

## *Evolving Case Study in an Infectious Disease Outbreak Investigation*

Jean Ann Davison, DNP, FNP-BC  
Clinical Assistant Professor to University  
of North Carolina at Chapel Hill  
Email: [davison@unc.edu](mailto:davison@unc.edu)



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## *Gap Statement*

Population health focused on health promotion and disease prevention is an essential competency element to the Nurse Practitioner (NP) education curriculum (AACN, 2013).

With emerging outbreaks of infectious diseases such as **Ebola** and **measles**, it is important for NP students to be able to:

- understand and use epidemiological information,
- assess for communicable diseases,
- understand their state guidelines and policies for reporting communicable diseases
- and collaborate with the public health departments and community organizations to contain and inform the public on these diseases.

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### *NP Faculty Objectives*

At the end of this presentation, faculty will be able to:

- Develop an evolving case study to be used to simulate an outbreak investigation.
- Incorporate teaching strategies to emphasize the need for infection control measures and prevention education.
- Discuss inter-professional collaborative outreaches on how to educate students and healthcare workers to respond to an outbreak, including how to discuss with patients, families and communities the importance of isolation precautions, basic hygiene and the importance of immunizations in preventable diseases.

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### *Healthcare Workforce in Sierra Leone, West Africa*

**3** physicians per 100,000 population *(before Ebola)*

**1.7** nurses & midwives per 10,000 *(before Ebola)*



davison@unc.edu

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### *Public Health Conditions in Sierra Leone, West Africa*



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### Malaria in Sierra Leone is Endemic

In Sierra Leone, 100% of the population is at risk for contracting malaria. It is a leading cause of death for both children and adults.

Population:  
5.7 million  
Reported malaria cases:  
2.2 million  
Cases among children under 5: 8,500  
Reported Deaths: 8,900



See more at:  
<http://www.netsforlifeafrica.org/where-we-work/sierra-leone#sthash.D9w17JR3.dpuf>

davison@unc.edu

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### Ebola Virus Disease: EVD

(note not all cases had Hemorrhagic Fever)

- Ebola is a RNA virus of the family *Filoviridae*, genus *Ebolavirus*. Five identified Ebola virus strains; four known to cause disease in humans.
- Discovered in 1976 near the Ebola River, Zaire (DR Congo).
- Recent outbreak noted 1<sup>st</sup> in Guinea (Dec 2013-March 2014, a two y.o. then a healthcare worker)
- Can cause disease in humans and nonhuman primates (monkeys, gorillas etc).
- Bats are the most likely reservoir

davison@unc.edu

8

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### Outbreak Investigation

- Establish a tentative diagnosis (to specify the disease to be investigated)
- Establish the case definition (to distinguish cases from non-cases)
- Determine whether an epidemic is occurring;
- Characterize the epidemic by time, place, and person; (this allows hypotheses on source & route)
- Develop hypotheses regarding spread (source, patterns of spread and mode of transmission) Test hypotheses (lab studies)
- Initiate control measures (sanitation, prophylaxis, dx and treatment)

davison@unc.edu

9

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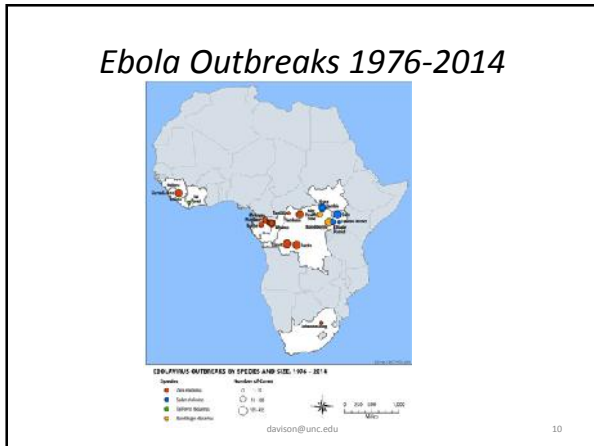
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### Make a Tentative Diagnosis

