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Containing a haemorrhagic fever epidemic: the Ebola experience in Uganda (October 2000—January 2001)☆

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Summary *Introduction*: The Ebola virus, belonging to the family of filoviruses, was first recognized in 1976 when it caused concurrent outbreaks in Yambuku in the Democratic Republic of Congo (DRC), and in the town of Nzara in Sudan. Both countries share borders with Uganda. A total of 425 cases and 224 deaths attributed to Ebola haemorrhagic fever (EHF) were recorded in Uganda in 2000/01. Although there was delayed detection at the community level, prompt and efficient outbreak investigation led to the confirmation of the causative agent on 14 October 2000 by the National Institute of Virology in South Africa, and the subsequent institution of control interventions.

Control interventions: Public health interventions to contain the epidemic aimed at minimizing transmission in the health care setting and in the community, reducing the case fatality rate due to the epidemic, strengthening co-ordination for the response and building capacity for on-going surveillance and control. Co-ordination of the control interventions was organized through the Interministerial Committee, National Ebola Task Force, District Ebola Task Forces, and the Technical Committees at national and district levels. The World Health Organization (WHO) under the Global Outbreak Alert and Response Network co-ordinated the international response. The post-outbreak control interventions addressed weaknesses prior to outbreak detection and aimed at improving preparations for future outbreak detection and response.

Challenges to control efforts included inadequate and poor quality protective materials, deaths of health workers, numerous rumors and the rejection of convalescent cases by members of the community.

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Conclusions: This was recognized as the largest reported outbreak of EHF in the world. Control interventions were very successful in containing the epidemic. The community structures used to contain the epidemic have continued to perform well after containment of the outbreak, and have proved useful in the identification of other outbreaks. This was also the first outbreak response co-ordinated by the WHO under the Global Outbreak Alert and Response Network, a voluntary organization recently created to co-ordinate technical and financial resources to developing countries during outbreaks.

Introduction

The Ebola virus, which belongs to the family of filoviruses, causes a severe illness characterized by acute onset of fever, malaise, myalgia, headache, and pharyngitis followed by vomiting, diarrhea, maculopapular rash, limited renal and hepatic involvement and haemorrhagic diathesis. The minimum incubation period is two days, and the longest is 21 days, with the majority of cases having an incubation period of eight days. The case fatality rate (CFR) varies from 50—90%.[1,6,8,11]

Diagnosis is by ELISA for specific IgG antibody (presence of IgM antibody indicates recent infection), by ELISA antigen detection in blood, serum or organ homogenates, or by PCR. Postmortem diagnosis is through immunohistochemical examination of formalin-fixed skin biopsy specimens.[1]

Person to person transmission occurs by direct contact with infected body fluids such as blood, sweat, saliva, semen, vaginal fluids, urine, and sputum, or through direct inoculation by contaminated instruments such as needles, pins, razors blades, etc.[13,14] Nosocomial transmission through contaminated needles and syringes has been documented.[1,11]

The Ebola virus was first recognized in 1976 when it caused massive concurrent outbreaks in Yambuku in the Democratic Republic of Congo (DRC), former Zaire and in the town of Nzara in Sudan.[3,4,7] Both countries border Uganda, with Sudan in the northern part and DRC to the west (Figure 1).

In the *Filiviridae* genus, the Marburg virus was initially identified in 1967.[6,10] To date, three distinct sub-types of the Ebola virus (which derives its name from the river Ebola in DRC) are described as pathogenic to man, namely Ebola—Zaire, Ebola—Sudan, and Ebola—Cote d'Ivore. A fourth sub-type, Ebola—Reston, identified in the USA, affects only primates.[12]

Uganda, which experienced an outbreak of Ebola haemorrhagic fever (EHF) in the last quarter of 2000 to beginning of 2001, comprises 56 administrative districts, which includes the three affected districts of Gulu, Mbarara and Masindi (Figure 1). Each of the districts is further sub-divided into counties, sub-counties and parishes. A village, manned by a local council one leader (LCI),[20] is the smallest administrative unit. A total of 425 presumptive cases with 224 deaths attributed to EHF were registered in the three affected districts of Uganda.[2,18] Presumptive cases include both the laboratory confirmed cases and those that met the clinical case definition of EHF and are epidemiologically linked to cases.

This paper outlines the outbreak detection and subsequent organization and implementation of the control interventions, highlighting some of the issues not considered in previous publications.

