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Original Article

Qualitative After-Action Review of Cholera in Ethiopia: Lessons Learnt, Best Practices, Challenges, and Perspectives for the Future

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Abstract

Background: *Cholera is a problem of public health importance worldwide. However, there was limited documentation of lessons learned from managing cholera outbreaks that could be applied to future improvements in Ethiopia. In October 2019, we assessed the overall cholera outbreak response and documented existing mechanisms and best practices in Ethiopia.*

Methods: *This After-Action Review (AAR) was conducted in Ethiopia from October 23rd to 25th, 2019 focused on the cholera outbreak from April 2019 to September 2019. A qualitative method with a participatory approach was used, using the standardized World Health Organization (WHO) guide for AAR. A total of 40 participants were from three regions (Afar, Amhara, and Oromia) and the Ethiopian Public Health Institute. The facilitators were from the Ministry of Health and WHO. Five working groups examined eight functional areas.*

Results: *The emergency operation center coordinated the national and regional cholera response. Social mobilization and reactive Oral Cholera Vaccine campaigns reduced financial burden and fostered trust in healthcare. Damaged water sources and pipeline maintenance helped control the outbreak. Redeployment of mobile health teams alleviated human resource shortages. Challenges during the response included late detection, weak multisectoral taskforce functionality, budget constraints, poor infrastructure, inadequate human resources, laboratory supplies, and delayed initial effective response.*

Conclusion: *Enhancing the surveillance system, operationalizing multisectoral coordination, and promoting community engagement and early risk communication can enhance the country's preparedness for future public emergency response, enhancing public health system responsiveness.*

Keywords: *After action review, Cholera, Outbreak response, Lessons learned, Core capacities, Ethiopia*
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Introduction

Cholera is a diarrheal disease caused by toxigenic serogroups of the bacterium Vibrio cholerae, which can cause rapid dehydration and death. Severe disease manifests as acute, profuse, watery diarrhea ("rice water stools"), usually with vomiting. This leads to rapid dehydration, which can result in hypotensive shock, renal failure, and death within hours of onset (1). Prioritizing high-risk areas could substantially increase cholera control programs' efficiency and eliminate 50% of the region's cholera (2). Cholera remains a persistent health problem in sub-Saharan Africa and worldwide. Higher attack rates were associated with longer times to outbreak peak, longer epidemic durations, and lower case fatality risks (3).

This study provides detailed evidence of the cholera outbreak in Ethiopia, highlighting the effectiveness of interventions in affected regions and recommending strategies for local mitigation. This AAR aimed to assess the overall cholera outbreak response to validate existing mechanisms and best practices and identify areas for enhancement to strengthen emergency preparedness and improve future responses in Ethiopia.

Methods and materials

Study setting, period, and design

This after-action review assesses the overall cholera outbreak response in Ethiopia's three regions affected by the outbreak, particularly the Afar, Amhara, and Oromia regions. The review covered the period from April 24,

2019, to October 11, 2019, and was conducted in Ethiopia from October 23rd to 25th, 2019.

Sample size

A total of 40 participants from the working groups involved in the response, who possess relevant knowledge and experience related to the outbreak, from three outbreak-affected regions and the national team participated.

Data collection tools and procedures

All the review teams used the standardized WHO guide for AAR as a framework (11). Participants were divided into five groups to conduct an AAR, which involved a review of eight functional areas. The process began with introductory presentations on the methodology, objectives, agenda, and event. The groups were surveillance and laboratory, coordination, case management and infection prevention and control (IPC), water sanitation and hygiene (WASH), risk communication and community engagement (RCCE), and oral cholera vaccination (OCV). The after-action review process of the cholera outbreak response had five major sessions that is taken from WHO AAR guideline which are listed below

Session 1 – What was in place before the response?
Session 2 –What happened during the response?
Session 3 – What went well? What went less well?
Session 4 – What can we do to improve for next time?
Session 5 – Way forward

Data collection techniques

A multidisciplinary team from EPHI and MoH involved in the cholera outbreak response included epidemiologists, public health specialists, WASH experts, laboratory specialists, RCCE specialists, data analysts, and WHO representatives.

