*Research Article*

# Active Case Finding for Improved Ebola Virus Disease Case Detection in Nimba County, Liberia, 2014/2015: Lessons Learned

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*Objectives.* Early case detection and isolation of patients infected with highly infectious diseases are crucial in the management and control of epidemics such as Ebola Virus Disease (EVD). In this paper, we share the lessons learned from implementation of active case finding as a strategy for improved EVD case detection in Nimba County, Liberia. *Methods.* We adopted the World Health Organization (WHO) active surveillance strategy to identify and report suspected EVD cases, follow up contacts of confirmed cases, and report community deaths. We identified, trained, and deployed 1060 Community Health Volunteers (CHVs) in 718 communities in Nimba County. The CHVs were supervised by 142 health workers within their catchment area. The health workers were supervised by the District Health Officers (DHOs). The DHOs reported to the County Health Team (CHT) who provided supportive supervision. Data collection was based on the EVD contact tracing and active case finding forms adopted from WHO. Data analysis was based on epi-weeks. *Results.* The number of EVD suspected cases increased by more than 75% following the initiation of active case finding. Average duration between symptom onset and case detection reduced from between three and five days to within 24 hours. Collection of oral swabs from dead bodies increased from two to 15 within the first week of active case finding strategy implementation. Reporting of other IDSR priority diseases and conditions also improved. *Conclusion.* Active case finding strategy in Nimba increased suspected EVD case detection and reduced the duration between onset of symptoms and detection of cases.

## 1. Introduction

Early case detection and isolation of patients infected with highly infectious diseases are crucial for timely initiation of supportive treatment and control of further transmission of the disease within a population [1–3]. Active case finding is a systematic search for symptomatic cases of an infectious disease using a specified case definition and has been used in infectious diseases such as poliomyelitis; its use in Ebola Virus Disease (EVD) is not well documented. Active case finding was effectively employed in containing the EVD outbreak in Nigeria as reported by Fasina and colleagues [1].

Passive EVD case detection has previously been done through screening of all patients presenting at healthcare facilities or other designated places and follow-up (or contact tracing) of persons known to have had contact with a confirmed case and by inviting community leaders and key informants to report all possible alert cases for follow-up [1]. Active case finding is an important approach for capturing all the cases as many may not have access to a healthcare facility

or may seek care elsewhere [4, 5]. Persistence of undetected cases in the community sustains EVD transmission chains and hence delayed outbreak control [5].

Africa has been greatly affected by most of the recent outbreaks of a number of diseases in the 21st century [6]. The EVD outbreak which started in Guinea was officially notified by the World Health Organization (WHO) in March 2014 [7, 8]. This outbreak then spread to Liberia, Sierra Leone, Mali, Nigeria, Senegal, North America, and Europe [9–11]. Liberia, which was the most affected country, confirmed its first case on March 30, 2014, and had registered 3,458 cases with 2,058 deaths (for a case fatality rate [CFR] of 60.8%) by September 30, 2015 [12].

In spite of having many chains of active transmission, there was low human resource capacity for case detection and follow-up of all contacts [3]. Conventional measures were no longer efficient as few cases were reported from the community and few presented at healthcare facilities and treatment centers due to fear, misconceptions, stigma, and lack of community trust [5, 12–14].

In October 2014, the Government of Liberia adopted the WHO strategy of active case finding as a proactive measure for seeking out suspected EVD cases from communities to improve early case detection [15, 16]. Implementation of this strategy also involved creating awareness on EVD through health promotion approaches [17].

Nimba County which confirmed its first EVD case in July 2014 adopted and started implementation of active case finding in November 2014 [16, 17].

In this paper, we describe the lessons learned in the implementation of active case finding as a strategy for improved EVD case detection in Nimba County.

## 2. Methods

Nimba County is located in north-central Liberia (Figure 1) and is the second largest of the 15 counties in Liberia. The county is also Liberia's second most populated covering an area of 23,000 square kilometres with a 2015 estimated population of 539,987 with 96,313 households and has 72 healthcare facilities distributed in six health districts.

