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Exploring the Role of Nursing in Managing Mass Casualty Incidents

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Abstract

Background:
Mass casualty incidents (MCIs) are complex events that often overwhelm healthcare systems, requiring rapid, coordinated responses to minimize mortality and morbidity. Nurses play a critical role in these scenarios, serving as frontline responders who provide essential care, facilitate efficient triage, and manage both physical and psychological needs of patients. Despite the increasing frequency of MCIs globally, there is limited comprehensive research on the multifaceted role of nurses in managing such crises effectively.

Aim:
This paper aims to explore the critical roles of nurses in managing mass casualty incidents, highlighting their contributions across the phases of disaster management—preparedness, response, and recovery. It also seeks to identify challenges faced by nurses and propose strategies to enhance their capacity in MCI scenarios.

Methods:
This study adopts a comprehensive literature review approach, analyzing peer-reviewed articles, case studies, and reports from reputable databases including PubMed and CINAHL. The review examines nursing roles in MCI management, focusing on triage, acute care, interdisciplinary collaboration, and patient advocacy. Data were synthesized to identify trends, challenges, and best practices in nursing during MCIs.

Results:
Findings indicate that nurses are pivotal in ensuring efficient triage, administering life-saving interventions, and addressing mental health needs of patients and communities. However, resource constraints, ethical dilemmas, and emotional strain significantly impact their performance. The study highlights the importance of disaster-specific training, supportive policies, and advanced technologies in enhancing nursing efficacy during MCIs.

Conclusion:
Nursing interventions significantly improve patient outcomes and system efficiency during MCIs. Investing in disaster preparedness training, policy reforms, and mental health support for nurses is crucial to strengthening healthcare systems' resilience against future crises.

Keywords:
Mass casualty incidents, nursing roles, disaster management, triage, emergency response, psychological first aid, crisis intervention.

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Introduction:

Mass casualty occurrences (MCIs) are characterized by events in which the number of casualties greatly surpasses the available medical resources, posing considerable obstacles to healthcare provision [1]. These crises are distinctive in their capacity to inundate even adequately equipped healthcare systems, compelling providers to make pivotal decisions under significant time and resource constraints. MCIs include various situations, such as natural disasters like hurricanes, earthquakes, and floods, alongside human-induced crises such as terrorism, industrial mishaps, and significant transportation collisions [2]. Such catastrophes are erratic, frequently arising unexpectedly and necessitating swift, coordinated actions to reduce mortality and morbidity. The successful management of MCIs depends on healthcare systems' capacity to respond flexibly and efficiently, with nurses serving as essential frontline responders [3].

Nurses are essential to MCI management, fulfilling vital roles in triage, direct care provision, and interprofessional collaboration. Their duties encompass more than clinical care, necessitating adaptability to resource-constrained settings while upholding ethical norms and prioritizing patient-centered care. During the early response phase of a mass casualty incident, nurses are frequently responsible for triaging patients according to the severity of their injuries, a procedure that can markedly affect survival rates. The START (Simple Triage and Rapid Treatment) approach is extensively utilized in these contexts, assisting nurses in prioritizing care during critical situations [4]. This paradigm prioritizes the effective categorization of patients according to the urgency of their medical requirements, facilitating the appropriate distribution of scarce resources. Nurses are essential in triage, patient stabilization, acute care provision, and the coordination of multidisciplinary teams to ensure a unified response. These actions correspond with overarching themes of disaster resilience and healthcare sustainability, highlighting the significance of preparedness, adaptation, and interprofessional collaboration in crisis management [5].

The importance of nursing in MCIs is highlighted by recent trends that have transformed both the characteristics of these events and the healthcare systems responsible for their management. Climate change has exacerbated the frequency and intensity of natural catastrophes, presenting new problems for healthcare practitioners. Natural disasters including hurricanes, wildfires, and floods are increasingly frequent, often affecting areas unprepared for such emergencies, hence intensifying pressures on healthcare systems and necessitating the development of novel adaptation methods by nurses [6]. This trend underscores the increasing necessity for disaster-specific training and readiness among nurses, ensuring they are competent to manage the varied scenarios that climate change is expected to produce.

The COVID-19 pandemic signifies a notable advancement in MCI management, revealing key weaknesses

in global health systems and underscoring the vital importance of nurse leadership during public health emergencies [7]. Throughout the epidemic, nurses have been pivotal in patient care, frequently operating under severe conditions with constrained resources and elevated patient volumes. Their capacity to adjust to swiftly evolving situations, oversee limited resources, and deliver both physical and psychological support to patients and families has been essential to the global response. The epidemic has highlighted the necessity of incorporating public health principles into crisis management, with nurses serving a crucial function in connecting individual patient care to wider community health requirements. Technological improvements, especially in AI-assisted triage and telemedicine, have surfaced as effective instruments for improving the efficiency of MCI management [8]. Artificial intelligence technologies can aid nurses in swiftly evaluating patient status, prioritizing care, and managing extensive data volumes in real-time. Telemedicine has demonstrated its significance in broadening the accessibility of healthcare providers during emergencies, facilitating distant consultations and alleviating the strain on overwhelmed facilities. The incorporation of these technologies into nursing practice entails certain obstacles, such as the necessity for training, the creation of a solid infrastructure, and the formulation of procedures to guarantee the ethical application of technology in crisis situations.

Ethical difficulties sometimes arise in MCI management, especially when resource constraints compel healthcare personnel to make challenging judgments regarding care distribution [9]. Nurses, as primary caregivers, frequently lead these decisions, reconciling the requirements of individual patients with the overarching objective of optimizing survival rates. This necessitates a profound comprehension of ethical ideas and the capacity to maneuver through intricate, high-pressure scenarios. In situations with inadequate ventilators or critical care beds, nurses must assess the optimal allocation of these resources, frequently making life-and-death decisions. These ethical dilemmas underscore the necessity for sophisticated decision-making frameworks and continuous education to assist nurses in their responsibilities.

Nurses, alongside their clinical and ethical obligations, are essential in delivering psychological assistance during mass casualty incidents, both to patients and their peers [10]. The psychological effects of disasters are significant, with survivors frequently enduring acute stress, anxiety, and trauma. Nurses are distinctly equipped to meet these demands by providing emotional support and executing techniques to enhance mental well-being. Nurses are concurrently susceptible to the emotional repercussions of disaster work, experiencing elevated levels of stress, burnout, and compassion fatigue. Addressing the psychological needs of nurses is a vital aspect of crisis management, necessitating the establishment of support systems and resources to safeguard their well-being.