Symptoms of Ebola include

- Fever (greater than 38.6°C or 101.5°F)
- Severe headache
- Muscle and abdominal pain
- Weakness
- Severe Diarrhea
- Vomiting
- \*Unexplained hemorrhage (bleeding or bruising) DIC
- High fatality rate

*Symptoms may appear anywhere from 2 to 21 days after exposure to Ebola, but the average is 8 to 10 days.*

*\* Not all confirmed cases had hemorrhage*

davisson@unc.edu 11

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### Establish the Case Definition

#### Person Under Investigation (PUI)

A person who has both consistent symptoms and risk factors as follows:

- **Clinical criteria**- includes fever > 38.6 degrees Celsius or 101.5 F, and additional sx -severe headache, muscle pain, vomiting, diarrhea, abdominal pain, or unexplained hemorrhage; **AND**
- **epidemiologic risk factors** within the past 21 days before the onset of symptoms, such as contact with blood or other body fluids or human remains of a patient known to have or suspected to have EVD; residence in—or travel to—an area where EVD transmission is active\*; or direct handling of bats or non-human primates from disease-endemic areas.

#### Probable Case

- A PUI whose epidemiologic risk factors include high or low risk exposure(s) (see next slide)

#### Confirmed Case

- A case with laboratory-confirmed diagnostic evidence of Ebola virus infection (blood culture, real time PCR) \* 3 days after symptoms appear.

davisson@unc.edu 12

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## Lab Confirmation via CDC

INTERIM GUIDANCE FOR  
Specimen Collection, Transport, Testing, and Submission  
for Patients with Suspected Infection with Ebola Virus Disease

INFORMATIONAL AND CONTACT INFORMATION

Healthcare workers follow the steps under each heading and the appropriate procedures for each laboratory consultation to be discussed by telephone with the local laboratory. CDC encourages any questions related prior consultation.

**770-488-7100**

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**WHEN SPECIMENS SHOULD BE COLLECTED FOR EBOLA TESTING**

Specimens should be collected only after the onset of symptoms, except those from blood or other fluids after symptom onset for the virus to reach detectable levels. Virus is generally detectable by real-time RT-PCR from 5-12 days after symptom onset.

Mostly, specimens should be taken when a symptomatic patient meets the case definition and is suspected of having an acute infection, whether at the onset of symptoms or at a later date, when specimens may be more likely to be readily detected.

**PREPARED SPECIMENS FOR EBOLA TESTING**

A minimum volume of 5 milliliters of whole blood (mononuclear layer is preferred for virus detection) is required for viral detection (RT-PCR). Whole or cell-free supernatant can be used for antibody testing.

Specimens should be shipped at 2-8°C in cool packs to CDC. Cooler packs are available to U.S. clinical laboratories. Terms and conditions outlined in Request Form.

Specimens that have been used for antibody testing should be submitted separately.

Special handling should be applied for each specimen. The appropriate test must be identified, and either real-time RT-PCR or antibody confirmation testing.

**STORAGE OF SPECIMENS FOR EBOLA TESTING**

Specimens for Ebola testing should be stored at 2-8°C.

**TRANSPORT OF SPECIMENS FOR EBOLA TESTING**

Approved shipping containers must be used for the transport of Ebola virus. Specimens should be shipped in a leak-proof container (e.g., a leak-proof container) with a secure lid and a secondary container. A leak-proof container is required for all specimens and specimens in a leak-proof container must be placed in a secondary container. (See the instructions for CDC Form 1073.)

Labels must be clearly labeled in a leak-proof container and include the following information: (1) the name of the patient, (2) the name of the laboratory, and (3) the name of the CDC laboratory to which the specimen is being shipped. (See the instructions for CDC Form 1073.)

Labels must be clearly labeled in a leak-proof container and include the following information: (1) the name of the patient, (2) the name of the laboratory, and (3) the name of the CDC laboratory to which the specimen is being shipped. (See the instructions for CDC Form 1073.)

13

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## Determine if an Epidemic Exists

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## Epidemic Curves of Ebola

**FIGURE 1**  
Cumulative and daily epidemic curves of Ebola virus disease (EVD) in Guinea, Liberia, and Sierra Leone, 12 March–26 August 2014.

