

After Action Review Qualitative research on Yellow Fever outbreak Coordination, Surveillance & Responses in Wolaita Zone of SNNPR Region, Ethiopia

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Abstract

Background: Coordinating outbreak investigations requires effective interagency communication. Important tasks include making the initial notifications, establishing roles and responsibilities for each jurisdiction, providing updates on the progress of the investigations, revising priorities for the investigation, and establishing the next steps. The major goal of surveillance activities is to identify and eliminate preventable causes of morbidity and mortality. Outbreak response basically entails preparedness which helps to establish arrangements in advance to enable timely, effective and appropriate responses to specific potential hazardous events or emerging disaster situations that might threaten society/environment

Objective: To review lessons learned from the October 2018 Wolayta Zone yellow fever outbreak management in SNNPR, Ethiopia.

Methods: Qualitative research approach, with Thematic Analysis. Purposive sampling method was used. Data were collected through FGDs, in-depth interviews, observation and document reviews **Results :** Among the main findings of the review is the weakness of the surveillance to detect case; the surveillance system was not that much effective for early detection of viral hemorrhagic fevers and there was knowledge gap to detect in the existing. The Review found out further that preparedness plan was weak, failing to consider the outbreak for VRAM. However, it is worth-noting that the Review showed that despite late detection, a rapid response team was set up and was able to save the lives of many during the outbreak. The findings further showed there was good coordination among various stakeholders at different levels and with satisfying sharing of roles and responsibilities.

Conclusion: Based on the major findings, it may be concluded that the surveillance system was weak to detect yellow fever outbreak occurrence in Wolaita Zone. A major gap is therefore the inability to include the case to the IDSR weekly report. Once the case was confirmed, the response to the crisis was fairly commendable. Even though there was a confusion on identifying the first case, after the confirmation of the first case, the case management went as per the standard guideline and SOPs, helping save so many lives through availing the service free of charge

Key terms: After Action Review; Outbreak Response; Yellow Fever, Surveillance, Coordination,

1. Background

The importance of experiential learning is highlighted when the situation is getting more multifaceted as in the yellow fever (Carroll, 1995). One method used to establish and promote mindfulness and safety in an organization is the after-action review (Allen et al., 2010). An After-Action Review (AAR), is a discussion of an event that enables health professionals and colleagues with similar or shared interests to discover what happened, why it happened, and how to sustain strengths and improve on weaknesses for future incidents (USAID, 2006).

Researchers emphasize the importance of post-incident discussion (i.e., AARs) that highlights strengths, weaknesses, and near failures and describe the findings as a key feature of safety cultures for future actions (Mearns et al., 2013). Thus, AAR is a qualitative review of actions taken to react to an emergency as a means of identifying best practices, gaps and lessons learned. Following an emergency response to a public health event, an AAR seeks to classify what worked well or not and how these practices can be maintained, enhanced, institutionalized and shared with relevant stakeholders, it works by bringing together a team to discuss a task, event, activity or project, in an open and honest environment. AARs can become a key aspect of the internal system of learning and motivation and should be part of all emergency management programmes [WHO, 2018].

Recently, yellow fever suspected cases were notified on 21 August 2018 in Wolayita Zone, Ethiopia and total of 35 cases with 10 deaths were reported. After confirmation of yellow fever, a reactive mass vaccination campaign was conducted from 13–20 October 2018 in six identified kebeles for 31,565 high risk populations. Following epidemiological, virological and entomological field investigation evidences, the Ethiopian Ministry of Health and international community decided to vaccinate 1,335,865 populations dwelling in nine woredas and institutions; seven from Wolaita and two from Gamo Gofa Zones. The institutions included Universities, colleges, prisons and other camps. This ring campaign was conducted from 16–22 November 2018 plus two additional days for mop up. Experts from partner organizations (WHO, UNICEF, MSF, IRC, AMREF and CDC) had supported government institutions on field to accomplish the vaccination effectively. The campaign was officially finalized on 24 November 2018.

Following the outbreak and its response, After Action Review (AAR) was done with the objective of reviewing lessons learned from yellow fever outbreak management in the wake of an outbreak in Offa District in Wolayta Zone of SNNPR; identifying best practices, gaps, lessons learned and how these practices can be maintained, improved, institutionalized and shared with relevant stakeholders following an emergency response to a public health event. The AAR was undertaken employing qualitative methodology over an extended period of fieldwork involving collection of data through interviews, discussions, observations and archival reviews. The Review yielded important insights and the findings of this review are presented and discussed in this report. Before going to this, we first present in some detail a brief review literature on the benefits and scope of AAR followed by the objectives and methodology employed in this study.

2. Method

Study setting and population

This AAR was been conducted in two woredas of Wolaita Zone, SNNPR, Ethiopia. Purposive Sampling Method was employed, commensurate with qualitative research approach. A total of 310,454 households were counted in this Zone, which results in an average of 4.84 persons to a household, and 297,981 housing units found at a distance of 157 Km and 338 Km from Hawasa City and Addis Ababa respectively. It has twelve rural woredas and three Town administrations. There are 324 rural and 28

urban 368 kebeles in the zone there are five governmental hospital two NGO and private hospital, 68 health centers, 152 private clinics, and 353 health posts in the zone.

Study Design

The present study employed Qualitative research approach, with Thematic Analysis. Purposive sampling method was used. Data were collected through face-to-face FGDs, in-depth interviews, observation and document reviews and Also Additional Field note were also taken. A total of eleven FGDs were conducted: one FGD per affected woreda for RRT members; one for health professionals comprising clinicians, pharmacist/pharmacy technicians and laboratory technologist/technicians and one for selected community members. In addition, there were one each FGD for Zonal, regional and national level. An FGD session contained 6–8 participants. Digital audio voice recorder was used to record conversations

Method and Data Collection

FGD

Before the initiation of every FGD it was started with by introduction, by setting ground rule, and by disclosure of the objective of the study. 7 men's and 4 women's FGDs were conducted. The FGD session were took maximum of 120 and minimum of 60 min. The size of group participants varied from 8 to 12. Four FGDs were conducted at the community level (near to their residence) and the rest 7 FGD were conducted from the health facilities to national level (workplace). Overall, 84 men and 16 women participated in the discussion, making a total of 100 participants from the 3 kebeles, 2 woredas, 1 zone, 1 region and national. No refusal were seen in all FGD session.

Individual Interview

4 individual interviews from woreda health office and administration head conducted from each and 2 from health center, 2 from each woreda head and 3 from Zone, Region and National head 1 from each. Data were collected through FGDs, in-depth interviews, observation and document review. Data collection tools, interview guide and semi structured checklist were prepared to generate data from RRT members, health professionals and selected community members.

For individual interviews, thirteen key informants from relevant offices in the health sector, at all level, Woreda to Federal. Were interviewed. Individual informants included Woreda health office heads, ZHD PHEM Unit, RHB PHEM leads, national PHEM unit and purposively selected RRT members at each level.

Interviews and discussion were conducted on questions deriving from the core AAR functional areas/ indicators/themes: Surveillance; Response; Coordination.

Observation

The verbal data from interviews were further corroborated with visual data, Patient card review at health facilities; Review of daily and weekly reports at woreda HO and Zonal health department; and Outbreak

investigation report by zonal PHEM and other supportive document like EPRP (Emergency Preparedness and Response Plan).

These data were linked to such important dimensions as to check the right coordination, surveillance response were in place. Observation was supported with visual documentation, using a digital still photo camera.

Data analysis

The data were recorded using a digital voice recorder. Translation from Amharic to English language and Transcription, transcripts returned to participants for comment &/or correction, the analysis were done after the provision of feedback from participants. Management and analysis were done using NVivo Version 11 (QSR International). The data were content-coded for thematic analysis. Initial coding activity was based on prior conceptual categories and further coding concepts were derived from the data. Explorations of coded data were done to make further analytical activities such as querying the data to find out frequently occurring concepts and themes, relationships among codes and themes. The analysis came up with three salient themes.

3. Result And Discussion

In the following sections, the major findings of the Review are presented and discussed. Following scientific approach to report structure, we shall first present the result and then discuss the result in light of comparative standards and norms. Result and discussion will follow the thematic scope approach, beginning with surveillance followed by response and coordination.