Outbreak detection and verification

On 8 October 2000 the Acting District Director of Health Services (Ag. DDHS), Gulu District received two concurrent reports concerning an unusual illness and deaths in the community and at the Lacor Hospital, a non-governmental hospital. The report, originating from the community, attributed the illness and death to a poisoning at a funeral in the remote village of Rwot Obilo, in the far north of Gulu. The second report concurrently conveyed to both the Ag. DDHS and to the Ministry of Health (MoH), came from the Medical Superintendent (MS) of Lacor Hospital. He reported a clustering of cases and deaths, which included two dead student nurses and three others who were critically ill. Most of the cases in the hospital reported a history of deaths with similar manifestations in their households. A possible outbreak of viral haemorrahgic fever (VHF) was suspected.

On 9 October a team was dispatched from the MoH to support the district team in outbreak investigation and confirmation. The team reviewed the clinical notes of patients, examined patients still admitted, and collected clinical specimens from eight suspicious cases and seven contacts for confirmation. Investigations in the surrounding

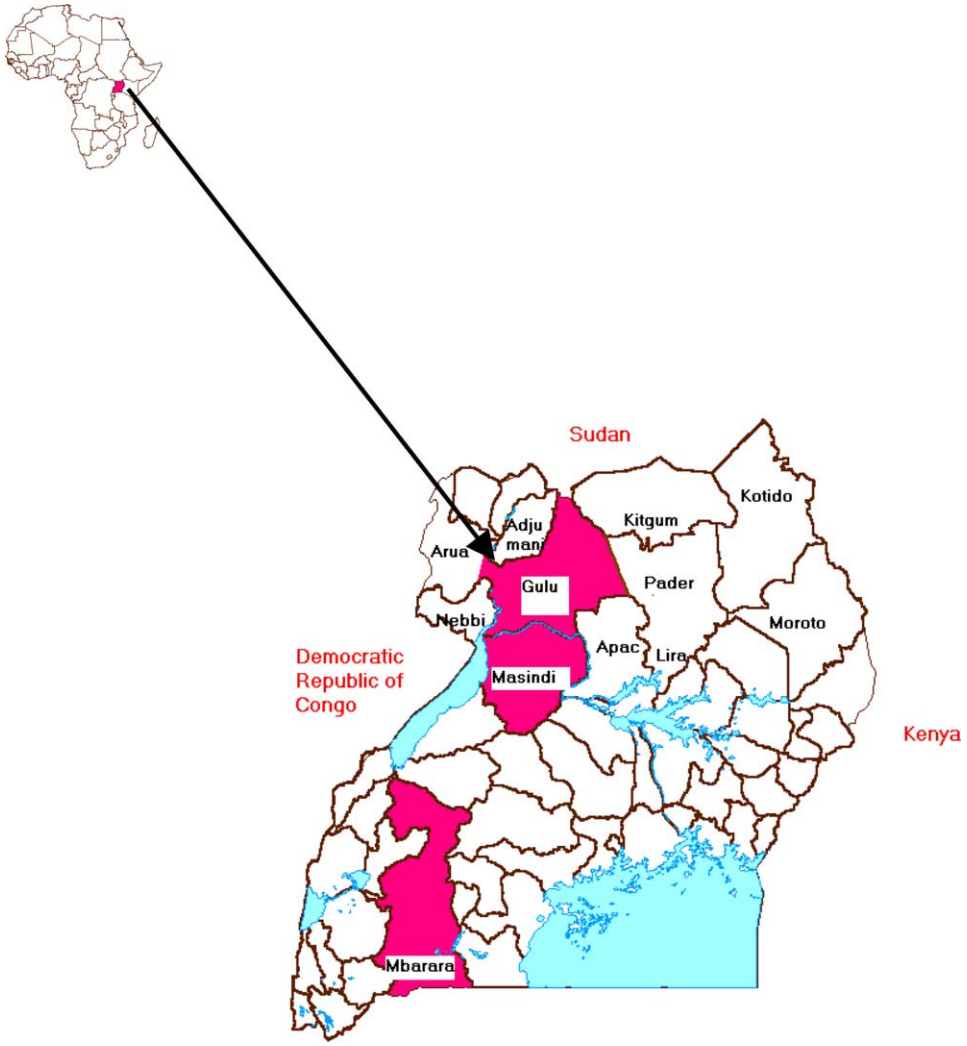


Figure 1 Map of Africa showing Uganda and districts.

villages revealed many other cases and deaths in the community.

