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Hospital Disaster Preparedness: A Comprehensive Evaluation Using the Hospital Safety Index

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Abstract: Mass-casualty incidents and disaster scenarios pose significant challenges for medical facilities, necessitating robust preparedness measures. This study aimed to evaluate the preparedness of a specific medical facility in Poland, using the hospital safety index (HSI). A comprehensive analysis of structural, functional, and organizational factors was conducted, assessing facility infrastructure, technical facilities, safety standards, work organization, cooperation with external facilities, human resource management, crisis planning, and communication strategies. The facility exhibited strengths in infrastructural requirements and inter-facility cooperation. Areas of improvement included adherence to safety procedures, crisis communication, and the frequency of evacuation drills. Furthermore, recommendations were provided for enhancing nurse reserves, adopting lean management, promoting a safety culture, and refining business continuity plans. The findings should be interpreted with caution, due to the single-facility focus, potential HSI protocol subjectivity, and the possible Hawthorne effect. This study underscores the importance of continuous research and improvement in crisis management strategies and disaster-victim care, emphasizing the pivotal role of the HSI as an evaluative tool.

Keywords: hospital safety index; mass-casualty incidents; disaster preparedness; safety culture; crisis management; lean management; healthcare

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1. Introduction

Community preparedness is a pivotal factor in mitigating the scale, consequences, and impacts of disasters or states of emergency on infrastructure, health care services, and the economy [1]. A health care system, which comprises various entities from pre-hospital to hospital units, must be primed to respond immediately. This response chain necessitates a unified command, control, and the capacity for coordination and cooperation. In this chain, hospitals are integral, as they manage a high number of emergencies and conduct daily activities that could potentially diminish their readiness in a mass-casualty incident or disaster scenario.

The importance of hospitals and other health care facilities is also recognized as a key element in one of the seven global targets of the Sendai Framework for Disaster Risk Reduction 2015–2030 [2], which was adopted by 187 member states during the Third United

Nations World Conference on Disaster Risk Reduction in Sendai, Japan, in March 2015. This framework serves as the first global policy structure of the post-2015 UN program. It represents a significant stride toward consolidating global policy, with explicit references to health, development, and climate change [2]. While global efforts set the stage, regional collaborations, such as the European Union Civil Protection Mechanism, further refine and implement these strategies. Countries worldwide, including Poland, have undertaken actions to realize the objectives of the Sendai framework, tailoring its broad directives to fit their local challenges and capacities.

The global agreement, ratified by Poland, identified clear goals, including the adoption of disaster risk-reduction plans at the local level, activation of local community actions, and fostering cooperation between public administration and academia.

In the vast landscape of international healthcare, an astute comprehension of crisis management becomes indispensable. By observing the global strategies and tactics, we gain insights into the myriad ways medical establishments navigate the intricate maze of challenges that are presented by emergencies and catastrophic events. Central to this discourse is the operational resilience and safety of hospitals. Their role is not limited to the routine provision of healthcare; they become beacons of hope during tumultuous times, ensuring continuous medical support during mass-casualty incidents and disasters. Recognizing this pivotal role, the World Health Organization (WHO), in synergy with the Pan American Health Organization, has championed the cause of fostering "safe hospitals". Their joint efforts culminated in the creation of the hospital safety index (HSI) [3]. The HSI is not just another evaluative tool; it stands as a globally acclaimed benchmark for gauging hospital preparedness. By meticulously assessing hospitals, the HSI delineates the capacity of hospitals to function optimally, not only during universally understood natural calamities but also in the face of man-made disasters.

Given the universal nature of certain challenges, studying the crisis management strategies of specific countries can provide invaluable insights. Poland, with its unique blend of global influences and local challenges, serves as an exemplar in this discourse.

Global incidents such as the recent earthquake in Turkey, frequent train accidents in India and Pakistan, the fires in Hawaii, and the tragic Ariana Grande bombing in Manchester illustrate the spectrum of disasters that health care systems around the world are required to address. These events, although geographically distant from Poland, offer lessons on the preparedness, responsiveness, and resilience of healthcare institutions in diverse settings. Each of these incidents brings forth unique challenges, emphasizing the importance of a versatile and dynamic approach to crisis management.

However, even with frameworks and mechanisms in place, achieving a robust level of hospital preparedness remains a challenge. For instance, diverse factors—such as funding limitations, staff turnover, technological advancements, and evolving threats such as new infectious diseases—all play a part in a hospital's level of preparedness. Such factors emphasize the need for constant monitoring and reevaluation, requiring that tools such as the HSI be adaptable and locally relevant. Furthermore, the collaboration between hospitals, local governments, and international bodies, while beneficial, can sometimes introduce complexities. Differing regulations, cultural nuances in patient care, and variations in infrastructure standards can pose additional challenges in harmonizing preparedness efforts.

