Ebola Hemorrhagic Fever: Lessons from Kikwit, Democratic Republic of the Congo

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The outbreak of Ebola hemorrhagic fever in Kikwit, Democratic Republic of the Congo, clearly signaled an end to the days when physicians and researchers could work in relative obscurity on problems of international importance, and it provided many lessons to the international public health and scientific communities. In particular, the outbreak signaled a need for stronger infectious disease surveillance and control worldwide, for improved international preparedness to provide support when similar outbreaks occur, and for accommodating the needs of the press in providing valid information. A need for more broad-based international health regulations and electronic information systems within the World Health Organization also became evident, as did the realization that there are new and more diverse partners able to rapidly respond to international outbreaks. Finally, a need for continued and coordinated Ebola research was identified, especially as concerns development of simple and valid diagnostic tests, better patient management procedures, and identification of the natural reservoir.

The outbreak of Ebola hemorrhagic fever (EHF) in Kikwit, Democratic Republic of the Congo (DRC), in 1995 caught the international community by surprise and captured the interest of the global media, conveying vivid images and commentary to all who had access to radio, television, and the printed press. It mobilized national humanitarian groups in a country where public health services were at a minimum and drew representatives from numerous international humanitarian groups and government-supported institutions. These representatives arrived soon after the declaration of the epidemic and formed an international commission, which played an important role in the management of patients and successfully contained the epidemic. As outlined in the following, many lessons were learned from the outbreak in Kikwit.

A Need for Stronger Infectious Disease Surveillance and Control

Weakened infectious disease surveillance in the Kikwit area of the DRC permitted the 1995 outbreak of Ebola (EBO) virus to continue through many generations and over a period of at least 12 weeks before it came to the attention of local health authorities. Retrospective tracing of contacts suggested that the outbreak began in January 1995; a review of hospital records showed that during this time, patients with hemorrhagic disease had been admitted to Kikwit hospitals, but this caused no alarm.

It was not until 13 weeks after the outbreak is thought to have begun that a local district health officer notified national Democratic Republic of the Congo authorities of an outbreak of serious gastrointestinal disease occurring in the district. The report was submitted in writing, but there was no national response. Three weeks later, the outbreak was amplified in Kikwit hospitals, and it was this event that brought the outbreak to the attention of national authorities.

Substandard hospital infection control practices (in particular, a failure in personal protection and barrier nursing) were the immediate cause of the increased transmission within hospitals. A surgical intervention for what was diagnosed as an “acute abdomen” (and which was known 2 weeks later to have been EHF) was shown to have been a particular risk for transmission of EBO virus to health workers. During this surgical intervention, barrier protection was not used by many who were in the operating theater, and latex gloves and other protective materials were in short supply.

Thus, the first lesson learned was that disease-detection and disease-response systems and basic public health practices in developing countries must continue to be strengthened. Training and development of skills in surveillance, prevention, and disease control are essential. At the same time, long-term measures to ensure the availability of essential materials and supplies must be continued, and research on more sustainable methods of ensuring universal infection-control measures must be promoted.

A Need for Improved International Preparedness

By mid-1995, when the EBO outbreak in Kikwit was first identified, international civilian laboratories that once had the materials and biosafety capacity to deal with biosafety level 4
(BSL-4) pathogens had decreased in number. In fact, the original specimens from Kikwit were first sent to one of the laboratories that had been important in supporting the first outbreaks of EBO, but the BSL-4 facilities had been dismantled during the 1980s because of insufficient funding. The Kikwit specimens were thus sent on to another laboratory with BSL-4 capability; the laboratory accepted these and future specimens from the outbreak.

During the interval between the EBO outbreaks in the late 1970s and 1995, international stockpiles of protective equipment and supplies had become outdated and had not been restocked. New supplies and equipment had to be identified and purchased before they could be shipped to the site of the outbreak; thus, their arrival in sufficient quantity was delayed. Field communication equipment was likewise in short supply, and training of field workers in its use had been neglected.

Thus, the second lesson was that international preparedness, including funding to strengthen existing civilian BSL-4 laboratories and to establish new ones for better geographic distribution, must be reinforced. International revolving stockpiles of protective equipment and supplies must be maintained, and the most up-to-date communications equipment and training in its use must be available.

**An End to Obscurity**

The widespread availability of portable satellite telephones and video link-ups by 1995 made possible the instantaneous transfer of images and commentary to the international media from journalists and camera crews arriving in Kikwit soon after the EHF epidemic was announced. This contrasted greatly with the first (simultaneous) EBO outbreaks in the DRC and Sudan in 1976, when media interest was limited to the time immediately following announcement of the outbreaks and to a time several months later when the results of the outbreak investigation became available. In 1976, representatives of the news media were absent from the outbreak sites, and the second appearances of EBO in the DRC (1977) and Sudan (1979) attracted essentially no media interest at all.