Of the 17 cases reviewed (see Table 1), eleven had died (CFR = 64.7%) and six were still hospitalized. Each of the patients had a history of having attended a burial in the few days before the onset of fever. Some of the patients had lost one or more family members with similar symptoms, within a short interval. Investigations by the local laboratory indicated a three fold increase in the level of transaminase (SGOT). The team suspected Marburg or Ebola.

On 12 October the clinical samples from cases and contacts were forwarded through the WHO Country Office to a WHO collaborating laboratory in South Africa, the National Institute of Virology (NIV).

Based on the recommendation of the team, an isolation unit was set up at Lacor Hospital on 10 October 2000. Limited protective materials for barrier nursing were mobilized on 12 October 2000. The team also recommended alerting the public about the risk of infection especially during funerals, the safe disposal of bodies, the provision of information and training on VHF to the affected area, the provision of a technical back up team from the centre to assist the health staff in the district, and the mobilization of more supplies and logistics for barrier nursing. A rudimentary active surveillance to identify suspects and their location was initiated. The initial cases and contacts were line listed on a form.

On 11 October a team comprising senior MoH staff and the WHO country office re-verified the existence and assessed the magnitude of the epidemic. They helped the district set up a District Task Force for co-ordination purposes and prepared a preliminary district budget for the response.

The National Ebola Task Force (NETF) was constituted on 12 October 2000 to co-ordinate and mobilize resources for the outbreak. Following confirmation by NIV on 14 October that the outbreak

Table 1 Symptoms and signs of cases reviewed and examined during preliminary investigation.

Symptoms/signs	Number $n = 17$	%
Acute fever (>38 °C)	16	94.1
Generalized weakness	15	88.2
Joint pains	15	88.2
Vomiting	13	76.5
Severe headache	13	76.5
Muscle pain/myalgia	6	35.3
Difficulty breathing	9	52.9
Loss of appetite	11	64.7
Difficulty swallowing	3	17.6
Fatigue	10	58.8
Diarrhoea	10	58.8
Haematemesis	7	41.2
Diarrhoea with blood	9	52.9
Reduced urine output	9	52.9
Chest pains and coughs	12	70.6
Bleeding tendencies (eyes, mouth, ear, vagina)	7	41.2
Terminal shock	9	52.9
Maculopapular skin rash	1	5.9

was due to *Ebola Sudan* virus an 'Alert' was sent to all districts of Uganda for epidemic preparedness and response. The Ministry of Health appealed for an international response and requested WHO to co-ordinate the international organizations and staff.

The outbreak response

Community response prior to outbreak detection and recognition

Professor Barry S Hewlett (unpublished report) documented the local community response to the outbreak, using the explanatory models of EHF among the Acholis (the dominant tribe in Gulu district) (Appendix A). He outlined how the local community first perceived the disease as a normal illness and sought modern medical care. As the outbreak progressed and became more complex, the communities sought treatment from both modern and traditional healers. As soon as the epidemic was confirmed to be due to Ebola, the community responded to the public health interventions and the advice of the health personnel.[5]

Public health interventions

Public health interventions to control the epidemic were broadly categorized into:

- Outbreak control interventions
- Post-outbreak public health interventions.

Outbreak control interventions

The outbreak control interventions aimed at minimizing transmission in the health care setting and in the community, reducing the case fatality rate due to the epidemic, strengthening co-ordination for the response and building capacity for on-going surveillance and control. The interventions comprised:

- Social mobilization, health education and training
- Case management
- Laboratory confirmation
- Active surveillance
- Resource/logistics mobilization
- Improved communication.

Community mobilization, health education and training. Community mobilization was initiated as soon as the outbreak was confirmed on 14 October 2000. 'Alerts' were sent to all districts for epidemic preparedness and response. Ten DDHSs from the districts surrounding Gulu district (Figure 1) were invited to Gulu for a one-day orientation on Ebola. Different cadres of professionals and community resource persons were trained on how to identify and control Ebola. 'Spots' on Ebola coupled with live radio discussions were on all radio stations daily. There were aggressive film shows of documentaries of previous outbreaks to local communities at institutions in the affected districts. Various posters and guidelines on Ebola were widely circulated to all districts. Awareness on the outbreak and control measures were enhanced through local drama and music groups, which were used to convey educational messages to the public. Community dynamics such as greetings through a handshake and large gatherings like discos and funerals were temporarily halted in districts affected by the outbreak. Traditional healers were banned from practicing and burial rituals were stopped.

