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OPERATIONALIZATION OF A DISTRICT-LEVEL HEALTH EMERGENCY OPERATION CENTER DURING THE MOUNT SEMERU ERUPTION: A FIELD REPORT

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List of Abbreviations

DHO	: District Health Office
EMT	: Emergency Medical Team
EMTCC	: Emergency Medical Team Coordination Cell
EOC	: Emergency Operations Center
FK-KMK	: Fakultas Kedokteran, Kesehatan Masyarakat dan Keperawatan / Faculty of Medicine, Public Health and Nursing
GIS	: Geographic Information System
HEOC	: Health Emergency Operation Center
MoH	: Ministry of Health
PHEOC	: Public Health Emergency Operations Center
PPE	: Personal Protective Equipment
SOD	: Sudden-Onset Disaster
UGM	: Universitas Gadjah Mada / Gadjah Mada University
WHO	: World Health Organization

ABSTRACT

Introduction: Indonesia is highly prone to natural disaster, including volcanic eruptions that often generate sudden public health emergencies requiring rapid coordination and effective management of health resources. The eruption of Mount Semeru in December 2021 caused mass displacement and increased demand for emergency health services in Lumajang District, East Java. **Objective:** This field report aims to describe the establishment and operationalization of a district-level Health Emergency Operations Center (HEOC) during the acute response to the Mount Semeru eruption. **Methods:** A descriptive field report design was applied using operational documents, real-time coordination records, and field observations collected during the first ten days of the emergency response. Data were analyzed descriptively to examine coordination mechanisms, information management, volunteer deployment, and logistics monitoring. **Results:** HEOC activation strengthened command and coordination through routine coordination meetings, centralized health information management, structured volunteer deployment, and integrated logistics monitoring. These mechanisms improved situational awareness, reduced duplication of efforts, and supported timely operational decision-making despite resource constraints. **Conclusion:** The operationalization of a district-level HEOC enhanced health sector coordination and operational efficiency during the acute response phase. This report provides practical insights into HEOC implementation and highlights its importance for strengthening district-level health emergency preparedness in disaster-prone settings.

Keywords: Health Emergency Operation Center; Disaster Health Coordination; Volcanic Eruption; Emergency Response; District-Level Health System

INTRODUCTION

Indonesia is one of the most disaster-prone nations in the world with a never-ending list of natural disasters including earthquakes, floods, landslides and volcanoes. Disasters, in particular, commonly produce rapid and enormous public health emergencies that necessitate immediate deployment of health-related resources, quick decision making and coordination between various agents. Volcanic eruptions are particularly difficult to manage from a health perspective, as they involve unpredictability, potential for mass displacement and impact on respiratory health (and other morbidity related to exacerbation of pre-existing conditions and injuries), disruption or loss of normal medical services (1).

An effective health emergency response requires not only access to medical resources but also a coordinated structure able to synchronize information, human resources, and logistics. Emergency health response would be fragmented, with lack of centralized command and military leaders working in almost isolation (2). These coordination lapses can have a negative impact on the efficacy of response efforts, especially at subnational or district-levels where frontline delivery takes place.

To address these challenges, the World Health Organization (WHO) recommends the establishment of a Public Health Emergency Operations Center (PHEOC) as a core component of national and subnational health emergency preparedness and response systems (3). PHEOC is defined as a physical or virtual hub that coordinates information, resources, and stakeholders to support incident management activities during public health emergencies. Key functions of a PHEOC include command and coordination, information management, resource tracking, and communication with relevant partners (4).

Despite current efforts for implementation of the PHEOC concept at national level, its operationalization at the district or local level is equally important, especially in decentralized health systems. At the district-level, health authorities coordinate health service delivery, mobilize healthcare workers and volunteers over logistics in their districts, and report on health information during public emergencies. At this level, the operationalization of a Health Emergency Operation Center (HEOC) constitutes an adaptation of the PHEOC concept. It allows local health operations to convert nationwide policies into effective coordination systems that are suitable for their specific context (3).

Even with increasing international acknowledgment of the significance of HEOCs, there are few empirical studies documenting how these centers function at a district-level, particularly in low- and middle-income countries. While literature and documents frequently provide event-based descriptions of emergency response activities or outputs of a cluster coordination system, there appears to be scant attention paid to the nature and type of internal operational processes, coordination workflows as well as information management systems that define how the HEOC works (5). Consequently, comprehensive documentation of district-level HEOC operations during real-world emergencies remains scarce.

