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Assessment of the Level of Readiness in Response to the Lassa Hemorrhagic Fever Virus Outbreak in Cotonou, Benin

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Abstract: Lassa Virus Hemorrhagic Fever (LVHF) can spread rapidly, causing large-scale epidemics and panic in the community, hence the need to be prepared. The study aims at assessing the level of preparedness of the health district of Cotonou 1 and 4 in response to the outbreak of LVHF in 2019. This is a descriptive and evaluative cross-sectional study led in the Health District of Cotonou 1 and 4. Variables were selected on the basis of documents of the national contingency plan for Ebola virus disease and other viral hemorrhagic fevers. The non-probability method and the reasoned choice technique were used for targets identification. The level of preparedness was assessed by calculating scores through Varkevisser scale. The preparedness level of the health district of Cotonou 1 and 4 in response to the outbreak of Hemorrhagic Fever with Virus Lassa in 2019, studied through resources, process and results was considered low with a performance of 58.43%. This health district has no contingency plan and private health facilities have no budget line for epidemic management. The preparedness for the response was characterized by poor coordination and low promptness in the transmission of case reports. The study showed that 14.49% of health workers and 40.0% community health workers had not a good knowledge of LHFV. Appropriate measures are required on these insufficiencies to improve the level of preparedness for the response to a possible LHVF epidemic both in Cotonou 1 and 4 and in the other health districts of Benin.

Keywords: Response, Epidemic, Hemorrhagic Fever, Lassa, Benin

1. Introduction

Viral hemorrhagic fevers (VHF) have become an important emerging disease in recent years, due to their very high mortality associated and the media attention they attract [1]. They are caused by viruses of the families *Arenaviridae, Bunyaviridae*, *Filoviridae* and *Flaviviridae*. The *Arenaviridae* family is responsible for diseases such as Lassa hemorrhagic fever (LHF), Argentinean hemorrhagic fever and Bolivian hemorrhagic fever [2]. LHFV is an endemic zoonosis in West Africa, particularly in Nigeria. It occurs recurrently in Benin as an epidemic since 2014. At risk population worldwide is estimated at 58 million people and the number of cases of LHFV is 100,000 to 300,000 in West Africa each year [3]. This illness causes about 5000 deaths in West Africa each year with an overall case fatality rate ranging from 1% to 5%. In 2019, in the Economic Community of West African States (ECOWAS) area, the number of recorded and confirmed cases of LHFV is 547 with 116 deaths, representing a case-fatality rate of 21.2% [4]. LHFV also accounts for deaths among health care workers as recorded in 2018 in southern Nigeria and northern Benin [5, 6]. This situation reflects, among other things, an inadequate preparation of health systems to respond to epidemic outbreaks despite the guidelines issued by the World Health Organization (WHO) and national health authorities. Several factors could explain this situation, such as the low level of knowledge of health professionals about VHF. Indeed, a study conducted by Obagha and al. in Nigeria in 2016 among health workers had revealed that more than

half (51.6%) had poor knowledge of LHFV [7]. The LHFV epidemic, as a public health emergency requires an immediate response. The health system in countries at risk should therefore be prepared to identify and respond to such a situation and this is one of their essential roles [8]. Preventive measures to protect both caregivers and the population are well known. However, their stringent application remains precarious given the current difficult socio-economic context and the brittleness of the national health system [9]. Preparedness consists of taking advance measures, before the outbreak or health event, so that teams can provide a rapid response and the necessary materials and equipment are available for prompt action [8]. In order to assess the capacity of countries to respond to a potential Ebola Virus Disease (EVD) outbreak, the WHO has developed a checklist with 11 components [10]. This checklist could be applied to LHFV. Benin has undergone five LHFV epidemic episodes in October 2014, January 2016, February 2017, January 2018, and December 2018, respectively. During the October 2014 outbreak, 16 cases were reported including nine deaths [11]. These LHFV outbreaks have always been registered in the northern part of the country [5]. Indeed, *Mastomys natalensis* rodents are very common in the north of Benin where they invade the traditional storage attics of cereals such as millet and sorghum [12]. No assessment has been made of the capacity of our health system to respond to this LHFV epidemic almost annually. This situation has raised the following question: What is the level of preparedness of Benin different health zones to respond to this outbreak? The present study is part of this logic in order to improve capacities of different key actors in the detection and effective response to LHFV epidemics; with the aim of assessing the level of readiness of one of the Health Zones (HZ) of Cotonou in the response to the LHFV outbreak in Benin.

