International Journal of Public Health Science (IJPHS)
Vol. 15, No. 3, September 2026, pp. 879~886
ISSN: 2252-8806, DOI: 10.11591/ijphs.v15i3.26973

Empowering disaster volunteers through a web-based information system for health workforce and logistics coordination

Emmelia Kristina Hutagaol[1], Afif Wahyudi Hidayat[1], Nico Suwarno[2], Nurali[2,3], Joao Manuel Correia Ximenes[3]
[1]Faculty of Medicine, Medika Suherman University, Bekasi, Indonesia
[2]Faculty of Science and Technology, Medika Suherman University, Bekasi, Indonesia
[3]Faculty of Health Science, Universidade de Dili, Dili, Timor-Leste

Article Info

Article history:

Received Jan 1, 2026
Revised May 31, 2026
Accepted Jul 12, 2026

Keywords:

Digital disaster management
Health workforce mapping
Logistics coordination
Volunteer empowerment
Web-based system

ABSTRACT

Digital transformation plays a critical role in strengthening disaster management systems, particularly in disaster-prone countries such as Indonesia. Despite the availability of several government-led digital platforms, limited systems integrate volunteer coordination, health workforce mapping, and logistics tracking within a unified framework. This study aimed to develop and evaluate a web-based information system designed to empower disaster volunteers by integrating volunteer profiling, healthcare human resource availability, logistics documentation, and public education features. A mixed-methods descriptive analytical design was employed. Qualitative data were collected through in-depth interviews to identify system requirements and operational challenges, while quantitative data were obtained from structured questionnaires completed by 71 of 75 health-background from TAGANA Rajawali Indonesia Foundation members and at least one disaster respon experience. Descriptive non-parametric analysis informed system design and feature prioritization. Results showed that 100% of respondents supported the development of a digital coordination platform, 94.7% preferred WhatsApp integration for communication, and 86.7% were willing to contribute as digital resource persons for public education. The developed system integrates real-time manpower mapping, logistics tracking, donation management, multimedia documentation, and reporting dashboards. This model addresses a critical gap in volunteer-centered digital disaster management and strengthens community-based preparedness by improving coordination efficiency, transparency, and public health resilience.

Corresponding Author:

Emmelia Kristina Hutagaol
Faculty of Medicine, Medika Suherman University
Bekasi, Indonesia
Email: kristina.hutagaol73@gmail.com

1. INTRODUCTION

Digital health development and use grown steadily over the past two decades. Digital transformation has become an essential component of modern disaster management systems. The integration of web-based platforms, real-time data systems, and digital coordination tools enhances response efficiency, improves transparency, and strengthens inter-agency collaboration. In disaster-prone countries such as Indonesia, digital governance in disaster management is increasingly important due to the country's high exposure to

earthquakes, floods, volcanic eruptions, and other natural hazards [1]. An effective disaster response can be archived only through sufficient preparedness before for occurrend of any disaster. Information from general public will be helpful to provide information for identifying the needs and early assessment in disaster management [2].

Digital transformation encompasses all areas of healthcare applications, telemedicine applications, telematics infrastructure activities, and applications. Several national digital platforms have been developed to support disaster risk reduction and emergency response. The National Board for Disaster Management/ *Badan Nasional Penanggulangan Bencana* (BNPB) developed InaRisk to provide regional disaster risk information and mitigation recommendations. Regional Disaster Management Agencies (BPBD) operate Disaster Management Information Systems (SIMPB) to update disaster data during emergency response. In the health sector, the Health Crisis Center, Ministry of Health/*Pusat Krisis Kesehatan Kementerian Kesehatan* integrates health crisis data, medical resources, and emergency procedures at the national level [3].

Although these systems are important, they are predominantly government-centered and institutional in orientation. Their primary focus lies in official reporting, monitoring, and administrative coordination. Community-based volunteer organizations, which play a significant role in disaster response, often operate outside these formal digital systems. One such organization is TAGANA Indonesia, a disaster preparedness volunteer group under the Ministry of Social Affairs. Despite its wide membership and long-standing involvement in disaster response, coordination among members largely depends on informal communication platforms such as WhatsApp groups.