3.1. Result and Discussion on Surveillance

3.1.1. Result

This thematic issue deals with surveillance dimension relating to the strengthening and capacity building of control mechanisms pertaining to the identification and reporting of the yellow fever. Lessons drawn from the manner in which surveillance of yellow fever incidence was undertaken during the 2018 mission will have a far-reaching significance in testing the systemic preparedness and capacity of the health system of the country down from the local to the federal levels.

This result section presents findings gleaned from the interviews, discussions, observations and document reviews during the 4 months fieldwork relating to issue of surveillance. The theme is subdivided into five major categories: case detection, case notification, entomological survey, early warning and communication and laboratory investigation. Following presentation of the results, discussions of the key issues abstracted from the findings are presented, situating the key findings within national and international standards of relevant protocols as well as comparable reports from other settings. Conclusion will be drawn based on the key result and discussions.

Surveillance is the collection, analysis, and interpretation of information about public health. An effective surveillance system helps health officials and experts to detect outbreaks of diseases and/or events. Ethiopia adopted immediately and weekly reportable diseases under surveillance and yellow fever is one the immediately reportable disease (Beck, Littlefield, & Weber (2012) and Scott et al. (2013)). The surveillance system was not active at the beginning from the point of service delivery, at the lower level. First, Soddo Christian hospital notified suspected yellow fever case on September 24, 2018 via phone to zonal PHEM through IDSR focal; but the first call not responded by zonal PHEM.

3.1.1.1. Case detection

A major sub thematic issue in surveillance is case detection. How did case detection go? How effective was it and what were the factors accounting for failure in early case detection as the results below show? We will present these and related findings under this sub section. As the participants replied the surveillance system could not detect the event though, the timeliness and completeness of routine weekly report of the region as well as the zone above 90% that included zero reports in case of yellow fever outbreak. Such failure in timely detection and reporting of the case was supported by a key informant interview with a senior EPHI member: “The surveillance didn’t pick the outbreak, it was delayed……. It delayed for almost one month to report after the index case was seen… Yellow fever is immediately reportable disease, but it should have been at least reported by including in weekly IDSR report…. Surveillance system changed …The surveillance did not pick the outbreak.” EPHI KII, 2019.

This is further corroborated by informants during group discussions and in-depth interviews at various levels. Thus, according to discussants of Woreda health office, zonal Rapid Response Team, and regional Technical Working Group, the surveillance system was weak to detect viral hemorrhagic fever outbreaks. Participants of FGD at the Zone noted: “Our surveillance was not active to detect case …It cannot detect earlier since our surveillance was not active for VHF ……… [Soddo] Christian Hospital notified for second time on September 27, 2018 as they suspected some viral hemorrhagic disease” (Wolaita ZHD FGD, 2019). Another participant from the Zonal FGD further declared: “Our surveillance was not active to trace this ……… It could not detect earlier since our surveillance was not active.” (Wolaita ZHD FGD, 2019). A key informant at Offa similarly reported that “There was problem to identify the case… When three persons died continuously in a family, we went there” (Offa WHO KII, 2019).

The index case was heard on August 21, 2018 as a rumor before Soddo Christian hospital notification. The surveillance system was activated after the second call of the hospital at zonal level; then to Woreda and health center on 27 September 2018 after three deaths within the same family. As informants from Gesuba and Offa HC reported, “We started the work when the number of deaths increased. ……… After we detected the disease and understood about the disease and we reported it. ………Up to 10 people died before identifying the disease. ………first, we heard the case suspicion on September 28, 2018 when the deaths notified (Gesuba HC FGD)). “It is interesting to note that about two months delayed without any detection of yellow fever outbreak in the district due to different reasons. That is why the community was triggered to look for other options to save their lives instead of seeking health service at the formal

medical system. The outbreak was detected after three people lost their lives and additional case with similar sign and symptom reached at Soddo Christian Hospital. Zonal surveillance system refused to acknowledge the first notification by Christian hospital about the case due to previous misdiagnosis and notification of other infectious disease like Ebola, cholera even it was not occurred.

This idea was raised by a key informant in Soddo Christian hospital. “..... we made call about the case to zonal health department on September 24, 2018; but no response. zonal PHEM visited the patient immediately after the second call on September 26, 2018” (Soddo Christian Hospital KII, 2019). As our interview with an EPHI member shows, “There was almost more than one-month delay in reporting since the onset of the r the index case ... So, to my understanding there is a gap here” (EPHI KII, 2019). Similarly, a participant from an Offa FGD episode noted, “This immediately reportable disease was not reported in the early stages ...the disease was not reported timely, due to knowledge gap to detect yellow fever and hence no progress after treatment, community resorting to traditional beliefs.” Offa WoHO RRT FGD, 2019.

However, the case detection experience of the Wolaita Zone yellow fever episode was comparably described as better during regional TWG group discussion session. One of the discussants from the regional technical working group noted that “.....relative to South Omo when many patients was died this outbreak was detected timely” (Regional TWG FGD, 2019).

But the surveillance system was challenged for early detection due to shortage of refreshment trainings, lack of early update and preparedness, knowledge gaps, insufficient surveillance officer and unavailability of yellow fever guideline at health facility level at the time of epidemic in addition to community traditional beliefs as it stated from our study participants. Regarding this, a participant at Gessuba HC noted as follows: “We confused for case detectionWe were unconscious to detect early since the case was new for us the surveillance system was not that much effective for early detection of viral hemorrhagic fevers There was knowledge gap to detect YF (Gesuba HC FGD, 2019). Similarly, a participant of Offa RRT FGD argued that “.... immediately reportable diseases were not reported in the early stages before. We did not have any knowledge of symptoms of yellow fever before. notified lately due to traditional beliefs (Offa WoHO RRT FGD, 2019). This is further confirmed by the views of participants at a regional TWG discussion: “.... it was handled secretly for not disclose timely for partners. no smooth system which helps IDSR focal to pick events easily for report. problem is mainly system weakness. Health facilities have not skillful professional on surveillance. ... RRT was not active and functional”. (Regional TWG FGD, 2019).

The results generally show that almost more than two months passed before yellow fever detection and onset of the index case. The first rumor of deceased case was on August 15, 2018, as reported from Offa RRT FGD: “.....the first died case was on August 15 in Busha Kebele (Offa WoHO RRT FGD, 2019)); but the case was notified on September 27, 2018 after the second notification from Soddo Christian Hospital. As described by informants at Soddo Christian Hospital, Wolaita zone RRT FGD, Gesuba health center RRT

FGD and Offa Woreda RRT FGD, the detection of yellow fever was challenging as the case presented similarity with manifestation of other viral caused viral fevers.

Due to this, “....Surveillance system didn’t pick it up and at least late for one month” (EPHI KII, 2019). As a key informant at Soddo Hospital argued, “.....we thought that would be yellow fever or infection with one of Hemorrhagic fever like zika virus, Dengue fever, Ebola... etc)” (Soddo Hospital KII, 2019). Another key informant at Soddo Hospital also argued: “..... we have got the same family history of the illness... it was extremely difficult to rule out the case as Yellow fever disease.....second patient was died after six hours after he was admitted to the ward” (Soddo Christian Hospital KII, 2019).

The system was not prepared and capable and “.....it cannot detect earlier since our surveillance was not active for VHF,” (Wolaita ZHD RRT FGD, 2019), as reported by a participant of RRT FGD and this all thus led to the death of “.....ten people before identifying the disease ” as a participant of an FGD at Gesuba HC noted (Gesuba HC FGD, 2019).

3.1.1.2. Case Notification

This theme shows the status of notification from different levels and gives some lessons on the surveillance system for future. As the regional TWG indicated Wolaita Zone Health Department notified suspected yellow fever case to regional PHEM on September 27, 2018 after it was detected by Soddo Christian hospital. Regional PHEM immediately notified to EPHI and then to Ministry of Health and EPHI management members on the same day.

This was stated by EPHI informant during in-depth interview. “.... first, notification was sent to the higher officials and to EPHI management bodies” (EPHI KII, 2019). The idea was seconded by one of regional TWG discussants. “..... YF outbreak was notified from Wolaita zone. the notification of YF outbreak to partners is timely compared to other previous outbreaks” (Regional TWG FGD, 2019). This is further confirmed by the views of participants at zonal FGD: “We informed the suspected yellow fever to regional PHEM on September 27, 2018.” (Wolaita ZHD RRT FGD, 2019). However, Offa Woreda reported the case on September 28, 2018 after they were informed by Soddo Christian hospital. “..... we were informed by Christian hospital that it could be diagnosed with a serious viral illness..... before it has been notified that death has occurred First, we heard the suspected case on September 28, 2018. we had reported to zonal health department on September 28, 2018” (Offa WoHO RRT FGD, 2019).

