Information Sharing Across Institutions: Practices and Barriers during Public Health Emergencies in Ethiopia

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Abstracts

Background: Rapid, integrated information exchange between stakeholders is critical for effective emergency preparedness and response. However, many low- and middle-income countries face barriers to seamless data sharing. While information accessibility is recognized as important for evidence-based decision-making and resource allocation in Ethiopia, factors influencing current health information sharing practices among stakeholders involved in public health emergency management programs are unclear. This study aims to examine multi-sectoral stakeholders' perspectives and experiences with health data sharing during emergencies in Ethiopia, to identify opportunities and challenges influencing practices to strengthen the national public health emergency response system

Methods: A mixed-methods study was conducted between June and August 2023, involving a survey of 169 stakeholders actively involved in PHEM programs in Ethiopia as well as 23 in-depth interviews with key informants in senior leadership or advisory roles. The data was analyzed using descriptive statistics in SPSS and thematic analysis of qualitative transcripts.

Results: During emergencies, it was observed that data sharing between different entities occurred. Quantitative findings showed the predominant types of health data shared between stakeholders during emergencies included hospital data (109, 64.5%), clinical case information, and laboratory results. Challenges limiting effective coordination included issues like limited functionality of digital health systems (75, 44%), incompatible data formats (13, 34%), and financial constraints (83, 49%) and and socio-cultural barriers constrain current practices in Ethiopia. Qualitative interviews identified five themes around risk communication and inclusive alert systems. Experts emphasized tailored, multichannel outreach but noted infrastructure gaps and digital divides currently limit poorer communities' engagement.

Conclusion: While collaborative health information exchange during emergencies is recognized as important, systemic, financial, and socio-cultural barriers constrain current practices in Ethiopia. Targeted strategies including capacity building, investment in integrated data infrastructure, economic optimization through innovative financing models, trust-based relationship development, and locally relevant communication channels informed by stakeholder perspectives can optimize information accessibility, coordination, quality, and equity of healthcare services during public health emergencies.

Keywords: Health information exchange, Barriers, public health emergency

1.Background

Effective communication and information sharing are crucial for preparedness, response, and recovery during public health emergencies [1, 2]. Timely access to health information enables evidence-based decision-making, coordinated containment strategies, and optimized resource allocation, ultimately saving lives during outbreaks and disasters [3]. Health information sharing among stakeholders has significant challenges and far-reaching effects that undermine effective public health emergency management [4]. One of the key challenges is the fragmented response that arises when data cannot be seamlessly shared between different stakeholders, including government agencies, healthcare systems, researchers, and the public. This fragmentation hampers collaboration and coordination during emergencies, leading to suboptimal response efforts [2, 5-7]. Major effect of poor health information sharing is the increased spread of diseases during outbreaks. When there is a delay or insufficient exchange of information across technical, political, and cultural divides, it allows for the further contamination of the population [8-10]. Poor health information sharing also contributes to higher hospital costs, particularly in underserved regions [8, 11, 12].

Past studies have quantified the detrimental impacts of poor health information exchange during public health emergencies. Research found a lack of interoperability and data standards contributed to an estimated 30-70% of adverse patient outcomes and billions in productivity losses annually in the US [2, 13]. Another study shows that, found that inadequate data sharing was associated with an estimated 50% higher likelihood of medical errors and up to 4-fold increase in repeated testing based on their analysis [14]. During disease outbreaks, insufficient information exchange contributed to an estimated 23-87% rise in infection rates by delaying interventions [8, 15]. Border regions with poor cross-border data sharing saw 2-3 times more disease spread compared to regions with coordinated information exchange [15]. A WHO study found around 55% of deaths during the 2014 Ebola outbreak resulted from delayed case reporting hindering contact tracing and quarantines [3]. Such evidence affirms the critical need for robust health information sharing to enable timely and well-coordinated emergency response.