Reliance on informal communication creates several challenges, including fragmented information flow, lack of structured volunteer profiling, absence of real-time health workforce mapping, limited logistics tracking transparency, and inadequate documentation for evaluation and accountability. Previous studies in disaster information systems have primarily focused on government-level platforms, mobile disaster reporting applications, or donation-based systems. However, limited research addresses the digital empowerment of volunteer-based disaster organizations through an integrated web-based system that simultaneously manages healthcare and non-healthcare personnel availability, logistics tracking, public education, and activity documentation.

Recent literature emphasizes the importance of interoperability, integrated data systems, and digital health workforce management in disaster response. Nevertheless, most digital systems remain top-down and institutionally driven, with minimal integration of volunteer-generated data. This gap is particularly critical in developing countries, where community-based disaster response significantly contributes to emergency operations [3]. A problem with the empowerment TAGANA Rajawali volunteer base is that the majority of volunteers are middle-aged to sexagenarian and not tech-savvy, but they are willing to help people who are suffering, which can make them spend their time and money. For them, having many experiences helping people without any attention to earning money is very pleasant [4].

Therefore, this study aims to develop and implement a web-based information system specifically designed to empower volunteer-based disaster management organizations. Unlike existing national platforms, this system integrates volunteer profiling, health human resource availability mapping, logistics management, multimedia reporting, and public disaster literacy within a single digital interface. This research contributes to the state-of-the-art by positioning community-based digital volunteer coordination as a complementary and integrated layer within the broader disaster management ecosystem [5]. Several web-based platforms in disaster management managed by the government are followed by volunteers, as shown in Table 1.

Table 1. Platform disaster management by government

Platform	Managed by	Usage
Ina-risk personal	National Board National for Disaster Management	Providing information on vulnerability to disaster in the region and recommendations for anticipatory actions that the community can take independently
eTangguh		A platform that provides online disaster management education and training in Indonesia [6], [7]
Disaster Management Information System (SIMPB)	Regional Disaster Management Regency (BPBD)	Active data update during disaster [5]
Disaster Management Information System (SIMPB)	BPBD DKI Jakarta	Disaster Management Information System (SIMPB) for the coordination system, current weather data, disaster risk, and disaster management monitoring [6], [8]
Health crisis centre	Health Ministry of Indonesia	Integrating data, procedures, devices, and human health resources to manage information in an integrated manner [9]

2. METHOD

This research is a collaboration between Suherman Medika University and TAGANA Indonesia, empowering them to build a web-based application to serve as an information system for the availability of volunteers, including health workers; provide education on disaster literacy; and document the availability of logistics, which are important in disaster management based on need [10]. The research is a descriptive analytical study with mixed-method data collection. The research was carried out as an implementation of collaboration between Suherman Medika University, in this case the Faculty of Science, in collaboration with TAGANA Indonesia. Firstly, in-depth one-on-one interviews were conducted with TAGANA Indonesia stakeholders from the Rajawali Volunteer Foundation to find out the problems that they have to face, experiences of a view narigating information and resources found, including challenges, limitations, benefit an usefulness of online sources, what information would be most useful, and how that information could ideally be presented online.

After it was discovered that there was no active information system owned, research began based on a literature study on the existence of several alternative solutions to the problem regarding the Information system that would be used. After that, a questionnaire was compiled to obtain an overview of the needs of TAGANA Indonesia. The information system is very much needed by volunteers to have easy access to information and coordination with fellow TAGANA colleagues throughout Indonesia, whether it is about the latest news. Availability of human resources, including health human resources, starting from June to October 2025.

To determine respondents, researchers took data from TAGANA RAJAWALI members who were still active and had at least one disaster response experience as inclusion criteria. The exclusion criteria for this study were Tagana members who did not complete their answers. Quantitative research was conducted by distributing a 25-question by Google Form to a total sample of 75 participants with a health education background, and 15 questions were tested for validity and reliability. Validity test results using Pearson correlation from 30 respondents showed that 15 questions had values above the table value > 0.361. Reliability test results using Cronbach's Alpha (value > 0.60 or 0.70) and the result was 0.620, so all the questionnaire items can be used [11].

