RAPID RISK ASSESSMENT

Outbreak of Ebola virus disease in West Africa

Third update, 1 August 2014

Main conclusions and options for prevention and control

An outbreak of Ebola virus disease (EVD), which started in December 2013, continues to evolve in Guinea, Liberia and Sierra Leone. The first cases were reported from Guéckédou prefecture, a forested region of south-eastern Guinea near the border with Liberia and Sierra Leone. After a slowdown in April, the outbreak has accelerated during the last two months. This is the largest EVD outbreak ever reported, both in terms of number of cases and geographical spread. It is also the first time EVD has spread to large cities.

As of 27 July 2014, the cumulative number of cases reported to have been infected in the three countries was 1 323, including 729 deaths (combined case-fatality rate = 55%). This includes one case exported from Liberia to Nigeria. The distribution and classification of the cases are as follows, based on best available information reported by ministries of health through the World Health Organization, Regional Office for Africa:

- Guinea: 460 cases (336 confirmed, 109 probable, and 15 suspected), including 339 deaths; case-fatality rate = 74%
- Liberia: 329 cases (100 confirmed, 128 probable, and 101 suspected), including 156 deaths; case-fatality rate = 47%
- Sierra Leone: 533 cases (473 confirmed, 38 probable, and 22 suspected), including 233 deaths; case-fatality rate = 44%
- Nigeria: one probable fatal case that was imported from Liberia and diagnosed with non-confirmatory methods in Lagos

Transmission of EVD requires direct contact with blood, secretions, organs or other bodily fluids of dead or living infected persons or animals or with material or utensils heavily contaminated with such fluids. This includes unprotected sexual contacts with patients who have recently recovered from the disease. The upsurge in the number of new EVD cases over the last weeks, the existence of urban transmission cycles, and the fact that not all chains of transmission are known, increase the likelihood for residents and travellers of being exposed to infected or ill persons. However, the risk of infection for residents and visitors to the affected countries through exposure in the community is still considered very low if they adhere to the recommended precautions.

Residents and visitors to the affected areas run a risk of exposure to EVD in healthcare facilities; the level of this risk is related to how well the infection control measures are being implemented in these settings and the nature of the care required. Recent reports of transmission to healthcare workers in different healthcare settings indicate that not all healthcare facilities in the region have managed to successfully implement infection control measures.

People infected with EVD may arrive in the EU by direct or indirect flights from affected countries or on board freighter or passenger ships. EVD cases may travel while incubating the disease and therefore not present with symptoms at the time of arrival, or arrive sick because they developed symptoms, or their condition deteriorated

Suggested citation: European Centre for Disease Prevention and Control. Outbreak of Ebola virus disease in West Africa. Third update, 1 August 2014. Stockholm: ECDC; 2014.

while travelling. Ebola virus disease can develop quickly, and cases are not always aware that they have been exposed to Ebola virus.

If an infectious case of EVD occurs in an EU Member State, secondary transmission cannot be ruled out, e.g. in healthcare settings or among direct close contacts (family members, relatives), in particular before an Ebola virus infection is suspected and infection control measures implemented.

The risk of importation to the EU is considered very low, in particular if returning travellers and healthcare providers are properly informed and are aware of the risk.

Visitors and residents in affected areas face a very low risk of infection in the community if precautions are strictly followed:

- Avoiding contact with symptomatic patients and/or their bodily fluids
- Avoiding contact with corpses and/or bodily fluids from deceased patients
- Avoiding contact with wild animals (including monkeys, forest antelopes, rodents and bats), both alive and dead, and consumption of 'bush meat'
- Washing hands regularly, using soap or antiseptics

There is an increased risk of infection in healthcare facilities. Options for prevention and control of this risk include:

- Avoiding unessential travel to affected countries
- Identify appropriate in-country healthcare resources in advance of travelling, through local business contacts, friends or relatives
- Ensure that in the event of any illness or accident, medical evacuation is covered by travel insurance, to limit exposure in local health facilities

In order to prevent exportation of cases to other countries, local authorities may consider to:

- prevent known EVD cases from leaving an affected country; this should also include their contacts for a period of 21 days (maximum duration of the incubation period). This measure can only be implemented in the country of departure and implies communicating contact details of these people to immigration authorities or airline companies; and
- prevent infectious febrile EVD cases from leaving an affected area by the screening all passengers at the time of departure.

Prevention of spread within the EU may involve:

- informing travellers from affected areas about:
  - the clinical presentation of the disease
  - the need to indicate their travel history when seeking medical care
  - the need to indicate possible contact with sick individuals or wild animals
  - the procedures for contacting public health authorities for support if infection is suspected; and
- informing and sensitising healthcare providers about:
  - the possibility of EVD among returning travellers from affected areas
  - the clinical presentation of the disease
  - the availability of protocols for the ascertainment of possible cases and procedures for referral to healthcare facilities
  - the need for strict implementation of barrier management, use of personal protective equipment and disinfection procedures, in accordance with specific guidelines and WHO infection control recommendations [39,40] when providing care to suspected EVD cases.

Source and date of request

ECDC internal decision on the update of this risk assessment: 28 July 2014.

Public health issue

To re-assess the risk of introduction and onward transmission of Ebola virus in the EU associated with the evolving outbreak of Ebola virus disease in West Africa.

Consulted experts

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Disease background information

Infections with Ebola viruses originating from Africa cause a severe disease in humans called Ebola virus disease (EVD). Since the first documented EVD outbreak in the Democratic Republic of Congo (formerly Zaïre) in 1976, five species of the genus *Ebolavirus* (Filoviridae family) have been identified: *Zaïre ebolavirus*, *Sudan ebolavirus*, *Reston ebolavirus*, *Taï Forest* ebolavirus and *Bundibugyo ebolavirus* [1-3]. Ebola virus is a biosafety level-4 pathogen (BSL-4; risk group 4) and requires special containment measures and barrier protection, particularly for healthcare workers.

The incubation period is usually four to ten days but can vary from two to 21 days. The case-fatality ratio for *Zaïre ebolavirus* infections is estimated to be between 50% and 90% [4].

