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Arief Tarmansyah Iman
Poltekkes Kemenkes Tasikmalaya, Tasikmalaya, arieftarmansyahiman@mail.ugm.ac.id

Hari Kusnanto
Universitas Gadjah Mada, Yogyakarta, harikoesnanto@ugm.ac.id

Ariani Arista Putri Pertiwi
Universitas Gadjah Mada, Yogyakarta, ariani_psik@ugm.ac.id

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Understanding User Needs in Health Crisis Risk Monitoring Information System Development: A Lesson from Tasikmalaya District, Indonesia

Arief Tarmansyah Iman[1,2], Hari Kusnanto[3], Ariani Arista Putri Pertiwi[4*]

[1]Department of Medical Record and Health Information, Poltekkes Kemenkes Tasikmalaya, Tasikmalaya, Indonesia
[2]Doctorate Program of Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
[3]Department of Family Medicine and Community, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
[4]Department of Basic Nursing and Emergency, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia

Abstract

A health crisis risk monitoring information system needs to be developed, especially during the pre-disaster phase; therefore, understanding the needs of prospective users is crucial. This study aimed to investigate the needs of potential users regarding the development of this system. This study employed a qualitative, exploratory approach to gather user needs from stakeholders through interviews (n = 7) and one focus group discussion (n = 12). The data were audio-recorded, transcribed verbatim, and then thematically analyzed using qualitative content analysis. The need for information was related to disaster preparedness and its preferred format. The system should be targeted, multiplatform, support multiple users, and easy to access. Features should include fully integration, advanced capabilities, online access, and the ability to generate fast and actionable information. It is essential to have this system for all users. A system must facilitate decision-making at various levels. The system should contain related information in a standardized format, easily accessible through various platforms and by multiple users, and serve as a tool for providing information for risk mitigation, monitoring, and reporting purposes.

Keywords: disaster preparedness, health crisis risk, health information system, pre-disaster, user need

Introduction

A disaster is defined by its impact on the health and health services of the affected community from a public health perspective. Public health is a fundamental aspect of emergency management, disaster risk reduction, and disaster risk management.[1] Information technology and data management tools are indispensable in the health care and public health communities for preventing, preparing for, responding to, and recovering from natural and manufactured public health emergencies. The effectiveness of preparedness functions during the pre-disaster phase can be enhanced by leveraging technology and data systems.[2,3]

Based on the Sendai Framework for Disaster Risk Reduction 2015–2030, as outlined by the United Nations World Conference on Disaster Risk Reduction, countries play a crucial role in addressing disaster risks that can lead to health crises. The framework highlights four priority action areas: understanding disaster risks, strengthening government disaster management, investing in disaster risk reduction by building resilience, and enhancing disaster preparedness for effective response and recovery processes.[4,5] Communities can reduce the impact of disasters on health systems and promote sustainable development by implementing effective disaster risk management strategies.[6]

The health information system plays a critical role in implementing disaster preparedness measures. However, due to the unique features and attributes of each area, no universal template can be applied consistently across all disaster zones globally. Therefore, innovative and sustainable initiatives must be undertaken to establish a system that aligns with disaster management requirements in a specific region.[7] Information technology has proven to be significantly applicable during every phase of disaster management. Local governments can reduce the risk of catastrophe by utilizing infrastructure monitoring technologies and managing public health emergencies caused by natural disasters or human activities.[2,3]

***Correspondence**:* *Ariani Arista Putri Pertiwi, Departement of Basic Nursing and Emergency, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia, Email: ariani_psik@ugm.ac.id.*

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The use of information systems is essential and increasingly plays a significant role in disaster management, spanning from the pre-disaster phase to the post-disaster phase and encompassing the disaster itself. A multi-layered decision-making theoretical framework integrates information systems and various stakeholders into a structured model, enhancing, facilitating, and supporting management processes during disaster events.[8] The Internet of Things (IoT) is one of the emerging technologies. It is one of the most promising application domains in environmental surveillance for public protection, disaster relief monitoring, and detection.[9] A system design also develops and builds a model of the Geospatial-Based Adolescent Reproductive Health Disaster Alert System.[10] Another important system is the Community Disaster Information System. With the global rise of information technology, communities are increasingly active in gathering, analyzing, and sharing information, making them key players in information management.[11] Information Communication Technology (ICT)-based methods, including robust databases, many-to-many communications, and Geographic Information System (GIS), can make this response faster, more transparent, and more easily accessible.[12]

