Surgeons' Roles and Responsibilities in Disaster and Public Health Emergency Management—A Transition from Multitasking Surgeons to a Collaborative Surgical Approach

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AIM: Surgeons have historically played critical roles in disaster management, particularly as military and trauma specialists. However, the role of surgeons in disasters has changed over time, with advancements in medical knowledge and disaster response capabilities. Recent public health emergencies and global events have signaled a paradigm shift, emphasizing the necessity of cross-disciplinary, transdisciplinary, and multidisciplinary approaches. This shift calls for revisiting and reevaluating surgeons' roles and responsibilities.
METHODS: In this narrative review, the literature concerning the roles and responsibilities of surgeons during disasters and public health emergencies was systematically searched and mapped. This streamlined process aimed to gather high-quality information typically found in a systematic review but within a shorter timeframe. The goal was to expedite the discovery of insights that could inform policy decisions or address urgent matters related to the study's topic. Furthermore, action research was performed to strengthen the paper's methodology, capture essential literature, and avoid missing important data.
RESULTS: The results indicate a change in surgical specialty and a shift in the paradigm from multitasking surgeons to a multidisciplinary approach in surgical disaster management. Current educational initiatives are insufficient, and training opportunities are lacking, indicating the need for novel educational initiatives, simulation training, a collaborative surgical approach, and a reevaluation of the current curriculum.
CONCLUSIONS: The study outcomes aim to guide future policy development and facilitate the creation of practical guidelines for disaster and public health emergency planners at local, regional, national, and international levels. Surgeons' future roles in disaster and public health emergency management will be characterized by innovation, collaboration, and a commitment to improving outcomes for affected populations, addressing the unique challenges of disasters, and strengthening healthcare systems globally.

Keywords: disaster; responsibility; role; surgeon; public health

Introduction

Tracing the history of disaster medicine is as challenging as defining "disaster" itself. It seems to have multiple origins and parallel developments rather than a single linear past [1]. Historically, the military has handled large disaster responses, a role they still play today, especially in prolonged overseas missions. However, modern disaster response and medical care are typically managed collaboratively by civilian or governmental organizations, many of which have military origins [2]. During the early years of disaster management, the focus was on the consequences of war and natural hazards, particularly physical injuries and infectious diseases [2, 3]. Consequently, surgeons have played a crucial role in disaster management both in the field and in medical care facilities.

The first surgical techniques were developed to treat injuries and traumas. Surgical diagnosis, prevention, and treatment advanced significantly during the Industrial Revolution. Early techniques included suturing wounds, amputations, and cauterizing injuries, with practices like using saltpeter and sulfur [4, 5]. Trepanation, the oldest surgical procedure, addressed intracranial emergencies, and ancient practices like bloodletting were prevalent [4, 5]. The Sumerians developed key medical techniques, and the Code of Hammurabi regulated surgical practices. Imhotep authored the first known surgical essay, Avenzoar conducted the first recorded tracheotomy, and Rogerius Salernitanus laid the groundwork for Western surgical manuals [6, 7].

In Europe, barber surgeons conducted procedures [2, 4]. Guy de Chauliac's "Chirurgia Magna" became a standard surgical text. Andreas Vesalius transformed the understanding of human anatomy, while Ambroise Paré revolutionized wound treatment [5]. Wilhelm Fabry recommended innovative surgical techniques, and John Hunter's empiri-

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cal approach advanced surgical knowledge, inspiring Benjamin Bell, Scotland's first scientific surgeon. Astley Paston Cooper achieved the first successful abdominal aorta ligation, and James Syme pioneered surgical procedures [6]. Antonius Mathijsen's invention of the Plaster of Paris cast revolutionized fracture treatment, and the discovery of modern anesthesia transformed surgery, allowing safer and more complex procedures [7].

Although military medicine heavily influenced disaster medical care, the exploration of disaster epidemiology and care during specific disasters created a distinct specialty. The evolution of emergency preparedness, disaster management, and disaster medicine is closely linked. While disaster management has existed since the formation of communities, modern disaster medicine emerged alongside advancements in medical science, with significant contributions from military practices [1, 5, 7]. Key developments include the 1790s triage system by Baron Dominique Jean Larrey, WWII rapid evacuation and field surgical care, and the establishment of disaster medical assistance teams (DMATs). Major pandemics, civil defense programs during the Cold War, increasing impacts of natural hazards, and the development of Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) response and humanitarian assistance have all shaped disaster medicine [6, 7, 8].

DMATs, which started on military installations, expanded their focus post-Tokyo attack to include responses to weapons of mass destruction (WMD), leading to specialized teams within the national disaster medicine system. Since then, they have significantly contributed to disaster responses, including major incidents such as 9/11 and Hurricane Katrina [8]. In most countries, disaster response involves local and state agencies, with hospitals having 72-hour in-house capabilities. Coordinating these diverse assets remains challenging and is often managed by state health departments or emergency agencies using advanced technologies, emphasizing the need for surgical team involvement at several levels [8, 9].