Case management. Enhanced case management was initiated on 10 October, with the creation of an isolation unit at Lacor Hospital. Subsequent isolation units were established at Gulu Regional Referral Hospital, and Masindi and Mbarara Hospitals where cases were confirmed, together with all the districts that reported alert cases. Alerts were reported in eight other districts: Arua, Kampala, Kamuli, Jinja, Nebbi, Kitgum, Apac and Rakai (Figure 1).

Efforts in case management aimed at reducing case fatality and minimizing nosocomial transmission were put in place, along with provision of supportive care, training and supervision of health workers on clinical evaluation and appropriate case management, infection control and barrier nursing practices. Health workers and those at risk of infection (burial and skin biopsy teams, care takers) were provided with protective materials (masks, gloves, plastic aprons, gum boots and head wear).

Health workers were trained in counselling and they were given guidelines for the proper discharge of patients, as discharge and management of convalescent patients became critical in the management of the epidemic.

Safe burial practices included identification and provision of a burial ground in districts where cases were identified, instituting trained burial teams and providing guidelines for burial. Burial team in Gulu district comprised volunteers from the army (8), police (6), staff of Lacor Hospitals (12) and DDHS staff/community volunteers (8). Because there were no volunteers for burial in Masindi district, some of the trained burial team members in Gulu had to conduct burials in Masindi district as well. Ebola corpses were safely transported from the isolation units in body bags to the burial ground. To avoid further spread of infection through transporting the dead bodies over long distance, suspicious community deaths were buried in the community by the trained burial team.

Laboratory screening. A temporary field-screening laboratory was set up at Lacor Hospital by the team from Centres for Disease Control and Prevention (CDC) on 21 October 2000. The aim was to provide on-site laboratory screening and confirmation of clinical and suspicious cases. Blood samples from alerts, suspects and probable cases reported from different parts of the country, (Gulu, Lira, Masindi, Mbarara, Nebbi, Jinja, Apac, Kitgum, Rakai and Kampala) were screened by this laboratory. Cases were only confirmed in the three districts of Gulu, Masindi and Mbarara (Figure 1). Four different tests were performed on each sample and they included IgG and IgM antibody tests and ELISA and PCR antigen detection tests. Serial testing was carried out on a number of cases and samples had to be submitted with clinical notes for ease of interpretation of the test results. Test results were made available within 24 hour and were used to guide public health decisions and actions.

Surveillance and epidemiology. Two surveillance systems (community and hospital-based surveillance) complemented by laboratory screening were established. The objective of the surveillance was to contain further spread through the enhancement of early case detection, timely commencement of case management, and the identification and monitoring of contacts of suspected and confirmed cases. The flow chart in Figure 2 illustrates the surveillance activities.

Four categories of the surveillance case definition adapted from the WHO/CDC manual were used, and included the 'Alert', 'Suspect', 'Probable' and 'Laboratory confirmed' case definitions (Appendix B).[2,18]

At the community level (village), a community leader (LCI) and a scout were identified and trained to identify cases and refer them using the 'Alert' case definition. Mobile team members, comprising different categories of personnel (Figure 3) verified the 'Alert' cases using the 'Suspect' case definition. The mobile teams notified the ambulance team in case of a suspected case or the burial team in case of community deaths, through established radio communication systems. The ambulance teams transported the suspects to the isolation units for further evaluation and screening. Burial teams buried the dead in the community after taking skin snips and/or performing a cardiac puncture for laboratory confirmation.

At each level of evaluation, case report forms on the cases were filled in, which were then categorized as 'Alert', 'Suspect', 'Probable' or 'Confirmed' cases (Appendix B). All the contacts at community and isolation units were also registered. Information from the case reports and contact recording sheets were entered into case and contact databases, respectively, created using Epi Info software. From the contact database, a daily list of contacts to be followed up by mobile teams was generated. Contacts were monitored for suspicious symptoms and signs for at least 21 days (the maximum incubation period for EHF).

In Gulu, security clearance to rebel infested areas had to be obtained from army personnel. Army escorts often accompanied the surveillance teams to insecure areas.

The outbreak lasted for about four and half months,[2,18] during which time a total of 425 presumptive and confirmed cases of Ebola were recorded, with 224 deaths (Table 2). The epidemic was declared over on 27 February 2001, two incubation periods after the last case sero-converted and became negative.

