Reflections on public health and private experiences in an Ebola outbreak in West Africa

M Rekart – February 17, 2015
As of 12 Feb 2015, Ebola in West Africa had claimed 9,100 lives
Overview

I. Ebola Virus Disease (EVD): etiology, natural history, epidemiology, clinical issues, patient management, case fatality, prognosis

II. EVD Public health control

III. Personal observations and experiences

* All names changed; all pictures taken with permission
I. Ebola Virus Disease (EVD)
Viral Hemorrhagic Fevers

Dengue
Lassa Fever
Chikungunya
Ebola
Marburg
Crimean–Congo
Rift Valley
Yellow Fever
Filoviridae

Cueva virus
Marburg virus
Ebola virus

Sudan
Tai Forest
Bundibugyo
Reston
Zaire ("Zebov")
Structure of the Ebola Virus

Ebola virus

- ssRNA
- Nucleocapsid
- Polymerase
- Viral membrane
- Glycoprotein spikes
- Matrix

20 nm

Ebola life cycle

**Enzootic Cycle**
New evidence strongly implicates bats as the reservoir hosts for ebolaviruses, though the means of local enzootic maintenance and transmission of the virus within bat populations remain unknown.

**Ebolaviruses:**
- Ebola virus (formerly Zaire virus)
- Sudan virus
- Tai Forest virus
- Bundibugyo virus
- Reston virus (non-human)

**Epizootic Cycle**
Epizootics caused by ebolaviruses appear sporadically, producing high mortality among non-human primates and duikers and may precede human outbreaks. Epidemics caused by ebolaviruses produce acute disease among humans, with the exception of Reston virus which does not produce detectable disease in humans. Little is known about how the virus first passes to humans, triggering waves of human-to-human transmission, and an epidemic.

Following initial human infection through contact with an infected bat or other wild animal, human-to-human transmission often occurs.

Human-to-human transmission is a predominant feature of epidemics.
Filoviridae Outbreaks

Africa

Region of current outbreaks of filovirus infections
Region of past and recent outbreaks of filovirus infections

- Bundibugyo ebolavirus
- Lake Victoria marburgvirus
- Sudan ebolavirus
- Tai Forest ebolavirus
- Zaire ebolavirus

Current Ebola Outbreak in West Africa

[Map showing the current Ebola outbreak in West Africa, including locations of Ebola cases, treatment centers, and capital cities.]
Ebola transmission: transcutaneous/mucosal

1. Ebola transmission occurs from contact with bodily fluids after patients become symptomatic & the viral load is high.

2. Contact with patient's sweat, blood, vomit, feces or semen can cause infection; the body is highly infectious after death.

3. Objects (like needles and syringes) that have been contaminated with the virus can act as inanimate vectors.

4. Ebola may be spread by handling bush meat (wild animals hunted for food) and contact with infected bats.

5. Health workers, family/friends in close contact with EVD patients @ highest risk due to blood/body fluid contact.
Ebola transmission

- Ebola is not spread through air, water, or in general, by food.
- Sneezing/coughing aren't common EVD symptoms and the disease is not airborne. Unless someone coughed directly into another person’s mouth, there is no risk.
- There is no evidence that mosquitoes/insects transmit Ebola.
- Only a few species of mammals (e.g. humans, bats, monkeys, and apes) can be infected with and spread Ebola.
- Ebola is less infectious than most communicable diseases e.g. HIV, SARS, measles, HIV, influenza, polio & common cold.
- Ebola DNA can be found in the semen & vaginal fluid after recovery but the potential for sexual transmission is unclear.
- Asymptomatic sero-positivity: 2-40%
EVD spread

- Mean incubation period = 11.4 days (95% in 21d)
- Mean serial interval (generation time) = 15.3d
- Mean time from symptoms to hospitalization = 5d
- Mean time from admission to death = 4 d
- Mean time from admission to discharge = 11.8d
- Mean hospital stay = 6.4d
Ebola Suspect Case Definition

