Outbreak of Marburg Hemorrhagic Fever Among Miners in Kamwenge and Ibanda Districts, Uganda, 2007

Marburg hemorrhagic fever (MHF) is an acute, severe febrile illness caused by Marburg virus (MARV; family, Filoviridae). After an incubation period of up to 21 days (typically 5–10 days), a sudden onset of fever, headache, and myalgia develops; hemorrhagic signs ensue within 6–8 days after onset [1]. The resulting small vessel damage and multisystem organ failure can be fatal. MHF outbreaks are rare, resulting from human exposure to a presumed zoonotic reservoir [2], and are frequently amplified by secondary person-to-person transmission through contact with infectious body fluids and tissues [3]. Case-fatality rates for large MHF outbreaks have ranged from 20% to 90% [4]; the largest and deadliest outbreak occurred in northern Angola in 2005, with 374 cases and a case-fatality rate of 88% [5].

On 13 July 2007, the Uganda Ministry of Health (MoH) was notified of a suspected case of viral hemorrhagic fever in a miner from Kamwenge District who was hospitalized and died in Kampala. A second miner who had been in contact with him was also hospitalized with suspected viral hemorrhagic fever. This report describes the epidemiologic investigation and the health education response.

The MoH convened a Marburg Task Force comprising government ministries, nongovernmental organizations, and international partner organizations. An initial investigation revealed that both patients had worked at Kitaka mine in Ibanda District and had lived in a tent camp in the Kibale forest reserve surrounding the mine. The tunnel mine was the roosting site of thousands of bats. The remaining miners reported working in the mine using little to no personal protective equipment (PPE), with use of only gloves, gum
boots, and occasionally hard hats reported; no one reported use of masks, respirators, or goggles. Kitaka mine was operated from 1953 until the mid-1970s by a commercial mining company, at which point the commercial operation ceased but local residents could access open passages in an unofficial capacity. From September through December 2006, another commercial mining operation reopened this mine, employing workers to expand tunnels prior to the start of mining operations. On 6 August 2007, at the recommendation of the Marburg Task Force, the Ugandan Department for Geological Survey and Mines officially closed Kitaka mine and a local miner was hired to help ensure that mine access was restricted.

A suspected case of MHF was defined as having an acute onset of fever with either 3 or more nonspecific symptoms or unexplained bleeding at any time since 21 June 2007. A probable case was defined as a suspected case with a history of 1 of the following in the 3 weeks prior to fever onset: travel to an area where an MHF case had occurred; direct contact with bodily fluids from a person or animal with probable or confirmed MHF; or work in a laboratory or animal facility handling MARV. A confirmed case was defined as a suspected or probable case with laboratory evidence of recent MARV infection by virus isolation antigen-detection enzyme-linked immunosorbent assay (ELISA), anti-MARV immunoglobulin M (IgM) or immunoglobulin G (IgG), immunohistochemistry, or reverse-transcription polymerase chain reaction (RT-PCR) and sequencing [6, 7].

Three confirmed cases of MHF were identified with onset occurring in June–July 2007; a fourth case occurred in September 2007 after closure of the mine. All 4 patients were male, were aged 22–29 years, and worked at Kitaka mine. The index case patient (patient 1), aged 29 years, presented to hospital A in Kampala on 7 July with a 3-day history of fever, chills, headache, and arthralgia. Three days after admission, he continued to be febrile and began vomiting. On 13 July, he developed confusion, seizures, hematemesis, and hematochezia, and died later that day. A blood sample collected on 13 July was sent on 23 July to CDC for testing. MARV was detected by RT-PCR and subsequently by virus isolation (isolate no. 200703648), RT-PCR, and in convalescent samples by anti-MARV IgG (Table 1). Sequencing of viral isolates from patients 1 and 4 showed 20% divergence at the nucleotide level, indicating that the 2 cases represented separate introductions and were not epidemiologically linked [8]. Some of the sequences obtained from the original bat (Roussettus aegyptiacus) specimens and isolated viruses from the same bats, sampled during the following ecological investigation, matched very closely to the unique sequence of the viruses isolated from the 2 patients [8].

We performed close monitoring of health workers and contact tracing in all districts to which the 4 patients had traveled from June through September 2007. Contacts were evaluated for fever and other symptoms for 21 days after last contact. Of 267 contacts identified, 161 were able to be located and followed up; 83 contacts (73 in Kamwenge and Ibanda districts; 10 in Kampala District) provided blood samples for testing. During the 21-day incubation period, 24 (15%) and 3 (2%) of the 161 contacts developed fever and bleeding, respectively; none of the contacts had evidence of MARV infection by antigen-detection, IgM, or IgG ELISA. Active surveillance for new cases continued in the affected districts for an additional 21 days. No additional cases were identified.

The number of MARV infections in this outbreak was limited, although the risk of MHF exists as long as people without PPE enter mines or caves inhabited by bats in areas where MARV infection is endemic. There are no reasons to believe that MARV exists only in Kitaka mine. The movements of fruit bats are partly regulated by food abundance and availability of spaces in the roosting areas. Some proportion of the population migrates to other colonies on a seasonal basis [9]. This risk of MARV being spread by bats was emphasized by the subsequent identification of 2 cases of MHF in tourists visiting the Python cave in nearby Queen Elizabeth National Park [10–12]. In the weeks following this cluster of cases, Kitaka mine was officially closed and the owner decided to destroy the residing bat population by fumigation and by closing the access to discourage recolonization by bats from other locations. Educational campaigns that targeted communities living around bat-inhabited caves and mines,
wildlife workers, and tourist groups were established in Uganda by the MoH, the Wildlife Authorities, and the Tourist Board with the support of CDC. A letter explaining the potentials risks of entering any bat-inhabited cave was sent by the MoH to the Association of Uganda Tour Operators. Posters and leaflets were designed in English and local languages and distributed to target populations. Health messages were posted on MoH and CDC Web sites. In recognition of the economic impact of the tourism industry in the parks and specifically Queen Elizabeth Park, it was decided that the site would be redeveloped for bat observation while protecting the health of the visitors. The park rangers received bat ecology and MHF-related education training. A viewing platform was erected at a safe distance to allow visitors to see the cave and the bats from a covered structure during the day, when bat movements in and out of the cave are limited. Educational signage concerning the ecology of bats, the environment, and MARV was posted in the campground, on the trail, and in the platform. All signs included specific warnings of the potential for the bats to carry MARV.

**CONCLUSIONS**

This outbreak was limited to 4 confirmed case patients, all of whom were male miners with regular contact with bats or their secretions. The association of MHF with mines and caves is likely related to exposure to bats in a confined space [2, 3]. Considering the incubation period, it also remains possible that all 4 cases had separate introductions. However, person-to-person transmission may have occurred sequentially from patient 3 to patient 2 to patient 1, although patient 3’s symptoms were mild, which makes it unlikely that he transmitted the infection to either patient 1 or patient 2. Without acute-phase samples from patients 2 and 3, it is impossible to prove both the timing and the source of their infection. Although the 2005 MHF outbreak in Angola included a significant number of cases from nosocomial transmission [5], our contact tracing revealed no evidence of health care–associated infection. Barrier nursing and infection control are known to be the most critical ways to prevent secondary transmission.

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References