Indonesia is a large country with varied geographical features. It is situated in the Ring of Fire, making it a country with the highest global disaster risk.[13] According to the Centre for Research on the Epidemiology of Disasters, Indonesia was the second most disaster-prone country after the United States.[14] One of the areas in Indonesia with a high disaster risk is the Tasikmalaya District in West Java Province, which has diverse geographical characteristics, from coastlines to active volcanoes. As of 2019, there were 149 disaster events in the Tasikmalaya District.[15] These disasters resulted in casualties, as well as physical and economic losses, with landslides being the most frequent. However, the disasters with the highest number of casualties were earthquakes and tsunamis, with 63 people killed and missing in one incident. Two destructive earthquakes were recorded in 2017.[15] Between 2020 and 2025, 31 natural disasters occurred, including 11 floods, four landslides, three earthquakes, and three tornadoes, in addition to incidents combining three floods and landslides.[16]

Based on these considerations, a project called the development of a health crisis risk monitoring information system (HCR-MIS) has been carried out by the authors together with the Tasikmalaya District Health Office since 2023, with the primary goal of measuring health crisis risk in improving regional preparedness in primary health care (PHC) and the District Health Office. HCR-MIS needs to be developed to meet the need for fast and accurate information for decision-making, as well as gathering and integrating data from various sources. Therefore, a thorough understanding of the needs of prospective users is crucial. This study aimed to explore potential users' needs regarding the desired content and function of the HCR-MIS.

Method

The HCR-MIS project was carried out from March 2023 to July 2024. The Tasikmalaya District, which encompasses diverse regions from mountainous areas to coastal zones, was selected as the research site due to its increased vulnerability to health crises. In the first phase of the research, a qualitative exploratory study was carried out through interviews and focus group discussions (FGDs) to enable an in-depth exploration of the prospective users' needs. The informants were stakeholders intentionally selected by the authors as potential users of this system, totaling 19 informants. They were responsible for providing daily reports and managing disaster and health crisis data. Informants were divided into two groups: interviews (n = 7), which consisted of the Health Crisis Center (HCC) of the Indonesian Ministry of Health at the national-level (n = 2), Provincial Health Office (n = 1), District Health Office (n = 3), and Regional Disaster Management Agency (RDMA) (n = 1). The second category was FGDs with PHC staff (n = 12), which were considered to represent the entire area, including PHC heads (n = 4), surveillants (n = 4), and medical team members (n = 4).

Data collection began on March 13, 2023. On average, the interviews with each informant lasted about 50 minutes, while the FGD session lasted around 90 minutes. The interviews and FGDs were conducted in the auditorium of the Tasikmalaya District Health Office. All interviews were digitally recorded and transcribed verbatim. In-depth interviews were conducted using an interview guide prepared by the research team. During the FGD process, a preview of the HCR-MIS to be developed was presented, with the research assistants serving as moderators, recording and noting important points. The FGD concluded after all issues were discussed using the FGD guide that was previously designed.

The content analysis method was used to analyze the interviews and FGD data. The informant double-checked and approved these data before the analysis process. Therefore, the analysis involved the inductive development of categories and their deductive application. Initially, using the preliminary category system, all transcripts were independently reviewed by each author. Additional key issues were identified during this review. After summarizing and labeling these key issues as codes, the authors sorted them into main and subcategories. The codes were clearly defined and linked with representative examples from the original texts. The categories were then discussed and further modified within the interprofessional research team until a consensus was reached on the category system. The data analysis was conducted using OpenCode, an open-source software. Informant characteristics will be analyzed descriptively in terms of age, sex, education, and professional experience. The data will be presented in the form of tables, figures, and interview quotes.

Results

Table 1 provides a detailed description of the characteristics of the interview and FGD participants. It shows that most of the respondents were male, both in the interview group and the FGD. The age group in the interview group was mostly over 50 years, while in the FGD, the age group was evenly distributed, with participants under 44.5 years and those 44.5 years or older. The interview group had more than 7 years of experience. In contrast, most FGD informants had less than 12 years of experience. Regarding education level, the interview group had a higher level of education than the FGD group.