Although the significant role of surgery and the responsibility of surgeons have been justified and well-defined in the past, increasing urbanization, coastal population shifts, and climate change are likely to escalate disaster impacts with new scenarios, making surgeons' roles more complex. Effective overseas disaster response, requiring swift deployment and robust coordination, poses additional challenges, though improvements in technology and transportation offer novel solutions. This new era, suggesting new hazards, necessitates a multi-professional approach to disaster management to address the necessary elements of surge capacity, i.e., 4S, comprising Staff, Stuff, Space, and System [10]. It also mandates a new round of discussions about the role and responsibility of surgeons in disaster management locally, regionally, nationally, and internationally. This is particularly true when the old-fashioned multidisciplinary surgeons rarely exist, and there seems to be a gap in the training of surgeons participating in emergency health missions at home and abroad compared to the expected scope of practice during these missions. This gap was especially evident in subspecialties such as obstetrics, orthopedics, urology, and neurosurgery, underscoring the need for surgeons on these missions to have broad-based training that includes common surgical procedures encountered in disaster settings [11, 12].

Acquiring these life-saving skills will improve mortality and morbidity outcomes and ensure that surgeons from high-income countries only perform procedures for which they are adequately trained, maintaining ethical standards [11, 12]. Similarly, at national hospitals, sub-specialization has heavily influenced the outcomes of emergency surgery, making emergency surgical procedures risky in some patient groups, especially in trauma surgery, due to the insufficient experience and skills of responsible surgeons [12, 13].

Having these challenges in mind, this paper aims to investigate the roles and responsibilities of surgeons during disaster and public health emergency (DPHE) management. It seeks to initiate a discourse on how collaboration between different surgical sub-specialties and with other non-surgical specialties may help to overcome these challenges. This study evaluates the breadth and depth of literature on the role and responsibility of surgeons in the DPHE response chain, providing an overview of the volume and focus of available studies and offering insights into emerging evidence.

Methods

Study Design

The study used a mixed method design, beginning with a systematic search following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [14]. An initial search was conducted to estimate the number of published articles based on specific research questions and keywords. The review aimed to answer the following research questions:

What are the roles and responsibilities of surgeons during DPHE management, and what can be expected of them in the collaborative management of DPHEs?

The results yielded a limited number of publications, preventing an in-depth, quantitative, and qualitative analysis of the findings. Consequently, the systematic search results were used to conduct a narrative review to summarize and interpret the current state of knowledge on the role of surgeons in DPHE management. Unlike systematic reviews or meta-analyses, narrative reviews are more qualitative and descriptive [15]. The study was further complemented by an "Action Research" approach to avoid missing significant data and important studies and to strengthen the scientific value and rigor of the study. This research method aims to investigate and solve an issue simultaneously [16].

The systematic search and Action Research method started on April 29, 2024, and was finalized on May 29, 2024. The paper was drafted, edited, and submitted on June 2, 2024. The systematic search was reported using the PRISMA checklist to increase the transparency of the search method and results (**Supplementary Material**) [17]. The level of evidence for each paper was evaluated using the suggested reporting list for narrative reviews, i.e., the Scales for the Quality Assessment of Narrative Review Articles (SANRA) [18].

Search Words

The search words: Disaster, Public Health, Responsibility, Role, and Surgeon, were used in isolation or in combination. Following the first word, other words were added until a manageable result was obtained.

Search Engines

The following databases: PubMed, Scopus, and Web of Science were used to search for available literature.

Search Strings

The following search strings: "Surgeon", "Responsibility", "Role", "Disaster", and "Public health", were used in each database separately by entering each word in a step-by-step procedure to obtain the highest number of articles, combining them with AND, and isolating them by "search word".

Inclusion Criteria

Studies encompassing the search words and discussing surgeons' responsibilities and roles during DPHE were included, with no time limitation, and in English.

Exclusion Criteria

Studies, proceedings, books, and book chapters that did not encompass the search words, did not discuss the topic, or were in other languages than English were excluded.

Study Eligibility

Studies were eligible for inclusion if they were reviews or original articles discussing the roles and responsibilities of surgical specialties during DPHEs.

Review Process

The abstract of each article was reviewed initially to obtain an overview of the compiled studies. Dubious publications were sent to a second review round, where the whole manuscript was reviewed, considering the inclusion or exclusion criteria of the study. To avoid missing any important publications, the reference lists of included papers were also reviewed, and relevant studies were added for the final review.

Reporting the Level of Evidence

SANRA is used to rate the quality of the narrative review article, using categories 0–2 freely to imply the general low and high quality of the evidence (https://www.aerzteblatt.de/down.asp?id=22862). In this article, the evidence levels are presented as High (10–12), High–Medium (7–9), Medium (6), Medium–Low (4–5), and Low (0–3) points.

Results

The search string for all search engines ended with "Disaster", since the addition of "Public Health" did not yield any new articles but reduced the number of papers on the list of obtained studies. The initial search resulted in 13 articles: PubMed (n = 2), Scopus (n = 10), and Web of Science (n = 1). Among these, three papers were duplicates, and four were deemed irrelevant. The remaining six papers were included after a thorough evaluation. Additional papers (n = 4) were found to be relevant from the reference lists of the included papers. Table 1 (Ref. [19, 20, 21, 22, 23, 24, 25, 26, 27, 28]) shows a summary of the 10 included papers, and Fig. 1 (Ref. [14]) illustrates the selection process in this study.