Crisis management and disaster-victim treatment have gained significant importance in Poland due to recent incidents [4]. As an active member of the European Union and various other international organizations, Poland has committed to numerous initiatives and programs for collaborative crisis management. One notable participation is Poland's involvement in the European Union Civil Protection Mechanism (EUCPM), emphasizing the nation's dedication to a unified approach in addressing emergencies.

The EUCPM plays a critical role in the European context. It acts as a nexus for coordinating disaster response activities and fosters cooperation, communication, and collaboration among member states during crises. Its primary aim is to enhance the

collective ability of Europe to respond to disasters, ensuring that aid reaches affected areas promptly and efficiently. This mechanism not only assists in direct crisis response, but also in knowledge transfer, promoting best practices and lessons learned across borders [4].

Within the Polish context, particular focus is given to the development of national crisis-management systems. This includes the creation and implementation of emergency plans for medical facilities, personnel training, and fostering cross-sector cooperation. In addition, Poland actively exchanges information, technology, and best practices related to crisis management and disaster-victim treatment with other countries.

The preparedness of hospitals to respond to mass casualties and disasters involves the prior development and implementation of actions, programs, and systems [5]. Such measures aim to ensure essential medical care for disaster victims and to minimize the negative impact of incidents on health services. In particular, such measures encompass the adequate training of medical personnel, suitable logistical security, and the validation of hospital crisis-response procedures. Assessing readiness for incidents and disasters, along with response effectiveness, can help identify and address potential gaps and weaknesses in hospital management during mass events [5].

The importance of crisis management and disaster-victim treatment in Poland has become especially evident in light of specific recent incidents [5]. First, the onslaught of the COVID-19 pandemic since 2019 dramatically tested Poland's healthcare system, emphasizing the urgency of effective crisis management and hospital preparedness. Additionally, the unusual heatwaves of 2019 added another dimension to Poland's challenges, underscoring the impact of extreme weather events on public health, particularly on vulnerable groups such as the elderly and those with chronic health conditions.

As a member of the European Union and various other international organizations, Poland has engaged in diverse initiatives and programs related to public health protection, crisis management, and response to threats. Notably, Poland is part of the EUCPM, which fosters coordinated actions in crisis situations and facilitates the exchange of information and experiences among member states [4].

Research gaps, especially in the context of Poland's healthcare system, become even more pressing when the dynamic nature of disaster preparedness is considered. Many studies have focused on immediate responses to disasters, but few have delve deeply into the intricacies of preparedness, especially in countries such as Poland, where both global influences from international agreements and local challenges coalesce. It is essential to understand not only how Polish hospitals are prepared at present, but how they can adapt and evolve in the face of both known and unforeseen challenges in the future.

Despite these demands, systematic research on the readiness of Polish hospitals and medical personnel to handle large-scale emergencies has been lacking [6]. This research deficiency extends not only to the application of the HSI, but also to the utilization of other assessment tools. To address this research gap, our study aims to explore the feasibility of using the HSI as a national tool for assessing the readiness of Polish hospitals to handle mass casualties and disasters.

2. Materials and Methods

2.1. Instrumentation

This study employed the hospital safety index, an instrument developed by the Pan American Health Organization (PAHO) and experts from the Caribbean and Latin America [3]. In line with the specific requirements of our study, we adopted a modified version of the HSI. This version, vetted by researchers from Songkla University in association with scholars from Gothenburg University, is recognized as a vital tool for assessing hospitals' operational capabilities during emergencies [7]. To cater to the unique conditions and requirements of Polish healthcare institutions, minor adjustments were made to the HSI tool. The integrity of its core principles and structure remained, to ensure a robust assessment. Details regarding the original modified HSI and our adaptations can be found in Appendix A, Appendix B, Appendix C, Appendix D.

2.2. Literature Review

- Search strategy: We initiated our comprehensive literature review by formulating a well-defined search strategy. This strategy was designed to capture the most relevant articles and publications pertaining to crisis management, HSI, and practices implemented globally in medical facilities.
- Databases and keywords: We extensively searched a range of scientific databases, including PubMed, Scopus, Web of Science, and Google Scholar. Key search terms used were "crisis management", "hospital safety index", "healthcare safety", "emergency preparedness", and "medical facility practices." Boolean operators (AND, OR) were employed to refine the search.
- Inclusion and exclusion criteria: Articles were screened based on predefined inclusion criteria: relevance to the study's objectives, articles published within the last ten years, and those available in English or with English abstracts. Excluded were articles not directly related to HSI or lacking empirical evidence, opinion pieces, and non-peer-reviewed articles.
- Data extraction: From the shortlisted articles, data pertinent to our study objectives were meticulously extracted. This involved documenting the author(s), the publication year, the primary focus or objective, the methods used, the main findings, and any recommendations or strategies discussed.
- Analysis: The accumulated data were then synthesized to identify prevailing themes, trends, and best practices in the domains of crisis management and healthcare safety. This not only informed our study's approach, but also provided a holistic view of the international stance on HSI application, contextualizing Poland's position within it.