Table 1. Informants' Characteristics

Code	Age (years)	Sex	Job Position	Experience (years)	Education	Data Collection Process
A01	54	Male	Coordinator of Health Services and Financing of the District Health Office	10	Master	Interview
A02	51	Female	Health Crisis Response Analysis at the District Health Office	1	Bachelor	Interview
A03	51	Male	Surveillance Data Manager at the District Health Office	7	Bachelor	Interview
A04	40	Male	Prevention and Preparedness Analyst at the Regional Disaster Management Agency	5	Bachelor	Interview
A05	54	Male	Epidemiologist, Team Leader of Hajj Health and the Health Crisis Center	16	Master	Interview
B01	27	Male	Administrator of the Data and Information Management and Monitoring of the Health Crisis Center	1	Diploma	Interview
B02	52	Female	Team Leader of the Data and Information Management and Monitoring of the Health Crisis Center	11	Master	Interview
C01	47	Male	Head of the Primary Health Care	1.5	Master	Focus Group Discussion
C02	42	Male	Nurse	3.5	Diploma	Focus Group Discussion
C03	39	Male	Medical Doctor	3.5	Bachelor	Focus Group Discussion
C04	53	Male	Head of Administration	27	Bachelor	Focus Group Discussion
C05	42	Male	Nurse	22	Diploma	Focus Group Discussion
C06	37	Female	Surveilans	1	Bachelor	Focus Group Discussion
C07	47	Female	Head of the Primary Health Care	1.5	Master	Focus Group Discussion
C08	37	Female	Epidemiologist	2	Bachelor	Focus Group Discussion
C09	47	Male	Nurse	21	Bachelor	Focus Group Discussion
C10	53	Male	Head of the Primary Health Care	7	Bachelor	Focus Group Discussion
C11	58	Male	Head of the Primary Health Care	17	Bachelor	Focus Group Discussion
C12	37	Male	Epidemiologist	3	Bachelor	Focus Group Discussion

Overall, an information system for monitoring health crises was highly needed and would be greatly beneficial if it functioned effectively. The data analysis process began with the compilation of interview transcripts, followed by coding and categorization until themes and subthemes/categories were identified (Figure 1).

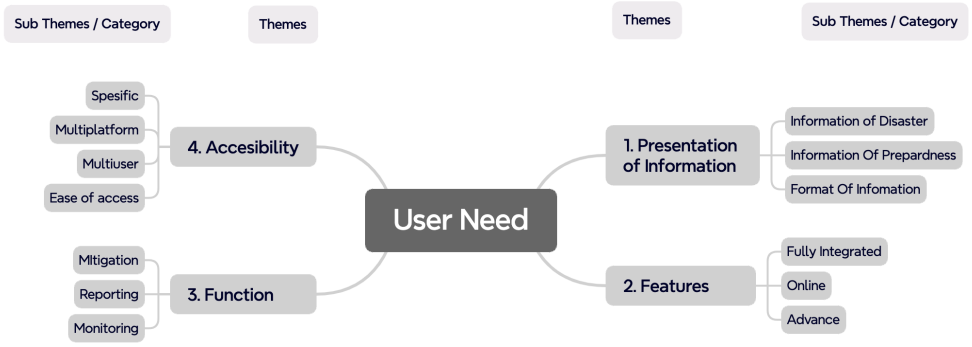

Figure 1. Overview of Identified Key Results Regarding User Needs

Based on Figure 1, the key findings from interviews and FGD regarding user needs were divided into four major themes: mitigation, reporting and monitoring, with features that facilitate full integration, online information generation, and rapid access. Accessibility required a specialized, multiplatform, multiuser, and easily accessible system. Meanwhile, the information itself encompassed disaster-related information, preparedness information, and standardized information formats. More detailed explanations of each theme, category, and code will be provided individually in Table 2.

Table 2. Themes, Categories, and Codes

Themes	Categories	Codes
Presentation of Information	Information on the disaster	Information on the disaster situation
		Information on the location of the disaster
	Information on preparedness	Early warning system
		Mapping area
	Format of information	National standardization
		Local specific needs
Features	Fully Integrated	Integrated with the Regional Disaster Management Agency
		Integrated with the Indonesian Ministry of Health system
		Integrated with Health Office Networks
	Online	Online system
	Advanced	Advance
Function	This system is needed for the mitigation	This system is needed for the mitigation
	Performance monitoring	Performance monitoring
	Activities monitoring	Activities monitoring
	Pre-disaster monitoring	Pre-disaster monitoring
	Reports are based on PHC's data	Reports are based on PHC's data.
	Graphical visualizations are available	Graphical visualizations are available.
	The need for a reporting system.	The need for a reporting system
Accessibility	Specific application	Need a specific application
		Application as a specific instrument
	Multiplatform	Web-based
		Mobile
	Multiuser	RDMA as a user
		RDMA as its functions
		User from base to top
	Ease of access	Easy to access
		The public can access it
		Easy to share

Notes: RDMA = Regional Disaster Management Agency, PHC = primary health care

Presentation of Information

The theme of information presentation was divided into three categories: information on disaster, information on preparedness, and format of information. In detail, the description of each category will be explained below.