Ebola viruses are highly transmissible by direct contact with infected blood, secretions, tissues, organs or other bodily fluids of dead or living infected persons. Transmission through fomites that have been contaminated with bodily fluids is possible [5]. Airborne transmission has not been documented, and person-to-person transmission is considered the principal mode of transmission for human outbreaks regardless of how the index case was infected. Burial ceremonies and handling of dead bodies are known to play an important role in transmission [3]. Sexual transmission up to seven weeks after recovery has been observed for another filovirus, Marburgvirus, and the same is assumed to be possible for Ebola viruses [6]. The risk for transmission is low in the early phase of symptomatic patients (prodromal phase) [4]. The risk of getting infected with Ebola virus according to type of contact with a human case is summarised in Table 1 [4].

Ebola viruses can survive in liquid or dried material for a number of days [7]. However, Ebola virus can be inactivated by UV radiation, gamma irradiation, heating for 60 minutes at 60 °C or boiling for five minutes. The virus is susceptible to sodium hypochlorite and disinfectants [8]. Freezing or refrigeration will not inactivate Ebola virus [9-11].

Table 1. Levels of risk of transmission of Ebola virus according to type of contact with an infected patient

Type of contact	Type of contact
Very low or no recognised risk	Casual contact with a feverish, ambulant, self-caring patient. Examples: sharing a sitting area or public transportation; receptionist tasks.
Low risk	Close face-to-face contact with a feverish and ambulant patient. Example: physical examination, measuring temperature and blood pressure.
High risk	Close face-to-face contact without appropriate personal protective equipment (including eye protection) with a patient who is coughing or vomiting, has nosebleeds, or who has diarrhoea. Percutaneous, needle stick or mucosal exposure to virus-contaminated blood, body fluids, tissues or laboratory specimens in severely ill or known positive patients

Adapted from [4]

The current EVD outbreak was first assessed in an ECDC rapid risk assessment entitled 'Outbreak of Ebola haemorrhagic fever in Guinea', dated 23 March 2014 [12]. Detailed information about the Ebola virus and the epidemiology of EVD can be found in a first update, entitled 'Outbreak of Ebola virus disease in West Africa', published on 8 April 2014 [13]. A second update was published on 9 June 2014 [14].

Event background information

Epidemiological situation in Guinea, Sierra Leone and Liberia

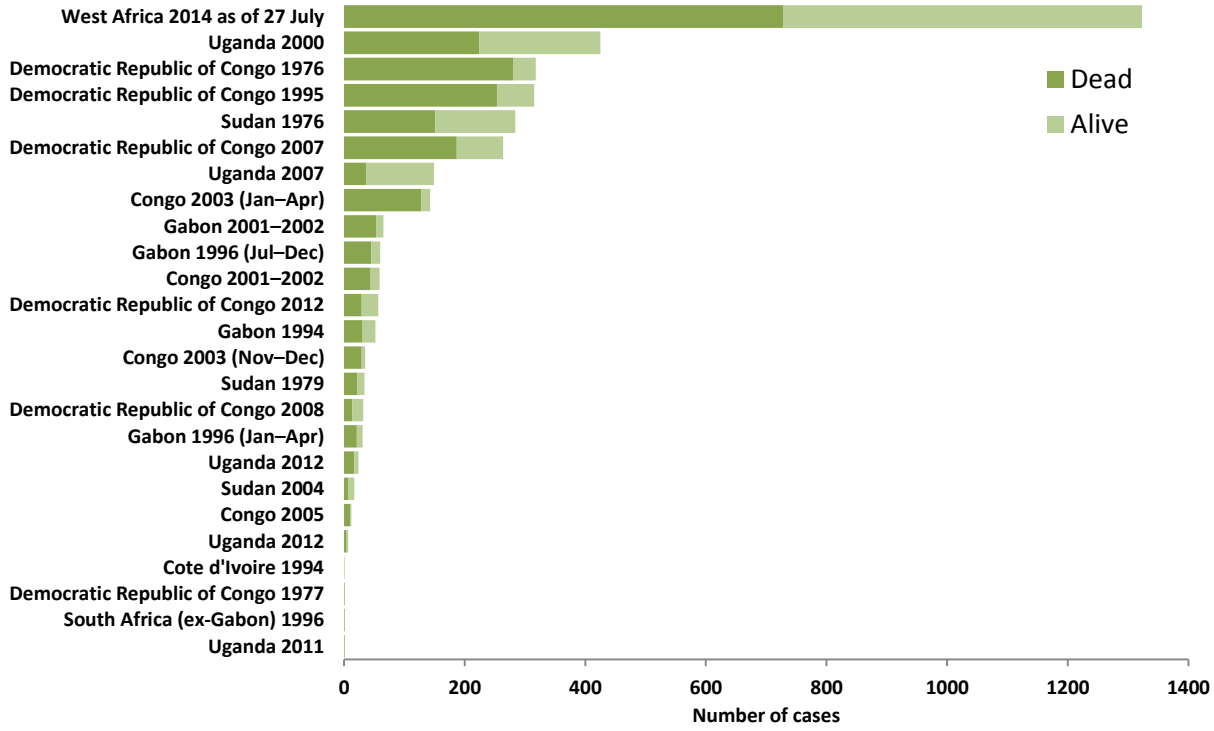
On 22 March 2014, the Guinea Ministry of Health notified WHO about a rapidly evolving outbreak of EVD [15]. Retrospective epidemiological investigations indicate that the first case of EVD probably occurred as early as December 2013 when a two-year-old girl from Guéckédou prefecture in the forested region of south-eastern Guinea died from symptoms compatible with EVD.

Specimens from patients tested in March at Institut Pasteur in Lyon, France, were positive for *Zaïre ebolavirus*. The Ebola clade (variant) of this outbreak is closely related but nevertheless distinct from the viruses that have been isolated from outbreaks in central Africa (Gabon and Democratic Republic of Congo) and clearly distinct from the *Taï Forest ebolavirus* that was isolated in Côte d'Ivoire [3,16,17].

