The Ebola Epidemic in Africa: Where We've Been, Where We're At, and Where We're Going

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I know less about Ebola virus infection today than I did six months ago; please take the information provided here with that acknowledgement

“The greatest obstacle to discovering the shape of the earth, the continents, and the oceans was not ignorance but the illusion of knowledge.”
–Daniel Boorstin

“For a successful technology, reality must take precedence over public relations, for Nature cannot be fooled.”
–Richard Feynman

Ebola Virus and Human Infection

• Named after the Ebola River in the Democratic Republic of the Congo where it was first discovered in 1976.
• Twenty-four outbreaks or isolated case occurrences documented since 1976; 20 were community-wide outbreaks
• These outbreaks involved approximately 2,400 cases. The most number of transmission generations was five.
• Ebola had “hardly pinged the human species” before the current West Africa outbreak
Ebola Virus and Human Infection

• Transmission of Ebola to and by humans has been documented by "direct contact" with an infected person/animal body fluids, including blood, vomit, feces and possibly perspiration
• The current outbreak has highlighted questions about transmission that remain unanswered;
  – fever
  – "airborne transmission"
  – worker safety
• Must not take our eye off the ball; its really about Africa

Ebola Virus Disease in West Africa — The First 9 Months of the Epidemic and Forward Projections

Table 1. Demographic, Characteristics and Signs and Symptoms in Confirmed and Probable Ebola Case Patients with a Definitive Clinical Outcome in Guinea, Liberia, Sierra Leone.

Top 5 Ebola Signs/Symptoms (all patients)

- Fever 87.1%
- Fatigue 76.4%
- Vomiting 67.6%
- Diarrhea 65.6%
- Loss of appetite 64.5%

Clinical Presentation of Patients with Ebola Virus Disease in Conakry, Guinea

Table 1. Characteristics, Symptoms, Viral Load, and Time Course of Clinical Progression of 37 Patients with Confirmed Ebola Virus Disease (EVD).

Top 5 Ebola Signs/Symptoms

- Fever 84%
- Fatigue 65%
- Diarrhea 62%
- Loss of appetite 57%
- Vomiting 57%
Ebola outbreak kills 59 in Guinea

The World Health Organization (WHO) yesterday confirmed an Ebola hemorrhagic fever outbreak in Guinea, signaling the first appearance of the disease in a West African country and involving an unusual lethal strain of the virus.

Based on information transmitted to health ministry, the WHO said the rapidly evolving outbreak started in a coastal area in the northeastern part of the country, with possible spread to one region involving two countries. Infection may have spread within the WHO's region of West Africa including countries of Guinea, Sierra Leone, and Liberia.

Earlier reports

Specialists said a “family” of Ebola viruses has been circulating since 1976 in Africa. The most dangerous strain has killed 90% of those infected, but the latest virus found in the current outbreak in Guinea has killed 80% of those infected.

The New England Journal of Medicine

Emergence of Zaire Ebola Virus Disease in Guinea

Since May 7, 2014, the Guinean Ministry of Health has confirmed the occurrence of 1,754 cases of probable or confirmed patients with Ebola hemorrhagic fever in Guinea, including 1,071 deaths.

France and the United States have identified probable cases of infection in people who had traveled to Guinea. The United Nations has stated the following: "In recent weeks, the situation has evolved so dramatically that this disease is now a priority threat to global health security."

The CDC

West Africa Ebola Virus Outbreak

As of Sept. 21, 2014

The European Centre for Disease Prevention and Control
Assuming no change in the control measures for this epidemic, by November 2, 2014, the cumulative reported numbers of confirmed and probable cases are predicted to be 5740 in Guinea, 9890 in Liberia, and 5000 in Sierra Leone, exceeding 20,000 in total.

"Extrapolating trends to January 20, 2015, without additional interventions or changes in community behavior … the model also estimates that Liberia and Sierra Leone will have approximately 550,000 Ebola cases (1.4 million when corrected for underreporting)."
Ebola intensifies the struggle to cope with Lassa fever

Ebola outbreak in Sierra Leone raises fears of new infection chain

Even in Liberia, where the number of Ebola cases has dropped significantly, the government is still watching for signs of new infections. The country has seen a decline in cases, but authorities remain cautious. The death toll has reached 5,180, including 2,400 health-care workers.

Lack of resources has prevented the government from implementing the necessary measures to control the virus. The country's health system is strained, and it relies heavily on international aid.

Ebola cremation ruling prompts secret burials in Liberia

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West Africa Short 75 Percent of Needed Beds for Ebola

A recent Bloomberg report highlights the strain on healthcare facilities in West Africa. The region is facing a severe shortage of beds, with only 25% of the needed capacity available. This is a major concern, as the virus continues to spread. The situation is dire, with healthcare workers at their breaking point. The global community must step up to support these countries and provide the necessary resources to combat the outbreak.

