Managing Ebola from rural to urban slum settings: experiences from Uganda.

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Abstract

Background: Five outbreaks of ebola occurred in Uganda between 2000-2012. The outbreaks were quickly contained in rural areas. However, the Gulu outbreak in 2000 was the largest and complex due to insurgency. It invaded Gulu municipality and the slum- like camps of the internally displaced persons (IDPs). The Bundigugyo district outbreak followed but was detected late as a new virus. The subsequent outbreaks in the districts of Luwero district (2011, 2012) and Kibaale (2012) were limited to rural areas.

Methods: Detailed records of the outbreak presentation, cases, and outcomes were reviewed and analyzed. Each outbreak was described and the outcomes examined for the different scenarios.

Results: Early detection and action provided the best outcomes and results. The ideal scenario occurred in the Luwero outbreak during which only a single case was observed. Rural outbreaks were easier to contain. The community imposed quarantine prevented the spread of ebola following introduction into Masindi district. The outbreak was confined to the extended family of the index case and only one case developed in the general population. However, the outbreak invasion of the town slum areas escalated the spread of infection in Gulu municipality. Community mobilization and leadership was vital in supporting early case detection and isolations well as contact tracing and public education.

Conclusion: Palliative care improved survival. Focusing on treatment and not just quarantine should be emphasized as it also enhanced public trust and health seeking behavior.

Early detection and action provided the best scenario for outbreak containment. Community mobilization and leadership was vital in supporting outbreak control. International collaboration was essential in supporting and augmenting the national efforts.

Keywords: Ebola,Uganda

DOI: http://dx.doi.org/10.4314/ahs.v15i1.45

Introduction

Ebola virus disease (EVD) is a highly fatal emerging infection. It is an acute infectious febrile illness with no known cure. In 1976, the first outbreak occurred near a river called Ebola, in the Democratic Republic of Congo. Eight major epidemics occurred[1,2] in DR Congo[3-6] and Gabon[7] and about 2000 cases were reported in the 25 outbreaks. Until 2013, the Uganda outbreak was the biggest and most complex. Some 425 cases and 224 deaths occurred[1,8] including 31 health care workers. Five distinct species of Ebola have been identified but only 3 have caused disease outbreaks in humans[9,10]. The virus is spread by direct contact with body fluids of cases (dead or alive). Contact with killed bats or non-human primates is also linked to transmission. The liver, spleen, thymus, and lymph nodes and macrophage rich lymphoid tissue, are targets for the Filoviruses. Liver damage leads to decreased production of clotting factors and impairment of coagulation. The adrenal gland maintains blood pressure homeostasis. Its damage leads to reduced production of steroids, sodium loss and hypovolaemia[11]. In this paper we report our experience with the Uganda ebola epidemics and discuss them in the context of the current ebola outbreak in West Africa.

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Methods:

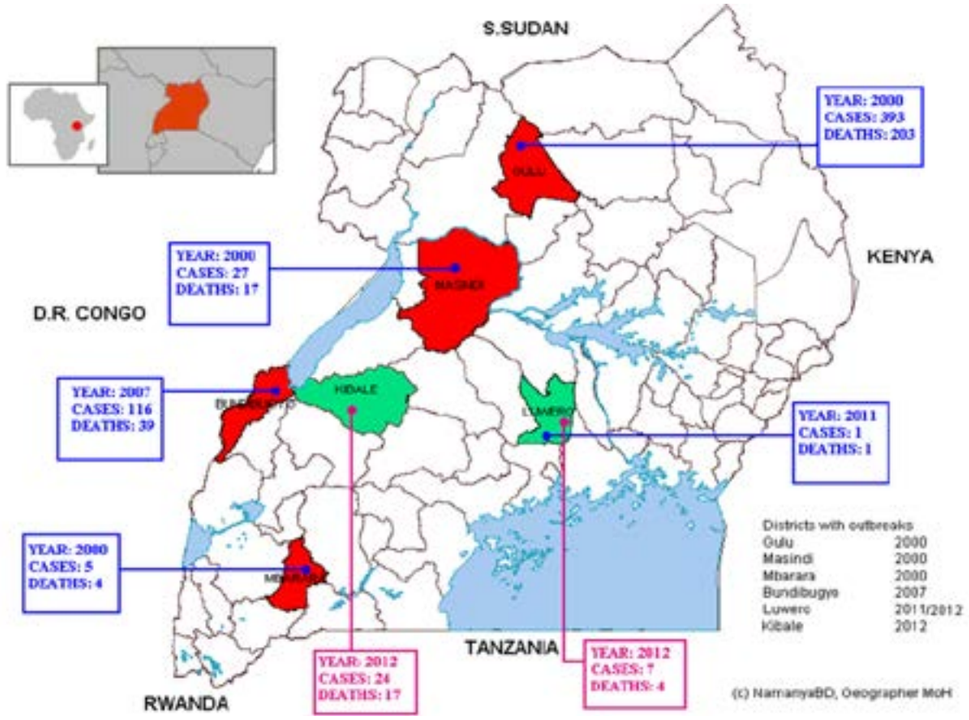
During the Ebola outbreaks in Uganda we kept detailed records of the cases, presentation outcome. Laboratory confirmation was in South Africa, USA and Uganda. The cause of the Gulu epidemic of 2000 was confirmed by the South Africa Institute of Virology. In the second ebola outbreak in Uganda which occurred in Bundibugyo district in 2007 laboratory confirmation was carried out by CDC Atlanta. The two Luwero outbreaks in 2011[12] and 2012[13] together with the Kibaale outbreak of 2012 were all confirmed by the Uganda Virus Research Institute.

Results:

Figure 1 Ebola affected districts, Uganda, 2000-2012

The ebola outbreak of 2000 occurred in Gulu district (Fig 1) in northern Uganda. Masindi and Mbarara districts were also affected with imported cases from Gulu. This was the first such outbreak in the country. Insecurity due to insurgency from LRA rebels made the rural villages inaccessible. Some 1.3 million internally displaced persons(IDPs) were leaving in slum like camps[14,15].

Fig 1 Map of Uganda showing ebola affected districts, 2000-2012



The camps were organised around trading centres or schools.

Each camp had between 1000 and 10,000 inhabitants living in temporary huts with minimal sanitation and overcrowded. The camps were low grade towns and slums (Fig 2). Infrastructure had collapsed including schools and roads. The health care delivery system had deteriorated severely. There was an acute shortage of staff due to lack of motivation to go to insurgency areas. Traditional beliefs explained the deaths within the context of witchcraft. The clustering of deaths by

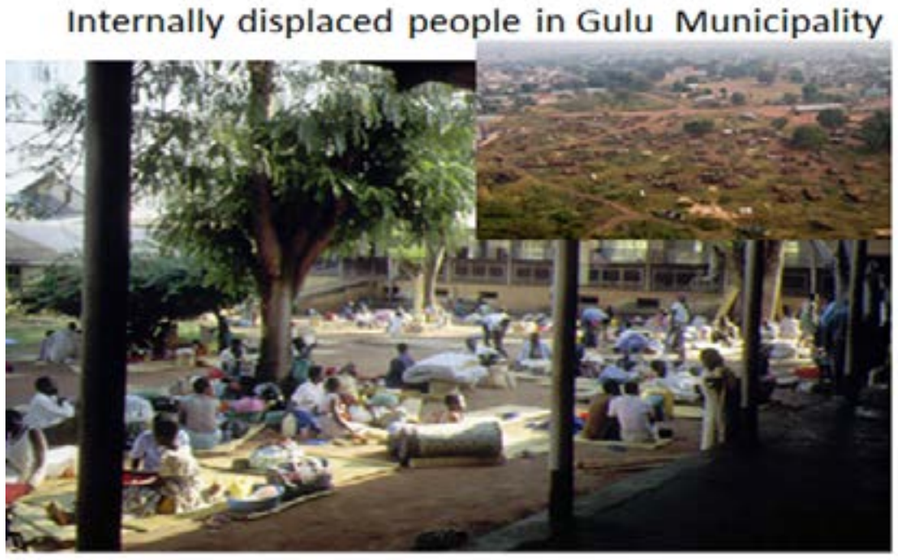
Figure 2: Camps of 1.3 million internally displaced persons (IDP), Gulu, Uganda,2000

Source : WHO Report, 2000

family lent support to this idea and fomented rumours, which the local media often capitalised on.