According to informants, case notification started just after the detection of the case from Soddo Christian hospital whereas the Woreda health office was notified lately. They further noted that the disease notification of the case was on time even though the detection was late: “.... the first suspected case was typical yellow fever and the same goes to rest after that. It was different but still they didn’t report it.” (EPHI KII, 2019).

3.1.1.3. Early Warning and Communication

Regarding early warning and communication, document observation and discussions with informants revealed that activities undergone during outbreak were managed effectively and coordinated properly after the confirmation of yellow fever outbreak. After the detection, early warning and active case search and surveillance were conducted in the Wolaita zone and other neighboring woredas of Gamo Goffa zone.

Surveillance data was collected and compiled well in which all suspected yellow fever cases were line listed and analysed for response in addition to sample collection for confirmation. Following August 21, 2018, a total of 35 cases were detected (5 lab-confirmed) from Offa and Sodo Zuria Woredas, of which ten died. Three of the deaths were siblings (aged 10, 15, and 18 years old) living in the same household, with only a report of high fever and not with Jaundice.

Facility deaths were recorded in Sodo Christian Hospital (1), Sodo Hospital (2), Adane Private Clinic (1), Muluken Private Clinic (1) and Tome Gerera Health Center (1) while other four died in the community. Of the total cases, 11 (31%) were reported to have nasal bleeding with six dying. Jaundice was also recorded in 7 patients, of which 5 died.

Most of the cases, including the index case, were from Kodo Kebele [25(71%)], four (11%) were from Busha Kebele, three (9%) were from Tida Kebele, one (3%) case was from Gesuba 02 Kebele and one(3%) from Tome Gerera Kebele(Sodo Zuria woreda). From the total of 35 Yellow Fever cases reported, 17(49%) were males and 18(51%) were females. The age of the cases and deaths ranges from 7 to 70 years old(2).

Early warning letter was written to all neighboring Woredas and zone in order to strengthen the surveillance system at all levels. A key informant from EPHI stated that the letter was written, and media informed about the disease. "To make media briefing we sent letters" (EPHI KII, 2019). Similarly, regional TWG responded that early warning letters, guidelines and leaflets were distributed to affected and neighboring Woredas and zones "..... early warning letter was written to neighbor zones". "..... additional yellow fever leaflets and guidelines distributed" (Regional TWG FGD, 2019).

Early warning and communication activities were approved further by Wolaita zone and Offa Woreda focus group discussants that its impact was assessed using standard checklist. "..... we used local radio, Fana FM and Wogeta FM, to disseminate the information to community.....the impact of social mobilization, early warning and communication assessed by using checklist" (Wolaita ZHD RRT FGD, 2019). ".... we wrote letters to religious institutions and other institutions in the Woreda. It was frustrating everything was written in a letter of warning/early warning letter The standard case definition posted at community and facility. Yellow Fever manifestation posted on market, administration offices, public places" (Offa WoHO RRT FGD). As the Offa Woreda and Wolaita Zone FGD participants' response, active case search was continued until a month after the zero report of yellow fever cases (Offa WoHO and Wolaita ZHD FGD, 2019).

3.1.1.4. Entomological survey

During the entomological assessment, a total of about 168 natural and artificial breeding sites were inspected from urban and rural households in Offa district, from these 55 containers were positive. Almost 87.3% breeding site in rural area was linked with Enset crop [Ensete ventricosom: false banana], a crop that was found almost all inspected houses of rural areas of this district. The researcher observed that there were the vectors hidden under water axilla of 'Enset' and the community witnessed the entomologist collected the water to check the presence of larvae of Aedes mosquitoes. ("..... the health workers took the water out of the pond and false banana 'Enset' for investigation" (Kodo Kebele community FGD, 2019).

However, the community complained that they could not identify yellow fever causing mosquito. This idea was raised by Busha kebele community FGD participants: ".....we did not know exactly which mosquito cause yellow fever" (Busha Kebele community FGD, 2019) .

As a preliminary investigation (Entomological investigation 2018) by showed, the density of Ae. luteocephalus and Ae. africanus vectors were high as assessed by human landing and larval collection in rural villages as compared to urban area of Offa district, and monkeys were frequently present around homes and farmlands. (Source: Final summary report on. This was further confirmed through informants from EPHI and Soddo Hospital. This idea was raised by FGD of Gessuba health center RRT participants: "The Aedes mosquitoes identified from water under false banana by the entomologist" (Gesuba HC FGD, 2019).

3.1.1.5. Laboratory Investigation

A total of 39 serum samples from 35 patients (duplicates of acute and convalescent samples taken from 4 cases) were submitted to the national influenza and arboviruses laboratory in October 2018 with first batch of 9 samples on October 02, 2018. The result of the theses samples was communicated on 03, October 2018 via email to EPHI higher officials and surveillance focal persons on the same day and the higher officials communicated to the partners and down to the experts on the field and local health authorities.

Moreover, as the first batch of samples was small requests for field investigation team was forwarded for collection and shipment of additional samples. Additional tests were also done for the 2nd batch of 12 samples and positive results were found by both RT PCR and IgM ELISA and immediately communicated to all stakeholders involved in the response activity.

EPHI initiated the shipment of samples to WHO reference laboratory on the next day (Oct 4, 2018) of the first yellow fever detection with facilitation and support of WHO and finally shipped on 14 October 2018 and delivered to the Dakar laboratory on 18 October 2018 and the Dakar Laboratory communicated test results on 22 Oct 2018. The test results in Dakar lab also confirmed that five samples by IgM ELISA and 2 samples by RT PCR were positive. Other test for differential diagnosis for dengue, chikungunya west nile, Zika, Chrimam Congo hemorrhagic fever virus and Rift valley fever viruses by at EPHI and/IPD. (29)

3.1.1.6. Challenges and Gaps of Surveillance

According to the response of participants, the event was new for the area and unfamiliarity with the case definition of yellow fever challenged to detect the case early. As confirmed by informants at Offa Woreda and Gesuba health center, yellow fever is new for the area to report and detect. The community had no previous exposure for such kind of case. In addition, Wolaita zone RRT and regional TWG discussants added that they lacked experience regarding it. Health professionals in the hospitals misdiagnosed the causes due to unfamiliarity of yellow fever case and also the sign and symptoms almost similar with other diseases. Key informants from Soddo hospital and Christian hospital reported that “...there was an awareness gap on Epidemic prone diseases case detection & management. the first diagnosis were severe and complicated malaria” (Soddo Hospital KII) and Soddo Christian Hospital KII, 2019).

The participants stated that capacity-building gaps were also great challenge for early detection that most of health professionals were not trained on surveillance of viral hemorrhagic fevers such as yellow fever even though it is one of immediately reportable diseases in the country. Key informant from EPHI confirmed the capacity building gaps on yellow fever related knowledge and researchers. One informant stated: “...they do not have knowledge of YF. This is a bad misconception. academic and research environment are in deep ignorance” (EPHI KII, 2019). One of key informants from hospitals described the difficulty to detect yellow fever case as: “.....it was extremely difficult to rule out the case as Yellow fever disease” (Soddo Hospital KII, 2019). Focus group discussion participants from Gesuba health center similarly argued: : “..... we have confused on the case to detect clinically.We diagnosed all cases as severe malaria before the detection of yellow fever.we did not detect yellow fever early” (Gesuba HC FGD, 2019),

Regarding yellow fever case detection, Woreda health office discussants mentioned the problem of knowledge gaps. They stated: “...we did not have any knowledge of symptoms of yellow fever” (Offa WoHO RRT FGD, 2019). Regional TWG admitted this: “.....we have a problem in case of capacity building for diagnosis. our clinicians do not know the definition of each reportable disease” (Regional TWG FGD, 2019). Similarly, a member of Wolaita zone FGD was argued: “..... there was no enough information among health workers about YF” (Wolaita ZHD FGD, 2019)

In addition to knowledge and capacity building gaps, there was only one focal person assigned at health facility level for surveillance. One of participants from regional TWG stressed: “..... no well dedicated trained surveillance officers at hospital level.we have capacity- building gap on YF diagnosis.our clinicians do not know the definition of each reportable disease. health professionals have skill gaps on HF surveillance.We have only one IDSR focal who works for 8 hours only at HF level” (Regional TWG FGD, 2019).