In December 2021, an eruption of Mount Semeru in Lumajang District East Java Indonesia resulted in mass population displacement and surge demand for emergency health services. The Lumajang District Health Office subsequently responded by initiating its health

emergency coordination structures (HEOC) and established a district-level HEOC to assist command, coordination and information management during the acute response period. Although descriptions of health coordination during this event have been shared at conferences, detailed documentation of HEOC operations including command and control, incident management, information management, volunteer coordination and logistics tracking has not been well demonstrated in the literature.

This field report aims to describe the establishment and operationalization of a district-level Health Emergency Operation Center (HEOC) during the response to the Mount Semeru eruption. It focuses on coordination mechanisms, information management processes, volunteer deployment, and logistics coordination implemented by the district health authority during the most acute phase of the emergency. By explicitly documenting district-level HEOC operational workflows, coordination mechanisms, and system-level functions, this report differs from prior event-based descriptions and seeks to provide practical insights to strengthen sustained health emergency preparedness and response in disaster prone settings.

METHODS

Study Design

The present study, which was based on operational records and personal observations during the emergency response of Mount Semeru eruption, used a descriptive field report design. This method was adopted to describe the organization of real-time coordination procedures, operational decision-making and system-level roles of the Health Emergency Operations Center (HEOC) operating framework in a sudden-onset disaster scenario in line with WHO recommendations for documenting public health emergency operations (4, 3).

Study Setting and Period

This research was carried out in Lumajang District, East Java Province, Indonesia after the eruption of Mount Semeru in December 2021. Data were collected in the acute response phase (5-15 December 2021), which was also when HEOC at Lumajang District Health Office was activated.

HEOC Activation and Operational Context

The Lumajang District Health Office organized a district-level Health Emergency Operation Center (HEOC) to manage health sector response action. The HEOC was established

as a permanent, central coordinating center in charge of command and control, health information management, volunteer allocation and logistics monitoring. Operational structures and workflows were adapted from national emergency response guidelines and aligned with the Public Health Emergency Operations Center (PHEOC) framework recommended by the World Health Organization (3).

Data Sources

Data were collected through multiple sources to ensure that the HEOC's activities have been well documented:

1. Operational files, comprising daily Situation Reports (SitReps), minutes of coordination meetings, records of volunteers in the field and logistics tracking forms;
2. The field observation was held directly during the HEOC daily coordination meetings and operation briefings;
3. Health information records, which comprise aggregate data on health service utilization obtained from health facilities and emergency medical teams.

Convergence of sources was then used to increase the credibility of operational findings, as per best practice for emergency response documentation (4).

Data Collection Procedures

The field investigations took place at the same time as HEOC was operating. Information consolidation and validation and operational decision-making meetings were conducted at daily coordination meetings. Google Sheet–based shared platforms fielded both health data, volunteer information, and logistics updates with real-time data entry and access for stakeholders. While this was cost effective in terms of coordination, it adhered to agreed data elements for the management of emergency information (3).

Data Analysis

Analysis Descriptive thematic analysis was conducted with focus on four predetermined levels of operations based on the WHO PHEOC framework:

1. Command and coordination mechanisms;
2. Health information management;

3. Volunteer management and deployment;
4. Logistics and resource coordination.

Results were narratively summarized and presented in Table 1 to illustrate main operational challenges and HEOC response. The complete coordination and operational process were outlined based on the HEOC activation and response cycle as shown in Figure 1.

Ethical Considerations

Aggregated operation data were used and individual patient identification identifiers were not included in this study. All data were obtained through standard emergency response activities. Thus, ethical approval was not necessary, as per WHO recommendation for the use of public health surveillance and response information 1 for operational reporting and learning (6).

This field report is descriptive in nature and does not aim to assess causal relationships or intervention effectiveness.

RESULTS

Health Emergency Operations Centers (HEOCs) Activation

The HEOC at the Lumajang District Health Office, which activated directly following the eruption, aimed to complement command, coordination and control of health sector response. As elaborated in Figure 1, this activation came after an initial needs assessment exercise conducted collectively by the DHO and supporting institutions which resulted in four prioritized operational functions:

1. Command and coordination,
2. Health information management,
3. Volunteer management, and
4. Logistics monitoring.

This model has been an organized way of making operational decisions and standardising the work process in the health organizations (7, 3).

