2014 EBOLA OUTBREAK IN WEST AFRICA: THE FACTS, ARGUMENTS AND EVIDENCE

Did American Researchers Cause the 2014 Ebola Outbreak in West Africa?

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Since the Ebola outbreak in Sierra Leone, Guinea, and Liberia, conspiracy theorists have attributed it to American researchers conducting experiments in these countries. Some people have gone as far as alleging that the USA owns a patent for the invention of the Ebola virus, the implication being that the USA created the virus from thin air. In November 2007, haemorrhagic fever (HF) cases were reported in Bundibugyo district of Western Uganda. Based on the blood samples that were collected from 29 suspect cases and sent in two air-transport shipments to the Centers for Disease Control and Prevention (CDC),
American scientists identified this to be an Ebola HF outbreak associated with a newly discovered Ebola virus species. Therefore, the patent was for the invention of a diagnostic method for detecting the Bundibugyo strain of the Ebola virus. This type of work is necessary for the development of vaccines and therapeutic drugs for Ebola. According to the inventors, “Cross-protection studies will need to be done to assess whether vaccine designs will need to incorporate the Bundibugyo ebolavirus.” The virus was not invented from thin air. It was detected in the blood samples of patients who had Ebola symptoms.

In a discussion with an “internet friend”, he opined that:

"The sudden outbreak of Ebola on the scale we are witnessing, coincidental with experiments in the outbreak regions would lead one to make a reasonable connection. I personally do not share the view that the experimenters set out to cause the Ebola outbreak, only that something would have gone wrong along the way."

A look at WHO data shows that there is enough randomness in the timing and severity of Ebola outbreaks. The Zaire strain was first detected in the Congo (DRC) in 1976. It did not appear in Gabon until 1994 (18 years later). In 1976, there were 318 cases of Ebola in the DRC. In 1977, there was only one case in the DRC. The Sudan strain was first detected in Sudan in 1976. It did not appear in Uganda until 2000 (24 years later); 425 cases. In 2000, Sudan had been Ebola-free for 21 years. Yet, the Sudan strain ended up in Uganda.

In thinking about the scale of the current outbreak, two factors or criteria are important:

(1) The rate of infection.
(2) The case fatality rate CONDITIONAL on infection.

The current case fatality rate based on current data (October 29, 2014 data) released by the WHO is less than 50%. According to the WHO, “A total of 13,540 confirmed, probable, and suspected cases of EVD and 4941 deaths have been reported up to the end of the 29 October 2014 by the ministries of health of Guinea
and Sierra Leone, and 25 October by the Ministry of Health of Liberia”. This implies a case-fatality rate of \( \frac{4941}{13,540} = 36.49\% \). That is not extra-ordinary relative to past case-fatality rates, six of which had fatality rates greater than 80\% and eleven with fatality rates of at least 65\% (see appendix A).

Therefore, on the basis of the criterion in (2), the current outbreak is not unusual. On the criterion in (1), Nigeria and Senegal contained the virus and stopped the spread of Ebola within three months. The recently reported case in Mali has not led to an epidemic. According to a recent article:

"In the Democratic Republic of Congo, numerous outbreaks of both Ebola and the Marburg virus have been stopped in their tracks in the past few years. In part this is because health workers in the DRC know what to do when they suspect Ebola, which is to act quickly and tell everyone. They have also learned not to leave people behind when they suspect they might be infected. Health worker’s trips to Ebola-affected communities factor in extra days to convince those who might be ill to come back with them. This is fairly common knowledge in the public health community, and therefore cannot be unknown to Liberia’s leaders."

Could it then be that this outbreak appears to be unusual because of the weak health infrastructure and lack of knowledge of the three affected countries (Guinea, Sierra Leone, and Liberia) and therefore this has nothing to do with the unique nature of the virus? I think so. Contrary to the allegations by some commentators, genomic sequencing and related work published in at least 5 scientific journals in 2014 have not shown that the virus has been "weaponized" through genetic engineering. Unlike the 1979 accidental anthrax leak in the Soviet Union, there appears to be no cover up where the medical records and data of victims were destroyed; scientists have had access to the serum samples of Ebola patients and victims and published their findings in journals within months. To accelerate Ebola research efforts, a group of scientists from Harvard University, Tulane University, Kenema Hospital (Sierra Leone), etc --- who analyzed the genomic sequence of the Ebola virus circulating in West Africa --- concluded their paper as follows:

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3 http://apps.who.int/iris/bitstream/10665/137424/1/roadmapsitrep_31Oct2014_eng.pdf?ua=1
4 Even if one were to take account of lags in reporting deaths and other reporting errors, the current outbreak is unlikely to have a case fatality rate that is higher than the top six previous outbreaks that had more than 80\% fatality rates.
5 For example, Francis Boyle, a professor of international law at the University of Illinois at Urbana-Champaign.