Bloomberg

Ebola outbreak: UN 'lacks resources' to fight deadly virus

The head of the UN mission in West Africa has said that the UN does not have the resources necessary to fight the disease. The virus has already spread to several countries, with more than 5,000 deaths reported. The UN has appealed for additional funding to support the fight against the virus. But the response has been slow, and the situation remains critical.
Genomic surveillance elucidates Ebola virus origin and transmission during the 2014 outbreak

Ebola Patient Flees Clinic In Search For Food

From Bad to Worse With Ebola

Liberia medics on strike as WHO calls Ebola 'worst health crisis'

Response to the World Health Organization's Ebola Road Map

Ebola outbreak: WHO admits it botched early attempt to stop disease
Ebola Doctors at Breaking Point: 'This Constant Feeling That the Boat's Sinking'

By Marie Annaos and Naam Kingdom
Oct 30, 2014 12:30 PM EDT

At 0:00 a.m. in the most dangerous Ebola treatment center, Dr. Lucien Vouny found the outbreak reduced to its essential patterns: only one bed remained empty. A cold sweat ran down his forehead and he found himself unable to work. He was alone in the room, surrounded by the sick and dying patients. He had lost all hope. There was nothing left but to admit defeat.

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Cuba’s Impressive Role on Ebola

The New York Times
Oct 31, 2014

Cuba’s impressive role on Ebola

By Michael Gerson
Oct 30, 2014

Cuba’s role in the Ebola crisis has been both significant and controversial. Some see it as a sign of the island’s newfound effectiveness in global health, while others question its motives and effectiveness.

Donations for Ebola Relief Efforts Are Slow to Take Off

The New York Times
Oct 31, 2014

When Mark Zuckerberg and his wife, Priscilla Chan, announced $25 million in donations to support the Ebola response in West Africa, they also acknowledged the challenges facing donors.

How much countries have donated to the Ebola fight, in one chart

The New York Times
Oct 31, 2014

The chart above shows the donations made by various countries to support the Ebola response in West Africa. The United States has been the largest donor, followed by Germany and Canada.

The Ebola Epidemic Is About To Get Worse. Much Worse.

Politico
Oct 31, 2014

Ebola is spreading faster than anyone would have thought possible. The world is not ready for this crisis, and the consequences could be catastrophic.
Ebola Vaccine and Treatment Studies

• Non-human primate (NHP) are regarded as the best disease models
• Insufficient clinical disease data to assess comparability between NHP and human pathogenesis and immunity
• Interventions targeting host functions and drug metabolism may be impacted by subtle species differences

Ebola Vaccines Under Study

• ChAd3/NIAD/GSK
  - Chimp adenovirus 3 with Ebola glycoproteins
  - Phase 1
  - Two dose

• Vesicular Stomatitis Virus (VSV-EBOV)
  - NewLink (Bioprotection)/PHAC
  - VSV with Ebola Zaire GP
  - Phase 1
  - Single dose

• Profestus: rVSV platform
Ebola Treatment Under Study

- **Therapeutics**
  - Compounds with antiviral activity
  - Other (supportive care/complications)

- **ZMapp™**
  - Triple monoclonal antibody cocktail
  - Produced in tobacco plants

- **Antibody infusion**

- **Viral polymerase inhibitor**

**Care for Severely Ill Ebola Patients**

- Investigational therapeutic interventions will not replace the need for intensive care
- Anecdotal reports suggest that aggressive approaches to clinical care can improve survival rates:
  - Targeted repletion of fluid and electrolytes
  - Monitoring and treatment for co-infections (emphasis on malaria and cholera)
  - Nutritional support
COMMENTARY: Health workers need optimal respiratory protection for Ebola

Editor’s Note: Today’s commentary was submitted to CIDRAP by the authors, who are experts in improving occupational respiratory protection and infection control training. It may be published in an upcoming issue of CIDRAP, Inc’s newsletter, CIDRAP News. The authors are a Professor and CIIRP on Infection Prevention and Control at the University of Iowa and Infectious Diseases, at the University of Iowa in Iowa City.

Healthcare workers play a crucial role in the successful containment of outbreaks of infectious diseases like Ebola. The most effective level of personal protective equipment (PPE) involves that healthcare workers wear a barrier between themselves and the patient's skin, and within the correct equipment, in order to protect themselves.

At time = 0, an aerosol is generated by person A. Person B receives droplet spray and inhales particles. Person C has no exposure.

At time = 1, the aerosol is dispersing, and many larger particles are settling. Person B inhales particles. Person C has no exposure.

At time = 2, the aerosol is dispersed, and many larger particles have deposited on the floor. Persons B and C inhale particles.
**CDC Healthcare Worker Guidance**  
**October 20, 2014**

• CDC is recommending all of the same PPE included in the August 1, 2014 guidance, with the addition of coveralls and single-use, disposable hoods. Goggles are no longer recommended as they may not provide complete skin coverage in comparison to a single use disposable full face shield. Additionally, goggles are not disposable, may fog after extended use, and healthcare workers may be tempted to manipulate them with contaminated gloved hands.