The literature on surgeons and their responsibilities in disaster management is limited. In this study, an action research strategy was employed, examining other sources, such as the reference lists of included papers, to increase the number of included papers.

The review of these studies indicates that effective management of disasters requires a coordinated, multidisciplinary approach involving various specialties, extensive training, and the integration of surgical and disaster planning to enhance resilience and response capabilities globally [19, 20, 21, 22, 23, 24, 25, 26, 27, 28].

Over the past century, surgeons have increasingly contributed to disaster responses worldwide through domestic disaster and trauma management, humanitarian missions, and global surgical activities. Multidisciplinary surgeons are uniquely qualified to participate in all aspects of disaster medical response, beyond just surgical operations [19, 20, 21]. Regrettably, due to sub-specialization within surgery, multidisciplinary surgeons are rarely found today. Differing specialties and the lack of training and experience in managing various injury types are core concerns in national and humanitarian emergency plans [20, 21].

In recent decades, the demands of disaster relief have evolved significantly, with changes in the types of threats, the scope of medical care, and the areas of operation. Previously, wars and natural hazards were the primary mass casualty incidents requiring surgical teams. However, surgeons are now increasingly involved in responding to public health emergencies and man-made disasters, including technological accidents and terrorism [19, 21]. Their ability to navigate missions and manage resource-limited events by adapting to the Hospital Emergency Incident

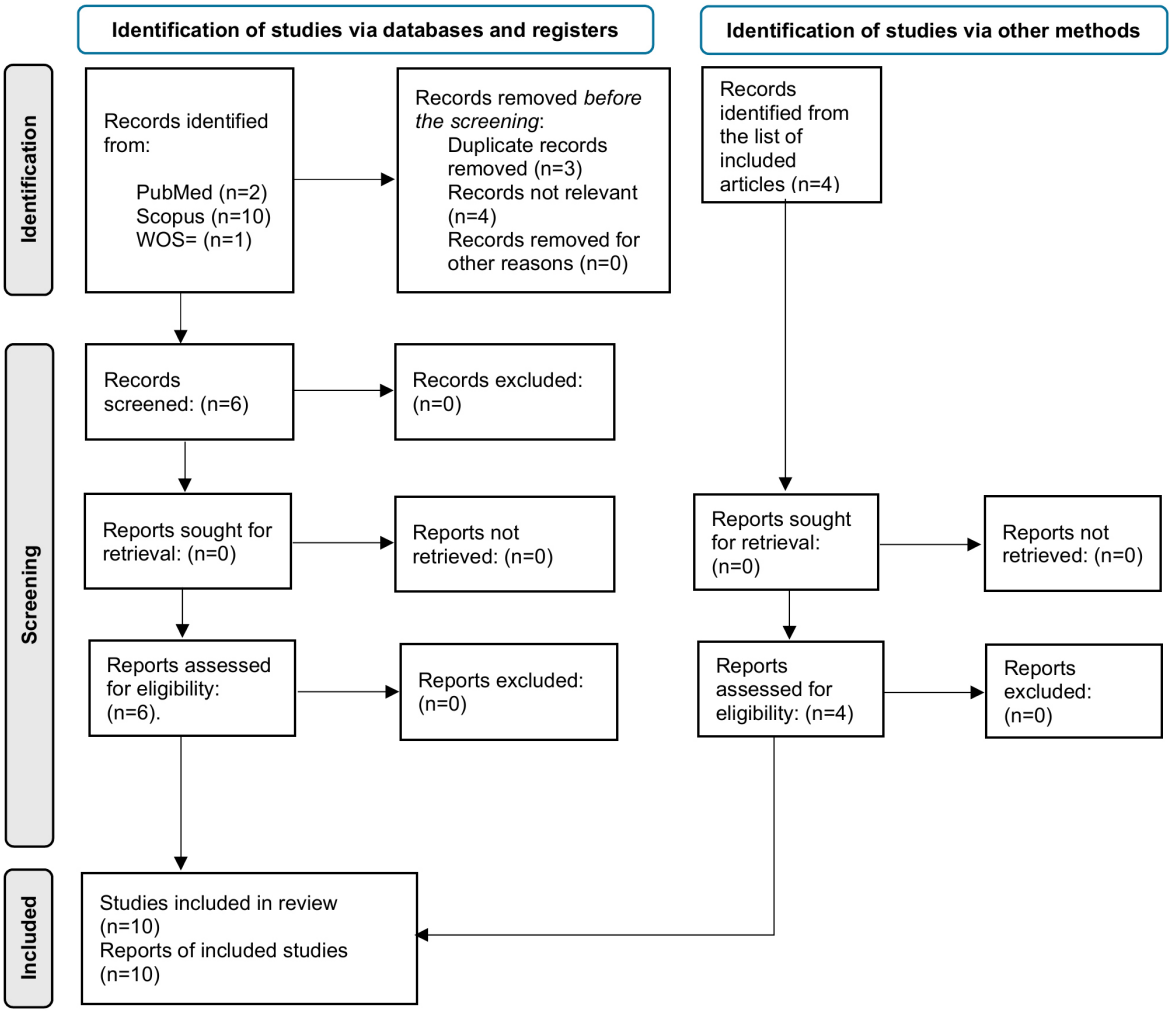

Fig. 1. PRISMA 2020 flow diagram for new systematic reviews, including searches of databases, registers, and other sources [14]. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Command System (HICS) highlights surgeons' leadership skills within hospital and prehospital structures, mass casualty management, and triage [19, 20].