In addition to that, the participants complained the surveillance system was not active to detect the events like viral hemorrhagic fever early at lower level: from woreda/district to community level. A higher official informant stated that “...The surveillance did not pick the outbreak” (EPHI KII, 2019). Discussants of Offa Woreda and Gesuba health center RRT supported the expression of EPHI: “...our surveillance was not active to detect case. as the institution, the surveillance system was not that much effective. ...

the surveillance system was not that much effective” (Offa WorHO RRT FGD, Gesuba HC FGD, 2019). As the participants from Gesuba health center, Offa Woreda health office, Wolaita ZHD and KII stated, Meskel festival was the main challenge for early detection of the outbreak. The annual celebratory event was a factor in delay in the early initiation of outbreak response activities from different levels of the health structure. According to Woreda health office and Gesuba health center RRT, the community related the disease with evil spirits; they called it as a curse from creator: “... community related these three deaths from single house with evil spirits” (Gesuba HC FGD, 2019).

Gap in capacity building like refreshment training, surveillance system and case detection was critical during outbreak response. Regional TWG clearly noted that “..... from diagnosis side we have a problem in case of capacity building. there is no smooth system, which helps IDSR focal to pick events easily for report. PHEM is not included in the structure of hospitals.system weakness. there is only curative structure in the hospital. PHEM has no structural allocation so it was not considered as primary function or core process” (Regional TWG FGD, 2019).

3.1.2. Discussion

The surveillance activities were done according to the standards after the detection and confirmation of yellow fever: line listing of cases (35 cases with 10 deaths), active case search (around the cases and neighboring kebeles), data analysis (descriptive analysis) and information producing (SITREP) for decision-making were done. The case notification and detection delayed for a month after death of index case as the surveillance of yellow fever and other re-emerging diseases was weak in Africa provided that WHO recommended it as immediately reportable disease in which the surveillance expected to detect immediately(WHO 2014;WHO 2004).

About two months passed without any detection of yellow fever outbreak in the district due to different reasons but the country recommended standard is not more than 3 days after first index case for detection (Kozlowski & Salas 2012). On the other hand, the detection of this outbreak was relatively rapid compared to that of previously occurred outbreak in 2013 in the region, which took about 8 months to detect, but it was almost the same as compared to yellow fever outbreak detection in Angola in 2015 (Lilay A et al 2017, ECDC 2016). The delayed detection led the community to resort to other options to save their lives instead of health service seeking. The outbreak was detected after three people lost their lives and additional case with similar sign and symptom reached to Christian hospital.

The surveillance of yellow fever is therefore critical for monitoring the incidence of the disease and allowing the prediction and early detection of outbreaks and the monitoring of control measures as WHO recommends (Id et al 2018). Early detection is one of strategies to control yellow fever disease (Iii EWC 2006). The surveillance of yellow fever outbreak in Wolaita Zone was relatively good as compared to that of South Omo, which re-emerged in May 2013 for the first time after 50 years (EPHI-FMOH 2016), as described by regional technical working group. Early notification of yellow fever is critical to begin investigations and implement control measures (IOM 2008). Yellow fever surveillance system was

needed to evaluate by its attributes since the system did not detect the outbreak and resulted in late detection and notification (CDC 2001).

Early warning and communication activities including active case search, line listing, alert letters, data compilation & analysis, case definition and guideline distribution were in place, which aligns with surveillance criteria of WHO AAR guidance (PHEM 2012). Active case search was conducted in Wolaita zone and neighboring districts of Gamo Goffa zone for early detection of newly infected cases and continued for a month after zero report.

'Enset' plant holds water on leave axilla and stays for long period, even in the dry season (prevents the water from sunlight and resist evaporation). Thus, was providing a longer life span to act as a mosquito-breeding site as compared to banana and other fruit plant. On the other hand, it was often difficult to remove all water from the plant and it is logistically not feasible to target these breeding sites for vector control. So, making Ae. Mosquito breeding possible all year round. Similar study was reported in East Africa that, this plant stem resist water from evaporation and challenges to isolate water from the plant. As a result, it helps mosquito to breed throughout the year (Serie et al 1968).

Presence of high density of Aedes mosquito and monkeys around the area suggested that the outbreak probably was sylvatic in nature. Similar studies showed that these vectors ensured YF virus transmission despite its low vector competence reported (Miller 1988).

The samples collected and transported to EPHI during the outbreak were in good condition even though some case reporting sheets were missing. There was limited capacity available to detect yellow fever by both PCR and ELISA. The result communications were timely and reached down to appropriate channel. The sample shipment process to Senegal Dakar was also initiated on the next day of outbreak detection; but it was able to be accomplished after a week due associated with absence of pre-identified sample courier agents. The involvement and coordination of the stakeholders was good and put much effort in the investigation and shipment process of the yellow fever outbreak samples. (Final summary report on varological investigation report on yellow fever outbreak outbreak in Offa Woreda of Wolaita zone, SNNPR, Ethiopia,2018)

From health center to federal level, there were sufficient human resources to respond the outbreak of yellow fever. However, financial and material resources like standard laboratory set up and national laboratory accreditation issue challenged the early response. The CDC of US stated that public health surveillance could be used to guide immediate action for cases of public health importance, measure the burden of the disease, monitor trends in the burdens of disease, prioritize the allocation of health resources and so forth (CDC 2013) Result and Discussion on Preparedness

3.2. Result and Discussion on Coordination

3.2.1. Result

3.2.1.1. Coordination: A General Overview

Coordination was made at different levels: at national, regional, zonal and woreda levels after the detection and confirmation of cases. Regarding coordination at federal level, a senior officer at EPHI noted that the: “TWG were established and the team also were deployed to the outbreak area immediately, Offa woreda, Wolayita zone”. He further added that “The RRT team were activated and met regularly with staff from different stakeholders who engaged in the outbreak management,” (EPHI DDG KII, 2019). The TWG established composed of partners from WHO, UNICEF, MSF and transform PHCU provided technical support, budget support and supporting in community mobilization.

At regional level, “the TWG was formed to facilitate coordination of internal expertise from Wolayita Zone, Offa Woreda, partners and sectoral offices to manage the outbreak. Then the tasks were shared among member of TWGs and meets regularly as per the schedule” (RHB_Head_KII, 2019). The team coordinated the daily activities: logistics supply, maintenance, community mobilizing, and finance. The regional Health Bureau head added that “The regional health bureau took the lead and continuously followed up and monitoring the coordination activities of the team through the outbreak management” He further said that “...there were regular meetings with TWG group and process owners, who were also members and part of this group. The sectors including education and water resources are part of this team who facilitated the activities. Thus, the coordination is multi-sectoral and well-organized. There is also vertical and horizontal coordination with stakeholders and partners.....” (RHB_Head_KII, 2019).

Furthermore, a regional level senior officer stated that “there were two ways of coordination: from the government and partners’ perspective; i.e. the government was coordinating between and woredas and other sectorial offices involved....and the partners coordinated the team from WHO, UNICEF and transform who were involved in provision of technical, logistic and financial support. Both coordination team from government and partner sides shared the role and responsibilities as per the action plan and led by RHB ...” (RHB_Head_KII, 2019). According the information obtained during an FGD at zonal level, there was coordinating team formed and they conduct regular meeting among different sectors and stakeholders. The coordination at zonal level was evaluated as well organized and multi-sectorial. They added that there was strong upward and downward coordination with stakeholders and horizontal with other sector and partners to manage the outbreak once the case confirmed as yellow fever (Wolayita Zone FGD., 2019). The participants of this assessment from the zonal level added that “the coordination team facilitated activities related to surveillance, case management, resource mobilization, technical, human power and logistic teams at different levels.”

The roles and responsibilities were shared to the team at zonal level who were established from woredas. Regarding the woreda level coordination, informants at an HC FGD reported that:

...the Offa Wereda administration was the leader of TWG of the team from different department of HC/Hospital been a member supporting activities: case management, surveillance, environmental health, pharmacy and logistic supplies. The health care providers coordinated at community level by providing

the health education for the local communities in the Kebeles... The local NGOs like UDAID, AMREF and PHC are also part of the team during the outbreak management (Wolayita Zone FGD and FGD_Gesuba_HC – RRT, 2019).