*2.1. Active Case Finding Strategy.* We employed an active case finding surveillance strategy from epi-week 43 of 2014 up to epi-week 52 of 2015 in which 1,060 Community Health Volunteers (CHVs) conducted daily household visits in the community looking for any cases experiencing signs and symptoms of illness and community deaths. The 1,060 CHVs are part of the health system in Nimba and were selected from their respective communities. They registered all the households within their catchment communities to facilitate supervision and follow-up. CHVs visited each household and interviewed the head of the household or any other adult household member at least once in three days. They also observed all household members who were present at the time of the visit. For households where the CHVs found any sick person, they reported to the Officer in Charge (OIC) of the health facility and followed up with the households

to ensure that the sick person reported to the health facility. Routinely, CHVs conduct community based disease surveillance and mobilize communities for immunization and other health promotion activities. This strategy is an adaptation of the polio eradication model, which we modified by going directly to the community in addition to reviewing patient records at the health facility and then tracing cases in the community. The other modification was the deployment of CHVs instead of health workers who review records and follow up cases in the community for polio active case finding [19]. In this strategy, CHVs conducted EVD contact tracing and updating of the contacts lists. They also reported community deaths regardless of presumed cause of death to enable oral swab collection from dead bodies and safe burial. In addition, the CHVs delivered EVD health education messages to the households visited within their communities and also identified cases of other Integrated Disease Surveillance and Response (IDSR) priority diseases.

The implementation team in this strategy was identified and mapped. Figure 2 summarizes the key stakeholders and their different roles in the implementation of active case finding in Nimba County.

*2.2. Recruitment of Implementation Team.* All the District Health Officers (DHOs) were recruited to supervise Officers-In-Charge (OIC) of health facilities within their districts. The OICs and one additional clinician from each of the 71 health facilities in Nimba were also recruited to supervise CHVs in communities within their catchment area. The CHVs in each of the communities were identified from existing records at the County Health Team (CHT) offices. For those communities that did not have CHVs, the CHT provided guidance and a volunteer was selected. A total of 1060 CHVs were recruited.

*2.3. Training of the Implementation Team.* Contact tracing and active case finding guidelines were used in 2-day training workshops for all teams at all levels. The CHT members were trained as supervisors and were trained by the WHO field team. The importance of respecting reporting and timelines and of reporting even when no case of ill health or death had been identified (zero reporting) was emphasized. The CHT trained 142 OICs and other clinicians and six DHOs to supervise and compile reports from the CHVs. The OICs then trained the CHVs on the active case finding strategy. Training for the CHVs was conducted in each of the six health districts. The training mainly focused on implementation of the strategy and hands-on practice in filling of active case finding tools; contact tracing forms adopted from WHO and also given information brochures and posters developed by the national social mobilization team [15].