While past studies have quantified the impacts of poor health information exchange, gaps remain in understanding contextual reasons for suboptimal practices, particularly in low-resource settings. While past studies will have quantified the impacts of poor health information exchange, gaps will

remain in understanding contextual reasons for suboptimal practices, particularly in low-resource settings. This study will help address such gaps by assessing health information sharing practices and influencing factors within public health emergency management (PHEM) programs in Ethiopia[2, 13, 15, 16]. The mixed-methods exploration will provide insights into stakeholders' perspectives, current coordination processes, and barriers at systemic, financial, cultural, and technical levels. However, the narrow Ethiopia-focused scope will preclude a comprehensive assessment across diverse healthcare actors over time. Continued research employing broader, longitudinal methodologies can further elucidate the dynamic information management landscape to strengthen emergency preparedness and response.

2. Methods

2.1 Study Design, Period, and Area

This study employed a mixed methods approach with a convergent parallel design to comprehensively evaluate health information sharing practices and influencing factors within public health emergency management (PHEM) programs in Ethiopia. As the national coordinating body for PHEM, the Ethiopian Public Health Institute [17] leveraged an existing list of Stakeholders involved in various national and sub-national PHEM initiatives, including but not limited to surveillance systems, capacity-building programs, and emergency response mechanisms, across all regions of Ethiopia to recruit a large number of participants between June to August 2023. Ethiopia provided an ideal context due to its large population, diverse geography, ethnically diverse residents, and active PHEM programs coordinated through governmental and non-governmental partnerships [16]. The convergent parallel design allowed for a nuanced understanding of information management practices to emerge through complementary quantitative and qualitative data collection and analysis [18].

2.2 Sampling Methods and Sample Size

EPHI maintains a database of organizations engaged in health emergency work. From this registry compiled through ongoing surveillance, a desk review identified 65 entities documented as actively involved in information sharing related to PHEM programs over the past two years (2022-2023). Represented were federal agencies, regional bureaus, specialized hospitals, international organizations like WHO and academic partners. The sample encompassed a variety of stakeholders involved in national and sub-national PHEM initiatives, including representatives from

government agencies, non-governmental organizations, healthcare institutions, and community-based organizations, across all regions of Ethiopia.

Simple random sampling was employed to select eligible stakeholders from the total of 65 stakeholders to get the required sample size of the study, which consisted of 169 participants. Random sampling minimized potential bias by providing all stakeholders with an equal chance of being selected. For the qualitative interviews, the population consisted of stakeholders in senior positions or with a minimum of two years' experience in PHEM programs, who could provide in-depth insights. A purposive maximal variation sampling approach was used to select 23 key informants, aiming to capture diversity in roles, sectors, locations, and perspectives. Data collection continued until the point of data saturation, where no new information or insights emerged. This ensured a comprehensive range of perspectives to understand health information sharing dynamics at national and sub-national levels.

2.3 Data Collection Procedures and tools

Data collection involved in-depth interviews with key informants to gather qualitative data on stakeholder perspectives via face-to-face meetings using a semi-structured interview guide, as well as a structured checklist distributed online through a secure web-based platform for quantitative data collection on stakeholder perspectives utilizing closed-ended questions and Likert-scale responses.

The checklist included sections on demographic information, health information sharing levels, socio-political factors, financial and infrastructure considerations, organizational aspects, technical factors, and individual perspectives. The interview guide covered stakeholder background, interests, concerns, involvement, perceptions of risks and benefits, agreements or disagreements, resource contributions, barriers and enablers, suggestions for improved engagement, and contextual factors [18-22].

2.4 Data Quality Assurance

To maximize data quality, several assurance procedures were implemented. The survey instrument was developed through an iterative process involving expert review and pilot testing to identify and address any issues prior to use. All data collectors received training on survey administration techniques, research ethics, and how to address any issues arising during data collection. The online survey platform's features such as required fields and response validation helped ensure

completeness and consistency of quantitative data collection. All interviews for the qualitative data collection were conducted by experienced researchers and audio recorded with participants' consent to allow for transcription verification. A random sample of transcripts were checked against their original recordings to identify any potential transcription errors. An initial coding framework was pilot tested with a sample of transcripts independently analyzed by two coders, with inter-coder agreement exceeding 90%. Finally, an independent audit examined a sample of the quantitative and qualitative analysis procedures and outputs to validate their accuracy.