2. Methods

2.1. Study Framework

Cotonou's town, with an estimated population of 2,401,067 in 2018, and bordering the Atlantic Ocean, is divided into four health zones: Cotonou 2 and 3, Cotonou 1 and 4, Cotonou 5 and Cotonou 6. The study was led inside Cotonou 1 and 4, gathering four public health centers (HCs), 22 private HCs, and the mother-child university hospital "Lagune" (CHU-MEL).

2.2. Type of Study

This is a cross-sectional, evaluative study of the level of readiness for the LHFV outbreak response. Data collection took place from March 25 to April 19, 2019. The targeted population were technical staff from the Departmental Health Office (DHO), the Coastal administrative department covering the entire city of Cotonou, the Quick Response Team (QRT), the providers from public and private health facilities, and then the community in the study area. The QRT was staffed by the Coordinating Doctor, the Epidemiological Surveillance Officer, the Laboratory Technician, the Hygiene and Sanitation Officer, and the Social Mobilization Officer. The healthcare providers in the public and private health facilities were doctors, nurses, midwives, auxiliaries, Qualified Community Health Workers (QCHWs) and community relays. A total of 138 health workers from 26 health centers and 20 QCHWs and community relays were involved in this study. They were chosen by exhaustive selection. All present subject during the data collection period, having gave their informed consent were enrolled.

2.3. Variables

The approach used to assess the level of preparedness of Cotonou 1 and 4 HZ to respond to the LFHV epidemic was based on the health interventions evaluation model as described by Donabedian [13]. The main component was the level of preparedness of the Cotonou 1 and 4 HZ for the response to the LHFV epidemic. The explanatory components were: structure, process and outcome.

2.3.1. Explanatory Component "Structure"

The aim was to verify the availability in quantity and quality of the various resources at the level of the QRT, the public and private health centers and the community relays. To do so, we used a "manual of standard operating procedures for the preparation and response to the Ebola virus disease epidemic and other viral hemorrhagic fevers in Benin" [14].

1) Human resources: QRT members; caregivers and community relays.
2) Material and logistical resources: computer equipment; data collection forms; incinerator; ambulance; sampling equipment; triple packing equipment; sprayer equipment; consumables; Personal Protective Equipment (PPE), hand washing device and isolation room.
3) Informational resources: LHFV case description; LHFV standard operating practices; Healthcare-associated infection manual; Sensitization posters; Note on the establishment of the QRT; and the contingency plan.
4) Financial resources: Existence of an operational budget for preparedness and response activities at the level of the HZ office and the HCs; and the existence of technical and financial partners involved in the fight against VHF.

2.3.2. Explanatory Component "Process"

These were the different activities to be carried out contained in the "National Contingency Plan for Ebola Virus Disease and other Viral Hemorrhagic Fevers", and the contingency plan at the health zone level. These activities are as follows:

1) Coordination, including periodic QRT meetings, active participation of QRT members, periodic meetings with Technical and Financial Partners (TFPs), and public-private collaboration.
2) QRT capacity building: Reactivation of the QRT; training of QRT members on LHFV epidemic preparedness and response; and acquisition of equipment,

materials and consumables.

3) Public Awareness: Participation of community relays and community leaders in sensitization; social mobilization and community sensitization on LHFV; sensitization in schools; health coverage of gatherings during endogenous religions; sensitization in markets, bus stations, worship places and other places of large gatherings; and the dissemination of posters and guides in health facilities.
4) Infection prevention: Training of health center professionals on the dosage of chlorine in disinfecting substances; the distribution of protection kits and contingency stocks in the health centers; the organization of monitoring and awareness-raising visits on hospital hygiene; and the assessment of incinerators.
5) Strengthening epidemiological vigilance: Briefing staff on the updated case definition and standard operating practices on LHFV; disseminating the updated case definition and task description for the management of LHFV in Benin; providing the health centers with LHFV surveillance materials; investigating rumors and suspected cases; identifying and following up on contacts; training community-based LHFV surveillance relays; and providing community-based LHFV surveillance relays with the case description.