- FEVER +
  - Headache
  - Vomiting/Nausea
  - Abdominal pain
  - Diarrhea
  - Weakness/Fatigue
  - Generalized muscular or joint pain
  - Difficulty in swallowing or breathing

- BLEEDING GUMS
- Rash
- Bleeding from nose
- Diarrhea
- Abdominal pain
- Weakness/Fatigue

- TRAVEL TO:
  - Guinea
  - Liberia
  - Sierra Leone

- CONTACT WITH:
  - Someone who has been sick with a febrile illness fromEBOLA
  - Liberia
  - Sierra Leone with confirmed cases
# Ebola Laboratory Testing

<table>
<thead>
<tr>
<th>Timeline of Infection</th>
<th>Diagnostic Tests Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within a few days <strong>after</strong> symptoms begin</td>
<td>• Antigen-capture ELISA testing</td>
</tr>
<tr>
<td></td>
<td>• IgM ELISA</td>
</tr>
<tr>
<td></td>
<td>• <strong>Polymerase Chain Reaction (PCR)</strong></td>
</tr>
<tr>
<td></td>
<td>• Virus isolation</td>
</tr>
<tr>
<td>Later in disease course or after recovery</td>
<td>• IgM and IgG antibodies</td>
</tr>
<tr>
<td>Retrospectively in deceased patients</td>
<td>• PCR</td>
</tr>
<tr>
<td></td>
<td>• Virus isolation</td>
</tr>
<tr>
<td></td>
<td>• Immunohistochemistry testing</td>
</tr>
</tbody>
</table>
EVD pathophysiology

- Immune suppression
- Increased vascular permeability
- Impaired coagulation
### Clinical Features of EVD

<table>
<thead>
<tr>
<th>Phase of Illness</th>
<th>Time since Symptom Onset</th>
<th>Clinical Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early febrile</td>
<td>0–3 days</td>
<td>Fever, malaise, fatigue, body aches</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>3–10 days</td>
<td>Primary: epigastric pain, nausea, vomiting, diarrhea; Associated: persistent fever, asthenia, headache, conjunctival injection, chest pain, abdominal pain, arthralgias, myalgias, hiccups, delirium</td>
</tr>
<tr>
<td>Shock or recovery</td>
<td>7–12 days</td>
<td>Shock: diminished consciousness or coma, rapid thready pulse, oliguria, anuria, tachypnea; Recovery: resolution of gastrointestinal symptoms, increased oral intake, increased energy</td>
</tr>
<tr>
<td>Late complications</td>
<td>≥10 days</td>
<td>Gastrointestinal hemorrhage, secondary infections, meningoencephalitis, persistent neurocognitive abnormalities*</td>
</tr>
</tbody>
</table>

* Secondary infections are presumptive diagnoses based on clinical features of distributive shock, oral or esophageal candidiasis, and oral ulcers; meningoencephalitis is a presumptive diagnosis based on clinical features of unconsciousness and stiff neck.
Guidelines for EVD Care (MSF)

