Scoping Review

Critical Care in Crisis: A Global Scoping Review of ICU Nurses' Roles in Disaster Management

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ABSTRACT

Objectives: To scope what is known from the existing literature about ICU nurses' disaster preparedness and response.

Methods: In August 2024, a systematic search was conducted in five databases: PROQUEST Nursing, Web of Science, Scopus, EMBASE, and PubMed. Using a combination of key terms and relevant subject headings, 670 sources were identified. Two investigators independently performed a two-stage screening using Rayyan's blinded function. Discrepancies were resolved through discussion, ensuring reliability.

Results: The final review included 52 articles. Analysis of the results yielded eight themes: professional education, guidelines, nurses' experiences, patient care, staff readiness, competence, patient experiences, and ethical considerations.

Conclusion: Evidence suggests that ICU nurses working in regions experiencing disasters and mass casualty events actively publish their experiences, are highly motivated to research these incidents, and acquire valuable knowledge from lessons learned. Given that the COVID-19 pandemic was a global crisis affecting nearly all ICU nurses, it presents an opportunity to initiate an international study examining the themes uncovered in this review.

Keywords: critical care nursing, crisis management, casualty, mass events, disaster preparedness, ICU nurses, disaster

Introduction

Disaster and mass casualty events are overwhelming incidents in size and scope, causing more casualties at one time than medical resources can manage. These events can result from various causes, including natural and man-made disasters, terrorist attacks, motor vehicle collisions, wars, tsunamis, building collapses, earthquakes, floods, and fires (Lomaglio et al., 2020). During a mass casualty disaster, the ICU faces significant challenges due to its critical role and inherent limitations, even under normal circumstances, such as limited beds, specialized equipment, and highly trained staff (Gallagher & Adamski, 2021). In such scenarios, the demand for ICU expertise escalates, requiring staff to work longer hours and handle higher patient loads, often leading to burnout and fatigue. Despite the pivotal role of ICU nurses in disaster response, existing literature often addresses general nursing preparedness without focusing specifically on the unique challenges faced by ICU nurses. This gap underscores the necessity of systematically reviewing evidence to identify and address the specialized needs of this critical group.

There are numerous topics related to ICU nurses and disasters. For example, knowledge, disaster preparedness, and skill competencies for managing possible injury scenarios can be assessed through surveys and simulation training (Jiang et al., 2022; Wax, 2019). Defining nurses' roles during disaster events is also critical (Firouzkouhi et al., 2021). This subject gained significant attention after the COVID-19 pandemic highlighted the scarcity of skilled ICU nurses during disaster and surge capacity incidents. Internationally, during COVID-19, ICU nurses collaborated to share coping strategies and best practices (Kissel et al., 2023; Schwerdtle et al., 2020). However, a comprehensive understanding of ICU nurses' disaster preparedness and response remains fragmented, necessitating further investigation into policies, guidelines, ethical decision-making, and coping strategies tailored to ICU settings (Sprung et al., 2023; Bader et al., 2020).

Several publications have addressed nurses' disaster response and readiness. For instance, Labrague et al. (2018) published a systematic review of nurses' readiness for disaster response. However, this review did not focus specifically on critical care nursing and preceded the COVID-19 pandemic. The included studies predominantly applied cross-sectional methodologies, encompassing a broad range of nursing specialties such as medical, surgical, pediatric, psychiatric, operating room, critical care, and emergency units. The key finding that nurses are generally ill-prepared for disaster response highlights a pressing need for targeted interventions in critical care settings. Similarly, a 2021 scoping review by Firouzkouhi et al. explored nurses' roles in disaster models, including emergency communication, triage, injury admission, and team coordination. However, this review also lacked a specific focus on ICU nursing, further accentuating the need for targeted research.

Given the heightened vulnerability of ICUs during disasters and the increasing frequency of such events globally, understanding the preparedness and response capabilities of ICU nurses is urgent and essential. A scoping review that synthesizes existing knowledge on this topic will provide a robust foundation for developing evidence-based training programs, policies, and practices tailored to ICU settings. To manage future crises effectively, ICU nurses worldwide must be equipped with comprehensive insights into disaster preparedness and response.

Method

Design

This scoping review addresses this critical need by answering the research question: What is known from the existing literature about ICU nurses' disaster preparedness and response?

The current scoping review examined the immediate responses and the lessons learned that could inform future disaster preparedness and response in ICU settings. This scope review study employed the methodology of Arksey and O'Malley (2005), which was deemed the most suitable for providing a comprehensive description and understanding of the selected topic (Peters et al., 2020). The process involved five main stages: (1) formulation of the research question, (2) identification of relevant studies, (3) selection of studies based on predefined criteria, (4) extraction of information, and (5) summary and reporting of the findings.

Eligibility criteria for relevant studies were established by defining the population (ICU nurses), concept (any disaster), and context (responses, coping strategies, and lessons learned), (Peters et al., 2020). This review's reporting adheres to the principles outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews Checklist (Tricco et al., 2018).

Definition of a research question

What is known from the existing literature about the ICU nurses' disaster preparedness and response?

Searching strategy and screening process

Utilizing medical center librarian, an initial search was conducted using five databases: PROQUEST Nursing, Web of Science, Scopus, EMBASE, and PubMed in August 2024. Using a combination of key terms and relevant subject headings, including MESH and EMTREE, 670 sources were identified. After re-moving 289 duplicates with Zotero, the remaining 403 sources were submitted to Rayaan for a two-step screening process.

The initial screening was performed by two ICU nurse researchers independent of each other and involved scanning titles and abstracts, while the second stage required reading the full articles. Inclusion criteria encompassed all types of studies focusing on disasters involving critical care nurses, published in English, without publication date restrictions, peer-reviewed, and with full-text access available. Two investigators (NB and JB) independently performed the two-stage screening using Rayyan's blinded function. Discrepancies were resolved through discussion, ensuring reliability. Ultimately, 52 articles were included in the final review (Figure 1).

Data extraction

Data extraction included the study authors, year of publication, geographic location by country, study purpose, population and sample size, type of study, type of disaster (Table 1).

Summary and findings reporting.

All extracted data were analyzed numerically and thematically following scoping review guidelines (Levac et al., 2010; Safarpour et al., 2020). This analysis led to data categorization into key themes,

detailed in Figure 2 and discussed in the results section. Researchers analyzed the data to ensure transparency and avoid bias, with the final themes determined by mutual agreement. These themes provided insights into past disaster responses and strategies, offering valuable guidance for future preparedness and response.

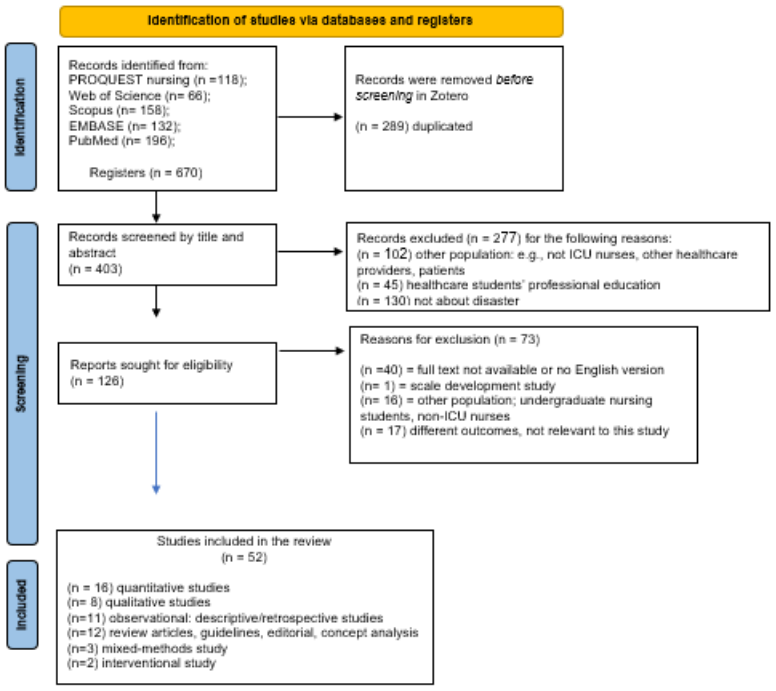


Figure 1. PRISMA FLOW DIAGRAM

Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

Results

Study characteristics

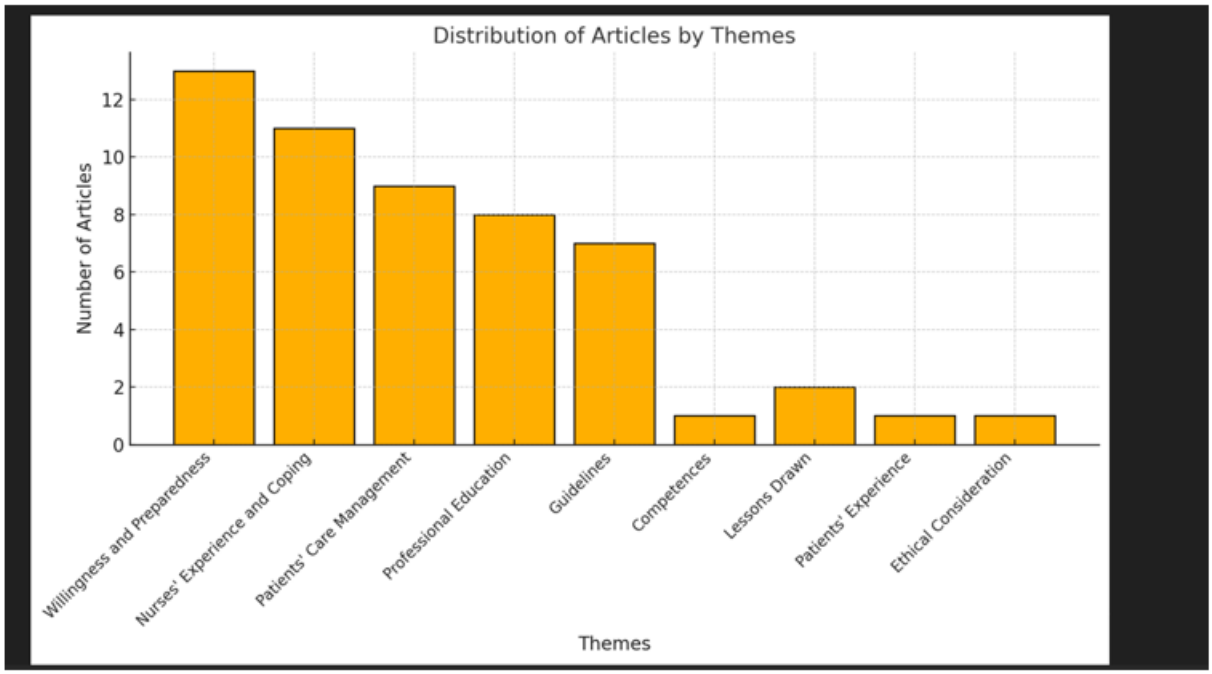
The studies reviewed were primarily conducted in the USA (n=19), utilizing cross-sectional (n=12) and descriptive observational (n=11) designs. Natural disasters, including earthquakes, hurricanes, and fires, were the most commonly studied disaster types. Thematic analysis identified eight key themes: professional education, guidelines, nurses' experiences, patient care, staff readiness, competence, patient experiences, and ethical considerations (Table 2).

Willingness and preparedness

The first and most significant theme, comprising 13 articles, focused on willingness and prepared-ness. Nurses' preparedness for disasters varies by type and location. Iranian nurses were underprepared for the MERS-CoV outbreak (Abdollahi et al., 2021), while Yemeni nurses faced similar challenges during COVID-19 (Al-Ashwal et al., 2020). Dutch nurses were well- prepared for pandemics but lacked readiness for nuclear incidents (Engels et al., 2023). Norwegian healthcare workers reported strong

preparedness during the first COVID-19 wave, attributed to ICU experience and simulation training, though communication issues and infection fears remained significant challenges (Lie et al., 2021).

Figure 2: Distribution by Themes



Preparedness for natural disasters also varied. In Oman, ICU nurses demonstrated higher disaster preparedness than their peers despite moderate overall readiness (Chen et al., 2016; Labrague et al., 2021). In California, NICU nurses lacked sufficient training for wildfire disasters, while Australian nurses, despite intense general disaster training, needed improved preparation for bushfires (Ranse et al., 2010).

In Israel, nurses' willingness to work in emergencies such as wars and terrorist incidents depended on perceived threats and cultural norms. Many hesitated due to personal and family safety concerns despite their ethical obligations (Ganz et al., 2019). Factors such as seniority, advanced education (Lin et al., 2023), and prior disaster training (Sellers et al., 2022) were crucial in preparing ICU teams for disaster response. However, in New Zealand, limited training resulted in low preparedness levels (Al-Shaqsi et al., 2015). Similarly, Turkish nurses reported low self-efficacy in psychological first aid during disasters, with prior train-ing boosting their confidence (Kiliç Bayageldi & Kaloglu Binici, 2023).

