Community-based surveillance: A pilot experiment in the Kabadougou-Bafing-Folon health region in Côte d´Ivoire

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KEYWORDS
Community-based surveillance, Epidemiological surveillance, One Health; Frontline SMS, Côte d´Ivoire

ABSTRACT

Introduction: This paper aims to assess the contribution of community-based surveillance to traditional surveillance systems through a pilot project launched in the Kabadougou – Bafing – Folon health region in Côte d'Ivoire by the International Rescue Committee with funding from the US Government through the Centers of Disease Control and Prevention. The system was initiated following the outbreak of Ebola Virus Disease in 2014 in Guinea and Liberia, which both share borders with Côte d'Ivoire. **Methods:** This is a descriptive cross-sectional study, covering the period from October 1, 2017 to September 30, 2018. Data collection, conducted from November 6-11, 2018, included document review, observations and individual interviews. The quantitative data analysis was completed using an Excel spreadsheet to calculate the proportion of alert cases (signals) investigated and reported and the proportion of suspected cases reported and confirmed biologically by the Institut Pasteur of Côte d'Ivoire. A comparison was made between cases confirmed through routine surveillance and those confirmed through community-based surveillance. Qualitative data were analyzed by theme. **Results:** A total of 2459 cases were reported at the community level, the majority of which concern watery diarrhea (51%), fever and rash (28%) and fever and yellow eyes (15%). The remaining cases reported (6%) included other reported morbid events. In total 4265 other unusual events were reported, majority of which relate to "the number of people who had died in the community" (48%) and "the number of sick or dead animals and fish" (42%).Investigation of unusual events increased from 44% (n=601) to 76% (n=543) during the study period. Data from community-based surveillance reports accounted for 33% of cases of confirmed diseases of epidemiological significance (n=30) in the Kabadougou-Bafing-Folon health region. These cases include yellow fever, measles, and rubella. No cases of meningitis, neonatal tetanus, or Guinea worm were reported by CHWs. **Conclusion:** Community-based reporting complemented and strengthened the surveillance system which otherwise focused on routine data reported at health centers. however, the initiative remains contingent on external funding.

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RECEIVED
30/07/19

ACCEPTED
21/11/19

PUBLISHED
05/12/19

LINK

www.afenet-journal.net/content/article/2/11/full

CITATION
Saya N'Guessan et al. Community-based surveillance: A pilot experiment in the Kabadougou-Bafing-Folon health region in Côte d´Ivoire. J Interval Epidemiol Public Health. 2019 December; 2(3):1
https://doi.org/10.37432/JIEPH.2019.2.3.20

Introduction

The outbreak of the Ebola Virus Disease (EVD) in Guinea, Sierra Leone and Liberia in 2014 [1-4] triggered strengthening of surveillance and preparedness activities in neighboring countries such as Côte d'Ivoire [5]. In order to manage EVD and other diseases with epidemic potential, the Côte d'Ivoire began strengthening its epidemiological surveillance system [6,7]. The International Rescue Committee (IRC), which had been operating in Côte d'Ivoire since 2003. IRC initiated a project in 2016 entitled "Global Health Security Partner Engagement: Expending Efforts and Strategies to protect and improve Public Health" (GHS) with funding from the US Government´s Centers of Diseases Control and Prevention (CDC). The GHS project complemented the traditional routine surveillance system with a community-based epidemiological surveillance (CES) component.

Similarly, in many countries in the region, the national disease surveillance and response system in Côte d'Ivoire monitors the activities of health facilities and detects diseases with epidemic potential or events that pose a threat to public health. In this system, health professionals conduct ongoing health surveillance, using commonly-agreed case definitions to describe a given disease and to ensure that similar information is collected from different locations.

Effective surveillance systems facilitate early detection of disease outbreaks, allowing for rapid preventive and control measures to mitigate their effects. Early detection allows for rapid interventions, which saves lives. Systematic information collection can be carried out at the level of health facilities (hospitals, clinics, health centers) or at the level of communities (villages, markets, schools, workplaces, places of worship) [8].

CES mainly consists of five key steps which are widely used in surveillance systems : (1) capture of the signal; (2) reporting of the signal by the community;(3) triage and verification by the health area (investigation of alert cases); (4) risk assessment of the event; and (5) investigation and response to the event [9].

Triage and verification of each detected alert is important if the health risk is identified for the first time, or if the number of cases unexpectedly increases during a disease outbreak, but declines once the outbreak is declared. It is important that communities are kept informed at each step, as a community will quickly abandon CES activities if they do not receive adequate and timely feedback. The benefits of surveillance at the community and health facility levels were highlighted by the World Health Organization (WHO) in the revised International Health Regulations (IHR) of 2005 [10], which aims to improve global health security and calls on countries to build capacity to quickly detect, assess, report and respond to public health risks.

The IRC-implemented GHS project in Côte d'Ivoire set up series of operations involving the organized collection, monitoring, evaluation and interpretation of specific, generally unstructured, information related to events or risks that may pose a significant threat to human health. This information is reported by community health workers (CHWs) who had been trained in recognizing the signs of diseases with an epidemic potential. The strength of this community-based surveillance system comes from the ability to rapidly mobilize the community if a response is needed. Indeed, during epidemics, many outbreaks begin with grouped cases of illnesses or sudden deaths within a community [7], which traditional surveillance systems may not detect quickly enough [5]. CES thus allows the community to perceive signs of danger and issue alerts based on a reliable mechanism allowing real-time communication. Community participation and mobilization, combined with a reliable intervention network made up of local, regional and national health systems, are key elements of effective community-based surveillance [8].