*2.4. Reporting.* Structured reporting was established which included immediate reporting of symptomatic cases, regular reporting according to timelines, and zero reporting for a number of households visited, suspected cases identified, blood sample, and oral swabs collected from dead bodies.
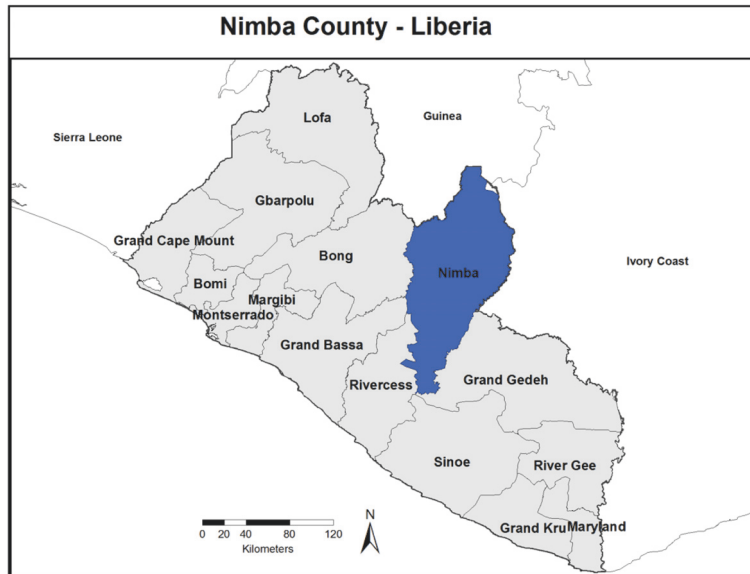
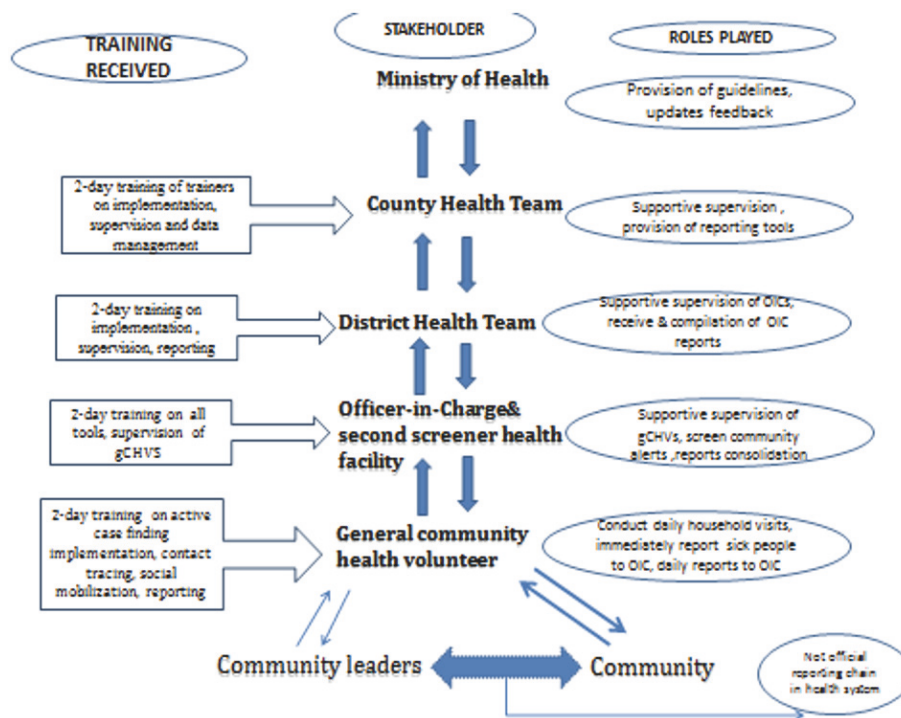FIGURE 1: Map of Liberia showing location of Nimba County.



FIGURE 2: Reporting chain under active case finding strategy.

Blood samples were taken off from the health facility by laboratory staff. Oral swab collections were done by environmental health officers. The CHVs reported on a daily basis to the OIC of their catchment health facility. The OICs submitted consolidated weekly reports every Sunday by 5:00 pm to the DHO who compiled and submitted the reports to the CHT every Monday by 5:00 pm.

*2.5. Data Storage and Analysis.* The Monitoring and Evaluation Officer, who was part of the supervisors at the county level, was trained in data storage and analysis in Microsoft Excel. Data were entered and analyzed using MS Excel spreadsheets to develop action points and provide feedback at all levels for implementation of recommended actions. Verification and completeness of data were managed by

WHO, Liberia, including extraction from Health Management Information System (HMIS) records, case investigation, supplementary active case finding in communities, and review of health unit case reporting records.

Data analysis was mainly based on epidemiologic weeks (epi-weeks) which is a standardized epidemiological method of counting weeks to allow for the comparison of data year after year [20]. Analysis was based on selected variables, namely, number of suspected EVD cases, number of confirmed EVD cases, number of oral swabs collected from dead bodies, and number of cases of other priority diseases reported.

## 3. Results

All the 96,313 households in the 718 communities of Nimba County were visited and appropriate EVD health messages delivered through interpersonal communication and use of Information, Education and Communication (IEC) materials). The health messages were delivered by the 1,060 trained CHVs (Table 1). The CHVs worked alongside 142 supervisors to whom they reported.

The number of reported EVD confirmed cases was highest in epi-weeks 39 and 44 but reduced by more than 75% in epi-week 46 of 2014 (Figure 3). At the initiation of active case finding strategy in epi-week 46, the reported number of confirmed EVD cases was one but increased to three cases in epi-week 47 before reducing to zero in epi-week 48. There was no documented case up to epi-week 52 when 2 cases were reported. The two cases reported in epi-week 52 were a mother and her daughter. There were no reported confirmed EVD cases in 2015.

As shown in Figure 4, the trend in EVD suspected cases varied greatly from epi-week 36 of 2014 to epi-week 14 of 2015. From epi-week 46 of 2014 when active case finding was initiated, the number of EVD suspected cases increased by more than 75% in epi-week 51 of 2014. In 2015, the number of reported suspected EVD cases increased from 12 in epi-week 1 to 45 in epi-week 6.