Nurses' experiences and coping

The second most prominent theme was nurses' experiences and coping methods during disasters (n=11). We can identify rapid and extraordinary adaptation as a highly effective coping style. This is evident in situations where teams operated without electricity and essential resources, requiring

extraordinary measures to safeguard patients' lives (deBoisblanc, 2012) while simultaneously addressing concerns for per-sonal safety (Kalia et al., 2023). Experiences from the COVID-19 pandemic highlighted instances of working beyond traditional roles, involving intensive workloads that necessitated the application of professional skills in areas for which the staff had no prior training (Fairley et al., 2019).

In several natural disasters, nurses participated in the immediate evacuation of intensive care units, utilizing temporary solutions such as stretchers and alternative lighting, as demonstrated during a hurricane (King et al., 2016). Collaboration among teams, and even between different hospitals, during disaster response is often described as a positive experience, fostering a sense of belonging (Mitchell et al., 2024) and enhancing leadership skills (Zhuravsky, 2014). However, challenges were also identified, including difficulties in cross-cultural communication with local teams, obstacles in collaboration (Segev et al., 2023), and psychological trauma experienced by healthcare teams (Shin et al., 2002).

Emotional support and structured debriefings following disasters improved team experiences and contributed to organizational learning (Ashworth, 1989). Strengthening social bonds within teams, which in turn provides emotional support, is described as a vital coping strategy during times of war (Muhammad et al., 2023; Scannell-Desch, 2010).

Patient care management

The third theme (n=9) reported topics about direct patient care in disaster situations addressing ethical and technical challenges beyond providing immediate care. These challenges impacted both nursing teams and the health system. For example, during the COVID-19 pandemic, allocating resources and balancing care between oncology and other patients highlighted the complexity of providing care in limited resource conditions (Boilève et al., 2020). Similarly, the conversion of a cardiothoracic unit to a general in-tensive care unit during a disaster resulted in changes to nurse-patient ratios (Santa Ana & Roach, 2020), while multi-team collaboration played a critical role in providing care to victims of natural disasters (Yang et al., 2019). The use of TELE-ICU technology enabled remote access to intensive care in war-torn areas, demonstrating relative success in providing critical care amidst severe logistical challenges (Moughrabieh & Weinert, 2015). Similarly, mobile intensive care units (Rice et al., 2008) and the implementation of the U.S. Air Force's Civilian Air Transport Team (CCATT) model facilitated the stabilization and early evacuation of critically ill patients in civilian disaster scenarios (Sariego, 2006).

In the context of natural disasters, the effectiveness of care often depended on essential skills for evacuating critically ill premature infants, which included prioritizing and managing critical equipment necessary for their care (Gray et al., 2019). Additionally, the care of victims of terrorist attacks, such as those with burn injuries, underscored the importance of disaster planning. This led to the integration of burn centers within large hospitals and the expanding of skilled staff, including intensive care nurses, to improve care delivery during such crises (Morell et al., 1990; Renz et al., 2017).

Professional Education

In the professional education theme (n= 8), these disaster management trainings prepare nurses to effectively manage crises by equipping them with the critical technical, ethical, and cultural skills to navigate complex disaster environments. This directly supports their central role in the resilience and recovery of health systems during disasters. The professional educational training content included early preparedness and risk identification, including planning resource allocation and preparing for patient evacuation during a disaster (Chen et al., 2016; Monteverde et al., 2021); simulations of evacuating of vulnerable populations and critically ill patients (Gildea & Etengoff, 2004; Farra et al. al., 2020; Tullius et al., 2023); responding to mass disaster situations, with an emphasis on staff and equipment reinforcement capabilities in intensive care units (Shah et al., 2012); improving interdepartmental communication and cooperation with external emergency forces (Tullius et al., 2023) or interprofessional collaboration (Conteras et al., 2020); ethical and culturally appropriate medical care in resource-poor settings (Monteverde et al., 2021), and cultural competence in nursing practice (Husna et al., 2021).

Guidelines

The guideline's theme comprised seven articles addressing several important nursing professional practice areas, emphasizing unique roles in ICU care during disasters. Key areas included planning and managing ICU capacity in overloaded situations (Hick et al., 2010; Einav et al., 2014; Rubinson et al., 2008), addressing staff shortages through creative models for recruiting and training medical and nursing teams (Devereaux et al., 2008; Bader et al., 2020), and ensuring effective interprofessional communication between teams and regional or national managers to maintain continuity of care (Rådestad et al., 2013). Additionally, the guidelines emphasized the importance of providing emotional care to teams and patients and conducting briefings after traumatic events (Sprung et al., 2023).

Competence

In the competency theme, only one article by Schumann and Costa (2020) examined nursing leadership skills in critical care during disasters, emergencies, and outbreaks. The article highlighted that critical care nurses provide care during disasters and play pivotal leadership roles in planning, implementing, and influencing disaster management strategies at the local, regional, and national levels.

Lessons drawn

One article in the "Lessons Learned" theme, Lessons from COVID-19 (Steinlage et al., 2023), emphasized the critical importance of establishing standardized Crisis Standards of Care (CSC) tailored to military Role 3 ICUs for the effective management of large-scale disasters or conflicts. It highlighted the need to develop programs to reduce the emotional and cognitive burden on nursing staff and prevent burnout. Additionally, promoting and implementing proactive training in leadership, ethical decision-making, and crisis management were identified as effective strategies to enhance the resilience, adaptability, and effectiveness of ICU teams in future crises.

Patient's experience

One article in this theme, Angeletti et al. (2012), focused on pain assessment and management following the L'Aquila earthquake. It highlighted the prevalence of pain and challenges in its treatment due to limited resources and a shortage of opioids. ICU nurses played a key role in providing care, assessing pain using standardized tools, and administering available treatments. They also offered psychological support, addressing physical and emotional needs, vital in improving patient outcomes during the disaster.

Ethical considerations

Finally, the article (Moradi et al., 2020) focuses on ethical considerations in disaster management, emphasizing the importance of respecting humanistic values, adhering to ethical principles, maintaining the dignity of victims, and providing spiritual support. Ethical care requires ICU nurses to go beyond their traditional roles, often beyond task descriptions, and to volunteer to assist in extreme conditions. Maintaining confidentiality, honesty, and trustworthiness were emphasized as essential, even in challenging circumstances.

Discussion

The purpose of this study was to comprehensively examine the preparedness, response, and roles of intensive care unit (ICU) nurses in disaster situations, focusing on key challenges and opportunities for improvement. The findings provide critical insights into professional education, guidelines, nurses' experiences, patient care management, and ethical considerations, forming a foundation for enhancing disaster preparedness and response practices.

The broad focus on preparedness and motivation reflects an understanding that this is critical in the foundation for successful disaster response. The extensive scope of this topic underscores that preparedness is not limited to technical training or professional knowledge but also encompasses psychological, cultural, and operational aspects (Firouzkouhi et al., 2021). ICU nurses' preparedness varies by disaster type and region, as observed during COVID-19, where levels differed geographically due to social and systemic factors (Al-Ashawi et al., 2020; Engels et al., 2023; Lie et al., 2021). Most data pertain to the first wave, highlighting the need for further research into the evolution of preparedness during prolonged crises.

Despite the insufficient global representation of disaster preparedness (including COVID-19), the review findings reveal significant disparities in nurses' readiness levels, primarily driven by differences in knowledge and training. This aligns with existing literature describing varying levels of preparedness, ranging from low (Songwathana & Timalsina, 2021) to moderate (Ghazi Baker, 2021). Another important point is that the articles included in the review lack detailed descriptions of how to measure and evaluate nurses' preparedness. This gap hinders the identification of weaknesses in training programs and limits their effective improvement. Furthermore, while the articles address disaster preparedness, they do not clearly differentiate between types of disasters (e.g., pandemics, natural disasters, or man-made events) and their unique impacts on preparedness levels. Since preparedness and motivation levels largely depend on social norms and nurses' perceptions of personal threats (Ganz et al., 2019), distinguishing between disaster types could be valuable for developing

tailored training programs. Such understanding would allow the identification of disaster types requiring greater attention.

The second most significant theme was the experiences of ICU nurses during disasters, emphasizing the complexity of working in extreme situations and the need to adopt unconventional solutions. Interestingly, nurses also reported positive experiences in these challenging circumstances, such as a sense of cohesion fostered through teamwork and mutual support (Mitchell et al., 2024). These experiences contributed to the teams' immediate well-being and could have long-term impacts, motivating nurses to enhance their professionalism and preparedness for future extreme situations (Çam, 2017).

Additionally, positive experiences form a foundation for developing personal (Peñacoba et al., 2021) and group (Amrose et al., 2022) resilience. Such resilience helps nurses adapt to more challenging circumstances and manage burnout resulting from prolonged stress. However, alongside these positive experiences, it is essential to explore further specific challenges or difficulties nurses report, such as logistical hurdles or emotional strain, and their effects on short- and long-term functioning. Working in disaster conditions presents unique dilemmas and challenges not encountered in routine situations. Critical care nurses must operate under demanding conditions while maintaining a high level of care, as highlighted in the third theme. These situations subject staff to prolonged mental stress and the need to make rapid decisions directly affecting patients' lives. Such pressures can lead to anxiety disorders and negatively impact staff members' mental health (Peñacoba et al., 2021a). These challenges emphasize the need for targeted training in decision-making under stress, guided by ethical principles such as justice, transparency, and equity. Such training can enable staff to make more informed decisions and reduce the psychological stress associated with the moral complexities of disaster response (Gustavsson et al., 2022). Equally important is implementing structured support mechanisms, including psychological debriefing and peer support programs. These initiatives help teams process their experiences, manage emotional impacts, and sustain their capacity to deliver high-quality care, even in the most challenging circumstances.

Professional education highlights significant gaps in disaster preparedness across countries, reflecting a lack of uniformity and regular updates in training programs based on past experiences. There is an urgent need for global training frameworks to ensure consistency and adaptation to evolving realities (Sellers et al., 2024). The COVID-19 pandemic demonstrated the importance of quickly adapting care and training for ICU medical and nursing staff. Embedding lessons learned and fostering international collaboration can lead to the development of unified global protocols. A key direction emerging from the guideline theme results is the need for a holistic approach to preparing intensive care teams for disaster scenarios. The findings emphasize the importance of planning and managing ICU capacity during overload situations, developing innovative models to address staff shortages, and improving interprofessional communication to ensure continuity of care. Additionally, the guidelines highlight the necessity of providing emotional support to teams and patients and conducting, briefings after traumatic events. This direction underscores that disaster preparedness is not limited to technical aspects but requires attention to human and organizational factors. Adapting protocols to enhance

individual and team resilience and maintain the quality of care under challenging conditions is essential.

The narrow focus on competency raises questions about how ICUs and the healthcare system prioritize this aspect. Competency is a key factor driving the quality of team responses in disasters (Pandian et al., 2024). However, the limited focus on this topic may suggest that technical aspects, such as preparedness and protocols, are perceived as more important. At the same time, leadership, decision-making under pressure, and the integration of ethics and practice are overlooked. The minimal representation of skills, lessons learned, patient experiences, and ethical considerations highlight critical gaps requiring further investigation. Expanding research on leadership, standardized care protocols, patient-centered strategies, and ethical training could provide valuable insights into these underrepresented themes and emphasize their importance in preparing critical care nurses for future disasters.

Limitations

This review has several limitations. The quality of the extensive literature search was ensured through repeated checks; however, errors may still exist. Another limitation is the language inclusion criterion, which is limited to English. The topic of interest is broad, and the numerous included studies embody various aspects of the topic but were not graded or systematically assessed (Arksey & O'Malley, 2005). Additionally, a search for grey literature was not conducted, and only empirical studies were included, which may have excluded relevant findings.

Conclusions

Evidence suggests that ICU nurses working in regions experiencing disasters and mass casualty events actively publish their experiences, are highly motivated to research these incidents, and acquire valuable knowledge from lessons learned. Given that the COVID-19 pandemic was a global crisis affecting nearly all ICU nurses, it presents an opportunity to initiate an international study examining the themes uncovered in this review.

