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Beyond clinical skills: Unlocking the drivers of effective crisis management in operating rooms -a qualitative study

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Abstract

Introduction

In-hospital crises, particularly in operating rooms, are critical events where human factors significantly influence the quality of crisis management. While clinical guidelines are standardized, the performance of operating room head nurses during crises varies considerably. Traditional quantitative studies often fail to capture the operational and emotional experiences that enhance crisis management. To address this gap, this qualitative study aimed to explore the factors that improve the performance of operating room head nurses in crisis situations.

Methods

A qualitative content analysis was conducted in western Iran from [April/2025] to [September/2025]. Participants included 17 head nurses from operating rooms of major hospitals in the western region of Iran, selected through purposive sampling with maximum variation. Data were collected through in-depth, semi-structured interviews. Graneheim and Lundman's systematic approach was employed to analyze the data and uncover latent and manifest content.

Results

The mean age of participants was 39.45 years (range 37–56 years), and most held a bachelor's degree in operating room technology (82.58%). The collected data were categorized into a theme titled "drivers of effective crisis management" and five main categories with 33 subcategories. These categories included professional leadership competencies, emotional leadership and team cohesion, strategic management of reactive capacities, proactive preparedness and crisis operations, and post-crisis support and rehabilitation.

Conclusion

Professional leadership competencies, emotional leadership, strategic management of reactive capacities, proactive preparedness, and post-crisis support were key drivers of effective crisis management in operating rooms. Empowering head nurses through leadership skills training, strengthening psychological support, ensuring adequate physical space and equipment, providing organizational incentives, and implementing operational training will be effective measures in this regard.

Introduction

Operating room crises represent one of the most demanding clinical scenarios in modern healthcare, characterized by rapidly escalating patient acuity, time-critical surgical interventions, and the need for seamless coordination among multidisciplinary teams [1]. Unlike emergencies in general wards, critical events within the operating room occur within a highly controlled yet unforgiving environment where even brief disruptions can precipitate cascading patient harm [2]. The operating room head nurse occupies a pivotal position within this ecosystem, simultaneously functioning as clinical leader, resource manager, and frontline responder [3]. However, the specific competencies and organizational conditions that enable these professionals to perform effectively during crises remain inadequately understood [4].

Contemporary evidence underscores that effective crisis management extends beyond technical proficiency to encompass human factors, team dynamics, and organizational support structures [5]. Studies examining nursing leadership during the COVID-19 pandemic have identified flexibility, problem-solving capacity, tolerance of uncertainty, and excellent crisis communication as key competencies that nurse managers relied upon during periods of extreme pressure [2]. Within the nursing literature, qualitative investigations have begun to illuminate the experiential dimensions of crisis engagement in surgical contexts [6]. Ergen and colleagues explored operating room nurses' experiences during the pandemic and identified four themes including changing systems and practices, psychological impacts, coping strategies, and lessons learned, documenting both the positive and negative effects on nursing practice [6]. Nevertheless, these insights derive predominantly from pandemic-specific contexts, leaving the unique operational realities of non-pandemic surgical crises comparatively underexplored [7].

Qualitative inquiries focused on operating room personnel during disaster and crisis events have yielded fragmented findings. Rostami et al. examined operating room nurses' experiences during the 2017 Kermanshah earthquake, identifying "insufficient disaster preparedness due to a faded preparedness" as the overarching theme, with major categories encompassing knowledge and perception, educational programs, equipment preparedness, and managerial-organizational preparedness [8]. However, this study focused on earthquake-specific disaster preparedness and did not identify the factors that enabled effective performance among those who responded competently. A recent cross-sectional survey of intensive care and operating room personnel assessed disaster knowledge, role clarity, and equipment use, yet quantitative measurement alone cannot capture the nuanced competencies that distinguish effective from ineffective crisis responders [9]. The extant literature thus reveals a theoretical-practical gap: while barriers to crisis management have been catalogued, the specific drivers of successful performance in the operating room have not been systematically investigated from the perspective of those who bear primary responsibility for surgical crisis coordination [10].