The objective of this study was to assess the contribution of CES to the routine surveillance system in the Kabadougou - Bafing – Folon (KBF) health region through a description of reporting data on alert cases and unusual events monitored.

Methods

Study Site

The study was conducted in the KBF health region, located in the north-western part of Côte d'Ivoire, with a population of approximately 533,081 [11]. This region covers the health districts of Touba,

Odienné and Minignan as presented in Figure 1, comprising a total of 103 health areas, 97 First Contact Health Facilities (FCHF), four General Hospitals (GH) and two Regional Hospital Centers (RHC). This system supports epidemiological surveillance as outlined in Figure 2.

The community definitions applied to diseases in the KBF region are summarized in Table 1.

Type and period of study

This is a descriptive cross-sectional study, covering the period from October 1, 2017 to September 30, 2018. It analyzes the effects of a CES pilot project whose main activities included: training of 542 CHWs on community case definitions and reporting, as well as training of 103 health care providers in health centers and four epidemiological surveillance officers (ESO) on Integrated Disease and Response Surveillance (IDRS).

As recommended by the WHO Community Health Guidelines, the CHWs were volunteers identified by their community who promote health for the benefit of their communities. Within the framework of the project, selection criteria for CHWs comprised a basic level of literacy, ability to use mobile telephones (able to type and send text messages) as well as in addition to experience in participating in community health projects (e.g. integrated community case management, "Prise en charge à domicile" project, or prevention against EVD) for at least 3 months. These CHWs also had to confirm their daily availability for surveillance activities, committing to at least 1 hour per day. A list of CHWs was proposed by the heads of health centers in accordance with these criteria. The project also provided each of the 542 CHWs with a mobile phones, reporting and time sheets, image boxes, and high-visibility clothing. The CHWs reported cases using SMS and the information was consolidated using the FrontlineSMS, free software used to collect and disseminate information via text messaging, sending data to an internet-connected computer for analysis. The health information collected by the CHWs is sent via SMS in coded form taking into account the following three details: the sender, the origin, and the event.

Cases reported as suspicious by the nurse are reported to the ESO, who enters them in the Episurveyor software (MAGPI) at the level of the health district. The information encoded in the MAGPI software is automatically sent to the National Institute of Public Hygiene (INHP). The 400 CHWs that were furthest from their health centers additionally received bicycles to facilitate their movement in the community

The project provided 103 health centers with mobile phones, forms to compile data reported by CHWs and sample collection kits. Personal protective equipment was also provided in 31 health centers located near the borders with Guinea and Mali in the north-western area of the country. CHWs and health care providers in health centers received a monthly telephone credit allowance for their electronic reporting, triage and verification activities. In addition, health workers received additional transportation allowances for bringing samples from the health centers to the relevant health district offices, who then forward them to the *Institut Pasteur* of Côte d'Ivoire via the postal service for testing.

Data collection and analysis

Data collection involved document review, observations and individual interviews.

Document review: Two members of the team who reviewed records from the FrontlineSMS database, reporting forms for alert cases, generic disease notification forms, extracts from the MAGPI database (via episurveyor), and weekly reports of notifications of diseases with epidemic potential from the health districts supported by the project. The data collected included the number of alert cases reported by CHWs based on the case definitions, using the tools represented in Figure 2, the number of events reported by CHWs, the number of cases investigated among the reported alert cases, the number of cases for which samples were taken among the investigated cases, the number of cases confirmed after sampling and laboratory examinations, and total number of cases reported by both CES and routine surveillance. An Excel file was prepared in advance to list the alert cases reported by the CHWs by text message in the FrontlineSMS database and by the health centers. Data on events were also collected and reported by the CHWs, specifically the numbers of sick health workers, deceased health workers, community deaths, people

in contact with animals, people arriving in the health region from a country with an outbreak, and dead or sick animals and fish. The limitation of this review was that some of the facts identified were not explained [12]. This was addressed using complementary methods including observations and individual interviews.

Observation: Using qualitative data collection methods and checklists[13] the esearch team made observations during successive pilot project supervision missions, making it possible to validate the quality of the reporting data on alert cases collected by CHWs and compiled at the health districts. During the study period, four supervision missions were carried out by the members of the research team on a rotational basis, and a supervision report was produced, validated, and archived each time. While validating the number of cases reported, the team also validated the application of the community definitions of diseases used by CHWs when reporting.

Key Informant (KI) interviews: [14, 15] Interview of KIs made it possible to clarify facts observed during the analysis of quantitative data collected from 93 health centers. These interviews targeted the eight most efficient health centers, in terms of reporting, triage and verification. A total of 90 individuals were interviewed by three project employees that were trained beforehand on the methodological technique. KIs included four FrontlineSMS database managers (three at district level and one at health region level), eight religious community leaders from the three health districts, eight health center nurses, eight herders, eight hunters, eight traditional medicine practitioners, six community members, and 40 CHWs All health workers from the eight facilities were listed 40 CHWs, selected randomly from among the list were interviewed, participated. Among community stakeholders (breeders, leaders, healers), only the most involved were selected for interviews. During the interviews, a semi-structured questionnaire was used, focusing on case detection, tools used, time spent on surveillance activity, verification of reported cases, mastery of the information channel, level of collaboration between health centers and other stakeholders (e.g. traditional medicine practitioners, hunters, breeders), feedback on samples collected and sent to the laboratory, and perception of CES. The information collected during the KI interviews was noted on the questionnaire form before their manually entered into the Excel framework.