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Table 1: Study characteristics

Authors (Country)/Year of publication	Aim	Target Population (Sample, N)	Study design	Disaster type
Engels et al., 2023 Netherlands	To evaluate the willingness of emergency healthcare workers, including ICU nurses, to work during crises or disasters in the Netherlands and identify the working conditions that would influence their decision to work	N= 306 healthcare workers, including 71.6% nurses (including ICU nurses) and 28.4% physicians	Cross-sectional, multicentre survey study	Various types of disasters, including pandemics (like COVID-19), natural disasters, nuclear incidents, and mass casualty events
Kalia et al., 2023 Ukraine	To highlight the extraordinary efforts and challenges faced by ICU nurses during the Ukrainian War, emphasizing their role in providing life-saving care under extreme conditions	No sample size	A narrative of the experiences and challenges faced by ICU health professionals during the Ukrainian War	Ukrainian War
Kiliç Bayageldi & Kaloglu Binici, 2023 Turkey	To determine nurses' psychological first aid (PFA) practice self-efficacy in disaster situations.	N = 580 nurses, including 108 (18.7%) ICU nurses	Descriptive cross-sectional design	The study focuses on various types of natural disasters (e.g., earthquakes, tsunamis, hurricanes, epidemics) and man-made (e.g., armed conflict, chemical or radiological events).

Lin et al., 2023 Taiwan	To assess hospital nurses' readiness for disaster responses and identify the determinants contributing to their readiness in Taiwan	N- 365 ICU nurses from a military medical center	cross-sectional study	There are various types of natural disasters, such as earthquakes, and typhoons
Muhammad et al., 2023 Syria	To explore the lived experiences of Iranian critical care nurses who served in war zones in Syria between 2014 and 2020, focusing on the challenges and insights gained while caring for critically injured individuals in such extreme conditions	The study involved 15 ICU male nurses, both military and civilian, all of whom had at least 6 months of experience working in war zones.	A qualitative phenomenological design based on Van Manen's hermeneutic phenomenology methodology	The study focuses on the Syrian Civil War, a man-made disaster
Segev et al., 2023 Israel	To investigate the challenges an Israeli humanitarian delegation faced in response to the 2023 earthquakes in Turkey. The study focused on difficulties in preparation, operations, and collaboration with local teams, to extract valuable lessons to enhance future disaster response efforts.	N= 32 nurses, including 12 ICU nurses, from the Israeli delegation who participated in the response to the earthquakes.	A qualitative descriptive design with focus group	The study focuses on a natural disaster, specifically the earthquakes that struck Turkey's Kahramanmaraş region in February 2023.
Steinlage et al., 2023 USA	To explore how lessons learned from managing the COVID-19 pandemic could	No sample size	Commentary and review	The study focused on lessons from the COVID-19 pandemic.

	inform the development of Crisis Standards of Care (CSC) for Role 3 Intensive Care Units during future large-scale military conflicts.			
Sprung et al., 2023 USA guidelines	To provide actionable guidance to improve healthcare workforce sustainment during pandemics and disasters by addressing mental health, burnout, and moral distress among healthcare workers	No sample size	A consensus report based on a modified Delphi approach	COVID-19 pandemic
Chien et al., 2022 Taiwan	To investigate the correlations among ER and ICU nurses' training needs, willingness to participate, achievement motivation, and job satisfaction in disaster nursing	N= 412 participants, (n=268; 65%) were ICU nurses.	Cross-sectional design	disaster nursing in general, with particular reference to biological disasters such as pandemics (e.g., COVID-19) and other types of disasters like earthquakes, floods, and terrorist attacks
Sellers et al., 2022 Australia	To analyze the concept of disaster preparedness within the context of Intensive Care Units (ICUs) and to understand how disaster preparedness is	18 peer-reviewed articles addressing disaster preparedness in ICUs.	concept analysis study utilized Rodgers' evolutionary concept analysis method	The study focused on various types of disasters, including pandemics, explosions, fires, and patient surges from non-defined disaster types

	applied in ICU settings			
Tullius et al., 2022 USA	To evaluate a city-wide evacuation simulation involving multiple Neonatal Intensive Care Units. The study sought to test the effectiveness of hospital-specific evacuation processes, evaluate NICU personnel's knowledge and competency, and familiarize first responders with the specialized needs of critically ill neonates	n= 30 participants from each of the six NICUs, including nurses	Descriptive observational design	fire disaster
Abdollahi et al., 2021 Iran	To determine Iranian nurses' preparedness against the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak and to identify factors influencing their preparedness	N= 155 nurses from the ICU and Emergency Department	A cross-sectional, multi-center design	Infectious disease outbreak, specifically the Middle East Respiratory Syndrome Coronavirus
Husna et al., 2021 Indonesia	To assess the impact of an Islamic-based disaster response	N= 147 nurses	RCT study with pre-post test	The study focused on general disaster response and was conducted in a region prone to natural

	program on nurses' knowledge, skills, and attitudes, focusing on psychological, psychosocial, and spiritual care			disasters such as earthquakes and tsunamis.
Labrague et al., 2021 Oman	To examine the relative influence of nurses' demographic characteristics, disaster knowledge, and disaster skills on their self-efficacy in responding to disasters in Oman	N= 444 registered nurses comprised of ICU nurses orthopedic and burn units.	Cross-sectional research study	The study focused on general disasters, including natural and man-made.
Lie et al., 2021 Norway	To survey the preparedness and working conditions of healthcare professionals in COVID-19 Intensive Care Units (ICUs) across Norway during the first wave of the pandemic	N= 484 healthcare professionals, including ICU nurses	Prospective, longitudinal observational cohort study	COVID-19 pandemic
Ma et al., 2021 USA	To assess NICU preparedness for wildfires in California, Oregon, and Southwest Washington and identify key tools and strategies for effective disaster response	Responses from 16 NICUs (4 in California and 12 in Oregon/Southwest Washington).	A mixed-methods study	The study focused on wildfires in the Western United States, specifically the 2020 wildfire season.
Monteverde et al., 2021 Argentina	To report the results of a nationwide critical-care	N = 10,123 healthcare professionals registered for the	Educational intervention study	COVID-19 pandemic

	course for non-intensivists to increase staff capacity in Intensive Care Units (ICUs) during the COVID-19	course, including ICU nurses		
Al-Ashwal et al., 2020 Yemen	To evaluate healthcare workers' knowledge, preparedness, counseling practices, and perceived barriers to confronting COVID-19	N= 514 healthcare workers, including (n=171; 33.3%) nursing (also ICU nurses), and (n=203; 39.5%) physicians	A cross-sectional study conducted	COVID-19 pandemic
Bader et al., 2020 USA	To develop and implement a disaster plan to manage the surge of critically ill COVID-19 patients in a non-academic hospital ICU, focusing on space, staff, supplies, and system	No sample size	An evidence-based approach, applying the CHEST consensus	COVID-19 pandemic
Boilève et al., 2020 France	To report on the management of a dedicated ICU in a cancer center during the COVID-19 pandemic, focusing on the challenges of resource allocation, staff redistribution, and the continuity of care for cancer patients	N=16 specialized ICU nurses. Overall, 33 COVID-19 patients were admitted, including 16 cancer patients.	Retrospective observational report	COVID-19 pandemic
Conteras et al., 2020	To quickly implement an	N= 750 healthcare workers,	Intervention study	COVID-19 pandemic

Ireland	interprofessional in situ simulation program for COVID-19, focused on training healthcare workers in infection control, safety, and crisis management	including 188 ICU nurses		
Farra et al., 2020 USA	To develop and implement an evacuation exercise for neonates using the National Preparedness Leadership Initiative's (NPLI) meta-leadership framework to enhance disaster management communication and leadership skills	N=70 staff members, including physicians, ICU nurses, respiratory therapists, and other support personnel	Case - study	natural disasters like hurricanes or earthquakes
Moradi et al., 2020 Iran	To explore the lived experiences of Iranian nurses providing ethical care to earthquake victims during the Kermanshah earthquake	N= 16 nurses, including ICU nurses	Qualitative study using a hermeneutic phenomenological approach based on Heidegger's philosophy	Nature disaster: earthquake
Santa Ana & Roach, 2020 USA	To describe the transformation of a cardiovascular ward into an Intermediate Specialty Care Unit following the impact of a natural disaster. The study focused on improving patient care,	No sample size	A multi-phase, descriptive observational design	The study focuses on the aftermath of a natural disaster, specifically Hurricane Ike in 2008

	patient/family satisfaction, and nurse satisfaction while optimizing the utilization of ICU beds in the aftermath of the disaster			
Shuman & Costa, 2020 USA	To describe and define the competencies required for ICU nursing leadership during disasters, emergencies, and outbreaks, specifically focusing on the COVID-19 pandemic.	No sample size	The study utilized a conceptual framework design informed by a review of relevant literature, professional organization recommendations, and expert opinions.	The study focuses on a public health disaster, specifically the COVID-19 pandemic, and general emergencies that could impact ICU operations.
Fairley et al., 2019 USA	To describe the response of a disaster medicine team during the COVID-19 pandemic, specifically their deployment to a hospital on the Texas-Mexico border.	The team included two physicians, two advanced practice providers (APPs), a nurse, and a paramedic	A descriptive observational design	The study focuses on a public health disaster specifically the COVID-19 pandemic
Ganz et al., 2019 Israel	To determine the willingness of Israeli registered nurses to work under threatening conditions, their perceived level of threat, and their perceptions of peer willingness to report to work	N= 249 nurses from four hospitals, including ICU, internal medicine, surgical, and emergency	Cross-sectional descriptive study	The study focused on various types of threatening conditions, including natural disasters (e.g., earthquakes), war, terror attacks, radiation or chemical disasters, and dangerous infections.
Gray et al., 2019 USA	To identify the crucial equipment and skills bedside nurses need to	N=23 experienced charge nurses from (ED) and Neonatal	This was an expert panel survey study using the Angoff	The study focused on preparedness for unexpected natural disasters like earthquakes and fires.

	safely evacuate critically ill infants during disasters and use this information to guide disaster training programs	Intensive Care Units	method	
Yang et al., 2019 Taiwan	To review and analyze the medical resource requirements and patient profiles	The study reviewed the medical records of 105 patients	A retrospective observational design	The study focuses on a natural disaster, specifically the earthquake that struck Tainan City in February 2016.
Chen et al., 2016 Taiwan	To evaluate nurses' participation in continuing education programs focused on disaster nursing in Taiwan	N= 1,817 nurses who attended 18 continuing education courses on disaster nursing between 2012 and 2015. n= 556 (30.6%) were from the emergency/critical care specialty, which includes ICU nurses	Descriptive cross-sectional design	various types of natural and man-made disasters common in Taiwan, such as earthquakes, typhoons, floods, infectious disease outbreaks, and aircraft accidents
King et al., 2016 USA	To analyse the evacuation of ICUs during Hurricane Sandy, focusing on the preparedness, challenges, and experiences of healthcare providers involved in the evacuation.	N=68 healthcare professionals from four hospitals, including ICU nurses	Cross-sectional survey study	The study focused on the natural disaster of Hurricane Sandy, which necessitated the evacuation of ICUs in several hospitals due to infrastructural damage
AL-SHAQSI et al., 2015 New- Zealand	To assess acute care providers' self-reported training, experience, and preparedness to respond to mass emergencies	N= 1500 acute care providers, including doctors, 441 nurses (also ICU nurses), and paramedics	A cross-sectional national survey	Various mass emergencies and disasters, including natural and man-made disasters
Moughrabieh & Weinert,	To describe the development and	No sample size	A descriptive observational	The study focuses on a man-made disaster, specifically

2015 Syria	implementation of the Syria Tele-ICU program, designed to provide critical care to patients in war-torn.		design	the ongoing conflict and war in Syria, which severely impacted the healthcare infrastructure, including the availability of critical care services.
Einav et al., 2014 International collaboration of USA, ISRAELIS and Canadians's experts	Guidance on managing critically ill patients during pandemics and disasters, with a focus on surge capacity logistics for delivering mass critical care (MCC).	No sample size	The consensus-based approach modified Delphi method	Pandemic and any king of disaster
Mitchell et al., 2014 Australia	The study aimed to evaluate a partnership between specialized nurses from geographically disparate hospitals in Australia to provide critical support during national disasters	N= 23 nurses, including 7 ICU nurses, participated in the partnership.	mixed-methods approach	The study focuses on disaster response in general, with potential scenarios including national disasters such as terrorist attacks, tsunamis, cyclones, bushfires, and floods.
Zhuravsky, 2014 New- Zealand	To explore the experiences of intensive care unit staff during the crisis resulting from the February 2011 earthquake	N= 10 ICU nurses	A qualitative descriptive design	The study focuses on a natural disaster, specifically the 6.3-magnitude earthquake that struck Christchurch, New Zealand, on February 22, 2011.
Rådestad et al., 2013 Sweden	To identify indicators essential for initial disaster medical response registration.	N= 30, including ICU experts with broad knowledge in disaster and emergency response and medical management.	The study utilized a Delphi, a structured communication technique involving multiple questionnaires sent to experts	The study addresses major incidents and disasters without focusing on a specific type of disaster. The indicators were intended to apply to various kinds of disasters, including both natural and man-made incidents.