2.3.3. Explanatory Component "Outcome"

Knowledge of health workers on the pathogenic agent tank, transmission modes, definition of a suspect case, prevention measures against LHFV in hospitals, knowledge of the alert threshold, the behavior in front of a suspect case, and the management of an accidental exposure to the Lassa virus;

Knowledge of community relays on the pathogenic agent tank, its modes of transmission, the definition of an alert case, the prevention measures in the community, and the conduct in the event of an alert case.

The quality of the Epidemiological Surveillance System (ESS): It includes the early detection of cases, the evaluation of the acceptability and the reactivity of the EES.

2.4. Data Collection Tools, Techniques and Process

Several data collection techniques were used: semi-structured interviews using an interview guide with the DHO and HZ coordination teams as well as with the heads of the health centers; administration of questionnaires to the QRT and the community; and use of documents related to epidemic prevention.

The recruited investigators were two nurses, two midwives, and two external social workers with experience in investigating LHFV epidemics in Benin. After recruitment, a training on the research protocol was led with an emphasis on data collection tools. At the end of the training, the tools were pre-tested at the HC of Saint Michel located in the Cotonou 5 Health Zone. Such step allowed a content review and completion of tools.

2.5. Data Analysis

The data were entered using Epi Info version 7 and analyzed using Stata software. For the sample description, proportions were calculated for qualitative variables and means followed by their standard deviation for quantitative variables. At the evaluative level, scores were calculated for each explanatory component. These scores were assessed using the Varkevisser measurement scale [15].

For a given component variable, the assigned score was 1 (Yes) when available or present/and 0 (No) when it was not. For the computation of a component score, the numerator was the sum of "Yes (1)" and the denominator was the sum of "Yes (1)" and "No (0)." The level of readiness per explanatory component was judged: "good" if the percentage obtained was between 80% and 100%; "average" if it was between 60% and 80%; and "poor" if it was between 0% and 60%. Table 1 presents a summary of the scores by explanatory component.

Table 1. *Modalities for assessing the level of preparedness of Cotonou HZ 1 and 4 for the response to the LHFV outbreak in 2019.*

Variables	Expected score	Rating scale
Resources	698	1) *Good":* if the obtained proportion is between 80 and 100%;
Process	25	
Results	210	2) *Average"*: if the obtained proportion is between 60 and 80%;
Total	933	3) *Poor":* if the obtained proportion obtained is between 0 and 60%.

2.6. Ethical Concerns

This study was carried out under the supervision of the HZ Core Team. The research protocol was validated by a panel of experts from the Regional Public Health Institute. During data collection, respondents were fully briefed on the purpose of the study, as well as on respect for data confidentiality. Targets were subjected to the survey after free and informed consent. Findings and recommendations were communicated to the core team in order to improve the performance of the response to the LHFV outbreak.

3. Results

3.1. Characteristics of the Targets

This study took place in a total of 26 health centers in Cotonou 1 and 4 health zones, including 22 private and four public health centers. Over 149 health workers targeted, 138 (92.61%) met the criteria to participate in this study. Moreover, 21 community relays were targeted, but 20 participated in this study.

3.2. Level of Readiness of the "Structure" to Respond to the LHFV Outbreak

The level of preparedness of the structure through the availability or adequacy of resources for the response to LHFV epidemics was average with a score of 471 out of 698 or 67.48% (Table 2). The availability of human resources was low with a score of 57.32%. The QRT laboratory specialist did not receive specific training in LHFV case sample collection and triple packaging. Of the health workers briefed on LHFV, in 51.42% had a demonstration of wearing and removing PPE.

The availability of material/logistical resources was average with a score of 66.83%; these resources were insufficient in the private HCs. The reliability of information resources was good with a score of 99.03%. However, the QRT did not have a contingency plan. Finally, the financial resources available were low; none of the private hospitals had a budget for response preparedness.