This qualitative study addresses this gap by exploring the experiences of operating room head nurses regarding the factors that enhance their performance during crises [11]. The operating room head nurse role involves distinctive managerial and clinical responsibilities that differentiate it from other nursing leadership positions, including immediate oversight of surgical scheduling, sterilization protocols, equipment readiness, and intraoperative staff coordination [12]. When crises occur, these professionals must rapidly transition from routine management to active crisis command, navigating resource

constraints, communication breakdowns, and emotional strain while maintaining patient safety [13]. Understanding what enables effective performance under these conditions is essential for developing targeted interventions that strengthen operating room crisis resilience.

Materials and Methods

Research Design

This study was designed as a qualitative study using a conventional content analysis approach. Conventional content analysis is widely used to interpret textual data in qualitative research, particularly when existing theory or literature on the phenomenon is limited [14]. This approach allows researchers to derive categories and themes directly from the data rather than imposing preconceived theoretical frameworks. The study aimed to explore and explain the experiences of operating room head nurses in crisis management. This report adheres to the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines [15]. The philosophical underpinning of the study was based on the interpretivist paradigm, which emphasizes understanding the subjective meanings that individuals attach to their experiences within specific social and organizational contexts.

Study Setting and Participants

The study population consisted of all operating room head nurses working in major hospitals across the western region of Iran, encompassing Kermanshah, Kurdistan, Hamadan, and Ilam provinces. This geographical scope was selected to capture diverse experiences of crisis management across different hospital contexts and resource levels. The most important determinant of sample size in qualitative studies is data saturation. Data saturation refers to the point at which data collection no longer yields new or relevant data [16]. In this study, data saturation was defined as the point at which subsequent interviews yielded no new and relevant information regarding the experiences of operating room head nurses concerning crisis management. This was evidenced by the repetition of themes and the absence of emergent new categories. Specifically, no new information emerged after interview 17, and interviews were conducted to confirm this saturation and enhance the depth and richness of the data. Participants were selected through purposive sampling with maximum variation. Inclusion criteria included having experience as an operating room head nurse, at least a bachelor's degree, direct experience of facing various crises such as war, earthquake, flood, explosion, or other critical conditions within the hospital, and willingness to participate in semi-structured interviews. Exclusion criteria included unwillingness to continue participation in the research and inability to express experiences.

Data Collection

Data were collected through in-depth, semi-structured, face-to-face interviews conducted individually to ensure confidentiality. Each interview lasted between 35 and 45 minutes. Prior to the interviews, the

researcher obtained the necessary ethical and administrative approvals from relevant authorities. A list of operating room head nurses working in medical centers in the western region of Iran was prepared, and each participant was contacted to introduce the research objectives, explain the interview process, and arrange a convenient time and place for the interview. Interviews were conducted at participants' workplaces outside of working hours and with participants' written consent. Before each interview, the purpose of the research, the interview process, confidentiality of information, and the voluntary nature of participation were explained to the participants. Written informed consent was obtained, and permission to record audio was received verbally. Following consent, the interviews were recorded. Demographic and professional characteristics relevant to the research were recorded before the main questions began.

A semi-structured interview guide was developed based on the research objectives. The interview questions were designed to explore experiences of facing crises, emotional experiences, challenges and problems, capabilities and strengths, weaknesses and shortcomings, and strategies used in crisis management. The main interview question was: "Please describe your experience of facing a crisis in the operating room." Probing questions were used throughout the interviews based on participants' responses to obtain more detailed explanations, such as: "Please explain this experience in more detail," "What happened in that situation?" and "How did you manage the existing resources and equipment?"

Data Analysis

In this qualitative study, data were analyzed using the conventional content analysis approach described by Graneheim and Lundman [17]. This method was selected due to its high capability in discovering implicit meanings, fundamental concepts, and hidden patterns within qualitative texts, particularly in healthcare contexts. The data analysis process consisted of several systematic steps. First, the full text of interviews and collected data were read several times to gain a deep understanding of the data and their content. Second, the text was divided into smaller meaningful units, and each unit was assigned a descriptive code based on its content. Third, similar and related codes were grouped together, and general categories and themes were extracted to create a conceptual structure from the data. Fourth, the extracted themes were reviewed and refined to ensure comprehensiveness, distinctiveness, and sufficient clarity, and to represent the key concepts of the research. Fifth, each final theme was assigned a precise and expressive name, and definitions were developed to facilitate understanding and interpretation for readers. Finally, the analysis results were compiled with detailed descriptions of each theme along with examples from the primary data to clearly express the analysis process and inferences.