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“To aid in relief efforts and facilitate rapid global research, we have immediately released all sequence data as it is generated. Ongoing epidemiological and genomic surveillance is imperative to identify viral determinants of transmission dynamics, monitor viral changes and adaptation, ensure accurate diagnosis, guide research on therapeutic targets, and refine public health strategies. It is our hope that this work will aid the multidisciplinary international efforts to understand and contain this expanding epidemic.”

On the “accident hypothesis”, one cannot completely rule it out. However, when accidents occur in labs (like the 1979 anthrax accident in the Soviet Union where workers at a ceramic plant across the street from the lab were infected and died), there usually appears to be a correlation between the initial cases of fatality or infection and distance from the lab. In this case, there was a 4 to 5-month lag between the detection of the disease in Kenema (Sierra Leone) were the main lab was and Guinea. The viral hemorrhagic fever (VHF) lab at Donka Teaching Hospital in Conkary (Guinea) is about 650 km away from Guèdekkou, Guinea. Yet the first reported cases were in Guèdekkou not Conakry. Even Macenta (Guinea) which is closer to Conakry than Guèdekkou was not the first place to report a case of Ebola. Tulane University’s School of Medicine teamed up with the International Center for Research on Tropical Infections in Nzérékoré (Guinea) to study VHFs. But Nzérékoré is about 200 km from Guèdekkou. This outbreak does not pass the "across the street from the lab" test, an inconsistency with the accident hypothesis. This contradicts Professor Francis Boyle’s claim that the Ebola virus in West Africa transmitted by air: “…is far more dangerous than the CDC and the WHO are telling anyone, because it’s clearly transmitted for a certain distance - we don’t know how far – by air.”:

http://www.informationclearinghouse.info/article40012.htm

If the Ebola virus is transmitted over a certain distance because it has been genetically modified by the USA into an airborne virus, why didn’t Thomas Eric Duncan, the Liberian who brought the virus to the USA, infect many people in Dallas, Texas? To the best of my knowledge, none of his family members (his girlfriend, Louise Troh; 13-year old son of girlfriend; nephew, brother, etc) in Texas was infected. The same professor Boyle claims that “… I have the Harvard genetic analysis of it. When I was in college I had very good courses in genetics, and

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...The first official case in Sierra Leone was detected on May 25, 2014 while the first official case in Guinea was
epidemiologically determined to have occurred in December 2013. See below for more details.

Guecdekou and Nzérékoré are both districts in the Nzérékoré region of Guinea. Nzérékoré is the capital city of the Nzérékoré region, one of the eight regions of Guinea.

A section on laboratory-acquired infections of the Ebola virus of a 2014 document by the Public Health Agency of Canada states that: “One reported near-fatal case following a minute finger prick in an English laboratory (1976) .... A Swiss zoologist contracted Ebola virus after performing an autopsy on a chimpanzee in 1994... An incident occurred in Germany in 2009 when a laboratory scientist pricked herself with a needle that had just been used on a mouse infected with Ebola; however, human infection was not confirmed. Additional incidents were recorded in the US in 2004, and a fatal case in Russia in 2004.”:


I have a friend who is a professor of genetics. I have a friend who is a professor of genetics and he is going to take a look at this and try to figure out if there’s been DNA genetic engineering perpetrated or performed on the Zaire/Ebola. Is there a genetically modified organism at work, a GMO? I don’t know. But if a GMO is at work that’s a pretty good sign it’s been weaponized.”

We are waiting for the results of Francis Boyle’s research.