2.5 Data analysis and processing procedure

Quantitative Analysis

Quantitative data underwent data cleaning and manipulation using Atlas ti software. Descriptive analyses provided participant demographics, and psychometric testing ensured consistent and reliable measurement. Inter-rater assessments were conducted for qualitative coding. The results were summarized using appropriate descriptive statistics, such as frequencies, percentages, means, and standard deviations to identify summarize influencing health information sharing practices in PHEM programs [23]. Hence, multi-item scales were developed to measure key health information sharing dimensions. The scales demonstrated good reliability, including Data Management (16 items, $\alpha=0.80$), Infrastructure (6 items, $\alpha=0.78$), Technical Factors (5 items, $\alpha=0.733$), Organizational Factors (8 items, $\alpha=0.90$), and Environmental, Financial, Political, and Cultural Factors (13 items, $\alpha=0.76$). The study aimed to provide insights into improving emergency management systems and healthcare delivery in Ethiopia through targeted strategies and interventions. Each Likert scale question item was systematically scored and aggregated. The distribution of the resulting data was examined to assess its conformity to a normal distribution. In cases where the data exhibited a normal distribution, the mean was computed as a measure of central tendency. Conversely, for data that displayed skewness, the median was utilized as a robust measure of central tendency. As a result of this analysis, a substantial proportion of the data was found to deviate from a normal distribution, indicating a skewed distribution. Responses exceeding the calculated mean or median were operationally defined as indicative of a "good" rating, while responses falling below were operationally defined as indicative of a "poor" rating [24].

Qualitative Analysis

A thematic approach was employed for the analysis of qualitative data. The process began by transcribing the interviews verbatim, which were then imported into the qualitative data analysis software Atlas.ti. A coding framework was developed, guided by the interview guide and emergent themes. To ensure reliability, a subset of transcripts underwent independent coding by two researchers, with regular meetings held to address any coding discrepancies. Following the coding process, the data was meticulously analyzed to identify patterns, themes, and relationships. Five overarching themes, along with three sub-themes for each theme, were developed. To enhance the overall understanding, the qualitative findings were triangulated with quantitative data. This approach adheres to established qualitative analysis frameworks commonly employed in public health and social sciences research, despite the absence of a specific methodological paper [25, 26].

3. Result

3.1 Quantitative result

3.1.1 Demographic characteristics

The survey comprised a sample of 169 participants, yielding a response rate of 81%. A considerable portion (71, 42.0%) of respondents fell within the 30-35 age bracket (**Table 1**). In terms of educational background, a significant majority (122, 72.2%) held master's degrees. Organizational affiliations varied, with the largest proportion (100, 59.2%) employed in government positions, while others were affiliated with health institutions, non-governmental organizations (NGOs), and diverse entities. Concerning professional roles, over (104, 61.5%) served as experts in public health and emergency management, while the remainder held positions such as directors, program managers, healthcare providers, and a smaller contingent in alternative role.

Table 1: Demographic Characteristics of Participants for Health Information Sharing Practices and Influencing Factors in Ethiopian Public Health Emergency Management, 2023

Characteristics	Category	Frequency	Percentage (%)
Age	25-30	30	17.8
	30-35	71	42.0
	35-40	50	29.6
	≥40	18	10.7

Sex	Male	155	91.7
	Female	14	8.3
Educational level	First degree	46	27.2
	Masters/second degree	122	72.2
	Third degree/above	1	0.6
Work Experience (in years)	<5	50	29.6
	5-10	82	48.5
	>10	37	21.9
Organization	Government	100	59.2
	Health institutions	31	18.3
	NGO's	2	1.2
	Others	36	21.3
Role in PHEM	PHEM Expert	104	61.5
	Program Manager	9	5.3
	PHEM Director	24	14.2
	Health care provider	29	17.1
	Others	3	1.8

3.1.2 Quantitative findings; Stakeholders' health information exchange (HIE) practices in public health emergencies

This analysis explores the health information exchange (HIE) practices employed during public health emergencies in Ethiopia in 2023. Covering a spectrum of aspects, the investigation scrutinizes data types exchanged, challenges within organizational health systems, cultural and technical barriers, legal and regulatory considerations, preferred modes of interaction, and financial impediments.

