Ebola
B Guery
Avril 2015
Date of outbreak: September–October 1976
Location of outbreak: Zaire (Democratic Republic of Congo)
Number of cases: 318  Number of deaths: 280
Mortality: 88%

Situation: Occurred in Yambuku and surrounding area. Disease was spread by close personal contact and by use of contaminated needles and syringes in hospitals/clinics. This outbreak was the first recognition of the disease.
**Date of outbreak:** June–November 1976  
**Location of outbreak:** Sudan (South Sudan)  
**Number of cases:** 284  
**Number of deaths:** 151  
**Mortality:** 53%  
**Situation:** Occurred in Nzara, Maridi, and the surrounding area. Disease was spread mainly through close personal contact within hospitals. Many medical care personnel were infected.
Date of outbreak: 1995
Location of outbreak: Zaire (Democratic Republic of Congo)
Number of cases: 315  Number of deaths: 250
Mortality: 79%
Situation: Occurred in Kikwit and surrounding area. Traced to index case patient who worked in forest adjoining the city. Epidemic spread through families and hospitals.
Date of outbreak: 2000–2001
Location of outbreak: Uganda
Number of cases: 425 Number of deaths: 224
Mortality: 53%
Situation: Occurred in Gulu, Masindi, and Mbarara districts of Uganda. The three most important risks associated with Ebola virus infection were attending funerals of Ebola hemorrhagic fever case patients, having contact with case patients in one's family, and providing medical care to Ebola case patients without using adequate personal protective measures.
Date of outbreak: 2007
Location of outbreak: Democratic Republic of Congo
Number of cases: 264  Number of deaths: 187
Mortality: 71%
Situation: Outbreak occurred in Kasai Occidental Province. The outbreak was declared over November 20. Last confirmed case on October 4 and last death on October 10.
Famille des *Filoviridae*

- Zaire
- Bundibugyo
- Reston
- Soudan
- Tai Forest
Diamètre de 80 nm
Longueur variable: jusque 14 000 nm
Génome 19kB
7 gènes
Structure interne
- Membrane virale
- Glycoprotéines transmembranaires
- Matrice (VP40, VP24)
- Nucleocapside (VP30)
- ARN
- Complexe polymérase (VP35 et Prot L)
Structure interne

- Membrane virale
- *Glycoproteines transmembranaires*
- Matrice (VP40, VP24)
- Nucleocapside (VP30)
- ARN
- Complexe polymérase (VP35 et Prot L)
Structure interne
• Membrane virale
• Glycoprotéines transmembranaires
• Matrice (VP40, VP24)
• Nucleocapside (VP30)
• ARN
• Complexe polymérase (VP35 et Prot L)

Inhibition de la signalisation IFN
Structure interne

- Membrane virale
- Glycoproteines transmembranaires
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- Nucleocapside (VP30)
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- Matrice (VP40, VP24)
- Nucleocapside (VP30)
- ARN
- Complexe polymérase (VP35 et Prot L)
Transmission

- Chimpanzé, gorille, chauve souris frugivores, antilopes, porc épics
  - Morts
  - Malades
- Contact avec
  - Sécrétions
  - Sang
  - Organes
  - Fluide

*Hypsognathus monstrosus (Hôte naturel)*
Transmission

• Transmission interhumaine
  – Contact direct
    • Peau lésée
    • Muqueuse
  – Environnement contaminé
  – Possiblement aérienne (Reston)

• Evénements
  – Rites funéraires

• Exposition à des objets contaminés
  – Aiguilles

• Patients convalescents
  – Sperme jusque 7 semaines après la guérison
Symptômes

- Incubation 2-21 jours (8-10j habituellement)

Les patients présentent en général:
- Fièvre
- Céphalée
- Douleurs articulaires et musculaires
- Faiblesse
- Diarrhée
- Vomissement
- Douleurs abdominales
- Manque d’appétit

Certains patients présentent:
- Une éruption
- Yeux rouges
- Hoquet
- Toux
- Maux de gorge
- Douleur à la poitrine
- Difficulté à respirer
- Difficulté à avaler
- Saignement à l’intérieur et à l’extérieur du corps
Traitement

- Thérapie supportive
  - Traitement des infections associées
  - Balance hydrique
  - Oxygénation et Hémodynamique

- Traitement spécifique
  - Plasma de convalescent
  - Antiviraux (“re-purposing”)
    - Favipiravir
    - Brincidofovir
Vaccin

• Deux vaccins sont en développement (inocuité chez l’homme)
  – ChAd3-ZEBOV (GSK) (Phase I-II)
  – rVSV-ZEBOV (New link genetics & Merck)

• Autres (stades plus précoces)
  – Johnson & Johnson: Ad26-EBOV et MVA-EBOV
  – Novavax (biotech)
  – Ministère de la santé russe (vaccin recombinant)
The ChAd3 monovalent vaccine against EBOV was immunogenic at the doses tested
Reversion of advanced Ebola virus disease in nonhuman primates with ZMapp

Combination of monoclonal antibodies (ZMapp), optimized from two previous antibody cocktails

Rescue 100% of rhesus macaques when treatment is initiated up to 5 days post-challenge.