Post-outbreak interventions

Interventions after the outbreak was contained were focused in Gulu district, which had seen the

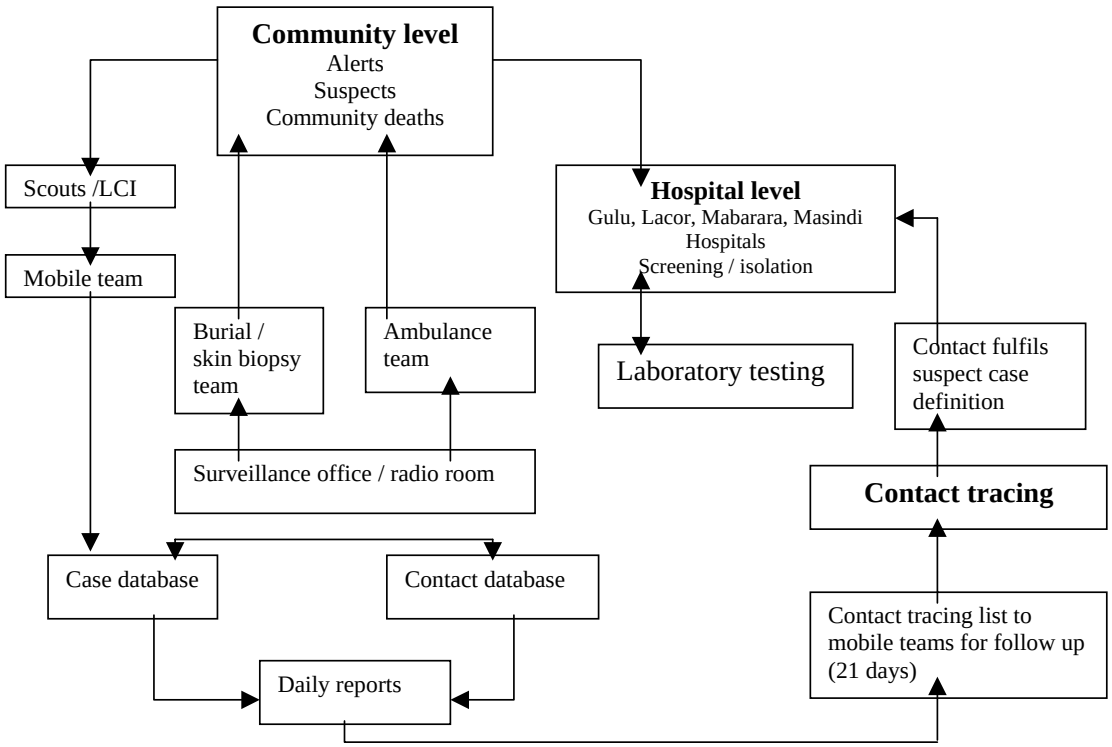
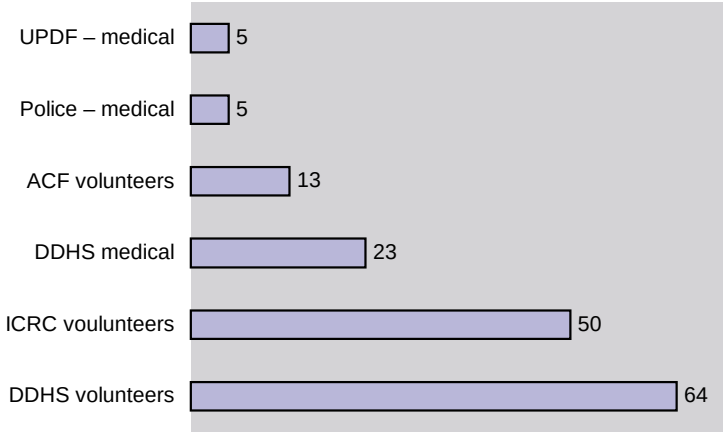


Figure 2 Epidemiology and surveillance flow chart.

bulk of the outbreak. The interventions were many and varied and comprised:

- Infrastructure development and improvement in the laboratory
- Infection control measures
- Enhancement of surveillance for early warning
- Revitalization of registration of births and deaths

These interventions aimed at improving preparations for future outbreak detection and response.



UPDF – Uganda People's Defence Force

ACF – Action Contra la Faime (Action Against Hunger)

ICRC – International Committee of the Red Cross

DDHS– District Director of Health Sciences

Figure 3 Mobile team members in Gulu district ($n = 160$).

Table 2 Summary of Ebola cases and contacts in Uganda by district (September 2000—January 2001).