The study revealed that (109, 64.5%) of respondents engaged in the exchange of hospital data, followed by case, laboratory, and demographic data (**Table 2**). Widespread challenges within organizational health systems were reported, with limited system functionality emerging as the most prevalent issue, acknowledged by over (75, 44%) of respondents. This pertains to the inadequate or restricted performance and capabilities of organizational health systems. Additional

reported barriers encompassed fragmented processes and inflexible structures. Notably, limited functionality surfaced as the predominant challenge impeding effective coordination among organizations.

Several categories of barriers hindering effective coordination were identified. Cultural barriers primarily involved a lack of trust between organizations and siloed structures. Concerning technical barriers, issues such as incompatible data formats and insufficient storage were prominent. Face-to-face interaction was identified as the most desirable communication preference, albeit not always feasible given Ethiopia's expansive geographical landscape. Remarkably, financial barriers emerged as the most frequently reported challenge, with nearly 50% of respondents citing issues such as high maintenance costs of digital systems.

Table 2: Stakeholders' Health Information Sharing Practices in Ethiopian Public Health Emergency Management, 2023

Section	Category	Frequency	Percentage (%)
Type of data being shared among stakeholders for the implementation of PHEM program	Case data	13	7.7
	Laboratory data	19	5.3
	Demographic data	33	19.5
	Hospital data	109	64.5
	Others	5	3
The data handling challenge within your organization	They are incomplete	13	7.7
	They are rigid	12	7.1
	They are fragmented	17	10.1
	They have limited functionality	75	44.4
	They are decentralized	52	30.7
Cultural barriers in PHEM information sharing	Lack of trust	20	11.8
	Competing priorities	57	33.7
	Organizational silos	57	33.7
	Insufficient communication channels	35	20.7

Technical barriers in PHEM information sharing?	Incompatible data formats	13	7.7
	Lack of interoperability	78	46.2
	Insufficient data storage capacity	58	34.32
	Poor data quality or data governance	20	11.9
Legal and/or regulatory barriers in PHEM information sharing	Data privacy laws	14	8.3
	Data sharing agreements	103	61.0
	Intellectual property rights	15	8.9
	No specific issues	29	17.2
		8	4.7
Preferred means of Interactions in PHEM information sharing	Face-to-face	69	40.8
	Phone	56	33.1
	Mail	29	17.2
	Zoom (or similar)	9	5.3
	Social media platforms (like telegram)	6	3.6
Financial barriers in PHEM information sharing	Maintenance costs	6	3.6
	Management costs	55	32.5
	High airtime costs	83	49.1
	Budget constraints	14	8.3
	Others	11	6.5

3.1.3 Socio-political factors impacting stakeholders' health information exchange

The socio-political factors impacting stakeholders' health information exchange (HIE) practices during public health emergencies in Ethiopia (2023) reveal several significant insights (**Table 3**).

The survey findings indicated that a majority of respondents, specifically over 60%, acknowledged the significance of cultural understanding in facilitating evidence-based decision-making recognizing recognizing the importance of considering cultural factors when making decisions based on available evidence. However, financial constraints were also noted as hindering effective data exchange practices.

Infrastructure, referring to the physical and organizational systems, facilities, and resources that are essential for effective functioning and operation, was recognized as important. However, over half of the respondents rated the existing capacities as poor, with specific concerns cited about outdated IT systems unable to support current data exchange needs, insufficient network coverage limiting connection of rural health facilities to centralized databases and understaffing at regional health centers straining human resources needed for regular maintenance, system updates, and effective emergency response coordination between sites. Study participants noted how these infrastructure deficiencies undermined timely access to patient health information during public health emergencies, impeding crucial clinical decision-making, resource allocation, and outbreak monitoring activities. Strengthening infrastructure across Ethiopia's health sector was emphasized as a priority area by stakeholders to help facilitate more robust health information exchange and pandemic preparedness.

Organizational elements, such as resources, trained staff, coordination, roles, policy involvement, training, technology, and incentives, were recognized as influential, but less than half assessed their current status positively. Nearly (86, 50%) of respondents found technical capabilities, such as computerizing manual systems, utilizing open-source technologies, addressing interoperability issues, and overcoming technical barriers, to be inadequate. On a positive note, approximately 45% of participants credited individual-level competencies, such as employees understanding the software language, software being developed in local languages, assessing employee needs when adopting new technology, perceiving usefulness of information exchange systems, using standardized data sets and forms for reporting, and seeking feedback. However, a concerning finding was that over half of the participants believed data management practices require improvement.