Data quality assurance

Data quality assurance was achieved through facilitation by experienced and trained facilitators and team leader leaders. The facilitators were trained for two days before the after-action review. Prior to the review format were developed to support data quality. Another method used were engaging all stakeholder so that were engaged during the response to the emergency to avoid information bias and crosschecking all information against credible source and facilitating open discussions to address potential inaccuracies. Sticky note was used during the discussion a visit round were made by each group to provide additional input and validate what has been done buy each group turn by turn until all group and thematic areas were addressed accordingly.

Data processing and analysis

Data analysis was conducted using a qualitative approach. Following the session, a compilation of all the notes, cleaning of all data and documentation was conducted The discussion's main ideas, takeaways, and suggestions are categorized and arranged methodically. Key information recorded in sticky note ,from the note taker of each group were and addition inputs were discussed and written one by one.

During analysis, the major pillars and sub-pillars of the response were topicalized to assign different categories of best practice strengths, weaknesses, and challenges for each pillar.

Results

A total of 40 participants of the working group who were involved in the response and possess relevant knowledge and experience related to the outbreak from three outbreak affected regions and the national team participated. Study participants are experts who were significantly contributed to response areas in key pillars like surveillance, laboratory, Coordination., Case management, WASH-IPC, RCCE and others at federal level and selected regions namely Amharas, Oromia and Afar Regions. The after-action review of the cholera outbreak in Ethiopia in 2019 assessed key functional areas of International Health Regulation (IHR) 2005 and presented them in five groups with best practices, challenges, and future improvement plans.

Surveillance and laboratory

An index case of cholera was reported on April 24th, 2019, in the Telemet Zone of the Amhara Region and gradually notified from the Afar and Oromia regions. Before the cholera outbreak, plans and policies were developed, including an early warning system, weekly bulletins, and continuous feedback. Vulnerability risk assessment, emergency preparedness, event-based surveillance, and indicator-based surveillance were performed. Region, zone, and woreda had designated Public Health Emergency Management (PHEM) officers and focal persons at health facility levels. Laboratory investigation formats, cholera guidelines, and case definitions were available at various levels.

.Some of the timelines are shown in the graph below (Figure 1).