Affected districts	Cases detected	Laboratory confirmed cases	Contacts identified	Deaths	CFR
Gulu	393	188	5608	203*	51.7
Mbarara	5	4	56	4	80.0
Masindi	27	24	157	17	63.0
Total	425	216	5821	224	52.7

* Some of the cases/deaths were identified retrospectively and are epi-linked.

Infrastructure development and laboratory improvement. In Gulu Hospital, the original three laboratories scattered in the three different buildings were replaced by a new purpose built laboratory for hematology, clinical biochemistry and microbiology. The initial medical ward was renovated and re-designed. One wing was reorganized to have two isolation/infectious disease wards, plus a store and a changing room. The other wing remained a medical and an emergency admission ward.

The infrastructure at Lacor Hospital changed in several aspects after containment of the outbreak. The original Ebola isolation unit was renovated as a pediatric ward. A new purpose built 28-bedded room with a single isolation unit was constructed. The medical ward was extended to allow more space per patient. Although there was no significant change in the laboratory aspects, laboratory activities suspended during the Ebola outbreak returned to normal a few months after containment.

Infection control measures. A standard procedure for infection control was adopted and staff received regular reinforcement regarding their infection control concepts and procedures.

Enhancement of surveillance for early warning and registration of vital statistics. As recommended by WHO, surveillance activities for EHF were scaled down and integrated into routine surveillance activities after the outbreak was declared over. The objectives of the surveillance for early warning is to enhance prompt detection of VHF and other epidemic prone/notifiable diseases in order to institute an appropriate and timely response.

Efforts were geared towards addressing the weaknesses in the routine surveillance system. Districts were supported to develop work plans for surveillance, and epidemic preparedness and response. To increase the awareness of peripheral health workers, all health unit in-charges were identified and trained in surveillance and epidemic preparedness and response. A health unit in-charge is a doctor, a medical assistant or a nurse who is mandated by the DDHS to be directly responsible and to oversee implementation of activities at the health facility. Rapid Response Teams (RRT) comprising the DDHS, Surveillance Focal Persons (SFPs), District Health Educator (DHE), District Health Inspector (DHI) and a District Laboratory Focal Person were set up in all districts of Uganda and trained in concepts of rapid response and outbreak investigation. The roles of the rapid response team are to promptly verify rumors and suspected outbreaks, recommend appropriate and timely response and notify central authorities.

In Gulu district, a community health worker was identified for each village, and trained to implement community-based disease surveillance activities. Their activities include detection and notification of suspected cases of VHF and other diseases of an epidemic nature such as cholera, measles and meningitis. This is being carried out concurrently with the revitalization of the registration of births and deaths, implemented at village level by the Local Council I (LCI).

Discussion

Outbreak detection and confirmation

Previous serological studies have indicated the presence of circulating antibodies against the Ebola virus in the eastern part of Uganda.[21] This outbreak, however, represents the first recognized and confirmed outbreak of EHF in Uganda.

The epidemic was not recognized for six weeks. The delayed detection of the outbreak by the health care delivery systems is illustrated by the epidemic curve which shows the time lag between the earliest recognized case, identified retrospectively (30 August 2000) and the date when it was first notified to the Ministry of Health (8 October 2000),[2,18] about one-and-a-half months later. By this time, a number of cases had occurred and many were incubating the disease. This delay in outbreak detection can

be attributed to a number of factors, which include a weak surveillance system, especially lower down the levels of the health care delivery system. The non-specific symptoms of the Ebola disease make it impossible to differentiate from other endemic conditions in Uganda such as malaria, dysentery, etc; the healthcare seeking behavior of the local community is such that many people resort to self medication, or consult traditional healers. Data from such informal sources are not captured by routine surveillance systems, which are based on formal healthcare delivery. This greatly affects detection, and delayed detection was seen with the Yambuku and Nzara outbreaks.[22,23]

Because this was the first outbreak of EHF in Uganda and the disease was characterized by non-specific symptoms and clusters of deaths, the local community members attributed the outbreak to some kind of poisoning, or to witchcraft. As seen in previous outbreaks elsewhere, it was the clustering of cases, amplified by nosocomial infection, that led to the recognition of the outbreak.[4,19,22]

While it is not easy to influence healthcare seeking behavior, improvement in early detection of outbreaks can be improved by involving the local communities in surveillance activities, a strategy now recommended by WHO through the Integrated Disease Surveillance Strategy.[9] The Community Based Disease Surveillance Strategy was thus initiated in the district of Gulu as part of the early warning system for epidemics.

