 2023;28(1):458. doi:10.1186/s40001-023-01444-5
14. Kim JT, Park JY, Lee HJ, Cheon YJ. Guidelines for the management of extravasation. *J Educ Eval Health Prof.* 2020;17:21. doi:10.3352/jeehp.2020.17.21
15. Wanli L, Pinghu W, Hui Z, et al. Risk factors for contrast media extravasation in intravenous contrast-enhanced computed tomography: an observational cohort stud. *Acad Radiol.* 2024;31(5):1792–1798. doi:10.1016/j.acra.2023.09.027
16. Shah R, Shah S. Diffuse bi-hemispheric cortical infarction secondary to cerebral air embolism after elective esophagogastroduodenoscopy: a case report and review of literature. *Cureus.* 2023;15(3):e36069. doi:10.7759/cureus.36069
17. Brown Andrew E, Rabinstein Alejandro A, Braksick Sherri A. Clinical characteristics, imaging findings, and outcomes of cerebral air embolism. *Neurocrit Care.* 2023;38(1):158–164. doi:10.1007/s12028-022-01664-3
18. Sandrine D, Nicole Richli M, Cosmin C, et al. Contrast media extravasations in patients undergoing computerized tomography scanning: a systematic review and meta-analysis of risk factors and interventions. *JBI Database System Rev Implement Rep.* 2018;16(1):87–116. doi:10.1112/JBISIRIR-2017-003348
19. Tao L, Xianqiong F, Yongli G, et al. Nursing interruptions in emergency room in China: an observational study. *J Nurs Manag.* 2021;29(7):2189–2198. doi:10.1111/jonm.13372

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