NOTE: The number of cumulative cases and the daily number of new cases of EVD are reported in the WHO Weekly Epidemiol. Rec. and Health Bull. See the accompanying text for EVD case definitions for each country with a coefficient of variation  $R^2 \geq 0.99$ .

DD: Reported daily incidence curves based on the smoothing spline model. Data from Sierra Leone and Liberia have been omitted due to the missing number of cases reported to their countries' health systems.

15

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## Characterize the Epidemic by Time, Place and Person Ebola 3/17/15

### Countries with Widespread Transmission

| Country      | Total Cases (Suspected, Probable, and Confirmed) | Laboratory-Confirmed Cases | Total Deaths |
|--------------|--|----------------------------|--------------|
| Guinea       | 3409   | 2979                       | 2231         |
| Liberia      | 9555   | 3150                       | 4283         |
| Sierra Leone | 11779  | 8502                       | 3702         |
| <b>Total</b> | <b>24743</b>                                     | <b>14631</b>               | <b>10216</b> |



davison@unc.edu

16

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## Develop Hypotheses Regarding Spread

Close contact with an infected person.

- Ebola is spread through direct contact with: blood or body fluids (such as saliva, sweat, semen, stool or urine) of an infected person
- or animal (uncooked bush meat)
- or through contact with objects that have been contaminated with the blood or other body fluids of an infected person.
- (primates - possible airborne - Reston primate facility)

davison@unc.edu

17

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## Initiate Control Measures

The infographic is divided into three main sections:
 

- Find:** Includes 'Find the first diagnosed patients', 'Find new symptoms', 'Blood test', and 'Laboratory test the'. It features icons of a person with a fever, a person being tested, and a laboratory setting.
- Respond:** Includes 'Isolate patients', 'Public education on symptoms', 'Wear protective gear', and '21 days' (referring to the incubation period). It features icons of a person in a hospital bed, a person being educated, and a person wearing protective gear.
- Prevent:** Includes 'Infection control' and 'Ban bushmeat'. It features icons of a person in protective gear, a person being educated, and a 'BUSHMEAT' sign with a red prohibition symbol over it.

18

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### WHO Key Facts Summary

- Ebola virus disease (EVD), formerly known as Ebola haemorrhagic fever, is a severe, often fatal illness in humans.
- The virus is transmitted to people from wild animals and spreads in the human population through human-to-human transmission.
- The average EVD case fatality rate is around 50%. Case fatality rates have varied from 25% to 90% in past outbreaks.
- Community engagement is key to successfully controlling outbreaks. Good outbreak control relies on applying a package of interventions, namely case management, surveillance and contact tracing, a good laboratory service, safe burials and social mobilization.
- Early supportive care with rehydration, symptomatic treatment improves survival. There is as yet no licensed treatment proven to neutralize the virus but a range of blood, immunological and drug therapies are under development.
- There are currently no licensed Ebola vaccines but 2 potential candidates are undergoing evaluation.

davison@unc.edu

19

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### Example of an Unfolding Case Study of an Outbreak

The purpose of this presentation is to give NP faculty an example of an unfolding case study using a scenario of a patient that has just traveled from India presenting to their primary care provider with a fever and rash to simulate an outbreak investigation.

Concepts reinforced:

- Hx (risk assessment), PE, Diagnostic Reasoning and Plan.
- Primary prevention to include vaccinations,
- Secondary prevention with USPSTF Screenings,
- Outbreak investigation and understanding specificity & sensitivity of lab tests along with reporting communicable diseases.

davison@unc.edu

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### Unfolding Case Study Outline

- Evolving case study composition and student's expected knowledge
- Linear composition (can go forward only with new information revealed),
- Student's background clinical knowledge for differential diagnosis
- Understanding of state and federal public health control measures and at risk populations
- Evidenced based health promotion and disease prevention interventions.

davison@unc.edu

21

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### Student Objectives

Students are expected in this unfolding case study to:

- Ask the important questions in the history of the presenting illness,
- Order the appropriate diagnostic tests based on signs and symptoms provided,
- Report the suspected disease as required via their state health department guidelines,
- Communicate/collaborate with their health care team and with their local health department in case identification and follow up
- and demonstrate leadership skills in promoting evidence-based guidelines for disease prevention and control when educating the public.

davison@unc.edu

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### Outbreak Evolving Case Study

**Outbreak Investigation Evolving Case Study Instructions:**

- Please note that this is an evolving case study, therefore you cannot go back and forward;
- That is you can only progress on to the next question after you have answered the first question and you cannot go back to change answers. There is no time limit to complete this as long as it is submitted by the due date, but save your answers as you go.