2.3. Study Setting and Data Collection

For the purpose of this pilot study, our research, conducted in December 2022, was centered on a single medical facility in Poland. This facility was selected as it mirrored the typical challenges and requirements associated with crisis management and healthcare safety in the country. To uphold research integrity and to garner unbiased responses during the evaluation process, the identity of the hospital was kept confidential. An exhaustive assessment of this facility was conducted using the adapted HSI protocol [3], focusing on structural, functional, and non-structural facets, adhering to international benchmarks [3,8].

Note: While using a single facility may raise concerns about generalizability, as this was a pilot study, the aim was to explore the feasibility of the methodology and not necessarily to generalize findings across all hospitals in Poland.

2.4. Data Analysis

The data procured were subjected to a qualitative analysis. This involved content examination and the application of case-study methodologies to derive a profound understanding of the facility's stance [8]. The insights drawn from this evaluation illuminated the hospital's strengths and weaknesses, in line with the HSI parameters [8].

2.5. Validation

To validate our findings, we sought feedback from crisis-management experts and representatives from the surveyed medical establishment. Their insights were paramount in reinforcing the accuracy and reliability of our conclusions, ensuring that the results aligned with on-the-ground experiences and the prevalent norms in the healthcare realm.

2.6. Expert Consultation

The validation process incorporated feedback from a panel of three experts in the field of disaster and crisis management. These experts were chosen based on their extensive experience, and they played a crucial role in evaluating the data and affirming the findings' congruence with current medical practices.

3. Results

3.1. Hospital Capabilities and Disaster Readiness

An analysis of data collected in December 2022 from the selected medical facility highlighted several aspects of the hospital's disaster readiness. Some elements were found to be robustly in place, while others revealed areas for improvement. The detailed specifics of the hospital's capabilities, as of December 2022, are outlined in Tables 1 and 2.

Table 1. Overview of hospital resources and capabilities.

Hospital Capability	Middle–Level Hospital
Annual Patient Traffic	25,000–50,000
Workforce	2167 people
Medical Team	Phisicians: 594; nurses: 929; EMTs: 12; pharmacists: 26; psychologists: 13; others: 108
Supporting Team	Engineers: 92; nutritionists: 7; dressing staff: 8; daily security/traffic: 50–60; finance: 26; information staff: 3
Reserve Capability (within 12 h)	Yes
Trauma Center Level	2
Fire Wound Care Capability	Yes (in some parts—this is not a specialist fire wound hospital)
Helicopter Parking	Permanent

Table 2. Information on general capability and reserved capability of the hospital.

Department/Area	Normal Capacity (Beds)	Reserved Capacity (within 12 h)	Heart Rate Monitoring Devices	Ventilators	Negative Pressure Rooms
Hospital	50	293	67	76 (incl. transplants)	50
Emergency Room	10	16	8	2	10
General and Oncological Surgery Department	5	18	-	8	5
Injury and Orthopedic Department	10	8	-	6	10
Department of Internal Medicine	5	10	-	-	5
Department of Gynecology and Obstetrics	5	5	-	-	5
Children's Ward	-	6	-	8	-
Pediatric Intensive Therapy and Anaesthesiology	-	13	2	-	-
Intensive Therapy and Anaesthesiology Department	-	23+	33	2	-
Central Operating Route	-	20	10	-	-
Nephrology	-	14	0	11	-
Thoracic Surgery	-	9	2	4	-
Cardiology	5	31	2	1	5

Table 2. *Cont.*

Department/Area	Normal Capacity (Beds)	Reserved Capacity (within 12 h)	Heart Rate Monitoring Devices	Ventilators	Negative Pressure Rooms
Hematology	-	6	1	6 (transplant)	-
Oncology Operating Block	-	8	2	-	-
Neurosurgery	5	8	1	-	5
Radiology	-	1	4 (transport)	-	-
Impact	5	29	2	4	5
Urology	-	5	0	6	-
COVID-19	-	20	18 Airvo-2	18	-

Table 1 provides fundamental information about the hospital, including its workforce, annual patient traffic, and the various specialized teams. Additionally, it details the reserve capability of the hospital within a 12 h window, its trauma center level, its fire-wound care capability, and the availability of permanent helicopter parking.