According to the participants of an FGD at zonal level, “the RRT members from federal, region and WHO conducted a regular meeting every two daysThe partners, notably, WHO and UNCEF staffs, supported technically in this process and local NGOs active in this woreda such as USAID, IMC and AMREF got involved and supported the activities. The Regional Health bureau team composed of the team from communication, PHEM further facilitated the activities...” (Wolayita Zone FGD, 2019). Thus, according to the zonal participants’ evaluation all in all, the overall performance in outbreak management from all levels and stakeholders was well led.... The researchers observed that the coordination at zonal level was multi-sectorial and organized enough” (Wolayita Zone FGD, 2019).

The national level discussants evaluated that there was high engagement of TWG and good performance in overall coordination from national to woreda/community level to manage the outbreak. The National PHEM director further added that “TWG were established at federal level to coordinate the activities at different levels with stake holders and partners, I [One of EPHI senior experts KII] personally chaired the TWG group formed from MOH,WHO, CDC and EPHIs and conduct regular meeting per a week even sometimes the teams conducted two or three times a week.....” (EPHI DDG KII, 2019).

It is interesting to note that the reports and claims from the various informants at different levels in the health system are generally corroborated through data obtained via observation and document reviews. While much of the reported cases were generally positively considered, the observation showed some gaps. For instance, the researchers of this AAR of YF at national and regional levels observed that there was no emergency operating center (EOC) activation to coordinate the outbreak management activities who centrally support surveillance, logistics and communication. This was the gap at national level.

3.2.1.2. Mapping of the Stakeholder

All stakeholders that were engaged in different health system structure were identified /mapped from federal to woreda level. As it was noted also in the formal document, participants noted that “.....What we did is to strengthen and create active coordination platform at zone level. We had 15 woreda structure in our zone;” Another participant also noted: “.....Fist RRT meet and discuss on it and then we knowing that its international concern, we bring it to the zonal taskforce and the taskforce led by zone administrator. Technically we prepared coordination document. We entitled it 'Wolaita zone coordination guideline' and we submitted it and then on 24th, and, as I said before, the woreda was called on 24th ...”. (Wolaita Zone FGD).

3.2.1.3. TWG Coordination

The TWG were formed at national, regional, zonal and woreda level to facilitate the coordination activities during outbreak management. As per the information from the participants at all levels, the researchers observed the coordination activities after confirmation of case. There was an overall coordination which

integrated the activities, the resource (human vs logistics), role and responsibilities of each thematic areas: surveillance, preparedness, community health education to manage the outbreak.

3.2.1.4. Stakeholder Engagement

Interviews and discussions show in overall there was an animated engagement at all levels from partners and government actors following the YF crisis. Engagement from the national level actors was described as “very high” according to interviews with officers at EPHI. One senior informant noted that “the Staffs from MOH, WHO, CDC and EPHI were part of the coordination team and we made meetings in parallel session,” further adding that “...First, WHO has to notify on its own structure that there is a yellow fever outbreak in Ethiopia by requesting media clearance...” (EPHI DDG, 2019).

3.2.1.5. Gaps and Challenges

Regarding the gap and challenges, the result of interview and observation shows some quite distressful gaps and challenges that require attention to draw lessons. Informants reported these gaps at all levels of the health system and other para-health stakeholders. As an example, during our interviews at the national level, one senior officer acknowledged that “.....our management staffs have no idea about situations, their knowledge were limited on the issue; it wasn’t complex but there was a communication gap among us due to the unexpected nature of the crisis.....” (EPHI DDG KII, 2019). He further noted that “.... Sometimes we could have contacted directly the zone without notifying the region, that also been the problem.”

Several gaps and challenges were witnessed at regional level as well. As reported by a senior regional health bureau official, for example, one of the most salient gaps and challenges was that “... the man-made (conflict induced IDP) situations severely exhausted and limited out capacity and resources, especially our financial resources; so it was so much difficult to respond quickly when we faced the natural/disease onset,” (RHB_Head_KII, 2019).

At the zonal scale, according to the Zonal officials as reported during an FGD session, the main gap and challenge was the elusive nature of the disease itself and its unexpected onset. As one FGD participant said, “... We were confused whether it could be yellow fever or not But when we engaged to work immediately we noticed that there were a death, since then we start to work with coordination.....” (Wolayita Zone FGD, 2019).

The reports from informants were further supported through researchers’ own field observations and documentary reviews. For example, EOC was not activated at National, Regional and at local level as well to coordinate the outbreak. Furthermore, the research team confirmed that there was no guideline and standard case definition regarding the Yellow Fever to suspect the case based on the sign and symptoms presentation (Researchers Observation, 2019).

3.2.2. Discussion

Coordination establishing the link among multi-sectorial organization to manage the disaster in public health management horizontally and vertically addresses links between among different organizational unit or hierarchy and level from national to kebele. It also, includes cross-border coordination with neighboring countries and inter-regional, between zones or woredas or kebeles within the country. Coordination in PHEM considered to be better managed if a committee or task force of all the stakeholders is established to manage the outbreak [PHEM Guidline 2012]

The members in TWG are multi-sectorial composition from relevant sectors and institutions such as water, agriculture, health facilities, universities, and partners to ensure comprehensive preparedness led by the correspondent administrative authority at different levels. The main activities of lies under the coordination are: Identify all sectors, collaborators and partners, their areas of intervention and capacity; communicate partners and stakeholder, develop ToR, monitor and evaluate the activities as per ToR or MOU, form TWG/RRT at different levels, report to the higher level as weekly or monthly basis (PHEM 2012). Rapidly determining which jurisdictions and agencies need to be involved in any outbreak investigation is critical for prompt notification and coordination of investigations. Investigations should be coordinated at the level where relevant investigation steps can be most effectively implemented, which requires that the agency have sufficient resources, expertise, and legal authority to collect, organize, analyze, and disseminate data from the investigation. Coordinating outbreak investigations across jurisdictions requires effective interagency communication. Conference calls among collaborating agencies have become a common feature of multistate outbreak investigations (Council to Improve Foodborne Outbreak Response 2014 Association of State and Territorial Health Officials, n.d.).

As presented above in the result section regarding the main thematic areas, coordination activities, in terms of stakeholder engagement and TWG/RRT coordination, it is interesting to see that some discernible pattern emerges when we examine all the main ideas raised in these sub-thematic areas from national/federal to woreda/kebele/community level. There was coordination among TWG at national level/federal, regional, zonal and wereda level and the members also shared roles and responsibilities. They also met regularly with scheduled time, when we see the members of these group as it was mentioned in the result part, respective staffs from department, partners and horizontal sectorial offices. Regarding RRT like TWG the same trends were implemented, from national to woreda level, after the detection and confirmation of the first case. This appears to fit more or less to the expected coordination standards as indicated in the foregoing international norms.

Regarding challenges and gaps faced during coordination at each level, it was mentioned that the manmade part (conflict induced IDP) situations where let the system empty human resource, so it been so much difficult to respond quickly when the natural/disease based were occurred. As it was mentioned it there was a confusion whether it could be yellow fever or not; but after the death of first few cases, they have engaged fully with a great deal of coordination. Similar repots elsewhere in Africa and beyond also show that the delivery of good coordination during a health service emergency management is often beset with a range of challenges, including natural factors and other socio-political and infrastructural

problems (Council to Improve Foodborne Outbreak Response 2014 Association of State and Territorial Health Officials, n.d.)

3.3. Result and Discussion on Response

3.3.1. Result

3.3.1.1. The Response Thematic Area-

‘Response’ is one of the main thematic pillars under After-Action Review (AAR), which is used to describe whether the right response was put in place or not in all aspects of interventions from case management, prevention & control and vaccination campaign. This is requisite, so as to manage the case effectively. This theme is divided into 5 sub thematic areas, based on the idea raised either in key Informant Interview (KII) and Focus Group Discussion (FGD). When we review reports from our informants regarding response in general, at national level, as higher officials at EPHI stated: “...immediately we established an RRT, activated and deployed timely and additional staff also deployed to support response activity and outbreak investigation as well” (EPHI DDG, 2019).

