# Ebola: Where are we now?

DIVISION OF INFECTIOUS DISEASES, METROHEALTH MEDICAL CENTER



- I have no conflicts of interest
- ► I will be discussing medications and vaccines in development.

### Objectives

- Participant will be able to describe the signs and symptoms of Ebola Virus disease (EVD)
- Participant will be able to describe use of personal protective equipment for prevention of Ebola
- Participant will implement measures to help identify potential cases of EVD

#### Outline

Overview of current outbreak of EVD
Ebola Virus signs/symptoms/disease course
Potential Vaccine/Treatment
Recommended PPE/hospital preparation

#### Current Ebola Outbreak in West Africa

#### Case Counts as of 1/16/15

#### Countries with Widespread Transmission

Country	Total Cases	Laboratory-Confirmed Cases	Total Deaths
Guinea	2825	2525	1829
Liberia	8362	3127	3556
Sierra Leone	10186	7825	3083
Total	21373	13477	8468

#### Liberia: Case Fatality Rate 42.5%

Graph 3: Cumulative reported cases and deaths of Ebola virus disease in Liberia, March 25, 2014 – January 14, 2015, by date of WHO Situation Report, n=8331



#### Guinea: CF Rate 64.7% Overall

Graph 2: Cumulative reported cases and deaths of Ebola virus disease in Guinea, March 25, 2014 – January 14, 2015, by date of WHO Situation Report, n=2806



#### Sierra Leone: Overall CF rate 30.2%

Graph 4: Cumulative reported cases and deaths of Ebola virus disease in Sierra Leone, March 25, 2014 – January 14, 2015, by date of WHO Situation Report, n=10124



Graph 4 shows the cumulative reported cases and deaths in Sierra Leone provided in <u>WHO situation reports</u> beginning on March 25, 2014 through the most recent situation report on January 14, 2015.



#### **EBOLA SITUATION REPORT**

#### 14 JANUARY 2015

#### SUMMARY

- Guinea reported its lowest weekly total of new confirmed Ebola virus disease (EVD) cases since the week ending 17 August 2014. Case numbers remain low in Liberia, with no confirmed cases nationally for the final 2 days of the week ending 11 January, and the lowest weekly total of confirmed cases since the first week of June 2014. Sierra Leone has now reported a decline in case incidence for the second week running, and recorded its lowest weekly total of new confirmed cases since the week ending 31 August 2014.
- Each of the intense-transmission countries has sufficient capacity to isolate and treat patients, with more than 2 treatment beds per reported confirmed and probable case. However, the uneven geographical distribution of beds and cases, and the under-reporting of cases, means that not all EVD cases are isolated in several areas.
- Similarly, each country has sufficient capacity to bury all people known to have died from EVD. However, the under-reporting of deaths means that not all burials are done safely.

#### WHO Situation Report Jan 14, 2015

- Guinea, Liberia and Sierra Leone report that between 84% and 99% of registered contacts are monitored, though the number of contacts traced per EVD case remains lower than expected in many districts. In areas where transmission has been driven down to low levels, rigorous contact tracing will be essential to break chains of transmission. In the week to January 11, 15% of new confirmed cases in Guinea arose from known contacts (equivalent information is not yet available for Liberia and Sierra Leone).
- There are currently 27 laboratories providing case-confirmation services in the 3 intense-transmission countries. Four more laboratories are planned in order to meet demand.
- Case fatality among hospitalized patients (calculated from all hospitalized patients with a reported definitive outcome) is between 57% and 60% in the 3 intense-transmission countries.
- A total of 825 health-care worker infections have been reported in the 3 intense-transmission countries; there
  have been 493 reported deaths.
- Many elements of the response to the Ebola outbreak, from safe burials to contact tracing, rely on actively
  engaging affected communities to take ownership of the response. At present, 33 of 38 (87%) of districts in
  Guinea, 100% of districts in Liberia, and 57% (8 of 14) of districts in Sierra Leone have systems in place to
  monitor community engagement activities.