Table 2. *Analysis of the readiness "structure" for the response to the LHFV outbreak in Cotonou 1 and 4 HZ in 2019.*

Variables	Expected Scores	Obtained scores	Mention
Informational resources	103	102	Good
Material and logistic resources	404	270	Average
Human resources	164	94	Poor
Financial resources	27	05	Poor
Total	698	471	Average

3.3. Level of Readiness of the "Process" to Respond to the LHFV Outbreak

The preparedness process for the response to the LFHV epidemic scored 88.00% (Table 3). Indeed, most of the planned interventions were carried out; these included capacity building of the QRT, public awareness, infection control and strengthening of epidemiological surveillance. However, weak coordination in the response preparedness process was observed with insufficient involvement of all stakeholders. The QRT benefited from supervision, but did not provide supervision of health workers in the health zone at the local level.

Table 3. *Analysis of the implementation of the preparation process for the response to the LHFV outbreak in Cotonou 1 and 4 HZ in 2019.*

Variables	Expected Scores	Obtained scores	Mention
Coordination	04	02	Poor
Capacity building of the QRT	03	03	Good
Public Awareness	06	06	Good
Infection prevention and control	05	05	Good
Strengthening epidemiological vigilance	07	06	Good
Total	25	22	Good

3.4. Level of Readiness of the "Outcome" to Respond to the LHFV Outbreak

The score of the "result" was low (37 out of 185) or 20.0% (Table 4). In fact, health workers 20/138 and community focal points 12/20 have a good knowledge of LFHV. The promptness of the response activities had a low score of 4/26, although the level of responsiveness was good.

Table 4. *Analysis of LHFV epidemic preparedness "outcomes" in Cotonou HZ 1 and 4.*

Variables	Expected Scores	Obtained scores	Mention
Health workers with good knowledge of LFHV	138	20	Poor
Community relays with good knowledge of LFHV	20	12	Average
Timeliness	26	04	Poor
Responsiveness	26	26	Good
Total	210	62	Poor

3.5. Overall Level of Preparedness of Cotonou HZ 1 and 4 for the Response to the LHFV Epidemic

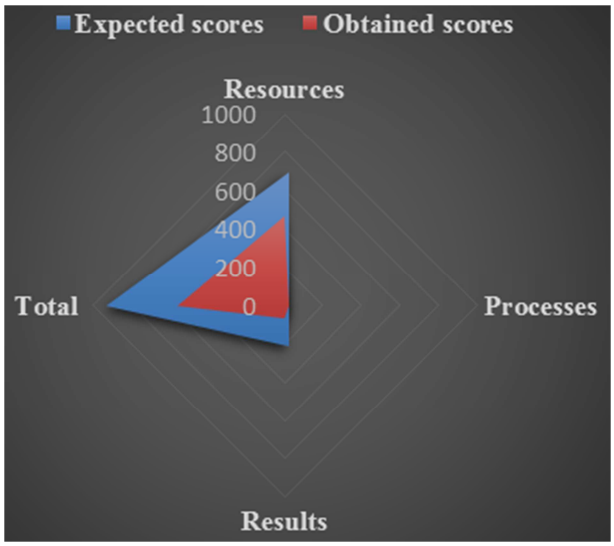

Figure 1. *Analysis of the implementation of the preparation process for the response to the LHFV outbreak in Cotonou 1 and 4 HZ in 2019.*

The overall level of preparedness of Cotonou 1 and 4 HZ for the response to the LHFV epidemic in 2019 was considered low since the results were poor although the levels of preparedness of the structure were average and the one of the processes was good as shown on figure 1.

4. Discussion

4.1. Statements of Principal Findings and Relation to Other Studies

Our study aims at assessing the level of readiness of the Cotonou 1 and 4 HZ for the response to the LHFV outbreak in 2019. The level of preparedness of our study area for the response to the 2019 LHFV outbreak was considered low. The components of the "Structure" and "Process" scored good and average, but the component "Results" was paradoxically poor. Main findings coming from our study are about the availability of inputs for LHFV response preparedness, the process of preparing for the LHFV outbreak response and the state of readiness to respond to any LHFV.

4.2. Strength and Weakness of the Study

Some information was based on the recall of the actors. This could introduce information/memory bias, minimized by

limiting the information sought to three months earlier, by asking the questions in stages and by asking for the same information under various questions in order to retrieve the most reliable information. Thus, experienced interviewers on the subject and familiar with the study area were recruited. Exhaustiveness was the method used both inside health facilities and respondent levels.