There are notable differences between the surgical impacts of disasters caused by man-made or natural hazards. In the former, healthcare infrastructure usually remains intact, and surgical resources are already in place with clear goals [21]. In the latter, however, affected areas often lack the necessary infrastructure, requiring surgical resources to be brought in, with goals varying based on the timing of intervention. In the immediate aftermath, international surgical teams aim to support local efforts, increase capacity, and provide resilience. Over weeks to months, the focus shifts to rehabilitation, specialized surgical care, training, and long-term needs assessments. Thus, surgical missions have more diffuse and evolving goals in disasters induced by natural hazards than in man-made incidents, although the demands on leadership and skills remain high [20, 21].

Hazards and disasters induced by different hazards significantly contribute to human death and suffering, worsening health inequalities and burdening vulnerable populations. Robust local health systems can mitigate this impact by managing the surge in patient volume and complexity post-disaster. This resilience depends on pre-disaster surgical capacity, particularly in trauma, neurosurgical, obstetrical, and anesthesia care. A coordinated approach to surgical and disaster policy is necessary for an effective response during a disaster, as only local surgical systems can provide adequate disaster care globally [22].

Nevertheless, individual skills, knowledge, willingness to act, and perception of individual and collective responsibilities are important factors when facing a disaster. As demonstrated during the 2015 Paris attacks, urologists' expertise in visceral surgery was critical for performing damage control (DC) surgery. Additionally, their clinical knowledge mandates them to coordinate the response process at each stage [23]. Another example is the role of plastic surgeons in limb reconstruction during Mass Casualty Incidents, which emphasizes the need for preparedness across all specialties and the multi-professional nature of disaster management [24].

Table 1. Summary and outcomes of the included papers identified through the systematic search.

No.	Author, journal, date	Title/type of study	Main outcomes	Level of evidence
1	Passantino *et al*. [28], Revue Scientifique et Technique (International Office of Epizootics). 2003; 22: 909–914.	The veterinary surgeons in natural disasters: Italian legislation in force. Narrative.	This paper examines the existing laws and related legislation concerning the Italian National Service of Civil Protection, which aims to safeguard life, property, settlements, and the environment from natural disasters, catastrophes, and calamities through a multiagency approach. The President of the Republic's Decree includes veterinary surgeons among those expected to respond to natural disasters. Veterinary surgeons must respond promptly to restore proper animal health conditions. They must assess whether they can manage the emergency independently or require external assistance. Natural disasters present a series of distinct emergencies, each necessitating specialized interventions. While public health issues can be identified, the priorities for intervention may vary. Effective management relies on immediate action, the practitioners' expertise, and the ability to coordinate efficiently.	High–Medium.
2	Cherian *et al*. [26], World Hospitals and Health Services. 2004; 40: 24–29.	Essential emergency surgical, procedures in resource-limited facilities: a WHO workshop in Mongolia. Narrative.	A WHO 'Training of Trainers' workshop on essential emergency surgical procedures was organized in collaboration with the Ministry of Health, Mongolia, in partnership with several surgical and non-surgical specialties. Participants emphasized the importance of partnerships in supporting national initiatives for emergency, and surgical care through training and education. Key strategies included: (1) Implementing best practice guidelines and education, (2) Training in the use of universal precautions, and (3) Reducing unnecessary blood transfusions, especially in trauma and pregnancy-related complications, by minimizing blood loss using surgical and anesthetic techniques, assessing and treating anemia, and using intravenous fluids.	Medium.
3	Ryan. [21], Scandinavian Journal of Surgery. 2005; 94: 311–318.	Natural disasters: The surgeons' role. Narrative.	There are distinct differences in the impact of surgical interventions between disasters caused by man-made incidents and those caused by natural hazards. In man-made mass casualty incidents, surgical resources are usually already in place with clear goals. In natural disasters, surgical resources must be brought in, and goals vary based on the timing of intervention. Initially (days), international surgical teams aim to support local efforts, increase capacity, and provide resilience to degraded medical assets. Over weeks to months, priorities shift toward rehabilitation, specialized surgical care, training, and conducting long-term needs assessments. Surgical missions in natural disasters have more diffuse and evolving goals compared to those in man-made incidents. There are two phases in the response timeline: an initial rapid assessment and deployment of teams (days), followed by a secondary assessment to address long-term needs (weeks). This article provides an overview of the principles and practices for surgical responses to major natural disasters, highlighting evidence-based examples of effective international surgical interventions.	High–Medium.
4	Ciraulo *et al*. [20], The Journal of Trauma. 2006; 60: 1267–1274.	An update on the surgeon's scope and depth of practice to all hazard's emergency response. Narrative.	The surgeon's role in responding to mass casualty incidents (MCIs) is multifaceted, addressing threats and injuries from natural, unintentional, and intentional disasters. Surgeons must actively engage in community preparation, training, planning, and executing MCI responses. The Joint Commission on Accreditation of Healthcare Organizations mandates hospitals to adopt the Hospital Emergency Incident Command System, highlighting the leadership role of surgeons within hospital structures. Surgeons play a critical role in mass casualty management and triage. Their clinical response to victims of weapons of mass destruction (WMD) varies, with surgical intensivists and infectious disease specialists crucial in biological attacks. Chemical and radiation events demand surgeons' expertise in managing burns, trauma, and physiological issues. Recent events have underscored the growing role of surgeons in MCI and disaster management, emphasizing the importance of trauma systems. Integrating Public Health departments and the Department of Homeland Security with existing trauma systems is essential for effective responses to terrorist threats.	High.