The epidemic started in a rural village around August 2000[1,8]. A husband and wife died followed by members of the immediate households. It is after community members started dying that medical assistance was sought. Six weeks later the first cases were admitted to Lacor hospital. Three student nurses died that week to be followed a few days later by more nurses and patients. On the 14th October2000, the Sudan Ebola virus was confirmed by the South Africa Institute of Virology as the cause of the epidemic. Health workers panicked and fled leaving patients, most of who died in the first weeks of the outbreak. Some IDP camp dwellers commuted to Gulu town at night to avoid abduction by the rebels (Fig 3) . They also feared ebola in rural areas. Unfortunately they brought ebola with them to the

Fig 3: Internally displaced persons (IDP), Gulu municipality, 2000



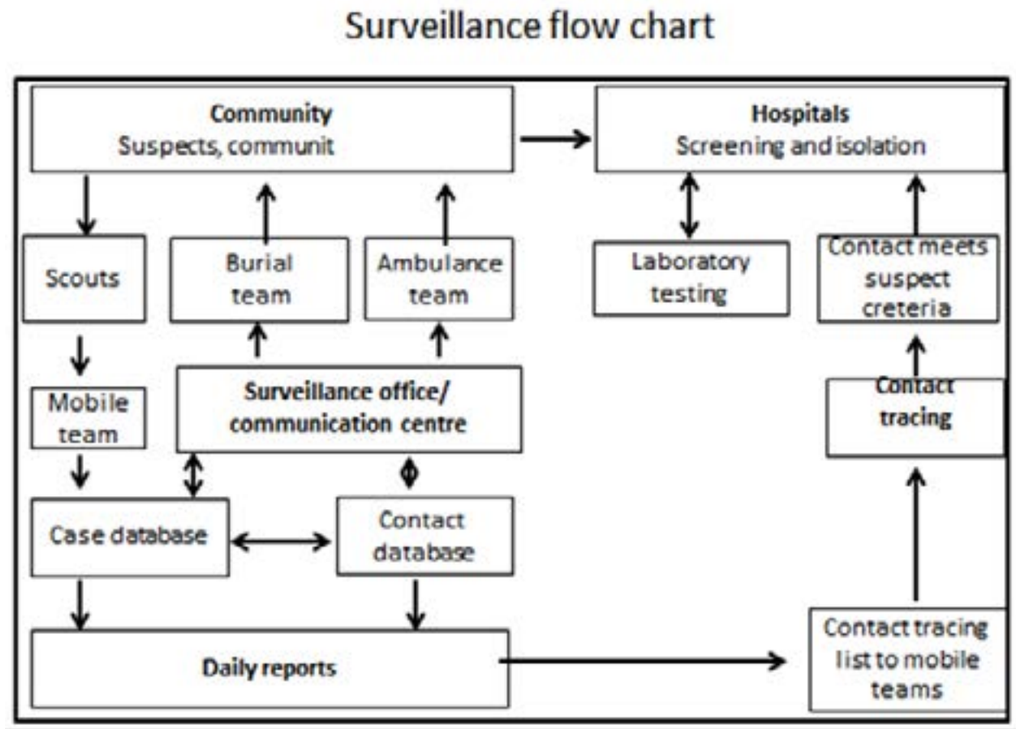
slum areas of Gulu Municipality. The urban invasion of ebola led to even more panic and scare. Cases escalated in the municipality.

Four more ebola outbreaks in the districts of Bundibugyo[2] (2007), Luwero (2011), Kibaale (2012) and Luwero in 2012 (Figure 1) have occurred. These outbreaks were basically rural and were ably contained.