#### Summary of Current Epidemic

#### Initial Events

#### Current outbreak started in Guinea

- First case was an 18 month old boy who developed fever and black stools on 12/26/13, then died 2 days later; likely through contact with animals
- Case occurred in a small village, in area known as Forest Region
- Much of the forest destroyed by mining and timber operations, leaving animals in closer contact with humans
- Within 2 weeks, family members became ill followed by midwives, healers and hospital staff at nearby hospital
- district health officials informed 1/24/14 of 5 cases of severe diarrhea with death; investigation done without firm conclusion, but thought to be cholera
- MSF group also investigated 1/27/14, and also concluded likely cholera

### Beginning of Epidemic

- 2/1/14, Ebola was brought into Conakry, capital city of Guinea, by member of boy's extended family; he died in hospital 4D later; Ebola not suspected
- No infection control measures in place to protect staff or other patients, as Ebola not suspected
- Cases spread to multiples villages; investigation by MSF 3/14 found epidemiological links to initial cases
- 3/21/14: Ebola Zaire strain confirmed as causative agent
- By this point, 49 cases and 29 deaths officially reported
- Cases had also been exported to Sierra Leone and Liberia by this time

## Factors Contributing to Spread of Ebola

- Ebola epidemics have not occurred in cities, and no major outbreaks in West Africa
- Healthcare workers in this area would not suspect Ebola; it was 3 months before disease was recognized
- By the time Ebola Virus was confirmed as causative agent, there was already widespread dissemination in an area with little healthcare, and no means of diagnosing this virus
- Guinea, Sierra Leone and Liberia are among the poorest countries, and have few resources, which contributed to spread of epidemic
- Traditional burial rituals, including returning to the native village to die and be buried contributed to the dissemination of this illness
- These countries had 1-2 doctors/100,000 population; nearly half of those are now dead from Ebola

#### Healthcare Workers

- In prior outbreaks, hospitals were main source of transmission
- Because so many people were infected, transmission in community was a greater factor here
- as the epidemic went on and started to decline, lapses in IC precautions were occurring, contributing to more cases in HCW's
- MSF had 3400 staff working in affected countries; 27 became infected and 13 died; infections occurred in communities, not treatment facilities
- Burial practices have been a major source of transmission, as in prior outbreaks
  - corpses are highly infectious, and mourners bathe the dead and may sleep near a corpse for several nights

#### Additional Factors

- Cases have also been traced to contact with traditional healers, who are main healthcare providers
- There was suspicion of hospitals as many people entered and never left; people also didn't want to forgo the traditional burial rites
- Communities resisted safe burial, as bodies not picked up in timely manner due to lack of resources, and not always buried in a dignified manner
- Hospital workers and burial teams also were on strike due to lack of pay, further impeding control efforts
- Public health messages about the seriousness of this disease, led people to care for sick at home, as there was no hope anyway
- The sick also were hidden in homes due to fear of stigma

#### Causative Strains

- The current outbreak is caused by Ebola Virus Zaire, but paper published in 8/2014 demonstrated a rapidly evolving virus, with several different strains infecting people
- Blood samples taken from 78 people between May to mid-June demonstrated at least 2 different strains introduced from Guinea at about the same time
- It is believed that bats migrated from central Africa and brought Ebola to West Africa
- The genomic sequences also showed rapid changes taking place, which would impact both PCR tests used for diagnosis as well as potential treatments
- Of the more than 50 individuals who contributed to the paper above, 5 had died of Ebola by the time it was published

#### Vaccines

Two vaccines currently being tested; one developed by GlaxoSmithKline in collaboration with the National Institute of Allergy and Infectious Diseases, the other by Merck in collaboration with the Public Health Agency of Canada

### Drug Therapies

- Pre-existing medications were evaluated in vitro for activity against Ebola
- ► Favipiravir and Brincidofovir were found to have activity
- Favipiravir entered clinical trials in Guinea in 12/14
- Brincidofovir was used in U.S. and clinical trial is planned in Liberia

#### Favipiravir

- antiviral medication from Japan that has activity against a number of viruses including: influenza, yellow fever, West Nile Virus, and hemorrhagic fever viruses
- it is effective in a mouse model of EVD: if given within 6 days of infection, there was 100% survival rate in mice
- the drug is oral, immediately available, and is safe