At the beginning of the outbreak, cases were reported in three south-eastern districts (Guéckédou, Macenta, and Kissidougou) of Guinea and in the capital city of Conakry. By 30 March, cases had been reported in Foya district in neighbouring Liberia, and in May, the first cases identified in Sierra Leone were reported to WHO [18,19]

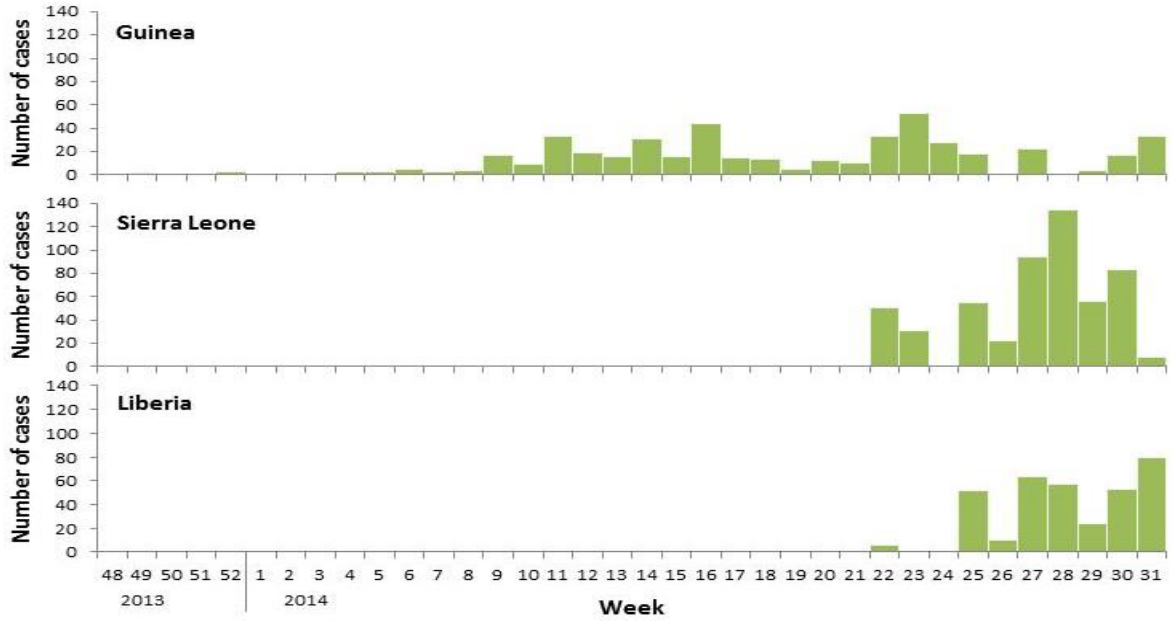
This is the first outbreak of EVD in West Africa (except for a single case caused by Taï Forest virus reported in Côte d'Ivoire in 1994) and the largest EVD outbreak ever documented (Figure 1). The largest previous outbreak occurred in Uganda during 2000–2001, when 425 cases were reported with 224 deaths (case-fatality rate = 53%). The current outbreak marks the first time that Ebola virus transmission has been reported in capital cities (Conakry, Monrovia and Freetown).

Figure 1. Overview of EVD outbreaks, 1976–2014



Sources: Adapted from WHO and CDC [3,20]

Figure 2. Distribution of reported confirmed, suspected and probable cases of EVD by week, in Guinea, Sierra Leone and Liberia, week 48/2013 to week 31/2014 (as of 27 July 2014)



Sources: Adapted from WHO Regional Office for Africa and Baize, et al. [16,21]. Partial data for week 31.

After a slowdown in April, new cases and deaths attributed to EVD have continued to be reported. Since the end of May, the outbreak has resurged and continues to increase at an alarming pace, primarily in Sierra Leone and Liberia (Figure 2).

Cases are categorised as follows [22]:

- Suspected (alive or dead person with fever and at least three additional symptoms, or fever and a history of contact with a person with haemorrhagic fever or a dead or sick animal, or unexplained bleeding)
- Probable (meets the suspected case definition and has an epidemiologic link to a probable or confirmed case)
- Confirmed (suspected or probable case that has laboratory confirmation)

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The number of EVD cases could change in the coming weeks due to retrospective epidemiological investigation, laboratory confirmation, and data consolidation by local health authorities. The difference in case-fatality rates between countries may reflect differences in specificity of the diagnostic test used and the collection and reporting of data, and does not necessarily reflect an actual differences in case-fatality rates.

Figure 3. Five week moving average of reported confirmed, suspected and probable cases of EVD in Guinea, Sierra Leone and Liberia, week 48/2013 to week 30/2014