The national response

The national response was comprehensive and multisectoral. His Excellency, the President mobilised the country for a national response. He directed all sectors to participate in the response. A national task force was appointed to coordinate the implementation of the national strategy. Similar coordinating mechanisms were set up at the district, county, subcounty, parish and village levels. Within weeks cascade training amplified by training of trainers had covered the country. Each village appointed leadership (Chairman and scout) to coordinate activities. The scout was the backborne of community based case search and isolation and public education. He was constantly on phone with the village

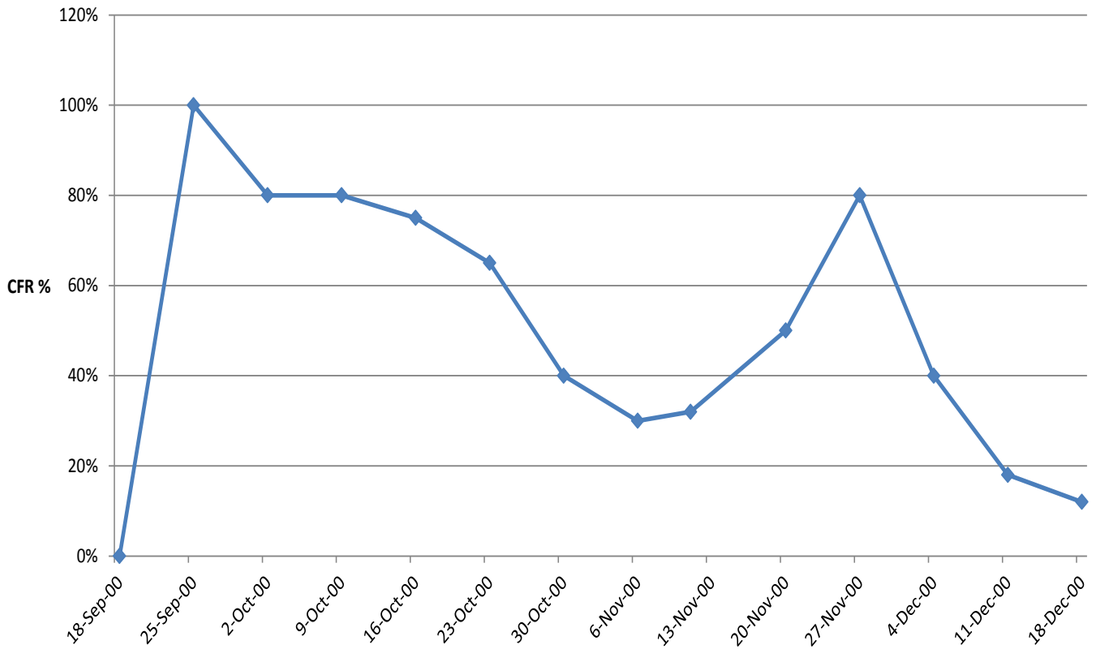
Fig. 4: Surveillance flow chart for community cases detection and isolation



team members and the district coordinating and surveillance[8]. The entire response was coordinated by the district task force and surveillance centre (Figure 4).

A special mobilisation team was required for the IDP camps, most of who were at great risk in view of the overcrowding and insanitary slum like environment. Camp leaders of blocks of 100 families were recruited, trained to undertake active case search of suspected cases. A village scout (secretary) supported the team with record keeping and liaison with the district task force and surveillance office. They were actually hired for the period the outbreak lasted. Incentives were paid to those for each ebola case reported and revalidated. A truce was negotiated between the community and the rebel leaders to allow free access to their area of operation. All the stakeholders including the rebels, security personnel and task force members were part of the 160 committed individuals that patrolled the camps and organised containment activities including burials and the ambulance service[8]. Soft power and negotiation and understanding were tools used with community in-

Fig. 5 Cases fatality rate of confirmed cases by week, 18th September- 18th December 2000, Gulu



volvement. Isolation and palliative care was provided at Lacor and Gulu hospitals. Case fatality improved to less than half towards the end of the outbreak (Fig 5).