Table 2 offers a comprehensive breakdown of the general and reserved capabilities across various departments within the hospital. This table provides information on the normal and reserved capacities in terms of bed availability, heart-rate-monitoring devices, ventilators, and negative pressure rooms across numerous specialized departments.

The hospital possesses a reserve of doctors in case of a disaster, but there is an insufficient number of nurses. Concerning crisis management, a formal mass casualty committee operates, although a designated official responsible for the crisis management is notably absent. A formal disaster management system exists, with mass-incident exercises conducted routinely. Information systems, including an official alert system, and personal protective equipment are available. However, the method of informing patients or mass-event victims is not adequately systematized. Medical products that are specifically designed for disaster scenarios are at hand, as outlined in Table 3.

Table 3. Disaster readiness and emergency response evaluation scorecard.

Category	Subcategory	Evaluation Score
Governance	Mass Casualty Incident Committee	2
	Mass Casualty Incident/Emergency Manager	2
	Hazards Vulnerability Analysis (HVA)	2
	Mass Casualty Incident Planning	2
	Mass Casualty Incident Drill/Exercise	3
	Hospital Incident Command System (HICS)	4
Finance	Financial Policy	1
Health Workforce	In-Hospital Team	1
	Assisting Emergency Medical Team (EMT)	1
Hospital Information System	Hospital Staff	2
	Infrastructure	1
	Alert System	2
	Patients/Victims Information	2
Medical Products and Technologies	Personnel Protective Equipment (PPE) and Equipment	3
	Logistic and Management	3
	Medical Stockpile	2
	Supportive Functions	1
Service Delivery	Hospital MCI Plan/Protocol	3
	Patients/Victims Care/Management	2
Participation	Coordination with Other Relevant Organizations/Agencies	2
TOTAL		42

SCORE: The current hospital emergency, MCI, or disaster management needs some improvement to provide adequate functioning during a crisis situation. The specific information in each category provided in the assessment tool also needs interventions to enable the hospital to have more readiness for MCIs and disasters.

3.2. Preparedness Checklist

Table 3 depicts a preparedness checklist, with each category and subcategory evaluated on a scoring scale. It was found that the current hospital management of emergencies, mass casualty incidents (MCIs), or disasters requires further enhancements to assure adequate functionality during such events.

3.3. HSI Impact on Facility Functioning

The study results provide detailed information about the impact of the HSI on the functioning of the investigated anonymous medical facility in Poland. Based on the HSI protocol, the analyzed aspects covered structural, functional, and organizational areas.

- Structural aspects of the HSI: The facility infrastructure mostly meets the HSI's infrastructural requirements, including access to electricity and water and the availability of medical rooms. While the facility is equipped with necessary medical and technological equipment, some of this equipment is somewhat outdated, which may affect service quality. Although the facility adheres to applicable safety standards, gaps in procedure adherence, which may increase the risk of incidents, were identified.
- Functional aspects of the HSI: The facility operates according to HSI principles in terms of work organization, but potential for improvement in the coordination between individual teams was observed. The facility maintains relations with other medical facilities and rescue services, but the analysis suggested that the information exchange and cooperation in crisis situations could be improved. Despite the staff being adequately educated and trained, there was an identified need for additional HSI training to better equip the team for crisis situations.
- Organizational aspects of the HSI: The facility has business continuity plans and crisis response procedures in place. However, these plans might be somewhat outdated, potentially hindering their effective implementation. The facility maintains constant communication with employees and other institutions, but there is room for improvement in crisis-situation communication. The surveyed facility exhibited awareness of safety culture, yet there were areas that require further development, such as conducting regular evacuation exercises and monitoring adherence to safety procedures. The introduction of additional HSI training could bolster the safety culture within the facility.

4. Discussion and Recommendations

The in-depth analysis conducted illuminates a blend of strengths and areas requiring improvement within the hospital's disaster preparedness, aligning with similar findings from previous research [7,9,10]. One critical concern is the apparent insufficient reserve of nurses available in crises, a challenge echoed in healthcare facilities worldwide [11,12]. In response, we recommend a strategic increase in the reserve of nurses who are readily available for disaster scenarios. This action aligns with the findings of several studies that emphasize the crucial role of nursing staff in a disaster response [13,14].

We propose the inclusion of regular mental health checks and the provision of psychological support services, as disasters can induce significant stress and trauma in healthcare providers. Addressing staff well-being could contribute significantly to the overall disaster resilience of the hospital workforce.

Further, we found that improving the system for informing patients or mass-event victims could significantly enhance crisis management. Communication during crises can significantly alter outcomes, ensuring timely and appropriate medical attention [15]. This is in line with research that emphasizes the crucial role of efficient communication systems in crisis management [16,17].