There is also evidence that the main lab where serious work really took place was at Kenema Government Hospital in Sierra not Conakry in Guinea. In fact, Guinea did not have the capacity to test for Ebola, so it notified the WHO and the blood samples of patients were sent to the Institut Pasteur in Lyon (France) where the Ebola virus was detected. In contrast, Augustine Goba, a Sierra Leonean and director of the diagnostic lab of Kenema Government Hospital ran a series of molecular tests at Kenema Hospital and detected the first official case of Ebola infection in Sierra Leone in May 2014. According to Dr. Sabeti of Harvard University in a September 2014 article titled “Studying Ebola, Then Dying From It: “Kenema was well positioned to detect and treat Ebola because of its experience combating
another deadly virus, Lassa, a project I started working on in 2008. As the hospital’s reputation for treating Lassa fever spread, more patients with unexplained fevers began to travel there.

Rapid diagnosis of more people not only helped treat individual patients, but it could also uncover other unexpected pathogens hiding in the population, thus warning of outbreaks before they became global threats … If diagnostic facilities like those at Kenema had been more widely available, the virus could have been caught as it emerged.”

In the article published in Science (referred to above) by scientists of Kenema General Hospital,

Tulane University, and Harvard University, the evolution of the virus in Sierra Leone was described as follows:

“In March 2014, Kenema Government Hospital (KGH) established EBOV surveillance in Kenema, Sierra Leone, near the origin of the 2014 outbreak …

Following standards for fieldbased tests in previous and current outbreaks, KGH performed conventional polymerase chainreaction (PCR) – based EBOV diagnostics; all tests were negative through early May. On 25May, KGH scientists confirmed the first case of EVD in Sierra Leone. Investigation by the Ministry of Health and Sanitation (MoHS) uncovered an epidemiological link between this case and the burial of a traditional healer who had treated EVD patients from Guinea. Tracing led to additional cases — all females who attended the burial.”

On March 10, 2014 hospitals in Guéckédou and Macenta (in Guinea) alerted the Ministry of Health of Guinea and Doctors without Borders in Guinea about clusters of a mysterious disease.

The WHO in Geneva identified the disease as Ebola. This was why the Kenema Government Hospital (KGH) in Sierra Leone established EBOV surveillance in March 2014 near the origin of the outbreak. Even with this heightened level of alertness, scientists at KGH discovered that all Ebola tests of patients or suspected cases in Sierra Leone from March 2014 to early May 2014 were negative. Although the first official Ebola case in Guinea was epidemiologically determined to have occurred in December 2013, recall that the first positive test for Ebola in
Guinea was confirmed by the WHO in March 2014. Working backwards, epidemiologists went through a chain of contacts and links to conclude that the index case occurred in December 2013 in Guinea. This process is described below.

The "*coincidental with experiments in the outbreak regions*" argument in internet friend’s quote above would have carried some force if the outbreaks in the three affected countries (Sierra Leone, Liberia, Guinea) had been almost simultaneous and no epidemiological link had been established between/among these countries. For example, if the probability of an outbreak in region A is $1/1000$, then the probability of independent outbreaks in three regions is $1$ out of a billion ($1,000,000,000$). If this were the case, then the probability would have been too small to attribute the three independent outbreaks to chance or natural causes. But based on epidemiological research by Sierra Leone's Ministry of Health, the outbreak in Sierra Leone (*4 months later*) was traced to Guinea. As indicated above, the outbreak in Liberia was also traced to Guinea. Therefore, what we have are not three independent events. **We have only one independent outbreak,** unless we want to doubt the fairly detailed epidemiological work, described above, by officials of the Ministries of Health in Sierra Leone, Guinea, and Liberia. This is a very important point. To reiterate, if there had been three (or even two) independent outbreaks that would have been suspicious because the probability that this joint event occurred by chance or was caused by natural events would have been too small. Conspiracy theorists who have sought to establish a link between labs in the Mano region (Sierra Leone, Liberia, and Guinea) and the Ebola outbreaks in the region have failed to make this important distinction between independent outbreaks and interdependent outbreaks. A counterargument is that reported cases need not be the same as actual initial cases. If so, these reporting errors would have been almost uniformly distributed across Sierra Leone and Guinea. Noting