1. Symptomatic care: medication for fever, pain, vomiting, diarrhea, anxiety, agitation, palliation

2. Supportive care: hydration with ORS or IV fluids

3. Electrolytes: correct imbalances (e.g. K⁺)

4. Presumptive treatment: anti-malarial and antibiotic

5. Nutrition: food, vitamins, therapeutic foods

6. Psychosocial support: patients & families
# EVD Case Fatality Rates

<table>
<thead>
<tr>
<th></th>
<th>Before Aug 18</th>
<th>Aug 18–Sept 14</th>
<th>In hospital</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guinea (n = 677)</td>
<td>69%</td>
<td>81%</td>
<td>65%</td>
<td>71%</td>
</tr>
<tr>
<td>Liberia (n = 1616)</td>
<td>80%</td>
<td>41%</td>
<td>67%</td>
<td>72%</td>
</tr>
<tr>
<td>Sierra Leone (n = 1439)</td>
<td>65%</td>
<td>84%</td>
<td>61%</td>
<td>69%</td>
</tr>
<tr>
<td>All countries (n = 3747)</td>
<td>71%</td>
<td>60%</td>
<td>64%</td>
<td>71%</td>
</tr>
<tr>
<td>MSF Kailahun (n = 3195)</td>
<td></td>
<td></td>
<td></td>
<td>55%</td>
</tr>
<tr>
<td>HIC hospital (n=11)</td>
<td></td>
<td></td>
<td></td>
<td>&lt;20%</td>
</tr>
</tbody>
</table>
EVD: Risk factors for death

Proven:
- Age: >40y or <5 y
- High EBV viral load
- Abnormal bleeding
- Any of: CNS alteration, dyspnea, diarrhea, conjunctivitis

Suspected:
- General previous health status
- Coexisting infections
- Nutritional status
- Intensive supportive care
II. EVD: Public Health Control
Why is this Ebola outbreak so large?

1. Large intermixing population (interconnectivity among 3 countries and between rural and urban populations)

2. Inadequate control efforts: $R_0 \sim 1.5$ means transmission need only be halved to control/eliminate EVD

3. Severe poverty and poor health care infrastructure

4. Emerging from years of war and conflict

5. Fear and distrust of government and authorities

6. High risk burial practices, e.g. ‘washing the body’
Evidence-based EVD Public Health Control

1. Community engagement

2. Individual risk reduction: hand washing, no touching, eliminate bush meat consumption & fruit bat contact

3. Reduce time from symptoms to hospitalization

4. Trace contacts

5. Enforce safe burial practices

6. Isolate cases

7. Enhance infection control & improve biosafety
1. Community Engagement
Case Reproduction Numbers and Weekly Incidence in Guinea, Liberia, and Sierra Leone (to 12 Jan 2015)

III. Personal observations and experiences
III. Personal experiences

1. December 5–25:

MSF Holland Ebola Management Centre (EMC) in Bo, Sierra Leone

2. December 26 – January 18:

MSF Switzerland Ebola Treatment Centre (ETC) at Prince of Wales (POW) School in Freetown, Sierra Leone
Hygiene officers accepting an Ebola ambulance
Ebola Triage - POW
Suspect Ebola rooms in high risk zone
Patient tents in high risk zone, nursing stations in low risk zone
Patient cubicles - ‘intensive care tent’
Central corridor – ‘intensive care tent’
Mohammed with a Caretaker
Personal observations: presentation

Clinical syndromes:

- GI: vomiting, diarrhea, anorexia, abdominal pain
- MSK: profound weakness, joint and muscle pain
- CNS: lethargy, confusion, disorientation, coma
- Contact to confirmed EVD – highly predictive
Personal observations: clinical management

- Dehydration: universal, over-hydration: rare
- IVs: challenging and rarely changed outcome
- Electrolyte imbalance: uncommon
- Malaria: co-infection 5–10%, only infection 5–10%
- Bleeding & worsening CNS; late/poor prognosis
- Blood transfusion could have saved lives
- Oxygen therapy: of little value
- Adequate feeding: most important intervention
Personal observations: mortality

✧ Newborns and babies < 2y: >90%
✧ Children 2–15y: ~75%
✧ Pregnant women: ~60%
  (improved survival with early miscarriage)
✧ Adults > 45y: ~70%
✧ Sudden, unexpected death occurred
✧ Decision to give palliative care is taken too late
Personal observations: life and work

- Staff: hard-working, compassionate, friendly
- Patients: cooperative, stoic, poor & uneducated
- Workload: heavy (≤ 12 hours/day, 7 days/week)
- Food & accommodation: adequate
- Social life: drinks/conversation after meals
- Weather: mostly tolerable, occasionally hot
- Deaths: hardest part, especially young children