Attachments

- MMWR September 13, 2013.pdf
- Reportable Diseases in NC 10a ncar 41a .0101
- USPSTF A and B Recommendations.docx
- Sakai Outbreak Investigation instructions.docx

davison@unc.edu

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### Fictional Case Study: Hx.

Sarah is a 22 year old college student and works part-time as a daycare worker.

- She presents to her student health center with the following chief complaint: " My throat hurts, I have a fever and rash" x 4 days
- **HPI:** c/o rash that "is all over" since yesterday with the onset of "flu like symptoms" beginning several weeks ago. "I felt sick traveling back from India" (states she went on a mission trip to India over school break) c/o fever that has ranged from 100 to 102 degrees F. Also c/o sores in mouth, coughing, sneezing and nasal congestion. Has been taking Tylenol and OTC cold meds with some relief of fever and aches. States she was surrounded by sick contacts; on the trip to India she was working in an HIV positive orphanage and here in the US she works in preschool "kids there are always sick with colds and pink eye". Meaning to her; "I thought it was just a cold until the rash came".

davison@unc.edu

24

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### Fictional Case Study: Hx.

- **ROS:** (see HPI) Positive for fever, chills, malaise, rash, HA, "red eyes" sore throat, swollen lymph nodes, sneezing, & cough. Denies; vomiting, diarrhea, dysuria or vaginal discharge.
- **ALLERGIES:** NKDA or allergies to food/latex
- **Meds:** OCP Birth Control Triphasic; Acyclovir 200mg prn "cold sores"; Tylenol or ibuprofen prn.
- **Past Med Hx:** (Denied surgical hx or hospitalizations)
- HSV type 1 (occasional out breaks of cold sore "when I am in the sun or feel stressed" my NP usually gives me acyclovir Rx prn). Abnormal PAP smear at 18 years old- repeated it six months later and told "it was ok"
- Chlamydia (2 years ago I tested positive; they treated me and my boyfriend at the time with azithromycin and I've never tested positive again)
- Childhood Hx: "chicken pox as a child" and usual childhood illnesses, cough, colds, ear infections etc. Immunizations: "My parents did not believe immunizations, I went to a private school and was exempted"
- **SEXUAL HISTORY and Social Hx - see and print out attachments**

davison@unc.edu

25

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### Part 1: Unfolding Case – Risk Factors

List three risk factors Sarah has for sexually transmitted infections:

- 1.
- 2.
- 3.

What three risk factors does Sarah have for measles?

- 1.
- 2.
- 3.

davison@unc.edu

26

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### Part 2: HIV Test Questions

**The USPSTF recommends that clinicians screen for HIV infection in adolescents and adults ages 15 to 65 years. Younger adolescents and older adults who are at increased risk should also be screened.**

Answer the following question True or False:

Rapid HIV testing may use either blood or oral fluid specimens and can provide results in 5 to 40 minutes. The sensitivity and specificity of the rapid test are also both greater than 99.%; however, initial positive results require confirmation with conventional methods.

- True or False

davison@unc.edu

27

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### Part 3: Objective Findings on PE

Students are given physical exam findings that include: temp 102, generalized maculopapular rash, sclera and conjunctival red and injection both eyes, depressed blue/white spots on buccal mucosa, erythema with ulceration in pharynx and cervical lymphopathy:

Question:

Name 3 physical objective signs that Sarah has consistent with acute HIV infection:

Name 3 physical signs that Sarah has consistent with acute measles (rubeola) infection:

davison@unc.edu

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### Part 4: Lab testing Sensitivity & Specificity

**CLIA Waivered Lab Tests ordered in House:**

- Urine HCG result = negative. Rapid strep = negative monospot test = negative and
- rapid influenza diagnostic test = influenza A and B negative

**Pending Labs (sent out):** Throat culture, CBC, CMP, HIV, RPR, IGG and IGM

- When you read the instructions for some of these CLIA waived lab tests, it refers to sensitivity, specificity and other terms.
- Using a standard 2 x 2 Table, match the following definitions.