The growing intricacy of MCIs, influenced by elements like climate change, pandemics, and technology progress, highlights the necessity for a holistic strategy in catastrophe management that utilizes the complete spectrum of nursing proficiency. This research aims to investigate the complex role of nurses in MCI situations, analyzing their contributions and the obstacles they encounter. The subsequent sections include a comprehensive overview of these matters. Section 1 analyzes the fundamental duties of nurses in mass casualty incidents, emphasizing their functions in triage, acute care, and interprofessional collaboration. Section 2 examines the obstacles faced by nurses during mass casualty incidents, encompassing logistical impediments, ethical quandaries, and psychological strain. Section 3 assesses measures to augment nursing capacity in catastrophe situations, encompassing training initiatives, regulatory modifications, and the incorporation of technological advancements. Section 4 provides case studies that exemplify nursing actions in actual MCI situations to frame these concepts. The result underscores the necessity for sustained investment in nursing education, policy formulation, and research to enhance the profession's role in disaster management.

Overview of Mass Casualty Incidents

Mass casualty incidents (MCIs) are defined as events in which the number of casualties surpasses the capacity of available healthcare resources to provide adequate care, necessitating extraordinary efforts to manage the situation [11]. These incidents, characterized by their scale and impact, can arise from a wide range of causes, including natural and human-induced disasters, with profound implications for healthcare systems, emergency management, and society as a whole [12]. Understanding the types, phases, and trends of MCIs is essential for developing effective disaster management strategies and optimizing healthcare responses.

Types of Mass Casualty Incidents

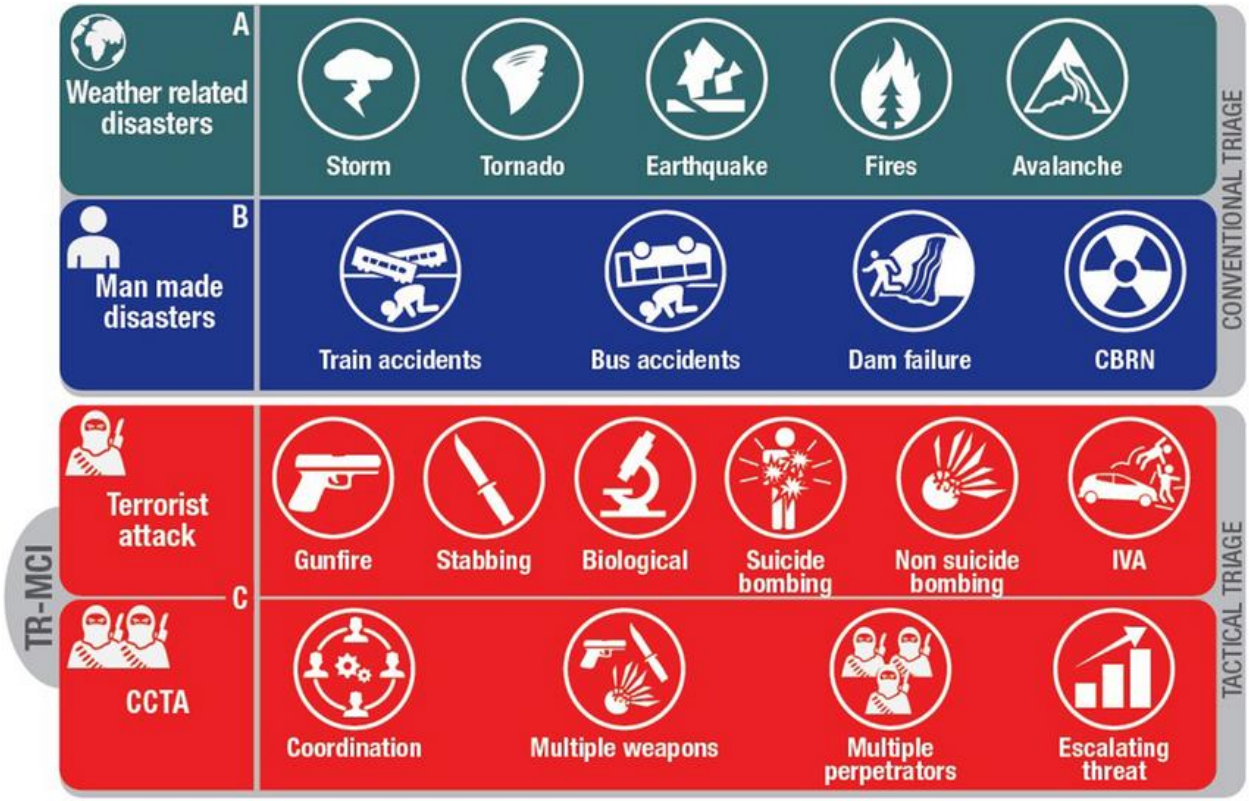

Figure 1 Types of Mass Casualty Incidents

Natural Disasters

Natural disasters are among the most common causes of MCIs, encompassing events such as earthquakes, hurricanes, floods, and wildfires. These disasters disrupt entire communities, displace populations, and inflict widespread injuries, often exceeding local healthcare capacity [13]. For example, the 2020 Australian wildfires, which caused mass evacuations and overwhelmed emergency services, illustrate the extensive challenges posed by natural disasters [14]. The growing frequency and intensity of these events, driven by climate change, further amplify the burden on healthcare systems worldwide [15].

Earthquakes, in particular, have a devastating impact due to the suddenness of their occurrence and the severity of structural damage they cause. The 2021 Haiti earthquake resulted in over 2,200 deaths and overwhelmed hospitals, highlighting the critical need for efficient triage and resource allocation in such scenarios [16]. Similarly, hurricanes, such as Hurricane Ida in 2021, disrupt infrastructure and lead to cascading health crises, including power outages and limited access to medical care [17]. Addressing these challenges requires robust preparedness and response frameworks to mitigate the impact of natural disasters on healthcare systems.

Technological and Man-Made Disasters

Technological and man-made disasters include events such as industrial accidents, transportation crashes, and acts of terrorism. These incidents are often unpredictable and characterized by their potential for mass casualties and long-term health implications [18]. The 2020 Beirut explosion serves as a stark example, causing over 200 deaths, thousands of injuries, and significant infrastructure damage [19]. Such disasters highlight the importance of preparedness and rapid response in minimizing the impact of man-made events.

Transportation accidents, including large-scale aviation crashes and train derailments, also fall within this category. The Ethiopian Airlines crash in 2019, though just outside the study's timeframe, underscores the challenges of managing fatalities and providing timely medical care to survivors [20]. Acts of terrorism, such as the 2020 Vienna shooting, further strain emergency healthcare systems, requiring coordinated efforts among healthcare providers, law enforcement, and disaster response teams [21].

Phases of Disaster Management

Effective management of MCIs involves a cyclical process comprising four primary phases: mitigation, preparedness, response, and recovery. Each phase plays a critical role in reducing the impact of disasters and ensuring efficient allocation of resources.