Outbreak response

Outbreak verification was prompt (within 48 hour of reporting) and the initiation of the response activities was fast and efficient.

Professor Hewlett documented the Acholi protocol (Appendix A) which is useful in limiting disease outbreaks. However, cultural practices before outbreak detection, such as caring for the sick, bathing dead bodies and communal hand washing from a common basin can amplify further transmission and spread of Ebola, as it did in Gulu district. This is because the Ebola virus is transmitted through contact with infectious body fluids. It is also documented that a high concentration of the virus is secreted through exudates on the skin of the dead cases.[15,24] Many of the cases therefore were exposed through the traditional practices of washing the corpses before burial. Consequently, whole families were wiped out before outbreak detection and initiation of public health interventions.

As a measure for epidemic preparedness and response, the DDHS for ten districts surrounding Gulu (Figure 1) received a one-day orientation on Ebola. This was because the chance of having the epidemic spill over to neighboring districts was perceived to be high, due to uncontrolled movements. This helped in the early recognition of the Masindi outbreak which, apart from affected health care workers, was limited to a single-family chain of transmission.

Analysis of the outbreak response indicates no difference in the quality of response as compared with previous outbreaks. There appears to have been no significant decrease in the overall CFR of 53%, which is similar to the CFR in the Sudan outbreak. It should be noted that most of the recorded deaths occurred before outbreak detection and therefore before initiation of public health interventions. By the time the epidemic was detected and control interventions instituted, most of the cases had already been exposed and were incubating the disease. In contrast to the outbreak in Yambuku (DRC) and in the town of Nzara (Sudan), the Ebola outbreak in Uganda provided the opportunity for the implementation of organized outbreak control interventions. Interventions were based on recommended scientific principles adapted to the existing systems and structures. While in the Zaire outbreak a lot of time was spent on applying inappropriate control strategies because the investigating teams had suspected yellow fever instead of Ebola, the response in Uganda was appropriately targeted from the beginning, as VHF was immediately suspected. The impact of the effectiveness of the control interventions is reflected in the epidemic curve, which shows a drastic decrease in the number of cases on implementation of organized control interventions.[2,18] The CFR also reduced from 64.7% at the beginning of the outbreak to 52.7%.

The organization of the outbreak control activities was unique, especially with regards to active surveillance, resource mobilization, management of the dead, co-ordination and media management. The surveillance case definitions applied were flexible enough to be used at different levels and were sensitive enough to identify all potential cases in the community. During the outbreak in Zaire, it was not possible to follow contacts and the movement of people between villages had to be stopped by employing soldiers[16]. There was no such quarantine instituted in Uganda; emphasis was on isolation of cases and close monitoring of contacts. The role of the media was better recognized than in previous outbreaks and this helped to minimize rumors.

Because of the excellent response, it was easy to win the confidence of the local community and obtain their participation. But community response varied; for fear of contracting Ebola, some people,

especially community leaders, market vendors and bank tellers adopted the practice of wearing latex gloves at the beginning of the outbreak. Refusing handshakes eventually became normal. In the case of Gulu district, where the outbreak was detected after it had affected many households which resulted in numerous deaths, they were very responsive. By contrast, the population of Masindi district were relatively less co-operative because the outbreak was limited to a family that had migrated from Kenya.

The epidemic was limited to only three districts of Uganda. The chain of transmission in Masindi district was in a family that originated from Kenya and had settled in Uganda. Spillage into Kenya was prevented through notification of the Kenyan counterpart of WHO/MoH, and isolation and aggressive monitoring of all contacts. This represents a good inter-country collaboration on disease surveillance and response, and it should be encouraged in future outbreaks.

It was during this outbreak that a field laboratory was first established and used for screening cases. This was invaluable in guiding case management and surveillance activities. The laboratory was useful in preventing further transmission by helping to identify cases from non-cases. The site for the laboratory was provided at Lacor Hospital which, because it is managed privately by Italians, had better infrastructure compared with many facilities in the developing world. The laboratory remained operational throughout the outbreak. This meant that the international laboratory personnel had to stay on site until the end of the epidemic. This may not always be feasible in all Ebola outbreaks because of the associated demand and sometimes difficult field conditions.

False positive and false negative diagnoses were contentious issues. Repeating the tests and interpreting the test results in the light of clinical symptoms of the cases helped to overcome some of the problems. This was only possible because the laboratory was at the epicenter of the outbreak.