Information on the Disaster

The informants agreed that the information should provide disaster situation information. Statements from each part complemented one another regarding the types of information that should be included in the HCR-MIS. One informant firmly stated that the information system should provide the following disaster situation information:

> *"To keep the community informed, disaster-related information, such as procedures to follow in the event of an earthquake or instructions on what to do in case of a flood, can be included in the information system." (C01)*

An informant added that the system should include data on disaster-prone areas. Two informants from PHC and the District Health Office emphasized that this information should be useful not only for department officials or the PHC but also accessible to the public.

Information on Preparedness

In addition to disaster-related information, the informants expressed the need for preparedness information. PHC informant stressed the need for an early warning system:

> *"It also serves as a warning. Being aware, for example, of an event of potential disaster. Information should be obtained from the Meteorology, Climatology, and Geophysics Agency. For instance, if there is a potential for heavy rainfall and landslides." (C01)*

According to them, this information was crucial for the community to be prepared and alert. One informant added that important information, such as the mapping of disaster-prone areas, should be available in the information system. Mapping disaster-prone areas is of utmost importance in this system, as it enables the identification of vulnerable areas and serves as a guide for determining the priority of response and vigilance toward potential disasters.

Format of Information

After discussing the information content, the participants also expressed their preferences regarding the generated information format. They desired standardized and nationally applicable information that was tailored to the specific needs of the Tasikmalaya Region.

> *"The desire is for the system/information to be standardized nationally." (A01)*

With a standardized format for information and reporting, the reports between regions would have a unified national format, eliminating differences between regions. However, one informant stated that the information generated by the information system should consider the conditions and needs of the local region.

> *"The information should be tailored to the Tasikmalaya District, so it should be adapted to the region." (A03)*

According to this informant, specific information may be relevant to a particular area but not applicable to other regions.

Features

The features required by users were categorized into three types: fully integrated, online, and advanced. A detailed description will be provided below.

Fully Integrated

One central issue discussed in both the interview groups and the FGD was the information system's complete integration. One member of the group stated that the information system should be integrated with the RDMA.

> *"When we have an application, we display information, but if RDMA or the relevant area/region is not connected, there is a concern about miscommunication." (C03)*

Additionally, the informant expressed that the RDMA can share data and information related to area mapping. Through its community-based network, the RDMA can contribute by providing and sharing disaster-related data and preparedness information with the public. The information network of the RDMA extends to the Subdistrict level,

which helps coordinate and assess existing resources. Furthermore, the RDMA can contribute by sharing information regarding the availability of community-based resources at the sub-district level, which can be integrated with other information systems from the Indonesian Ministry of Health, such as the online integrated referral information system called SISRUTE, which provides data on the readiness of crisis victims and available capacities.

The current crisis management system at the ministry level is integrated with the information system for the Health Reserve Workforce, serving as a list of available health personnel during health crises. Another informant suggested integrating the system with the government's full-scale application called SatuSehat. All integrations with the current Indonesian Ministry of Health are coordinated through the information center called Pusdatin. The HCC's information system is open to collaborating with the HCR-MIS development in the regions.

Another critical integration that should be implemented in this information system is the integration of the Health Office network, including PHCs, District Health Office, and Provincial Health Office. The informant expressed the hope that this system can be integrated with the existing PHC systems. Integration is also desired for higher-level health facilities such as hospitals. Data can be easily and quickly retrieved with the integration of existing systems in PHCs. Integration within the health office network will also facilitate the processing of data, where the district health department will aggregate the input data from PHCs.

Online Systems and Advances

The next expectation from the informants regarding the HCR-MIS is that it should be an advanced system that keeps up with the latest technology trends and is accessible online. The informant stated that the information system should be capable of generating fast information.

> *"The system can provide fast information to relevant leaders based on their needs." (B01)*

Function

The function themes were divided into three categories: disaster mitigation, risk monitoring, and risk reporting. In detail, the description of each category will be explained below.