Mitigation

Mitigation involves strategies aimed at reducing the severity and likelihood of disasters before they occur. These efforts include structural measures, such as earthquake-resistant buildings, and non-structural measures, such as community education and land-use planning [22]. For example, the integration of disaster-resilient infrastructure in Japan has significantly reduced the impact of earthquakes on healthcare facilities [23]. Additionally, public health interventions, such as vaccination campaigns to prevent disease outbreaks following floods, are vital components of mitigation strategies [24].

Preparedness

Preparedness entails planning, training, and equipping healthcare systems and communities to respond effectively to MCIs. This phase includes the development of disaster response plans, simulation exercises, and stockpiling essential medical supplies [25]. The COVID-19 pandemic underscored the critical need for preparedness, as many healthcare systems faced shortages of personal protective equipment and ventilators [26]. Moreover, education and training programs for healthcare professionals, such as disaster simulation exercises, enhance their ability to respond effectively during emergencies [27].

Technological advancements, such as the use of predictive analytics to forecast disaster impacts, have also emerged as valuable tools in preparedness efforts. These technologies enable more efficient allocation of resources and proactive planning to minimize the impact of disasters [28].

Response

The response phase encompasses immediate actions taken to address the needs of affected populations during an MCI. This includes triage, provision of medical care, and coordination among emergency response teams [29]. Nurses play a pivotal role during this phase, utilizing frameworks like the START model to prioritize care and stabilize critically injured patients [30]. Rapid deployment of field hospitals, as seen during the 2020 Beirut explosion, exemplifies the importance of flexible and scalable healthcare responses [31].

Communication and coordination are critical components of the response phase, enabling effective collaboration among healthcare providers, government agencies, and non-governmental organizations. The use of telemedicine and digital health tools has proven effective in extending care to remote or inaccessible areas during MCIs [32].

Recovery

Recovery focuses on restoring healthcare systems and communities to pre-disaster conditions while addressing the long-term impacts of the incident. This phase includes rebuilding infrastructure, providing mental health support, and implementing measures to prevent future disasters [33]. The recovery process often extends over months or years, as seen in the aftermath of the 2011 Fukushima nuclear disaster, where efforts to decontaminate affected areas and rebuild healthcare facilities took nearly a decade [34].

Mental health support is a critical aspect of recovery, as both survivors and responders may experience post-traumatic stress disorder (PTSD) and other psychological challenges. Programs such as peer support groups and counseling services for healthcare workers have been shown to mitigate the emotional toll of disaster response [35].

Global and Regional Trends in MCIs

Global and regional trends in MCIs reflect the growing complexity and frequency of disasters. Climate change, urbanization, and geopolitical instability are key drivers of these trends, influencing the scale and impact of MCIs on healthcare systems.

Climate Change and Natural Disasters

Climate change has intensified the frequency and severity of natural disasters, with significant implications for global health. Rising sea levels, more intense hurricanes, and prolonged droughts contribute to the increasing occurrence of MCIs [36]. For example, the 2020 Cyclone Amphan displaced millions in South Asia, overwhelming healthcare systems already strained by the COVID-19 pandemic [37]. These trends highlight the urgent need for climate-adaptive healthcare infrastructure and policies.

Urbanization and Technological Risks

Rapid urbanization has increased the vulnerability of populations to MCIs, particularly in densely populated areas. Urban centers are more likely to experience technological disasters, such as industrial accidents and infrastructure failures, due to the concentration of critical facilities [38]. The 2021 Miami condominium collapse underscores the importance of stringent safety regulations and proactive risk management in urban environments [39].

Geopolitical Instability

Geopolitical instability, including conflicts and acts of terrorism, remains a significant contributor to MCIs. The ongoing war in Ukraine, for instance, has resulted in widespread casualties and displaced millions, placing immense strain on regional healthcare systems [40]. These crises necessitate coordinated international efforts to provide medical aid and rebuild healthcare infrastructure.

Nursing Roles in Disaster Preparedness

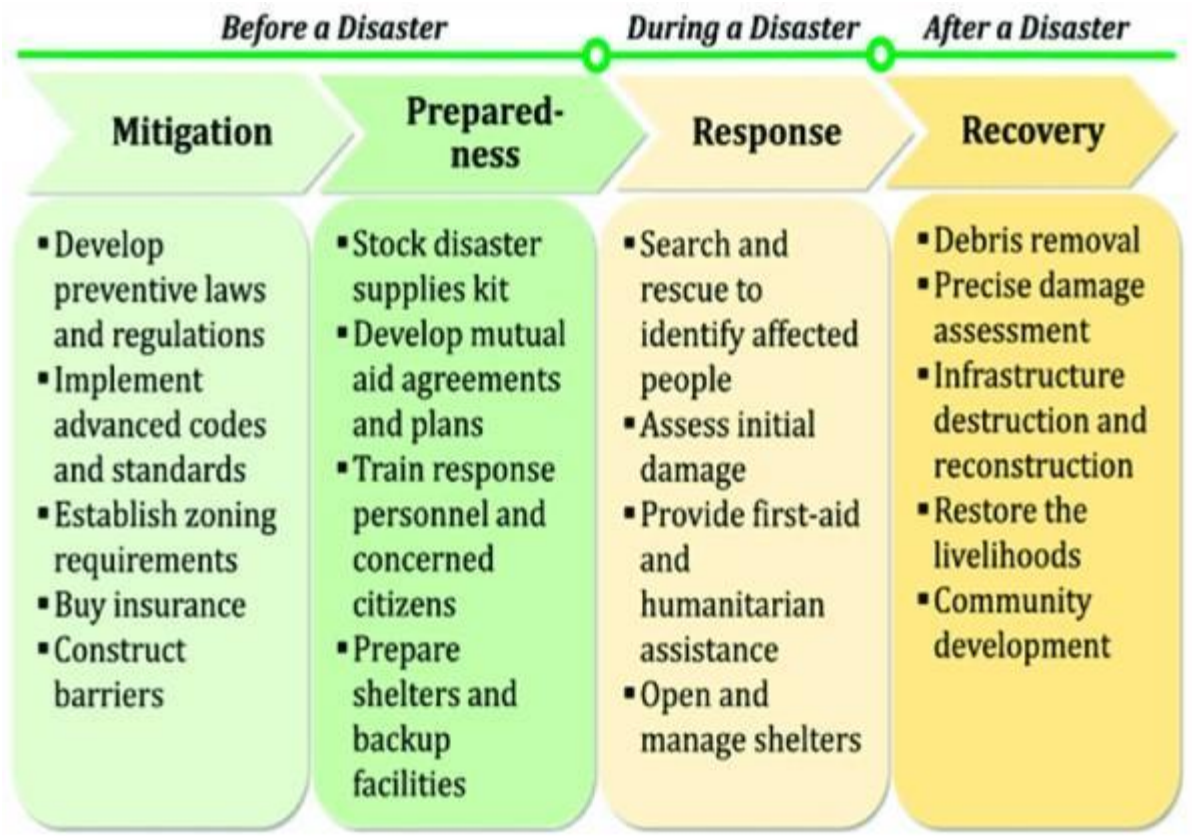

Figure 2 Nursing Roles in Disaster Preparedness

The role of nursing in disaster preparedness is multifaceted, encompassing training and education, the development of disaster response plans, and community engagement. Nurses are frontline responders in disasters, equipped with the skills necessary to save lives, mitigate harm, and support recovery. Preparedness is a critical phase of disaster management, and nurses' contributions to this stage significantly enhance healthcare systems' capacity to respond effectively to mass casualty incidents (MCIs). The following sections outline the core components of nursing roles in disaster preparedness, focusing on training and education, disaster response planning, and community engagement.