### Brincidofovir

- Antiviral agent used for some of the U.S. cases
- Effective against CMV, adenovirus, smallpox and Ebola
- oral nucleotide analog with broad-spectrum in vitro activity against all five families of DNA viruses that affect humans, including viruses in the herpes virus family and adenovirus.
- Brincidofovir has shown no evidence of kidney or bone marrow toxicity in nearly 900 patients treated to date
- It has received fast track designation by FDA for CMV and adenovirus

#### Lessons Learned from 2014

- Countries with weak healthcare systems cannot handle the impact of a disease such as Ebola, or any major catastrophe. Healthcare systems need to be available in order to have social stability.
- Being prepared for imported cases can stop the spread of the epidemic. Countries that treated initial cases as an emergency were able to halt the spread of disease: Nigeria, Senegal, Mali
- Contact tracing and isolation of any potential cases is needed to halt spread in communities
- Trust and engagement from communities affected by Ebola is essential. Without this, cases are hidden, and transmission goes on.

#### Ebola in Nigeria

- American-Liberian man, working for ArcelorMittal (large international mining company), had a sister who died 7/8/14 from Ebola
- An internal memo at the company stated that a worker's family member had died, but that there was minimal contact
- He was under observation in Liberia for 21D, but despite this, boarded a plane to Lagos to attend a conference in Nigeria
- Video footage shows him looking obviously sick in the airport (lying on the floor in the airport) and became very ill on the plane

#### First Case Nigeria

- He was taken to hospital immediately on landing
- Even though he was under observation and known to have contact with a case, Liberian officials allowed him to travel to Nigeria
- Once in hospital, there was immense pressure on hospital staff to allow him to be discharged and attend the conference
- He died 5 days after arrival in Nigeria
- This pt has been identified as Patrick Sawyer, who had planned to return to Minnesota, where his wife and children live a few days after the conference.

### Ebola in Nigeria

- Sawyer was taken by a diplomat to hospital; this person eloped to Port Harcourt despite being under quarantine, and was treated by a private physician in a hotel room; physician was the second case in Nigeria and died
- the diplomat was eventually located and tested positive for Ebola antibodies, but survived
- The physician who treated the diplomat became ill, saw patients in his clinic and performed surgery 8/11-13; he became more ill and stayed home 8/13, was hospitalized 8/16 and seen by most of the hospital staff during his 6D hospital stay until he died.
- Physician's wife, also a physician, is also ill as well as a patient in hospital.
- As of 8/31, Nigeria has 21 cases and 7 deaths. There was no Ebola in Nigeria prior to this individual's travel.

#### Current Travel Screening

- All travelers screened at point of exit from countries with high rates of transmission
- All travelers screened for symptoms at airports in Europe and again in U.S.
- All travelers from affected areas must provide contact information and location of travel in U.S.
- Local health departments contact each traveler for 21D after arrival
- It is extremely unlikely that an individual would show up without warning in a hospital or clinic

#### Filoviruses

#### Filoviruses

- Ebolavirus is 1 of 3 members of the Filoviridae family along with Marburgvirus and Cuevavirus. Genus Ebolavirus comprises 5 distinct species: Bundibugyo ebolavirus (BDBV), Zaire ebolavirus (EBOV), Reston ebolavirus (RESTV), Sudan ebolavirus (SUDV), Taï Forest ebolavirus (TAFV).
- BDBV, EBOV, and SUDV have been associated with large EVD outbreaks in Africa, whereas RESTV and TAFV have not.
- The RESTV species, found in Philippines and the People's Republic of China, can infect humans, but no illness or death in humans from this species has been reported to date.
- These viruses have been associated with large hemorrhagic fever outbreaks with case fatality rates 53-90%
- Ebolavirus species have genomes that are 30-40% different from each other, reflecting different ecological niches

#### Filoviruses

- First known outbreak of Marburg virus occurred in 1967 in lab workers handling African green monkeys; 31 cases and 23% mortality rate. Few additional cases have been seen, all in travelers
- First recognized Ebola outbreaks in Democratic Republic of Congo and Sudan in 1976
- Outbreaks were self-limited because of the high mortality rate among healthcare workers, leading to closure of hospitals/clinics and loss of major route of exposure