The primary data, in the form of questionnaire results, were subjected to non-parametric analytical description. Qualitative research was conducted through in-depth interviews with stakeholders from relevant institutions [12]. Participation was voluntary, and informed consent was obtained digitally before data collection. Data confidentiality and anonymity were maintained throughout the study.

Volunteers who were participating in the survey were directed to a Google Form asking how were recruitment, their volunteer experience during becoming a TAGANA member, and their expectations for an empowering institution in digitalization. After being open for one week, a total 71 from 75 members that has health science background completed the survey [13]. The sequence of work steps in the form of a flow chart, as shown in Figure 1 [14]:

i) Conduct data analysis base on the information [15]
ii) Design by building web-based application [16]
iii) Implementation by completing the system design [17]
iv) Testing to carried out wheter the user is running well [18]
v) Maintance by dividing the tasks among volunteers to update photos, videos, and information provided update data the website [15]

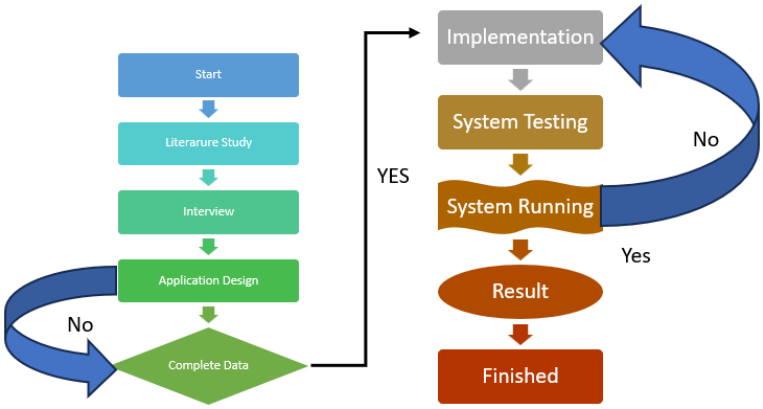

Figure 1. Conceptual framework

3. RESULTS AND DISCUSSION

In-depth interviews were conducted with representatives from TAGANA Indonesia (Table 2), the BNPB, and the Ministry of Social Affairs, identified that: i) the absence of an integrated digital information system for volunteer coordination; ii) limited documentation of manpower deployment duration; iii) dependence on WhatsApp-based communication; iv) lack of structured logistics reporting; and v) need for multimedia documentation (activity photos, reports, volunteer profiles).

This study demonstrates that volunteer-based disaster organizations require structured digital systems to improve coordination, transparency, and accountability. Although national platforms developed by BNPB provide disaster risk and monitoring information, they do not specifically integrate volunteer profiling and real-time health workforce availability [10]. There is much evidence that trained volunteers play an effective role in improving the management of disasters at all stages; particularly, healthcare providers are the most crucial element in delivering quality care and services from mitigation to recovery [19]. As shown in Table 3, from 75 distributed questionnaires, 71 were completed (94.7% response rate): 28 respondents had medical science backgrounds, 27 had non-medical health science backgrounds, 45 had long-term membership, and 39 reported ≥2 disaster response involvements.

Based on the needs assessment, a web-based system was developed (Figure 2) with the following core features: i) volunteer profiling and health workforce availability mapping; ii) logistics and donation tracking module (Figure 3); iii) news and activity documentation dashboard (Figure 4); iv) multimedia reporting system (Figure 5); and v) social media integration. The system architecture was modeled using use-case and sequence diagrams and implemented using an open-source MySQL database. Web applications enable a multimedia-based online information system that can be accessed using a web browser and can also make the organization well-known [20].

Disaster can thus impact general practice business continuity and the ability to provide healthcare. The community might have increased need for care as a result of the disaster. Practice equipment and supplies are pre-planned in the disaster planning stage for general practice, such as creating supplies to inform the donors in disaster management [21].