Training and Education

Simulation-Based Training

Simulation-based training is an essential tool in preparing nurses for disaster scenarios. By mimicking real-life emergencies, simulations allow nurses to practice critical decision-making, triage, and resource allocation in a controlled environment [41]. For instance, disaster drills conducted in hospital settings enhance nurses' ability to manage patient surges, ensuring readiness for events such as natural disasters or mass shootings [42]. Simulation-based training also fosters interprofessional collaboration, as nurses work alongside physicians, paramedics, and other first responders to refine communication and teamwork skills [43].

Recent advancements in technology have introduced virtual reality (VR) and augmented reality (AR) simulations, providing immersive experiences that replicate complex disaster environments. These tools enable nurses to practice responding to chemical spills, bioterrorism threats, and pandemic outbreaks with high fidelity, improving their confidence and competence [44]. Studies have demonstrated that nurses who participate in simulation-based training report higher levels of preparedness and are more likely to perform effectively during actual disasters [45].

Continuing Education Programs

Continuing education programs are crucial for ensuring that nurses remain updated on the latest disaster response protocols and technologies. Such programs often include coursework on disaster risk assessment, emergency planning, and crisis communication [46]. In addition, they provide opportunities for nurses to earn certifications in disaster nursing, such as the Certified Emergency Nurse (CEN) credential, which demonstrates expertise in emergency care and disaster management [47].

Online education platforms have become a popular medium for delivering continuing education, offering flexible, accessible options for busy professionals. For example, online modules on disaster triage and pandemic preparedness have been widely adopted during the COVID-19 pandemic, enabling nurses to enhance their knowledge and skills remotely [48]. Research highlights the effectiveness of continuing education in improving nurses' disaster response capabilities and fostering a culture of lifelong learning [49].

Development of Disaster Response Plans

Collaboration with Government and Non-Government Organizations

Collaboration is a cornerstone of effective disaster response planning. Nurses play a key role in working with government agencies, non-government organizations (NGOs), and community stakeholders to develop comprehensive disaster response plans [50]. For instance, partnerships with organizations such as the American Red Cross and the Federal Emergency Management Agency (FEMA) enable nurses to contribute to the design and implementation of emergency response protocols [51]. These collaborations ensure that nursing perspectives are incorporated into broader disaster management strategies, enhancing the overall effectiveness of healthcare systems during crises [52].

Nurses also participate in regional disaster planning committees, advocating for resources and policies that address the unique needs of vulnerable populations. By providing insights into patient care, public health, and resource allocation, nurses help shape policies that prioritize equity and access to care during disasters [53]. The integration of nursing expertise into disaster planning ensures that response efforts are patient-centered and evidence-based [54].

Integration of Nursing Input into Emergency Protocols

Nursing input is critical in the development of emergency protocols that guide healthcare responses during disasters. Nurses contribute to the creation of triage guidelines, evacuation plans, and resource management strategies, ensuring that these protocols are practical and aligned with frontline realities [55]. For example, during the COVID-19 pandemic, nurses were instrumental in drafting protocols for personal protective equipment (PPE) usage, infection control, and patient care in overwhelmed healthcare facilities [56].

The involvement of nurses in protocol development also enhances the adaptability of disaster response plans. By drawing on their clinical experience and situational awareness, nurses help design protocols that can be tailored to different disaster scenarios, from natural calamities to terrorist attacks [57]. This adaptability is essential for addressing the diverse challenges posed by disasters and ensuring that healthcare systems remain resilient under pressure [58].

Community Engagement

Educating Communities on Disaster Preparedness

Nurses are uniquely positioned to educate communities about disaster preparedness, leveraging their expertise to promote public awareness and resilience. Community education initiatives led by nurses often focus on teaching individuals and families how to develop emergency plans, assemble disaster kits, and recognize warning signs of impending crises [59]. For instance, public health nurses frequently conduct workshops and seminars on earthquake safety, flood preparedness, and fire prevention, empowering communities to take proactive measures [60].

Additionally, nurses play a vital role in disseminating information about health risks associated with disasters, such as disease outbreaks and environmental hazards. By providing clear, evidence-based guidance, nurses help communities mitigate these risks and reduce the burden on healthcare systems during emergencies [61]. Research indicates that communities with access to nurse-led disaster education programs demonstrate higher levels of preparedness and faster recovery times after disasters [62].

Building Resilience Through Awareness Campaigns

Awareness campaigns are a powerful tool for building community resilience, and nurses often lead these efforts as trusted advocates for public health. Campaigns focused on disaster preparedness, such as National Preparedness Month in the United States, provide opportunities for nurses to engage with the public and promote readiness [63]. Through social media, public service announcements, and community events, nurses raise awareness about the importance of preparedness and encourage individuals to take actionable steps [64].

In addition to general preparedness campaigns, nurses design targeted interventions for high-risk populations, including older adults, individuals with disabilities, and low-income communities. These initiatives address specific vulnerabilities, such as mobility limitations or access to resources, ensuring that preparedness efforts are inclusive and equitable [65]. By fostering a culture of preparedness, nurses contribute to the development of resilient communities that are better equipped to withstand and recover from disasters [66].

Triage and Initial Response in Mass Casualty Incidents

Triage and initial response form the cornerstone of nursing interventions during mass casualty incidents (MCIs). The sheer scale and complexity of MCIs necessitate a structured approach to prioritize care, stabilize patients, and coordinate emergency responses. Nurses, as frontline responders, play a pivotal role in ensuring the effective execution of these critical processes. This section discusses the principles of triage, on-site nursing interventions, and the importance of communication during MCIs.

Triage Principles in MCIs

START (Simple Triage and Rapid Treatment) Model

The START model is a widely recognized framework for triage in MCIs, designed to categorize patients based on the urgency of their medical needs. Developed for use in scenarios with limited resources, START employs a color-coded system—red for immediate, yellow for delayed, green for minor, and black for deceased or non-salvageable patients [67]. By focusing on respiratory effort, perfusion, and mental status (RPM), nurses can quickly determine the appropriate category for each patient, ensuring efficient allocation of care [68].