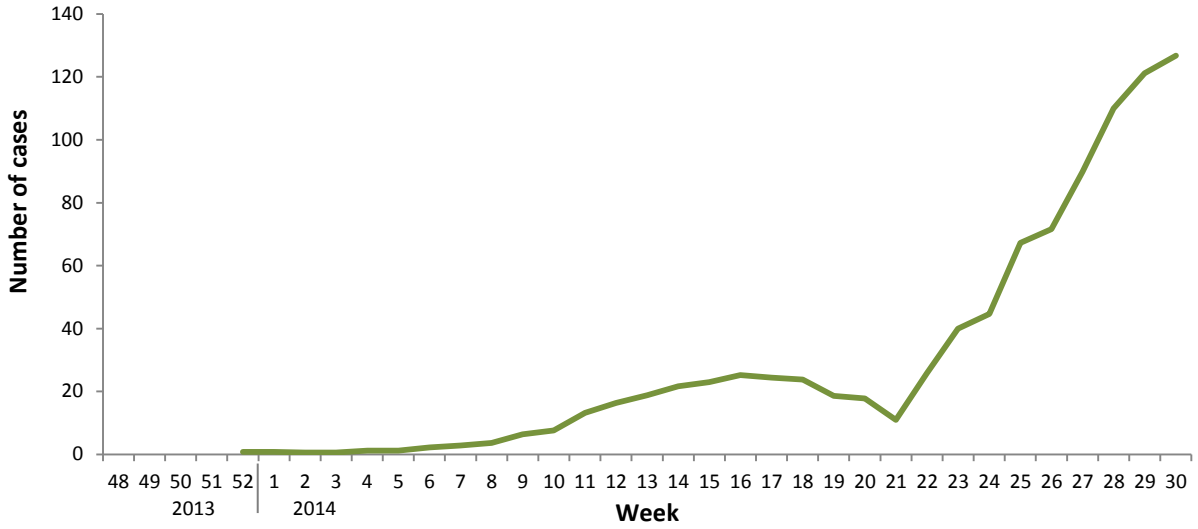


Figure 3 shows the trend in the occurrence of new cases in the affected countries. It shows a bimodal curve with an increase of cases up until week 16 of 2014, with 25 cases reported as an average over the previous five weeks. The moving average decreases to 11 cases in week 21 and then increases to 127 in week 30 of 2014, a five-fold increase over the earlier peak.

Imported case in Nigeria

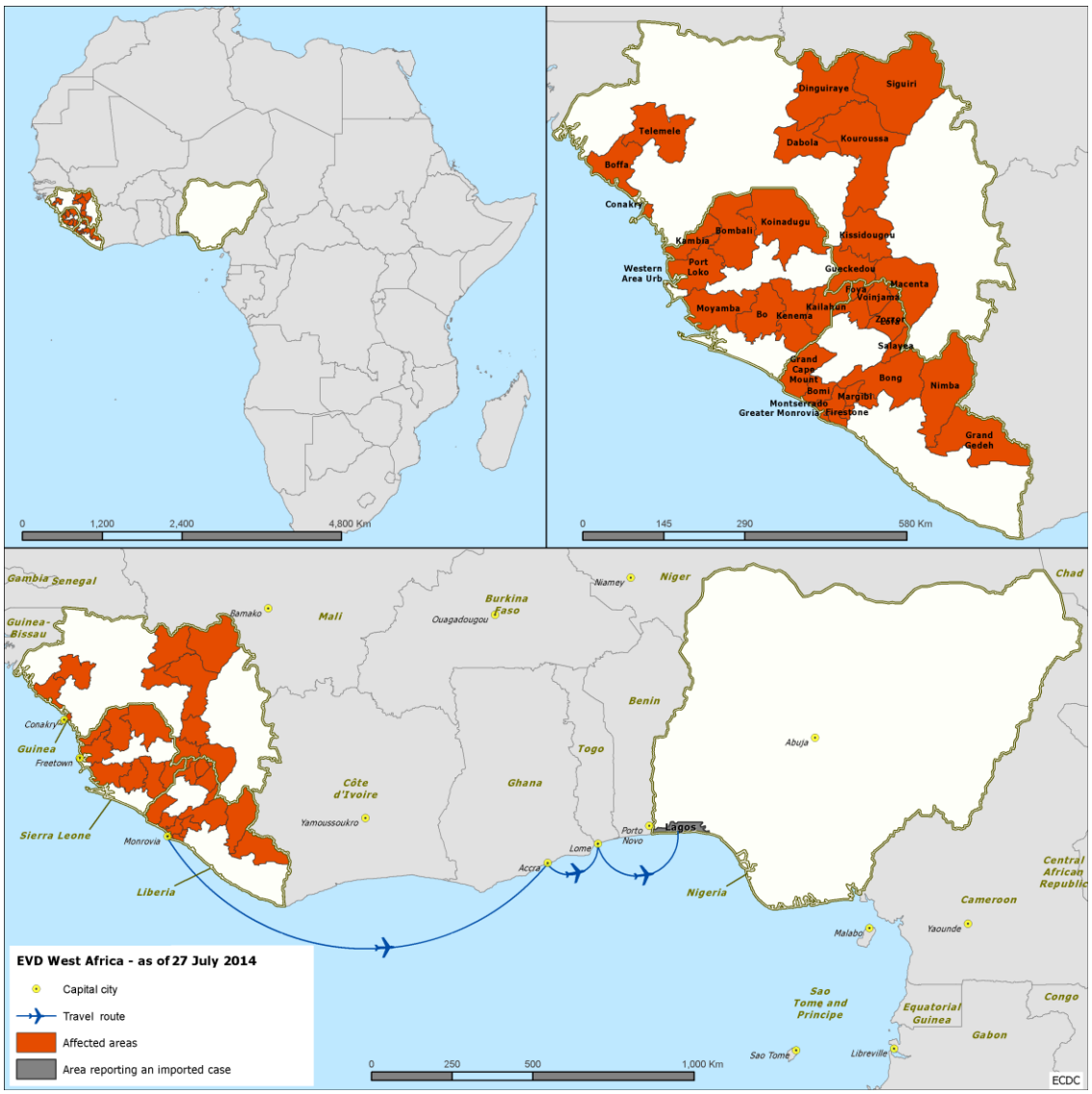
On 25 July, the Ministry of Health of Nigeria reported an imported probable case of EVD [21]. The case, a 40-year-old American national of Liberian origin who had a history of contact with a previously reported EVD case in Liberia, made a planned business trip by air on 20 July. He travelled from Monrovia, Liberia, to Lagos, Nigeria, which included a flight via Lomé, Togo, and Accra, Ghana. He was reported to be symptomatic before the flights, and his condition deteriorated during the trip. On arrival in Lagos, he was seriously ill and had to be assisted off the aircraft. He was immediately taken to a private hospital. He was initially believed to suffer from severe malaria but later transferred to another hospital for isolation because EVD was suspected. A preliminary laboratory test performed in the virology laboratory of Lagos University Teaching Hospital was positive for Ebola virus. The sample from this case is yet to be sent to the WHO Collaborating Centre at the Institut Pasteur in Dakar, Senegal. The patient died on 25 July. Fifty-nine contacts (15 airport staff, 44 hospital staff) have so far been identified. The national authorities in Nigeria, Togo and Ghana continue to work closely with WHO and other partners in the identification of contacts and contact tracing.