It should be noted that for data analysis, interviews were reviewed several times, and peer debriefing was used to increase validity. Meaning units were identified, semantic similarities were reviewed, and codes were assigned to meaning units. Final coding was performed by reviewing the data based on generated codes and modifying, deleting, or combining codes and categories. MAXQDA software version 10.0R250412 was used for data processing, and finally, report writing and presentation of results were

carried out. To ensure the accuracy and reliability of the data, the criteria proposed by Guba and Lincoln were used [15, 18].

Use of AI tools

The authors used AI-assisted translation tools to translate the Persian interview transcripts and manuscript drafts into English. The tool was used solely for language translation and editing purposes. All data analysis, interpretation, and scientific writing were performed by the authors, who take full responsibility for the final content.

Trustworthiness and Rigor

To ensure the trustworthiness and rigor of the data in this study, the criteria proposed by Guba and Lincoln were employed, which include credibility, dependability, confirmability, and transferability [15, 18].

Credibility was established through prolonged engagement with participants and the data. This allowed for a deep understanding of the data and ensured the accuracy of the interpretations. In the present study, in addition to selecting participants with maximum variation, the researchers ensured data credibility through deep and prolonged engagement with the data and review of data by research team members and participants. Transcripts were read several times by the first author and research team members to immerse themselves in the texts and fully understand them. To achieve credibility through participant review, the study results were provided to 19 participants. To increase the credibility of the research findings, member checking was performed as one of the actions related to the credibility criterion in qualitative research. After conducting interviews and the process of coding and content analysis, a sample of the findings was sent to 19 participants, of whom 10 provided their responses and feedback. In this process, related codes, subcategories, and main categories extracted from the interviews, along with a summary of the content related to each, were provided to participants, and they were asked to review the extent to which these findings aligned with their experiences and perspectives. The received feedback was compared with the primary data and interview transcripts after re-review by the researcher. In cases where the participant suggested a specific correction or clarification, the coding and naming of the relevant subcategories or categories were re-examined and, if confirmed based on the interview data, necessary corrections were made. This process contributed to increasing the credibility and trustworthiness of the qualitative research findings [19].

Dependability was ensured through documentation of all stages of the research, including interview procedures, recording, and systematic data analysis. In the present study, three research team members with sufficient experience in qualitative research analysis performed coding steps separately to determine data reliability. Through discussion and review of data analysis in multiple sessions, consensus was achieved. Additionally, test-retest reliability was used to calculate the reliability of the conducted interviews. Several interviews were selected as samples, and each was coded twice within a

short and specified time interval. The codes identified at two-time intervals were compared for each interview. Subsequently, the Kappa coefficient was calculated.

Confirmability was ensured by the primary researcher sharing transcripts, codes, and categories with other team members. The data analysis process was collaboratively reviewed and approved. In the present study, to achieve confirmability, several interviews were randomly selected and, along with research objectives, codes, and themes, were provided to two experts in qualitative studies who were not part of the study team, and their recommendations were used in the analysis process.

Transferability was facilitated by providing a thick description of the context, methodology, and participant characteristics. This allows readers to assess the generalizability of the findings to other similar contexts. In the present study, transferability of data was made possible by using a complete description of the study context, purposive sampling from head nurses of the western region of Iran, and clear and precise expression of the characteristics of the research population and research process to create the possibility of following the research path. Additionally, publication of findings and reader judgment will help determine data transferability.

Findings

A total of 17 operating room head nurses participated in this study. The mean age of participants was 39.45 years (range 37–56 years), and most were male (52.94%). The average work experience was 23.88 years, and most held a bachelor's degree in operating room technology (82.58%). Each interview lasted 35–45 minutes. Table 1 summarizes participant characteristics. Data saturation was achieved after 17 interviews, with no new codes emerging in the final interviews. No notable differences were observed in the experiences of participants based on gender or educational background.