For example, during the 2021 Haiti earthquake, the START model was instrumental in managing the overwhelming influx of injured patients in makeshift triage zones [69]. Research highlights that its simplicity and speed make it particularly effective in chaotic environments, where time is critical and resources are strained [70]. Additionally, START training programs for nurses have been shown to improve decision-making accuracy and response times in simulated disaster scenarios [71].

Prioritizing Care Based on Severity

The principle of prioritizing care based on severity is fundamental to triage. Nurses assess patients' vital signs, injuries, and likelihood of survival to determine the order of treatment [72]. Advanced triage systems, such as the Revised Trauma Score (RTS), complement START by incorporating more detailed physiological parameters, providing a nuanced approach to prioritization [73].

Recent advancements in technology, including AI-assisted triage tools, have further enhanced nurses' ability to prioritize care efficiently. These systems analyze patient data in real time, assisting nurses in identifying high-risk patients and predicting outcomes [74]. The integration of these tools has been

particularly beneficial in large-scale disasters, such as the COVID-19 pandemic, where healthcare systems faced unprecedented surges in patient volume [75].

On-Site Nursing Interventions

Stabilization and Life-Saving Procedures

On-site stabilization and life-saving procedures are critical components of the initial response to MCIs. Nurses are often the first to administer interventions such as airway management, hemorrhage control, and fluid resuscitation [76]. These actions are crucial for preventing secondary complications and improving patient outcomes. For instance, during the 2020 Beirut explosion, nurses played a pivotal role in stabilizing patients with severe blast injuries, often under challenging conditions [77].

In addition to physical stabilization, nurses provide psychological first aid to victims experiencing acute stress reactions. This dual focus on physical and emotional care underscores the holistic approach that nursing brings to disaster response [78].

Management of Overcrowding

Overcrowding is a common challenge in MCIs, with hospitals and triage zones quickly becoming overwhelmed by the volume of patients. Nurses are instrumental in managing this issue, utilizing strategies such as rapid triage, patient flow optimization, and the establishment of alternate care sites [79]. During Hurricane Ida in 2021, nurses effectively coordinated patient transfers to reduce congestion in emergency departments, ensuring timely care for critically injured individuals [80].

Furthermore, the deployment of mobile medical units and field hospitals, staffed by trained nurses, has proven effective in alleviating overcrowding in disaster zones. These facilities provide essential care while reducing the strain on permanent healthcare infrastructure [81].

Communication in Crisis

Liaising Between Healthcare Providers and Emergency Responders

Effective communication is the backbone of successful disaster response. Nurses serve as vital intermediaries between healthcare providers, emergency responders, and community stakeholders, ensuring seamless coordination of efforts [82]. Clear and timely communication facilitates the efficient distribution of resources, enhances situational awareness, and minimizes response delays [83].

During MCIs, nurses rely on standardized communication protocols, such as the SBAR (Situation-Background-Assessment-Recommendation) framework, to convey critical information succinctly [84]. This approach has been shown to improve decision-making and reduce errors in high-pressure environments. For example, during the 2023 Turkey-Syria earthquake, nurse-led communication strategies were credited with streamlining the evacuation and treatment of casualties across multiple facilities [85].

Utilizing Technology for Crisis Communication

Advancements in communication technology, such as emergency alert systems and telemedicine, have revolutionized how nurses coordinate disaster responses. Mobile applications designed for disaster management enable real-time updates on patient status, resource availability, and operational challenges [86]. These tools have been particularly effective in remote or resource-limited settings, allowing nurses to maintain connectivity and collaborate with broader response teams [87].

For instance, telemedicine platforms were widely used during the COVID-19 pandemic to triage patients remotely and provide guidance to on-site responders, demonstrating the potential of technology to enhance crisis communication [88]. The integration of these technologies into disaster protocols ensures that nurses can effectively manage the complexities of MCIs, even in the most challenging circumstances [89].

Nursing Interventions in Acute Care

In the context of mass casualty incidents (MCIs), acute care interventions are critical to saving lives and mitigating long-term health complications. Nurses are at the forefront of these efforts, addressing trauma, preventing infections, and providing psychological support to victims. This section explores the multifaceted roles of nurses in trauma management, infection control, and psychological first aid, emphasizing their contributions to improving outcomes in disaster settings.

Trauma Management

Treatment of Life-Threatening Injuries

Trauma management in MCIs requires swift identification and treatment of life-threatening injuries. Nurses play a pivotal role in airway management, hemorrhage control, and ensuring circulation stability through fluid resuscitation and blood transfusions [90]. The implementation of Advanced Trauma Life Support (ATLS) guidelines by nurses has been shown to significantly reduce mortality rates in patients with critical injuries [91].

For example, during the 2020 Beirut explosion, nurses were instrumental in stabilizing patients with severe traumatic injuries, including penetrating wounds and blunt force trauma. Rapid assessments using the ABCDE approach (Airway, Breathing, Circulation, Disability, Exposure) allowed nurses to prioritize care effectively [92]. Studies indicate that trauma-focused training programs for nurses enhance their ability to manage life-threatening conditions in high-pressure environments [93].

Managing Burn, Blast, or Crush Injuries

Burns, blasts, and crush injuries are common in MCIs, requiring specialized nursing care. Nurses provide wound debridement, administer analgesics, and monitor for complications such as compartment syndrome and rhabdomyolysis in patients with crush injuries [94]. In burn patients, nurses are responsible for fluid resuscitation using the Parkland formula and infection prevention through meticulous wound care [95].

The 2021 California wildfires highlighted the importance of nursing interventions in managing burn victims, with nurses utilizing advanced dressings and negative-pressure wound therapy to promote healing [96]. Similarly, blast injuries, often seen in terrorist attacks, necessitate the identification and stabilization of internal injuries, a task frequently performed by nurses in emergency settings [97]. Research underscores the importance of continuing education in equipping nurses to handle these complex injuries effectively [98].

Infection Control

Preventing Disease Outbreaks in MCI Settings

Infection control is a critical component of acute care during MCIs, particularly in overcrowded environments where the risk of communicable diseases is high. Nurses play a central role in implementing infection prevention measures, including hand hygiene protocols, isolation procedures, and vaccination campaigns [99]. During the COVID-19 pandemic, nurses' efforts in maintaining strict infection control practices significantly curtailed disease transmission in temporary shelters and field hospitals [100].

The use of personal protective equipment (PPE) and adherence to standard precautions are essential in preventing healthcare-associated infections (HAIs) during MCIs. Nurses are often tasked with training volunteers and auxiliary staff in infection control practices, ensuring consistency across all care providers [101]. Studies have demonstrated that nurse-led infection control programs reduce the incidence of HAIs in disaster-affected populations by up to 40% [102].