Data Analysis: Quantitative data was entered into an Excel spreadsheet and proportion of alerts (signals) investigated and reported and the proportion of biologically confirmed suspect cases reported, as well as to compare confirmed cases from routine surveillance with those from community-based surveillance. Graphs and tables were developed to better describe the findings [16]. Qualitative data was grouped by theme within the Excel framework [17, 18] and the information that clarifies the observed facts was synthesized along with quantitative information on notifications, investigations and case confirmations.

Ethical considerations

The project was presented to and authorized by the administrative and health authorities of the KBF health region on March 23, 2016 at the project launch ceremony. Subsequently, at the beginning of the study, the data collection protocol managed by the Minignan, Touba and Odienné health districts was validated by each chief medical officers. During the interviews, an informed consent document was signed by each of the interviewees. During the analysis, the confidentiality and anonymity of all participants were preserved. A code was assigned to each interviewee to safeguard the transcripts of the interviews. As the data presented were extracted and aggregated from the FrontlineSMS database, no other ethical procedures were required.

Results

Reporting

Reporting of morbid events

During the study period, a total of 2459 alert cases were reported at the community level, the majority of which concerned watery diarrhea (1242 cases or 51%), fever and pimples (697 cases or 28%) and fever and yellow eyes (361 cases or 15%). There were 159 (6 % of cases) other morbid events reported. Details of the results are highlighted in **Figure 3**.

The CHWs interviewed confirmed that cases of watery diarrhea were the most commonly observed, especially for children under 5 years of age. All reported cases were referred to the health center. However, the CHWs mentioned that nearly half of the patients did not go to the health center due to insufficient financial resources. CHWs and nurses also reported telephone network failures at certain times and places, limiting daily SMS notifications. The healers interviewed confirmed that they received cases and collaborated with CHWs in reporting cases that meet the community definition of potentially epidemic diseases.

Reporting of unusual events

For these unusual events, out of a total of 4265 cases reported, 2062 (48%) related to " Community deaths"; 1773 (42%), "sick or dead animals and fish" and 430 (10%) "Number of other events". The graph in **Figure 4** illustrates these results.

Death in the community was the most frequent and ultimately the most reported event according to the CHWs. All the actors interviewed reported that good collaboration between community actors was fostered by awareness sessions during home visits and the use of information channels in the different neighborhoods. According to the CHWs, the event regarding "person arriving from countries with epidemics" remains difficult to investigate due to the reopening of the various borders with Guinea and Liberia after the end of the EVD epidemic in 2014. Individuals declared as "persons arriving from neighboring countries" may be ordinary travelers and not necessarily persons exposed to diseases with epidemic potential.

Investigation

The investigation rate increased ,44%(n=601) to 76%(n=543) during the study period (**Figure 5**). This rate varied from one disease to another during the quarters of the study period, as shown in **Figure 6**.

According to the health center nurses interviewed, the introduction of telephone fleets and sampling kits greatly improved the verification of alerts reported by CHWs. This information is corroborated by the CHWs who confirmed that the verifications were conducted by the nurses at the health centers both by telephone and in person.

Confirmation of cases

Surveillance at community level

The evolution of the number of investigations among cases reported in the community by CHWs and the number of confirmations among cases investigated is illustrated in **Figure 7**. Cases of watery diarrhea were the most reported (1242 cases). For all reported cases, there is a significant difference between the number of reported cases (2459) and the number of confirmed cases (10).

Routine surveillance

Figure 8 presents the evolution of the number of confirmed cases among the suspected cases reported by health center nurses in the traditional routine system, excluding the CES component.

According to ESOs interviewed, the issue of delays in the delivery of samples by the Ivorian postal service to the central laboratory in Abidjan presents a major difficulty. Some districts are not serviced by the Post Office, particularly in Minignan, where executive team members drive a minimum of 67 km by car to transport samples to the nearest health district with a Post Office. The delivery of samples is only carried out on working days (Monday to Thursday), which is a major cause of long delays in the delivery and analysis of samples taken. Nurses and ESOs deplore the systematic delay in the return of laboratory results. According to them, the delay reduces the quality of care and the community's trust in the health centers.

Contribution of CHWs to epidemiological surveillance in the KBF region

Reports by CHWs accounted for 33% of all confirmed cases in the KBF region. These cases include yellow fever, measles, and rubella. No cases of confirmed meningitis, neonatal tetanus, nor Guinea worm were reported by CHWs as presented in **Table 2**.

Discussion

The purpose of this study was to assess the contribution of CES to the overall surveillance system of the KBF health region through the description of reporting data on alert cases and monitored events. The study demonstrated that the pilot project has led to improved epidemiological surveillance through community-based reporting, the involvement of multiple stakeholders in the reporting of cases creating a link between animal and human health at the community level, ownership of the investigation by the local health system, and awareness of the challenges of case confirmation.

The reporting of alert cases at community level contributes to the strengthening of epidemiological surveillance

Community-level notification through SMS made it possible to report 33% (10 out of 30) of confirmed cases and to strengthen the surveillance system which was initially focused on routine data reported by health centers. This system strengthening supports other studies on the community-level reporting of events by electronic means [19]. However, the reporting activities supported by the pilot project are dependent on external funding. The system requires computer and telecommunications equipment (computer, mobile phone, internet connection) as well as monthly telephone credit, which represent costs not yet budgeted by the Ministry of Health and Public Hygiene of Côte d'Ivoire. The appropriation of community supervision by state authorities through the establishment of a sustainable financing procedure could guarantee the sustainability of the benefits observed during the pilot project. It should be noted that the financial investment required to maintain this system is meager compared to the resources necessary to respond to an epidemic.