Table 1
Characteristics of the participants

Variable	Frequency	Percent
Gender		
Male	9	52.94
Female	8	47.06
Educational level		
BSc Operating Room	12	70.59
BSc Anesthesia	4	23.53
BSc Nursing	1	5.88
Work experience (years)		
Mean (range)	23.88 (6–27)	

Analysis of 17 interviews yielded 946 primary codes, 59 subcategories, and 11 categories, organized into two main themes. The present paper reports the first theme, "Drivers of Crisis Management in the Operating Room," which comprised 557 primary codes organized into 33 subcategories and five categories (Tables 2 and 3). Representative quotations for each category are presented in Table 4. The complete table with three representative codes per subcategory is provided in Supplementary Table 1.

Table 2
Categories, subcategories, and representative codes of drivers of crisis management in the operating room

Category	Subcategory	Representative code
Professional leadership competencies	**Identification of staff capabilities**	**Recognizing faster and more agile staff regardless of experience**
	Error management in crisis	**Use of labels for unidentified patients to prevent wrong operations**
	Managerial and interdepartmental competencies	**Effective time and place management during crisis**
	Technical competencies	**Basic repair capability before expert arrival**
	Self-management in crisis	**Maintaining calm as priority to avoid secondary crises**
	Professional commitment in crisis	**Complete treatment without discrimination**
	Dual role fulfillment	**Transformation from coordinator to crisis manager**
Emotional leadership and team cohesion	**Participatory leadership**	**Direct participation in work to reduce staff pressure**
	Effective interaction with support units	**Justifying procurement and accounting about real needs**
	Supportive leadership and relationship with staff	**Creating empathy among staff through friendly relationships**
	Psychological management in crisis	**Attention to staff psychological state and emotional support**
Strategic management of reactive capacities	**Targeted human resource management**	**Registration of crisis on-call staff in monthly schedule**
	Expertise-oriented human resource management	**Management of forces based on background and skills**
	Role change management	**Fair distribution of new missions with staff justification**
	Team structure and unified command	**Necessity of taking orders from a single commander**
	Voluntary mobilization and staff collaboration	**Voluntary presence of retired staff during crisis**
Proactive preparedness and crisis operations	**Flexible human resource management**	**Use of information bank of former staff during shortage**

Category	Subcategory	Representative code
Professional leadership competencies	Identification of staff capabilities	Recognizing faster and more agile staff regardless of experience
	Error management in crisis	Use of labels for unidentified patients to prevent wrong operations
	Patient surge management and clinical prioritization	Prioritization of patients with life-threatening injuries
	Supportive management and humanitarian assistance	Distribution of hygiene supplies to earthquake victims
	Capacity preservation and service prioritization	Cancellation of elective surgeries to preserve capacity
	Infection control and safety protection	Full protection protocol with N95 mask and double gloves
	Clinical emergency management	Gathering all staff for critical patient resuscitation
	Resource consumption management and rationing	Rationing of masks and gloves based on attendance
	Structural and equipment preparedness for war crisis	Preparation of backup sets for emergency conditions
	Use of alternative space	Performing casting and suturing in emergency operating room
	Anticipation of operating room capacity preservation	Keeping one room empty for emergency conditions
	Anticipation of specialized resources and human resources	Estimation of human resources before crisis
	Proactive preparedness	Role of proactive planning in crisis prevention
Post-crisis support and rehabilitation	Application of crisis lessons learned	Learning from prior experience in field hospitals
	Strengthening organizational motivation post-crisis	Effect of encouragement on staff motivation
	Head nurse advocacy in service compensation	Request for written appreciation and incentive leave
	Service compensation and appreciation	Value of verbal appreciation and visible encouragement
	Organizational support in the midst of crisis	Payment based on active presence during crisis

Table 3
Frequency of categories and subcategories

Category	Number of codes	Participants
Professional leadership competencies	124	15
Emotional leadership and team cohesion	62	17
Strategic management of reactive capacities	82	15
Proactive preparedness and crisis operations	233	16
Post-crisis support and rehabilitation	56	14

Table 4
Representative quotations for each category

Category	Representative quotation	Participant
Professional leadership competencies	"The head nurse must have sufficient knowledge of the staff... being able to recognize that is very important"	15
Emotional leadership and team cohesion	"The most important strength a head nurse should have is being a good friend and companion for their staff"	11
Strategic management of reactive capacities	"Orders must definitely be taken from one person, from one team leader"	9
Proactive preparedness and crisis operations	"A good head nurse must always have good planning so that when a crisis occurs, they can quickly gather the work"	11
Post-crisis support and rehabilitation	"If they gave us a single flower... saying thank you for leaving your family and coming to the hospital"	15

Main Theme: Drivers of Crisis Management in the Operating Room

This theme represents the factors that, from the perspective of head nurses, influence their approach, decision-making, and performance and that of the operating room team in crisis conditions.