Table 1. Continued.

No.	Author, Journal, Date	Title/Type of study	Main outcomes	Level of Evidence
5	Chokshi *et al*. [25], American Journal of Disaster Medicine. 2008; 3: 5–14.	Disaster management among the pediatric surgeons: preparedness, training, and involvement. Survey study.	This study suggests that pediatric surgeons have an undefined role in disaster management. It aims to determine pediatric surgeons' experiences, preparedness, willingness, and availability to participate as first receivers during disasters. The results indicated that most pediatric surgeons feel unprepared and require more training for disaster response. Current training methods may not effectively build a willing and prepared pool of first receivers. Those with prior disaster experience felt four times more prepared, and individuals in defined leadership roles felt twice as prepared and nearly five times more willing to respond. Other factors predicting willingness included contractual agreements to respond, combat experience, and prior disaster experience. These results were statistically significant.	High–Medium.
6	Kaplan *et al*. [27], Prehospital and Disaster Medicine. 2012; 27: 583–588.	Ethical considerations in embedding a surgeon in a military or civilian tactical team. Narrative.	Designed initially for individuals trained as police officers and paramedics, Tactical Emergency Medical Services (TEMS) provide immediate medical support within the inner perimeter of Special Weapons and Tactics (SWAT) team operations. However, TEMS now increasingly includes physicians and paramedics who may not have police training. This report examines the ethical considerations of integrating surgeons into military or civilian tactical teams, focusing on issues such as identity, ethical actions, triage, responsibilities, training, certification, and potential future enhancements of the Tactical Police Surgeon (TPS) role. The outcomes show that the role of the TPS is complex, guided by ethical principles, and often influenced by safety and physical location concerns. While standard triage rules generally apply, the bond between a TPS and the tactical team may appropriately influence triage decisions in special circumstances. Further refinements in TPS training and certification could enhance their support for tactical teams and their contributions to the forensic aspects of team activities.	Medium.
7	Briggs. [19], Journal of the American College of Surgeons. 2017; 225: 691–695.	Responding to crisis: Surgeons as leaders in disaster response. Narrative.	Over the past century, surgeons have increasingly contributed to disaster responses worldwide. Multidisciplinary surgeons are uniquely qualified to participate in all aspects of disaster medical response, beyond just surgical operations. The demands of disaster relief have evolved significantly, with changes in the types of threats, the scope of medical care, and the areas of operation. Previously, wars and natural disasters were the primary mass casualty incidents requiring surgical teams. Now, surgeons are increasingly responding to man-made disasters, including technological accidents and terrorism.	Medium–Low.
8	Pyda *et al*. [22], BMJ Global Health. 2019; 4: e001493.	Towards resilient health systems: opportunities to align surgical and disaster planning. Narrative.	Natural disasters significantly contribute to human death and suffering, exacerbating pre-existing health inequalities and burdening vulnerable populations. Robust local health systems can mitigate this impact by managing the surge in patient volume and complexity post-disaster. This resilience hinges on pre-disaster surgical capacity, particularly in trauma, neurosurgical, obstetrical, and anesthesia care. However, the disaster management and global surgery communities have not coordinated the development of surgical systems in low- and middle-income countries (LMICs) with disaster resilience in mind. The authors argue for a coordinated approach to surgical and disaster policy to ensure an effective peri-disaster response, as only local surgical systems can provide adequate disaster care in LMICs. Three key opportunities for policy collaboration are highlighted: (1) Both the Lancet Commission on Global Surgery and the Sendai Framework for Disaster Risk Reduction advocate for strengthening health systems in LMICs, despite having independent roadmaps, (2) Integrating surgical and disaster planning is crucial. Disaster risk reduction plans should explicitly recognize the role of surgical systems in disaster preparedness and pre-emptively identify deficiencies. National Surgical, Obstetric, and Anesthesia Plans can then address these gaps to enhance disaster resilience, and (3) The recent momentum for national surgical planning in LMICs provides a political opportunity to integrate surgical policy with disaster risk reduction strategies.	Medium.

Table 1. Continued.