Mitigation

The functions of the HCR-MIS were an important topic discussed. The informant stated that the PHC needs this information system to provide data or information for mitigation.

> *"So, actually, the PHC also needs it, including for mitigation." (C04)*

Monitoring

Furthermore, one informant expected the HCR-MIS to monitor the performance of personnel in handling health crises.

> *"About monitoring, or what else? Monitoring is about assessing the extent of our success or the extent of our work in handling the crisis" (A01).*

It is also essential to monitor the activities carried out by the personnel.

> *"Requesting reports and information on the activities carried out in the field and assessing the outcomes." (A01)*

Another function of the information system was to perform pre-disaster or health crisis risk monitoring.

> *"Regarding disasters, for example, the pre-disaster phase. Therefore, while monitoring the safety situation in the area, we repeatedly ask whether it is related to seasonal or situational factors." (A01)*

The system was designed to function in this manner. The specific application for which the informant expressed a need for an information system that generates graphical reports.

> *"For example, in the application, the types of reporting might be something like an early warning graph. We can automatically see the fluctuations and trends." (A01)*

Reporting

The HCR-MIS is also expected to function as a reporting system.

> *"It helps us coordinate, and we do need some kind of reporting application." (C03)*

The reporting feature in this information system can also facilitate the Health Office in generating reports because the PHC personnel already enter the data directly.

> *"Therefore, the ones who should fill it out should be from PHC, where PHC is the lowest level. If it is here, the personnel are from the PHC (there are more of them), so it would be better if they fill it out from the PHCs and then submit it to the District Health Office." (B02)*

Accessibility

The accessibility theme was divided into four categories: specific application, multiplatform, multiuser, and ease of access.

Specific Application

The informants expected a specific application or information system for health crisis risk monitoring; therefore, developing an HCR-MIS that the public could also access was essential. Likewise, the other informant stated that they required an application to provide support data for advocacy or decision-making purposes and to create an automated report.

> *"....we need to create a program (system), whatever its name, especially for reports, there could even be a specific one that suits our needs to create disaster reports." (A03)*

Multiplatform

One crucial aspect discussed by the informant is the information system's accessibility. One informant suggested developing a specific information system for disaster management. Furthermore, another informant stated that a specific application for disaster management could be developed.

Based on information from the HCC, the information system was centered on a web-based platform. Additionally, a mobile-based application was being developed to complement the web-based application. Furthermore, one informant requested that the information system be accessible through social media platforms for faster dissemination.

Multiuser

In addition to multiplatform access, the informants emphasized the importance of various users for the effectiveness of the system. One informant suggested that the RDMA should be a user in the system.

> *"...it would be great if the RDMA could be a user as well." During the COVID-19 response, the coordination between the Health Office and RDMA was always in sync." (A04)*

The involvement of the RDMA should align with its role and function. One informant added that the users of this system should range from the lower level (PHCs) to the higher level (Health Office).

Ease of Access

The informants also highlighted the importance of easy access to the information system. The PHC informant requested that the system be easily accessible anytime, anywhere.

> *"The challenge for us is to make it easily accessible anytime, anywhere." (C05)*

Furthermore, one informant expressed the hope that the system could be accessed by the public in terms of accessibility. Another informant suggested that the system should be made more accessible to the public, for example, through their mobile phones.

Discussion

Disaster management is a multifaceted field in public health that encompasses preparedness, response, recovery, and mitigation.[17] These efforts aim to safeguard and enhance the well-being of communities affected by disasters. A comprehensive health systems approach, including risk assessments and disaster risk management fact sheets, is crucial for enhancing disaster management and mitigating associated risks.[17] Therefore, the implementation of information systems as tools for monitoring health crisis risk is essential to address health crises effectively. The results of the data analysis indicated that the informants desired an easily accessible, advanced, online, and fully integrated HCR-MIS with the need to present information on disasters, preparedness, and the preferred format for

such information.

The first theme was user-required information. This information included details related to disaster events or hazards, such as location, time, and type of disaster. In addition, information was required for preparedness. This information was formatted following national standards that also addressed regional needs. Therefore, during system development, it was necessary to consider variables related to disaster and hazard information, as well as preparedness data, presented in a standardized format and aligned with field conditions.