A mobile team or a trained burial team would be despatched immediately on request. The scout worked in liaison with the other levels and stakeholders. A single updated and jointly owned situation report was announced in the evening of each day. This ensured transparency and ably managed rumours. This outbreak which stared in a rural area invaded Gulu municipality slums with devastating consequences. Some 393 cases in Gulu district alone occurred. The most affected areas were in the municipality (Table 1).The attack rates for the municipality from slum areas was the highest (15

Table 1: Cumulative ebola cases by most affected parish, Gulu municipality, Uganda, 2000

Parish	Sub county	County	No. of cases*
Kasubi	Bardege	Gulu Municipality	40
Kirombe	Layibi	Gulu Municipality	36
Atibaar	Bungatira	Aswa	31
Bardege	Bardege	Municipality	19
Kanyonga	Bardege	Municipality	18
Techo	Layibi	Municipality	17
Ariaga	Laroo	Municipality	17
Pageya	Koro	Omoro	16
Patudat	Layibi	Municipality	15
Vanguara	Pece	Municipality	13
Pabbo Kal	Pabbo	Kilak	13

*Population data at sub county unknown to compute attack rates

Table 2: Ebola Attack rates per 10,000 population by county, Gulu district , Uganda, 2000

County	Population, 2000	Confirmed cases	Attack rates	Relative risk*
Omoro*	111,886	19	1.6	1.0
Aswa	88,450	9	1.0	0.6
Mwoya	45,350	10	2.2	1.4
Gulu Municipality	45,768	109	23.8	14.9
Kilak	105, 995	32	3.0	1.9

* Reference county

fold) compared with other rural counties (Table 2). It took 6 months to contain the outbreak which had invaded the municipality through slums.

Examples of successful mobilisation: the critical role of the community

Community mobilisation was a central strategy of the national response. The community undertook early detection and swift reporting of suspected cases, enforced isolation at household level and maintained working relationship with the rebels. The community included the rebels and other stakeholders including opinion leaders and traditional healers.

The vital role of the community was demonstrated when a case escaped from Gulu hospital to her ancestral home in Masindi district. She belonged to an extended family of 73 members in the district. The local community imposed quarantine of these members and successfully prevented transmission beyond the extended family. Some 25 out of 27 total cases in the district were only among the extended family members. In contrast, only one case occurred in the general Masindi district population of 314,000[16].

The second ebola outbreak in Uganda occurred in Bundibugyo district in 2007. Although we were prepared this was another different experience. This was a new virus which was isolated 6 months after onset. The isolation was carried out at the CDC, Atlanta. However once the diagnosis was confirmed it took just 3 weeks to contain the outbreak. Community mobilisation and involvement contained the outbreak. Altogether 116 cases and 39 deaths were confirmed, including 14 health care workers. Unlike in the Gulu outbreak, the health care workers contracted infection before the isolation units were established.

Early detection was vital in limiting the Luwero 2011 outbreak to a single case[12]. This was the third outbreak since 2000. On the 5th of May, a 13 year old girl was admitted to Bombo hospital with a 5 day history of fever, diarrhoea and vomiting. She was isolated and a blood sample taken. She developed vaginal bleeding and deteriorated and died the following day. The laboratory results from the Uganda Virus Research Institute, Entebbe confirmed the Sudan Ebola subtype[12]. The results were communicated quickly to the community on the media and on mobile phones. The outbreak was promptly contained with just a single fatality. Twenty four contacts were followed up with community support. This should be the ideal scenario for Ebola containment. This was a typically a rural ebola outbreak.

The fourth Ebola outbreak[17] occurred in the district of Kibaale. On the 12th July 2012, a 16 year old female from Kikaara village 55 km west of Kagadi. She was opening up forest land with her husband when she fell sick. She was admitted to Hapuyo Health Centre III with complaints of fever, diarrhoea and vomiting, and a

nose bleed just before she died. Nine relatives who participated at the funeral died including a mother, sisters and a priest. One health care worker also died. This was typically a rural outbreak during which the community supported the follow up of 408 contacts. Some 24 cases and 16 deaths occurred. The outbreak was contained in six weeks.

Six months later another Ebola outbreak erupted in Luwero district and was confirmed early by the Uganda Virus Research Institute. This time the index case was a 30 year old motorcycle taxi rider. He was admitted to Nyimbwa Health centre IV on the 20th October 2012, with complaints of fever and difficulty in breathing. He died 3 days later and was buried the following day by relatives from as far as 70 miles away in Jinja. Contact tracing by the community and members of the district task forces was carried on all who participated at the funeral. A wife, mother and a sister all died within 2 weeks. The brother of the index case had escaped to Mulago the national hospital, but was quickly isolated. The Jinja contact too developed fever, but was identified early and isolated. Some 119 contacts were followed without incident. The epidemic was contained in 6 weeks.