Table 3: Socio-political Factors Affecting Stakeholders' Health Information sharing Practices in Ethiopian Public Health Emergency Management, 2023

Item	Category	Frequency	Percentage (%)
Cultural factors on PHEM information sharing	Good	65	61.5
	Poor	104	38.4

Political factors on PHEM information sharing	Good	78	46.2
	Poor	91	53.9
Financial factors on PHEM information sharing	Good	88	47.9
	Poor	81	52.7
Infrastructure factors on PHEM information sharing	Good	77	45.6
	Poor	92	54.4
Organizational factors on PHEM information sharing	Good	89	47.3
	Poor	80	52.6
Technical factors on PHEM information sharing	Good	86	50.9
	Poor	83	49.1
Individual factors on PHEM information sharing	Good	75	44.4
	Poor	94	55.6
Data management factors on PHEM information sharing	Good	80	47.3
	Poor	89	52.6

Table 1: Demographic characteristics of key informants Health Information Sharing Practices and Influencing Factors in Ethiopian Public Health Emergency Management, 2023

SN	Variable	Frequency	Percentages
Sex	Male	15	65
	Female	8	35
Age	Less than 36	12	53
	36 and +36	16	47
Level of education	Master's degree	23	100

Area of specialization	Epidemiologist	4	17
	Field epidemiologist	6	26
	General public health	1	4
	Laboratory technologist	2	9
	Medical emergency specialist	1	4
	Nutritionist	3	13
	Psychologist	1	4
	Public health specialist	5	22
Position	Emergency nutrition officer	3	13
	MHPSS	2	9
	PHEM Expert	17	74
	Surveillance officer	1	4
Types of organization	Governmental	17	74
	Non-governmental	6	26

3.2 Qualitative findings

3.2.1 Demographic characteristics of key informants

The key informant sample in this study consisted of individuals with advanced master's degrees (23, 100%) in various public health disciplines. Participants spanned different career stages, ranging from early to later stages. Their specializations covered critical areas of PHEM. The majority (17, 4%) had direct PHEM experience from governmental entities, while (6, 26%) represented non-governmental organizations (**Table 4**).

Table 4: List of key Health information Health Information Sharing Practices and Influencing Factors in Ethiopian Public Health Emergency Management Program, 2023.

SN	Sex	Age	Educational status	Area of specialization	Position	Organization

P1	Male	29	Master's degree	Nutritionist	Emergency nutrition	NGO
P2	Female	45	Master's degree	Epidemiologist	PHEM Expert	Government
P3	Male	36	Master's degree	Public health specialist	PHEM Expert	Government
P4	Female	25	Master's degree	Public health specialist	PHEM Expert	Government
P5	Male	26	Master's degree	Epidemiologist	PHEM Expert	Government
P6	Male	42	Master's degree	Psychologist	MHPSS	Government
P7	Female	41	Master's degree	Field epidemiologist	PHEM Expert	Government
P8	Male	39	Master's degree	Field epidemiologist	PHEM Expert	Government
P9	Female	37	Master's degree	General public health	MHPSS	NGO
P10	Male	37	Master's degree	Laboratory	PHEM Expert	Government
P11	Female	42	Master's degree	Field Epidemiologist	PHEM Expert	Government
P12	Male	34	Master's degree	Epidemiologist	Surveillance officer	Government
P13	Male	29	Master's degree	Nutritionist	Emergency nutrition officer	NGO
P14	Female	36	Master's degree	Public health specialist	PHEM expert	Government
P15	Female	43	Master's degree	Field Epidemiologist	PHEM Expert	Government

P16	Male	25	Master's degree	Public health specialist	PHEM Expert	Government
P17	Male	28	Master's degree	Epidemiologist	PHEM Expert	NGO
P18	Male	37	Master's degree	Laboratory technologist	PHEM expert	Government
P19	Male	30	Master's degree	Nutritionist	Emergency nutrition officer	NGO
P20	Male	38	Master's degree	Medical emergency specialist	PHEM Expert	Government
P21	Female	30	Master's degree	Field Epidemiologist	PHEM Expert	Government
P22	Male	40	Master's degree	Public health specialist	PHEM Expert	Government
P23	Male	35	Master's degree	Field epidemiologist	PHEM Expert	NGO

3.2 .2 Key qualitative findings

Interviews with various stakeholders provided valuable perspectives on communication strategies, challenges faced, and opportunities for improvement. Effective communication requires a multi-pronged approach using diverse channels tailored to different audiences. As many participants emphasized, this enhances reach and allows for two-way dialog. Tailoring delivery through preferred mediums also makes messages more relevant and comprehensible.

