The 2014 West African Ebola Outbreak: Summary and Impact on OUHSC Campus

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News Headlines

• Ebola Could Strike 20,000, World Health Agency Says — New York Times

• Ebola in My Backyard? — The Source

• Ebola in Mind, US Colleges Screen Some Students — The Buffalo News Associated Press
Objectives

• Provide background on Ebola Virus Disease (EVD)
• Outline the outbreak progression
• Describe how the Ebola outbreak affects the OUHSC campus
WHAT ARE A FEW DISEASES MOST CAPABLE OF STRIKING FEAR INTO THE HEARTS OF MANKIND?

Why?
BACKGROUND ON EBOLA VIRUS DISEASE
Ebola Virus Disease: Signs and Symptoms

**Initial Symptoms**
- Fever >101.5°F or 38.6°C
- Severe headache
- Muscle pain
- Weakness
- Diarrhea
- Vomiting
- Abdominal pain
- Lack of appetite

**Secondary Symptoms**
- Impaired kidney and liver function
- Internal and external bleeding
- Low white blood cell and platelet counts
- Elevated liver enzymes

Course of Illness

• Symptoms appear 2–21 days after exposure
  – 8–10 days most common
• Among those who die, duration of illness is 3–15 days (median 10 days) to death
• Among those who survive, duration of illness is 10–25 days (median 15 days) to recovery

http://www.cdc.gov/vhf/ebola/symptoms/index.html
Animal Reservoir

- **Fruit bats** (*Hypsognathus monstrosus, Epomops franqueti, and Myonycteris torquata*) most likely natural hosts
  - Transmission among fruit bat species unknown

http://media-cache-ak0.pinimg.com/236x/aa/7b/5d/aa7b5d2fc537805a44a54793190e2c77.jpg
Fruit bat (H. monstrosus)
Transmission

• Zoonotic transmission: handling infected chimpanzees, gorillas, fruit bats, monkeys, forest antelopes, and porcupines
  – Blood, secretions, organs, other bodily fluids

• Person-to-person transmission: direct contact through broken skin or mucous membranes
  – Blood, secretions, organs, other bodily fluids (including semen for up to 7 weeks post-recovery)
  – Burial ceremonies a risk factor

• Health care setting: poor adherence to infection control precautions
  – Reusing needles
Infectiousness

• 1 primary case generates 1-3 secondary cases
  – Compare to Measles, which is 14-17 new cases in West Africa

Diagnosis

• Laboratory tests include
  – Enzyme-linked immunosorbent assay (ELISA)
  – Antigen detection
  – Serum neutralization
  – Reverse transcriptase polymerase chain reaction (RT-PCR)
    • Can be done in hours
  – Electron microscopy
  – Virus isolation (cell culture)

http://www.who.int/mediacentre/factsheets/fs103/en/
Treatment and Vaccine

• Severely ill patients require supportive care
  – Manage blood pressure, kidneys, liver
  – Oral re-hydration

• New drug therapies being investigated

• No licensed vaccine available
Case Fatality Rate

- **Case fatality rate**, in epidemiologic terms, is usually expressed as the percentage of persons diagnosed as having a specified disease who die as a result of that illness within a given period.
- Typically 50%–60%
  - May be as high as 90%
Prevention and Control

• Instituting contact precautions
• Contact tracing
• Changing burial practices
  – Culturally sensitive and challenging
• On farms, culling infected animals
• Education
  – Reducing wildlife-to-human transmission
  – Use gloves and protective clothing
  – Avoid eating sick bush meat
Infection Control in Health Care Settings

- Early identification of patient infected with Ebola virus
  - Strict adherence to standard precautions
    - All patients, all diagnoses, all the time

- Enhanced contact precautions for known Ebola cases
  - Face protection (goggles and mask or face shield), long-sleeved gown, gloves
Geographic Origins

- https://www.google.com/maps/place/Ebola+River,+Democratic+Republic+of+the+Congo/@3.2893969,20.9042507,12z/data=!4m2!3m1!1s0x10b15a5ce39edb6d:0xc36f8c323b0798d0?hl=en
History of EVD Outbreaks

First EVD Outbreaks

- First recorded human outbreak in Zaire and Sudan in 1976
  - Zaire is now the Democratic Republic of Congo
- 318 cases, 280 deaths
  - Case fatality rate in Zaire was 88%
  - (Case fatality rate in Sudan was 53%; 284 cases and 151 deaths)
Ebola Strains