We noted several opportunities to improve management methods within the hospital. We propose the adoption of lean management methods. This approach, rooted in principles of waste reduction and continuous improvement and focusing on value from the customer's perspective, has proven effective in enhancing organizational efficiency

in healthcare settings [18,19]. By promoting innovative and efficient solutions over excessively controlling approaches, lean management could significantly improve the overall effectiveness of the institution.

It is important to note that the data for this study were collected from a single medical facility and that this was a pilot study to evaluate the hospital's disaster preparedness using the HSI. Given that the focus was on an in-depth analysis of a single facility, generalizing the findings to a larger set of medical facilities should be cautiously pursued.

The structural, functional, and organizational aspects of the hospital revealed potential areas of improvement. While the hospital's infrastructure met most of the 'is's requirements, the technical facilities and safety standards could benefit from modernization to enhance the quality of services and reduce potential safety incidents [20]. Similar findings were noted in studies that emphasized the influence of up-to-date infrastructure on healthcare delivery [21].

While the hospital demonstrated commendable work organization and cooperation with other facilities, improved team coordination, an enhanced information exchange in crisis situations, and additional HSI training could further optimize these operations [22,23].

Moreover, despite the hospital's business continuity plans and crisis-response procedures, their potential outdatedness may hinder effective implementation. We recommend regular updates to these plans and procedures to reflect current best practices and potential-threat landscapes, a strategy reinforced by existing literature [24,25].

Effective internal and external communication during crisis situations plays a pivotal role in managing such scenarios [26]. Investing in communication training and tools could vastly improve the timeliness and efficacy of information flow, aligning with the findings of numerous studies that highlighted the importance of effective communication in crisis management [27,28].

Fostering a safety culture within the hospital is another crucial area that requires attention. The regular conduct of evacuation exercises, continuous monitoring of adherence to safety procedures, and additional HSI training could significantly enhance the safety culture [29,30]. In multiple studies, the development of a safety culture has been shown to positively impact patient outcomes and staff satisfaction [31,32].

From a financial perspective, a reconsideration of the current funding model could have substantial benefits. We suggest separating the financing of hospital operations from staff financing, together with introducing a more stable source of funding for disasters and MCIs. This method of resource allocation could lead to an elevated quality of care, aligning with findings from recent research [29,33].

The strengthening of the role of the facility's mass-casualty-incident committee and the appointment of a crisis-management individual could ensure a more streamlined and coordinated response to crises [34].

Conducting regular exercises related to mass incidents could be instrumental in maintaining high readiness levels among medical and managerial staff [5,35]. Such exercises offer practical experience and prepare personnel for real-world crisis scenarios, a practice supported by existing research [36].

Collaboration with other medical facilities, rescue services, and local authorities is an important focus area, with collective efforts leading to the development and implementation of comprehensive action plans for disaster scenarios [37,38].

In terms of international cooperation in crisis management and disaster-victim care, integrating with international networks of hospitals and medical facilities could aid in the development of new strategies and procedures [39,40].

On the technological front, developing and implementing modern technologies and information systems could improve coordination and the efficient use of available resources and diagnostic tools during MCIs and disasters [41,42].

The implications of our findings reach beyond the singular Polish medical institution studied. Hospitals globally, regardless of their size or location, can benefit from our detailed insights into disaster preparedness and the profound impact of the human factor in crisis

management. The present research underscores the importance of periodic preparedness assessments, staff training, and the continual updating of procedures to reflect the latest best practices and challenges.

Furthermore, the dynamic landscape of healthcare, characterized by rapid technological advancements, regulatory shifts, and unpredictable global challenges, requires hospitals to be agile and forward-thinking [43]. Our findings can serve as a reference point for institutions worldwide, emphasizing the balance between technological advancements and the core human values of clear communication, responsibility, and duty.

Future studies could explore the integration of digital solutions, such as AI and machine learning, into disaster-preparedness assessments. A comparative analysis of different preparedness protocols across various geographical regions could yield insights into best practices, tailored for specific local challenges. Moreover, an investigation of the long-term impacts of regular staff training on patient outcomes and staff morale during crises might be worthwhile. Such research directions would not only build upon our study, but also open doors globally to more holistic and efficient disaster-management strategies for healthcare institutions.

Apart from the HSI, other evaluation tools such as the Hospital Preparedness Assessment Tool (HPAT) and the Emergency Management Program Guidebook for Hospitals have also shown promise in assessing hospital preparedness. Future research can consider using a combination of these tools to provide a more comprehensive assessment of hospital readiness [44,45]. Additionally, the inclusion of digital platforms, like data analytics software or machine learning algorithms, may help in automatic and rapid data analysis, identification of patterns, and provision of actionable insights.

Highlighting the value of interdisciplinary collaboration and learning within the hospital is crucial. By incorporating diverse professional insights—from nurses, physicians, paramedics, and administrative staff—the disaster-preparedness strategy could be more comprehensive and effective.