No.	Author, Journal, Date	Title/Type of study	Main outcomes	Level of Evidence
9	Crystal *et al*. [24], Plastic and Aesthetic Research. 2019; 6: 1.	The role of plastic surgeons in extremity reconstruction following mass casualty incidents. Review.	This is a review of the literature, including institutional experience with the 2013 Boston Marathon Bombings, the 2015–2016 Terror Attacks in Ankara, and the 2010 earthquake in Haiti, assessing extremity reconstruction following MCIs. It shows that an effective response requires the quick mobilization of emergency medical staff and hospital activation. It also highlights the nature of extremity wounds in MCIs and the critical reconstructive role of plastic surgeons in the multidisciplinary management of trauma, especially in limb reconstruction. Limb salvage is often possible and preferred following disasters.	High–Medium.
10	Savoie *et al*. [23], Progres en Urologie. 2021; 31: 1039–1053.	The urologist confronted with a mass killing. Review.	Following the Paris attacks in 2015, the French hospital system had to adapt to handle mass casualties, particularly those with hemorrhagic shock. Experience shows that the first wave of casualties often goes to the nearest medical facility, regardless of its suitability. Therefore, any surgeon, including urologists, must be prepared for such crises due to the unpredictable nature of terrorist attacks. In a mass casualty event, a urologist's visceral surgical expertise is critical for applying damage control (DC) at each stage. Responsibilities include: (1) Coordinating role, if the urologist is the most experienced surgeon available and (2) Damage Control Surgery, focusing on speed and efficiency without performing primary reconstruction. The goal is to stabilize the patient by controlling bleeding and urine leaks quickly, allowing for faster transfer to intensive care, (3) Assisting in the stabilizing measures in the intensive care unit, and (4) Definitive surgical management–once the patient is physiologically stable, urologists need to be prepared to take on various roles such as sorting, organizing, or performing technical procedures during mass casualty events to manage hemorrhagic injuries effectively.	Medium.

WHO, World Health Organization.

A 2008 study suggested that pediatric surgeons often feel unprepared for disaster management and require more training. Those with disaster experience felt significantly more prepared and willing to respond, indicating the importance of knowledge, skills, and training [25]. The outcomes of the latter study confirm the findings of another study reported from a World Health Organization (WHO) 'Training of Trainers' workshop in Mongolia, which emphasized the importance of training and partnerships in supporting national emergency and surgical care initiatives through education [26]. Finally, Tactical Emergency Medical Services (TEMS) increasingly include physicians and paramedics without police training. The role of a Tactical Police Surgeon (TPS) has proven to be complex, guided by ethical principles, and influenced by safety and location concerns. Further refinements in TPS training and certification could enhance their support for tactical teams and their contributions to the forensic aspects of team activities [27].

The multidisciplinary management of disasters should involve various specialties and professionals, potentially creating legal issues and limitations [10]. In Italy, a presidential decree includes veterinary surgeons among those expected to respond to disasters, highlighting the need for immediate action and coordination. Veterinary surgeons must respond promptly to re-establish proper animal health conditions. They must assess whether they can manage the emergency independently or require external assistance. Such situations present a series of distinct emergencies, each necessitating specialized interventions [28]. While veterinary professionals may identify public health issues, the priorities for intervention may vary. Effective management relies on immediate action, the practitioners' expertise, and the ability to coordinate efficiently. Although veterinarians' responsibility might be clear, veterinary surgeons may find themselves in situations where their knowledge and skills could be used more effectively if legally possible.

Discussion

From a global perspective, disasters and public health emergencies, regardless of their cause, affect all medical disciplines and necessitate diverse activities and approaches within the surgical field. The ever-changing nature of disasters results in the recognition of new hazards, requiring strategies beyond the existing physical management of disasters. These scenarios may change the roles and responsibilities of all healthcare staff, including surgeons [1, 9, 10, 11, 12]. This study highlights gaps in the educational and organizational systems, requiring novel solutions to achieve optimal capacity surge in one of the most important elements of surgical surge capacity, i.e., the surgical staff.

Humanitarian emergencies, disasters, conflicts, and complex emergencies pose major threats to global health security. Recent literature highlights the complex public health consequences of these events, including physical and emotional trauma, increased morbidity, and mortality from chronic and infectious diseases. Disasters affect population numbers, health status, and lifestyle, causing deaths and severe injuries. Specifically, they increase the risk of infectious diseases, damage health facilities and water systems, and result in food shortages and population displacement. Consequently, these effects require a broad spectrum of medical professionals, irrespective of disaster etiology, directly or indirectly influencing the surgical discipline before, during, and after an incident [29, 30]. This calls for preparedness and a change in the disaster response paradigm within the surgical specialty.

Within national contexts, surgeons are rarely involved in disaster and public health management outside a hospital unless they are present at the incident site. However, within a medical facility, they can be involved in planning and executing responses to incidents at several levels, together with other specialists from anesthesiology and emergency medicine. While their involvement at the incident site follows larger prehospital planning and structure, their triage and surgical skills are paramount for positive outcomes during events in the hospital setting. They navigate diverse activities such as referrals and outpatient clinics, elective surgery, cancer treatment, emergency surgical care, management of postoperative complications, and the dynamics of the surgical team [23, 31, 32].