The inadequate quality of protective materials, especially at the beginning of the outbreak, was a big problem and contributed to transmission of the Ebola virus within the healthcare setting. This resulted in nosocomial transmission among the health care professionals, patients with other medical problems and caretakers. For future outbreaks, the quality of protective materials, especially masks and goggles, needs to be taken into consideration. Other challenges to the outbreak control included the death of health workers, numerous rumors and rejection of convalescent cases by community members.

The Ebola film, documenting the 1976 outbreak of Ebola in Zaire, illustrates the burning of contaminated materials within the hospital. This elicited the same response among the local communities who acted by burning all properties of suspect and convalescent cases. This had some negative impact on the control strategies as it led to a temporary hiding of cases in the community. In the future it will be important to document and produce more local films to provide flexibility of use within different settings and environments.

Through the Ebola National Task Force and the Global Outbreak Alert and Response network, it was possible to mobilize human, financial and logistical resources that were critical for outbreak response and control.

The post-outbreak control interventions were also geared to improving the Epidemic Preparedness and Response in case of a resurgence or a new epidemic. In the future it is expected that the registration of vital statistics (births and deaths) will complement the efforts of surveillance practices for the early warning of epidemics. The information collected will also show the evolution of the disease burden in the community, by detecting unexpected or severe health events.

A number of lessons were learnt in this particular outbreak that could be useful in tackling future outbreaks.[17] Some of the lessons include the need to involve the media and local communities in outbreak control strategies, effective co-ordination at both local and international level, ensuring that infection control measures are emphasized in all hospital wards and not just the isolation units and examining the ethical and social issues in relation to outbreak control. The legal issues, especially in relation to health workers and others involved in outbreak control, needs special and urgent consideration, especially when some health workers contract the virus and develop the disease.

Conclusion

This was the first recognized outbreak of EHF in Uganda and control activities successfully contained it. Despite implementation of barrier nursing techniques, health care workers still succumbed to infection. The community structures set up for surveillance activities have continued to perform well after the Ebola outbreak containment. They have also proved useful in the identification of other abnormal health conditions and outbreaks such as measles and bloody diarrhoea. There is a need to extend the community-based disease

surveillance practices to all the other districts in Uganda for the early detection of epidemics.

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Conflict of interest: No conflicting interest declared.

Appendix A. Acholi protocol to control epidemics: an extract from Professor Hewlett's report

These methods are utilized only when the illness has been identified and categorized as a killer epidemic.

1. Quarantine/isolate the patient in a house at least 100 meters away from all other houses. Nobody should be allowed to visit the patient.
2. A survivor of the epidemic feeds and cares for the patient. If no survivors are around, an elderly woman or man will be the care giver.
3. Houses with ill patients should be identified with two long poles of elephant grass; one on each side of the door.
4. Villages/households with ill patients should place two long poles with a pole across them to notify those approaching the village/household.
5. Everyone should limit their movements — stay in your household and do not move between villages.
6. Do not eat any food from outsiders.
7. Pregnant women and children are especially prone to epidemics and should be especially careful to avoid the patient.
8. Increase harmony with the household; no harsh words or conflicts within the family.
9. Nobody should have sex.
10. Nobody should dance.
11. Do not eat rotten or smoked meat, only eat fresh cattle meat.
12. Once the patient gets better (no longer has symptoms), they should remain in isolation for one full lunar cycle before moving freely in the village.
13. If the person dies, the survivor/attendant buries the person and the person is buried at the edge of the village/homestead.

Appendix B. Surveillance case definitions

Four categories of the surveillance case definitions were in use:

The 'Alert' which was any case of sudden onset of high fever OR sudden death OR any form of bleeding. The peripheral health center or mobile teams would be notified on such cases.

The 'Suspect' case definition was all persons, living or deceased with:

History of contact with EHF case and fever OR fever and three or more of the following symptoms: (headache, vomiting, loss of appetite, diarrhoea, weakness or severe fatigue, abdominal pain, body aches or joint pains, difficulty in swallowing, difficulty in breathing and hiccoughs) OR unexplained bleeding of any kind OR any unexplained death.

A 'Probable' case was defined as a suspect but had the assessment done by a clinician.

A 'Confirmed' case was one who met the clinical case definition and confirmed to be antigen, antibody or PCR positive in the laboratory.

A 'Contact' was defined as someone who slept in the same household as the case within one month, or had direct contact with the case (dead or alive) or touched his/her linens or body fluids.

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