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National Institute for Communicable Diseases/NICD, Republic of South Africa (RSA)
Transmission?

From reservoir to human population:
Contact with non-human primates? Bats? Bush meat?

From person-to-person:
Blood, bodily fluids, tissues of a person after first symptoms have developed
Cadavers: virus in dead bodies remain infectious for up to 60 days after demise
Semen (i.e. sexual contact): males may transmit virus for up to 3-7 months in convalescence
Nosocomial transmission: contaminated needles

• Incubation period (m: 11.4 days, 2-21 d after exposure to virus)*

Relatives of sick person and mourners are at high risk
Healthcare workers are at high risk
Those who treat and bury the bodies of the dead are at high risk

25 EVD Outbreaks in Africa

• 2292 EVD cases from 23 outbreaks in Africa during 1976-2012

• > 40% of EVD cases reported before 2014 occurred during DRC outbreaks

• Most are confined to isolated pockets in remote areas where risk of transmission is slight.

Map created from data available on http://www.cdc.gov/vhf/ebola/outbreaks/history/distribution-map.html
Timeline: West Africa EVD Spread

- **December 2013:** Outbreak started in Guinea (Guéckédou).

Sources:
- Graphs created from total case data reported by the Centers for Disease Control and Prevention and World Health Organisation as of 19 July 2015.
Timeline: West Africa EVD Spread

- **31 March 2014:** 122 cases in Guinea and 8 in Liberia when officially reported.
- **8 June 2014:** Sierra Leone first 89 cases reported.
- **6 August 2014:** Extra Ordinary Meeting of SADC Ministers of health on EVD in Johannesburg, South Africa: Concerted support in the event of an outbreak in any of the Member States as a way of containing EVD under WHO.
- **8 Aug 2014:** WHO IHR Emergency Committee meeting\(^1\):
  
  Ebola outbreak declared as a Public Health Emergency of International Concern.
  
  » Only the third time in the WHO’s history: H1N1 declared as PHEIC in 2009 and Polio virus declared as PHEIC in 2014.
  
  » Un preceded scale, geographic range, international spread to Nigeria, restrained public health capacity, dysfunctional health systems, a severe shortage of doctors, inexperience with Ebola outbreaks, high mobility and cross-border movement, high number of health care worker infections, high case-fatality ratio, extreme poverty and rampant fear.
  
  » At that time in Guinea, 506 cases and in Liberia, 599 cases and in Sierra Leone 730 cases and in Nigeria, 12 cases (9-10 August 2014).
  
  » No general ban on international travel or trade but no travel of EVD cases and contacts except for medical evacuation recommended by WHO.

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Widespread EVD transmission in Guinea, Liberia, Sierra Leone

Peak increase Liberia 935 cases 19-26 (23) Oct 2014
Peak increase Sierra Leone 863 cases 26 (23) Oct-02 Nov 2014
Former widespread transmission and Current, Established

Control Measures

Graphs created from total case data reported by the Centers for Disease Control and Prevention and World Health Organisation as of 19 July 2015
Previously Affected: Nigeria, Senegal, Mali

- **17 October 2014:** Senegal declared Ebola-free
- **20 October 2014:** Nigeria declared Ebola-free
- **18 January 2015:** Mali declared Ebola-free

Timeline created from case data reported by the World Health Organisation and other resources
## EXPORTATION OF EVD IN 2014-2015

<table>
<thead>
<tr>
<th>Non-African countries</th>
<th>Total Cases</th>
<th>Lab Confirm Cases</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Spain</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>UK</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Italy</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>9</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>African countries</th>
<th>Total Cases</th>
<th>Lab Confirm Cases</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>20</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>Senegal</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mali</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22</strong></td>
<td><strong>21</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

..and so my fellow Americans the 2014 election really comes down to this..

... Are you safer today than you were four years ago?
Risk of EVD Importation in South Africa?

- **South Africa top 15 country at risk of EVD case importation in the short term**
  

- **Ranks 17 in top ten final destinations from Guinea, Liberia Sierra Leone**
  

- **21 August 2014: Travel ban** for non-SA citizens travelling from Guinea, Liberia and Sierra Leone to South Africa (except business and political). Medium risk Kenya, Ethiopia, Nigeria.

Timeline: African EVD spread and restrictions

- **17 August 2014:** The NICD establishes field Ebola Molecular Diagnostic Facility in Freetown-Lakka, Sierra Leone. Up to March 2015 eight teams deployed to operate the EMDF. Providing of local skills transfer for logistics, biosafety, diagnostic testing.
Timeline: African EVD spread and restrictions