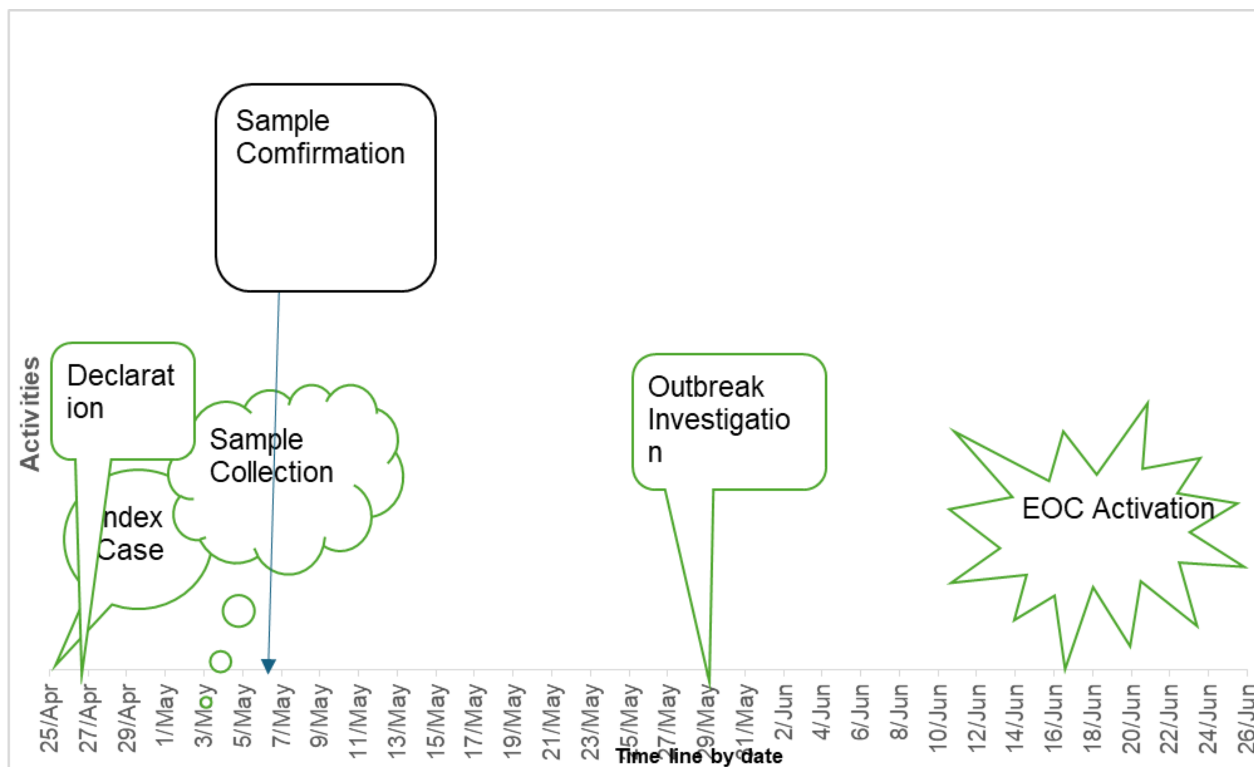

Figure 1: Timeline of Cholera outbreak and response activities in Ethiopia, April to June 2019

The cholera outbreak response faced numerous challenges, including delayed case detection, weak multi-sectoral task force, budget constraints, poor infrastructure, human resources shortages, and insufficient capacity to test food and water samples. These issues led to high morbidity, compromised surveillance activity, and outbreak control. Dagu, a traditional communication system for surveillance in the Afar region by clan leaders, has significantly reduced death rates and increased active surveillance by fostering trust among the community. The Emergency Operations Center leads cholera response at national and regional levels, improving coordination. Regular TWG meetings in the Amhara region enhance coordination and resource utilization. Best practices during response include regular bulletins and feedback, facilitated by the PHEM system.

Coordination

The cholera response was coordinated through an emergency preparedness plan, contingency plan, and national health emergency communication plan. Mechanisms of coordination included the Health Cluster Coordination Forum, National Public Health Emergency Operation Center (PHEOC), Sub-National EOC, Public Health Emergency Management System, region-cross-border forums, and National Cholera Task Force. Timelines of critical milestones and coordination activities during the cholera outbreak are shown in the table below (**Table 3**).

Case management and IPC

Before the cholera outbreak, contingency plans included mapping hospitals, transporting patients to CTCs, and identifying construction sites. An ORP was established, with 25% of emergency drugs allocated for outbreak responses and a task force was coordinated at regional and district levels. Essential preparedness mechanisms included a pre-positioned CTC kit, RRT, and health workers.

The cholera response faced several challenges, including delayed notification of cases due to poor community awareness, inadequate water supply, poor hygiene, sanitation, and IPC practices. Poor corpse management increased cross-contamination and prolonged outbreaks.

Risk communication and WASH

Before the cholera outbreak, plans and policies were developed, including joint plans with neighboring regions and emergency preparedness. Resources for cholera preparedness from national to district levels included a communication unit, guidelines, a women's development army, ICC/BCC materials, telegram channels, higher religious leaders, computers, and vehicles at regional and national levels. An emergency task force, partners, and rapid response

Table 3: Timelines of critical milestones and coordination activities during the cholera outbreak in Ethiopia, 2019

Date	Milestones	Location
03/01/2019	IDP EOC established	Addis Ababa, EPHI
28/04/2019	National Cholera EOC	Addis Ababa
20/05/2019	Oromia EOC	Oromia Health Bureau
03/06/2019	Tigray EOC	Mekelle, Tigray
15/06/2019	Addis Ababa EOC	AA
28/06/2019	RRT deployed for Amhara, CTC established, and	Amibara (Afar region)
24/06/2019	Afar EOC	Semera (Afar Region)
08/07/2019	On-job training for health workers	Amibara (Afar Region)
15/07/2019	Community-Based surveillance training	Addis Ababa
15/07/2019	Basic level training for health workers	Addis Ababa
15/07/2019	Community-Based surveillance training	Oromia, Hararghe
15/07/2019	Community-Based surveillance training	Amhara
19/07/2019	Prepositioning and coordination for the Qulube Gabriel holiday Mass gathering	Addis Ababa, Hararghe
19/07/2019	Hot spot mapping	Addis Ababa
25/08/2019	Cholera elimination and control plan launched	