Angeletti et al., 2012 Italy	To assess pain prevalence and treatment in patients during the five weeks after the April 6, 2009, L'Aquila earthquake in Italy	N= 958 triage patient documents	An observational retrospective design	Natural disaster—specifically, the earthquake that struck the Abruzzi region of central Italy on April 6, 2009
deBoisblanc, 2012 USA	To reflect on the experiences of ICU nurses during the aftermath of Hurricane Katrina, particularly focusing on the challenges faced during the evacuation of ICU patients	No sample size	Reflective essay describing nurses' real-life experiences	Nature disaster: Hurricane Katrina in 2005
Renz et al., 2012 USA	To evaluate the U.S. Army Burn Center's 10-year experience in managing combat-related burn injuries, highlighting challenges and advances in care.	No sample size. The study describes the role of critical care nurses but doesn't mention ICU nurses.	A retrospective review and analysis of the burn care	The study focuses on combat-related burn injuries sustained during military operations in Iraq and Afghanistan.
Shah et al., 2012 USA	To assess the ability to follow the PICU surge plan and provide appropriate medical management during a mass-casualty event	36 simulated patients (actors) and various healthcare professionals, including PICU nurses, physicians, and respiratory therapists	A prospective, single-center, full-scale simulated disaster drill.	The study focused on a chemical disaster scenario involving chlorine overexposure
Hick et al., 2010 USA	To provide recommendations and standard operating procedures (SOPs) for the intensive	No sample size	A consensus-based guideline	The guidelines apply to various disasters, including pandemics (e.g., H1N1 influenza) and mass casualty events such as bomb detonations and other

	care unit and hospital preparations for mass disasters or influenza epidemics			sudden or gradual events
Ranse et al., 2010 Australia	Describe the clinical background, disaster training and education, and nurses' roles during the health response to the 2009 Victorian bushfires, known as "Black Saturday."	N=24 nurses with ICU experience	A retrospective descriptive postal survey design	The study focuses on a natural disaster, specifically the bushfires in Victoria, Australia, in February 2009, commonly called "Black Saturday."
Scannell-Desch & Doherty, 2010 USA	To describe the lived experiences of U.S. military nurses who served in Iraq or Afghanistan during the war years 2003 to 2009, and their life after returning from war.	N=37 military nurses (18 Army, 4 Navy, 15 Air Force) with ICU skills who served in Iraq or Afghanistan.	Qualitative study employed a phenomenological approach using Colaizzi's method	Iraq and Afghanistan wars
Devereaux et al., 2008 USA	To develop and provide expert recommendations for managing mass critical care during disasters, focusing on surge capacity and allocating scarce essential care resources	N= 37 experts from various fields, including critical care, disaster preparedness, emergency medicine, ethics, and government planning	A consensus-driven project that involved extensive literature reviews, expert meetings, and discussions to develop a framework for mass critical care	mass casualty events, including pandemics (such as influenza), natural disasters, and intentional catastrophes (e.g., terrorist attacks), where critical care would exceed usual capacity.
Rice et al., 2008 USA	To review the development and use of portable ICU capabilities and critical care transport strategies in	No sample size	Review	The study discusses natural disasters such as earthquakes and hurricanes, as well as military conflicts, including examples from the USA, Turkey, Iran, and Iraq.

	austere environments, focusing on natural disasters and military operations.			
Rubinson et al., 2008 USA	To provide a framework for delivering essential critical care, termed emergency mass critical care, during mass casualty events.	No sample size	A consensus-based guideline	The guidelines apply to various disasters, including natural disasters (such as earthquakes and pandemics) and man-made disasters (such as industrial catastrophes and terrorist attacks).
Sariego, 2006 USA	To explore how the U.S. Air Force's Critical Care Air Transport Teams (CCATT) model could be adapted for civilian disaster management	No sample size	Analytical discussion based on the author's personal experiences during Hurricane Katrina and other military operations	Hurricane Katrina, a natural disaster
Gildea & Etengoff, 2004 USA	To evaluate the preparedness and capability of a community hospital to conduct a vertical evacuation of critically ill patients using a simulated drill. The study specifically focused on the efficiency of evacuation teams, the physical exertion required, and the safety of patients during the evacuation process	No sample size	a descriptive observational design	Natural disaster, like fire

Shin et al., 2002 Taiwan	The study aimed to uncover nurses' most unforgettable rescue experiences during the first 72 hours following the 9-21 Taiwan earthquake	N=46, including ICU nurses	cross-sectional with mixed methods	Natural disaster
Morell et al., 1990 Spain	To retrospectively analyze the treatment of burn casualties resulting from the terrorist bombing	Number of Patients: The study reviewed 20 out of 24 casualties admitted to the Burn Centre following the bombing. No specific data about ICU nurses	A retrospective analysis	The study focused on terrorist bombing
Ashworth, 1989 UK	To explore ICU nurses' challenges during disasters and highlight the need for emotional support and coping strategies	No sample size	Editorial paper	Nature disasters, including fires (Kings Cross and Piper Alpha), plane crashes (Lockerbie and Kegworth), and the Hillsborough football disaster

Table 2. Main themes of findings

Authors	Theme/ Main findings
	Professional Education
Tullius et al., 2022	✓ Evacuation Time and Efficiency: (evacuation times, efficiency of procedures) ✓ Staff Preparedness and Competency: (knowledge gaps, role clarity) ✓ Collaboration with First Responders: (coordination challenges, responder familiarity) ✓ Equipment and Resource Management: (equipment issues, resource allocation) ✓ Psychological Impact on Staff: (stress levels, support systems)
Husna et al., 2021	Evidence-based Intervention Group: ✓ Six sessions, 60-90 minutes each, focusing on standardized disaster response competencies. ✓ Covered disaster overview, impacts, psychological, psychosocial, and spiritual care. ✓ Methods included lectures, discussions, role-play, and storytelling. Islamic-based Intervention Group: ✓ sessions, each 60-90 minutes long, which integrate Islamic principles and values. ✓ Included training on Islamic-based communication techniques, emotional freedom techniques, and religious practices like prayers. ✓ The approach was grounded in Islamic law, using the Quran and hadith as foundational texts.
Monteverde et al., 2021	Four modules: ✓ Protective measures against virus transmission, universal precautions, PPE, triage, and transport. ✓ Care basics for non-intensivist caregivers. ✓ Pediatric critical care basics. ✓ Hospital preparation, surge capacity, and special issues such as corpse management and communication of bad news.
Conteras et al., 2020	The simulation training was integrated with the Plan-Do-Study-Act (PDSA) cycle, allowing rapid adaptation and testing of workflows specific to the COVID-19 outbreak. Training was conducted using high-fidelity and low-fidelity manikins, emphasizing practical skills and mental rehearsal.
Farra et al., 2020	Simulation of the safe evacuation of critically ill neonates from a 59-bed NICU during a disaster scenario. ✓ Enhance Leadership Skills: ✓ Improve Disaster Management Communication: ✓ Test and Refine Evacuation Procedures
Chen et al., 2016	The TWNA disaster nursing continuing education course. The course content included: ✓ Mitigation phase (epidemiology and risks of the disasters and management recourses of the national and community disasters) ✓ Preparation phase (exercise of the disaster preparation plans; ethical, legal, and liability issues in disasters; gender and cultural consideration and needs; personal

	preparation and protection in various disasters; and communication and sharing of the information) ✓ Response (Disaster assessment and community resources management; Infection control and management principles in disasters; Initial aid and disaster triage; Interaction with and support for disaster victims; Physical, mental, and family care of the disaster victims; Care to vulnerable groups and their families; Health care models in disasters) ✓ Recovery (Recovery of the individual, family, and community; Referral resources and long-term care in disasters. And Records and research in disasters)
Shah et al., 2012	Simulation Training: The educational program involved creating 30 simulated patients, nine of whom would eventually require Pediatric Intensive Care Unit (PICU) management. Senior medical professionals were involved in developing the appropriate medical interventions for these patients. The actors had a patient profile card detailing their chief complaints, physical exam findings, expected interventions, and final dispositions.
Gildea & Etengoff, 2004	Simulation ✓ Evacuation Times and Efficiency: (mean evacuation time and team performance) ✓ Physical Exertion and Vital Signs of Firefighters: (vital signs monitoring, heart rate, blood pressure, ventilatory rate, exertion) ✓ Safety and Patient Care: (patient safety, communication and coordination) ✓
Guidelines recommendations	
Sprung et al., 2023	**Mental Health and Well-being for Staff in Medical Settings:** o **Balancing Workloads:** Excessive workloads and long hours were identified as primary contributors to healthcare worker (HCW) distress and burnout. The study suggests flexible work hours, balancing work between high- and low-stress environments, limiting shift duration, ensuring sufficient rest periods, and reducing nonessential responsibilities. o **Emotional Health Support:** Healthcare organizations must provide mental health support that is easily accessible, destigmatized, and integrated into the workplace. This includes having mental health professionals available for drop-in sessions, embedding them within healthcare teams, and offering virtual mental health services. o Targeted Support for High-Risk Groups: Specific groups of HCWs, such as less experienced staff, those with direct patient contact, and those with significant family or childcare responsibilities, are at higher risk of burnout. Early assessment and intervention are recommended for these groups. **System-Level Support and Leadership:** o **Staffing and Training**: The availability of trained healthcare staff is critical, particularly during public health emergencies. The study recommends state support for loan repayment programs and educational support to expand training for future

	healthcare workers. Additionally, health systems should ensure pay equity between temporary/traveling and permanent staff. ○ **Empowerment and Autonomy:** Empowering HCWs in decision-making processes, especially during crises, was identified as improving job satisfaction and resilience. The study emphasizes the need for decentralized decision-making and increasing HCW input into organizational decisions. **Communication and Transparency:** Effective communication within healthcare organizations is crucial, especially during crises. The study highlights the need for timely, transparent communication from leadership, with regular updates on issues like PPE availability, staffing shortages, and policy changes. **Research Priorities and Gaps:** ○ **Mental Health Research:** The study calls for more research on the prevalence of mental health disorders, moral distress, and burnout among HCWs, particularly before, during, and after pandemics or disasters. It also emphasizes the need for multidisciplinary research to evaluate the effectiveness of interventions promoting resilience. ○ **Barriers to Implementation:** Identifying barriers and facilitators to implementing mental health interventions is crucial. The study suggests further research on how communication, messaging, and feedback impact moral distress and other mental health conditions during prolonged crises. **Key Suggestions:** ○ **Resilience and Retention**: The study provides detailed suggestions for fostering resilience and improving retention among HCWs. These include creating supportive work environments, offering coping strategies, and ensuring adequate staffing levels. ○ **Minimal Essential Suggestions**: The study outlines minimal essential suggestions that every healthcare institution should implement or work towards, such as ensuring adequate staff rest, providing mental health support, maintaining consistent communication, and increasing HCW input into decision-making.
Bader et al., 2020	The hospital's disaster management plan during the COVID-19 pandemic included an ICU response plan and a new staffing model: **New Staffing Model: based on 2-Tiered Approach**: This model was designed to address nurse shortages during crisis. It involved pairing ICU-trained nurses with non-ICU nurses to care for multiple critically ill patients. Depending on the severity of the crisis: ✓ 1 ICU nurse paired with one non-ICU nurse to care for three patients. ✓ 1 ICU nurse paired with two non-ICU nurses to care for four patients. ✓ 1 ICU nurse paired with three non-ICU nurses to care for six patients. **ICU Response Plan:** ✓ **Space Management:** converting non-traditional areas, such as post-anesthesia care units and other non-ICU spaces, into functional ICU spaces to handle the surge of COVID-19 patients. ✓ **Staffing Adjustments:** retraining and reallocating nurses with prior ICU experience to reinforce the ICU staffing pool.