- **24 August 2015:** Unrelated 7th EVD outbreak in Democratic Republic of Congo in Jeera County, Equateur Province since 1976
- **4-5 September 2014:** 2nd Extra Ordinary Meeting of SADC Ministers of health on EVD in Victoria Falls, Zimbabwe.
  - Support to World Food Programme for provision of priority staple food to >1 million people under lockdown
  - Considerable support from African countries under the U.N. - African problem
  - Sub Saharan Africa’s growth by 4.6% instead of 5% due to EVD, falling oil an commodity prices
  - Diminished tourism throughout the African continent
- **22 September 2014:** 2nd WHO IHR Emergency Committee meeting
- **23 October 2014:** 3rd WHO IHR Emergency Committee meeting
- **20 November 2014:** DRC outbreak declared over with total of 66 cases.
- **21 January 2015:** 4th WHO IHR Emergency Committee meeting
- **10 April 2015:** 5th WHO IHR Emergency Committee meeting
- **9 May 2015:** Liberia declared Ebola-free
- **25 May 2015:** Travel ban lifted in South Africa from Liberia after declared EVD free on 9 May 2015
- **28 June 2015:** Man dies in Liberia of Ebola
- **7 July 2015:** 6th WHO IHR Emergency Committee meeting
South Africa’s VHF’s history and experience?

Viral Haemorrhagic Fevers

• **1996**: A physician who had been treating EVD patients in Gabon travelled back to South Africa. He developed EVD but recovered, however the nurse who was treating him in a Johannesburg hospital died of EVD.

• **2007**: A public health physician acquired Lassa fever infection while involved in an immunisation campaign in Nigeria. He was medevacuated and treated in South Africa. West Africa is endemic for this rodent borne arenavirus.

• **2008**: A patient with unexplained VHF was medevacuated from Zambia to South Africa. A new arenavirus, named LuJo virus was identified as the aetiologic agent. The index patient and three of the four healthcare workers involved died of LuJo virus infection.

• **1981-2015**: CCHF (Crimean-Congo Viral Haemorrhagic fever) is a tick-borne viral infection of animals and humans endemic in South Africa. Hundred-ninety-nine CCHF cases have been laboratory confirmed. CCHF is the most common VHF in South Africa, with an average of 7 cases reported annually.
Preparedness: NICD responses

- Emergency Operating Centre established at NICD:
  - Co-ordination of multi-sectoral responses
  - Epidemiological investigations, Laboratory investigations; Social mobilization; Ports.
- SADC responses: appointment of NICD as referral laboratory

SADC Preparedness Training held at NICD, 22-23 September 2014
Preparedness: NICD responses
Preventive Measures in South Africa

Case definition:
Any person presenting with an acute onset of fever (greater than 38.6°C) with any of the following additional symptoms: severe headache, muscle pain, vomiting, diarrhoea, abdominal pain and unexplained haemorrhage who has: Visited or been resident in Guinea, Liberia, Sierra Leone or any other country reporting imported cases with local transmission in the 21 days prior to onset of illness AND Had direct contact or cared for suspected/confirmed EVD cases in the 21 days prior to onset of illness, or been hospitalized in Guinea, Liberia, Sierra Leone, Nigeria or any other country reporting imported cases with local transmission OR Has unexplained multisystem illness that is malaria negative

Interview: Travel itinerary and activities, length of your stay and rate of transmission at the time

http://www.cdc.gov/vhf/ebola/hcp/packaging-diagram.html
Preventive Measures in South Africa

PROCEDURE FOR SUBMISSION OF SPECIMENS FOR EBOLA VIRUS DISEASE INVESTIGATIONS IN SOUTH AFRICA

STEP 1: REPORT THE SUSPECTED CASE TO THE NICD TO ALLOW A RISK ASSESSMENT TO BE CARRIED OUT AND GUIDE LABORATORY TESTING
• Contact the NICD Hotline 2 42782-883-9920

STEP 2: COMPLETE THE CASE INVESTIGATION FORM
• Fully complete the case investigation form

STEP 3: SUBMIT SPECIMENS FOR SPECIALIZED LABORATORY INVESTIGATION
• Submit both a clotless blood (red or yellow top tube) and EDTA treated tube (purple top tube) per patient
• The specimens should be packaged in accordance with the guidelines for the transport of dangerous biological goods (triple packaging using absorbent material) and transported directly and urgently to:
  Centre for Emerging and Zoonotic Diseases
  Special Viral Pathogens Laboratory
  National Institute for Communicable Diseases (NICD)
  National Health Laboratory Service (NHLS)
  No. 1 Modderfontein Rd
  Sandringham, 2131

• Ensure that the completed case investigation form accompanies the specimen
• Samples should be kept cold during transport (cold packs are sufficient).
• Refer to guidelines available at www.nicd.ac.za for more information regarding transport arrangements.