Coordination Mechanisms and Daily Operations

Daily operational meetings took place at the HEOC to update the situation, confirm intelligence and task teams. Operationally, we generated Situation Reports (SitReps), data

verification summaries and lists of prioritized actions for our field health facilities and posts. The flow of the coordination process along with the daily cycle of operations are also organized in Figure 1, to illustrate how SitRep review, data quality control and task assignment systematically integrated within the core command mechanisms of HEOC (7).

Volunteer Deployment and Management

Over 100 health volunteer participants were recruited via a real-time Google Sheet for name data, professional backgrounds and deployment schedule. This mechanism facilitated effective mobilization of volunteers to the evacuation centers, health posts and primary health care (7, 8). Revised and enhanced volunteer management also helped to decrease duplication in assignments as well as balance the distribution of workers across the workforce (9, 10, 11).

Health Information and Surveillance

Data were gathered from a number of health facilities including casualty reports, complaints such as respiratory and dermatologic conditions following ash exposure, and profiles of service delivery. Centralization of information management a theme indicated in Table 1 resulted in more consistent timely surveillance updates, that were also corroborated during HEOC coordination meetings as demonstrated by Figure 1 (3, 4, 7, 8).

Logistics and Resource Monitoring

Logistics oversight comprised monitoring of essential drugs, PPE (Personal Protective Equipment), medical instruments and transfer resources. The integrated stock out monitoring system resulted in early identification of shortages and rapid coordination with the provincial authorities for replenishment (3). The effects of logistics monitoring on enhancing resource allocation are listed in Table 1.

Table 1. Summary of Key Findings During the Initial Phase of HEOC Activation in the Mount Semeru Eruption Response

Component	Key Findings	Impact on Response
Health Emergency Operations Centers (HEOCs) Activation	Four priority functions activated: command & coordination, health information management, volunteer management, and logistics monitoring	Improved communication flow and clarified command structure

Coordination Mechanisms and Daily Operations	Daily coordination meetings, SitRep development, cross-unit data verification.	Faster decision-making and increased data consistency.
Volunteer Deployment and Management	100+ health volunteers registered and deployed; Google Sheet used for monitoring	More balanced volunteer distribution, reduced duplication
Health Information and Surveillance	Consolidated casualty data, disease surveillance, service disruptions.	Faster situation reporting and identification of priority needs
Logistics and Resource Monitoring	Centralized tracking of medicines, PPE, equipment.	Early detection of shortages enabled timely resupply.
Key Challenges Identified	Inconsistent early data, limited communication, overlapping volunteer arrivals, limited DHO human resources.	HEOC activation mitigated major operational constraints

Source: Yogadhita et al., 2026

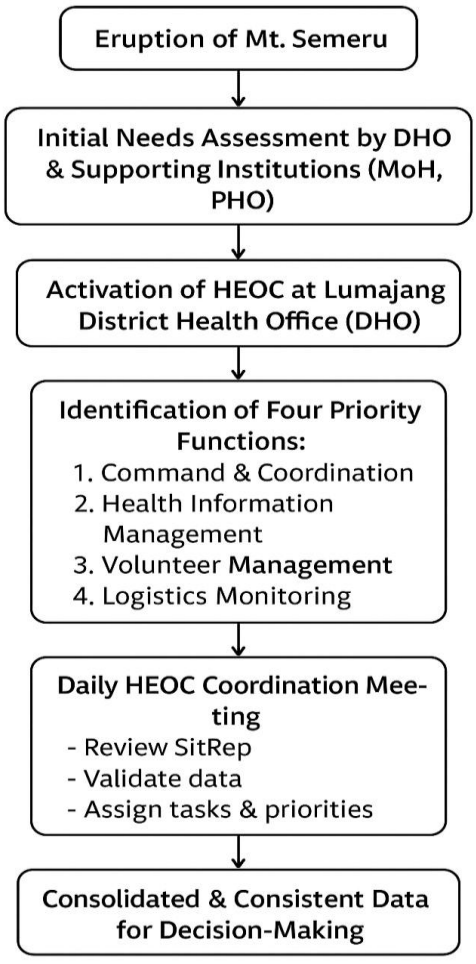

Figure 1. Flowchart of HEOC Activation and Operational Process During the Semeru Eruption Response

Source: Yogadhita et al., 2026

Key Challenges Identified

A number of operational issues were raised at the outset:

1. Unreliable information received from various reporting sources before the activation of HEOC.
2. Poor systems for communication, particularly in the first 24 hours.
3. Stacking volunteers in with no proper scheduling.
4. Inadequate DHO personnel to handle the massive volume of incoming information.