Regarding the overall response implementation, discussion with FGD participants from regional level showed that during outbreak response there was a coordination at all levels. This was confirmed by key informant interviews. According to an Internist at Sodo General Hospital, “All Woreda and Zonal leaders, HEW and health workers got involved in response activities...” (KII Sodo General Hospital, 2019)

In the following paragraphs, we will present results on the prevention and control measure that were taken including vaccination campaign, outbreak investigation, and Entomological and vector control as key sub-thematic areas under response.

3.3.1.2. Outbreak Investigation

Key ideas regarding outbreak investigation include case and entomological investigation in relation to the investigation of yellow fever case. One of the main ideas raised by our FGD participants regarding outbreak investigation was how it followed appropriate measures and protocols. For example, it was disclosed by a participant during discussion at Offa Woreda with RRT: “.....Even though its late detection, a rapid response team was set up to save the lives of many regardless of time or speed during the outbreak....” Another participant also mentioned that “....the team deployed and the suspect cases were being identified for treatment....the team conducted as early as the epidemic was detected and conducted to verify the disease first....” A further statement from another participant showed blood samples were collected from febrile cases and effort was made to “...conduct as early as epidemic was detected to verify the disease first....” (FGD_Offa Woreda RRT, 2019).

Further, regarding entomological investigation it was mentioned that “.....The Aedes mosquitoes was identified from water under false banana by the entomologist.....” (FGD_Gesuba_HC – RRT).

3.3.1.3. Vector Control and Entomological Investigation

Regarding entomological investigation, it was reported that efforts were made to identify the vector *Aedes* mosquitoes causing the yellow fever. It was further noted that “Even though the laboratory confirmation did not arrive, we submitted and that was mandatory, we identified YF causing vector, *Aedes* mosquito” (EPHI DDG KII, 2019).

Likewise, supporting ideas from a local community FGD was obtained; participants noted: “Health workers provided us with a medicine and they also took water sample from ponds/stagnant water for further investigation, from the place where the first suspect person was....” (Kodo Kebele community FGD, 2019). Likewise, local people further reported that “... In addition, indoors residual spray, anti-mosquito spraying chemical was done properly (FGD_Kodo Kebele_Offra community, 2019).

3.3.1.4. Vaccination Campaign

The main issues raised regarding vaccination campaign are the status of vaccination, coverage, resource mobilization, targeted group, mass mobilization, AEFI and other related events. One of key ideas mentioned regarding vaccination campaign was reported by a senior officer at EPHI who noted that “the option we have in hand was to provide reactive mass vaccination even if we’re not dead sure, if we respond there would be a tendency to save life in process....” ((EPHI DDG KII,2019, 2019). Similarly, it was also noted by another participant who said: “ ...As long as the case definition met and we have one laboratory test read positive if we vaccinate thinking its yellow fever we can save life.....we decided to give this six kebelels selective reactive mass vaccination,” (EPHI DDG KII,2019).

Ideas raised during local level discussion about the vaccination campaign further show that the vaccination campaign was declared and then was conducted immediately., as reported one of the participants. Another participant from the same group further said that “First 10,000 doses of yellow fever reactive vaccine was delivered for six most affected kebeles, following one positive case then it was decided to give for all kebeles.....” (FGD_Gesuba_HC – RRT, 2019).

Information obtained at zonal level discussion further corroborate this as claimed by a participant, who noted: “.....We visited homes and checked who has taken the vaccine and who has not in the vaccination post. By this time, everyone has been vaccinated against the yellow fever,” (Wolaita Zone YF FGD). Another participant from the same group noted “Regarding the vaccine, it was done in rapid manner in. 6 kebeles. Its coverage was about 95%...” (ibid., 2019). A participant from one of the affected kebeles also provided supporting statement, saying, “Regarding vaccination, I am sure every person from children to older ones were vaccinated by HEWs”(Tomi Gerera Kebele community FGD participant, 2019).

3.3.1.5. Prevention and Control

This sub-thematic area is mainly focused on the intervention which was in place during yellow outbreak. In this regard, a salient issue was poor prevention activity. As an internist at Sodo Hospital noted, “The prevention activity did not begin as early as possible by both the government and the partners....” (KII Soddo General Hospital Internist, 2019).

At community level a range of prevention activities were reported as disclosed during an FGD. One of the participants said “..... In the community, we conducted awareness creation on bed net utilization, crushing and destroying of stagnant water sources....” Another also reported that “..... The prevention methods that we used for malaria were also applied to prevent yellow fever..... Further still, a third participant provided an insightful statement on this, saying: “.....We agreed that a committee that would work to prevent and control until this problem would be identified. Next, we went into action on how to deal with the case and by setting up of disease surveillance teams (FGD_Gesuba_HC – RRT, 2019).

3.3.1.6. Logistic & Supplies

Regarding logistics and supply, information obtained at all levels show a worrying scale of limitation. An informant at SGH noted: “..... We requested budget for different prevention activity.....The woreda cabinet discussed it and approved 100,000 Birr budget for various activities (KII Soddo General Hospital Internist). This financial supply, although served well to address the crisis, was not obviously sufficient enough... A major logistics and supply issue was discernible from what higher officers at EPHI reported: “...It took a month to request ICG and process the vaccine and epidemiological and entomological investigation. While doing so, we decided to give selective reactive mass vaccination to seven kebelels” (EPHI DDG KII, 2019). He further mentioned that “.... Covering human cost and operational cost and taking vaccine from routine vaccine stock after letting a supply enough for a month to re stock after the ICG process ends (ibid.)

3.3.1.7. Challenges and Gaps

As a sub-theme under ‘Response’, the research team gathered information on the challenges and gaps from all levels. Data obtained through interviews and group discussions were corroborated by observation and document reviews. A salient challenge and gap, highly decried during the fieldwork was the deficient laboratory standard. This was emphatically noted by FGD and KII participants. A senior officer at EPHI noted: “.....Our laboratory is not confirmatory at this level and nationally our laboratory is not a yellow fever lab.....” (EPHI DDG KII, 2019).

Another equally troubling challenge was delays in responses. Participants during FGD stated that “.... The challenge during this was the delay response after detection, the result of the sample took more time; two months passed between first case disease onset and response.....” A third major challenge was shortage of qualified health professionals as discussion participants said: “.... There was shortage of health workers to conduct outreach activities to assess the disease”.

The scale of the problem and the magnitude of people requiring attention was a fourth major challenge, as an informant reported: “.....There were so many pregnant mothers, who did not receive the vaccine, and there was unvaccinated children whose age less than 9 months of age...”

The elusive nature of the disease itself was a fifth challenging problem. This was emphasized by many informants. For example, one informant said: “There was a challenge to differentiate yellow fever from other VHF, hepatitis B and other disease”. A related challenge was that there was little or no expectation

of this disease happening as it was thought long eradicated: “Moreover since this epidemic were occurred 50 years ago we were panicked, which we have not seen in our life.....” FGD_Offfa Woreda RRT, 2019). Finally, there was a serious gap in capacity building, as it was noted by regional officers: “..... From diagnosis side we have a problem in case of capacity building.” (Regional FGD, 2019).

Overall, even though the response activities from national/federal to woreda level were late and insufficient, it has been noted from all participants that the response activity was coordinated and it was in place as per the standard intervention/response protocols. Discussion

3.3.2. Discussion

The public health emergency response focuses on rapid assessment of outbreaks, outbreak investigations, implementing control and prevention measures, and monitoring of the interventions. The benefits of a rapid and effective response are numerous. Rapid response limits the number of cases and geographical spread, shortens the duration of the outbreak and reduces fatalities. These benefits not only help save resources that would be necessary to tackle public health emergencies, but also reduce the associated morbidity and mortality. It is therefore important to strengthen epidemic response, particularly at woreda and community levels. Attention needs to be focused on response strategies and continuous monitoring and evaluation of these activities (PHEM Guideline, 2012).

Draft for Yellow Fever vaccination campaign guideline (2013) stipulates that to reduce the risk of outbreak two main strategies are being promoted; one is risk assessment and surveillance, which mainly implemented by identifying the population at risk and the other detect the outbreak early. The second one is vaccinating and outbreak response that include contain outbreaks through emergency response (reactive campaign); the other prevent outbreaks through massive vaccination (preventive) and finally the other is to protect children through routine immunization.