4.3. Availability of Inputs for LHFV Response Preparedness

Concerning the availability of inputs, the structure level of preparedness was average at 67.48%. In our study area, only half (50.72%) of the health workers were briefed on the LHFV. This low percentage is explained by the briefing held for all health workers in the public sector while two health workers per private health center were selected for training. Similarly, a small percentage of health workers (26.08%) had received a demonstration on the use and removal of PPE. This result is similar to the finding of Alli and al [16]. Informational, material, logistical and financial resources are likely to be used wisely when the response to an outbreak is well prepared with a detailed preparedness plan. An epidemic preparedness plan is a written document that provides guidance to decision-makers and other key actors on a list of activities to be carried out in response to epidemics [17]. This list provides what is expected or required to be done, before, during, and after an LHFV outbreak according to the study by Akinola and al. The HZ did not have this LHFV contingency plan. This was due to the study area's lack of exposure to the LHFV epidemic. The HZ Core Team was responsible for disseminating information resources and protection kits to public and private health centers. All the health centers had soap and gloves available, with a better availability of boots, protective suits and goggles as noted by Ijarotimi and al [18] in their study. As for the availability of isolation rooms, they were only available in three out of ten HCs. However, another study showed a better availability of sodium hypochlorite, i.e., 10 out of 10 HCs compared to 6 out of 10 HCs in our study. These differences could be due to the number of HCs covered (26 versus 59), the study setting (urban versus rural) and resource mobilization [18]. In the study conducted by Alli and al. district hospitals and HCs did not have PPE (9.6%) unlike the present study [16]. Biomedical waste disposal was done by incinerators in public HCs and by Non-Governmental Organizations (NGOs) in private HCs. This finding is different from that made by Saïzonou and al. which demonstrated that HCs without incinerators burned the waste or threw it into pits; gloves and compresses were packed in bags and thrown into the household waste garbage cans collected by the NGOs [19]. The unavailability of sampling and triple packaging materials for the QRT could be explained by the insufficient number of materials available at the DHO and the lack of training of the laboratory technician, a member of the QRT, on sampling and triple packaging of samples.

4.4. The Process of Preparing for the LHFV Outbreak Response

The process of preparing for the response to the LHFV epidemic scored well, with 22 of the 25 planned activities completed. This result could be explained by the small number of activities in this component compared to others (Structure and Results) and the capacity to implement them. However, the absence of a Term of Use (TOU) in the HZ does not allow for better response planning. According to the National Guide for Integrated Disease Surveillance and Response, the main functions of the TOU were to develop a preparedness and response plan for all potential emergencies, in particular epidemics and establishing a communication plan at Community level before, during and after health emergencies. It is also responsible for mobilizing resources for the prevention and control of emergency situations, and for strengthening links with community monitoring relays to ensure the flow of information for the early detection of health events. Finally, it should regularly include simulations of response to emergency situations, coordinate post-emergency assessment and provide for the communication of results to populations [8]. This study showed poor coordination in the response preparation process, while Akinola and al. in their study demonstrated the importance of good coordination. They noted that the management of epidemics requires adequate knowledge of the clinic and/or public health; and effective management requires adequate coordination of all specialized areas involved in intervention activities. Indeed, as Akinola and al confirms, the pre-positioning of PPE at HCs level is important. In this study, activities to strengthen epidemiological surveillance were also carried out, dissemination of technical guidelines and data collection tools, surveillance to detect in a timely manner any unusual situation or event for action. Monitoring and reporting are issues raised by Akinola and al., but have not been incorporated into this study. The QRT was supervised but did not in turn supervise health workers to assess their knowledge, attitudes and practices.