1. Professional Leadership Competencies of the Head Nurse

This category includes seven subcategories. One participant stated: *"Planning is the most important thing; if it's not there, even if you use the strongest staff, if there's no proper planning, it affects staff morale and brings fatigue"* (Participant 4). Professional leadership competencies, through proper planning and organization of human resources, play a facilitating role in maintaining staff morale and preventing fatigue. This competency encompasses not only technical proficiency but also the ability to recognize and deploy staff capabilities appropriately, manage errors under time pressure, and fulfill dual managerial and clinical roles during crises, Representative quotations for this category are provided in Table 4.

Regarding **identification of staff capabilities**, a participant stated: *"The head nurse must have sufficient knowledge of the staff. Without expectation, even some less experienced staff are faster practically than some experienced ones. At that moment, being able to recognize that is very important"* (Participant 15).

Regarding **error management**, a nurse with 14 years of experience stated: *"Many patients were unidentified. With labels that were leucoplast, I would write the patient's characteristics..."* (Participant 6).

Regarding **technical competencies**, a head nurse with 46 years of age narrated: *"Anyone who becomes an operating room head nurse must have complete mastery and ability with all devices... so that when essential equipment breaks down during surgery, the head nurse themselves has enough basic capability to solve it"* (Participant 17).

Regarding **self-management**, a participant stated: *"In any crisis, maintaining calm is the priority... instead of solving the crisis, don't create a new crisis"* (Participant 7).

Regarding **professional commitment**, a head nurse aged 38 stated: *"We tried our best to save each one of them because each of the patients was like our brothers and sisters"* (Participant 10).

Regarding **dual role fulfillment**, a participant stated: *"During the crisis, my role changed, and I became the crisis manager for my staff"* (Participant 9).

2. Emotional Leadership and Team Cohesion

This category was formed based on 62 primary codes and includes four subcategories. One participant stated: *"The most important thing in emergency and crisis conditions is the presence of the supervisor, management, and giving encouragement to newly hired staff"* (Participant 13). Emotional leadership encompasses the head nurse's ability to foster team cohesion through participatory engagement, psychological support, and effective communication with both staff and support units, Representative quotations for this category are provided in Table 4.

Regarding **participatory leadership**, a participant stated: *"Since there was no antenna, we couldn't call staff... So I started working myself, brought equipment to the operating room, moved patients. I did everything so the staff wouldn't be under pressure"* (Participant 11).

Regarding **effective interaction with support units**, a head nurse aged 56 stated: *"The good relationship I established with procurement and accounting departments... they accepted better, and I think their cooperation was somewhat good"* (Participant 3).

Regarding **supportive leadership**, a participant stated: *"The most important strength a head nurse should have is being a good friend and companion for their staff. This way, when a crisis occurs, everyone is friends and companions"* (Participant 11).

Regarding **psychological management**, a head nurse with 8 years of experience stated: *"I would arrange staff schedules in a way that was mostly what they wanted... we would hold meetings and listen to their*

problems" (Participant 14).

3. Strategic Management of Reactive Capacities

This category was formed based on 82 primary codes and includes five subcategories. Strategic management of reactive capacities refers to the head nurse's ability to identify, organize, and deploy existing human resources effectively in response to rapidly changing crisis demands, Representative quotations for this category are provided in Table 4.

Regarding **targeted human resource management**, a participant stated: *"We have on-call, and I had it in the schedule before. Actually, in the schedule, one person is designated as on-call in each anesthesia and operating room group"* (Participant 14).

Regarding **expertise-oriented management**, a participant stated: *"Use individuals in the position they are in... for many specialized tasks, that service worker performs 70% or 80% of the work physically, but the main work must be done sensitively there; that itself becomes a crisis"* (Participant 6).

Regarding **role change management**, a head nurse aged 42 stated: *"Initially, I faced staff resistance... But after a while, staff came to terms with this issue, that we must all strive to save human lives because we were the frontline of this crisis"* (Participant 12).