As it was presented above in the result section all the above-mentioned responses mechanisms, rapid assessment of outbreaks, case management, outbreak investigations, implementing control and prevention measure were not in place as per the standard; i.e., the case management was implemented after the detection of the first case. Prior that all the case been ruled out either as it was severe malaria, or other VHF diseases, but since after the case were knows as Yellow fever, all the investigations were in place, like outbreak investigation, Entomological investigation and also interventions like vaccination campaign, vector control and general control activities were implemented in all affected kebeles.

Regarding outbreak investigation, after report of the first yellow fever case on 21 August 2018, by Wolaita Zone Health Bureau, the team from EPHI were deployed, comprising one field epidemiologist, one medical doctor, one public health specialist and one Entomologist to undertake the outbreak investigation activities. This was done in collaboration with zonal and woreda health and other sector staffs. All in all, a total of 35 cases with 10 deaths were recorded. The last case was detected on 16 October 2018. All cases and deaths were from Wolaita Zone; 34 from Offa and 1 from Sodo Zuria woredas.

Epidemiological, virological and entomological field investigation evidences confirmed this (SITREP 2018).

According to PHEM guideline (2012) Health staff should promptly investigate the problem and respond to the immediate cases. Some health events require investigation to start as soon as possible. Woredas should aim to investigate suspected epidemics within 3 hours of notification. The Guideline further stipulates that suspected outbreak of these diseases (immediately reportable disease) should be notified from level to level within 30 minutes of identifications follows: and also the immediately reportable disease should be investigated with is 3hour of notification. (ibid). Against this standard, as presented above, it was late for notification and also to undertake investigation or intervention/response, which took more than one month. When it was compared WHO standard either from notification to identification (30minute) or notification to investigation, which is 3 hours. In light of this standard, the case was notified or investigated after it was been more than a month.

As far as vaccination campaign is concerned, prompt detection of yellow fever and rapid response through emergency vaccination campaigns are essential for controlling outbreaks, as standard norms require. However, underreporting is a concern – the true number of cases is estimated to be 10 to 250 times what is now being reported. WHO recommends that every at-risk country have at least one national laboratory where basic yellow fever blood tests can be performed. A confirmed case of yellow fever in an unvaccinated population is considered an outbreak. A confirmed case in any context must be fully investigated. Investigation teams must assess and respond to the outbreak with both emergency measures and longer-term immunization plans (<https://www.who.int/news...> 2019)).

As it was observed in documents at each level, all documents similarly stated that the vaccination campaign were in place in two rounds, in six affected woredas ring reactive vaccination with 95% coverage from the target population and in nine wereda, two from wolayita zone and two Gamo Gofa zones, respectively. Immediately after confirmation of yellow fever, a reactive mass vaccination campaign was conducted from 13–20 October 2018 in six identified kebeles which benefited 31,565 (95% of targeted population) high risk populations. Following epidemiological, virological and entomological field investigation evidences, the Ethiopian Ministry of Health and international community have decided to vaccinate 1,335,865 (103% of the Target). Populations dwelling in nine woredas and Institutions; seven from Wolaita and two from Gamo Gofa Zones Institutions include University, colleges, prisons and other camps. This ring campaign was conducted from 16–22 November 2018 plus two additional days for mop up. The campaign is officially finalized on 24 November 2018 (Yellow Fever Vaccination Campaign 2018).

When we see the yellow fever occurrence and its management in Wolaita Sodo, it seems to fall short of the national and international protocols, although it was mentioned at national level, the RRT were activated and deployed timely to support and guide the local response team. The fact that the detection was reported one month after the detection shows such failure as the accepted standards show that yellow fever is immediately reportable disease according to PHEM national guideline.

The mis-diagnosis of the cases lead to clinical miss-management as sever malaria when the patients visited the HC. They didn't get improvement; as a result, they were referred to Referral hospitals.

In general, even though there was a confusion on identifying the first case, as all FGD and KII mentioned and the document reviewed also show, since after the confirmation of the first case, the case management went as per the standard guideline and SOPs it also saved so many lives and it was also free of charge. Vector

With respect to control and entomological investigation, since vector control is a cross-sectorial activity, coordination across ministries (i.e., health, sanitation, environment, education) was necessary. Vector surveillance and control programs were intensified to curtail viral transmission. A key component of yellow fever eradication, vector control measures targeted high-risk environments that were conducive to mosquito breeding (WHO 2016).

The density of *Ae. luteocephalus* and *Ae. africanus* vectors were high as assessed by human landing and larval collection in rural villages as compared to urban area of Offa district, and Monkeys were frequently present around homes and farmlands. Thus, it suggested that the outbreak probably was sylvatic in nature. Similar studies show, these vectors ensured YF virus transmission despite its low vector competence reported by Miller et al. (1988). Finally, we note that the estimated risk of yellow fever outbreak is possible in the assessment areas of this district if the YFV was introduced. (SNNPR YF Report, 2018).

Regarding Vector control and entomological investigation, as mentioned above, all major interventions that could take to control malaria were in place showing that this is more or less comparable to excepted norms.

As mentioned in result section, all the intervention methods that were used to control malaria, like proper bed net utilization, avoiding mosquito breeding sites, disturbing stagnant water and others were also implemented; all parties including communities were engaged. Mosquito control is vital until vaccination takes effect. The risk of yellow fever transmission in urban areas can be reduced by eliminating potential mosquito breeding sites and applying insecticides to water where they develop in their earliest stages. Application of spray insecticides to kill adult mosquitoes during urban epidemics, combined with emergency vaccination campaigns, can reduce or halt yellow fever transmission, "buying time" for vaccinated populations to build immunity. Mosquito control programs targeting wild mosquitoes in forested areas are not practical for preventing jungle (or sylvatic) yellow fever transmission (FMOH 2013).

The main gaps and challenges hampering yellow fever response action, as presented above are often seen persistent ones in the country as observed in other similar contexts. The challenges of substandard laboratories, inexperienced health workers, lack of facilities, and poor coordination are further observed in similar comparable contexts in the country and beyond. The laboratory, reporting, facility, and expertise

standards in SNNRPS, as might be the case in other regions in the country do not meet the national norms.

4. Conclusion

The aim of this assessment was to investigate the challenges, gap, practices and lesson learned from the outbreak management. The information was generated from FGDs, KIIs, observation and document reviewed to assess the efficacy and robustness of the five key dimensions of AAR; namely, surveillance, preparedness, coordination, risk communication and community engagement and response.

As per the PHEM guideline, yellow fever is one of the immediately notifiable diseases. But the surveillance system was weak to detect occurrence of yellow fever outbreak in Offa district of Wolaita Zone, southern Ethiopia; the system couldn't notify and immediately report to the IDSR weekly report. Yellow fever outbreak was not timely detected and hence active case search and contact tracing were conducted even after the outbreak was over. The link between health facilities with health offices of different level was not adequate.

The causes of the outbreak were detected lately, and the notification of the outbreak was rapid as far as time of detection was considered. Detection was done after deaths reported and additional cases with similar symptoms were there. The reason for delayed detection was due to the lack of knowledge and experience of the health professionals and community about yellow fever and weak communication between the health facilities and PHEM structures.

The outbreak could be detected /confirmed at EPHI and regional reference laboratory though the referral system was too tedious and much delayed. Entomological assessment was conducted to assess and identify natural and artificial breeding sites of the vector. Assessment of human landing results indicated the higher density of Ae. Mosquito in rural areas compared to urban areas of the Offa districts and the movement of monkey around the areas might be evidenced that the Yellow Fever outbreak was sylvatic in nature.

The response of yellow fever outbreak started lately as the result of laboratory confirmation took much time since there was no pre-informed set-up for sample shipment to accredited laboratory following late detection of the case. Moreover, yellow fever surveillance system was not strongly enough to detect and notify as well as communicate early in spite of national PHEM guideline that proclaimed yellow fever as immediately reportable disease.

Regarding coordination, it was seen and observed from the assessment that, even though the coordination started lately after the confirmation of the first case and about three month later after the first notification, it has been considered as a good and well organized coordination with in the health system, and horizontal inter-sectorial collaboration and the required partner and stakeholders with full commitment and engagement. The TWG from national to woreda level were established, activated and

roles and responsibilities also shared as well, the required RRT from federal/EPHI to woreda level were activated and deployed timely and they also meet regularly.