Reporting of unusual events, involvement of multiple stakeholders at community level and the link with animal health

The reporting at the community-level of unusual events such as the "number of sick or dead animals and fish", representing 42% of the unusual events reported in the study suggests the necessity of coordination between the human and animal health sectors. This reporting is the result of the involvement of several stakeholders, including breeders and hunters, in addition to CHWs. The link between animal health and human health should be re-enforced with the involvement of veterinarians [20].

The Health District takes ownership of the investigation of alert cases through the nurses in the health centers

In the CES system introduced by the IRC project, health center nurses are essential at the level of case investigation. These nurses, who are part of the public health system, very quickly took ownership of the community-based case notification component by verifying cases from telephone conversations with CHWs or by visiting the homes of individuals who had been reported. The investigations, which were primarily conducted in person, also allowed for the supervision of CHWs, strengthening their multi-faceted work [21, 22] beyond epidemiological surveillance. Several field studies [23, 24], show that programs using CHWs can make significant contributions to the improvement of health- and nutrition-related behaviors, the reduction of infant mortality [24], the use of key preventive and curative health services, and the diagnosis and treatment of severe cases.

Confirmation of cases

This component of the system remains laborious even though it has led to the confirmation of some cases of diseases under surveillance. The earlier the outbreak is detected and the quicker its investigation is conducted in conjunction with the health authority, the greater the potential preventive impact [25]. However, the delivery of samples collected in response to suspicious cases is often quite delayed in the KBF health region and thus constitutes a risk of ineffective management, particularly in cases of highly-monitored diseases such as yellow fever [26-28]. Samples collected are often transported by the postal service in line with an agreement dating back to January 26, 2018 between the INHP, the Directorate for the Coordination of Expanded Immunization Programs, and the postal services of Côte d'Ivoire. However, the post office is weakened by the fact that it is closed on non-working days, thus delaying the delivery of samples. In addition, the results are returned extremely late, sometimes three to six months after the samples have been sent. A

new mechanism for routing samples to laboratories must be established in order to optimize case confirmation and the response to diseases with epidemic potential.

This study had the following two major limitations: first, there was insufficient time to measure the appropriation of the pilot project by the health system, and second, the context of the study does not allow the results to be extrapolated to other areas which do not border countries that have experienced EVD, thus not previously threatened by the virus.

Conclusion

The contribution of the pilot project's CES activities in the KBF health region are significant. In addition to strengthening the health system, and in particular the global surveillance system, CES has made it possible to establish the link between human and animal health through CHWs' reporting of cases and events related to animal and fish diseases and death. However, CES faces constraints, namely the need for funding and the difficulties around capacity for biological confirmation of cases. The integration of community reporting is effective at the level of the local health system, but its appropriation requires financial resources to ensure sustainability.

What is known about this topic

- The principles of a global surveillance system

What this study adds

- The study demonstrates the possibility of linking human and animal health surveillance at the community level in a One health approach
- IT also demonstrates the effectiveness of electronic notification via FrontlineSMS

Competing interests

The authors declare that they have no competing interest.

Authors' contributions

Saya, Henri and Hermès participated in the study design, data collection and data analysis, and manuscript writing. Seringue, Mamadou, Ramatou and Youssouf participated in data analysis and revision of manuscrit. Grace and Leonardo participated in the study design, analysis of data, the writing of the manuscript. All authors read and approved the final manuscript.

Acknowledgments

To the Ministry of Health and Public Hygiene through INHP and in particular Professor Benié Vroh Joseph for the training of healthcare providers in health centers on integrated disease and response surveillance and for the validation of the community surveillance guide.

To the Regional Director of KBF health district (Dr. Yao Ablo Alfred) and the departmental directors of the districts of Minignan (Dr Koffi Oura Olivier), Touba (Dr Kouakou Koffi Eugène) and Odienné (Dr Sahandé Vakaba).

To Mr. Louis Falcy, Director of the IRC in Côte d'Ivoire for his support to the project and for his very relevant comments on the results observed.

To the entire GHS project team based in Odienné.

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Table 1: Community definitions of diseases under surveillance, 2018, KBF health region	
SIGNS (diseases)	**Community definitions of diseases**
Diarrhea	Anyone who has had 3 or more heavy watery stools in one day
Fever + Stiffness	Anyone suffering from fever (hot body) and neck stiffness (for adults) or bulging fontanel (for infants)
Paralysis	Any child under 15 years of age who crawled or walked and suddenly no longer crawls or walks
Fever + Pimples	Anyone with a fever (hot body) and pimples on the body
Fever + yellow eyes	Anyone suffering from fever (hot body) with yellowing of the eyes or skin (soles of the feet, nails, palms of the hands)
Fever + bleeding	Anyone suffering from high fever (hot body), of sudden onset, combined with bleeding or bloody diarrhea or blood in urine, or any person who has died suddenly
Refusal to breastfeed + Stiffness	Any newborn baby (less than one month old) who refuses to breastfeed and becomes stiff. Or any child who dies during his or her first month of life
White worm + wound	Anyone suffering from wounds on the body with one or more white worms appearing
Source: 2016 Community Surveillance Guide for Côte d'Ivoire - Monitoring & Evaluation	

Table 2: Contribution of community surveillance to case confirmation, October 2017 to September 2018, KBF health region