	✓ **Supply Management:** involves implementing strategies to manage shortages of PPE, medications, and other critical supplies, including rationing and alternative solutions. ✓ **System Strategies:** developing new guidelines and protocols specific to COVID-19 care, including modifications to existing practices, such as pruning and ventilator management, to address the unique challenges posed by the pandemic.
Einav et al., 2014	✓ **Stockpiling and Interoperability**: the importance of stockpiling equipment, supplies, and pharmaceuticals was emphasized. This ensures that these resources are interoperable and compatible across regions to facilitate a coordinated response. ✓ **Staffing and Training**: the need for adaptive staffing measures, including additional shifts, cross-training, and role definition, to handle reduced staffing levels during a disaster. Staff preparedness, including knowledge of standard operating procedures and the use of incident command systems, is crucial. ✓ **Alternative Care Spaces**: alternative spaces be used for critical care during surges, and specific planning is required to prepare these areas for patient care. ✓ **Deployable Critical Care Services**: suggestion for using deployable critical care services as a temporary solution when hospital infrastructure is overwhelmed, with the aim of transferring patients to definitive care locations as soon as possible. ✓ **Triage and Patient Flow**: the need for experienced clinicians to manage patient triage and in-hospital placement during mass critical care events is stressed, along with the importance of early discharge and the prioritization of less intensive treatments when necessary. ✓ **Technology and Remote Consultation**: Technology, such as telemedicine, is recommended to support critical care delivery, especially when direct oversight is unavailable. ✓ **Transportation Assets**: inclusion of predetermined standards for patient transfer in surge capacity plans, prioritizing the movement of assets to patients when direct patient transfer is not possible.
Rådestad et al., 2013	**Development Round 1** ✓ **Initial Statements:** The first round started with 85 predefined statements based on a literature review. These statements were categorized into eight areas: ✓ **Consensus Achieved:** After Round 1, 44 of the 85 statements reached the predetermined consensus level of 80%. The statements that reached consensus mainly pertained to essential aspects of initial disaster medical response, such as: ✓ **Revisions and Additions:** Based on expert feedback, 25 statements were withdrawn due to redundancy or lack of relevance, and 37 new statements were added for the next round. The new statements addressed issues such as the content of reports and the timing of specific actions during the disaster response. **Development Round 2** ✓ **New Statements:** Round 2 included 53 statements, comprising the 16 statements from Round 1 that did not reach consensus and the 37 new statements suggested by the experts. ✓ **Consensus Achieved**: In this round, 12 additional statements reached consensus. These included indicators related to injury severity, mortality, and the content of reports and decisions at the local level (scene of the incident). ✓ **Remaining Statements:** After Round 2, 41 statements did not reach the required consensus level.

	Development Round 3 ✓ **Final Review**: In Round 3, the 41 statements from the previous round were reviewed. This round resulted in 29 participants, with 12 of 13 statements regarding management/liaison and incident management reaching a consensus. ✓ **Final Consensus**: By the end of Round 3, 77 out of 97 statements had reached consensus. These statements covered a wide range of critical areas, including: Timing and coordination of initial medical response activities. Patient triage and transport logistics. Communications and documentation during the incident. The role of protective equipment and the use of specific triage systems.
Hick et al., 2010	Tiered Response Framework, which includes: ✓ **Conventional Capacity**: normal operations where hospitals manage patient loads within existing resources. ✓ **Contingency Capacity:** minor adjustments are made, such as repurposing space or modifying staff roles to accommodate increased patient loads. ✓ **Crisis Capacity:** major adjustments where standards of care may be altered, including the use of non-traditional spaces for critical care and expanded roles for staff. **Infrastructure Considerations:** ✓ **Space Expansion:** to identify and prepare alternative care sites, such as post-anesthesia care units (PACUs), operating rooms, and other non-ICU areas that can be converted for critical care use. ✓ **Ventilation and Oxygen Supply:** ensure adequate ventilation and oxygen supplies during a surge. This may include the use of portable ventilators and oxygen concentrators. ✓ **Infection Control:** infrastructure planning should include measures for infection control, especially during pandemics. Recommendations include establishing isolation areas and negative pressure rooms to minimize the spread of infectious diseases. **Staffing Adjustments:** ✓ **Extended Roles for Staff:** cross-training staff, including non-ICU nurses and other healthcare professionals, to perform critical care tasks under the supervision of experienced ICU nurses and physicians. ✓ **Staff-to-Patient Ratios:** in crises, staff-to-patient ratios may need to be adjusted. The article recommends ratios of one ICU nurse to up to four patients, depending on the severity of the crisis and the availability of resources. **Resource Allocation:** ✓ **Triage Protocols:** emphasize the importance of having clear triage protocols to prioritize care for patients most likely to benefit from critical interventions. This includes establishing criteria for the allocation of scarce resources, such as ventilators. ✓ **Supply Chain Management:** hospitals should establish relationships with suppliers to ensure a continuous supply of essential medical equipment, drugs, and personal protective equipment (PPE) during a surge.

	Communication and Coordination: ✓ **Incident Command Systems (ICS):** using Incident Command Systems to ensure effective communication and coordination within the hospital and with external agencies during a disaster. ✓ **Real-Time Data Monitoring**: hospitals should implement systems to monitor patient volumes, bed availability, and resource usage in real-time to make informed decisions during a surge. **Ethical Considerations:** ✓ **Altered Standards of Care**: during extreme surges, it may be necessary to implement altered standards of care, where the focus shifts from individualized care to the best possible outcome for the greatest number of patients. ✓ **Legal Protections**: the need for legal protections for healthcare workers and institutions when operating under altered standards of care during a declared public health emergency. **Implementation and Feasibility** ✓ **Challenges:** challenges to implementing the recommendations, including funding limitations, staff resistance to role changes, and the logistical complexities of expanding space and resources. ✓ **Training and Drills**: To overcome these challenges, the article recommends regular training and disaster drills to ensure that staff are familiar with the surge protocols and that the infrastructure adjustments can be implemented swiftly and effectively.
Devereaux et al., 2008,	The specific recommendations include: **Critical Care Surge Capacity:** ✓ The Task Force recommended that every hospital with an ICU should be prepared to provide emergency mass critical care (EMCC) during disasters. ✓ Hospitals should plan to handle a critically ill patient load of at least three times their usual ICU capacity for ten days without external assistance. **Resource Allocation Framework:** ✓ A framework for allocating scarce critical care resources during mass casualty events was developed, emphasizing the need for fair, transparent, and ethical triage processes. ✓ The framework includes guidelines for proportionally rationing critical care resources to the actual shortfall, applying consistent criteria for withholding and withdrawing life-sustaining treatments. **Staffing and Equipment:** ✓ The Task Force suggested that hospitals prepare staffing models that can adapt to surge conditions, including delegating duties across different healthcare workers based on their abilities and experience. ✓ Recommendations were made for the minimum types and quantities of critical care equipment, such as mechanical ventilators, required to manage a surge in critically ill patients. **Ethical Considerations:** ✓ The importance of ethical considerations in triage decisions and allocating scarce resources was emphasized. The Task Force proposed that these decisions should be made transparently, focusing on maximizing overall survival.

	Facility Repurposing: ✓ The study suggested that in situations where hospitals reach capacity, additional areas such as post-anesthesia care units, telemetry units, and even non-medical facilities could be repurposed to provide critical care.
Rubinson et al., 2008	Emergency Mass Critical Care (EMCC) Framework: The framework includes recommendations on medical resources, staffing, and treatment protocols. **Critical Care Provision During Disaster:** o Essential Care Elements: during a disaster, the goal should be to provide life-sustaining care to the maximum number of critically ill patients. This care is limited to interventions that can be delivered with available resources and includes: - Mechanical ventilation - Basic monitoring (e.g., pulse oximetry) - Fluid resuscitation - Antibiotic therapy - Sedation and analgesia **Medical Equipment and Resources:** o Ventilator Requirement: The study outlines the need for ventilators that can be used in mass critical care scenarios. Portable ventilators are recommended due to their adaptability and ease of use in non-hospital settings. o Alternative Treatment Spaces: It suggests expanding critical care capacity by using non-traditional spaces, such as operating rooms, post-anesthesia care units (PACUs), and even general wards, to accommodate critically ill patients. o Minimum Equipment Standards: The study establishes minimum equipment standards necessary to provide EMCC, including mechanical ventilators, oxygen supply, suction devices, and basic monitoring tools. **Staffing Models:** o Nurse Staffing Ratios: The article recommends adjusting nurse-to-patient ratios to increase the number of patients a single nurse can care for during a disaster. Compared to the typical one-to-one or one-to-two ratio in standard ICU care, the suggested ratio for ICU nurses during mass casualty events is one nurse to four patients. o Role Adaptation: It suggests cross-training non-ICU nurses and other healthcare personnel to assist with critical care duties under the supervision of experienced ICU nurses. This adaptation is essential for scaling up the critical care workforce during a surge. **Ethical Considerations** o Triage and Allocation: The study addresses the ethical challenges of triage and resource allocation during mass casualty events. It underscores the importance of transparent and consistent triage protocols to prioritize patients who are most likely to benefit from critical care interventions. **Palliative Care**: The study recommends integrating palliative care to manage symptoms and provide comfort for patients who are unlikely to survive even with critical care.

	Implementation and Feasibility: o Operationalizing EMCC: The study discusses the operational challenges of implementing EMCC, such as the need for rapid resource mobilization, logistical coordination, and real-time decision-making. o Resource Availability: The study highlights the importance of pre-planning and stockpiling essential medical supplies and equipment to ensure they are available when needed.
Nurses' Experiences, coping, and consequences	
Kalia et al., 2023	✓ Challenges Faced by ICU Health Professionals: (Resource Shortages, Electricity Issues, Personal Safety Concerns, Emotional and Psychological Toll) ✓ Innovative Solutions and Adaptations: (Hand-Cranked Ventilators, Improvised Medical Equipment) ✓ Teamwork and Collaboration: (Enhanced Teamwork, Support for Patients and Families)
Muhammad et al., 2023	✓ **Blossoming of Talents on the Battlefield:** This theme highlights how the war environment led to the development and enhancement of nurses' skills and talents: (Training in the Field, Professional Development) ✓ **Capable Nurses at War:** This theme focuses on the adaptability and resilience of nurses in the challenging conditions of a war zone: (Work in Different Situations, Dealing with War Injuries, Multiple Tasks) ✓ **Nursing Jihad:** This theme reflects the spiritual and moral dimensions of the nurses' experiences: (Seeking Martyrdom, Holy Job) ✓ **Mental Preoccupations:** This theme addresses the psychological impact of working in a war zone: (Concerns, Psychological Wounds, Facing the Unknown
Segev et al., 2023	Experiences and lessons from Turkey's 2023 earthquakes: **Predeparture Preparation** o **Sense of Mission:** Nurses expressed a strong sense of commitment to the mission, viewing their participation as a significant and honorable duty. This sense of mission overshadowed personal concerns, with many nurses eager to contribute to the disaster relief efforts. o **Time Management Issues:** Participants reported frustration with the extended time between team assembly and actual departure, which they felt could have been used more effectively for team bonding, thorough briefings, and better preparation o **Flattening of Hierarchies:** The traditional professional hierarchies in hospital settings diminished during the mission. Nurses and physicians worked collaboratively, irrespective of rank, creating a more supportive and unified team environment. **Challenges in the Disaster Zone** o **Inclement Weather:** Upon arrival in Turkey, the nurses faced significant challenges due to the harsh weather conditions, including bitter cold and inadequate protection from the elements. These conditions added to the team's physical and mental strain.

	○ **Language Barriers:** Communication difficulties arose due to language differences with the local population and medical teams. However, some Israeli team members who spoke Arabic effectively bridged the communication gap, particularly with Syrian refugees. English was also used during medical handovers to facilitate collaboration. ○ **Collaboration with Local Teams**: Integrating with local healthcare teams posed challenges due to differences in medical practices and standards. Initial skepticism and disagreements were overcome through professionalism and the demonstration of skills, eventually leading to mutual respect and better collaboration. **Post mission Lessons** ○ **Nurse-Physician Ratio:** The study highlighted an imbalance in the nurse-to-physician ratio, with a shortage of nurses relative to doctors, leading to increased workload and stress for the nursing staff. ○ **Medical Records Language Compatibility:** A significant barrier was the incompatibility of medical records' language between the Israeli and Turkish teams. Israeli medical documentation was in Hebrew, making it difficult for local staff to understand, necessitating a dual documentation process. ○ **Psychological Closure:** The study identified a lack of sufficient psychological support for the nurses after the mission. While some ad-hoc sessions were conducted, participants felt that more structured and comprehensive psychological debriefings were needed to process the intense experiences and provide closure.
Fairley et al., 2019	✓ Scope of Practice Challenges: (Role Expansion, Hesitation and Ethical Concerns) ✓ Medicolegal Considerations: (Credentialing and Liability, Legal Protections) ✓ Team Roles and Responsibilities: (Daily Operations, Consultation Model) ✓ Ethical Considerations: (Non-maleficence and Beneficence, Health Maximization and Justice)
King et al., 2016	**ICU Evacuation Planning and Preparation:** ○ only 21% of respondents had participated in an ICU evacuation drill in the past two years, and 28% had prior training or real-life experience with ICU evacuation. ○ Most respondents (61%) indicated that their ICU was at least somewhat involved in regional evacuation planning, but less than a quarter had any vertical evacuation training or experience. ○ Despite limited training, 77% of respondents felt adequately trained for the ICU evacuation during Hurricane Sandy. **ICU Evacuation Coordination and Leadership:** ○ Most respondents (83%) reported having good situational awareness during the event. However, communication was identified as a significant barrier, with 43% of respondents citing it as a primary challenge. ○ Leadership was mentioned as a primary success by 29% of respondents, but teamwork was highlighted as a critical success factor by 57%.