Regarding **unified team structure**, a participant stated: *"In a crisis, everyone comes and gives orders in some way... orders must definitely be taken from one person, from one team leader"* (Participant 9).

Regarding **voluntary mobilization**, a head nurse aged 47 stated: *"A staff member who retired in the war year 95 called saying we are ready to help in any department if you need staff"* (Participant 7).

4. Proactive Preparedness and Crisis Operations

This category was formed based on 233 primary codes and includes twelve subcategories. Proactive preparedness and crisis operations reflect the head nurse's capacity to anticipate, plan, and execute flexible strategies that preserve operational continuity under crisis conditions, Representative quotations for this category are provided in Table 4.

Regarding **flexible human resource management**, a participant stated: *"Having an information bank... so that we can use other people who previously worked here when facing staff shortage"* (Participant 13).

Regarding **patient surge management**, a participant stated: *"Those with life-threatening injuries had to be operated first"* (Participant 6).

Regarding **supportive assistance**, a participant stated: *"We prepared hygiene packages for all clients who came as earthquake victims"* (Participant 5).

Regarding **capacity preservation**, a head nurse stated: *"We had to keep our capacities for emergency conditions... we canceled elective surgeries"* (Participant 9).

Regarding **infection control**, a participant stated: *"Every patient transferred to the operating room was considered COVID-positive. We implemented full protection protocol"* (Participant 1).

Regarding **clinical emergency management**, a participant stated: *"I closed all rooms, took all surgeons off the small surgeries... all staff came to help"* (Participant 17).

Regarding **resource rationing**, a head nurse stated: *"Mask rationing was done monthly for staff based on weekly schedule attendance"* (Participant 8).

Regarding **structural preparedness**, a participant stated: *"We always have backup... so many backup sets that are regularly sterilized and replaced very quickly"* (Participant 15).

Regarding **alternative space**, a head nurse stated: *"We performed patient work in the emergency operating room—casting, splinting, suturing"* (Participant 5).

Regarding **capacity anticipation**, a participant stated: *"We try to keep one of the rooms for emergency conditions either empty or with very light surgeries"* (Participant 12).

Regarding **resource anticipation**, a head nurse aged 56 stated: *"I would try to anticipate things that might happen and consumable items that were needed, and prepare those items before they were needed"* (Participant 3).

Regarding **proactive preparedness**, a participant stated: *"A good head nurse must always have good planning so that when a crisis occurs, they can quickly gather the work"* (Participant 11).

5. Post-Crisis Support and Rehabilitation

This category was formed based on 56 primary codes and includes five subcategories. Post-crisis support and rehabilitation reflects the organizational and interpersonal processes that restore staff motivation, recognize contributions, and consolidate lessons learned after crisis resolution, Representative quotations for this category are provided in Table 4.

Regarding **application of lessons learned**, a participant stated: *"In the first days, we had neither masks nor clothing, and staff suffered a lot. It became an experience..."* (Participant 11).

Regarding **organizational motivation**, a head nurse aged 47 stated: *"I myself treat each colleague like my own son, like my own daughter... this creates motivation for them"* (Participant 7).

Regarding **advocacy for compensation**, a participant stated: *"A good head nurse must think about their staff, go to the hospital director and say, see, my staff are working so hard"* (Participant 11).

Regarding **service appreciation**, a head nurse with 19 years of experience stated: *"If they gave us a single flower... saying thank you for leaving your family and coming to the hospital under the noise of bombs"* (Participant 15).

Regarding **organizational support**, a participant stated: *"During the height of the crisis, war pay was paid... based on the shift arrangement and presence they had"* (Participant 15).

Discussion

This study identified five interconnected categories of drivers of effective crisis management among operating room head nurses: professional leadership competencies, emotional leadership and team cohesion, strategic management of reactive capacities, proactive preparedness and crisis operations, and post-crisis support and rehabilitation. These findings demonstrate that optimal crisis performance in the operating room is a multidimensional phenomenon requiring the integration of clinical expertise, relational capacity, organizational readiness, and systemic support.