Shortage of water supply in outbreak areas, poor wash infrastructure, and weak collaboration between health and the Ministry of Mine, Energy, and Water further exacerbated the situation.

team (RRT) were available from national to zonal levels. The leading cause of the cholera outbreak in the Amhara region was a damaged water pipe, which was repaired on June 28, 2019.

The response to the outbreak faced challenges such as a lack of trained human power, low community awareness, and inadequate resources. The outbreak led to delays in detection, increased morbidity and mortality, increased infection rates, human resource scarcity, and delayed case management. Limiting factors included high staff turnover and inadequate infrastructure budget,

The Dagu system in the Afar region was instrumental in reducing cholera transmission by promoting community engagement and trust through clan leaders. Identifying damaged water supplies and immediate maintenance of pipelines helped control the outbreak, while deploying mobile health teams relieved human resource shortages. Regular TWG meetings improved coordination and early mitigation. Health workers created awareness about hand washing and posted important messages around latrines, preventing person-to-person and feco-oral transmission.

Oral Cholera Vaccine

The EPRP plan was prepared before the outbreak, and human resources were in place but not trained for a specific OCV vaccine. The PHEOC, TWG, and task force were established for coordination at the national level. Major preparedness activities focused on using the existing cold chain system even though it wasn't adequate for OCV vaccines and training human power for vaccine-preventable diseases, especially cholera.

The national OCV plan was prepared in June 2019. The first OCV vaccine was requested on June 29, 2019. The first vaccination campaign for at-risk street children occurred in Addis Ababa, followed by the second campaign in the Afar region.

Challenges faced during the OCV campaign include the inability to coordinate vaccination, poor procurement procedures, the inability to target specific areas, and a shortage of OCV doses.

Discussion

The after-action review of the cholera outbreak in Ethiopia in 2019 has assessed some of IHR's key functional areas and discussed them in five groups with best practices and challenges.

Surveillance and laboratory

The first cholera case was reported in the Amhara region on April 24, 2019, and the notification was received on April 25, 2019, indicating a late notifi-

cation compared to the national PHEM Guidelines (7) that recommends notifications of immediately reportable disease to be within 30 minutes to the next higher levels. Despite this, it fulfilled the 7-1-7 target for detection, notification, and response to public health threats (12).

The cholera outbreak response faced challenges such as delayed case detection, budget constraints, infrastructure, inadequate human resources, and a shortage of laboratory supplies. These issues compromised surveillance activity, delayed response, and outbreak control. This is supported by the fact that early detection of outbreaks can reduce cases and deaths, while late detection results in a delayed response with limited opportunity for control (7).

Dagu, a traditional communication system in the Afar region, has strengthened community-based surveillance and fostered trust. This is supported by the evidence that utilizing the existing community structures in community and event-based surveillance systems in a well-organized way helps to engage the community in the identification and notification. This finding is consistent with the fact that the ability of Ethiopian laboratories to confirm cholera cases quickly and the degree to which local populations seek healthcare are closely related factors (14).

Coordination

The cholera response in regions and nationally faced challenges such as inadequate funding, partner fatigue, and medical, political, and IDP situations, leading to prolonged outbreaks and constraints for the OCV campaign. The absence of safe water supply in outbreak areas was due to natural causes, poor WASH infrastructure, and low collaboration between the health and water sectors. Difficulty of access to communities in hard-to-reach areas resulted in delayed referrals and a high CFR of 1.5%. When the fatality rates creep above 1 percent, it usually signals problems with the quality, access, and speed of treatment (15,16).

The National PHEOC Guideline highlights the importance of the media in preventing and controlling public health emergencies (17). Inadequate frontline human resources during the outbreak resulted in compromised case management and burnout among health workers; this strongly affects the quality of healthcare service in emergencies, as shown in studies conducted in Ethiopia (18)19). During the cholera outbreak, there is a weak subnational structure, and this finding is also highlighted in the national PHEM Guideline (20).