Pathology	**Number of confirmed cases of diseases reported after routine surveillance**	**Number of cases of diseases confirmed by CES**	**Total**	**Community contribution (%)**
Yellow fever	1	1	2	50
Measles	8	6	14	43
Rubella	8	3	11	27
Meningitis	1	0	1	0
Neonatal Tetanus (NNT)	**1**	0	1	0
Guinea worm	1	0	1	0
Total	**20**	**10**	**30**	**33**

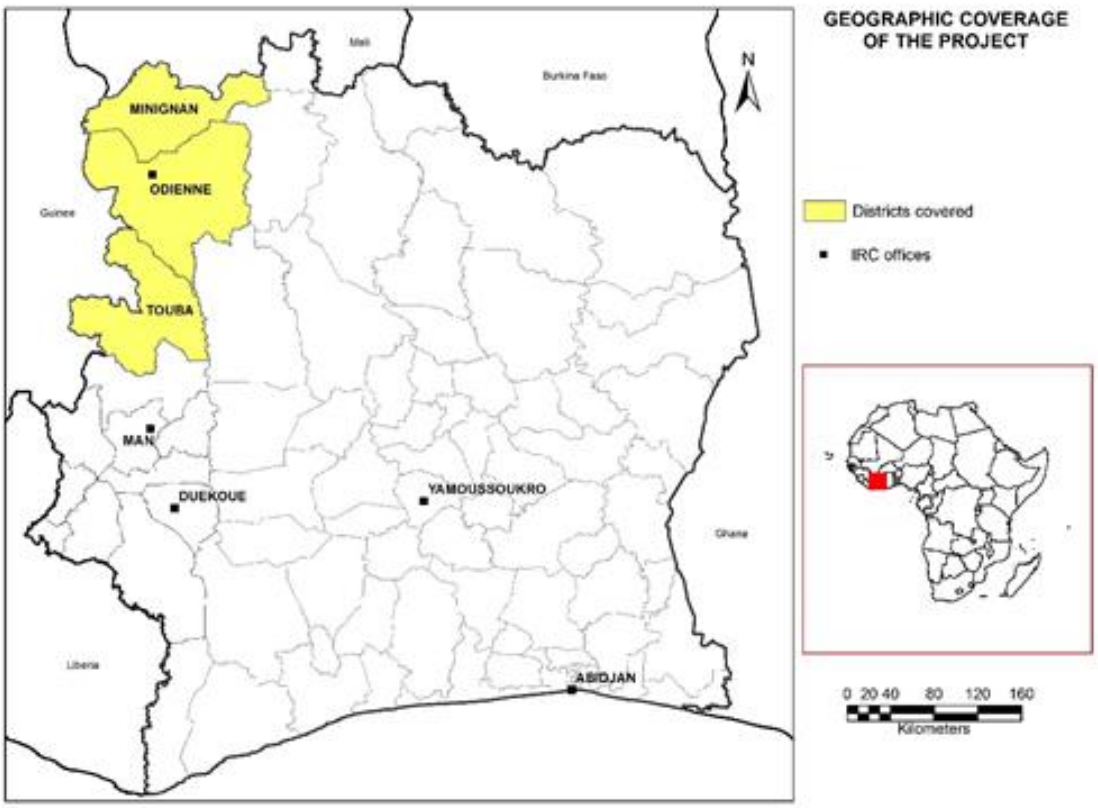
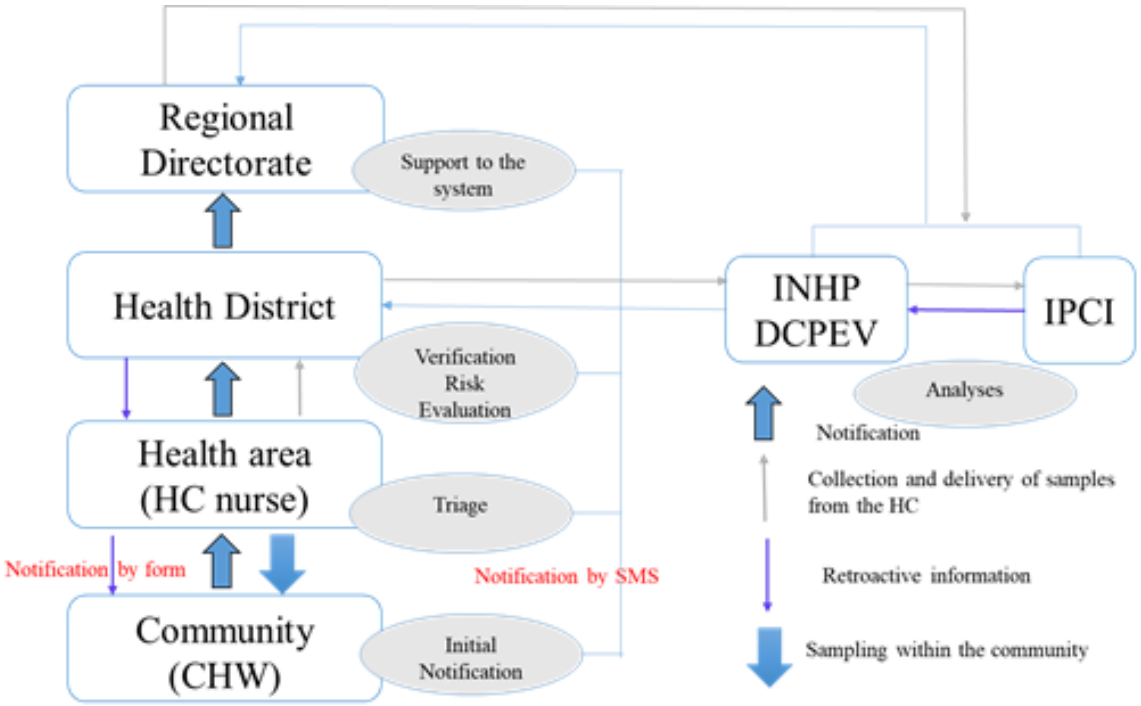