Figure 5 shows that the average duration between onset of symptoms and EVD case detection reduced when active case finding was initiated. The average duration reduced from 3-5 days between epi-week 31 and 43 to within 24 hours in epi-week 46.

Figure 6 shows that there was a sharp rise in oral swabbing of dead bodies after active case finding was initiated. The highest number of dead body oral swabs were collected in epi-week 38 but reduced to almost zero in epi-week 42. From epi-week 43, the number of oral swabs collected increased by more than five times from two to 15 in epi-week 44. The number of oral swabs varied widely from as high as 20 in epi-week 37 of 2014 to as low as two in epi-week 13 of 2015.

From the fourth quarter (Q4) of 2014, there was a general increase in suspected cases in all the IDSR priority diseases and conditions; the number of suspected cases was particularly higher for measles and bloody diarrhea. From Q4 2014 to the third quarter (Q3) of 2015, the number of reported suspected measles cases increased from zero to over 20 cases.
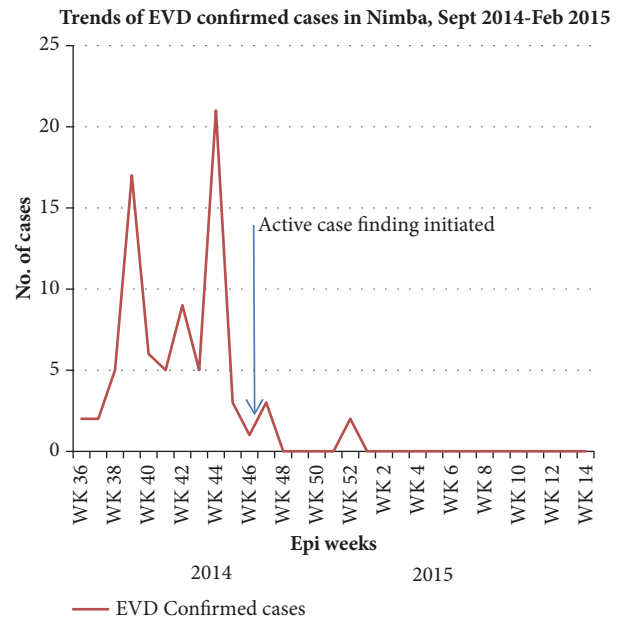


Figure 3: Trends of EVD confirmed cases in Nimba County, September 2014 to February 2015.
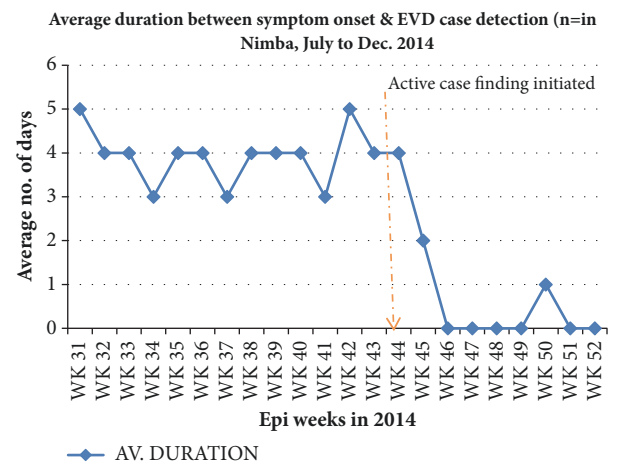


Figure 4: Average duration between symptom onset and EVD case detection in Nimba County, July to December 2014.

There was a sharp decrease in suspected measles cases from 21 in the Q3 to 7 in Q4 of 2015. The number of suspected cases for the other diseases and conditions generally fluctuated between about 3 and 8 (Figure 7)

## 4. Discussion

In our description of the implementation of EVD active case detection in Nimba County during the 2014-2015 EVD outbreak, we observed that active case finding strategy enriched case detection and reduced the duration between onset of symptoms and case detection. We also noted improvements in death notification and acceptability of taking oral swabs of dead bodies in the communities.

TABLE 1: Structure for implementation of EVD active case finding strategy in Nimba County, June 2014 to December 2015.