Disaster and preparedness information must adhere to the variable data required in the Health Crisis Management Regulation of the Minister of Health No. 75 of 2019.[18] By referring to these regulations, data and information can be standardized nationally, and information related to specific local regions can be adjusted to existing standards. Standardization is crucial in providing a universal framework for data exchange across healthcare systems.[19] Although national and even global standardization is crucial, the need for data specific to local contexts must still be addressed. These findings align with research emphasizing the need to carefully examine the local context and dynamics, as well as to identify needs a priori. Ideally, any product should be codeveloped with local stakeholders through a user-centered design approach.[20]

In addition to content, the identification of user-desired features and system capabilities was also conducted. The informants strongly expected integration and advanced online system information. Data integration is a crucial issue in an information system. Integrating data and platforms facilitates centralization and enables each stakeholder to participate more effectively. It is designed to be extensible, making it convenient to add new features according to user needs and feedback.[21]

It is important to develop a clear and context-specific understanding of what effective integration entails, how it should be implemented (i.e., what needs to be integrated and how different system activities can be coordinated), and what benefits will be obtained, including identifying best practice examples.[22] The integration of modern technologies, such as Artificial Intelligence, IoT, and GIS, can enable faster and more efficient crisis responses, helping organizations, including crisis management agencies, make better resource allocation decisions during emergencies and improve overall performance.[23-24]

Integration also facilitates coordination, aligning with a previous study that emphasizes the importance of data integration, particularly in risk management and disaster response, where data are integrated from each relevant government agency.[25] Various models of integration can be identified, including information-oriented integration through information exchange, such as databases and Application Programming Interfaces (APIs); process-oriented integration through centrally managed processes to support information flow; service-oriented integration to share common business logic or methods;[26] user-oriented integration to enable users to have a consistent view of various systems.[27] The proposed integration model should align with user expectations, and the most appropriate approach should be selected based on contextual suitability.

The system functions theme was divided into three categories: disaster mitigation, risk monitoring, and risk reporting. The information system serves as a tool for mitigation, and real-time spatial data is essential in disaster management and disaster response.[28] Therefore, in the pre-crisis phase, hazard management and disaster mitigation become crucial.[29] The functions expected by the informants must be realized as a form of effort to reduce the risk of health crises. In line with the health Emergency Disaster Risk Management (EDRM) framework, the comprehensive approach refers to closely interrelated prevention and mitigation, emergency preparedness (including operational readiness), response, and recovery measures. It is based on the premise that prevention and mitigation measures can reduce the likelihood and severity of emergencies and that sound preparedness will lead to a more timely and effective response.[30] In practice, one of the risk mitigation efforts is risk monitoring, which includes resource management, infrastructure improvement, contingency planning, education, and family planning. These efforts are documented and reported within a reporting system, making it a unified package for recording and reporting.[31]

The final theme is accessibility, which consists of four categories: specific application, multiplatform, multiuser, and ease of access. The accessibility needs of users align with the current advances in information technology, making it essential to recognize. Accessibility aligns with the principles of multiplatform or cross-platform systems, as the development of information and communication technology, particularly web-based applications, evolves rapidly.[32] A cross-platform application is an example of this type of development. This approach reflects the importance of usability and accessibility as key quality characteristics in software development.[33] Technology must be accessible to

all, and accessibility should be integrated into the development process of information systems.[34] It is crucial to ensure that everyone can use the final version of a given technology. In this context, the HCR-MIS will play its role as a system that assists a variety of users, particularly leaders at the PHC and District Health Office levels, in decision-making.

The rapid development of ICT, particularly web-based internet applications, underscores the importance of involving potential users in the design of a system to ensure that it is centered around their interests and needs. This study included informants from various levels, ranging from the PHCs frontliners to national-level HCC personnel at the Indonesian Ministry of Health. This approach provided diverse insights across roles, professions, and expertise levels. However, this study had some limitations, such as a male-dominated group of informants and a significant gap in the informants' experience in the field of health crisis management. Not all elements of the Penta-helix approach were involved, as the system was dedicated to the main users in the health cluster. Additionally, the findings might not be fully generalizable to other regions or the entire country.

Conclusion

The system should meet the needs of both implementers and leaders by providing standardized disaster-related information, including preparedness, mitigation, and early warning. It must be accessible across platforms and usable by multiple stakeholders, including the public. The system should support health crisis risk mitigation, monitoring, and reporting, while integrating with other related online systems. To ensure sustainability, collaboration with community groups, media, and the business sector through the Penta-helix approach is essential.