Table 3: Propotion of screened suspected cases revalidated as true cases by the supervisors, Uganda

District	Identified by mobile teams	Revalidated by supervisors as cases	Regarded by supervisors as non-cases	Positive predictive value %	95% CI
Gulu	1069*	536	533*	50.1%	47.1 – 53.2
Bundibugyo	192	116	76	60.4%	53.1 – 67.3
Luwero	5	1	4	20.0%	-***

*Those with all data and infomation available.
*** numbers few.

Table 4: Laboratory results of suspected ebola cases, Bundibugyo, 2007, Uganda

Laboratory status	Number	Proportion %
Laboratory positive	42	21.9
Laboratory negative	76	39.5
Laboratory negative but probable	74	38.5
Total tested	**192**	**100**
Total lab positive and probable combined (42+76)/192	116	60.4

Discussion

In this paper we describe our experience with several ebola outbreaks in Uganda.

Lessons to learn from these scenarios are that it was easier to stop the rural based epidemics. However in the case of Gulu the outbreak had become urbanised in the camps and also in town slums. As a result, attack rates increased steeply in town suburbs of Gulu (Table1, 2). These outcomes depend on the greater mobility of the people and the differences between rural and urban. While the rural people have a communal spirit, social networks, are self-reliant and are easy to mobilise, the urban slum dwellers are individualistic, luck social support, and are money dependant and difficult to mobilise in their overcrowded neighbourhoods. For instance community mobilisation was quick in Masindi in response to an ebola patient who had escaped to the district from Gulu. The community imposed isolation of all 73 members of the index extended family. Of the 27 infections in the district 25 were from the extended family. Only one case came from the general population [16].

Role of early detection and action

Delays in early detection prolonged the spread of infection and late action in the districts of Gulu district (6 weeks); Bundibugyo (6 months); Kibaale (6 weeks). Most (75%) of the delays were at community level. Once the diagnosis was made, it took on average 5- 17 days to contain the outbreak, except for the Gulu outbreak. It took 66 days post confirmation to register the last case in Gulu. The Luwero outbreak of 2011 was contained during the first week. The critical role of early diagnosis and action was vital in containment.

Challenges in early diagnosis and detection

Besides the slum environment there were some technical challenges which affected timely detection and isolation of cases. Some of these challenges are associated with some weaknesses in the application of the clinical syndromic based diagnosis. The clustering of deaths and bleeding manifestations and the death of health care workers is suspicious. However, there are many conditions that mimic Ebola in Uganda and include illnesses like malaria and other enteric and parasitic fevers. Some atypical cases presented without fever or bleeding. Fever was absent in 15% of cases while bleeding tendencies were observed only in 30-53% of admissions in Gulu[18] . Bleeding manifestation was also rare in the West Africa outbreak[19]. About half of the suspected cases identified by the community surveillance were revalidated as true cases. Only half of the suspected and probable Ebola cases tested yielded positive laboratory results[20] (Table 3). This low positive predictive value for the case definition and the laboratory tests is a major weakness affecting early diagnosis critical in initiating the national response.This is frustrating to the patients and the community. Laboratory tests and results helped in the confirmation of cases and the management of admission to isolation units and also the management of discharges. The sensitivity and the specificity of the tests are not known and need local revalidation.

Table 5: Timeline and level of delays in outbreak confirmation of cases, Uganda, 2000- 2012

District	**Gulu, 2000**		**Bundibugyo, 2007**		**Luwero, 2011**	
Level	Date	Days since onset	Date	Days since onset	Date	Days since onset
Onset of strange disease in community	19/09/2000	0	02/08/2007	0	01/05/2011	0
Report to Ministry Health	9/10/2000	20	27/09//2007	56	06/05/2011	6
Investigation: Blood sampled	12/10/2000	24	29/09/2007	59	06/05/2011	6
Blood confirmation Ebola	14/10/2000	26	28/11/2007	117	09/05/2011	9
Declaration national action	15/10/2000	27	29/11/2007	118	09/05/2011	9
Last Case	14/01/2001	117	08/01/2008	159	06/05/2011	0
Total days epidemic lasted**		**117**		**159**		**6**
From laboratory confirmation to last case		91		42		**-6**

** Timelines approximate

Isolation and case management

Isolation and care plays a critical part in outbreak management. We demonstrated in the Gulu outbreak that isolation and care actually reduced mortality[18] . When the health care workers become more confident and motivated performance and patient survival improved. There was reduction in case fatality from 100% at the beginning of the outbreak to less than 50% as quality treatment was instituted over time (Fig 5) . Hence care and survival and not just quarantine be emphasized.