#### Transmission

- Natural reservoir not definitely known; appears to be spread from animals
- Initial cases may arise from butchering animals infected with Ebola or handling dead animals (primates, forest antelopes, fruit bats, porcupines)
- Ebola is spread through direct contact of mucous membranes or non-intact skin with body fluids or objects than have been contaminated with body fluids
- Healthcare workers and the family and friends in close contact with Ebola patients are at the highest risk of getting sick due to contact with body fluids

#### Exposure

- Most common route of exposure is via body fluid (blood, vomit, sweat, stool, etc.) exposure during funeral rites
- Family members preparing the body for burial, traditional healers, healthcare workers are all at risk via this route
- Patients both alive and dead are potential sources of infection
- Ebola is excreted in breast milk : Length of viral shedding in breast milk unknown
- Individuals who survive Ebola can have virus in semen for up to 3 months, so sexual transmission can occur
- Contact with contaminated linens or medical equipment
- Virus does not survive long on surfaces, unless contaminated with body fluids

#### Animal Exposure

- Exposure to infected animals (often bats or primates) alive or dead; handling or consumption of infected animals
- Virus killed when meat thoroughly cooked, but butchering the animal causes exposure to infected fluids
- Going into fields or near trees where infected bats roost can also be a source of exposure

#### Natural Reservoirs

- Species of fruit bats implicated as reservoirs for Zaire ebolavirus, and a cave-dwelling fruit bat linked to Marburg virus
- Different species of bats may be the natural reservoirs for different species of ebolaviruses, and can infect other animals and humans

#### Clinical Illness

### **Clinical Presentation**

- ILI 8-12D (mean 9-11D in this outbreak) after exposure, with abrupt onset of fever, chills, myalgias, malaise, anorexia, intense weakness, muscle pain, headache and sore throat
- Initial symptoms followed by vomiting, diarrhea, rash, impaired kidney and liver function, and in some cases, both internal and external bleeding.
- Incubation period range is 2-21D after exposure in current outbreak, but in current outbreak 8-10D
- Diffuse erythematous maculopapular rash may develop days 5-7 after onset of illness, that can desquamate.

#### Presentation cont'd

- After about 5D of nonspecific symptoms, puts develop severe watery diarrhea, nausea, vomiting and pain
- Pts can also develop SOB, HA, change in mental status, chest pain and conjunctival injection may occur
- Hiccups have been reported and may be a sign of pericarditis
- Bleeding doesn't occur in all cases, and can show up as petechiae, ecchymosis/bruising, or oozing from venipuncture sites and mucosal hemorrhage. Bleeding seen in 18% of puts in current outbreak.
- Patients may develop a diffuse erythematous maculopapular rash by day 5 to 7 (usually involving the neck, trunk, and arms) that can desquamate.
- The most common signs and symptoms reported from West Africa during the current outbreak from symptom-onset to the time the case was detected include: fever (87%), fatigue (76%), vomiting (68%), diarrhea (66%), and loss of appetite (65%).

#### Severe Disease

- Patients with fatal disease usually develop more severe clinical signs early during infection and die typically between 6-16D
- Death occurs from complications including multi-organ failure and septic shock
- CF in West Africa with a known outcome is about 71% (ranges from 46% in Nigeria to 69%-72% in Guinea, Liberia, and Sierra Leone).
- Risk factors associated with fatal outcome include, age >45, unexplained bleeding, and a number of other signs and symptoms (diarrhea, chest pain, cough, difficulty breathing, difficulty swallowing, conjunctivitis, sore throat, confusion, hiccups, and coma or unconsciousness).