- 5 known strains of Ebola Virus
  - Named after outbreak locations
  - Ebola-Zaire is the most deadly and the strain affecting the current outbreak in Western Africa
CURRENT OUTBREAK
Emergence of Current Outbreak

• First case likely occurred in December
  – Outbreak first recognized in March
• 2 year old boy in a village in Guinea
• Porous borders – migrant population
• Bat migration lead theory regarding how Ebola-Zaire wound up in Guinea

Current EVD Outbreak in Western Africa

• Outbreak still ongoing
• As of Sept 12, 2014
  – Suspected & confirmed cases = 4,390
  – Laboratory confirmed cases = 2,639
  – Suspected deaths = 2,226
  – Case fatality rate = 50.7%
• 48% of all cases occurred within last 3 weeks

http://www.cdc.gov/vhf/ebola/outbreaks/guinea/index.html
## Cases and Deaths by Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Suspect &amp; confirmed cases</th>
<th>Lab confirmed cases</th>
<th>Suspected Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guinea</td>
<td>861</td>
<td>678</td>
<td>557</td>
</tr>
<tr>
<td>Liberia</td>
<td>2,081</td>
<td>654</td>
<td>1,137</td>
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<tr>
<td>Sierra Leone</td>
<td>1,424</td>
<td>1,287</td>
<td>524</td>
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<tr>
<td>Nigeria</td>
<td>21</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>Senegal</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,390</strong></td>
<td><strong>2,639</strong></td>
<td><strong>2,226</strong></td>
</tr>
</tbody>
</table>

Updated 9/12/14
Distribution of Cases by Affected Countries

[Bar chart showing the distribution of cases by affected countries in West Africa over epidemiological weeks 2014.]
Histogram and Curve for Guinea and Conakry

- **Confirmed**
- **Probable**

Histogram and Curve for Liberia and Monrovia

- Confirmed
- Probable

Histogram and Curve for Sierra Leone and Freetown


Confirmed

Probable
Geographical Distribution of New Cases and Total Cases in Guinea, Liberia, and Sierra Leone
Projected Outbreak Size in 3 Most Affected Countries

- By December 31, 2014: 25,000 cases
- Peak in April 2015
- Outbreak over in mid-2016: 140,000 cases

Infection among Health Care Workers

• To date, 301 health care workers infected and 150 have died (9/12/14)

• Reports of health care workers not going to work
  – Likely a minority of health care workers

• Reports of health facility closures
Challenges in Using Personal Protective Equipment (PPE)

- Insufficient supplies
- Africa’s climate is hot – only allowed to wear it for 40 minutes at a time
  - 5 minutes to dress
  - Have a “designated dresser”
  - Time each other so do not lose track of time

Work Flow

• Confirmed, Probable, and Suspect cases
  – A tent for each group of patients
  – Health care workers must adhere to strict circuit
    • Suspect tent to probable tent to confirmed tent

Collateral Damage

• Disruption of other health services
  – Malaria, HIV, TB, women’s health, etc.
• Economic loss
• Insecurity
• Social disruption
• Stigmatization
Medecins Sans Frontieres Health Staff in Protective Clothing Constructing Perimeter for Isolation Ward

A Story about Ebola Patients

“It’s the children who distress me most. In the confirmed-case tents, I cared for a 6-year-old boy and his 3-year-old sister. Their parents and grandmother had died from Ebola. A midwife in their village then took care of the children, but they began to show symptoms of Ebola and were sent to us. Sadly, they came too late. When the boy died, we tried to console and calm his sister, but the PPE made it difficult to touch her, to hold her, even to speak with her. She died the next day. The midwife who had taken care of them also ended up at our center, and she too, died.”

Challenges to Interrupting Transmission

“The Ebola outbreak has been out of control for months, but the global health community has taken a long time to react. All organizations have limits, and here in Kailahun, MSF’s limit is in case management. The current international Ebola response remains dangerously inadequate. Last week, 250 contacts of infected persons were identified for contact tracing, but given the number of confirmed cases, there should have been more than 1500. The alert system – whereby an investigation team (and, if needed, an ambulance) is sent to a village when a suspected case or death is reported – is not functioning properly, and the Ministry of Health has only four ambulances in a district with about 470,000 people. Our health promotion teams are still visiting villages where no other health care provider has been. Every day sees deaths in the community that are surely caused by Ebola, but they are not counted by the Ministry of health because the cause has not been confirmed by laboratory testing. The epidemiologic surveillance system is nonfunctional. We need to define chains in Ebola transmission to interrupt them, but we lack key data.”