During public health crises, coordinated information exchange underpins effective response. Qualitative analysis of data from Ethiopian public health experts gleaned several promising strategies and opportunities for optimizing inclusive emergency risk communication practices.

On effective communication approaches, participants stressed utilizing multiple channels that accommodate diverse needs (P1, P2). This "diversity of outreach" provides tailored updates across newer interactive platforms and traditional broadcast media enabling two-way dialogue and

awareness regardless of access preferences according to one nutritionist (P1). Accurate, transparent data delivered promptly builds confidence managing uncertainties an epidemiologist advised (P6, P18). Partnerships harness unique strengths through collaborative networks, amplifying messaging a public health specialist recognized (P7, P17).

Breakdowns notably harm information dissemination. Misinformation, inaccuracies, or delays bring "confusion costing lives," agreed experts like a PHEM director, demanding fact-based advisories that guide protective behaviors (P15, P16). "Fragmented sharing breeds fragmented response," recognized an emergency manager, requiring coordinated operations for efficiency amid dynamic events (P10, P17). Meanwhile, lacking transparency erodes the trust vital for voluntary cooperation a specialist observed (P19, P20).

An expert said that because of limited resources and infrastructure, it's hard for everyone to be included. The experts also said, 'we need to find ways to make sure everyone has access to technology, especially because some groups are being affected more by problems with phone and internet connections' (P16, P23). When there are different stories being told, it's hard to know what's really true and important during emergencies (P21, P22). And when things are kept secret in the past, it made it harder for people to trust each other and work together (P23)."

Optimizing information sharing demands coordinated strategies. "Access powers awareness" determined an expert, necessitating a "bridge" between technological barriers and populations through optimized infrastructure (P23). Participatory engagement cultivates ownership by addressing priorities across communities, recognized participants (P14, P23). Moreover, "one message does not fit all," a specialist elucidated - requiring customized communications that convey accessible, empowering data for self-reliant crisis response (P11, P23).

Specifically, inclusive infrastructure maintaining connectivity can counter divides by powering situational awareness according to a public health specialist (P23). Through localized relevance and voluntary cooperation secured via stakeholder inputs, preparedness progresses boundlessly participants recognized (P14, P23). Targeted information conveys life-saving facts in simple, multilingual formats across differentiated groups and needs as emphasized (P11, P23).

Insightful perspectives surfaced addressing emerging risks. Information overload and misinformation obscure guiding facts, diminishing response according to a communication expert (P21). By illuminating such complexities, findings provide a strategic roadmap to strengthen public health security. Addressing qualitative guidance could enhance coordinated emergency management nationally through optimized, empowering communications bolstered by engaged infrastructure as envisioned. These participatory solutions hold promise to address barriers impeding information flow disproportionately impacting communities. Equipping Ethiopia's health system to protect vulnerable populations demands inclusive, multilevel initiatives informed by stakeholders' wisdom (**Table 5**).

Table 5: Summary of Health information Health Information Sharing Practices and Influencing Factors in Ethiopian Public Health Emergency Management Program, 2023.