While this study provides insights into the disaster preparedness of a single medical facility, it is crucial to view it as a pilot endeavor. To reach more comprehensive conclusions, larger-scale studies encompassing multiple facilities are recommended.

Finally, the HSI, as a rapid and inexpensive diagnostic tool, can provide valuable insights into a hospital's preparedness for emergencies and disasters, a sentiment echoed in prior research [46,47].

In conclusion, continuing research in the fields of crisis management and disaster-victim care is essential to identify new challenges and to develop innovative solutions enhancing hospital operations during crises. The readiness of hospitals in disaster scenarios is a critical factor in safeguarding public health and can significantly contribute to saving lives and reducing the impact of such disasters on communities.

5. Limitations

While this HSI study yielded valuable insights into the analyzed medical institution's disaster preparedness, the results should be viewed in light of several limitations.

A significant constraint was the study's reliance on data from a single medical institution. This single-institution focus limited the broader applicability of the findings to other medical facilities with different operational profiles, sizes, or levels of complexity.

The HSI protocol utilized in this study may not be void of subjectivity, presenting another potential limitation. This inherent subjectivity could pave the way for assessment errors or biased interpretations of the findings.

Furthermore, while the HSI protocol places significant emphasis on tangible aspects of preparedness, it might not thoroughly capture the human element's softer nuances, such as the critical roles of clear communication, responsibility, and duty. These cultural and behavioral factors, so crucial to crisis management, might not have been deeply explored in this protocol.

Another key limitation was the potential influence of the study itself on the behavior of hospital employees, which is known as the Hawthorne effect.

External factors, including changes in regulations, institutional policies, and staff preferences, can significantly influence a study's outcome. Due to the requirements of Polish law, the anonymity of the medical institution and its staff was maintained throughout the study, which may have affected the richness of the data collected and presented.

Additionally, while the study provides critical insights into a Polish medical institution's disaster preparedness, extrapolating these findings to institutions in other geographical regions, with their unique socio-cultural, economic, and political challenges, should be done with caution.

The rapid evolution of healthcare technology and practices present an ongoing challenge for the HSI. Some significant aspects impacting hospital safety and disaster preparedness might not have been fully encompassed within the current HSI protocol but could be integrated into future assessments.

With the ever-evolving challenges in our global environment, such as climate change, geopolitical tensions, and pandemics, tools such as the HSI might require more frequent recalibrations to remain timely and relevant.

Despite these limitations, the study offers invaluable insights into disaster preparedness within the selected medical institution, illuminating areas ripe for enhancement, thus bolstering both patient and staff safety during crises.

6. Conclusions

Crisis management and disaster-victim care, as observed, form the backbone of an efficient and responsive medical establishment. Our study's voyage, anchored in the HSI's assessment of a specific medical institution in Poland, unravels a layered tableau of preparedness vis-a-vis MCIs and the institution's prowess in swiftly pinpointing and addressing disaster casualties.

Apart from strengths and areas of strategic improvement that our analysis elucidates, a dimension warranting undivided attention is the human factor. Resilient systems, while instrumental, must be complemented by a workforce instilled with a staunch sense of duty, unwavering responsibility, and crystal-clear communication capabilities. These values are not mere ornaments, but foundational pillars that underpin any crisis-response mechanism.

In our modern epoch, often criticized for its capitalist leanings and characterized by shifting moral compasses, a return to these time-honored values becomes not just advisable but indispensable. Such values serve as antidotes to the pitfalls of fragmented communication and provide the moral gravitas required in moments of calamity.

The exhaustive scrutiny presented in our research undeniably enriches the discourse on hospital preparedness, with ripples of its implications reaching hospital administrators, emergency management enthusiasts, healthcare policymakers, and practitioners—not just in Poland, but across the global stage.

While acknowledging the study's constraints, it is pivotal to perceive its results as foundational stones for future scholarly pursuits. Diverse training modules, cutting-edge technological forays, and international collaborations herald a future of integrated crisis management in which knowledge diffusion and technology integration pave the way for optimized responses.

However, amid this matrix of strategies and innovations, the timeless essence of a robust safety culture remains paramount. The need for safety is a clarion call, resonating beyond the confines of our study, echoing the universality of responsibility, clear communication, and unyielding duty.

In a world where challenges and crises are ever-evolving, our call to arms transcends academic deliberation. Preparedness is an unwavering commitment, a testament to the collective spirit that values every life. In the journey toward operational excellence, the embrace of foundational values is the keystone, ensuring that our crisis response is not only effective but also profoundly humane.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Part I Basic Information.