FOR MORE INFORMATION REFER TO THE GUIDELINES AVAILABLE FROM WWW.NICD.AC.ZA

Training offered to national participants and SADC in IATA Regulations for shipping of hazardous materials, December 2014
Training offered in EVD diagnosis, 2014: Ethiopia, Mozambique
Ebola Virus Disease in West Africa
EDPLN laboratories for Ebola or Marburg virus diagnostic

EDPLN: Emerging and Dangerous pathogens Laboratory Network

1. Senegal
   Institut Pasteur de Dakar

2. Gabon
   Centre international de Recherches Médicales de Franceville

3. South Africa
   National Institute for Communicable Diseases

4. Uganda
   Uganda Virology Research Institute

5. Kenya
   Kenya Medical Research Institute (KEMRI)

6. Germany
   Bernhard-Nocht-Institut für Tropenmedizin (BNI)

7. France
   Institut Pasteur Lyon et Paris

8. United States of America
   Centers for Disease Control and Infection

9. Canada
   National Microbiology Laboratory Public Health Agency of Canada

Source: WHO, 10 April 2014
Centre for Emerging and Zoonotic Diseases, Special Viral Pathogens Laboratory, Sandrigham

Scientists working at Biosafety-level-4-facility at NICD
Critical information: Date of onset of fever/symptoms
Epidemiological link to EVD cases, or other relevant epidemiological history
Differential diagnosis?

Comprehensive Diagnostic Approach

Fever
RT-PCR
ELISA IgM
ELISA IgG

IgM: up to 3 – 6 months
IgG: 3 – 5 years or more (life-long persistence?)
Laboratory Investigations

Molecular

NICD scientists performing RT-PCR on inactivated samples of suspected EVD patients
Laboratory Investigations
Serology
Laboratory Investigations
Virus Isolation
38 patients investigated for EVD in South Africa 2014-2015

- Specimen only of patient received by South Africa
- Patient entered South African borders
Travel histories of EVD investigated cases in South Africa 2014-2015

- Specimen only to SA
- Medevacuted to SA
- For. Nat. came to SA
- SA Nat. returned to SA

Sierra Leone: 9
DRC: 5
Liberia: 7
Nigeria: 2
E. Africa Moz./Tan.: 2
Guinea: 2
Zambia: 2
Angola: 1
Senegal: 1
Unknown: 3
### Diagnoses of 38 patients investigated for EVD in South Africa

<table>
<thead>
<tr>
<th>Diagnosis of 38 patients tested for Ebola virus disease</th>
<th>Tested &amp; Confirmed at the NICD**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ebola virus disease (38 tested)</td>
<td>0 cases confirmed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible differential diagnoses for Ebola virus disease</th>
<th>Number of confirmed cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>11 cases confirmed</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>1 case confirmed</td>
</tr>
<tr>
<td>Dengue fever</td>
<td>1 case confirmed (7 tested negative**)</td>
</tr>
<tr>
<td>Yellow fever</td>
<td>0 cases confirmed</td>
</tr>
<tr>
<td>Congo-Crimean haemorrhagic fever</td>
<td>0 cases confirmed</td>
</tr>
<tr>
<td>Tick bite fever</td>
<td>0 cases confirmed</td>
</tr>
<tr>
<td>Lassa fever</td>
<td>0 cases confirmed</td>
</tr>
<tr>
<td>Leptospirosis</td>
<td>0 cases confirmed</td>
</tr>
<tr>
<td>Typhoid fever</td>
<td>0 cases confirmed</td>
</tr>
<tr>
<td>Meningococcal (bacterial) septicaemia</td>
<td>0 cases confirmed</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>0 cases confirmed</td>
</tr>
<tr>
<td>HIV with sepsis</td>
<td>0 cases confirmed</td>
</tr>
<tr>
<td>URTI, GIT, UTI, bacterial infection</td>
<td>6 cases diagnosed</td>
</tr>
<tr>
<td>Parvovirus B19 infection</td>
<td>1 case confirmed</td>
</tr>
<tr>
<td>Sickle cell anemia</td>
<td>2 cases diagnosed</td>
</tr>
<tr>
<td>Non-infectious aetiology</td>
<td>3 cases diagnosed</td>
</tr>
</tbody>
</table>

Most common observed EVD symptoms: Fever (87%), fatigue (76%), arthralgia (39%), myalgia (39%), Headache (53%), Chest pain (37%), Cough (30%), vomiting (68%), diarrhoea (66%), anorexia (65%), abdominal pain (44%), dysphagia (33%), Any unexplained bleeding (18%), Conjunctivitis (21%)*, Death (50-90%) *WHO Ebola Response team. NEJM. 2014

Symptoms observed in patients with differential diagnoses: Fever, arthralgia, diarrhoea, vomiting, abdominal pain, thrombocytopenia, bleeding, rash, jaundice, raised LFT, kidney failure, death
Conclusions

• Efforts to respond to the Ebola outbreak in West Africa far exceeded the borders of the countries reporting EVD cases

• South Africa and SADC have put jointly measures in place to try and prevent introduction of EVD in the Region. The NICD was appointed as laboratory for confirmation of all EVD cases that may occur in SADC

• Many African countries have imposed travel ban or restrictions. South Africa has lifted the ban for Liberia

• Numbers of EVD cases are declining in the affected countries, but ongoing vigilance and efforts are required to ensure that the last cases of EVD of the 2014/15 outbreak are managed appropriately.

• Analysis of outbreak data will revise and update epidemiologic parameters of EVD
Acknowledgements

• NICD- Staff of the Centre for Emerging and Zoonotic Diseases, Division for Surveillance and Public Health Response, members of the Emergency Operating Centre and others
• National Department of Health of South Africa