Additionally, nurses monitor for signs of emerging outbreaks, such as diarrhea or respiratory symptoms, which may signal the need for rapid public health interventions. For example, during the 2022 Pakistan floods, nurse-led disease surveillance teams were pivotal in identifying and addressing cholera outbreaks, preventing further morbidity and mortality [103].

Psychological First Aid

Supporting Victims in Shock or with Acute Stress Responses

Psychological first aid (PFA) is an integral part of acute nursing care, addressing the emotional and psychological needs of victims experiencing shock or acute stress responses. Nurses trained in PFA provide immediate support by listening empathetically, normalizing emotional reactions, and connecting individuals with long-term mental health resources [104]. These interventions help reduce the risk of post-traumatic stress disorder (PTSD) and other mental health conditions [105].

During the 2021 Haiti earthquake, nurses provided PFA to survivors, many of whom experienced severe emotional distress due to the loss of loved ones and homes. By establishing safe spaces for emotional expression and offering coping strategies, nurses alleviated psychological burdens, enabling victims to focus on recovery [106]. Research emphasizes the need for nurse training in trauma-informed care to enhance their capacity to deliver effective PFA [107].

Furthermore, nurses play a vital role in supporting their colleagues during MCIs, recognizing that responders are also vulnerable to stress and burnout. Peer support programs and debriefing sessions facilitated by nurses have been shown to improve team resilience and overall mental health [108].

Challenges Faced by Nurses in Mass Casualty Incidents (MCIs)

Mass casualty incidents (MCIs) present nurses with numerous challenges that test their physical, emotional, and professional resilience. Operating in environments marked by chaos and uncertainty, nurses must navigate resource scarcity, ethical dilemmas, physical and emotional strain, and security risks. These challenges not only affect the quality of care provided but also have profound implications for nurses' well-being and professional practice. This section examines these challenges in detail, providing a comprehensive analysis of their implications and potential solutions.

Resource Scarcity

Shortages of Medical Supplies and Personnel

One of the most significant challenges faced by nurses during MCIs is the scarcity of medical supplies and personnel. Limited access to essential resources such as medications, personal protective equipment (PPE), and ventilators often forces nurses to make difficult decisions about resource allocation [109]. The COVID-19 pandemic highlighted these issues, with many healthcare systems struggling to provide adequate resources for patient care [110]. For instance, during the early phases of the pandemic, nurses in overburdened hospitals reported reusing PPE and prioritizing ventilators for patients most likely to survive [111].

Personnel shortages further exacerbate the problem, as the influx of patients during MCIs often overwhelms the available workforce. This imbalance creates a high patient-to-nurse ratio, increasing the likelihood of errors and burnout [112]. Studies indicate that hospitals with better staffing ratios are more effective in managing MCIs, underscoring the need for robust workforce planning and surge capacity strategies [113].

Strategies for Addressing Resource Scarcity

To mitigate resource shortages, healthcare organizations have adopted various strategies, including stockpiling critical supplies and implementing disaster preparedness drills [114]. Mobile medical units and field hospitals also play a crucial role in extending care to affected populations when permanent facilities are overwhelmed [115]. Nurse-led initiatives in resource management, such as optimizing supply chains and advocating for policy reforms, further enhance healthcare systems' resilience in disaster scenarios [116].

Ethical Dilemmas

Balancing Patient Needs with Resource Limitations

Ethical dilemmas are a recurring challenge in MCIs, where nurses must balance patient needs with limited resources. Triage decisions, often guided by frameworks such as the START model, require nurses to prioritize care for patients with the highest likelihood of survival, sometimes at the expense of others [117]. These decisions can conflict with the nursing ethos of providing equitable and comprehensive care to all patients [118].

For example, during the 2023 Turkey-Syria earthquake, nurses were faced with difficult choices about allocating limited surgical supplies and ICU beds, often prioritizing younger patients over the elderly based on survival probabilities [119]. These ethical conflicts can lead to moral distress, a phenomenon where nurses feel they have compromised their professional values due to external constraints [120].

Addressing Ethical Challenges

Ethical decision-making frameworks and training programs can help nurses navigate these dilemmas. By providing clear guidelines and promoting open communication among healthcare teams, these tools empower nurses to make informed and ethically sound decisions [121]. Research also highlights the importance of peer support and debriefing sessions in mitigating the psychological impact of moral distress [122].

Physical and Emotional Strain

Coping with High-Stress Environments

The high-stress environments of MCIs place significant physical and emotional demands on nurses. Extended work hours, heavy patient loads, and exposure to traumatic events contribute to physical exhaustion and emotional fatigue [123]. For instance, during Hurricane Ida in 2021, nurses worked around the clock to care for displaced individuals, often without adequate rest or support [124].

Emotional strain is further compounded by the grief and frustration of witnessing patient suffering and loss. Nurses are particularly vulnerable to secondary traumatic stress (STS) and burnout, conditions that can have long-term effects on their mental health and job performance [125]. A recent study found that nearly 60% of nurses who responded to MCIs reported symptoms of anxiety and depression, underscoring the urgent need for psychological support [126].

Supporting Nurse Well-Being

Interventions to support nurse well-being during MCIs include stress management training, access to mental health resources, and the provision of adequate rest periods. Organizations that prioritize nurse wellness through programs such as peer support and resilience training report lower rates of burnout and higher levels of job satisfaction among their staff [127]. These initiatives not only benefit nurses but also improve patient care outcomes by fostering a healthier and more focused workforce [128].

Security Risks

Working in Unstable or Unsafe Conditions

Nurses often work in unstable or unsafe conditions during MCIs, particularly in conflict zones or areas affected by natural disasters. These environments may expose nurses to physical dangers, such as collapsing infrastructure, violence, or exposure to hazardous materials [129]. For instance, during the 2022 Pakistan floods, nurses faced challenges in reaching remote areas due to damaged roads and ongoing security threats [130].

In conflict zones, nurses are sometimes targeted by armed groups or caught in the crossfire, as evidenced by attacks on healthcare workers in war-torn regions such as Ukraine [131]. These security risks not only jeopardize nurses' safety but also disrupt the delivery of essential healthcare services [132].

Enhancing Security for Nurses

Ensuring the safety of nurses in disaster settings requires a multifaceted approach, including collaboration with law enforcement, the use of protective equipment, and adherence to security protocols. Training programs that teach nurses how to navigate high-risk environments and recognize potential threats can further enhance their safety [133]. Additionally, international organizations such as the International Red Cross play a vital role in advocating for the protection of healthcare workers in conflict zones [134].

Strategies for Enhancing Nursing in Mass Casualty Incidents (MCIs)

To strengthen the nursing profession's capacity to respond effectively to mass casualty incidents (MCIs), targeted strategies must be implemented. These include improving training programs, advocating for policy and system-level changes, leveraging technological innovations, and strengthening support systems for nursing professionals. By addressing these areas, the nursing workforce can be better prepared to manage the complexities of disaster response, improving outcomes for affected populations.