Recent cases among healthcare workers

Since the beginning of the outbreak, several cases have been reported among healthcare workers in Liberia and Sierra Leone. In Liberia, at least 18 healthcare workers have died from EVD, including three local physicians and an expatriate doctor from Uganda. In Sierra Leone, the chief physician treating Ebola patients was recently diagnosed with EVD and died on 29 July 2014. Three nurses, who worked in the same treatment centre as the physician, have also died from EVD.

In Liberia, two expatriate Americans, a physician and a hygienist, have contracted EVD and are currently undergoing intensive treatment at ELWA Hospital in Monrovia. The physician, who is employed by the American aid organisation Samaritan's Purse, worked in a treatment centre where a local nurse was recently infected. The hygienist, who works for Serving in Mission (SIM), a partner organisation of Samaritan's Purse, decontaminated those entering and leaving the isolation ward of the Case Management Centre at ELWA hospital [48].

Figure 4. Areas affected by Ebola virus disease, as of 27 July 2014



Source: Adapted from WHO Regional Office for Africa and Samaritan's Purse

Outbreak response

Outbreak control aims at the interruption of direct human-to-human transmission through the early identification and systematic isolation of cases, timely contact tracing, proper personal protection, safely conducted burials, improved community awareness about risk factors of EBOV infection, and individual protective measures [3,17]. Isolation of infected patients and monitoring of their contacts has been shown to effectively stop the spread of the disease in previous outbreaks.

The ministries of health in the three affected countries have initiated control measures. Activities, supported by WHO, UNICEF and Médecins Sans Frontières (MSF) and numerous other partners, include the establishment of EVD treatment centres, contact tracing, enhanced surveillance, strengthening of infection control practices, free-of-charge access to healthcare for suspected cases, and social mobilisation. A team of scientists from the EU-funded European Mobile Laboratory project has established a field laboratory in Guéckédou (Guinea) to test suspected cases.

In addition, MSF is training community health workers to deliver essential health messages to people in their villages about how to protect themselves against Ebola and what action to take if someone develops signs or symptoms of the disease. Information and educational materials have been developed and distributed; intensive multimedia communications are underway; and psychosocial support is being provided to patients, their families and the affected communities. There is ongoing training for carers in safe practices, and safe burial practices are promoted at community level.

On 16 July 2014, WHO established a sub-regional outbreak coordination centre in Conakry, Guinea, to better meet the needs to control the outbreak, as a follow-up action to the Emergency Ministerial meeting that was held by WHO in Accra, Ghana, on 2 and 3 July. The centre aims at consolidating and harmonising the technical support to West African countries and will assist in resource mobilisation.

ECDC threat assessment

The origin of this outbreak remains unknown. Exposure to bush meat has been suspected for the primary cases, as well as transmission through close contact with blood, secretions, organs or other biological fluids from infected animals. The subtropical regions of West Africa, including the initial outbreak foci, are habitats for a species of fruit bats known to be a potential reservoir of Ebola virus.

As in previous EVD outbreaks elsewhere in Africa, transmission is primarily driven by human-to-human transmission. The wide geographical spread is believed to result mainly from the movement of infected people who travel during the long incubation period. Ebola virus is transmitted primarily through contact with the contaminated body fluids of sick and deceased patients. High-risk activities include taking care of symptomatic patients, particularly when they are most ill; handling of the bodies of deceased patients; and handling contaminated clothes, materials and equipment. Traditional burial ceremonies that include washing and handling the dead body pose a particular risk, and such practices have been banned during previous outbreaks.

The currently available epidemiological information is insufficient to fully assess the extent and the dynamics of the epidemic. The detection of cases and the monitoring of contacts seem incomprehensive in some affected areas, and there are probably additional cases in areas which have not yet been reported as affected. The case-fatality ratio reported in the affected countries varies, suggesting problems with disease surveillance, data management (e.g. status updates for cases), and the performance of the tests used for laboratory confirmation.

The current epidemic trend of the EVD outbreak in Sierra Leone and Liberia is considered serious because of the increasing numbers of new reported cases and deaths. The increase in the number of new EVD cases in Guinea in week 30 – after several weeks of lower viral activity – indicates that transmission is still occurring in the community in Guinea. This is likely to result from a combination of undetected chains of transmission and importation of cases infected in Liberia and Sierra Leone. This is the first outbreak with transmission in densely populated urban areas, including the capitals of Freetown, Conakry and Monrovia. Contact tracing is likely to be particularly difficult in these environments.

Major challenges in the efforts to control the outbreak include its wide geographic spread (Figure 4); weak healthcare infrastructures; community mistrust and resistance, which affects timely case detection and the monitoring of contacts [25]. In addition, local funeral rites, the stigmatisation of patients, and denial of the disease are thought to play an important role in the propagation of the outbreak.

It is likely that in the coming months additional cases will continue to be reported in the three affected countries. Additional infected cases will likely travel to countries in the region and beyond, as was observed in Nigeria. There is a risk that the epidemic will spread to countries bordering affected areas. The actual rate of spread in the region will depend on the effectiveness of the control measures.

Healthcare workers have become infected while treating EVD patients [26,27]. Transmission has occurred after close contact with EVD patients; this includes settings where infection control precautions were in place but not strictly adhered to [28]. Healthcare workers are exposed not only through direct contact with cases but also through contaminated hospital materials and medical waste. However, the risk of healthcare-associated Ebola virus infections can be controlled by consistent and appropriate use of infection control precautions and strict barrier nursing procedures [29].

Isolation of patients, barrier nursing and other Ebola virus control measures are burdensome, particularly in a hot climate, and it can be difficult to ensure compliance over time. Recent transmission to healthcare workers was observed in Liberia and Sierra Leone, two countries which lately experienced a large increase in case numbers. There is no evidence that a change in infectivity of the virus was responsible for the observed transmission to healthcare workers. There is also no evidence that the recommended infection control measures are insufficient to ensure an appropriate level of protection when applied appropriately.