RESPONSE
Travel Restrictions

• Many flights cancelled to and from region
  – Air France suspended service to Freetown.
  – British Airways suspended service to Freetown and Monrovia.
  – Royal Air Morocco is the only airline providing regular service to capitals of Sierra Leone and Liberia.

• Travel restrictions may impair response more than contain outbreak.

Emergency Status

• WHO declared Ebola outbreak on 8/8 to be Public Health Emergency of International Concern
  – Legally binding agreement made by 196 countries to contain major international health threats
• Heads of state to declare national emergencies, activate national disaster-management mechanisms, open Emergency Operations Centers, etc.
• No international travel of infected persons or their contacts
• Quarantine may be implemented if necessary

International Response

• WHO issued roadmap on Aug 28, 2014
  – Take 9 months to stop outbreak
• Cuban medical team headed for Sierra Leone
• Pressure on African countries to take lead
• Pressure on U.S. to take lead
• World Food Programme provides food, common services, logistical assistance
  – 1.3 million people
Cost Estimates and Donations

• Current cost estimates = $500 million

• Pledges
  – WHO = $100 million
  – World Bank = $200 million
  – European Commission = $181 million
  – U.S. = $75 million

• $1.5 billion price tag represent < 1 penny for every $390 of the GDP of world’s 20 largest economies

U.S. Contribution

• President Obama has asked congress for additional $88 million in:
  – Military presence
  – Portable hospitals
  – Doctors/experts
  – Supplies
• At least 105 staff in W. Africa
• Providing “robust on-the-ground support, including contact tracing in Lagos.”
• “Equipping the hardest-hit countries with computer hardware and software that will soon allow real-time reporting of cases.”
• Prompt case finding
  — Follow contacts for 21 days – monitor fever

Poverty and Ebola

- Guinea, Liberia, and Sierra Leone among poorest countries in the world
- Fear
  - 1-2 doctors/100,000 population
    - 2/1,000 in Oklahoma (and we’re ranked #46)
    - 250 HCWs needed per 70 patients
    - Infection among health care workers escalates fear
- Isolation wards nearly non-existent
- Fluid population looking for work

“Even in wealthy countries with well-educated populations, fighting fear with facts is hard”

— Margaret Chan, WHO Director
ZMapp

• AKA “Secret Serum”
• 3 monoclonal antibodies against EV glycoprotein epitopes
• Two Americans received it and reportedly improved afterwards
  – Both received it many days after illness onset, likely would have survived anyway
• A third patient died after having received it
• Limited quantities – remaining doses given to Liberia

Other Experimental Drugs

- TkM-Ebola - targets EV RNA polymerase L
  - Reduced mortality in a nonhuman primate model

- AVI-7537 – targets EV protein VP24 through RNA interference technology
  - Confers survival benefit to nonhuman primates

- BCX-4430 – adenosine analogue
  - Showed benefit against Marburg virus in rodents and nonhuman primates
Vaccine Research

• NIH announced initial Phase I testing to begin first week of September
  – Healthy volunteers
• NIH partnered with British-based consortium to begin middle of September

PROJECTIONS
Projected Risk of International Spread

Projection for 2014-09-22

Projected Outbreak Size Should it Spread to that Country

IMPACT TO THE UNIVERSITY COMMUNITY
Impact on University Campuses

• Primary concern is importing Ebola virus disease to campus
  – Incubation period as long as 21 days
  – Incoming international students from affected countries are health care providers
  – Faculty, student, staff involvement in activities such as Doctors without Borders (MSF), medical missions, etc.
Exposure Assessment Tool

• Developed an exposure assessment tool meant to be administered by phone

• Ask about key risk factors
  – Contact with Ebola patients
    • Clinical, household, etc.
  – Contact with burial ceremonies
  – Contact with animals subject to infection

• Symptom screening
Coordination with Partners

- Oklahoma State Department of Health
- Oklahoma City/County Health Department
- Tulsa City/County Health Department
- CDC
- U.S. State Department
References

- [http://media-cache-ak0.pinimg.com/236x/aa/7b/5d/aa7b5d2fc537805a44a54793190e2c77.jpg](http://media-cache-ak0.pinimg.com/236x/aa/7b/5d/aa7b5d2fc537805a44a54793190e2c77.jpg)
References (cont.)

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Questions?