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The first official case in Guinea was identified as **Emile Ouamouno**, a two-year old who died on December 6, 2013. Emile’s 3-year-old sister, his mother and his grandmother all died by January 2014. Emile lived in the village of Meliandou in the Guéckédou region of Guinea. After Emile and his family members became sick, two health care workers in the village — a nurse and the village midwife — also contracted Ebola and died. The sick midwife was cared for by a family member who lived in nearby Dandou Pombo village, and then six additional deaths occurred in that location. The virus also spread to Gbandou and Dawa villages by family members who **attended the funeral of Emile's grandmother**. The outbreak escalated from there: A health care worker who may have been infected in Dawa or Meliandou, went to a hospital in another town, Macenta, resulting in 15 additional cases there. The virus also reached people in two other districts in Guéckédou, as well as Kissidougou. In Liberia, people who had been infected with Ebola in Guinea later died in Foya district, Lofa county. According to Liberia's Deputy Health Minister and Chief Medical Officer, Dr. Bernice Dahn, “All the six suspected (initial) cases came from Guinea for treatment in hospitals in Foya and Zorzor Districts, Lofa County.” A family member of one of the Foya cases carried the disease into Monrovia (Montserrado county) and Margibi country. By early April, cases were reported in Nimba and Bong counties as well. Several healthcare workers were infected and killed. By mid-April, suspected or confirmed cases were reported in six counties: Bong, Grand Cape Mount, Lofa, Margibi, Montserrado and Nimba.:
also shows that Sierra Leone had the labs that could test for Ebola while Guinea did not, these reporting errors cannot account for the 4-month lag between the outbreaks in Guinea and Sierra Leone if these were indeed independent events in the two countries. If there were simultaneous outbreaks of a mysterious disease in a town/village in Sierra Leone and Guinea, it is unlikely that the villagers in Guinea would have reported this incident about four months earlier than the villagers in Sierra Leone or that for about four months, the occurrence of the disease would not have been known in Sierra Leone which had the capacity to test for Ebola. It is, of course, obvious that the probability of almost simultaneous and independent lab accidents in the three countries is very close to zero.

The porous nature of Guinea-Sierra Leone border where Guéckédou is located was described in an article in *Nature* as follows: "... the border doesn’t exist in the way that many might imagine a border would. Here, the border is porous, and people regularly cross back and forth. They have family on both sides and they frequently cross the border to travel to markets — or to funerals."

According to Wikipedia, "Guéckédou is renowned for its large weekly market, which attracts traders from across Southern Guinea, Sierra Leone, Liberia and Côte d'Ivoire." 13 We also have evidence that the virus has been in the region as far back as 1982 (Guinea), 1995 (Liberia) and 2006 (Liberia, Guinea, and Sierra Leone). In the case of Liberia, researchers found that a warrior in the Liberian civil conflict had antibodies to the Ebola virus after he fell sick with Ebola-like symptoms and was tested for Ebola two weeks later.14 and in the Sierra Leonean case, researchers found that between 2006 and 2008, antibody prevalence to the Ebola virus in human beings in the most-affected countries was 8.6%.15 And in the Guinean case, it was found that at least 19% of the samples tested had antibodies to the Ebola virus.16 It is also known that the virus could be in a region for a long time without any outbreak, for example, the discoveries of the different strains of the Ebola virus in chimpanzees in Cameroun and in monkeys in the

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13Cote d'Ivoire has closed its borders with the Guinea and Liberia since March 2014. For more details, read the article “No Ebola, S'il Vous Plait, We're French: The Ivory Coast Mindset”: http://www.npr.org/blogs/goatsandsoda/2014/10/29/359878582/no-ebola-s-il-vous-plait-were-french-the-ivory-coastmindset


15Randal J. Schoepp, Cynthia A. Rossi, Sheik H. Khan, Augustine Goba, and Joseph N. Fair (2014). *Undiagnosed*
Acute Viral Febrile Illnesses, Sierra Leone. Emerging Infectious Diseases, Volume 20, Number 7—July 2014.