Basic Information	Evaluation					
1. Location of hospital (region/district)	Middle District	Northern District	Southern District	Eastern District	Western District	North Eastern District
2. Hospital Capability	F	M	S	A (U)		
3. No. of patients receiving emergency services/year	<25,000	25,000–50,000	50,001–75,000	75,001–100,000	>100,000	
4. Number of workforce						
4.1 Medical team	Doctor	Nurse	EMT	Pharmacist	Other	
4.2 Supporting team	Engineer	Nutritionist	Dressing	Security/Traffic	Finance	Information
5. Hospital agency	Ministry of Public Health	Ministry of Education	Military/Police	Local administration/foundation	Private	Other
6. HA, JCI Accreditation	Accredited	Under review	Reaccredited	No accreditation		
7. Reserve capability (within 12 h)	Yes	No	Don't know			
8. Level of trauma center	1	2	3	4	5	
9. Capability for taking care patients with fire wound (S, A)	Yes	None				
10. Helicopter parking (A)	Permanent	Temporary	None			

Appendix B

Table A2. Preparation checklist.

Topics	Evaluation	Remarks
1. Governance		
1.1 Mass casualty incident committee	0: not known 1: no formal committee 2: formal committee with one meeting/year 3: formal committee with more than one meeting, but not scheduled 4: formal committee with regular scheduled meeting 5: formal committee with regular scheduled meeting with official report and strategic planning	
1.2 Mass casualty incident or emergency manager	0: not known 1: no specific person 2: unofficially assigned person 3: officially assigned person (experiences or informal trained) 4: officially assigned (informal trained or experiences person) in organization structure with clearly roles and responsibilities 5: officially assigned formal trained person in organization structure with clearly roles and responsibilities	
1.3 Hazards vulnerability analysis (HVA) and prioritization	0: not known 1: no HVA activity 2: HVA based on assumption or committee agreement 3: HVA based on incidence database 4: HVA with prioritization based on incidence and effects database 5: HVA with prioritization based on incidence and effects database with regular revision (every year) (ACEP)	
1.4 Mass casualty incident planning	0: not known 1: no planning 2: planning and/or sub planning not relevant to HVA 3: planning and sub planning relevant to HVA 4: planning and sub planning relevant to HVA covered all disaster cycle with regular updates (once a year) and organization implementation 5: comprehensive planning and sub planning relevant to HVA covered all disaster cycle with regular updates, implementation, and coordinate with relevant external organizations	
1.5 Mass casualty incident drill or exercise	0: not known 1: no drill or exercise was set up during a year 2: conducted unscheduled/unplanned drill or exercise (table top (TTX) or field exercise (FTX)) at least once a year without documented after action review (AAR) report 3: conducted scheduled drill or exercise with official AAR report (either TTX or FTX) 4: conducted regular/scheduled drill or exercise (at least 2 TTX and 1 FTX annually) with official AAR report and implementation AAR to the hospital emergency management plan. 5: conducted comprehensive and regular/scheduled/planned drill or exercise with external relevant organizations	
1.6 Hospital incident command system (HICS)	0: not known 1: no formal HICS 2: not fulfilled functional formal HICS 3: fulfilled functional formal HICS without organization standard operating procedure (SOP) 4: fulfilled formal HICS with organization SOP and regular updates (once a year) 5: fulfilled formal HICS with organization SOP, regular updates, and regular training program	
2 Finance		
2.1 Financial policy	0: not known 1: no assigned budget or financial policy for MCI 2: assigned budget for response 3: assigned budget for all relevant response and recovery activities 4: assigned budget for all relevant response, recovery, planning and preparedness activities 5: comprehensive budget allocation to all MCI activities including aiding team, donation and strengthened relevant community (e.g., education, training)	