The five-fold increase in the number of patients to be cared for over the past two months (Figure 3) also means that more healthcare workers are exposed to ebolavirus in the event of a breach of infection control measures.

Risk for the EU

Risk of exposure to EU residents and travellers in affected countries

Risk of exposure in the community

Transmission of EVD requires direct contact with blood, secretions, organs or other bodily fluids of dead or living infected persons or animals or with material or utensils heavily contaminated with such fluids. This includes unprotected sexual contacts with patients who have recently recovered from the disease. The upsurge in the number of new EVD cases over the last weeks, the existence of urban transmission cycles, and the fact that not all chains of transmission are known, increase the likelihood for residents and travellers of being exposed to infected or ill persons. However, the risk of infection for residents and visitors to the affected countries through exposure in the community is still considered very low if they adhere to the recommended precautions (see below). Infection cannot be ruled out if people with mucosa or skin abrasions come in contact with contaminated material, directly or indirectly through contaminated hands.

People visiting friends and relatives in the affected countries tend to have more and closer contacts in the community and they are more likely than other visitors to participate in burial ceremonies an activity known to be associated with transmission of the Ebola virus.

Risk of exposure in healthcare settings

Residents and visitors to the affected areas run a risk of exposure to EVD in healthcare facilities; the level of this risk is related to how well the infection control measures are being implemented in these settings and the nature of the care required.

Recent reports of transmission to healthcare workers in different healthcare settings indicate that not all healthcare facilities in the region have managed to successfully implement infection control measures. The infection risk is not limited to hospitals that provide care to known EVD cases because infectious cases may initially seek medical attention at any healthcare provider. Furthermore, the risk of exposure in healthcare settings also exists in areas that have not yet reported cases because it is suspected that not all cases of EVD are being detected and reported.

The risk for EU residents and visitors needing medical attention is also related to the type of medical procedures needed. While the risk is very low for a consultation requiring non-invasive tests and prescription of oral drugs, it may be increased in case of invasive procedures for testing or treatment.

The risk of being exposed to the Ebola virus is higher for healthcare workers, e.g. volunteers from NGOs which provide assistance in settings where no infection control measures have been implemented. The risk is particularly high for healthcare workers who carry out invasive medical procedures or provide care to EVD patients.

Risk of importation to the EU

People infected with EVD may arrive in the EU by direct or indirect flights from affected countries or on board freighter or passenger ships. EVD cases may travel while incubating the disease and therefore not present with symptoms at the time of arrival, or arrive sick because they developed symptoms, or their condition deteriorated while travelling. Ebola virus disease can develop quickly, and cases are not always aware that they have been exposed to Ebola virus. Incubating cases do not show symptoms and cannot be detected through screening at points of entry. They may be unaware of exposure, and when presenting to an EU healthcare facility, clinicians may not suspect EVD. Making returning travellers and physicians aware of the possibility of EVD infection and the need for appropriate infection control measures is essential in this context.

Patients presenting with symptoms and seeking medical attention in the EU

There is a possibility that persons who were exposed to Ebola virus and developed symptoms board a commercial flight to seek medical attention in the EU. It is highly likely that such patients would report to a healthcare facility upon arrival in the EU and then be isolated to prevent further transmission.

Travel and transport risk assessment

A traveller on board an airplane may be already ill or become ill during the flight, showing symptoms compatible with EVD. In this situation, the possibility of transmission to co-passengers and crew should be assessed using the ECDC RAGIDA guidelines [10].

If an investigation concludes that the passenger has symptoms compatible with EVD and was exposed to EVD in the past 21 days, all passengers and crew who report direct contact, as well as all passengers seated one seat away from the sick person, should be monitored for 21 days. In addition, all passengers, crew members and cleaning staff who had direct contact with the suspected case's bodily fluids or potentially contaminated fomites such as contaminated clothing, towels, or utensils should be investigated and monitored.

If a person who was exposed to Ebola virus develops symptoms while on board of a freighter/passenger ship sailing to the EU, this should be declared in a Maritime Declaration of Health form and in accordance with article 37 of the 2005 International Health Regulations [30]. Affected crew members or passengers should be taken care of appropriately in order to prevent any further spread of the disease.

Annex 1 presents additional information regarding specific scenarios.

Risk related to biosafety

There is a theoretical risk that a biological sample is sent to an EU laboratory for further testing, without proper indication of a possible connection to Ebola virus. Strict compliance with sample shipment regulations and universal precautions in the receiving laboratory should mitigate this risk [31].

Risk of transmission through substances of human origin

According to the EU Blood Directive [32], current geographic deferrals for malaria also exclude residents and travellers from EVD-affected countries from donating blood.

Risk of spread within the EU

If an infectious case of EVD occurs in an EU Member State, secondary transmission cannot be ruled out, e.g. in healthcare settings or among direct close contacts (family members, relatives), in particular before an Ebola virus infection is suspected and infection control measures implemented.

The risk of importation to the EU is considered very low, in particular if returning travellers and healthcare providers are properly informed and are aware of the risk.

Options for prevention and control

Prevention of infection for visitors and residents

Visitors and residents in affected areas face a very low risk of infection in the community if precautions are strictly followed:

- Avoiding contact with symptomatic patients and/or their bodily fluids
- Avoiding contact with corpses and/or bodily fluids from deceased patients
- Avoiding contact with wild animals (including monkeys, forest antelopes, rodents and bats), both alive and dead, and consumption of 'bush meat'
- Washing hands regularly, using soap or antiseptics

Generic precautions for travelling in West African countries also apply to the prevention of EVD infection:

- Washing and peeling fruit and vegetables before consumption
- Practising 'safe sex'
- Avoiding habitats which might be populated by bats, such as caves, isolated shelters, or mining sites

There is an increased risk of infection in healthcare facilities. Options for prevention and control of this risk include:

- Avoiding unessential travel to affected countries
- Identify appropriate in-country healthcare resources in advance of travelling, through local business contacts, friends or relatives
- Ensure that, in the event of any illness or accident, medical evacuation is covered by travel insurance, to limit exposure in local health facilities

Prevention of importation of cases

WHO does not recommend any travel or trade restrictions be applied to countries involved in this outbreak. WHO, CDC and PHE published an overview of recommendations for travellers [33-37].