Philippines18 and in bats in China19 and Bangladesh.20 We also know that the virus (not antibodies to the virus) was found in 1994 in the Tai Forest of Côte d'Ivoire in dead monkeys, although it was not of the Zaire strain;21 Based on an analysis of serum samples collected from bats in Ghana in 2007, researchers concluded that "... our findings demonstrate that at least 1 serotype of EBOV (Ebola virus) circulates in bats in the Upper Guinean forest ecosystem in West Africa."22 The Upper Guinean Forest Ecosystem stretches from southern Guinea into eastern Sierra Leone and eastward through Liberia, Côte d'Ivoire and Ghana into western Togo. Therefore, the presence of Ebola virus in this region is not unusual. The presence of antibodies in humans is, of course, an indication that people in these regions were exposed to it in the past but survived. This leads to the question: "... if Ebola virus was present in Guinea, wouldn't we have seen cases before?” According to two scientists:23 “Not necessarily. Many pathogens may be maintained in animals with which humans normally have little contact, thus providing limited opportunity for infection. Furthermore, the proportion of infected animals may often be very low, so even frequent contact may not result in pathogen transmission. Even if human Ebola virus infection has occurred, it may not be recognized; contrary to popular concept, the clinical presentation of viral hemorrhagic fever is often very nonspecific, with frank bleeding seen in a minority of cases, so cases may be mistaken for other, more common diseases or, in the case of Guinea, Lassa fever, which is endemic in the area of the outbreak. Nor are laboratory diagnostics routinely available in West Africa for most viral hemorrhagic fevers.”

As noted above, the epicenter and site of first introduction of the virus in the current outbreak in West Africa is the region of Guéckédou in Guinea's remote southeastern forest region. This is


consistent with the evidence that previous outbreaks of Ebola began in (rain) forest regions (e.g.,Kikwit in DRC (Congo) and Tai National Park in Cote d’Ivoire). In addition, given that blood samples of patients collected in 1982, 1995 and 2006 in Guinea, Liberia, and Sierra Leone respectively indicated antibodies to the Ebola virus, it is pointless to doubt the presence of the virus in West Africa on the grounds that there had not been previous outbreaks or cases in the region. SARS (Severe acute respiratory syndrome) was unknown until the world experienced the SARS epidemic in 2002/2003. The origin of SARS was traced to the Guangdong Province of China and in 2006, scientists from the Chinese Centre for Disease Control and Prevention of Hong Kong University and the Guangzhou Centre for Disease Control and Prevention established a genetic link between the SARS coronavirus in civets (bats) and humans. The virus was also found in raccoon dogs. According to an article in the Journal of Virology:24 “Dengue is one of the most important emerging diseases of humans, with no preventative vaccines or antiviral cures available at present. Although one-third of the world's population live at risk of infection, little is known about the pattern and dynamics of dengue virus (DENV) within outbreak situations … Two DENV serotypes (DENV-1 and DENV-3), and multiple component genotypes, spread concurrently and with similar epidemiological and evolutionary profiles during the initial outbreak phase of a major dengue epidemic that took place in Singapore during 2005.” Some people in Sierra Leone, Liberia, and Guinea have antibodies to the dengue virus. According to a recent article in Emerging Infectious Diseases:26 “Reported incidence of dengue has increased worldwide in recent decades, but little is known about its incidence in Africa. During 1960 – 2010, a total of 22 countries in Africa reported sporadic cases or outbreaks of dengue; 12 other countries in Africa reported dengue only in travelers. The presence of disease and high prevalence of antibody to dengue virus in limited serologic surveys suggest endemic dengue virus infection in all or many parts of Africa.
Dengue is likely under-recognized and underreported in Africa because of low awareness by health care providers, other prevalent febrile illnesses, and lack of diagnostic testing and systematic surveillance.”


_Randal J. Schoepp, Cynthia A. Rossi, Sheik H. Khan, Augustine Goba, and Joseph N. Fair (2014). Undiagnosed Acute Viral Febrile Illnesses, Sierra Leone. Emerging Infectious Diseases, Volume 20, Number 7—July 2014._


Like the Ebola virus, there may be many other viruses lurking in our backyard. To belabor the point, the authors of a recent article on the origin and evolution of the Avian Flu observed that: 27 “Outbreaks of highly pathogenic avian influenza caused by H5N1 viruses were reported almost simultaneously in eight neighboring Asian countries between December 2003 and January 2004, with a ninth reporting in August 2004, suggesting that the viruses had spread recently and rapidly. However, they had been detected widely in the region in domestic waterfowl and terrestrial poultry for several years before this, and the absence of widespread disease in the region before 2003, apart from localised outbreaks in the Hong Kong … is perplexing.