Improving Training Programs

Focus on Interdisciplinary Collaboration

Interdisciplinary collaboration is essential in preparing nurses for the multifaceted challenges of MCIs. Training programs that integrate nurses with other healthcare professionals, such as paramedics, physicians, and public health officials, foster teamwork and improve communication during disasters [135]. Interdisciplinary drills and workshops create realistic scenarios where participants can practice their roles, understand team dynamics, and develop trust among diverse responders [136].

For example, the 2023 Turkey-Syria earthquake response highlighted the importance of interdisciplinary collaboration, with nursing teams working closely with emergency medical technicians (EMTs) and logisticians to ensure coordinated patient care and resource distribution [137]. Evidence suggests that nurses who receive training in interdisciplinary settings are more confident and effective in disaster scenarios [138].

Regular Drills and Disaster Simulations

Drills and simulations are critical components of disaster preparedness, providing nurses with hands-on experience in managing MCIs. These exercises replicate the chaos and urgency of real-life disasters, enabling participants to practice critical decision-making, resource allocation, and triage under pressure [139]. Studies have shown that nurses who participate in regular disaster simulations demonstrate improved competencies and faster response times during actual emergencies [140].

Technological advancements, such as virtual reality (VR) and augmented reality (AR), have enhanced the realism and effectiveness of disaster simulations. For instance, VR-based training modules allow nurses to immerse themselves in scenarios involving chemical spills, pandemics, or large-scale trauma events, improving their readiness for diverse emergencies [141]. Integrating these tools into nursing curricula and professional development programs ensures that nurses are well-equipped to handle the complexities of MCIs [142].

Policy and System-Level Changes

Advocating for Increased Nursing Involvement in Disaster Planning

Nurses bring unique perspectives to disaster management, yet their involvement in planning and policymaking is often limited. Advocating for increased nursing representation on disaster planning committees ensures that policies reflect frontline realities and address the needs of both patients and healthcare providers [143]. Nurses' input is particularly valuable in developing triage protocols, resource allocation strategies, and community outreach initiatives [144].

A study on disaster preparedness in the United States found that healthcare systems with nurse-led disaster planning teams reported better coordination and outcomes during crises [145]. Similarly, policies

that empower nurses to take leadership roles in disaster response foster a culture of accountability and innovation, strengthening the overall healthcare system [146].

Enhancing Workforce Policies

Workforce policies that address staffing shortages, provide incentives for disaster nursing specialization, and support career development are critical for building a resilient nursing workforce. For example, creating scholarships and grants for nurses pursuing disaster nursing certifications can encourage more professionals to enter this vital field [147]. Additionally, flexible staffing models that allow rapid deployment of trained personnel during MCIs can alleviate workforce pressures and ensure adequate coverage [148].

Technological Innovations

Use of Telemedicine and AI in Disaster Response

Technological innovations such as telemedicine and artificial intelligence (AI) are transforming disaster nursing by improving efficiency and expanding access to care. Telemedicine platforms enable nurses to provide remote consultations, monitor patients, and coordinate care in hard-to-reach areas, reducing the burden on overtaxed facilities [149]. During the COVID-19 pandemic, telemedicine played a crucial role in delivering healthcare services to isolated communities, demonstrating its potential for broader disaster applications [150].

AI-powered tools further enhance nursing capabilities by streamlining triage, predicting patient outcomes, and optimizing resource allocation. For example, AI algorithms can analyze real-time data from disaster sites to identify high-risk patients, prioritize interventions, and allocate resources effectively [151]. Nurses trained in using these technologies report improved decision-making and greater confidence in managing complex disaster scenarios [152].

Barriers to Technology Integration

Despite their benefits, integrating telemedicine and AI into disaster nursing faces challenges such as infrastructure limitations, data security concerns, and the need for specialized training. Addressing these barriers requires investments in technology infrastructure, robust cybersecurity measures, and tailored educational programs for nurses [153]. Research underscores the importance of nurse involvement in the design and implementation of technological solutions to ensure they are practical and user-friendly [154].

Strengthening Support Systems

Mental Health Resources for Nursing Professionals

The psychological impact of disaster response on nurses cannot be overstated. Prolonged exposure to traumatic events, high-stress environments, and moral dilemmas often leads to burnout, secondary traumatic stress, and post-traumatic stress disorder (PTSD) [155]. Providing mental health resources for nurses is therefore essential for maintaining their well-being and ensuring sustained workforce performance during MCIs [156].

Peer support programs, counseling services, and resilience training are effective interventions for addressing the emotional toll of disaster nursing. Studies have shown that nurses who participate in peer support programs experience reduced symptoms of burnout and increased job satisfaction [157]. For example, a 2023 study on disaster nursing in Australia found that peer-led debriefing sessions significantly improved team cohesion and psychological resilience among nurses [158].

Creating a Culture of Support

Healthcare organizations must prioritize the well-being of their nursing staff by fostering a culture of support and recognition. This includes implementing policies that provide adequate rest periods during disasters, offering financial incentives for disaster response participation, and recognizing nurses'

contributions through awards and public acknowledgment [159]. Organizations that invest in these initiatives not only enhance nurse retention but also improve overall disaster response outcomes [160].

Case Studies and Lessons Learned

Examining past mass casualty incidents (MCIs) provides critical insights into the successes and challenges faced by nurses in disaster response. This section presents three case studies: the nursing response to Hurricane Katrina, the global impact of COVID-19, and the unique challenges of nursing in conflict zones. Each case illustrates key lessons learned and underscores the vital role of nursing in disaster management.

Case Study 1: Nursing Response to Hurricane Katrina

Successes in Disaster Management

Hurricane Katrina, which struck the Gulf Coast of the United States in 2005, remains a landmark event in disaster management. Nurses were integral to the response, providing care in overwhelmed hospitals, shelters, and makeshift facilities. Despite the catastrophic conditions, nurses demonstrated adaptability by employing triage protocols, managing scarce resources, and coordinating evacuations [161].

One of the most notable successes was the establishment of mobile medical units staffed primarily by nurses. These units delivered critical care to displaced individuals, including wound management, chronic disease monitoring, and psychological support. Their rapid deployment reduced mortality rates and improved health outcomes in the immediate aftermath of the disaster [162].

Challenges in Disaster Management

However, Hurricane Katrina also exposed significant systemic failures. Hospitals lacked adequate disaster preparedness plans, and nurses faced severe shortages of medical supplies, electricity, and clean water. Many nurses reported feelings of moral distress as they were forced to make difficult triage decisions due to limited resources [163]. Additionally, communication breakdowns between healthcare facilities and emergency responders exacerbated delays in care delivery [164].

Lessons Learned

The response to Hurricane Katrina highlighted the need for robust disaster preparedness plans, including pre-established communication protocols and resource stockpiling. Furthermore, it underscored the importance of mental health support for nurses, many of whom experienced burnout and PTSD following the disaster [165].