	ICU Evacuation Processes: o Patient triage and prioritization were often determined during the disaster rather than beforehand. Only 24% of respondents used predetermined criteria for patient prioritization. o Transfer forms were inconsistent, with 28% using typical transfer forms and 21% using evacuation or disaster forms. o Most respondents (51%) continued providing patient care during transport or at the receiving facility, although most required emergency credentialing. **Evacuation Tools and Equipment:** o The most helpful tools identified were flashlights (24%), transport sleds (21%), and oxygen tanks or respiratory therapy supplies (19%). o The "wish list" for tools included walkie-talkies/phones (26%), portable ventilators (16%), and better lighting/electricity (18%). **Provider Performance Stressors:** o Major stressors affecting provider performance during the evacuation included lack of water, food, and toilets, personal concerns about family, and limited means to dispose of the dead.
Mitchell et al.,2014	Disaster response capacity included: **Nursing Practice** o The study found that PAH nurses in the RDH rotation program felt confident and clinically prepared for disaster care. The two-week rotations enabled them to integrate smoothly into RDH, form strong working relationships with the staff, and often lead specific procedures. However, some nurses expressed concerns about their ability to care for pediatric patients, highlighting a clinical gap that needs attention. **Family concerns** o The study also examined the rotation program's impact on PAH nurses' families. Pre-rotation concerns about family disruption were less significant than anticipated. Post-rotation surveys showed that most nurses reported minimal or no impact on their families, suggesting the program was manageable and likely contributed to job satisfaction and nurse retention.
Zhuravsky, 2014	**Formal Leadership** ✓ **Decision Making**:The ability to make quick and effective decisions under pressure was highlighted as a critical trait of formal leaders in the ICU. ✓ **Ability to Remain Calm**: Staying calm under pressure was another key characteristic of effective formal leadership. ✓ **Effective Communication**: Communication was critical during the disaster, with formal leaders ensuring that information was shared accurately and promptly. Effective communication helped coordinate efforts, manage resources, and support emotional well-being among the staff.

	Informal Leadership ✓ **Motivation to Lead**: Informal leaders emerged based on their motivation and willingness to step up during the crisis. These individuals often took on leadership roles without formal authority, driven by their sense of responsibility and commitment to the team. ✓ **Autonomy**: Informal leaders demonstrated a high level of autonomy, making decisions independently and handling tasks without needing constant direction from formal leaders. This autonomy was essential in managing the many challenges that arose during the earthquake response. ✓ **Emotional Leadership**: Providing emotional support was a key role for informal leaders, who helped their colleagues cope with the psychological stress of the disaster. This emotional leadership was crucial in maintaining team morale and ensuring that staff could continue to perform their duties effectively. ✓ **Crisis as Opportunity**: The crisis allowed informal leaders to demonstrate their capabilities, which were often recognized by formal leaders. This recognition sometimes led to opportunities for professional growth and advancement within the organization. **Shared Leadership** ✓ **Within Formal Medical and Nursing Leadership Groups**: Shared leadership among formal leaders was essential in managing the complex challenges of the crisis. This approach involved collaboration between medical and nursing leaders, ensuring that decisions were made collaboratively and that leadership tasks were distributed effectively. ✓ **Between Formal and Informal Leaders**: Shared leadership extended to include interactions between formal and informal leaders. This collaborative approach allowed for a more coordinated response, as informal leaders supported formal leaders in managing tasks and making decisions.
deBoisblanc, 2012	Five main themes were extracted: ✓ Caring for Patients Under Extreme Conditions: (Manual Ventilation, Hand Ventilation) ✓ Facing Harsh Environmental Conditions: (Heat and Lack of Sanitation, Stress and Fatigue) ✓ Evacuation Efforts: (Rooftop ICU, Compassionate Care) ✓ Teamwork and Leadership: (Breaking Down of Traditional Roles, Leadership Under Duress) ✓ Emotional Impact:(Emotional Toll)
Scannell-Desch & Doherty, 2010	Seven main themes, covering both the professional and personal impacts of their service, were extracted: **Deploying to War:**

	○ **Deployment Experiences:** Nurses shared stories about how they were deployed to Iraq or Afghanistan, whether they volunteered, were called up from reserve units, or were part of active-duty deployments. ○ **Living Conditions:** The nurses described a range of living conditions, from primitive tents and makeshift showers to more developed bases with better facilities as the wars progressed. ○ **Workplace Environments:** Their workplaces varied from ICU tents and mobile surgical units to air evacuation missions, with each setting presenting its unique challenges. **Remembrance of War: Most Chaotic Scene:** ○ **Chaotic War Scenes:** Nurses recalled the chaotic and traumatic scenes they encountered, such as dealing with severe injuries, amputations, and the overwhelming influx of casualties. ○ **Sensory Memories:** They vividly described the sounds, smells, and sights of war, including the noise of helicopters, the smell of burning waste, and the sight of grievous injuries. **Nurses in Harm's Way: More Than I Bargained For:** ○ **Personal Danger**: Many nurses faced direct physical danger, including being wounded by mortar blasts or gunfire. They described carrying weapons even in medical settings and dealing with the constant threat of attacks. ○ **Wounded in Action:** Some nurses were injured during their deployments, dealing with the physical and psychological aftermath of these incidents. **Kinship and Bonding: My Military Family:** ○ **Camaraderie:** The nurses formed strong bonds with their fellow military personnel, describing these relationships as essential for coping with the stresses of war. ○ **Teamwork:** Their intense situations fostered a deep sense of teamwork, with nurses relying on each other to provide care and support under extreme conditions. **My Wartime Stress: I'm a Different Person Now:** ○ **Psychological Impact**: The nurses reported significant psychological changes due to their experiences, including symptoms of PTSD, anxiety, and depression. Many struggled with these issues long after returning home. ○ **Homecoming Challenges:** Many nurses found reintegration into civilian life difficult. They found the adjustment more challenging than expected and often felt disconnected from their previous lives. **Professional Growth: Expanding My Skills:** ○ **Skill Development:** Despite the hardships, many nurses reported that their clinical skills were significantly expanded during their deployments. They gained experience in trauma care, surgical assistance, and handling complex medical situations. ○ **Increased Confidence:** The intense and varied medical challenges they faced helped build their confidence, making them more resilient and adaptable in their professional roles.

	Listen to Me: Advice to Deploying Nurses: o **Advice for Future Nurses:** The nurses offered advice to those who might deploy in the future, emphasizing the importance of mental and emotional preparedness, coping strategies, and building a support network. o **Encouragement**: They encouraged other nurses to embrace the experience, acknowledging the unique professional growth and personal insights that can come from serving in a war zone despite the significant challenges.
Shin et al., 2002	Taiwanese nurses' most unforgettable rescue experiences in the disaster area after the 9-21 earthquake included: **Negative Aspects of the Experiences** ✓ **Prevalence of Psychoneurotic Syndromes:**50% of the nurses reported encountering severe psychoneurotic symptoms among survivors, such as anxiety, panic, hopelessness, and uncontrollable crying ✓ **Destruction of Geographic Treasures:** 43% of the participants were deeply affected by destroying natural and cultural landmarks, including virgin forests, mountains, and historic villages ✓ **Buried-Alive Bodie:** 33% of the nurses were shocked by the sight of entire families or village populations being buried alive. ✓ **Inadequate Care for Homeless Children and Teenagers:** 22% of the nurses observed that many children and teenagers were left without proper care or shelter due to the destruction of homes and schools ✓ **Deterioration of Health Conditions:** 15% of the nurses reported that the conditions of patients with chronic illnesses, such as diabetes and hypertension, deteriorated due to the harsh environment, lack of sanitation, and limited medical supplies. ✓ **Manifestation of Greed and Selfishness:** 13% of the nurses were disheartened by the greed and selfish behaviour exhibited by some individuals during the disaster. Looting and hoarding of supplies were particularly distressing. **Positive Aspects of the Experiences** ✓ **Feeling Rewarded from Helping Others:** 43% of the nurses felt a deep sense of reward and honour from helping the victims. The survivor's gratitude reinforced the nurses' commitment to their profession and provided a sense of fulfillment. ✓ **Mutual Support Among Residents:** 33% of the nurses expressed mutual support and solidarity with the disaster survivors. ✓ **Support from Other Health Professionals:** 15% of the nurses appreciated the kindness and assistance provided by other healthcare professionals and residents
Ashworth, 1989	✓ **Sustained Effort**: Unlike emergency services that deal with immediate responses, intensive care nurses often have to sustain their efforts over an extended period, providing ongoing care to disaster survivors. ✓ **Emotional Demands:** Nurses face significant emotional challenges, especially when dealing with young patients who were previously healthy and active. The emotional toll of caring for severely injured or dying patients can be profound.

	✓ **Resource Strain:** Disasters often place extreme demands on available resources, including medical supplies, equipment, and staff. Nurses must manage these resources effectively while still providing high-quality care. ✓ **Psychological Impact:** Nurses may experience psychological stress or trauma from their involvement in disaster care. The traditional expectation that "nurses will always cope" can prevent them from seeking the emotional support they need. ✓ **Need for Emotional Support:** Structured emotional support systems, such as defusing and critical incident stress debriefing, are essential to helping nurses process their experiences and reduce the risk of long-term psychological effects.
Patients care management	
Boilève et al., 2020	✓ **Increase in ICU Capacity:** The ICU capacity was significantly increased from 28 beds to accommodate more patients, emphasizing the creation of dedicated spaces for COVID-19 patients. This expansion involved converting non-ICU beds into ICU beds and reallocating resources such as ventilators and medical staff from other departments. ✓ **Patient Demographics and Outcomes:** A total of 33 COVID-19 patients were admitted to the ICU, 17 of whom were cancer-free and 16 had cancer. Out of these, 23 patients required mechanical ventilation, and 4 patients died (2 of whom had cancer). ✓ **Human Resource Management:** The ICU faced significant staffing challenges, addressed by retraining staff from other departments, including surgical nurses and anesthetists, to work in the ICU. ✓ **Resource Allocation:** difficulties in managing material resources, particularly the shortage of essential medications like narcotics and curares. The pharmacy department implemented strict protocols to manage the limited supplies effectively. ✓ **Psychological Support for Staff:** Recognizing the immense stress on healthcare workers, the center provided psychological support through dedicated consultations with psychologists and psychiatrists. ✓ **Infection Control and Safety:** Despite the high risk of infection, the ICU staff successfully avoided nosocomial infections by adhering to stringent infection control protocols. This included adequately using personal protective equipment (PPE) and maintaining separate zones for COVID-19 and non-COVID-19 patients. ✓ **Ethical Considerations:** The ICU team had to navigate complex ethical decisions, particularly concerning allocating limited resources and prioritizing cancer patients during the pandemic. A daily cross-disciplinary ethical meeting was instituted to guide these decisions. ✓ **Family Communication:** Access to the ICU was highly restricted to protect both patients and staff. Family members were kept informed through daily phone calls and, in some cases, video calls using digital tablets.
Santa Ana & Roach, 2020	**Multi-Phase Nursing Leadership Project:** The hospital implemented a multi-phase nursing shared leadership project, which included: ✓ A comprehensive review of the nursing staff's knowledge and expertise. ✓ Redesignation of a 16-bed unit as an Intermediate Specialty Care Unit.