Possible explanations include limited virus excretion by domestic waterfowl infected with H5N1, the confusion of avian influenza with other serious endemic diseases, the unsanctioned use of vaccines, and the under-reporting of disease as a result of limited surveillance. There is some evidence that the excretion of the viruses by domestic ducks had increased by early 2004, and there is circumstantial evidence that they can be transmitted by wild birds.” The authors of another article noted that:28 “The first known cases of human infection with highly pathogenic avian influenza (HPAI) H5N1 viruses in Vietnam occurred in late 2003. However, HPAI H5N1 and low-pathogenic avian influenza (LPAI) H5N2 and H9N3 viruses were isolated from domestic waterfowl during live-bird market (LBM) surveillance in Vietnam in 2001 and 2003.

To understand the possible role of these early viruses in the genesis of H5N1 strains infecting people, we performed sequencing and molecular characterization

… Our findings suggest that the H5N1 and H5N2 viruses that circulated among geese and ducks in LBMs in Hanoi, Vietnam, during 2001 and 2003 were not the immediate ancestors of the clade-1 viruses
associated with fatal human infections in Vietnam. The clade-1 HPAI H5N1 viruses were independently introduced into Vietnam.”

There are epidemics whose origins are perplexing to scientists or that they cannot fully explain; these epidemics are not limited to Africa. As the above examples show, they have also occurred in Vietnam, China, Singapore, etc. We should be wary of conspiracy theories. My contention is not that the current Ebola outbreak cannot be linked to the labs in the region. I have only raised reasonable doubt and thereby given the USA the benefit of the doubt. Based on the totality of the evidence above), I assign an almost zero probability to a lab accident or a deliberate act being the cause of this outbreak. The evidence of those who claim that the USA may be responsible for the ongoing Ebola crisis is based on mere correlations (i.e., US medical research labs were in the region, and so they must have been the cause of the outbreak). One cannot definitively rule out this possibility. But we ought to be measured in making such an allegation. If the evidence is compelling, I shall revise my views.


Finally, African countries should invest more in research on tropical diseases and pathogens; pathogens in their backyard. Ebola research is primarily led by western scientists in western laboratories. According to Oyewale Tomori, president of the Nigerian Academy of Science and former WHO regional virologist for Africa, “… in 1995, when we had the Kikwit (Ebola) epidemic, at the end we sat down at a table and discussed what we should do. There was a laboratory in Kinshasa built by the French; it was almost completed, but then abandoned. We had raised almost $2 million at the time. And we said: "Why not take a bit of that money and complete this lab and maintain it? Then at least when we have issues like this we can do quick testing." But nothing happened. The carcass is still there. Each time I pass the place, I think: "What a waste."29

Appendix A
The WHO provides a list of major Ebola outbreaks, including their fatality rates. Here are the outbreaks in which at least 10 people died:
1976, Congo. 318 infected, 280 dead. 88% fatality rate.
1976, Sudan. 284 infected, 151 dead. 53% fatality rate.
1979, Sudan. 34 infected, 22 dead. 65% fatality rate.
1994, Gabon. 52 infected, 31 dead. 60% fatality rate.
1995, Congo. 315 infected, 254 dead. 81% fatality rate.
1995, Gabon. 31 infected, 21 dead. 68% fatality rate.
1996, Gabon. 60 infected, 45 dead. 76% fatality rate.
2000, Uganda. 425 infected, 224 dead. 53% fatality rate.
2001-2002, Gabon. 65 infected, 53 dead. 82% fatality rate.
2001-2002, Congo Republic. 59 infected, 44 dead. 75% fatality rate.
2003, Congo Republic. 143 infected, 128 dead. 90% fatality rate.
2003, Congo Republic. 35 infected, 29 dead. 83% fatality rate.
2005, Congo Republic. 12 infected, 10 dead. 83% fatality rate.
2007, Congo. 264 infected, 187 dead. 71% fatality rate.
2007, Uganda. 149 infected, 37 dead. 25% fatality rate.
2008, Congo. 32 infected, 14 dead. 44% fatality rate.