Figure 1: Map of Districts supported by the GHS / IRC project



Legend: HC (Health Center), CHW (Community Health Worker), INHP (Institut National de l'Hygiène Publique *National Public Hygiene Institute*), DCPEV (Direction de la Coordination des Programme Elargis de Vaccination *Vaccination Program Coordination Directorate*), IPCI (Institut Pasteur de Côte d'Ivoire *Pasteur Research Institute*)

Figure 2: Information reporting channel in the CES pilot project, 2018, KBF health region

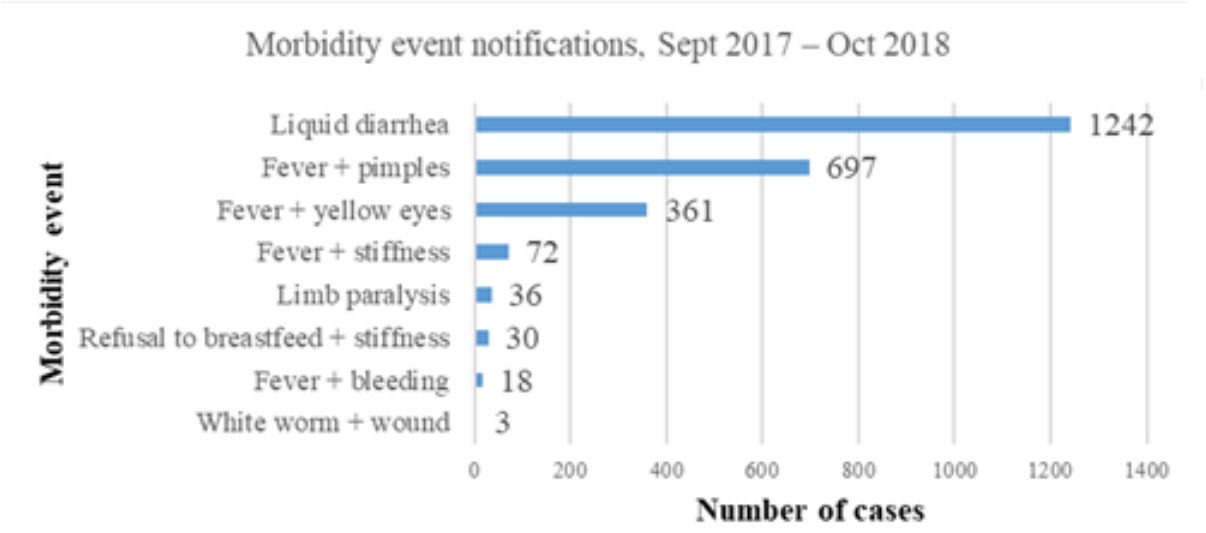


Figure 3: Distribution of reports by type of alert for diseases monitored at the community level, October 1, 2017 to September 30, 2018, KBF health region

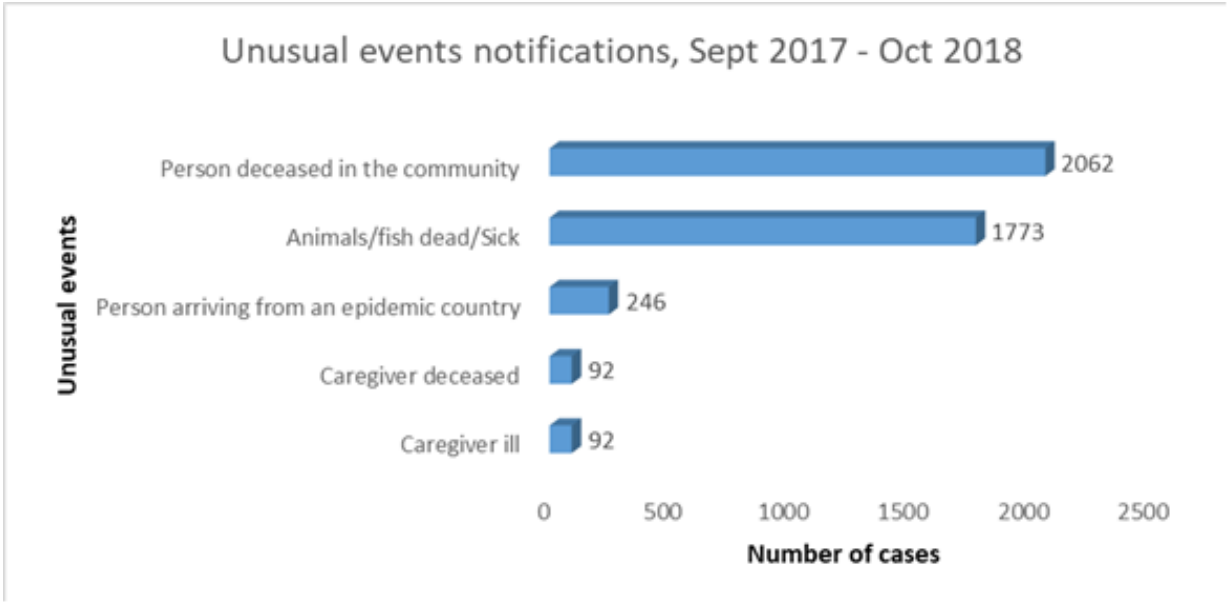


Figure 4: Distribution of reports by type of alert for unusual events, October 2017 to September 2018, KBF health region