### Pathogenesis

- Virus enters through mucous membranes, breaks in the skin, or parenterally and infects many cell types (monocytes, macrophages, dendritic cells, endothelial cells, fibroblasts, hepatocytes, adrenal cortical cells and epithelial cells).
- The incubation period may be related to the infection route (e.g., 6 days for injection versus 10 days for contact).
- Virus migrates from initial infection site to regional lymph nodes and then to liver, spleen and adrenal gland.
- Although not infected by EV, lymphocytes undergo apoptosis resulting in decreased lymphocyte counts. Hepatocellular necrosis occurs and is associated with dysregulation of clotting factors and subsequent coagulopathy.
- Adrenocortical necrosis can be found and is associated with hypotension and impaired steroid synthesis. Ebola virus appears to trigger a release of proinflammatory cytokines with subsequent vascular leak and impairment of clotting ultimately resulting in multi-organ failure and shock

### Lab Findings

- Leukopenia, frequently with lymphopenia followed later by elevated neutrophils and left shift.
- Thrombocytopenia (50-100K)
- Amylase may be elevated, reflecting pancreatic involvement
- Hepatic transaminases are elevated with AST exceeding alanine ALT; values may peak at more than 1,000 IU/L.
- Proteinuria may be present.
- PT and PTT are prolonged and fibrin degradation products are elevated, consistent with DIC

### Differential Diagnosis

- Malaria
- Typhoid
- Shigellosis
- Meningococcal disease
- Other viral hemorrhagic fevers: Lassa fever, Yellow fever, Rift Valley fever, etc.

#### Immune Responses in Ebola

- Immune dysfunction occurs early in Ebola infection and determines fate of individuals at an early stage of illness
- Asymptomatic cases of Ebola occur. These individuals have high levels of IL-1β, IL-6 and TNFaa- early in infection, and are able to control viral replication
- People who die have early massive macrophage/monocyte activation, and extensive intravascular T-cell apoptosis with insufficient levels of IL-1β, IL-6 and TNF-a
- Presence of elevated levels of IL-1β and IL-6 during the early symptomatic period can be used as markers for nonfatal disease
- Early and well-regulated immune responses are associated with survival, whereas massive macrophage/monocyte activation and defective immune responses are associated with death

#### **Experimental Therapies**

- Convalescent serum from patients usually has low levels of antibodies, but hyperimmune horse serum has been found to be protective in baboons and guinea pigs, but not rhesus monkeys or mice
  - production of monoclonal antibodies against Ebola virus surface protein from mRNA extracted from bone marrow of Kikwit survivors is a possibility for future safe therapeutic antibodies

### ZMapp

- Combination highly purified monoclonal antibodies
- Components produced in a nicotine plant according to standard manufacturing guidelines
- In rhesus monkeys, Zmapp given as late as 5 days post exposure to a lethal intramuscular dose of Ebola virus provided protection
- One monkey with very high levels of viremia did not survive, and it is postulated that higher doses may be needed according to level of viremia
- This potential drug is preferable to whole blood transfusions used in the Kikwit outbreak, and may be a viable treatment option in the future
- Whether this drug provided any benefit to the few humans who have been treated is unknown, as this was not done in the context of a clinical trial

#### **EVD** Case Definitions

#### Person Under Investigation (PUI)

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

- Clinical criteria, which includes fever of greater than 38.6 degrees Celsius or 101.5 degrees Fahrenheit, and additional symptoms such as 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 below)

#### **Confirmed Case**

A case with laboratory-confirmed diagnostic evidence of Ebola virus infection

#### Infection Control for Suspect/Confirmed EVD

#### Key Components of Standard, Contact, and Droplet Precautions Recommended for Prevention of EHF Transmission in U.S. Hospitals

Component	Recommendation	Comments
Patient Placement	<ul> <li>Single patient room (containing a private bathroom) with the door closed</li> <li>Facilities should maintain a log of all persons entering the patient's room</li> </ul>	<ul> <li>Consider posting personnel at the patient's door to ensure appropriate and consistent use of PPE by all persons entering the patient room</li> </ul>
Personal Protective Equipment (PPE)	<ul> <li>All persons entering the patient room should wear at least: <ul> <li>Gloves</li> <li>Gown (fluid resistant or impermeable)</li> <li>Eye protection (goggles or face shield)</li> <li>Facemask</li> </ul> </li> <li>Additional PPE might be required in certain situations (e.g., copious amounts of blood, other body fluids, vomit, or feces present in the environment), including but not limited to: <ul> <li>Double gloving</li> <li>Disposable shoe covers</li> <li>Leg coverings</li> </ul> </li> </ul>	<ul> <li>Recommended PPE should be worn by HCP upon entry into patient rooms or care areas. Upon exit from the patient room or care area, PPE should be carefully removed without contaminating one's eyes, mucous membranes, or clothing with potentially infectious materials, and either</li> <li>Discarded, or</li> <li>For re-useable PPE, cleaned and disinfected according to the manufacturer's reprocessing instructions and hospital policies.</li> <li>Instructions for donning and removing PPE have been published</li> <li>Hand hygiene should be performed immediately after removal of PPE</li> </ul>