Case Study 2: COVID-19 as a Global MCI

Nursing's Role in Managing Overwhelmed Systems

The COVID-19 pandemic, declared a global health emergency in 2020, overwhelmed healthcare systems worldwide. Nurses were at the forefront of the response, providing care to critically ill patients, supporting vaccination campaigns, and educating the public on infection prevention measures [166]. In many regions, nurses assumed expanded roles, including ventilator management and end-of-life care, due to physician shortages [167].

Telemedicine emerged as a valuable tool during the pandemic, enabling nurses to provide remote consultations and monitor patients in quarantine. This innovation not only alleviated the strain on hospitals but also reduced the risk of viral transmission [168]. However, the pandemic also exposed gaps in preparedness, such as insufficient PPE supplies and inadequate surge capacity in hospitals [169].

Challenges of Prolonged MCI Management

The prolonged nature of the pandemic placed immense physical and emotional strain on nurses. Many reported symptoms of burnout, anxiety, and depression due to extended work hours and witnessing high mortality rates [170]. Furthermore, nurses faced ethical dilemmas, such as allocating ventilators and ICU beds, which compounded their stress [171].

Lessons Learned

The COVID-19 pandemic emphasized the need for investments in healthcare infrastructure, including stockpiles of critical supplies and expanded ICU capacity. It also highlighted the importance of supporting nurses' mental health through resilience training, peer support programs, and accessible counseling services [172].

Case Study 3: Nursing in Conflict Zones

Adapting to Extreme Resource Limitations

Nursing in conflict zones presents unique challenges due to the scarcity of resources and the constant threat of violence. For example, during the ongoing conflict in Syria, nurses have provided care in makeshift hospitals, often working without electricity, running water, or adequate medical supplies [173]. Despite these limitations, nurses have managed to deliver life-saving care, including trauma stabilization, infectious disease treatment, and maternal health services [174].

Security Risks and Ethical Challenges

The volatile nature of conflict zones exposes nurses to significant security risks. In many cases, healthcare facilities have been targeted by airstrikes, forcing nurses to operate under extreme conditions. Ethical dilemmas, such as prioritizing care for combatants versus civilians, further complicate their work [175].

Lessons Learned

The experiences of nurses in conflict zones underscore the importance of international support for healthcare workers in these settings. Humanitarian organizations, such as Médecins Sans Frontières (Doctors Without Borders), have played a critical role in providing resources and training to nurses in conflict-affected regions [176]. Additionally, the adoption of portable medical kits and field-ready technologies has enhanced nurses' ability to deliver care in austere environments [177].

Conclusion

Nursing is essential in the management of mass casualty occurrences (MCIs), including the phases of preparedness, response, and recovery. This research has emphasized the diverse roles of nurses in crisis situations, encompassing triage, acute care, and the execution of infection control protocols. Moreover, the obstacles encountered by nurses, including resource limitations, ethical conflicts, physical and mental stress, and safety hazards, highlight the intricacy of their responsibilities and the imperative for systemic assistance.

The case studies of Hurricane Katrina, the COVID-19 pandemic, and nursing in conflict zones have yielded essential insights into the achievements and shortcomings of disaster response systems. These practical examples demonstrate the necessity for comprehensive training programs, interdisciplinary cooperation, and technology progress to augment nurses' ability to manage MCIs. The integration of telemedicine, artificial intelligence, and virtual reality simulations has surfaced as a promising strategy for enhancing catastrophe preparedness and response. The incorporation of these tools necessitates investments in infrastructure, education, and policy formulation.

This investigation underscores the need of prioritizing nurses' mental health and well-being, especially in high-stress settings. Programs like peer support, resilience training, and counseling services are vital for maintaining a competent and motivated workforce.

A coordinated effort is required by healthcare systems, policymakers, and worldwide organizations to empower nurses and guarantee their safety, effectiveness, and resilience in mass casualty incidents. By utilizing acquired knowledge and adopting creative solutions, the nursing profession may maintain a transformative role in alleviating the effects of disasters, eventually preserving lives and enhancing community resilience. Subsequent research should investigate new difficulties and optimize solutions to augment nursing's vital role in disaster management.

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دور التمريض في إدارة الحوادث الجماعية

الملخص

الخلفية

تُعد الحوادث الجماعي m (MCIs)

أحداثًا تتجاوز فيها أعداد المصابين قدرات الموارد الطبية المتاحة، مما يضع أنظمة الرعاية الصحية أمام تحديات هائلة. يلعب الممرضون دورًا حيويًا في هذه الحالات من خلال تقديم الرعاية العاجلة، إدارة الفرز الطبي، والتنسيق بين فرق الطوارئ المختلفة. تشمل هذه الأدوار إدارة الإصابات الحرجة، توفير الدعم النفسي، والمساهمة في السيطرة على العدوى في البيئات المكتظة

الهدف

يهدف هذا البحث إلى تسليط الضوء على الأدوار المتعددة التي يؤديها الممرضون في الحوادث الجماعية، مع تحليل التحديات التي تواجههم مثل ندرة الموارد، الضغوط البدنية والعاطفية، والمخاطر الأمنية. كما يستعرض المقال استراتيجيات لتحسين كفاءة التمريض في إدارة هذه الحوادث من خلال التدريب، الابتكار التكنولوجي، ودعم الصحة النفسية

الطرق

يقدم المقال مراجعة متكاملة للأدبيات الحديثة حول التمريض في الحوادث الجماعية، مع التركيز على تطبيقات عملية مثل نموذج الفرز الطبي واستخدام التكنولوجيا مثل الطب عن بُعد والذكاء الاصطناعي. كما يتم تحليل دراسات حالة مثل استجابة التمريض لإعصار كاترينا، (START) جائحة كوفيد-19، والعمل في مناطق النزاعات

النتائج

يوضح البحث أن التمريض هو العنصر المحوري في نجاح إدارة الحوادث الجماعية. تظهر دراسات الحالة نجاحات مثل استخدام الوحدات الطبية المتنقلة، وأهمية التدريب القائم على المحاكاة. ومع ذلك، يواجه التمريض تحديات كبيرة تشمل الأخلاقيات المهنية والضغط النفسي

الخلاصة

يعكس التمريض في الحوادث الجماعية التحديات والفرص في آن واحد. يشير البحث إلى أن الاستثمار في التدريب، تطوير السياسات، وتوفير الدعم النفسي من العوامل الأساسية لتعزيز دور التمريض في الكوارث. يلزم المزيد من البحث لتطوير استراتيجيات مستدامة تضمن كفاءة التمريض في مواجهة الأزمات

الكلمات المفتاحية

الحوادث الجماعية، التمريض، الفرز الطبي، إدارة الكوارث، الصحة النفسية، الابتكار التكنولوجي، دعم الطوارئ