False-negative error rate

A.  $(1 - \text{sensitivity})$

- False-positive error rate

B.  $a / (a + b)$ .

- Negative predictive value

C.  $(1 - \text{specificity})$

- Positive predictive value

D.  $d / (c + d)$

davison@unc.edu

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### Part 5: Assessment & Plan

After making your initial assessment, what would be the most appropriate next step response?

- A. Notify the local health department within 24 hours if you suspect it is possibly measles infection
- B. Wait for all labs to return to confirm measles infection.
- C. Contact the CDC for investigation into a potential outbreak.
- D. Vaccinate everyone in your clinic for MMR immediately.

davison@unc.edu

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### Vaccination Questions

If a patient is immune-compromised such as with AIDS, which vaccine would most likely be dangerous to that person?

- A. Diphtheria and Tetanus vaccine
- B. Measles vaccine
- C. Hepatitis B vaccine
- D. Typhoid vaccine (inactivated)

Measles vaccine used to be given to children younger than 1 year of age, but is now delayed until children are 15 months old. The principal reason for the change is:

- A. Infants are immune to measles.
- B. Measles vaccine in infants causes acute disease.
- C. Infants are protected from measles by the Herd immunity.
- D. Maternal antibodies inactivates the measles vaccine in infants.

davison@unc.edu

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### Part 6: State Lab Results

The State Laboratory confirmation was achieved by means of serologic testing for immunoglobulin G (IgG) and M (IgM) antibodies, isolation of the virus, and reverse-transcriptase polymerase chain reaction (RT-PCR) evaluation for measles. Genotype D8, the most commonly identified measles genotype in India was identified.

What is the most appropriate sequence of action in an outbreak investigation?

- Establish a tentative diagnosis (to specify the disease to be investigated)
- Establish the case definition (to distinguish cases from non-cases)
- Determine whether an epidemic is occurring
- Characterize the epidemic by time, place, and person; (this allows hypotheses on source & route)
- Develop hypotheses regarding spread (source, patterns of spread and mode of transmission) Test hypotheses (lab studies)
- Initiate control measures (sanitation, prophylaxis, dx and treatment)

davison@unc.edu

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### Part 7: Talking to Parents of Unvaccinated Children.

You just found out your child goes to an elementary school with only a 70% vaccination rate due to philosophical exemptions. As a health care provider, you know vaccines confer active immunity to many serious infectious diseases. Using the **Health Belief Model** as a guide for you to talk to the parents and staff about the measles disease and the MMR vaccine protection from the disease, fill in the word(s) for the 4 beliefs that parent(s) generally must believe before vaccinating their child.

- The disease is \_\_\_ if acquired
- They or their children are personally \_\_\_ for the disease
- The vaccine is \_\_\_ in preventing the disease
- There are no \_\_\_ risks or barriers involved in vaccinating their child

davison@unc.edu

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### Follow up with Sarah and Prevention

Sarah tells you she would like to be immunized for other potential infections that are prevented by vaccines. Which of the following immunization(s) would you recommend she get?

(choose only one answer)

- A. Influenza
- B. Tetanus, diphtheria, & pertussis (Tdap)
- C. Human papillomavirus virus (HPV)
- D. All of the above, in addition to others for adults that are recommended even in pregnancy and immune-compromised conditions.

davison@unc.edu

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Informational Websites:

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- Compassion Med International: <http://www.compassionmed.org/>
- Nets for Life <http://www.netsforlifeffrica.org/where-we-work/sierra-leone>
- WHO: <http://www.who.int/countries/sierraleone/>
- <http://www.who.int/csr/disease/ebola/en/>

davison@unc.edu

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For further information contact  
Jean Ann Davison email: [davison@unc.edu](mailto:davison@unc.edu)  
[www.compassionmed.org](http://www.compassionmed.org)



davison@unc.edu

36

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