Weak cross-border collaboration was a problem due to a lack of prior relationships and the absence of collaboration forums, resulting in increased geographical spread and reduced information sharing. However, the national PHEM guideline principles recommended that emergency managers synchronize (coordinate) the activities of all relevant stakeholders to achieve a common purpose (7).

Case management and IPC

Inadequate water supply at households and the CTC resulted in poor hygiene, sanitation, and IPC practices in the CTC, resulting in prolonged outbreaks (16). Low clinical documentation and supervision led to difficulties in death reports, and poor management of corpses increased cross-contamination. Training gaps, lack of work experience, and inadequate staff contributed to poor case classification and management. A lack of skilled human resources hindered the closure and decontamination of CTC sites. The timely distribution of logistics and supplies was facilitated by dedicated leadership, a developed EPRP, and inter-sectoral solid coordination.

WASH and RCCE

Regular bulletins and feedback were effective for communication and decision-making practices during the cholera response. The cholera outbreak response faced challenges such as high staff turnover, inadequate infrastructure budget, and bureaucratic procurement processes. This is also relatively similar to the Dengue Fever outbreak, a public health emergency in Dire Dawa, Ethiopia that was challenged with a lack of budget allocation for risk communication and community engagement (22). However, the Dagu tradition in the Afar region contributed significantly to reducing transmission by promoting community engagement and trust through clan leaders. Identifying damaged water supplies and immediate pipeline maintenance also helped control the outbreak.

Oral Cholera Vaccination

The PHEOC, TWG, and task force were established at the national level for coordination. Several innovative OCV vaccination strategies have been introduced in different cholera epidemic and endemic countries, such as case-area targeted interventions (23), ring vaccination (24)(25), self-administration of the second dose of OCV (26), and integration of WASH intervention delivery at health facilities with vaccination programs (27). Challenges faced during the campaign included coordination issues, poor procurement procedures, targeting specific areas, and OCV dose shortages.

Limitations of the study

Limitations could be related to recall bias, which may have been introduced because some participants may forget the cholera outbreak preparedness and response details.

Conclusions and recommendations

The 2019 cholera outbreak in Ethiopia has led to several improvements. However, much work remains to ensure adequate preparedness for future outbreaks at national and subnational levels. The AAR has identified best practices that need to be institutionalized for continuity and challenges upon which preparedness activities have

been developed.

Major recommendations to better address the challenges and mitigate the impact of potential outbreaks include establishing a community-based surveillance system, conducting hot spot analysis and risk mapping, operationalizing multisectoral EOC/coordination forums, conducting inter-sectoral coordination meetings, and conducting regular water quality tests. Improving regular WASH service is very critical.

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Author contributions

YF, YA, MA, and MB**:** designed the study, coordinated data collection, performed thematic analysis and interpretation of the data, and drafted the manuscript. NA, TS, AG, MB, JA, BM, MH, and ME, drafted the manuscript, reviewed the first draft, and interpreted the findings. All authors have read and approved the final manuscript for publication.

Declaration of conflict of interests

The authors declared no conflicts of interest concerning this article's findings, authorship, and publication.

Ethical approval and consent to participate

The EPHI has the power and duties to conduct on-site investigations during epidemics or public health emergencies, verify outbreaks, issue alerts, provide warnings, disseminate information, mobilize resources, support response activities at woredas, zones, and regional levels, and implement international health regulations on grave public health emergencies implying international crises, as per the Federal Negarit Gazeta of FDRE Regulation No.301–2013 (11). The working group consisted of government employees who were key players in the outbreak response. No ethical approval was required for their participation in the working group, and no human or animal samples were taken through any invasive procedure.

Consent for publication

Not applicable.

Acronyms

AAR	After Action Review
CTC	Cholera Treatment Center
EOC	Emergency Operation Center
IPC	Infection Prevention and Control
OCV	Oral Cholera Vaccine
PHEM	Public Health Emergency Management
RHB	Regional Health Bureau

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