Table 2. Stakeholder interview findings

Stakeholder	Key issues identified	System needs identified
TAGANA Administrator	Lack of structured digital coordination; reliance on WhatsApp; limited documentation of volunteer deployment	Volunteer profiling; manpower availability tracking; activity documentation; multimedia integration
National Disaster Management Authority	Limited visibility of volunteer activity duration and field reporting	Real-time monitoring dashboard; standardized reporting system
Ministry of Social Affairs	Need for improved mitigation and emergency coordination	Integrated logistics and volunteer coordination system

Table 3. Characteristic respondent

Sex	Educational background		Membership duration		Level of attendance in disaster management		Information resources for calling duty			Commonly used social media	
	Medical science	Non-medical science	Not a long ago	Long enough	< 1	≥ 2	Friend	Social media	Independent	WhatsApp	IG
Male	26	15	15	26	4	37	15	21	5	38	3
Female	2	12	15	19	2	32	13	17	4	33	1
Amount	28	27	30	45	6	39	28	38	9	71	4

Figure 2. Home view on website

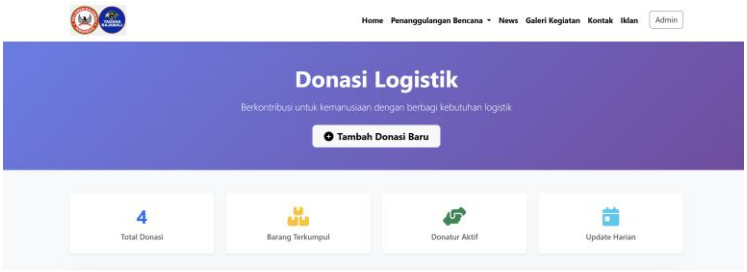

Figure 3. View for donation

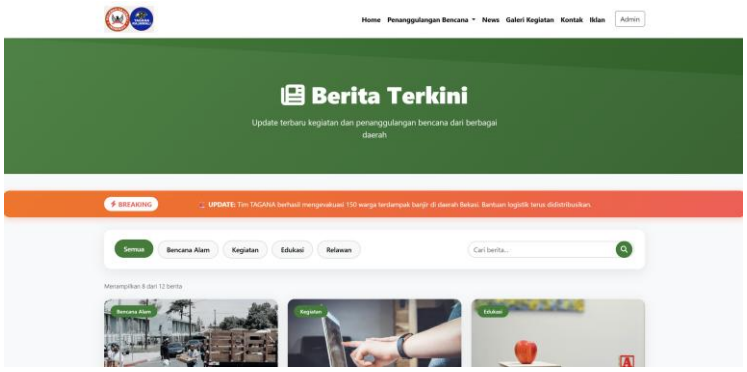

Figure 4. View for news

Figure 5. Activity report

Donations are permanent contributions from donors to an association, for example: money, medicine, clothing, and other logistics. In disasters, there are several specific needs that depend on the type of disaster, characteristics or culture of people, and supplies [22], [23]. The system development used [24]: i) To create a use case diagram by modelling it based on the results of deep interviews and forum discussion group; ii) Use a sequence diagram to show interactions between objects; and iii) Use an open-source database, namely MY SQQL, which support for multhi-threaded and multi-user applications. Activity report organization that can update information because they can show the latest news, alerts, and announcements relevant. Assign a content manager to ensure accuracy and consistency to avoid misinformation [25].

3.1. Implications for disaster and public health systems

The integration of volunteer health workforce mapping into a structured digital system has several implications for disaster management: i) improved health workforce allocation by real-time availability data supports rapid mobilization during emergency response; ii) enhanced logistics transparency by structured tracking reduces duplication and misallocation of resources; iii) strengthened community-based surveillance by volunteers can contribute multimedia documentation and early reporting; iv) digital health literacy expansion by the platform facilitates dissemination of disaster-related health education; v) complementary

governance model by the system acts as a bottom-up digital layer complementing national disaster information platforms. These findings suggest that volunteer-centered digital systems can enhance resilience within decentralized disaster management structures, particularly in middle-income countries [26]. Health equity approaches at the policy level are limited, with recommendations mainly oriented to individual support and based on data from the web application of Tagana Rajawali [27].