The current surgical sub-specialization has left few, if any, multidisciplinary surgeons [11, 12, 13]. Although emergency, trauma, and disaster surgeons nowadays often show full commitment and high morale during emergency events, they may be unable to handle the situation alone and need help from other surgeons. Unfortunately, other sub-specialists within the surgical discipline often lack the necessary skills and experience to handle physical and traumatic outcomes of emergencies [23, 24, 25, 26, 33, 34]. Consequently, they cannot help their colleagues, who are then left to handle a high number of injuries alone. This highlights the insufficiency of the current educational and organizational structures, necessitating novel solutions.

In addition to these shortcomings, the last decades of disasters, conflicts, and especially the Coronavirus disease 2019 (COVID-19) pandemic have underscored the need for collaborative approaches to hazardous incidents. Hence, all physicians should be prepared for disasters and emergencies due to the necessity of responding to all-hazard emergencies [20, 24, 33]. Besides urologists, pediatric surgeons, and plastic surgeons, other sub-specialists can also help contribute to disaster and emergency management with their skills and knowledge. Vascular, gastrointestinal, orthopedic, and transplantation surgeons all possess valuable expertise for emergency management [20, 21, 33, 34]. However, they need educational initiatives and collaboration exercises to harmonize their knowledge and skills with the rest of the response chain actors.

Table 2. Recommendations to clarify the role of surgery in disaster and public health management strategies.

No.	Recommendation
1	Recognize the need for disaster and public health education for all specialties.
2	Incorporate disaster and public health knowledge in medical schools and allied medical specialties at the early stage of education.
3	Recognize the roles and responsibilities of surgeons in disaster and public health emergencies by integrating surgical and disaster planning to preemptively identify deficiencies.
4	Facilitate collaboration between partners, at the highest level, such as the Lancet Commission on Global Surgery and the Sendai Framework for Disaster Risk Reduction. This offers a political opportunity to integrate surgical policy with disaster risk reduction strategies.
5	Facilitate collaboration between and within different specialties and sub-specialties.
6	Create guidelines outlining the roles and responsibilities of experienced surgeons, irrespective of sub-specialization (coordinating, leadership, working in intensive care units, triage, emergency department activities, etc.).
7	Initiate educational initiatives and simulation exercises to familiarize sub-specialists with disaster and emergency surgical approaches, such as Damage Control Surgery, focusing on speed and efficiency without primary reconstruction, aiming to stabilize the patient quickly.
8	Initiate educational initiatives and simulation exercises to inform different specialties of each other's limitations and possibilities during emergencies.
9	Clarify legal and ethical aspects of disaster management, supporting the engagement of different specialties in disaster and public health emergency management.
10	Promote discourse on local, regional, national, and international levels about multiagency, transdisciplinary, and collaborative approaches to disaster and public health emergency management.

One way to share knowledge and gain more experience in surgical skills is through global exchanges between diverse institutions and nations However, the lack of experience and knowledge among surgeons has significant global implications. Emergency general surgical care carries a tremendous global burden of death and disability, surpassing many other health issues. Nearly 1 million deaths annually result from emergency surgical conditions, compared to 250,000 maternal deaths worldwide [35]. This burden is especially high in low- and middle-income countries (LMICs), which account for 70% of these deaths. Although there has been progress, with deaths decreasing from 15.8 per 100,000 in 1990 to 12.9 per 100,000 in 2010, the response remains inadequate, particularly in LMICs where surgical capacity is low in terms of human and physical resources and necessary processes [35].

While both developing and developed countries face challenges regarding the roles and responsibilities of surgeons in various emergencies, they need different solutions and approaches. The first step is to realize the important role of surgery within global and national healthcare systems to achieve the United Nations Sustainable Development Goals [36].

Understanding the roles and responsibilities of surgeons in mass casualty incidents and trauma is well-established, but their involvement during public health events and pandemics might be questioned. The COVID-19 experience illustrated the multi- and transdisciplinary demands of pandemic management, described as "One for all and all for one". During the COVID-19 pandemic, leadership and the Hospital Incident Command System were crucial in standardizing care protocols and patient management strategies, especially in larger hospitals with a large number of patients. Besides partaking in emergency department activities, surgical staff contributed significantly by developing protocols for line access, anticoagulation, and endotracheal tube exchange, which were critical to positive patient outcomes [32, 37]. Moreover, senior surgical residents with extensive intensive care unit (ICU) training in ventilator care, respiratory mechanics, and critical care management also helped relieve the workload of anesthesiologists [31]. This highlights the need for complementary courses in practical ICU work for surgeons globally, which would eventually benefit them in both domestic and foreign missions, especially in areas with limited resources. In preparation for COVID-19, additional refresher courses were provided, and residents were given autonomy to manage patients under close supervision, performing procedures such as central and arterial line placements with guidance from senior staff [31].

Collaborative practice among physicians improves patient and staff satisfaction while reducing length of stay, error rates, and hospitalization costs [36, 38]. Key factors for successful collaboration between surgeons and other specialties include transparent leadership, resilient residents, and community support. Despite disruptions to traditional training, a recent study showed that surgical residents gained invaluable experience in ventilator management and infectious disease protocols. This experience highlighted the importance of foundational medical knowledge and clinical observations in improving patient outcomes [31].