In 1995, the first representatives of the news media arrived in Kikwit unannounced, 2 days after the first members of the international commission arrived. The journalists and photographers arrived in a group on a small chartered plane and within minutes, had forcefully violated many of the protective barriers in order to get that “most sensational story or photograph.” Ethical standards, such as patient consent to be filmed, were breached; cultural sensitivity was ignored as crews filmed family members caring for the sick or burying the dead; inaccurate reports were dispatched; and the work of those caring for patients and containing the epidemic was disrupted. Order was established only when daily press briefings were begun by the international commission and camera crews were accommodated through prearranged filming sessions.

Less obvious and negative repercussions included competition with the press for such commodities as vehicles. Prices for renting vehicles necessary for epidemic control from the already limited fleet more than doubled once the press arrived, and accommodations for newly arriving members of the international commission became scarce and difficult to find.

On the other hand, the presence of the international press created a worldwide environment that facilitated rapid and timely mobilization of national and international experts, provision of equipment and supplies, and >2 million dollars (US) for immediate epidemic control, surveillance, and research.

The Kikwit outbreak clearly signaled an end to the days when physicians and researchers worked in relative obscurity and patients were shielded from unwanted scrutiny—a bitter-sweet lesson for the public health community. The unprecedented media attention posed a challenge to the team working to contain the outbreak. Rather than antagonizing and competing with the media representatives at the site, the challenge was to capitalize on the powerful positive role that the global media could play and to accommodate their needs without detracting from the primary mission of patient care, epidemic control, and research.

The third lesson learned was that the public health community must recognize the powerful positive potential of the international media in mobilizing public sentiment and resources for infectious disease control, and they must accommodate their needs without detracting from the primary mission.

**Filling the Void**

During the initial days of the epidemic in Kikwit, quarantine officers and other public health officials around the world required immediate information in order to advise national public health authorities on what measures, if any, were required for international travel. Stories in the international media were often conflicting or noncomprehensive and did not provide a basis for making decisions; electronic mail discussion groups provided useful forums for exchange of ideas and information on an informal basis, but they could not replace true international consensus on policy issues.

At the same time, the World Health Organization (WHO), the international organization charged with providing guidance on policies concerning diseases of international importance, was receiving nonstop telephone inquiries during the first week after the epidemic was reported. Many callers who sought guidance were unable to reach the switchboard. In addition, the only international legislation aimed at ensuring maximum security from infectious diseases (the International Health Regulations, which are administered by WHO) did not include hemorrhagic fevers. Consequently, in the absence of WHO consensus guidelines, many countries imposed unnecessary travel and trade restrictions.

The fourth lesson was that WHO must provide guidance to policymakers through a round-the-clock authoritative source...
of information on outbreaks. This source must use the most up-to-date electronic communications technologies. Moreover, the International Health Regulations must be modified to accommodate the need for information on international travel.

**New Partnerships in Epidemic Control**

The EBO outbreak in Kikwit assembled more and different types of national and international partners for patient management and epidemic control than had any previous EBO outbreak. The international public health and scientific communities that were present represented many of the same institutions that had participated in previous EBO outbreak control and research efforts. Numerous nongovernmental organizations (NGOs) were new and welcome partners who played a vital role in patient management and epidemic control, strengthening both the infrastructure and the logistics requirements.

**National partners.** During the Kikwit outbreak, local volunteer groups were created soon after the outbreak was detected. In particular, an association of local merchants mobilized >$12,000 (US) to support epidemic control and patient management, an important sum considering that the annual per capita income in the DRC in 1995 was probably <$220 (US). Representatives of the community participated in a rumor reporting system, which led to rapid identification of current and past cases of EBO and permitted tracing of the outbreak to the index case. The local Catholic mission provided meals for patients and their families; coordinated the receipt and distribution of materials that arrived for outbreak control; and made available aircraft, vehicles, fuel, and their radio network that connected missions throughout the district. Use of the radio network made it possible to collect information about the outbreak and share it with major mission and government health facilities within a 500-km radius of Kikwit. The network was also crucial for early delineation of the extent of the outbreak and its control. It was through the local mission group that the specimens that confirmed the outbreak were first sent to Europe.

The local Red Cross chapter also played an essential role in the control of the epidemic by providing public education, patient transport, and safe burial. The dedication of the Red Cross volunteers was untiring, and tragically, 3 volunteers died after becoming infected with EBO before protective clothing was available. The local branch of Oxford Famine Relief was an equally important partner, providing health education and ensuring that messages about the need to isolate patients and avoid contact with corpses were widely diffused to the entire population through their network in the region. Finally, local medical students whose schooling had been disrupted by the outbreak were trained, and they conducted active surveillance and containment activities in 20 teams of 2 students each.

**International partners.** The response of the international NGOs and government institutions also played an important role in controlling the Kikwit outbreak and improving the understanding of the transmissibility and epidemiology of EBO infection. Medecins sans Frontieres (Belgium chapter) ensured sanitation and isolation of the hospital wards, training, and supply of protection materials to health facilities throughout the region. They also assisted in organizing the massive active surveillance effort that was required for identifying EBO-infected persons in the community. EPICENTRE (Paris) provided epidemiologists who played an important role in active surveillance and contact tracing, and the International Federation of Red Cross and Red Crescent Societies developed and widely distributed guidelines for personal protection.