« Only 10% of new molecular entities succeed from the point of preclinical candidate selection to commercial launch » Rid et al Lancet 2014
On March 10, 2014, hospitals and public health services in Guéckédou and Macenta alerted the Ministry of Health of Guinea and — 2 days later — Médecins sans Frontières in Guinea about clusters of a mysterious disease characterized by fever, severe diarrhea, vomiting, and an apparent high fatality rate.
Rt<2 indicate that control could be attained by preventing over half of the secondary transmissions per primary case.

Rougeole R0: 14-17 en Afrique de l’ouest
1 April 2015

**Figure 1: Confirmed, probable, and suspected EVD cases worldwide (data up to 29 March 2015)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guinea</td>
<td>3492</td>
<td>2314</td>
</tr>
<tr>
<td>Liberia</td>
<td>4332</td>
<td>9712</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>3799</td>
<td>11974</td>
</tr>
<tr>
<td>Mali</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Nigeria</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>Senegal</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Spain</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>United States of America</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10460</strong></td>
<td><strong>25213</strong></td>
</tr>
<tr>
<td>Country</td>
<td>Case definition</td>
<td>Cumulative cases</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Guinea</td>
<td>Confirmed</td>
<td>3068</td>
</tr>
<tr>
<td></td>
<td>Probable</td>
<td>414</td>
</tr>
<tr>
<td></td>
<td>Suspected</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3492</td>
</tr>
<tr>
<td>Liberia</td>
<td>Confirmed</td>
<td>3151</td>
</tr>
<tr>
<td></td>
<td>Probable</td>
<td>1879</td>
</tr>
<tr>
<td></td>
<td>Suspected</td>
<td>4682</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>9712</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>Confirmed</td>
<td>8545</td>
</tr>
<tr>
<td></td>
<td>Probable</td>
<td>287</td>
</tr>
<tr>
<td></td>
<td>Suspected</td>
<td>3142</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>11 974</td>
</tr>
<tr>
<td>Total</td>
<td>Confirmed</td>
<td>14 764</td>
</tr>
<tr>
<td></td>
<td>Probable</td>
<td>2580</td>
</tr>
<tr>
<td></td>
<td>Suspected</td>
<td>7834</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25 178</td>
</tr>
</tbody>
</table>
Table 3: Ebola virus disease infections in health-care workers in the three countries with intense transmission

<table>
<thead>
<tr>
<th>Country</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guinea</td>
<td>186</td>
<td>94</td>
</tr>
<tr>
<td>Liberia</td>
<td>372</td>
<td>180</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>303</td>
<td>221*</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>861</strong></td>
<td><strong>495</strong></td>
</tr>
</tbody>
</table>

Data are confirmed cases and deaths only, apart from deaths in Sierra Leone, which include confirmed, probable, and suspected deaths.

*Data as of 17 February.*
Figure 3: Confirmed weekly Ebola virus disease cases reported nationally and by district from Guinea

Data source: Patient Database - Situation Report

Number of Cases

Beyla
Boffa
Boke
Conakry
Coyah
Dabola

Dalaba
Dinguiyaye
Dubreka
Faranah
Forecariah
Fria

Gueckedou
Kankan
Kerouane
Kindia
Kissidougo
Kouroussa

Lola
Macenta
Mali
N’Zerekore
Pita
Siguiri

Telimele
Tougue
Yomou
Table 4: Key performance indicators for Guinea for Phase 2 of the Ebola Response

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cases and deaths</strong></td>
<td><strong>Hospitalization</strong></td>
</tr>
<tr>
<td>19 Jan – 29 Mar</td>
<td>Aug - Feb</td>
</tr>
<tr>
<td>Number of confirmed cases</td>
<td>Time between symptom onset and hospitalization (days)†</td>
</tr>
<tr>
<td>Zero</td>
<td></td>
</tr>
<tr>
<td>Cases and deaths</td>
<td>Outcome of treatment</td>
</tr>
<tr>
<td>19 Jan – 29 Mar</td>
<td>Aug - Feb</td>
</tr>
<tr>
<td>Number of confirmed deaths</td>
<td>Case fatality rate (among hospitalized cases)‡</td>
</tr>
<tr>
<td>60</td>
<td>49%</td>
</tr>
<tr>
<td>Number of confirmed deaths that occurred in the community</td>
<td></td>
</tr>
<tr>
<td>Zero</td>
<td></td>
</tr>
<tr>
<td>Diagnostic services</td>
<td>Safe and dignified burials</td>
</tr>
<tr>
<td>23 Feb – 29 Mar</td>
<td>19 Jan – 29 Mar</td>
</tr>
<tr>
<td>Number of samples tested and the percent of positive EVD results*</td>
<td>Number of reports of unsafe burials</td>
</tr>
<tr>
<td>60</td>
<td>Zero</td>
</tr>
<tr>
<td>Contact tracing</td>
<td>Community engagement</td>
</tr>
<tr>
<td>12 Jan - 22 Mar</td>
<td>19 Jan – 29 Mar</td>
</tr>
<tr>
<td>Percent of new confirmed cases from registered contacts</td>
<td>Number of districts with at least one security incident or other form of refusal to cooperate</td>
</tr>
<tr>
<td>0%</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 6: Key performance indicators for Sierra Leone for Phase 2 of the Ebola Response