In order to prevent exportation of cases to other countries, local authorities may consider to:

- prevent known EVD cases from leaving an affected country; this should also include their contacts for a period of 21 days (maximum duration of the incubation period). This measure can only be implemented in the country of departure and implies communicating contact details of these people to immigration authorities or airline companies; and
- prevent infectious febrile EVD cases from leaving an affected area by the screening all passengers at the time of departure.

WHO does not recommend screening of passengers, neither at departure nor at arrival. WHO considers screening using thermal scanners as costly and unlikely to detect all infected cases.

Screening of passengers with thermal scanners aims at allowing the detection of febrile travellers. The likelihood of a febrile passenger to be an infectious case of EVD would however be very low given the relative low attack rate of EVD in the general population of the affected countries. It would not detect incubating afebrile passengers but could prevent the boarding of a febrile case of EVD.

Screening would be more effective and less costly at the point of departure (exit screening). A screening programme should anticipate the practical issues around the management of the detected febrile passengers.

Preventing the spread within the EU

Prevention of spread within the EU may involve:

- informing travellers from affected areas about:
  - the clinical presentation of the disease
  - the need to indicate their travel history when seeking medical care
  - the need to indicate possible contact with sick individuals or wild animals
  - the procedures for contacting public health authorities for support if infection is suspected; and
- informing and sensitising healthcare providers about:
  - the possibility of EVD among returning travellers from affected areas
  - the clinical presentation of the disease
  - the availability of protocols for the ascertainment of possible cases and procedures for referral to healthcare facilities
  - the need for strict implementation of barrier management, use of personal protective equipment and disinfection procedures, in accordance with specific guidelines and WHO infection control recommendations [38,39] when providing care to suspected EVD cases.

Annex 1. Possible scenarios for the EU/EEA

These scenarios were initially developed for the second rapid risk assessment on EVD ('Outbreak of Ebola virus disease in West Africa' [13], 8 April 2014). The four scenarios below were updated for this publication.

Scenario 1: Suspicion of exposure to Ebola virus

An EU citizen travelling to, or residing in, an affected country who suspects that they have been exposed to Ebola virus should be evaluated and assigned a 'level of risk of transmission', using the criteria described in Table 1.

If the risk of transmission is considered low or moderate, the person should be reassured and asked to monitor his/her temperature for 21 days.

If the risk of transmission is deemed high, e.g. a healthcare worker that has experienced a needle stick injury, active monitoring of health status should be implemented immediately; medical evacuation should be considered at an early stage and carried out by specialised air providers under high containment provisions.

Scenario 2: Person presenting with symptoms compatible with EVD

Symptoms compatible with EVD include flu-like symptoms with fever, muscle aches, myalgia, weakness, headache and sore throat at the prodromal phase, which may develop into various clinical manifestations with gastrointestinal symptoms (vomiting, diarrhoea, anorexia and/or abdominal pain), neurological symptoms (headaches, confusion, prostration), vascular symptoms (conjunctival/pharyngeal injections), cutaneous symptoms (rash) and respiratory symptoms (cough, chest pain, shortness of breath).

An EU resident residing or visiting an affected area who develops such symptoms should be assessed for possible exposure:

- If the person has not been exposed or the risk of exposure was low, other diseases such as malaria should be investigated.
- If the risk of exposure was moderate or high (Table 1), medical evacuation should be considered at an early stage. Evacuation should be carried out by specialised air providers under high containment provisions. At an advanced stage of the disease, patients cannot be effectively monitored or treated because of the completely closed environment of the air transport isolator. Airlifting symptomatic EVD patients is a complex logistical effort and increases the risk for all people involved and should be preceded by an analysis of the pros and cons. Independent investigations for other possible causes of disease should be initiated immediately.

Scenario 3: Passenger with symptoms compatible with EVD on board an airplane

Cabin crew members who identify a sick passenger on board and suspect an infectious disease, and members of the ground staff who receive the passenger at the destination, should strictly follow the IATA guidelines for suspected communicable diseases [40]. These guidelines provide information on how to handle a sick passenger during the flight, how to reduce the risk of transmission on board the aircraft, how to communicate the event to the destination airport, and how to record contact details on passenger locator cards for the passengers in the two rows around the case. Extending the use of passenger locator cards beyond the two rows around the suspected case is possible if the crew, in consultation with the airline ground staff, deems it necessary. Recording passenger details on passenger locator cards does not automatically imply that passengers will be traced, but provides health authorities with contact details that may be helpful at a later point in time.

Public health authorities and emergency medical services at the airport of destination should be informed in advance of arrival. On arrival, the sick passenger should be put in a separate room awaiting medical assessment. The assessment of possible exposure to Ebola virus and of the compatibility of the symptoms with EVD is outside the scope of the airline crew's actions and should be performed by medically trained ground staff.

The population incidence of EVD is low, even during an outbreak, and it is considered highly unlikely that a passenger infected with Ebola virus boards an airplane. In addition, the prodromal presentation of the disease is not characteristic enough to distinguish an Ebola virus infection from many other viral diseases. The public health response to a sick passenger on an aircraft should be based on a thorough assessment of the patient's possible exposure to Ebola virus rather than on the clinical presentation. The evaluation of the exposure should check if, within the past three weeks, the passenger has:

- visited a country where EVD has been confirmed (for the current outbreak: Guinea, Sierra Leone and Liberia); AND
- been in contact with a sick or dead wild animal (particularly bats) while there; OR
- cared for and touched a severely ill or dead person.