	✓ Changes in the nurse-to-patient ratio and improved competency-based orientation. **Creation of Intermediate Specialty Care Unit:** ✓ The unit's designation changed in 2014, focusing on patients from three specialty services: cardiothoracic surgery, vascular surgery, and advanced heart failure/heart transplant. ✓ The nurse-to-patient ratio was adjusted to 1:3, and specific admission and exclusion criteria were established. **Decompressing ICUs:** ✓ The hospital faced a scarcity of ICU beds due to the high demand, leading to patient admissions delays. The transformation allowed patients to be admitted to the intermediate specialty care unit instead of occupying ICU beds, saving ICU resources for those most in need. ✓ Specialized training for nursing staff enabled the care of patients requiring advanced monitoring and treatment outside of the ICU setting. **Cost and Effectiveness:** ✓ The transformation saved approximately 955 ICU days and over $900,000 through more efficient use of nursing staff and resources. ✓ The unit's adaptability to patient acuity and the advanced training provided to nursing staff contributed to decreased RN turnover and increased job satisfaction.
Yang et al., 2019	Retrospective analysis of providing critical care during an earthquake ✓ **Hospital Admissions:** Advanced Procedures: Several advanced procedures were performed, including: ✓ **Imaging and Diagnostics:** The study reported a significant increase in the demand for imaging services, with 259 X-rays and 27 computed tomography (CT) scans performed within 24 hours after the earthquake. ✓ **Surgical Interventions:** 20 emergent surgeries were conducted, with 10 of these surgeries (50%) directly related to earthquake injuries.
Gray et al., 2019	Key Skills Identified: ✓ Physiological Management: (Thermoregulation, Respiratory Support, Infection Control, Monitoring) ✓ Documentation and Identification: (Patient Identification, Documentation) ✓ Communication and Decision-Making: (Communication, Anticipating Future Needs) ✓ Equipment Ratings: (Most Essential Equipment, Less Essential Equipment) ✓ Overall Readiness: (Readiness to Evacuate)

Moughrabieh & Weinert, 2015	✓ Implementation of Tele-ICU Services ✓ Impact on Patient Care ✓ Challenges and Limitations ✓ Resource Management ✓ Educational and Logistical Support ✓ Ethical and Operational Considerations
Renz et al., 2012	Operations, challenges, and advancements of the U.S. Army Institute of Surgical Research (USAISR) Burn Center over a decade of military engagement following 11/9. ✓ **Burn Center Operations**: The USAISR Burn Center provides comprehensive care for patients with severe thermal trauma, inhalation injury, and related conditions. The center supports military personnel, veterans, and civilian emergency patients within a large trauma service area surrounding San Antonio, Texas. ✓ **Casualty Care**: The center saw an increase in military casualties due to combat operations in Iraq and Afghanistan. Explosions were the primary cause of thermal injuries among military personnel. ✓ **Multidisciplinary Approach**: The burn center operates with a multidisciplinary team, including 20 different occupational specialties such as surgeons, anesthesiologists, nurses, and respiratory therapists. Daily multidisciplinary rounds are crucial for effective patient care. ✓ **Nursing Staff**: The nursing team, composed of approximately 100 registered nurses (RNs), licensed vocational nurses, and certified nursing assistants, plays a central role in patient care. Burn care requires specialized skills in wound management, patient resuscitation, and advanced technologies. ✓ **Medical and Surgical Care**: The burn center employs advanced resuscitation protocols, such as the Modified Brooke formula and Burn Resuscitation Decision Support System (BRDSS), to manage fluid resuscitation in burn patients. The surgical team focuses on early excision and grafting to reduce sepsis and improve outcomes. ✓ **Research and Innovation**: The center conducts ongoing research in burn care, focusing on wound healing, resuscitation, and long-term outcomes. The burn center has also contributed to more than 200 peer-reviewed publications over the past decade. ✓ **Rehabilitation and Reconstruction**: The burn rehabilitation service addresses the complex needs of war casualties, including those with amputations and severe burns. Surgical reconstruction aims to restore form and function, emphasizing the face and upper extremities. ✓ **Military Deployment and Education**: The burn center's staff also serve in deployed environments, providing burn care in combat zones. The center supports education and training for military and civilian medical providers, ensuring a stable cadre of professionals equipped to handle burn injuries.
Rice et al., 2008	**Portable ICU and Critical Care Transport:** ✓ The development of portable ICUs allows for the rapid establishment of critical care capability in areas affected by natural disasters or military operations.

	✓ Two primary strategies have emerged: establishing portable ICU capabilities on-site and rapidly evacuating critically ill patients to more advanced medical centers. **Challenges in Austere Environments:** ✓ Delivering critical care in austere settings, such as disaster zones or combat areas, presents significant challenges, including limited infrastructure, scarce resources, and the need for rapid deployment and adaptability. ✓ Effective critical care in these settings often requires integration with local medical systems and careful planning for sustainability and follow-on care. **Case Studies:** ✓ The document references several examples of successful critical care delivery in austere environments, including responses to the 1999 earthquake in Turkey, the 2001 Tropical Storm Allison in Texas, and the 2003 earthquake in Bam, Iran. ✓ These cases illustrate the importance of flexibility, preparedness, and the ability to adapt to rapidly changing and resource-limited situations. **Critical Care Air Transport:** ✓ The U.S. Air Force's Critical Care Air Transport Teams (CCATTs) are highlighted as a model for providing advanced critical care during transport. These teams are equipped to manage critically ill patients during long-range flights, maintaining a level of care comparable to an ICU. ✓ The challenges of in-flight critical care include managing changes in barometric pressure, limited access to medical resources, and the physical constraints of the aircraft environment.
Sariego, 2006	Application of the U.S. Air Force's Critical Care Air Transport Teams (CCATT) as a model for civilian disaster management. ✓ **Hurricane Katrina and Critical Care Overload:** Hurricane Katrina in 2005 overwhelmed the healthcare infrastructure along the Gulf Coast, highlighting the inadequacies in critical care resources during disasters. Hospitals, even if structurally intact, struggled to manage the sudden influx of critically ill patients. ✓ **Current Disaster Response:** Existing disaster response plans often assume that in-hospital critical care resources will suffice, which is not always the case. Critical care services quickly become scarce when patient numbers exceed average capacity, leading to a breakdown in care delivery. ✓ **CCATT: The Air Force Model: to** provide critical care while transporting severely injured patients on the ground and in the air. A standard CCATT comprises a critical care physician, a critical care nurse, and a cardiopulmonary technician. These teams are mobile, carrying essential equipment and supplies in backpacks, and can deliver advanced critical care to up to six patients during transport.

	✓ **Transition to Civilian Use:** The CCATT model has proven effective in military contexts, particularly in recent conflicts like Operation Enduring Freedom and Operation Iraqi Freedom. The author argues that this model could be adapted for civilian disaster scenarios to provide mobile, rapidly deployable critical care teams. ✓ Civilian healthcare systems should consider forming similar teams that can be activated during disasters, with the military possibly providing training and operational support.
Morell et al., 1990	Analysis of the medical response to the terrorist bombing that occurred on June 19, 1987: ✓ Logistics and Resource Management ✓ Hospital Preparedness
	Willingness and preparedness
Engels et al., 2023	✓ **"Fight or Flight" survey** included questions about their training, perceived competence, and willingness to work during a pandemic or other disaster scenarios. ✓ **Willingness to Work (WTW):** Like other healthcare workers, ICU nurses were willing to work at varying levels depending on the disaster scenario. They were more likely to express doubt or require certain conditions to be met before coming to work during high-risk scenarios like nuclear incidents and dirty bomb events. ✓ **Conditions for Working:** The most critical conditions for ICU nurses to be willing to work include having access to adequate personal protective equipment (PPE) and ensuring the safety of their families. ✓ **Impact of Previous Training:** ICU nurses with previous disaster management training were likelier to express willingness to work across various disaster scenarios than those without such training.
Kiliç Bayageldi & Kaloglu Binici, 2023	✓ **PFA Training and Application: The study found that 91.3% of the nurses had not received prior PFA training, and 90.3% had never provided PFA services. Despite this, the average PFA Application Self-Efficacy Scale score was 131.61 out of 175, indicating moderate self-efficacy among the participants.** ✓ **Barriers to PFA: The study identified several barriers to PFA implementation, including a lack of knowledge, insufficient training, and the perception that physical first aid is more critical than psychological support during disasters.**
Lin et al., 2023	Nurses' readiness for disaster response in Taiwan focuses on the impact of various factors such as nursing experience, education level, work unit, and previous disaster training. **Readiness Levels:** Nurses reported moderate readiness for disaster response, with an overall average score of 114 out of 200 (46.3%). The highest readiness was observed in clinical management (56.1%), while the lowest was in emergency response (42.9%). **Determinants of Readiness:** o Nursing Experience: Longer nursing experience was positively associated with higher readiness across all domains, including personal preparedness, self-protection, emergency response, and clinical management.

	○ Education Level: Nurses with a master's degree or higher showed greater emergency response and clinical management readiness than those with only a bachelor's degree. ○ Work Unit: Nurses in ICUs or emergency rooms were significantly more prepared for disaster responses than in other units. ○ Previous Disaster Training: Nurses who had received prior disaster training demonstrated significantly greater readiness in all domains.
Chien et al., 2022	✓ **Training Needs and Willingness to Participate: The study found that higher training needs were positively correlated with a greater willingness to participate in disaster relief efforts. This suggests that as nurses perceive a greater need for disaster training, their desire to engage in such efforts increases.** ✓ **Willingness to Participate and Achievement Motivation: There was a positive correlation between nurses' willingness to participate in disaster relief and their achievement motivation. This implies that nurses more willing to participate in disaster relief are also more motivated to achieve in their roles.** ✓ **Achievement Motivation and Job Satisfaction: Achievement motivation was found to significantly positively impact job satisfaction. Nurses who were more motivated by their achievements reported higher levels of job satisfaction.** ✓ **Mediating Effect of Achievement Motivation: The study revealed that willingness to participate in disaster relief indirectly affected job satisfaction through the mediating role of achievement motivation. This means nurses' willingness to participate can enhance job satisfaction by boosting their achievement motivation.**
Sellers et al., 2022	Concept analysis of disaster preparedness and its application to Intensive Care Units (ICUs). **Concept Definition:** Disaster preparedness in the ICU context was defined by three key attributes: space, physical, and human resources. These attributes were identified as critical for managing patient surges during disasters. **Attributes:** ○ **Space:** The availability and adaptability of ICU bed spaces, including the ability to repurpose other hospital areas for ICU care during disasters, were emphasized. ○ **Physical Resources:** Essential resources such as ventilators, personal protective equipment (PPE), and other critical supplies were highlighted as necessary for disaster response. The study noted that the availability and adequacy of these resources were particularly critical during pandemics. ○ **Human Resources:** Key components of preparedness were the availability of trained healthcare professionals, their ability to handle increased workloads, and the need for cross-training to expand the ICU workforce during disasters
Abdollahi et al., 2021	✓ **Overall Preparedness:** The average preparedness score among the nurses was 51.27%. The lowest preparedness was in the dimension of "training for MERS-CoV" (31.77%), while the dimensions of "management and prevention" (55.13%) and "awareness of the center's policies" (58.42%) showed higher preparedness scores.

	✓ **Gaps in Preparedness:** The study highlighted the need for improved in-service training, especially in areas like visitor management and the use of protective equipment. Additionally, the findings suggested that many nurses were not fully aware of infection control policies, indicating a need for better communication and education within healthcare institutions.
Labrague et al., 2021	**Predictors of disaster response self-efficacy among nurses in Oman:** **Moderate Self-Efficacy: Nurses in Oman reported moderate levels of disaster response self-efficacy, with an average score of 3.643 on the Disaster Response Self-Efficacy Scale (DRSES).** **Predictors of Self-Efficacy:** o **Nationality: Filipino and Indian nurses reported higher self-efficacy in disaster response than nurses from other nationalities, such as Omani and Tunisian.** o **Unit of Assignment: Nurses assigned to emergency rooms, critical care units, orthopedic units, and burn units had significantly higher self-efficacy scores than those in other departments.** **Disaster Knowledge and Skills: Both disaster knowledge and skills were strong predictors of self-efficacy. Nurses with higher levels of disaster knowledge (β = 0.358) and skills (β = 0.130) reported greater confidence in responding to disaster situations.** **Training Gaps: Over half of the nurses (54.5%) had not attended any disaster-related courses or training, highlighting a significant gap in disaster preparedness education.**
Lie et al., 2021	Preparedness and working conditions of healthcare professionals in COVID-19 ICUs across Norway during the first wave of the pandemic. **Professional Preparedness:** 81% of healthcare professionals, including nurses, doctors, and leaders, reported being professionally prepared for working in COVID-19 ICUs. Factors contributing to this included previous ICU work experience and participation in COVID-ICU simulation training. **Psychological Preparedness:** 74% felt psychologically prepared, with higher age, having a spouse or partner, previous ICU experience, and simulation training being significant contributors. **Working Conditions:** o Challenges: Many respondents reported challenges in communication with coworkers, with 84% finding it difficult and 46% fearing infection. The physical demands of working in PPE were also significant, with over 50% reporting symptoms such as sweating, tiredness, dehydration, and headaches. o Positive Aspects: Most respondents saw working with new colleagues and facing new professional challenges as positive despite the challenges.