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Target</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cases and deaths</strong></td>
<td></td>
<td>19 Jan – 29 Mar</td>
</tr>
<tr>
<td>Number of confirmed cases</td>
<td>Zero</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td><strong>Hospitalization</strong></td>
<td></td>
<td>Aug – Feb</td>
</tr>
<tr>
<td>Time between symptom onset and hospitalization (days)</td>
<td></td>
<td>&lt;2 days</td>
</tr>
<tr>
<td><strong>Outcome of treatment</strong></td>
<td></td>
<td>Aug – Dec</td>
</tr>
<tr>
<td>Case fatality rate (among hospitalized cases)</td>
<td></td>
<td>&lt;40%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>64%</td>
</tr>
<tr>
<td><strong>IPC and safety</strong></td>
<td>19 Jan – 29 Mar</td>
<td></td>
</tr>
<tr>
<td>Number of newly infected health workers</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td><strong>Diagnostic services</strong></td>
<td>19 Jan – 29 Mar</td>
<td></td>
</tr>
<tr>
<td>Number of samples tested and the percent of positive EVD results</td>
<td></td>
<td>1606</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2%</td>
</tr>
<tr>
<td><strong>Safe and dignified burials</strong></td>
<td>26 Jan – 29 Mar</td>
<td></td>
</tr>
<tr>
<td>Number of reports of unsafe burials</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td><strong>Contact tracing</strong></td>
<td>12 Jan – 22 Mar</td>
<td></td>
</tr>
<tr>
<td>Percent of new confirmed cases from registered contacts</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>67%</td>
</tr>
<tr>
<td><strong>Community engagement</strong></td>
<td>19 Jan – 23 Mar</td>
<td></td>
</tr>
<tr>
<td>Number of districts with at least one security incident or other form of refusal to cooperate</td>
<td>Zero</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
Transmission of Ebola virus from animals to humans is possible in 22 countries across Central and West Africa.

- **A. Hypsignathus monstrosus**
- **B. Myonycteris torquata**
- **C. Epomops franqueti**
- **D. Composite**

- 22 million people live in the areas at risk.
Mapping the zoonotic niche of Ebola virus disease in Africa

A

(A) Shows the locations of WHO regions
(B) Numbers of passengers arriving in each of these regions from countries predicted to contain areas at risk of zoonotic Ebola virus transmission in 2005 and 2012.
Changes in annual outbound international passenger volume by country predicted to contain areas at-risk of zoonotic Ebola virus transmission between 2005 in red and 2012 in blue.

- The grey rectangle highlights countries in which index cases of EVD have been reported
- The remainder are countries in which risk of zoonotic transmission is predicted, but where index cases have not been reported.
Global trends in emerging infectious diseases

Kate E. Jones¹, Nikkita G. Patel¹, Marc A. Levy¹, Adam Storeygard³⁺, Deborah Balk³⁺, John L. Gittleman⁴ & Peter Daszak²

Epizooties issues animaux sauvages Epizooties issues animaux domestiques

Pathogènes résistants aux drogues Pathogènes transmis par vecteurs

A timeline of major pandemics transmissible through the respiratory tract
1956

AIR FRANCE

SUPER CONSTELLATION
LOCKHEED

ON THE WORLD'S LARGEST AIR NETWORK, THE WORLD'S BEST NEW AIRCRAFT.

VICKERS VISCONT

LE PLUS RAPIDE DES APPAREILS À TURBO-PROPULSION, RECONNAISSABLE PAR LA DOUCEUR DE SON VOL, PRATIQUE, MÊME SANS VARIATIONS ET POUR SES VASTES HUBLOTS.
2014
2 billions de voyageurs/an
**Figure 2: WHO continuum of pandemic phases with actions for risk management**

IHR=International Health Regulations. PHEIC=public health emergency of international concern.
Emergence and Spread of Infectious Disease Threats in a Globalized World

Closely adhere to your healthcare provider’s recommendations for antibiotic use to prevent the emergence of drug resistant microbes.

Support local and global initiatives to strengthen infectious disease surveillance and diagnostics, especially in low-income countries.

Promote awareness of the growing link between human health and animal health.

Participate in initiatives to attenuate the effects of climate change, which are intertwined with changes in infectious disease activity in the world.

Wash hands frequently, especially after contact with animals.

Learn to cough and sneeze into your sleeve to decrease the probability of disease spread.

Support local and global initiatives to strengthen public health capacity, especially in low-income countries.

Keep your vaccinations up to date.

Declare animals or animal products when traveling across an international border.

Visit a travel medicine clinic before embarking upon an international trip, especially if attending or directly participating in a mass gathering.

Contact your healthcare provider if ill after returning from abroad.

Stay away from others, including work, if unwell.