Abbreviations

IoT: Internet of Things; ICT: Information Communication Technology; GIS: Geographic Information System; HCR-MIS: Health Crisis Risk Monitoring Information System; PHC: primary health care; FGD: focus group discussion; HCC: Health Crisis Center; RDMA: Regional Disaster Management Agency.

Ethics Approval and Consent to Participate

Ethical approval for the research was obtained from the Ethical Committee of the Faculty of Medicine, Public Health, and Nursing at Gadjah Mada University (Ref. No: KE/FK/0181/EC2023).

Competing Interest

The authors declare no conflicts of interest.

Availability of the Data and Materials

All data sources and information used in this research are available upon request. If further details are needed, including access to the datasets or supplementary files referenced in this study, the author may contact interested parties directly via email. The corresponding author's email address is provided for inquiries and requests related to the research materials.

Authors' Contribution

HK conceptualized the study and methodology, and ATI designed and prepared the initial draft. AAPP and ATI interpreted, validated, reviewed, and edited the data. All authors have reviewed and approved the manuscript.

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References

1. Blanchard K. Defining the role of public health in disasters and emergency management. In: Marie A-S, Rasmus D, eds. Defining Disaster: Disciplines and Domains. Edward Elgar Publishing Ltd.; 2022: 72–89.
2. Cheng M-Y, Chiu K-C, Hsieh Y-M, et al. BIM integrated smart monitoring technique for building fire prevention and disaster relief. Auto Construct. 2017; 84: 14–30. DOI 10.1016/j.autcon.2017.08.027.
3. Quiram BJ, Pennel CL, Carpender SK. Information technology and data systems in disaster preparedness for healthcare and the broader community. In: Dwivedi A, ed. Handbook of Research on Information Technology Management and Clinical Data Administration in Healthcare. IGI Global; 2009: 17. DOI: 10.4018/978-1-60566-356-2.ch016.
4. United Nations. World Conference on Disaster Risk Reduction: Sendai framework for disaster risk reduction 2015–2030. 1st ed. Geneva: United Nations; 2015.
5. Aitsi-Selmi A, Egawa S, Sasaki H, et al. The Sendai framework for disaster risk reduction: Renewing the global commitment to people's resilience, health, and well-being. Int J Disaster Risk Sci. 2015; 6: 164–176. DOI: 10.1007/s13753-015-0050-9.
6. Harris M, Charnley G. Disaster risk management: A resilient health system. In: Eslamian S, Eslamian F, eds. Disaster risk reduction for resilience: Disaster risk management strategies. Springer International Publishing; 2022: 47–176. DOI: 10.1007/978-3-030-72196-1_7.