Regarding response, the most important conclusion is that the case was detected lately after two months of since the first case were detected and all cases which were admitted in this period were mis-diagnosed of the cases and leading to some deaths. However, once the case was confirmed, the response to the crisis was fairly commendable. All the actions taken were as per the standards and they have been effective in saving of many lives.

In general, based on the foregoing results and discussions we can conclude as follows:

- There was a big gap on the communication parts, like taking the media as an opportunity for communication on the situation;
- early warning, environmental health risk, and the risk communication for the community were not done properly.
- it is not the right way to focus only on selected diseases, it behooves us to think beyond the scope
- However, one positive aspect worth-noting is that the coordination at all levels, horizontally or vertically with all stakeholders and partners was strong and exemplary in that it was multi-sectorial composition of professionals and there was high political engagement during the outbreak management. Thus, the coordination to manage the outbreak should be considered as a good practice or strength of the system and hence may be scaled up.

5. Abbreviations

AEFI Adverse Effect Following Immunization

AMREF African Medical and Research Foundation

AAR After Action Review

CDC Center Disease Control

DDG Deputy Director General

EPHI Ethiopian Public Health Institute

EPRP Emergency Preparedness and Response Plan

FGD Focus Group Discussion

FMOH Federal Ministry Of Health

FDRE Federal Democratic Republic of Ethiopia

HC Health Center

HO Health Office

IRC International Rescue Committee

IDSR Integrated Disease Surveillance and Response

KII Key Informant Interview

MOH Ministry Of Health

MSF Médecins Sans Frontières

PHEM Public Health Emergency Management

RHB Regional Health Bureau

RRT Rapid Response Team

SNNPR Southern Nations and Nationalities People Region

SITREP Situational Report

SOP Standard Operating Procedure

TWG Technical Working Group

WHO World Health Organization

UNICEF United Nation International Children's Emergency Fund

YF Yellow Fever

YFV Yellow Fever Virus

VHF Viral Hemorrhagic Fever

VRAM Vulnerable Risk Assessment and Mapping

ZHB Zonal Health Bureau

6. Declarations

Ethics approval and consent to participate

According to Federal *Negarit Gazeta* of FDRE Regulation No.301-2013 EPHI establishment council of Ministry of Regulation page 7175 ,20th year 10 Addis Ababa 1st January 2014 Ethiopia Public Health Institute have a power and duties conduct, during epidemics or any other public health emergency or public health risk, on sight investigation when deemed necessary, verify outbreaks, issue alert, provide warning and disseminate information to the concerned organs, mobilize or cause the mobilization of resources, support the response activities carried out at *weredas*, zones and regional levels as deemed necessary;. And “implement international health regulations on grave public health emergencies having implication of international crisis; Article 14 and 16, respectively.

This study has been done in conformity with the ethical codes clearance approved by the Ethiopia Public Health Institution (EPHI, ref: 3.10/446/11) to SSNPR and Preceded by the permission request letter from SSNPR health bureau 33-/86/261/11 written to the zonal health bureau then to *Gessuba* health centers and Christian hospital and explaining the study objectives and its significance.

The qualitative study was informed by, among other things, respect for culture, local norms, privacy and principles of honesty, truth and beneficence. Audio-visual recording was done obtaining permission from the participants. The participants were reciprocated through cash payment of 100 ETB (roughly 3.44 USD) per head for the time they spent in the sessions.

And consent were read for each FGDs’ participated and the discussion were continued with the approval of each participants, based on the FGD tools in AAR templates.

Consent for publication

Not Applicable

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due this data mainly contain countries’ secret health policies and strategies, but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

Funding

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Competing interests

No competing interests

Authors’ contributions

YA,YF,WM,MA,MM,NY,SH,ZD and BW have different experience in conducting qualitative research and their credentials were PhD, Assistance professor, MD, MPH and MSc were been participated in all part of the work, including data collection tools development, participated in each FGD and KII as facilitator and interviewer facilitated fieldwork logistics, analyzed and interpreted the data; and the other MN,SH,DS,AT,SK were been assisted/contributed in translation, transcription and analysis the SA,ZA,TT,AH,FR and others were participated in reviewed the manuscript and prepared the draft manuscript. And finally ZD were give special Assistance and contribution in data analysis, thereby helping in the drafting process. And finally all authors' were read and approved the final manuscript.

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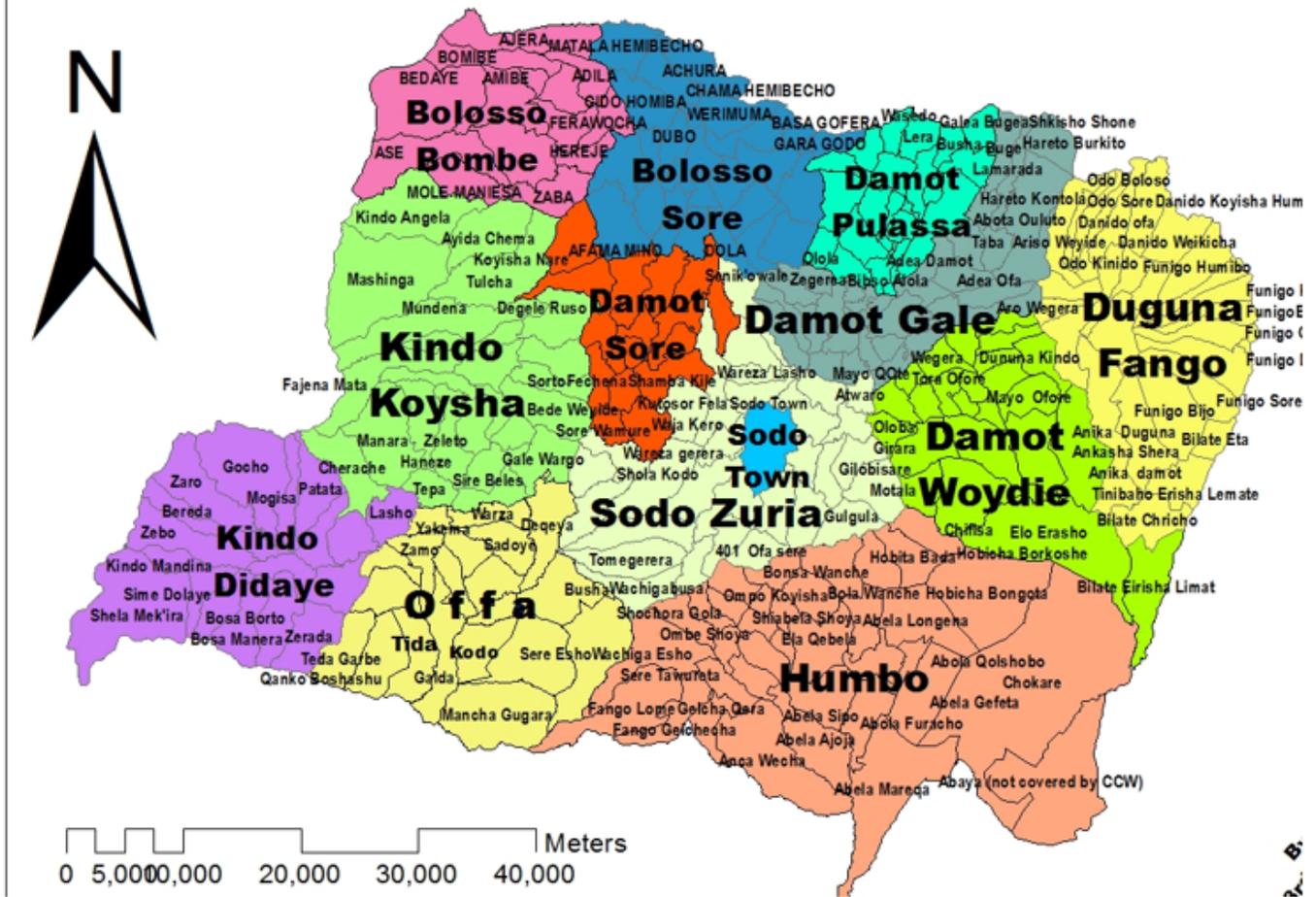
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Figures

Administrative Map of Wolaita Zone, SNNPR, Ethiopia



Source: Wadu Mashalo

Figure 1

Administrative Map of Wolaita Zone, SNNPR, Ethiopia.

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