Physicians and virologists from the Centers for Disease Control and Prevention (Atlanta), the Institut Pasteur (Paris), the South African Institute for Virology (Johannesburg, South Africa), and the Institute of Tropical Medicine (Antwerp, Belgium), and physicians, virologists and technicians from the Swedish Rescue Service Agency (Karlstad) also contributed. They provided reinforcement activities, such as training and support for national staff, direct participation in patient management and isolation, and health education, sanitation and hygiene, epidemiologic surveillance, and research.

Finally, epidemiologists and technical officers from WHO (Geneva and Brazzaville and Kinshasa, DCR) reinforced national coordination and logistics support to the international commission at the epidemic site. In addition, they provided daily information briefings for local and international media and mobilized funds and experts for national epidemic control and postepidemic reinforcement of surveillance and epidemic preparedness. Table 1 shows the members of the commission that was created from the international NGOs and institutions participating at Kikwit and the times of their arrival at the site.

The fifth lesson was that an increasing number of international partners are capable of outbreak investigation and control, and each has an important and sometimes unique place in the international response to epidemics. On-site and international measures and information must be coordinated to maximize efforts aimed at early detection of, prevention of, and response to future epidemics.

### Table 1. Members of the International Scientific Commission that was created in Kikwit, Democratic Republic of the Congo, in 1995 and the date of their arrivals in Kikwit.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Date of Arrival</th>
</tr>
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<tbody>
<tr>
<td>World Health Organization (Geneva/Brazzaville/Kinshasa)</td>
<td>10 May</td>
</tr>
<tr>
<td>Medecins sans Frontieres (Belgium)</td>
<td>11 May</td>
</tr>
<tr>
<td>Centers for Disease Control and Prevention (Atlanta)</td>
<td>12 May</td>
</tr>
<tr>
<td>Institut Pasteur (Paris)</td>
<td>12 May</td>
</tr>
<tr>
<td>First journalists and television crews</td>
<td>13 May</td>
</tr>
<tr>
<td>South African Institute for Virology (Johannesburg, South Africa)</td>
<td>15 May</td>
</tr>
<tr>
<td>Institute of Tropical Medicine (Antwerp, Belgium)</td>
<td>15 May</td>
</tr>
<tr>
<td>Swedish Rescue Service Agency (Karlstad)</td>
<td>16 May</td>
</tr>
<tr>
<td>EPICENTRE (Paris)</td>
<td>19 May</td>
</tr>
</tbody>
</table>
A Need for Continued Research

The studies conducted during the course of epidemic control in Kikwit and the rejuvenated interest among the scientific community after the outbreak contributed to a better understanding of the epidemiology of the EBO virus. Unpublished data collected between the 1976 and 1995 epidemics were reexamined in several international forums, and heightened awareness and surveillance for EBO in other African countries subsequently contributed to the early identification of other EBO outbreaks. However, further work is required to address several issues that remain.

First, there is a need to determine optimal patient management procedures. Patient management was particularly difficult during the Kikwit outbreak, and although treatment with convalescent serum was attempted, no firm conclusions can be made about its efficacy. Antiviral therapy was not tried because results of previous studies in animal models suggested that existing antivirals, such as ribavirin, were not effective. Case fatality rates remained high, as in previous outbreaks. Further research could help to determine the efficacy of convalescent serum.

Second, there is a need for the development of new diagnostic tools. The lack of a safe and simple-to-use field diagnostic test made laboratory confirmation of patient diagnosis in Kikwit problematic. New laboratory procedures for the diagnosis of EBO infection are being studied: They include procedures on skin snips from persons who died with a case definition of hemorrhagic fever (see Zaki S, et al., this supplement). However, this promising procedure does not permit early patient diagnosis and patient triage during an outbreak. A simple and safe procedure for inactivating blood specimens at the time of collection and a simple laboratory test for diagnosis of acute and convalescent infection from such specimens are needed. Such a test would be necessary if convalescent or hyperimmune serum (or both) and antivirals are to be studied during future outbreaks. A simple laboratory test would also facilitate surveillance programs and provide more timely results.

Third, the reservoir for EBO virus in nature is not known, despite at least five studies to identify an infected animal or insect in nature. New approaches for ecologic studies, such as obtaining clues from EBO-infected nonhuman primates (e.g., the chimpanzee), are required before a decision is made concerning which animals or insects to sample.

The final lesson was that despite the knowledge gained during and since the Kikwit outbreak, EBO virus remains a public health challenge for surveillance and control in tropical Africa. New diagnostic technologies are required, as are research protocols for controlled trials of hyperimmune serum and antiviral drugs for use in future outbreaks. New approaches for the identification of the EBO reservoir must be attempted so that the cause(s) of reemergence can be understood and prevented.