A 'yes' to question 1 and to either question 2 or 3 would signify that the ill passenger has been potentially exposed to Ebola virus in an affected country in the past three weeks. If the investigation does not conclude a significant risk of exposure to Ebola virus (no specific exposure for the sick traveller, no symptoms during the flight), contact tracing is not indicated. If the passenger is at risk of having been exposed to Ebola virus, the following epidemiological measures based upon proximity to the index patient should be considered (see ECDC RAGIDA guidelines):

- **Passengers and crew with reported direct contact**
  Co-travellers and crew members who had reported direct body contact with the index case should be traced-back. To gather this information, any records of significant events on the flight should be obtained from the airline.
- **Passengers seated one seat away from the index patient**
  As direct contact is the main route of transmission for Ebola virus, only passengers who were seated one seat away from the index case in all directions should be included in the trace-back. If the index case occupied an aisle seat, the three passengers seated directly across the aisle from the index case should also be traced-back.
- **Crew members of plane section**
  Crew members who provided in-flight service in the section of the aircraft where the index case was seated should be included in the trace-back, as well as other crew members who had direct contact with the patient.
- **Cleaning staff of plane section**
  The staff that cleaned the section seat where the index case was seated and the toilet facilities (if used by the index case) should be traced-back.

Traced-back passengers, crew members and cleaning staff who have been identified should be assessed for their specific level of exposure. The risk for transmission is considered low if no direct contact with the passenger or with material potentially contaminated by the passenger's bodily fluids has occurred. Self-monitoring of temperature should be considered for 21 days for all contacts. The same measures should be considered if a patient reports symptoms during a flight but fails to alert the crew.

There is no reason to quarantine the airplane upon arrival when a passenger presents with symptoms during the flight.

Further reading

ECDC guidance. Risk assessment guidelines for diseases transmitted on aircraft (Part 2): http://ecdc.europa.eu/en/publications/publications/1012_gui_ragida_2.pdf [10]

IATA guidelines: http://www.iata.org/whatwedo/safety/health/Documents/health-guidelines-cabin-crew-2011.pdf [40]

Interim guidance about Ebola virus infection for airline flight crews, cargo and cleaning personnel, and personnel interacting with arriving passengers: http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/ebola/Ebola_airline.pdf [41]

Interim guidance about Ebola virus infection for airline flight crews, cleaning personnel, and cargo personnel. http://www.cdc.gov/quarantine/air/managing-sick-travelers/interim-guidance-ebola-virus-infection-airline-flight-crews-cleaning-cargo-personnel.html [42]

Scenario 4: Patients and healthcare workers having been exposed to an unrecognised Ebola patient

Unrecognised EVD has a high potential for spreading within a healthcare setting. This is caused by close person-to-person contacts and possible exposure to bodily fluids that occurs during nursing, diagnostic and treatment procedures, including the handling of biological samples. The risk to other patients and/or healthcare workers may rise to 'moderate' or 'high', depending on the condition of an undiagnosed patient. It is essential to diagnose or refute EVD in a symptomatic patient as quickly as possible in order to contain outbreaks in a healthcare setting.

Once a case of EVD is suspected, the procedures in the healthcare facility are carried out as if EVD was already confirmed:

- Contact tracing among staff and patients who have been in contact with the suspected patient
- Medical monitoring of identified contacts (fever and prodromal symptoms)
- Immediate notification of the relevant public health authorities

- Improvised barrier management in all areas where the suspected patient has been treated (contaminated zone, transition or sluicing zone, 'clean' zone)
- Patient handling under droplet hygiene precautions; in case of invasive, potentially aerosol-generating procedures: airborne transmission precautions
- Retaining waste and any type of bodily fluids from the patient in the contaminated zone until appropriate decontamination and disposal provisions are in place
- Handling and shipment of patient samples in accordance with the international procedures for 'transport of category A infectious substances assigned to UN 2814 or UN 2900' [11]

Hospital preparedness measures promoting early detection and safe handling of viral haemorrhagic fever cases:

- Sensitisation of staff working in 'ports of entry' of a healthcare facility (emergency departments, ambulance services, GP offices) for early and advanced symptoms of viral haemorrhagic fever
- Focussing on systematic recording of travel history and vaccinations received
- Establishing a standard diagnostic procedure for ruling out common differential diagnoses at an early stage (e.g. malaria, yellow fever, dengue, Lassa fever, rickettsia and leptospirosis)
- Establishing a protocol for notification of the competent public health authorities at an early stage if suspecting an EVD case
- Knowledge of, and establishing contact with, reference laboratories able to perform viral haemorrhagic fever diagnostics
- Knowledge of, and establishing contact with, specialised treatment centres with high containment facilities;
- Delivering basic training to healthcare workers on principles of provisional barrier nursing and use of personal protective equipment for droplet transmission precaution

Further reading

ENIVD guidance on management and control of VHF: http://www.enivd.de/NETZ.PDF [38]

VHF assessment chart for patients in emergency departments: http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317135155050 [43]

RKI guidance on Ebola and Marburg virus (updated on 25th March 2014, German): http://www.rki.de/DE/Content/InfAZ/E/Ebola/Uebersicht.html [44]

Public Health Canada: Pathogen safety data sheet on Ebola virus: http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/ebola-eng.php [8]

Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings: http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf [45]

Management of hazard group 4 viral haemorrhagic fevers and similar human infectious diseases of high consequence: http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947382005 [39]

International guidelines for shipment of infectious substances: http://www.who.int/ihr/infectious_substances/en/ [11]

WHO Guidance on regulations for the transport of infectious substances 2013–2014: http://apps.who.int/iris/bitstream/10665/78075/1/WHO_HSE_GCR_2012.12_eng.pdf [31]

Guidance on public health management of epidemics from unusual and high consequences diseases (pages 385–520, in German): http://www.bbk.bund.de/SharedDocs/Downloads/BBK/DE/Publikationen/PublikationenForschung/BioGef-I_3Auflage.pdf [46]

Guidance on clinical treatment of VHF (pages 191–203, in German): http://www.bbk.bund.de/SharedDocs/Downloads/BBK/DE/Publikationen/PublikationenForschung/BioGefahren-II-MedVers.pdf [47]

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