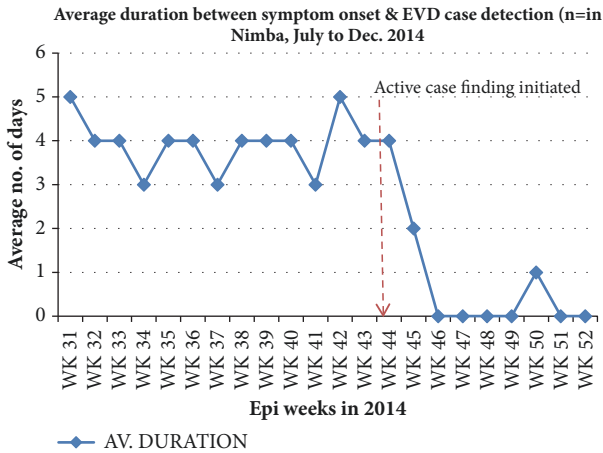| No | Name of health district | Estimated population | Number of households | Number of CHVs | No of CHV supervisors |
|----|------------------------|---------------------|---------------------|----------------|----------------------|
| 1 | Sanniquelie Mah | 144,268 | 20,610 | 289 | 36 |
| 2 | Gbehlay Geh | 85,843 | 12,263 | 172 | 26 |
| 3 | Tappita | 79,126 | 11,304 | 158 | 24 |
| 4 | Saclepea Mah | 87,126 | 12,447 | 174 | 28 |
| 5 | Zoe Geh | 99,328 | 14,190 | 199 | 22 |
| 6 | Yarwin Mehnsonnah | 34, 220 | 4,889 | 68 | 6 |
| | **Total** | **529,911** | **96,313** | **1,060** | **142** |



FIGURE 5: Average duration between onset of symptoms and suspected EVD case detection in Nimba, July-Dec 2014.



FIGURE 6: Oral swab collection from dead bodies in Nimba County, Sept 2014–Feb 2015.
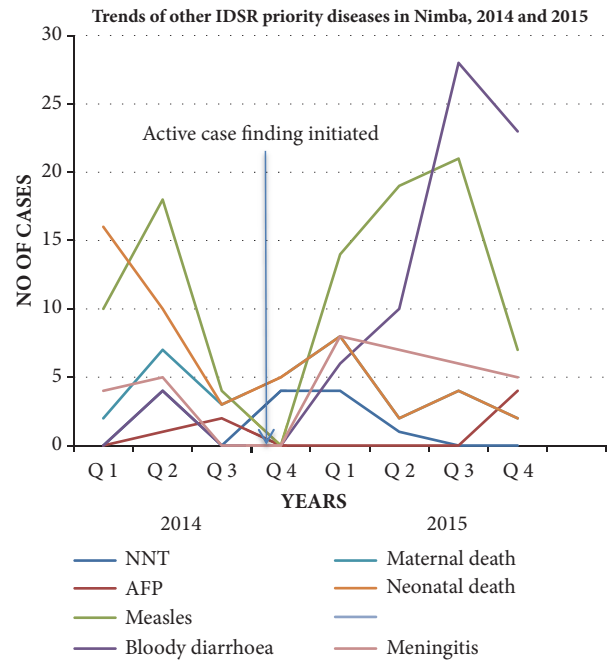


FIGURE 7: Trends of other priority disease and conditions detected in Nimba County, Jan 2014–Dec 2015. *NNT= neonatal tetanus, AFP = acute flaccid paralysis. Q1-Q4 denotes quarters 1 through 4.* These cases are suspected cases as per the case definitions in the IDSR technical guidelines [18].
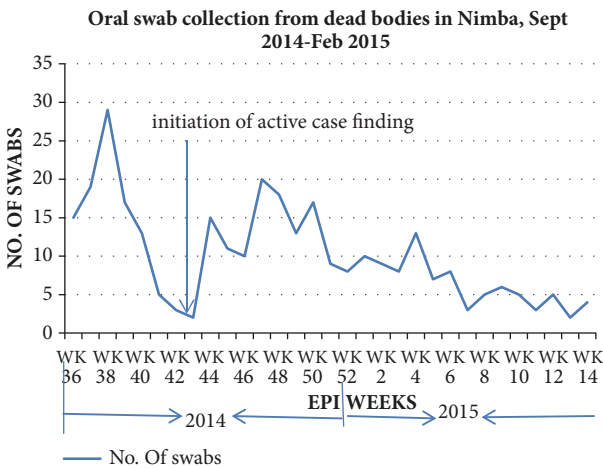
The reported number of other IDSR priority diseases such as measles also increased during the active case finding implementation period.