#### IC cont'd

#### Aerosol Generating Procedures (AGPs)

- Avoid AGPs for Ebola HF patients.
- If performing AGPs, use a combination of measures to reduce exposures from aerosol-generating procedures when performed on Ebola HF patients.
- Visitors should not be present during aerosol-generating procedures.
- Limiting the number of HCP present during the procedure to only those essential for patient-care and support.
- Conduct the procedures in a private room and ideally in an Airborne Infection Isolation Room (AIIR) when feasible. Room doors should be kept closed during the procedure except when entering or leaving the room, and entry and exit should be minimized during and shortly after the procedure.
- HCP should wear gloves, a gown, disposable shoe covers, and either a face shield that fully covers the front and sides of the face or goggles, and respiratory protection that is at least as protective as a NIOSH certified fit-tested N95 filtering facepiece respirator or higher (e.g., powered air purifying respiratory or elastomeric respirator) during aerosol generating procedures.
- Conduct environmental surface cleaning following procedures (see section below on environmental infection control).
- If re-usable equipment or PPE (e.g. Powered air purifying respirator, elastomeric respirator, etc.) are used, they should be cleaned and disinfected according to manufacturer instructions and hospital policies.
- Collection and handling of soiled re-usable respirators must be done by trained individuals using PPE as described above for routine patient care

- Although there are limited data available to definitively define a list of AGPs, procedures that are usually included are Bilevel Positive Airway Pressure (BiPAP), bronchoscopy, sputum induction, intubation and extubation, and open suctioning of airways.
- Because of the potential risk to individuals reprocessing reusable respirators, disposable filtering face piece respirators are preferred.

#### Room Cleaning

- Be sure environmental services staff wear recommended personal protective equipment including, at a minimum, disposable gloves, gown (fluid resistant/ impermeable), eye protection (goggles or face shield), and facemask to protect against direct skin and mucous membrane exposure of cleaning chemicals, contamination, and splashes or spatters during environmental cleaning and disinfection activities. Additional barriers (e.g., leg covers, shoe covers) should be used as needed. If reusable heavy-duty gloves are used for cleaning and disinfecting, they should be disinfected and kept in the room or anteroom. Be sure staff are instructed in the proper use of personal protective equipment including safe removal to prevent contaminating themselves or others in the process, and that contaminated equipment is disposed of as regulated medical waste.
- Use a U.S. Environmental Protection Agency (EPA)-registered hospital disinfectant with a label claim for a non-enveloped virus (e.g., norovirus, rotavirus, adenovirus, poliovirus) to disinfect environmental surfaces in rooms of patients with suspected or confirmed Ebola virus infection. Although there are no products with specific label claims against the Ebola virus, enveloped viruses such as Ebola are susceptible to a broad range of hospital disinfectants used to disinfect hard, non-porous surfaces. In contrast, non-enveloped viruses are more resistant to disinfectants. As a precaution, selection of a disinfectant product with a higher potency than what is normally required for an enveloped virus is being recommended at this time. EPA-registered hospital disinfectants with label claims against non-enveloped viruses (e.g., norovirus, rotavirus, adenovirus, poliovirus) are broadly antiviral and capable of inactivating both enveloped and non-enveloped viruses.
- Avoid contamination of reusable porous surfaces that cannot be made single use. Use only a mattress and pillow with plastic or other covering that fluids cannot get through. Do not place patients with suspected or confirmed Ebola virus infection in carpeted rooms and remove all upholstered furniture and decorative curtains from patient rooms before use.
- To reduce exposure among staff to potentially contaminated textiles (cloth products) while laundering, discard all linens, non-fluid-impermeable pillows or mattresses, and textile privacy curtains as a regulated medical waste.