• PPE recommended for U.S. healthcare workers caring for patients with Ebola includes:
  - Double gloves
  - Boot covers that are waterproof and go to at least mid-calf or leg covers
  - Single use fluid resistant or imperable gown that extends to at least mid-calf or coverall without intergraded hood.
  - Respirators, including either N95 respirators or powered air purifying respirator (PAPR)
• PPE recommendations continued:
  – Single-use, full-face shield that is disposable
  – Surgical hoods to ensure complete coverage of the head and neck
  – Apron that is waterproof and covers the torso to the level of the mid-calf should be used if Ebola patients have vomiting or diarrhea

CDC Healthcare Worker Guidance
October 20, 2014

Los Angeles Times

Ebola research: Fever not a surefire sign of infection

For public health workers screening more than 3,000 air travelers who arrive each week in the United States from Ebola-affected West Africa, one symptom above all others is supposed medical danger: Fever. So long as an individual’s temperature does not exceed 100.5 degrees and there are no visible symptoms of Ebola, health authorities say it should be assumed the person is not infected.

The Los Angeles Times

U.S. Ebola fears fuel new demand for protective gear

By YoYin variants. U.S. Ebola diagnostics doctors: Disasters:

Los Angeles Times

Ebola Virus Disease in West Africa — The First 9 Months of the Epidemic and Forward Projections

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<tr>
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<td>Loss of appetite</td>
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The Los Angeles Times

What We’re Afraid to Say About Ebola

The Los Angeles Times

Ebola Hemorrhagic Fever, Kikwit, Democratic Republic of the Congo, 1995: Risk Factors for Patients without a Reported Exposure

The Los Angeles Times
"If you don’t know where you’re going, any road will get you there.”

Lewis Carroll
“Are these the shadows of the things that Will be, or are they shadows of things that May be, only?”

Ebenezer Scrooge
Un Ebola vaccine drafts reported positive in Sierra Leone, as victims surge into Port Loko

2 November 2014: Observers at the vaccination center in Freetown, Sierra Leone, are watching as health workers deliver the first doses of the experimental Ebola vaccine to patients. The vaccine is being tested to determine whether it is effective in preventing the disease.

The vaccine, called rAd5-EBOV, is being developed by the National Institute of Allergy and Infectious Diseases (NIAID) and is being manufactured by the Coalition for Epidemic Preparedness Innovations (CEPI).

Fauci and Collins agree to stop Ebola vaccine development and NIH funding

By Andrew Clein, December 24, 2014

On December 24, 2014, Anthony Fauci was asked whether it was "painful" to see how much money was being spent on an Ebola vaccine that was not likely to be effective. He said, "It's very painful to see the money going down the drain," and added that "we need to be smart about how we use our resources." The vaccine, which was developed by the National Institute of Allergy and Infectious Diseases (NIAID), was stopped after the first dose was given to a patient in Sierra Leone.

The development of the vaccine was funded by the National Institutes of Health (NIH) and the National Institute of Allergy and Infectious Diseases (NIAID).

The Washington Post

Obama administration urges calm over US Ebola case

By Associated Press, October 2

WASHINGTON - The Obama administration on Friday urged calm over the single case of Ebola in the United States, seeking to reassure the American public that there is little chance of an outbreak of the disease in this country. The Pentagon said it had begun the long-anticipated Ebola drill to test whether the government is prepared to respond to an outbreak.

The administration has long feared that the best way to contain Ebola is by making it as easy to control as possible. The Pentagon's response was to hold off on any major development until the outbreak is under control.

The administration has also been criticized for the lack of preparedness for a possible outbreak.

Dallas Ebola Watch clears first group quarantined

By Associated Press, October 25

Deborah James is a nurse who works at a hospital in Dallas, Texas. She has been treating patients with Ebola and has tested positive for the virus.

James was first treated at Emory University Hospital in Atlanta, Georgia, but was transferred to Texas Health Presbyterian Hospital in Dallas after her condition worsened.

James is the first American to be diagnosed with Ebola in the United States.

James is currently being treated in isolation at Texas Health Presbyterian Hospital in Dallas.

Per cent of particles deposited in the lung

(Perl size in μm)

<table>
<thead>
<tr>
<th>Particle size in μm</th>
<th>0.1 μm</th>
<th>1.0 μm</th>
<th>2.0 μm</th>
<th>5.0 μm</th>
<th>10 μm</th>
<th>20 μm</th>
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<tr>
<td>Larynx-airway region</td>
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<td>12</td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
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<tr>
<td>Trachea-bronchial region</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Alveolar region</td>
<td>2</td>
<td>2</td>
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