With the exception of the two cases reported in epi-week 52 of 2014, there were no confirmed EVD cases from epi-week 48 of 2014 up to the end of the active case finding implementation period. These two cases were a mother and her daughter who had history of travel from an EVD affected neighboring country and were identified by a CHV during his daily routine visits. This early case detection interrupted a potentially new chain of transmission. Early case detection has been identified as an extremely important approach in the prevention of EVD transmissions and eventual control of EVD outbreaks [17, 21]. Identification and subsequent isolation of cases especially within 4 days of onset of symptoms are an important milestone in EVD epidemic control and management [5, 8]. The reduction in EVD confirmed cases during the active case finding strategy period could have coincided with the end of this outbreak in Nimba due to other previous interventions. In fact, when we observed a reduction in number of EVD confirmed cases, we thought that there were EVD cases that were not being reported from the communities. In response to this observation, we initiated

the active case finding strategy in Nimba to strengthen the EVD surveillance.

Following the initiation of the active case finding strategy in October 2014, the number of suspected EVD cases increased by more than three-quarters irrespective of the reducing number of confirmed case. It is reasonable to believe that the increased number of suspected EVD cases was as a result of the initiated active case finding strategy which aimed to identify all individuals with ill health. The identified individuals were reported to the OIC of the catchment healthcare facility for initial assessment to identify EVD suspected cases. This led to early identification and isolation of all suspected EVD cases, and reduced the number of close contacts for the confirmed cases. The number of close contacts and viral load are the two major determinants of transmissibility for highly infectious viral diseases such as EVD [22, 23]. In addition to the comprehensive approach, the number of suspected EVD cases could have increased due to increased community awareness as a result of health education and social mobilization messages delivered by CHVs as well as other social mobilizers. Furthermore, we noted a reduction in the average number of days between onset of symptoms and case detection from 5 days to 1 day or less. Logically, a reduction in duration between onset of symptoms and case detection is an expected finding in active case finding strategy because the suspected cases are identified early and monitored.

The highest number of oral swabs in epi-week 38 corresponds to the period when we had high numbers of EVD confirmed deaths. The rapid decline in the number of oral swabs from 29 in epi-week 38 to only two in epi-week 43 was in part due to the reduction in deaths due to EVD in Nimba County because there was a decline in the number of confirmed EVD cases during the same period. Following the initiation of the active case finding, we observed an increase in the number of oral swabs collected from dead bodies irrespective of the presumed cause of death; we believe that this was an indicator of community acceptance because oral swab collection from dead bodies had been earlier resisted by most communities in Nimba County. Continuous community engagement and interpersonal communication during EVD epidemics enhance community acceptance of outbreak control interventions [17].

Following the EVD outbreak in Liberia, most efforts were mainly focused on controlling the EVD epidemic at the expense of the other routine health care services including immunization [11]. It is therefore not surprising that the number of suspected measles and other vaccine preventable diseases increased during this period. The increase in the number of reported IDSR priority diseases and conditions could also have been due to improved community vigilance and health seeking behaviors. Early detection of these suspected cases enabled the health team to institute timely and appropriate response to avert other potential outbreaks.

The increased suspected case detection, reduced duration between onset of EVD symptom and case detection, and the increased detection of suspected IDSR priority diseases and conditions demonstrate a best practice for IDSR implementation. Active surveillance strategy through the deployment of Community Health Volunteers (CHVs) has been recommended by the Liberia Ministry of Health and Social Welfare. This policy proposes designation of a CHV for every five-kilometre distance [21].

The experiences shared in this paper are limited by possible missing information because we relied on the collected information during the implementation period. Because of the same reason, we were not able to collect specific information such as disaggregated data on oral swabs collected in the community and in the healthcare facility. We are also not able to know the number of suspected cases that were particularly detected by CHVs.

Active case finding strategy in Nimba enriched EVD case detection and, therefore, contributed to prevention of sustained community transmission. It also reduced the average duration between onset of symptoms and detection of EVD cases. We recommend community engagement to initiate community led interventions for control of EVD epidemics. We further recommend innovative approaches in EVD outbreak control because we observed that conventional approaches may not apply in some situations.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Disclosure

The authors are sharing lessons learned from the implementation of the active case finding strategy. The data used is part of the information that they collected during their routine work.

## Conflicts of Interest

None of the authors has conflicts of interest in this study.

## Authors' Contributions

All authors agreed to publish this study.

## Acknowledgments

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