According to the Global Guidance for Surgical Care during the COVID-19 pandemic presented by COVIDsurg Collab-

orative, hospitals should develop pandemic plans for immediate implementation when infected cases are identified locally. These plans should include all surgical specialties and services and have plans for conducting infection control drills, including patient transfers and Personal Protective Equipment (PPE) use. Furthermore, plans should have clear instructions on reducing non-urgent activities such as outpatient clinics and non-cancer elective surgeries, while ensuring the safe continuation of urgent elective surgeries, especially for cancer patients. Additionally, hospitals should prepare for increased emergency surgical demand and potential staff absences, establish team structures to minimize infection risks, maintain a high suspicion for infectious cases in emergency admissions and postoperative complications, and arrange isolation and testing for suspected patients [32].

In the global arena, establishing an international task force or empowering agencies such as the WHO could enhance global disaster response, as evidenced by the widespread impact of the Ebola epidemic. Surgery should be recognized as a crucial global health intervention [35, 39]. Therefore, it is vital to enhance surgical capacity in low- and middle-income countries to achieve this goal. Although challenging, this goal is attainable by collaborating with providers and policymakers leading the public health movement [40]. Global health need not be a competition for resources; a unified movement can include surgery. The WHO should take the lead in advancing surgical care in global health and develop action plans to address unmet surgical needs. Enhanced political will and technological advancements are essential to mitigate the health effects of future disasters [35].

Collaboration often starts with synchronizing resources and working patterns between two partners before reaching common goals and targets. There have been few occasions, if any, like COVID-19 to test the true spirit of collaboration. Introducing the concept of flexible surge capacity, several authors have described the collaborative work between hospitals and communities [10, 40, 41].

In one study, physicians who could not work within the hospital during the COVID-19 pandemic created home isolation centers, facilitating the diagnosis, treatment, and follow-up of patients suspected of COVID-19 infection in Bangkok, Thailand [41]. Besides utilizing physicians with differing backgrounds, they employed community resources and telemedicine to relieve the eminent pressure on hospitals by following collaborative factors outlined in CSCATTT, an acronym for Command and Control, Safety, Communication, Assessment, Triage, Treatment, and Transport, used in Major Incident Medical Management and Support (MIMMS) courses [42].

Simulation exercises involving multi-agency groups, transdisciplinary professionals, and students can increase the knowledge, skills, and confidence needed to manage DPHEs [43]. The successful implementation of CSCATTT as a model in the flexible surge capacity concept has also been incorporated into other simulation exercises [44], suggesting its inclusion at the early medical education level through current technological advancement [45]. Incorporating disaster and public health knowledge in the early years of medical and allied medical school is a necessary step to increase the knowledge about disaster medicine and public health, thereby broadening the human resources for DPHE management [46, 47]. The flexible surge capacity concept also advocates using primary healthcare, veterinary, and dental clinics during DPHEs. These clinics may offer possibilities to conduct some surgical procedures, a promising solution that requires financial and legal support, as well as surgeons' involvement [10, 38, 40, 41].

Limitations

The main limitation of this study is its narrative review method conducted by one author. The planned systematic review did not result in a sufficient number of studies, resulting in a narrative review instead. However, adding an action research approach increased the number of included documents and the study's rigor. Despite being performed by one author, the narrative review still fulfills its aim of exploring the subject [15]. Future multi-author systematic reviews might result in less bias and enable a more thorough assessment of the scientific quality of the included studies. The use of the PRISMA reporting checklist aims to increase the transparency of the search procedure.

Recommendations

Table 2 offers several recommendations based on the current review, aiming to initiate a primary discourse regarding the roles and responsibilities of surgeons in DPHEs. However, these statements need further validation by experts, preferably using a Delphi method (Table 2) [19, 20, 21, 22, 23, 24, 25, 26, 27, 28].

Conclusions

In summary, the roles and responsibilities of surgeons in disaster management, if only focusing on trauma and injuries, face challenges that call for new professional and educational approaches. With the rise in public health emergencies, disaster medicine and public health education should be integrated into medical and allied health programs, including training for nurses and paramedics. Surgical residents should also be prepared to assist other specialists, such as anesthesiologists and emergency physicians. Similarly, surgical sub-specialists should collaborate with their trauma colleagues during mass-casualty incidents or pandemics.

These steps are essential for building a resilient healthcare system capable of responding to critical situations. Educational initiatives, simulation exercises, and legal and financial support are needed to achieve this resilience, applicable to major incidents and disasters at home as well as in

foreign missions and humanitarian aid. Surgeons' future roles in disaster and public health emergencies will involve innovation, collaboration, and a commitment to improving outcomes and strengthening global healthcare systems.

Availability of Data and Materials

Data to support the findings of this study are available on reasonable request from the corresponding author.

Author Contributions

AKM designed the research study, analyzed the data, wrote and revised the manuscript. The author read and approved the final manuscript. The author has participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

The author declares no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.62713/aic.3468.

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