Professional leadership competencies emerged as a foundational driver, encompassing technical mastery, error management, self-management, and the capacity to deploy staff capabilities effectively. This finding aligns with a qualitative study by Jääski et al. examining crisis management competencies needed in hospital settings during the COVID-19 pandemic, which identified the ability to make decisions under uncertainty and adapt rapidly to changing circumstances as core competencies for nurse leaders [20]. Similarly, our participants described assuming dual roles—functioning simultaneously as head nurse and crisis manager—a finding consistent with research on first-line healthcare leaders' experiences during the pandemic, which documented role expansion and ambiguity as inherent features of crisis leadership [22]. The emphasis on technical mastery of operating room equipment reflects the unique operational demands of the surgical environment, where equipment failure during a crisis can rapidly escalate into a life-threatening situation [6].

Emotional leadership and team cohesion represented a second critical driver, with participants describing participatory leadership, psychological support, and relational trust as essential for sustaining team function. This finding is supported by Verhoeven et al., whose qualitative interpretive study demonstrated that relational leadership struggles during hospital crises significantly influence nursing's capacity to contribute to strategic decision-making and maintain team cohesion [20]. The emphasis on supportive leadership—characterized by empathy and advocacy for staff wellbeing—resonates with research identifying socio-emotional competencies as essential for nurse leaders coping with crises, including social awareness, regulation, self-control, creativity, and emotional awareness [23]. The subcategory of effective interaction with support units underscores the interdepartmental nature of crisis management, wherein operating room head nurses must navigate organizational boundaries to secure resources and maintain operational continuity [24].

Strategic management of reactive capacities reflects the head nurse's ability to rapidly mobilize and deploy human resources in response to crisis demands. Participants emphasized pre-designated on-call

staff, expertise-oriented deployment, and role flexibility as essential strategies. This finding is consistent with research on crisis management competencies among nurse leaders, which identified the need to quickly adapt staffing models and redistribute responsibilities as a core competency during crisis situations [21]. The emphasis on unified command structures and the avoidance of multiple, conflicting directives reflects established principles of crisis leadership, particularly the importance of clear authority and coordinated communication during high-stakes events [25]. Voluntary mobilization of staff, including retired personnel, highlights the resourcefulness required when formal staffing systems are overwhelmed, a phenomenon also observed in disaster preparedness studies among operating room nurses [6].

Proactive preparedness and crisis operations constituted the largest category, encompassing anticipatory planning, resource stockpiling, capacity preservation, and infection control. This finding strongly aligns with the main theme of "insufficient disaster preparedness due to a faded preparedness" identified by Rostami et al. in their study of operating room nurses during the Kermanshah earthquake, which emphasized the critical role of knowledge, equipment readiness, and managerial-organizational structures in disaster response [6]. The proactive planning described by participants—including anticipating equipment needs, preserving operating room capacity, and preparing backup sets—reflects a sophisticated understanding of the resource-constrained reality of crisis conditions. The subcategory of using alternative spaces demonstrates adaptive capacity in response to physical infrastructure limitations, a strategy also noted in disaster preparedness research [6]. Infection control and safety protection measures, particularly during the COVID-19 pandemic, underscore the evolving nature of crisis management demands and the need for continuous updating of protective protocols [2].

Post-crisis support and rehabilitation emerged as a critical yet often overlooked driver. Participants emphasized the importance of organizational recognition, financial compensation, and managerial presence during and after crises. This finding is consistent with research by Udod et al. identifying the need for organizational resilience and psychological support to sustain healthcare leaders and staff following crisis events [22]. The subcategory of applying lessons learned reflects an organizational learning orientation that is essential for developing resilience to future crises [6]. The emphasis on advocacy for staff compensation and recognition indicates that head nurses perceive themselves as intermediaries between organizational leadership and frontline staff, a relational positioning that has been shown to influence nursing's influence in hospital crisis management [20]. Research on trauma operating room nurses similarly highlights the critical unmet need for systemic psychological support structures, suggesting that individual resilience alone is insufficient to sustain wellbeing in high-stress environments [27]. Similar findings have been reported among healthcare workers experiencing post-traumatic stress following the COVID-19 pandemic, underscoring the need for organizational mental health interventions [26].

From a theoretical perspective, the findings can be understood through the lens of non-technical skills frameworks. Non-technical skills—including situational awareness, team communication, task management, leadership, and decision-making—have been increasingly recognized as essential for

effective crisis management in the operating room [28]. A systematic review by Redjem et al. demonstrated that simulation-based training targeting these skills is the predominant method for improving team effectiveness, yet such training remains primarily focused on medical staff rather than nurses [28]. Our findings suggest that operating room head nurses mobilize non-technical skills—particularly emotional leadership, participatory decision-making, and team coordination—as critical enhancers of crisis performance, underscoring the need for targeted training that addresses both technical and non-technical competencies [28].