4. CONCLUSION

The results of this study are an information system based on the web. This application is based on TAGANA needs: user-friendly, easy to access, guaranteed security, accurate data, report display helps decision making, user guide available, and member participation. For empowering volunteers, they need to know their digital work matters, such as digital reporter, data validator (checking accuracy), communication volunteer (updates information in social media), logistic tracker. This information system for healthcare and volunteers in disaster management goals are giving more multimedia information for activities, coordination, and collaboration, and it is useful for disaster management because made on need.

This study contributes to disaster informatics by introducing an integrated volunteer-centered digital coordination model that combines health workforce mapping, logistics tracking, and multimedia documentation within a single web-based platform—an approach not commonly implemented in community-based disaster organizations. Leadership refers to the inclusiveness and representativeness of all community interests and groups. Needs assessment describes the role played by community members in identifying the health needs and designing the program to be implemented; it is the extent to which programs strengthen the community's capacity to make decisions about the program's direction, development, monitoring, and evaluation.

This study has several limitations: i) The quantitative component involved a relatively small sample (n = 71) drawn from volunteers with health-related backgrounds within a single organizational network. Therefore, generalizability to other volunteer organizations or regions may be limited; ii) The evaluation focused primarily on system development and user acceptance rather than long-term effectiveness. The study did not measure operational performance indicators such as response time reduction, logistics efficiency, or health outcome improvements during actual disaster deployment; iii) The findings relied partly on self-reported questionnaire data, which may introduce response bias. Although triangulated with qualitative interviews, behavioral validation of digital system usage was not conducted over an extended period; and iv) Interoperability testing with national disaster management systems was not implemented at this stage. The system currently operates as a standalone platform.

Despite these limitations, the study provides an important initial framework for volunteer-centered digital disaster coordination. Effective disaster management requires cross-actor collaboration. Strengthening cross-agency collaboration and improving information systems will contribute to more comprehensive disaster mitigation efforts and responsive disaster mitigation efforts. This research funding from Universitas Medika Suherman. This research has non-financial competing interests, including a declaration of political, personal, religious, ideological, academic, and intellectual competing interests. There are no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

FUNDING INFORMATION

Authors state no funding involved.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Emmelia Kristina	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Afif Wahyudi Hidayat						✓		✓	✓	✓	✓	✓		
Nico Suwarno	✓		✓	✓			✓			✓	✓		✓	
Nurali	✓		✓							✓				
Joao Manuel Correia Ximenes				✓	✓		✓			✓		✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

ETHICAL APPROVAL

Ethical approval was obtained from the institutional ethics committee of Universitas Medika Suherman (Approval No: 0017/11/Universitas Medika Suherman/2025).

INFORMED CONSENT

Informed consent was obtained from all participants before the distribution of the questionnaires.

DATA AVAILABILITY

The data that support the findings of this study are openly available in https://drive.google.com/drive/folders/1fck5sGbuvUfMwEZnhhwFvu3ayEhpgBiw?usp=sharing.

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BIOGRAPHIES OF AUTHORS

Emmelia Kristina Hutagaol is a dentist, academic, and reseacher primary involved in public health administration. Strong background in community health training and empowering communities in health education (disaster volunteer support) and hospital disaster planning. She can be contacted at email: kristina.hutagaol73@gmail.com.

Afif Wahyudi Hidayat academic and reseacher primary involved in public health administration. His strong background in hospital administration. He can be contacted at email: afifwahyudi.awh@gmail.com.

Niko Suwarno is an academic, researcher and consultant in data science, mining, and business intelligence. Strong background in business intelligence. He can be contacted at email: suwaryoniko@gmail.com.

Nurali is an academic and reseacher primary involved in business digital. Strong background in web application. He can be contacted at email: nuralispdmm@gmail.com.

Joao Manuel Correia Ximenes is a senior health system specializing in health policy development and health system approach. Experienced with all stages of the health policy, system and program implementation from ground-up. Strong background in project management and people centered approachment and NDC program in primary health setting. He can be contacted at email: xjoaomanuelcorreia23@gmail.com.