#### Collecting Lab Specimens

- Health department needs to be notified immediately of any suspected cases.
- Any specimen should be hand carried to lab, not sent through tube system
- All specimens from a suspect case, not just diagnostic specimens, any lab test, has to be placed in a secondary container prior to transport; secondary containers are available from the lab; lab must be notified prior to delivering any specimens

#### **Collection Procedures**

**Recommendations for specimen collection by staff**: Any person collecting specimens from a patient with a case of suspected Ebola virus disease should wear gloves, water-resistant gowns, full face shield or goggles, and masks to cover all of nose and mouth Additional PPE may be required in certain situations.

**Recommendations for laboratory testing by staff**: Any person testing specimens from a patient with a suspected case of Ebola virus disease should wear gloves, water-resistant gowns, full face shield or goggles, and masks to cover all of nose and mouth, and as an added precaution use a certified class II Biosafety cabinet or Plexiglass splash guard with PPE to protect skin and mucous membranes. All manufacturer-installed safety features for laboratory instruments should be used.

### Diagnosis

Timeline of Infection	Diagnostic tests available
Within a few days after symptoms begin	<ul> <li>Antigen-capture enzyme-linked immunosorbent assay (ELISA) testing</li> <li>IgM ELISA</li> <li>Polymerase chain reaction (PCR)</li> <li>Virus isolation</li> </ul>
Later in disease course or after recovery	IgM and IgG antibodies
Retrospectively in deceased patients	<ul> <li>Immunohistochemistry testing</li> <li>PCR</li> <li>Virus isolation</li> </ul>

#### Ebola and Pregnancy

- No evidence that pregnant women are more susceptible to infection from Ebola than general population
- Limited evidence that pregnant women are likely to be at increased risk of severe illness and death when infected with Ebola
- Pregnant women with Ebola also appear to be at an increased risk of fetal loss and pregnancy-associated hemorrhage
- In previous outbreaks in Africa, infants born to mothers with Ebola have not survived, but whether Ebola was the cause of death has not always been known.

#### Pregnancy

- Most pregnant women present with intra-uterine fetal death
- In countries where Ebola is occurring, 3-5% of the general population is pregnant.
- Differentiating EVD from other problems is very difficult as bleeding and fever can happen from other causes during pregnancy

### Procedures for Pregnant Women in Iow-Resource Countries

- C-sections and vacuum aspiration are considered very high risk, and are not done as the risk to medical staff is too great.
- Also, prognosis for both the mother an infant are very poor.
- Give oral medications if possible instead of IV
- Place IV early, when pt is not yet in labor to avoid needlesticks
- No induction of labor if patient is viremic/febrile

# Management of Labor (MSF Guidelines)

- Wait for spontaneous labor, even if it takes several days, to protect medical staff.
- Artificial rupture of membranes should be avoided
- Even if patient no longer has fever, the amniotic fluid/placenta still contain virus for unknown period
- If fetus survives, it will also have virus for unknown time period
- No artificial rupture of membranes
- Iimit pelvic exams to absolute minimum
- During Delivery: no episiotomy, no vacuum extraction, no destructive delivery (craniotomy)
- Obstructed labor is managed expectantly

### Labor cont'd

- ▶ No fetal monitoring, since no actions taken if not normal or absent
- No clamping or cutting of the umbilical cord; when baby is stillborn, no need for clamping or cutting cord
- when delivering placenta, prevent splashes
- ▶ if baby is born alive, clamp cord and cut with disposable scissors

### Labor cont'd

- No suturing of any tears to avoid needlestick injuries
- Risk of getting Ebola through needlestick injuries is close to 100%
- no vaginal exams after delivery
- oxytocin IM or misoprostol po is given to prevent postpartum hemorrhage
- no controlled cord traction; wait at side of patient for placenta to deliver spontaneously to avoid splashes

#### Complications

- Postpartum hemorrhage is a common complication; use usual drugs; no suturing of any tears, no bimanual compression of the uterus in order to avoid splashes
- Retained Placenta: await spontaneous delivery. No manual removal. Can be given trial of oxytocin or misoprostol as an alternative
- Retained products of conception after miscarriage: no D&C. Misoprostol.
- Complications requiring surgery are not treated: morphine.