The findings have several implications for practice and policy. First, the development of professional leadership competencies should be prioritized through targeted training that addresses technical mastery, decision-making under uncertainty, and self-management strategies [21]. Second, organizational support systems should recognize and reward emotional labor and relational work, which are essential yet often invisible components of effective crisis management [23]. Third, proactive preparedness—including resource stockpiling, capacity planning, and scenario-based training—should be institutionalized to ensure that operating room teams are equipped to respond effectively to diverse crisis scenarios [6]. Fourth, post-crisis support mechanisms, including debriefing, recognition, and mental health resources, should be systematically implemented to sustain staff wellbeing and organizational learning [22]. Finally, the interdepartmental and organizational dimensions of crisis management suggest that interventions targeting individual competencies alone will be insufficient; systemic support and structural readiness are equally essential [20].

Several limitations should be acknowledged. First, the study was conducted in western Iran, and findings may not be directly transferable to other cultural or organizational contexts. Second, the qualitative nature of the study means that findings represent participants' perspectives rather than objective measures of crisis management performance. Third, despite maximum variation sampling, the predominance of male participants and bachelor-level education may limit the diversity of perspectives. Fourth, the retrospective nature of the interviews may introduce recall bias. Fifth, the study focused on head nurses' perspectives and did not include other team members or organizational stakeholders.

Future research should address these limitations through multi-center and cross-cultural studies, mixed-methods designs, and longitudinal investigations that track crisis management performance over time. Additionally, research examining the perspectives of staff members, physicians, and organizational leaders would provide a more comprehensive understanding of systemic factors that enable or constrain effective crisis management in operating rooms.

Conclusion

This qualitative study identified five key drivers of effective crisis management among operating room head nurses: professional leadership competencies, emotional leadership and team cohesion, strategic management of reactive capacities, proactive preparedness and crisis operations, and post-crisis support and rehabilitation. These findings demonstrate that effective crisis management in the operating

room is not solely dependent on clinical expertise but emerges from the integration of individual capabilities, team dynamics, organizational readiness, and systemic support. The study contributes to the literature by providing a comprehensive framework of enhancing factors from the perspective of those who bear primary responsibility for surgical crisis coordination.

The findings hold significant implications for healthcare policymakers, hospital administrators, and nursing educators. Policymakers should prioritize the development of crisis leadership training programs that address both technical and non-technical competencies, recognizing that effective crisis management requires more than clinical proficiency [21]. Hospital administrators should invest in proactive preparedness measures, including resource stockpiling, capacity planning, and scenario-based training, while also establishing systematic post-crisis support mechanisms that recognize and reward staff contributions [22]. Nursing educators should incorporate crisis leadership competencies and non-technical skills into operating room nursing curricula to better prepare future head nurses for the demands of crisis situations [28].

Declarations

Ethics approval and consent to participate

The Institutional Review Board of Kermanshah University of Medical Sciences and the Iran National Committee for Ethics in Biomedical Research approved this study (Ethics Code: IR.KUMS.REC.1404.426). Informed consent was obtained from all participants, and all information (including participant names, interview files, and writings) was kept confidential, and the confidentiality principles were strictly followed. Participants' right to withdraw from the study was described at the start of the interview and reserved at any time. In the present study, all methods were performed in accordance with the relevant guidelines and regulations, including the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Use of AI tools

The authors used AI-assisted translation tools to translate the Persian interview transcripts and manuscript drafts into English. The tool was used solely for language translation and editing purposes. All data analysis, interpretation, and scientific writing were performed by the authors, who take full responsibility for the final content.

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Author Contribution

All authors designed the study. F.Y., N.HM, and A.G. participated in coordination and data collection. F.Y. and N.H.M. analyzed the data. F.Y., N.H.M., A.G., H.A and E.E. wrote the report and the final article. All authors read and approved the final manuscript.

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Data Availability

The final interview format, all quotations, and codes taken from the interviews have been uploaded in the supplementary files section. Also, the data and materials are available by contacting the corresponding author.

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