Major Theme	Sub-theme	Quote
Effective Communication Strategies	Using multiple communication channels	"*A diversity of communication channels provides a symphony of outreach during public health crises, enabling broader, more resonant messaging through traditional and digital media, interpersonal interactions, and community partnerships*"[P1].
	Providing accurate and timely information	"*Truth and transparency are the strongest foundations for building public trust in turbulent times, countering misinformation with candid insights and data that affirm a commitment to serve the public good*" [P18].
	Coordination and engagement	"*Individually, our impact is limited. However, through collaboration, we have the potential to achieve significant outcomes. Effective crisis communication relies on cohesive partnerships*" [P23
Effective Stakeholder Communication	1. Employing multiple channels	"*You need to communicate openly, honestly and frequently. Keeping the public informed builds trust and compliance*" [P6].
	Tailored and accessible messaging	"*Common ground requires an uncommon touch. Customize messages to resonate across all groups,*

		reflecting community insights and formats that make complex data accessible and actionable for each audience" [P2].
	Timely information sharing	*"Real-time data builds real-time awareness. Share information early and often to synchronize emergency response, enabling data-driven, agile decision making as situations rapidly evolve"* [P7].
Communication Breakdown Impacts .	Delayed and inaccurate information dissemination	*"Lost in lies and lateness lives are lost. Truth and timeliness save lives in public health emergencies, countering misinformation with candid, real-time data that guides protective behaviors"* [P15].
	Reduced coordination	*"Fragmented communication breeds fragmented response. Open information exchange is the heart of coordinated crisis management, saving lives through rapid, transparent data sharing among partners"* [P17].
	Eroded trust	*"Confidence springs from transparency. Earn public trust through openness and you will reap public support, conveying complete insights that affirm your commitment to serve the greater good"* [P19].
Barriers to Information Sharing	Infrastructure and resource limitations	*"Technology gaps create awareness gaps. Communication infrastructure enables inclusion,"* [P21]
	Dissemination challenges	"Accurate content, not volume, wins hearts and minds. Cut through the noise with clear priorities" [P21]
	Trust and credibility issues	*"Where there is secrecy, there is doubt. Transparency and engagement breed trust"* [P23]
Strategies to Improve Information Sharing	Communication infrastructure	*"Access powers awareness. Close the digital divide through coordinated infrastructure"* [P23]
	Stakeholder engagement	*"Progress has no limit when built together. Engage diverse stakeholders for optimal crisis response, tapping*

		localized insights and addressing unique needs through inclusive communication that secures comprehensive buy-in and cooperation"[P14]
	Customized information	"One message does not fit all. Target communications to empower communities," [P11]

Discussion

The study's findings provide insights into crucial facets of health information sharing within the Ethiopian PHEM landscape. The prevailing preference for face-to-face communication among stakeholders underscores a delayed embrace of digital technology in emergency contexts, accentuating a disparity between strategic aspirations and practical implementation. Noteworthy barriers such as transparency and privacy concerns were identified, significantly undermining trust and impeding effective coordination. Furthermore, financial constraints, cultural factors, fragmented systems, and incompatible data formats surfaced as formidable obstacles to seamless information sharing. Despite these challenges, the study unearthed opportunities for enhancement, emphasizing the importance of data sharing during emergencies and advocating for centralized systems and feedback loops.

A significant portion of stakeholders (69, 40.8%) expresses a preference for face-to-face communication over digital health information sharing. This finding indicates a gap between strategic aspirations and practical implementation, highlighting the delayed adoption of technology in emergency contexts. Existing literature emphasizes the crucial role of effective communication during emergencies for a timely and efficient response [27]. While some studies have demonstrated successful technology integration as a supplement to face-to-face engagement when adapted locally, such as the use of WhatsApp during the 2014 Ebola outbreak in West Africa to disseminate over 130,000 health messages weekly when in-person outreach was limited [28]. Ethiopia could explore complementary approaches like these. For instance, initiating small-scale pilots to test tailored messaging on popular platforms may help build comfort and capacity over time [29]. Addressing this gap can enhance the speed and accuracy of information sharing, leading to improved coordination and response during public health emergencies. The study found hospital data (109, 64.5%)) and limited functionality (75, 44%)) hindered coordination in Ethiopia.