4.5. Readiness to Respond to the LHFV Outbreak

The results obtained from the preparation for the response to the LHFV epidemic were considered to be low, at 20%. Like the study conducted by Attinsounon and al, all community relays had received information on LHFV, mainly through the media (radio, television, social networks) [12]. According to the WHO, the Lassa reservoir is a rodent of the genus *Mastomys natalensis*, commonly known as a multi-udder «rat» [3]. In our study only one community relay knew precisely that the rat is the reservoir of the virus. However, 19 out of 20 of them associated with it any mouse. However, in the study conducted by Attinsounon and al., there was no relay linking rodents to Lassa fever. The difference between these results is explained by the fact that in the Attinsounon and al. study the relays heard more about Ebola Virus Disease (EVD) than about LHFV in a regional or even international context of EVD. However, in our study, the relays were all briefed on LHFV and our study took place in the context of a national LHFV epidemic. The results of Agbonlahor and al study confirmed that, in addition to *Mastomys natalensis*, other rodents such as *Rattus rattus* and

Mus musculus musculus (gray mouse) can also be used as tank for Lassa virus [20]. In one suspect case, our study found that about six out of ten relays knew that they had to contact the care site while complying with the barrier measures. This result is similar to that found by Attinsounon and al., which showed that about seven out of ten relays would use health workers without touching the patient [12]. Although the two studies were conducted in two different settings (south and north), and the study methods were different, the results for dealing with a community alert case were similar. In this study, all health workers had information about LHFV and learned about it either through the media (74.63%). In Tobin and al. study, however, only 24.6% received information on LHFV via the media [21]. This difference may be due to multiple sources of information in their study. Some health workers were the source of information for others (60.8%) on LHFV. Other sources included public health campaigns and awareness programs (6.2%), as well as school (8.4%). Health workers who received a briefing on LHFV in 50.72% of cases and therefore had some knowledge of LHFV as revealed by the study conducted by Obagha and al [7]. The result of our study is similar to that of Idris and al. showing no statistically significant difference between the knowledge of public and private health workers [22]. Health workers in this study in 42.03% knew that the rat is the Lassa Virus tank; in contrast, in the study conducted by Obagha and al., 10% of health workers knew the reservoir of the virus. From Tobin and al. study, it appears that the most common mode of transmission in HCs, mentioned by 68.4% of health workers, is unprotected contact with the secretions of a patient, just as in the present study, where 62.31% of health workers mentioned contact with the secretions of an infected person with LHFV virus [21]. As health practitioners, this mode of transmission is the first to be known, since it determines whether or not protective barriers are used. In the previous study, 90.62% reported fever as a major manifestation of VHFs and 64.9% reported that fever did not respond to antimalarial drugs. However, in our study, 73.91% of the surveyed officers failed to mention contact with rodent excreta or a confirmed case or a notion of travel to an endemic area.

4.6. Discussion of Important Differences in Results

This performance obtained in our study is different from that found by WHO in 2016 for assessing Benin's preparedness for responding to a possible EVD outbreak (73%). The difference between these two results can be explained by the fact that our study took place in one health zone and the other at the national level, without forgetting that the two studies covered two different Viral Hemorrhagic Fevers (VHFs). The knowledge of most health workers was not good; what could be explained by the quality of the training provided; as a result, trained officers did not return the training to their untrained peers. This is compounded by inadequate oversight focused on preparedness to respond to diseases with epidemic potential.

4.7. What Is Known About the Mechanism of Response to Epidemics

After experiencing the painful effects of Ebola Virus Disease in West Africa in recent years, Benin has witnessed four episodes of Lassa fever, with deaths among health workers. The health system still has shortcomings in terms of preparedness and response, despite the efforts made by the public authorities.

4.8. What This Study Adds

This study serves as a warning of the poor performance of the health system in controlling future epidemic episodes, as the level of preparedness to respond to epidemics and pandemics remains relatively low. The covid-19 pandemic is an illustration of this weak performance of the health system and the need to strengthen strategies for greater efficiency and resilience.

5. Conclusion

This study has shown that the level of preparedness of the Cotonou 1 and 4 HZ for the response to the LHFV epidemic in 2019 was low. This result confirms the weaknesses observed in the health systems of African countries south of the Sahara. This performance is linked to shortcomings at the level of structure, process and, above all, results, and is essentially due to the absence of a contingency plan, insufficient material and logistical resources for the QRT, weak involvement of private health centers, insufficient training of human resources, and poor promptness in the weekly notification of diseases with epidemic potential. Facing these shortcomings, concerted actions are required from all stakeholders to improve the level of preparedness of the Cotonou 1 and 4 health zones and certainly of the other health zones to respond to a possible LHFV epidemic.

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