As detailed in Table 1, these problems were addressed by activating the HEOC to clarify command roles, centralize information gathering and enhance inter-agency collaboration (3). The operating process shown in Figure 1 serves as an additional demonstration on how specific procedures helped solve these problems.

DISCUSSION

The analysis of this field report has shown that the activation of a district-level Health Emergency Operation Center (HEOC) played a significant role in the enhanced coordination, information management and operational effectiveness as part of the response to Mount Semeru eruption sequently. As illustrated in Figure 1, the HEOC created a defined operating cycle that tied initial needs assessment, regular coordination of activities and field-level execution firmly together. This organized system of operations management provided solutions to some typical problems experienced in sudden onset disasters, such as fragmented command structures, subordination of responsibility and uneven information gathering.

Strengthening Command and Coordination

Among the most important results of the activation of HEOC was the creation of an integrated command and coordination system in the health sector. Before the activation of HEOC, coordination mechanisms had multiple parallel reporting lines and shared responsibilities in institutions leading to possible duplication and stagnation. Establishment of daily coordination meetings provided a centralized mechanism for joint status updates, task allocation and prioritization of health resources.

Summary of the coordination mechanisms is shown in Table 1 which contributed to enhancing communication and minimizing ambiguity regarding operational roles (3, 2). The operational cycle illustrated in Figure 1 also showed that organized coordination allowed the

HEOC to act as a nexus between national policy, provincial backing and district-level interventions. These end point results are similar to the international disaster management standards that strongly advocate a clear cut, single chain of command for effective emergency response with respect to subnational levels.

Health Information Management and Situational Awareness

Improved management of health information was also identified as a significant benefit provided by the HEOC. Early in the response, coordinating data on deaths and on disease surveillance is which became one of the most operationally challenging aspects. With hardware dedicated to servers repurposed for the HEOC, their switch over to a distributed shared Google Sheets database also allowed them to bring all of the data from multiple health facilities and field posts together in a simplified and simultaneous situation report.

Table 1. This method had a number of benefits such as improving data consistency and information currency, leading to more enhanced situational awareness for decision-makers (4). Sharing of surveillance and service availability data at daily coordination meetings was visualized in Figure 1 which helped for rapid cross validation of the information and evidence informed decisions. Such function is consistent with WHO recommendation that information management should be an integral part of public health emergency operations centers and particularly pertinent in settings where routine information systems could be disrupted during emergencies.

Volunteer Management and Operational Efficiency

Mobilization of volunteers was a double-edged sword in the response to the Mount Semeru eruption. The ad hoc influx of health volunteers from various organizations in the beginning led to uneven distribution and overlap of roles at response sites. This issue was met with HEOC-managed volunteer systems focusing on a centralized registration, screening, dispatch process.

As can be seen in Table 1, organized volunteer management served to avoid duplication and to ensure that human resources were distributed to priority regions. HEOC leadership was able to make real-time adjustments in order to best meet the responding field needs, by including volunteer deployment decisions as part of the day-to-day HEOC operational cycle (Figure 1). These findings are in line with other evidence which suggests that having uncoordinated volunteer response can be a barrier to emergency service delivery, while a

coordinated volunteer system leads to greater operational efficiency, accountability and effectiveness (1, 10, 11).

Logistics Coordination and Resource Allocation

Another important achievement of HEOC activation is the efficient logistics coordination. The centralised monitoring of key medical commodities, including medicines, personal protective equipment and medical devices allowed early detection of stock-outs and facilitated timely coordination with provincial health authorities. As can be seen in Table 1, this central logistics function allowed to accelerate resource allocation and reduce service delivery delays (12).