7. Vardarlıer P. Strategic approach to human resources management during crisis. Procedia Soc Behav Sci. 2016; 235: 463–472. DOI 10.1016/j.sbspro.2016.11.057.
8. Abd-Alrahman AM, Ekenberg L. Modelling health information during catastrophic events — A disaster management system for Sudan. IEEE; 2017. DOI: 10.23919/ISTAFRICA.2017.8102390.
9. Khan A, Gupta S, Gupta SK. Multi-hazard disaster studies: Monitoring, detection, recovery, and management, based on emerging technologies and optimal techniques. Int J Disaster Risk Reduct. 2020; 47: 101642. DOI 10.1016/j.ijdrr.2020.101642.
10. Hadi MS, Hastono SP, Prabawa A. Design and Development of a Geospatial-Based Information Systems for Disaster Management of Adolescent Reproductive Health in Nusa Tenggara Barat Province in 2020. IOP Conf Series Earth Environ Sci. 2021; 755: 012073. DOI: 10.1088/1755-1315/755/1/012073.
11. Meesters K, Nespeca V, Comes T. Designing disaster information management systems 2.0: Connecting communities and responders. Proceed Int ISCRAM Conf. 2019; 2019: 1089–1102.
12. Shuvo SRS, Islam MdN, Islam ST. Role of information and communication technologies in Build Back Better to post disaster recovery practices: Insights from Bangladesh. Int J Disaster Resil Built Environ. 2022; 13: 233–247. DOI: 10.1108/IJDRBE-08-2021-0097.
13. Badan Nasional Penanggulangan Bencana. Indeks Risiko Bencana Indonesia Tahun 2021. Jakarta: Pusat Data, Informasi dan Komunikasi Kebencanaan Badan Nasional Penanggulangan Bencana; 2022.
14. Centre for Research on the Epidemiology of Disasters. 2022 Disasters in Numbers: Climate in Action. Brussels: Centre for Research on the Epidemiology of Disasters; 2023.
15. Deputi Bidang Pencegahan dan Kesiapsiagaan. Kajian Risiko Bencana Kabupaten Tasikmalaya Tahun 2019-2023. Jakarta: Badan Nasional Penanggulangan Bencana; 2018.
16. Pusat Krisis Kesehatan. Pantauan Bencana Pusat Krisis Kesehatan Kementerian Kesehatan Republik Indonesia. Jakarta: Pusat Krisis Kesehatan; 2025.
17. Murray V, Aitsi-Selmi A, Blanchard K. The role of public health within the united nations post-2015 framework for disaster risk reduction. Int J Disaster Risk Sci. 2015; 6: 28–37. DOI: 10.1007/s13753-015-0036-7.
18. Menteri Kesehatan Republik Indonesia. Peraturan Menteri Kesehatan No. 75 Tahun 2019 Tentang Penanggulangan Krisis Kesehatan. Jakarta: Kementerian Kesehatan Republik Indonesia; 2019.
19. Ademaj G, Saenyi B. Systematic literature review: Data standardization in health information systems. ECIS 2022 Research Papers; 2022.
20. Paul JD, Bee E, Budimir M. Mobile phone technologies for disaster risk reduction. Clim Risk Manag. 2021; 32: 100296. DOI: 10.1016/j.crm.2021.100296.
21. Zhou L, DeAlmeida D, Parmanto B. Applying a user-centered approach to building a mobile personal health record app: Development and usability study. JMIR mHealth uHealth. 2019; 7: e13194. DOI: 10.2196/13194.
22. Michelsen K, Brand H, Achterberg P, Wilkinson J. Promoting Better Integration of Health Information Systems: Best Practices and Challenges. Copenhagen: WHO Regional Office for Europe; 2015.
23. Jayaratne M, Nallaperuma D, De Silva D, et al. A data integration platform for patient-centered e-healthcare and clinical decision support. Future Gen Comput Syst. 2019; 92: 996–1008. DOI: 10.1016/j.future.2018.07.061.
24. Byrne E, Heywood A. Use of routine health information systems data in developing and monitoring district and facility health plans: A scoping review. BMC Health Serv Res. 2023; 23: 1049. DOI: 10.1186/s12913-023-09914-6.
25. Abbass M, Akhai S, Chouksey A, et al. Disaster risk reduction and management with emerging technologies: Applications of IoT, AI, and data analytics for resilient urban infrastructure. In: Al Maqousi A, ed. Revolutionizing Urban Development and Governance with Emerging Technologies. IGI Global Scientific Publishing; 2025: 71-110. DOI: 10.4018/979-8-3373-1375-7.ch003.
26. Adenuga OA, Kekwaletswe RM, Coleman A. eHealth integration and interoperability issues: Towards a solution through enterprise architecture. Health Inf Sci Syst. 2015; 3: 1. DOI: 10.1186/s13755-015-0009-7.
27. Dlodlo N, Hamunyela S. The status of integration of health information systems in Namibia. Elect J Inf Syst Eval. 2017; 20: 61–61.
28. Alamdar F, Kalantari M, Rajabifard A. Towards multi-agency sensor information integration for disaster management. Comput Environ Urban Syst. 2016; 56: 68–85. DOI: 10.1016/j.compenvurbsys.2015.11.005.
29. Rafi MM, Aziz T, Lodi SH. A comparative study of disaster management information systems. Online Inf Rev. 2018; 42: 971–988. DOI: 10.1108/OIR-06-2016-0168.
30. World Health Organization. Health emergency and disaster risk management framework. Geneva: World Health Organization; 2019.
31. Twigg J. Disaster risk reduction. London: Humanitarian Policy Group Overseas Development Institute; 2015.
32. Mustofa GG, Mulyanti B, Widiaty I. The implementation of multiplatform technology. IOP Conf Ser Mater Sci Eng. 2021; 1098: 022112. DOI: 10.1088/1757-899X/1098/2/022112.
33. Quintal C, Macías JA. Measuring and improving the quality of development processes based on usability and accessibility. Univ Access Inf Soc 2021; 20: 203–221. DOI: 10.1007/s10209-020-00726-7.
34. Teixeira P, Eusébio C, Teixeira L. Understanding the integration of accessibility requirements in the development process of information systems: A systematic literature review. Req Eng. 2024; 29: 143–176. DOI: 10.1007/s00766-023-00409-8.