Ma et al., 2021	✓ **NICU Preparedness:** Out of 16 responses, only one NICU reported being "over-prepared." Five NICUs felt "very prepared," another five were "somewhat prepared," four were "a little prepared," and one was "not prepared at all." This indicates variability in perceived readiness across the surveyed NICUs. ✓ **Evacuation Tools and Strategies:** Common evacuation tools included bassinets, emergency backpacks, Med Sleds®, and baby aprons. However, there was a notable difference between California and NW IPA NICUs. California NICUs used the TRAIN™ tool for resource allocation, while none of the NW IPA NICUs reported using it. ✓ **Evacuation Plans**: NICUs had various plans for transporting babies out of hospitals, including ambulances, private cars with car seats, and ground or air transport teams. Babies were typically identified using ID bands, stickers on the baby's abdomen, or color-coded triage systems. ✓ **Challenges and Lessons Learned:** The study highlighted the need for improved coordination and communication during evacuations. For example, one NICU faced difficulties in coordinating with other NICUs due to a lack of regional collaboration. Debriefings after the evacuation process were emphasized as critical for identifying gaps and improving future responses.
Al-Ashwal et al., 2020	✓ **Knowledge:** Most HCWs demonstrated good knowledge about COVID-19, with a median score of 8 out of 9. However, 37% of respondents knew that asymptomatic individuals could transmit the virus. ✓ **Preparedness:** Overall, preparedness levels were suboptimal, with a median score of 9 out of 15. Only 18% felt confident managing COVID-19 patients independently, and a significant proportion lacked essential skills for prioritizing and managing COVID-19 cases. ✓ **Counseling Practices:** The median score for counseling practices was 25 out of 30, indicating that most HCWs regularly advised patients on COVID-19 preventive measures, such as social distancing and handwashing. ✓ **Barriers:** Major barriers included the lack of public awareness about preventive measures (89.1%), poor healthcare infrastructure (85.2%), and insufficient PPE supply (86%).
Ganz et al., 2019	**Willingness to Work:** ✓ Nurses were most willing to work during terror attacks and war scenarios, with lower willingness observed for natural disasters such as earthquakes. ✓ There was a weak positive correlation between perceived threat levels and willingness to work, indicating that as the perceived threat increased, willingness to work slightly decreased. **Perceived Threat Levels:** ✓ The highest perceived threat was associated with natural disasters (e.g., earthquakes), while the lowest was linked to war and terror attacks. ✓ Nurses in ICUs and emergency departments perceived higher levels of threat but were more willing to work compared to those in other departments.

	Peer Influence: ✓ Nurses' perceptions of their peers' willingness to work were positively correlated with their willingness to work. This suggests that nurses who believe their colleagues are likely to work under threat are more likely to do the same.
AL-Shaqsi et al., 2015	✓ **Experience and Training:** Only 29.2% of acute care providers had prior experience with mass emergency management, and 53.5% reported having formal training in this area. Paramedics were more likely to receive formal training and participate in emergency drills than doctors and nurses. ✓ **Preparedness:** The factors associated with strong self-reported preparedness included having received formal mass emergency training, participating in drills, and being able to locate a written emergency plan. Paramedics and nurses reported higher levels of preparedness than doctors. ✓ **Willingness to Respond:** Providers who were willing to respond to infectious disease or man-made emergencies were more likely to feel prepared for mass emergencies. However, willingness to respond to natural disasters was not significantly associated with perceived preparedness. ✓ **Confidence and Awareness:** Providers who felt confident in mass emergency triage and those aware of their role during such events were likelier to report robust preparedness. Confidence in dealing with emergencies (natural, CBRN, terrorist) was also linked to higher self-reported preparedness.
Ranse et al., 2010	Roles, preparedness, and characteristics of nurses who responded to the 2009 Victorian bushfires, known as Black Saturday. ✓ **Roles Undertaken**: Nurses undertook various roles, including clinical care, command functions, and auxiliary tasks. Most provided care at staging areas and worked alongside other health professionals, including paramedics and medical officers. ✓ **Disaster Training**: Most participants had previous disaster-related education and training, although the type and duration varied. However, none had training related explicitly to bushfire emergencies.
	Competence
Shuman & Costa, 2020	**Key Competencies for ICU Nursing Leadership** **1. Communication** **Communicating In (to staff)**: o ICU nurse leaders must provide regular updates and clear instructions to their staff during a disaster. This communication builds trust and helps maintain morale. The study emphasizes the importance of demonstrating empathy and understanding, especially during crises like the COVID-19 pandemic.

- Effective communication helps manage interpersonal conflicts, such as when staff members are hesitant to work with COVID-19 patients, and ensures that staff feel supported and informed.

- **Communicating Up (to higher management)**:
  - Nurse leaders are responsible for advocating for their staff's needs to hospital executives. This includes communicating the necessity of certain staffing models or resource allocations to optimize patient care under limited resources.
  - For example, during the COVID-19 pandemic, some ICUs transitioned to a team nursing model, where a mix of ICU and non-ICU nurses managed multiple patients. Nurse leaders had to justify this model to higher management while ensuring staff understood its benefits.
- **Communicating Out (to policymakers and the community)**:
  - The study highlights the importance of nurse leaders engaging in external communication, particularly in policy advocacy and public health messaging. Despite being the largest group of healthcare providers, nurses are often underrepresented in media and policy discussions.
  - Nurse leaders are encouraged to develop public policy communication skills to effectively advocate for the profession and influence decision-making processes at higher levels.

2. Business Skills

- **Financial Competency**:
  - Nurse leaders must be financially savvy, especially during disasters when budgets are strained. The ability to manage costs, innovate solutions, and maintain financial stability is critical. The study suggests that leaders should involve bedside staff in generating cost-saving ideas and communicate these solutions effectively to executives.
  - For instance, implementing team nursing models not only addresses staffing shortages but also helps control costs associated with increased ICU admissions.
- **Strategic Planning and Management**:
  - Effective disaster response requires strategic thinking and planning. Nurse leaders must develop and implement disaster preparedness plans, identify Incident Command Centers, and ensure staff receive adequate training, including simulations.
  - The study notes the importance of using localized data to inform decision-making during a disaster. For example, ICU nurse leaders might analyze data on community infection rates to predict patient surges and adjust staffing accordingly.

3. Leadership Skills

- **Adaptability in Leadership Styles**:
  - Nurse leaders must be flexible in their leadership styles, adapting to the specific needs of their teams during different phases of a disaster. The study

	references various leadership styles, such as relational leadership, which may be more effective during the initial chaotic phases of a disaster like the COVID-19 pandemic. o Leaders need to be aware of their own stress levels and seek support when needed, as personal well-being is crucial for maintaining effective leadership during prolonged crises. • **Evidence-Based Practice (EBP) Implementation**: o The ability to implement evidence-based practices (EBP) during a disaster is a critical leadership skill. The study emphasizes that nurse leaders must stay informed about rapidly evolving evidence, particularly during a pandemic, and ensure that their teams are delivering care based on the best available evidence. o For example, during COVID-19, leaders had to quickly adopt and implement new infection control practices, such as the use of personal protective equipment (PPE), and adjust care protocols as new information became available.
Lessons drawn and Important conclusions	
Steinlage et al., 2023	The Military Health System currently lacks specific CSC guidelines for deployed Role 3 ICUs, which could be detrimental in future large-scale conflicts. **Background and Context:** o The shift from counterterrorism operations to large-scale conflicts with near-peer competitors (like China or Russia) necessitates the development of CSC for battlefield ICUs. o Future conflicts may involve continuous, massive, and prolonged mass casualty events, which will challenge the existing medical infrastructure, particularly ICUs. **Lessons from COVID-19:** o The pandemic highlighted the need to shift from an egalitarian ethic (treating everyone equally) to a utilitarian ethic (providing the greatest good for the most significant number). o Establishing clear definitions, decision points, and decision authorities is crucial for effective resource allocation and management. **Ethical Principles:** o The shift to a utilitarian ethic during the pandemic should be considered for battlefield scenarios, where the goal is to maximize collective benefits rather than individuals. o Ethical dilemmas include prioritizing care for soldiers over enemy combatants and deciding whether to remove a patient from ICU care to make room for another.

	Crisis Standards of Care: o Depending on resource availability, CSC involves transitioning care from conventional standards to contingency and crisis phases. o The DoD's COVID-19 Practice Management Guide provides an example of how CSC phases can be defined based on ICU capacity. **Decision-Making Tools and Authorities:** o The document emphasizes the need for clear decision-making authorities and tools, such as ICU triage algorithms, to guide resource allocation during crises. o Triage decisions should be evidence-based and adapted to the unique conditions of the battlefield. **Surge Capacity:** o Expanding ICU capacity during crises, as was done during the COVID-19 pandemic, is crucial for managing high patient volumes. o Surge plans should include strategies like just-in-time training, scope of practice changes, and efficient demand allocation. **Palliative and Hospice Care:** o The document also discusses the importance of palliative and hospice care for patients who are unlikely to benefit from ICU admission in resource-limited settings. o Providing high-quality end-of-life care is essential to address the moral and psychological burdens on healthcare providers.
Patients experience	
Angeletti et al., 2012	**Pain Prevalence** **Overall Pain Prevalence:** o Pain was detected in 332 patients, with a prevalence of 34.6% during the five-week observation period. o Severity of Pain: Severe pain, defined as a verbal Numerical Rating Scale (v-NRS) score between 7 and 10, was the most frequent, reported in 58.8% of the pain cases. The average pain intensity was 8 ± 0.9 on the v-NRS scale. o Pain Conditions: The most common painful conditions included contusions (19.88%), wounds (15.66%), and low back pain (12.65%). Other reported conditions included fractures, burns, and headaches. **Time Course of Pain Conditions** o First Week: The highest number of patients seeking pain treatment occurred in the first week after the earthquake, accounting for 42% of the cases.

	○ Biphasic Pattern: The study observed a biphasic pattern in pain prevalence, with an initial peak in acute traumatic pain during the first 15 days, followed by a decrease, and then a resurgence of pain around week five, largely due to work-related injuries during rebuilding efforts. **Pain Management and Medications** ○ Drugs Used: Pain management was primarily limited to the available drugs, including: ○ Non-steroidal anti-inflammatory drugs (NSAIDs) such as diclofenac, ketorolac, nimesulide, ibuprofen, and aspirin (24% of cases). ○ Paracetamol was used in 19% of cases. ○ Weak opioids, such as tramadol, were used in 17% of cases, either alone or in combination with other medications. ○ Strong opioids were administered in 4% of cases, often in combination with other drugs like pregabalin or ketorolac. **Routes of Administration:** ○ Oral administration was the most common (48% of cases). ○ Intramuscular injections were used in 26% of cases. ○ Intravenous administration was used in 24% of cases. ○ Transdermal routes were used in 2% of cases. Pain Relief and Treatment Efficacy ○ Short-Term Pain Relief: The average pain score decreased significantly from 7.59 ± 1.3 before treatment to 3.54 ± 1.2 within 1 to 6 hours after treatment. ○ -Follow-Up: In patients who returned for a follow-up evaluation within 24-48 hours, pain scores further decreased to 2.78 ± 0.8, indicating continued efficacy of the pain management approach.
Ethical Considerations	
Moradi et al., 2020	Four main themes from the nurses' experiences during the Kermanshah earthquake were identified: **Respecting Humanistic Values:** ○ **Sacrifice:** Nurses are willing to put their safety and well-being at risk to provide care. For example, some nurses entered partially collapsed buildings to retrieve medical equipment despite ongoing aftershocks. ○ **Stepping Beyond Task Descriptions:** Nurses went beyond their usual duties, taking on roles outside their typical scope of practice, such as performing tasks usually done by physicians or other medical staff. ○ **Voluntary Work:** Many nurses volunteered their services during the crisis, even if they were on leave or retired. Their sense of duty and compassion drove them to contribute without formal obligation. **Commitment to Ethics:**

	○ **Honesty:** Nurses emphasized the importance of honesty, even in situations where admitting a mistake could have serious consequences. They believed that maintaining trust with patients and their families was crucial. ○ **Confidentiality:** Nurses upheld the principle of privacy, ensuring that patients' personal information and medical conditions were kept private, even in the chaotic environment of a disaster. ○ **Trustworthiness**: Nurses felt a strong obligation to be trustworthy, often going to great lengths to fulfill promises made to patients and their families, reinforcing the ethical standards of the nursing profession. **Respecting Dignity of Victims:** ○ **Respecting Cultural Values**: Nurses were sensitive to the cultural needs and preferences of the victims, such as assigning nurses of the same gender to patients when possible to respect cultural norms. ○ **Maintaining Privacy**: Nurses tried to protect the victims' privacy despite the challenging conditions. For example, they used improvised barriers to provide privacy during procedures. ○ **Effective Communication:** Nurses prioritized clear and compassionate communication with the victims, recognizing that effective communication was essential for maintaining the dignity and emotional well-being of the patients. **Spiritual Support:** ○ **Helping Patients with Religious Rituals:** Nurses assisted patients in performing religious practices, such as arranging for ritual cleansing or positioning patients towards prayer. ○ **Psychological Support:** Recognizing the trauma experienced by the victims, nurses provided emotional and psychological support, offering comfort and reassurance during an extremely difficult time.