Consistent with the PHEOC model, logistics coordination served as a base of operations for clinical and public health activities (5). By embedding logistics monitoring into daily coordination meetings (Figure 1), supply decisions became reflexive to real time field conditions.

Challenges and System-Level Implications

Nevertheless, difficulties persisted despite the general improvements engendered by HEOC activation. The coordination processes were highly stretched by limited communication infrastructure and human resources at the district health office, on one hand and increased demands for information, on the other. However, as shown in Table 1, the HEOC overcame many of them by standardizing reporting processes and concentrating command and coordination efforts centrally.

These results emphasize the need for preparedness action provided in advance of the disaster, including regular teaching and simulation exercises as well as improvement of standardized data management at district-level. Critical to this effort is the establishment of HEOC institutionalization in peacetime, which could lead to a reduced dependence on ad hoc mechanisms for coordination during crises and improve future response (13).

Contribution to Disaster Health Governance

Conclusion this experience adds to the growing body of evidence on the functions of district-level emergency operations centers in disaster-prone areas. By recording the operationalization of an HEOC in the context of an acute emergency, this research generates

useful knowledge about ways in which structured coordination arrangements better facilitate command, information processing, volunteer control and logistics coordination. The relationship between operational results (Table 1) and coordination processes (Figure 1) emphasizes the need for converting policy structures into practical, context-adapted operational systems that facilitate an effective response to health emergencies at district-level.

LIMITATION

There are some limitations in this field report that must be taken into account to interpret the findings. First, observational experience was the basis of the study and not published studies compared to one another. As such, the results are limited to reader interpretation as applying only to immediate context of operations during eruption response at Mount Semeru and not automatically extrapolatable elsewhere in disaster settings or governance environments.

Second, the analysis was based on secondary operational data that had been produced during an ongoing emergency response such as situation reports and real time coordination logs. Although the validation of data occurred through regular coordination meetings, differences in data completeness and reporting accuracy could have affected the comparability of some findings especially at early stages of the response.

Third, the Google Sheet-based data management system did not include standardized metadata structures common in established health information systems and, although it enabled rapid information sharing and aggregation from multiple sources, information coordination was more difficult. This limitation could have prevented consistent data harmonization within individual reporting units, particularly during the launching phase of HEOC.

Fourth, this study was not able to investigate reductions in morbidity or improved service coverage for child health outcomes and program effectiveness. As the study was of a qualitative and operational nature, we were more focused on documenting coordination mechanisms and operational processes than describing any population-level health impacts related to HEOC activation.

Lastly, the study was limited to the acute response period and thus does not capture longer-term recovery activities, the sustainability of coordination structures or institutional learning post emergency. Future prospective and qualitative investigations are required to assess the sustainability and long-term impact of district-level HEOC operationalization beyond the immediate response.

CONCLUSION

The establishment of district-level Health Emergency Operation Center (HEOC) on response against the eruption of Mount Semeru had contributed to improve capacity of health emergency response at district-level. Through creation of a dedicated coordination mechanism, the HEOC facilitated the reporting process, enhanced management of volunteers and tracking of logistics during the acute phase.

As shown in Table 1 and operationalized via the flow diagram depicted in Figure 1, the introduction of regular HEOC coordination meetings led to better situational awareness, decreased inconsistencies in data reporting, and increased coherence in decision support. These mechanisms allowed better organization of health sector actors and supported the operational planning by ensuring that general policy orientations were translated into concrete action in the field.

While issues concerning communication infrastructure, and shortage of human resource shortages persisted, coordination gaps were reduced by HEOC due to the centralization of information flow along with the standardization in operational workflow. Public health implications: These results emphasize the need for reinforcing HEOC preparedness at district-level by providing regular training, simulation exercises and establishment of standardized data management systems before an emergency occurs.

Given the applied focus of this field report, statements resulting from the results may be acknowledged as locally specific experiences rather than accurate indicators of health outcomes. However, this paper demonstrates the utility of HEOC clearly demonstrates as a governance tool to enhance coordination, information handling and allocation in SOD.

In conclusion, the analysis advances practical understanding for HEOC implementation at the district-level in disaster-prone areas. Lessons learned from the Mount Semeru eruption response could help guide how to strengthen health emergency preparedness and response capacities in Indonesia and other similar settings.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

ETHICAL APPROVAL

Not applicable. This study was based on a field response report and did not involve human subject research.

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