Inadequate human resource was a major challenge in the operations of the isolation wards. Isolation wards are labour intensive; they need adequate, motivated and well rewarded workers.

Similarities with the West Africa outbreak

The ebola outbreak in West Africa is very similar to the outbreak in Gulu. Both occurred in slum conditions in low resource countries. The Gulu outbreak started in a remote rural village near Southern Sudan, and entered the slums of Gulu municipality. It also entered the overcrowded slum like internally displaced persons (IDP) camps. In Gulu confirmation was done 3 weeks after onset. In West Africa the outbreak started at a remote common border of three countries but took nearly 6 months to confirm[19,21]. Guinea, Sierra Leone and Liberia were severely affected. The clinical and technical challenges were similar to the Gulu experience. There was also a problem with laboratory outcomes. Only half of the suspected and probable cases yielded positive laboratory results[18-21]. At its peak, some 150 new cases were reported daily[22]. By February 2015 some 22,000 cases with 8800 cases had been reported and 10% were health care personnel[23]. This unexpected burden of disease and death overwhelmed the health care system. Gaps in isolation procedures were reported in both outbreaks[18,19].In Gulu there was failure to implement barrier nursing as 64% of the 31 health care workers got infected after the establishment of the isolation units. In Gulu several of these infections occurred inadvertently in general wards. Some also occurred among support staff including ambulance drivers. It is reported also that 19 out 25 staff working in the Ebola isolation ward in Kenema hospital in Sierra Leone also contracted the infection[19]. An assessment of the causes of this breach in barrier nursing needs further investigation.

Conclusion

The experiences of Uganda are relevant but should be put in their true perspective.

Africa potentially remains the epicenter of the burden created by Ebola virus disease (EVD). Practical steps must be taken at country level particularly in critical areas.

First there is a need to strengthen leadership at community level for contact tracing and the early identification and isolation of cases. This was the backbone of the management of infection in the affected areas in the Uganda context. This was applied in the rural and later in the slum settlements in the Gulu municipality. Second, the need to strengthen laboratory capacity for early detection of the infection is critical. Third, focusing on supportive treatment and survival not just quarantine as such intervention reduced case mortality, isolated cases and increased public trust. Fourth, the need to eliminate the gaps in barrier nursing by institutionalizing infection control policy and plans in health facilities for ALL health workers and ALL their working environments. Fifth, the need to develop a human resource policy and plan that attracts rewards and retains workers. In order to support these critical areas there is a need to strengthen health care systems so that they can readily respond to the demands of future outbreaks.

There is need to strengthen international collaboration and partnerships to support the building of comprehensive health systems for surveillance and care. Regional teams and Centers of Excellence will need to be developed to support rapid response and provide timely emergency stocks, expertise and technical support. The experience in West Africa demonstrates that the outbreak if note detected early can paralyze socioeconomic activities and impact on development and security. The best hope for low resource countries at least for now is early detection and action.

Acknowledgements

We acknowledge the contributions from all the organizations, institutions, professionals, health care workers, political and civic leaders and local communities and the support from the international agencies and partners. The following were key local contributors:

Ministry of Health, Uganda; Office of the Prime Minister, Uganda; District Councils for Gulu, Masindi, Mbarara, Bundibugyo, Luwero; Gulu, Lacor and Mbarara hospitals; Bundibugyo hospital; Mulago hospital.

We also give special thanks to these international organizations and Partners who were major contributors: WHO, CDC, MSF, UNICEF, WFP, UNHCR, USAID, DFID, SIDA, DANIDA, Italian Cooperation, Chinese Red Cross, and AMREF

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