### Infant Care in Low-Resource Settings

- Likelihood of survival approaches zero.
- If mother is able to breastfeed, this is preferred (in low-resource countries, not U.S.)
- Baby is considered contagious. Both the mother an infant should be considered to be contagious.
- When the baby does not survive, medication to stop milk production should be administered to the mother.
- For lactating women who develop EVD, milk should be expressed with a pump to prevent engorgement. Women should not resume breastfeeding as virus remains in milk for an indeterminate period of time.

#### Personal Protective Equipment

### Personal Protective Equipment (PPE)

- PPE must be donned correctly in proper order before entry into the patient care area and not be later modified while in the patient care area. The donning activities must be directly observed by a trained observer
- PPE must remain in place and be worn correctly for the duration of exposure to potentially contaminated areas. PPE should not be adjusted during patient care.
- Healthcare workers should perform frequent disinfection of gloved hands using an ABHR, particularly after handling body fluids.
- If during patient care a partial or total breach in PPE (e.g., gloves separate from sleeves leaving exposed skin, a tear develops in an outer glove, a needlestick) occurs, the healthcare worker must move immediately to the doffing area to assess the exposure. Implement the facility exposure plan, if indicated by assessment.

### Doffing PPE

- The removal of used PPE is a high-risk process that requires a structured procedure, a trained observer, and a designated area for removal to ensure protection
- PPE must be removed slowly and deliberately in correct sequence to reduce the possibility of self-contamination
- A stepwise process should be developed and used during training and daily practice
- Double gloving provides an extra layer of safety during direct patient care and during the PPE removal process. Beyond this, more layers of PPE may make it more difficult to perform patient care duties and put healthcare workers at greater risk for percutaneous injury (e.g., needlesticks), self-contamination during care or doffing, or other exposures to Ebola. If healthcare facilities decide to add additional PPE or modify this PPE guidance, they must consider the risk/benefit of any modification, and train healthcare workers on correct donning and doffing in the modified procedures.

#### Ebola: Personal Protective Equipment (PPE) Donning and Doffing Procedures

#### Select Personal Protective Equipment

Begin by clicking on the type of respirator you will be using.



Personal Protective Equipment (PPE) is intended to prevent contact with the infectious agent, or body fluid that may contain the infectious agent, by creating a barrier between the worker and the infectious material. Gloves protect the hands, gowns or coveralls protect the skin and/or clothing, masks and respirators protect the mouth and nose, and face shields protect the entire face.

#### Comprehensive Training Videos

- Trained Observer
- Donning N95 Respirator & Coveralls
- Doffing N95 Respirator & Coveralls
- Donning N95 Respirator & Gown
- Doffing N95 Respirator & Gown
- Donning Personal Air Purifying Respirator & Coveralls
- Doffing Personal Air Purifying Respirator & Coveralls
- Donning Personal Air Purifying Respirator & Gown
- Doffing Personal Air Purifying Respirator & Gown

More >

### Disinfection

#### Figure 1: Decreasing order of resistance of microorganisms to disinfection and sterilization.

Resistant to disinfection sterilization processes Prions (e.g., Creutzfeldt-Jakob Disease) Bacterial spores (Bacillus atrophaeus) Coccidia (Cryptosporidium) Mycobacteria (M. tuberculosis, M. terrae) Mycobacteria (M. tuberculosis, M. terrae) Non-enveloped viruses (polio, coxsackie, norovirus) Fungi (Aspergillus, Candida) Vegetative bacteria (S. aureus, P. aeruginosa) Lenveloped viruses (Ebola, HIV, herpes, hepatitis B) Susceptible

Modified from Russell (1998) and Favero (2001).

#### What have we learned?

- Almost every research paper discussing Ebola ends with a warning regarding the likelihood of future epidemics.
- Having inadequate health facilities and inability to adhere to standard infection control precautions anywhere in the world, puts all of us at potential risk.
- The current epidemic is an international problem. It is our problem. Failure to put the proper resources in place to assist countries that cannot contain the epidemic puts the entire world at risk.
- Proper infection control precautions, early recognition of cases and proper isolation/quarantine of cases can stop the spread of Ebola.

#### Questions?