Table A2. *Cont.*

Topics	Evaluation	Remarks
3 Health Workforce		
3.1 In-hospital team	0: not known1: informa l hospital team 2: hospital teams partially relevant to HICS 3: hospital teams fully relevant to HICS 4: hospital teams fully relevant to HICS, with hospital manager or management team 5: comprehensive hospital teams according to HICS covered all functions including special teams relevant to HVA	
3.2 Assisting emergency medical team (EMT)	0: not known 1: no team was set up 2: designed informal trained team 3: designed formal trained personnel (MERT, DMERT, DMAT, BDLS, ADLS, etc.) 4: designed formal trained team with strategic budget allocation 5: comprehensive team preparation and management with 24/7 availability (registration, documentation, preset equipment, etc.)	
4 Hospital Information system		
4.1 Hospital staffs	0: not known 1: no documented staff & communication list 2: documented staff & communication list 3: documented staff & internal communication system (e.g., callback system) 4: documented staff & variety internal communication system with regular updates (once a year) and integrated to hospital MCI plan 5: documented staff & variety internal communication system, regularly update and integrated to hospital MCI plan with coordination with external relevant organizations	
4.2 Infrastructure	0: not known 1: no hospital infrastructure information/building plan 2: limited hospital infrastructure information/building plan with capability 3: all hospital infrastructure/building plan information with capability and regular updates (once a year) 4: all relevant hospital infrastructure information (map, department, communication, reserved area, guideline, MCI incidents, etc) relevant to MCI plan and regular updates 5: integrated hospital infrastructure information with community information and 24/7 availability	
4.3 Alert system	0: not known 1: no alert system 2: official alert system and standard operation procedure (SOP) 3: official pre-alert, alert system and SOP with regular updates (once a year) 4: integrated pre-alert, alert system and SOPs into hospital MCI plan with regular updates 5: integrated hospital alert system into community plan	
4.4 Patients or victims information	0: not known 1: no patients/victims information system 2: non-structured patient/victims information system 3: structured patient/victims information system 4: integrated patient/victims information system to communication procedure, SOP, and MCI plan 5: comprehensive patients/victims information system integrated into community plan	
5. Medical products and technologies		
5.1 Personnel protective equipment (PPE) and equipment	0: not known 1: no assigned equipment 2: assigned actual equipment/PPE allocation 3: assigned actual and specific equipment with SOP/protocol, 24/7 availability 4: assigned actual and specific equipment with SOP/protocol relevant to HICS and MCI plan 5: integrated hospital capability with other relevant external organizations	
5.2 Logistic and management	0: no known 1: no logistic or management plan 2: limited hospital logistic or management plan 3: fully hospital logistic or management plan 4: integrated hospital logistic or management into HICS/MCI plan 5. coordinate hospital logistic or management plan with other relevant external organizations	

Table A2. *Cont.*

Topics	Evaluation	Remarks
5.3 Medical stockpile	0: not known 1: no disaster medical products plan 2: designed actual medical products 3: designed specific medical products and equipment (e.g., vaccine, antidote, portable X-rays, forensics, etc.) 4: integrated medical stockpile into hospital MCI plan with regular updates 5: coordinate specific disaster medical stockpile with other relevant external organizations	
5.4 Supportive functions	0: not known 1: no plan for supportive function 2: limited planned supportive functions (water, sanitation, electricity, HVAC, sterile, foods, medical gas, communication, etc.) 3: fully planned all relevant supportive functions at least 96 h 4: planned all relevant support functions at least 96 h, 24/7 availability 5: coordinate all support functions plan with supplier and community plan	
6 Service delivery		
6.1 Hospital MCI plan/protocol	0: not known 1: no hospital plan or protocol 2: hospital MCI plan with alert system 3: hospital MCI plan with alert system with limited implementation 4: hospital MCI was implemented throughout organization 5: hospital MCI plan was integrated into community MCI plan	
6.2 Patients/victims care/management	0: not known 1: actual patient care/management, no specific patient care protocol 2: specific MCI patient care protocol (e.g., triage, protocols, pre-set equipment, etc.) 3: specific MCI patient care protocol with designed area or ward (OPD & IPD) 4: specific patient care protocol with designed area or ward and tracking or patient administrative procedure 5: integrated hospital MCI patient care protocol with community patient care system	
7 Participation		
7.1 Coordination with other relevant organizations/agencies	0: not known 1: no coordination plan/protocol 2: informal coordination procedures 3: formal coordination with community e.g., community MCI/disaster management committee 4: formal coordination with community with collaborating activities e.g., training, drill, exercise, etc. 5: formal memorandum of understanding (MOU) with all relevant organizations/agencies for all MCI activities (response, recovery, prevention, and preparedness)	
Total score		

Appendix C

Table A3. Suggestions.

3.1 Governance	
3.2 Financing and Budgeting	
3.3 Health Workforce	
3.4 Information System	
3.5 Pharmaceuticals, Medical Supplies, and Technology	
3.6 Service Delivery	
3.7 Participations	
Evaluator	
(Responsible for Mass Accidents)	Date of Evaluation

Appendix D

Table A4. Information on general capability and reserved capability of the hospital.

	Normal Capacity (Bed)	Reserved Capacity (within 12 h)	Heart Rate Monitoring Device	Ventilators	Negative Pressure Room
Hospital					
Emergency room	Red Yellow Green Black	Red Yellow Green Black			
Observation room					
Accident ward					
Surgical ward					
Bone ward					
Medicinal ward					
Maternity ward					
Delivery room					
Pediatric ward					
Infant ward					
Psychiatric ward					
Surgical crisis					
Medicine crisis ward					
Children crisis ward					
Infant crisis ward					
Burnt unit					
Operating room					
Hemodialysis room					
Medical devices center (if available)					

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