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However, COVID-19 responses highlighting inconsistent hospital data increased errors in the US [14] and cost billions due to lack of interoperability standards [2, 13]

The study identified transparency and privacy concerns as significant factors undermining trust among stakeholders and hindering coordination. This finding aligns with previous research that shows the impact of unclear information sharing policies on collaboration [30]. However, other contexts successfully addressed such issues. After public backlash over practices, Estonia redesigned its national e-health system using an open-source blockchain model with citizen oversight. The unprecedented transparency gained wide acceptance [31]. Rwanda's mandate for detailed community consultations throughout the health facility data pooling process, coupled with proactive identification and addressing of concerns, as well as independent audits, further bolstered confidence in the stringent protection measures and studies demonstrated that this collaborative and accountability-enabling approach significantly contributed to building strong confidence in the system [32]. Ethiopia could consider outlining information policies transparently while establishing ongoing input mechanisms to engage stakeholders. Piloting trust-building technologies like blockchain may also boost accountability over time and maintain trust as systems evolve through continued engagement.

The study identified several barriers to health information sharing among stakeholders in Ethiopian PHEM, including financial constraints, cultural factors, fragmented health information systems, and incompatible data formats. These findings are consistent with the existing literature on challenges in health information sharing, particularly in resource-constrained settings [1]. The study also highlighted opportunities for improvement, such as data sharing between hospitals during emergencies and the need for centralized data and feedback loops. The literature supports these opportunities, emphasizing the importance of strategic investments in technology interfaces, cost optimization, cultural alignment, and relationship-building for effective health information sharing [2, 33]. Addressing identified barriers and maximizing opportunities through multi-pronged approaches could strengthen Ethiopia's health information sharing environment. Lessons may be drawn from South Africa's experience co-designing cultural training with local health workers, demonstrating an approach that when adapted for Ethiopia through stakeholder collaboration, may support addressing socio-cultural barriers [34]. Indonesia also provides an example through its establishment of cross-sector governance committees to build consensus on

iterative technology upgrades [35]. By learning from successful programs covering technological, financial, social and governance aspects implemented elsewhere, Ethiopia can refine current solutions to facilitate collaboration and emergency preparedness through optimized health data exchange.

Limitation of the study

The study has several noteworthy limitations that warrant consideration. Firstly, the limited sample size employed in the research raises concerns regarding the generalizability of the findings. The study primarily concentrated on stakeholders directly involved in public health emergency management, potentially neglecting valuable insights from other healthcare actors involved in information sharing. This narrow focus may restrict the comprehensive understanding of health information sharing practices. Additionally, the findings are bound by the specific time period in which the study was conducted and may not fully capture the dynamic nature of these practices over time. It is imperative for future research endeavors to acknowledge and address these limitations by employing larger and more diverse samples, incorporating perspectives from a broader range of healthcare stakeholders, and conducting longitudinal investigations to elucidate the evolving landscape of health information sharing practices.

Implication

To improve health information sharing during emergencies, key strategies include investing in ICT infrastructure, addressing resource constraints and skill shortages, promoting standardization and interoperability of health information systems, implementing capacity building initiatives, establishing clear data sharing policies, fostering trust, enhancing collaboration among stakeholders, and ensuring inclusive participation by bridging the digital divide and providing under-resourced groups with access to critical health information.

Conclusion:

In conclusion, this study provides valuable insights into the challenges and opportunities in health information sharing within Ethiopian public health emergency management. The findings underscore the importance of robust and context-specific strategies for effective emergency preparedness and response. By addressing the identified barriers and implementing evidence-based interventions, such as capacity building, improved data infrastructure, economic optimization, trust-based relationships, and locally aligned communication, Ethiopia can enhance

its health information sharing capabilities within emergency management programs. This may strengthen emergency preparedness and outbreak response. The study contributes to the existing literature on health information sharing practices and highlights the need for context-specific interventions to improve public health outcomes related to emergencies.

Declaration

Ethical consideration

The study protocol, tools, and consent forms were submitted to EPHI-IRB for approval. Participants provided informed consent, with the option to withdraw at any time. Data was securely stored, access restricted to the research team, and personal identities kept confidential in this report.

Consent for publication

Not applicable

Availability of data and material

All data analyzed during this study are included in its supplementary information files.

Competing interests

The authors declare that they have no competing interests.

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Author Contributions

SDS and MS originated the research idea. SDS, MS, PZ, MS, and GA contributed to the data synthesis and writing the manuscript. All authors have read and approved the manuscript.

Abbreviations

PHEM: Public Health Emergency Management

ICT: Information and Communication Technology

EWS: Early Warning Systems

HIS: Health Information Sharing

MHPSS: Mental Health and Psychosocial Support

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