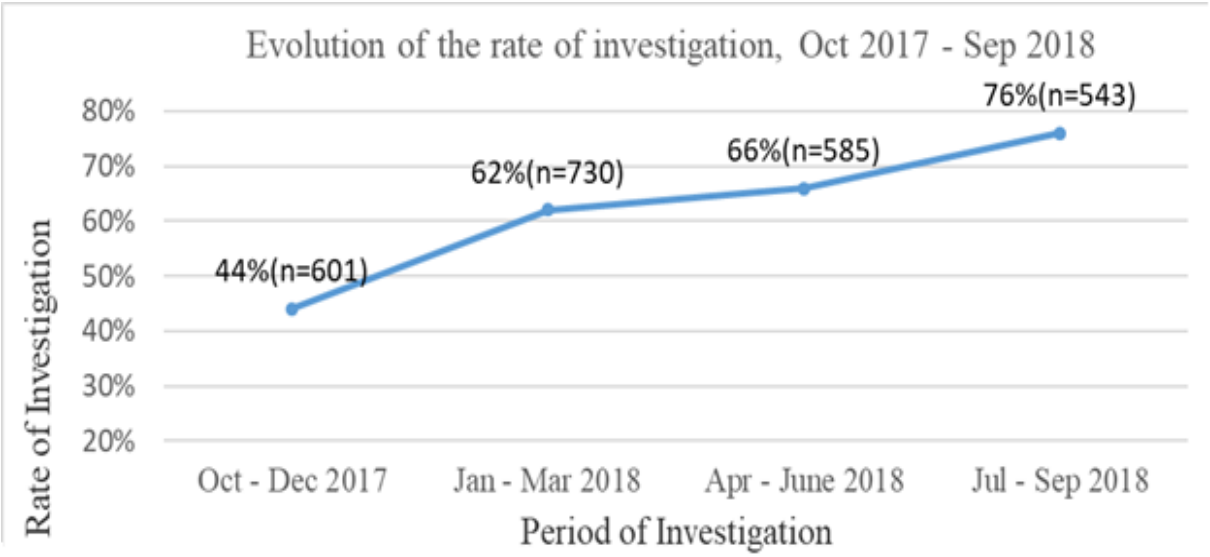


Figure 5: Evolution of the investigation rates of alert cases of diseases reported by CHWs,October 2017 to September 2018,KBF health region

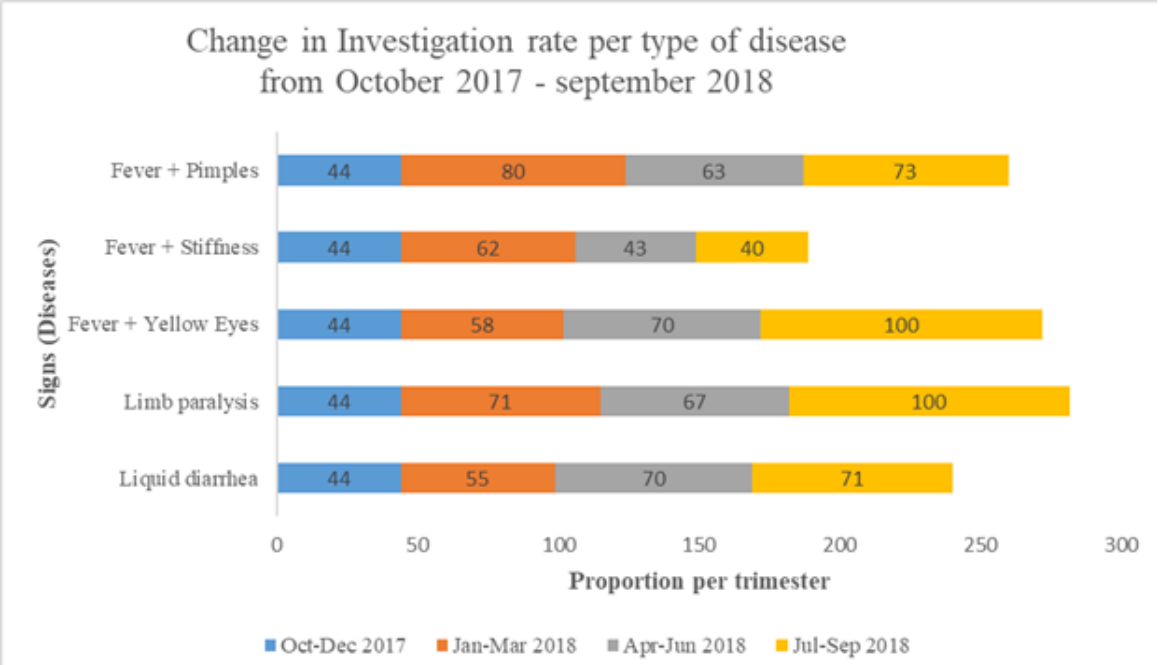


Figure 6: Evolution of investigation rates by type of alert,October 2017 to September 2018, KBF health region

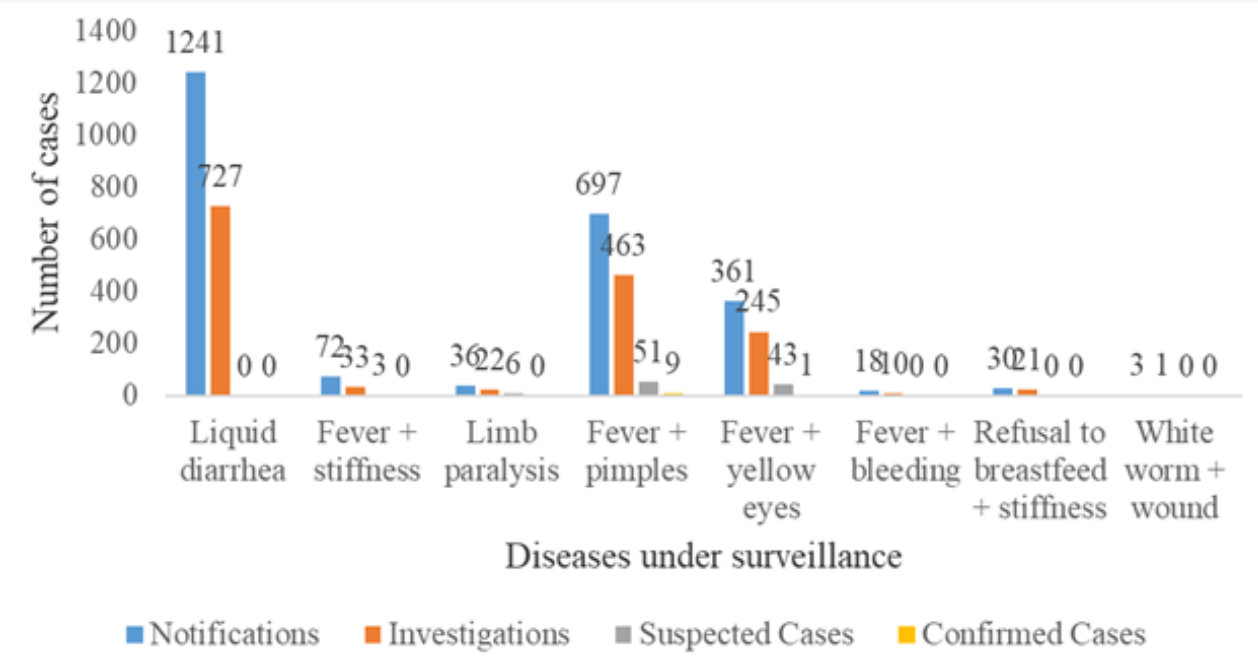


Figure 7: Follow-up of cases from alert to biological confirmation, October 2017 to September 2018, KBF health region

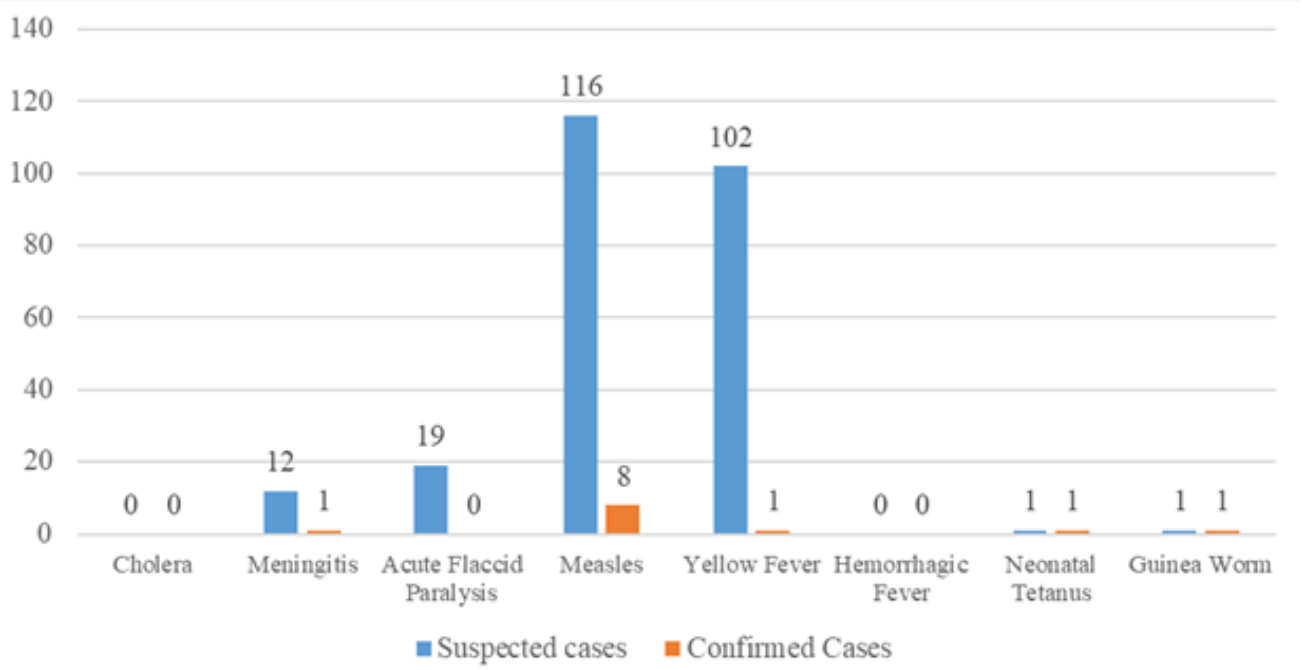


Figure 8: Follow-up of cases consulted, from suspicion to biological confirmation, October 2017 to September 2018, KBF health region