Infection Prevention and Control for Healthcare Workers

This lecture describes infection prevention and control principles for healthcare workers in Ebola Treatment Units (ETUs) in Africa. Please note infection prevention and control measures described in this lecture are somewhat different from those used in hospitals in the United States. In addition, these infection prevention and control recommendations might be different from those you encounter in the ETU to which you are deployed. However, the principles described should help you understand the rationale underlying infection prevention and control recommendations, and help you stay safe during deployment.

The learning objectives for this lecture are to:

▶ Explain the rationale for recommended infection prevention and control principles for Ebola virus
▶ Describe infection prevention and control principles currently recommended for Ebola virus
▶ Describe the principles of using personal protective equipment (PPE) safely in the ETU
First, let’s review how Ebola virus is transmitted. A primary transmission route is contact transmission. Direct contact means contact with body fluids such as blood, saliva, mucus, vomit, urine, or feces from an infected person, whether alive or dead. This can occur if you touch your eyes, nose, mouth, or abrasion with contaminated hands or other objects. Percutaneous injuries, such as a needlestick, can also transmit the virus.

Sexual contact and breastfeeding may be possible routes for virus transmission.

Ebola can theoretically be transmitted by large droplets generated by coughing, sneezing, or talking. These large droplets may be produced during certain medical procedures, such as resuscitation, suctioning, or bronchoscopy. However, there is no evidence of aerosol transmission (transmission through tiny airborne droplets containing virus that remain suspended in the air for long periods of time, or dust particles containing the virus). Airborne transmission does not fit the epidemiologic pattern seen in this epidemic or other Ebola outbreaks.

By understanding the ways that Ebola virus is transmitted, you will be able to understand why standard, contact, and droplet precautions are recommended.

The key elements of healthcare precautions that we will discuss today are hand and respiratory hygiene, PPE, and injection and medication safety. However, other infection prevention and control measures are also critically important, including appropriate use and cleaning of patient care equipment, cleaning of the ETU environment, and safe management of corpses. These measures will be discussed in a later lecture.
Standard infection prevention and control principles, similar to those you would routinely follow in a U.S. healthcare setting, are the minimum required in the ETU and in patient intake areas. Triage and rapid isolation of suspected cases are critical to eliminate unprotected contact between patients suspected to have Ebola, staff, and other possibly uninfected persons.

Standard principles you are already familiar with are also used in the ETU:

- Perform hand hygiene.
- Use PPE, including gloves, suits, and masks and facial protection (goggles/shields) when you interact with patients suspected to have Ebola.
- Ensure safe injection practices and safe handling, cleaning, and disinfection of equipment and surfaces.
- Ensure safe waste management.

For maximum infection prevention and control, placing patients in a single room is optimal. However, in African ETUs, it is far more common to have multiple patients in an open area. If this is the case, then patients suspected to have Ebola and those confirmed to have Ebola should be in separate areas, with beds at least one to two meters, or three to six feet, apart. You will want to restrict movement between the two areas. However, this can be challenging when family cohorts wish to remain together, especially those where young children are involved. And as expected, you will want to use disposable equipment where possible, or disinfect all equipment between patients. You will hear more about ETU setup and design in another lecture.

Hand hygiene cannot be stressed enough. It is a critical component to stop the spread of the Ebola virus disease.
Outside the high-risk zone of the ETU, when hands are ungloved, wash your hands regularly. This includes when entering and leaving the ETU environment. Use soap and water, 0.05% chlorine solution, or an alcohol-based hand rub. Contaminated hands are the most common way to transfer contaminated material to mucous membranes in the eyes, mouth, and nose.

Handwashing must be very thorough. This slide shows how to perform good hand hygiene and appropriate techniques.

While in the high-risk zone of the ETU, always remember to wear double gloves. Remove any gloves that become torn or damaged. If you suspect you have torn a glove through to skin level, leave the ETU immediately and remove PPE following your ETU’s doffing procedures. You can then re-don a new set of PPE following the usual procedures.

Perform hand hygiene with gloves on between patients. Even if your ETU requires you to change your outer gloves between patients, you must perform hand hygiene with the first set of gloves still on before donning the new gloves. You don’t want to transfer pathogens between patients, including many other pathogens besides Ebola virus. In the suspect area, note not everyone has EVD, and those who don’t are at high risk of acquiring it while in the suspect area. Therefore, healthcare workers must be very careful in practicing hand hygiene between patients.
This slide shows the typical parts of the hands missed due to poor hand hygiene technique. In studies, the black and dark gray areas shown here, including the backs of fingers and hands, are most often missed. Thorough handwashing might seem basic and routine, but it could be a potentially lifesaving step for infection prevention and control. Please pay careful attention to hand hygiene at all times, both inside and outside the ETU.

It is important to note that wearing gloves does not mean you can skip hand hygiene. You must perform hand hygiene after removing your gloves.

Donning and doffing of gloves are important. This slide shows the steps in donning gloves. After removing a glove from the original container, try to touch only the cuff edge of the glove as you put it on. Then use your ungloved hand to take the second glove out of the box. Avoid touching your forearm with your gloved hand by hooking your gloved fingers around the cuff of the second glove, and pulling it onto the second hand. Then put on the second pair of gloves using the same technique. Once you have on gloves, don’t touch things not meant to be touched with gloved hands, including your face.

Removing gloves is a critical step in the doffing process. You will be tired and eager to get out of your hot PPE. But you must still pay close attention to removing your gloves to avoid contaminating yourself. Start by pinching one glove at your wrist and peeling it away. Typically, this turns the glove inside out. Hold the glove you removed in your other gloved hand. Slide the fingers of your ungloved hand between glove and wrist; then roll the glove down your hand, folding it into the first glove. Do this gently. Don’t snap the gloves off. This can eject droplets of contaminated material onto surfaces or onto you. Discard the gloves safely; then perform hand hygiene. In African ETUs, hand hygiene will often be done with a 0.05% chlorine solution, but soap and water or an alcohol-based hand rub are also effective.
Other PPE, in addition to gloves, are essential elements of healthcare precautions in an ETU. PPE will vary depending on the practices of your ETU. However, certain principles are universal.

The general infection prevention and control principle for PPE is to cover all mucous membranes and skin. Here is the checklist for PPE you need to be wearing before you start caring for patients who might have Ebola virus disease (EVD). All persons entering the ETU high-risk zone or in direct contact with patients with suspected or confirmed Ebola should wear:

- 2 pairs gloves
- Disposable fluid-resistant suit or gown
- Waterproof apron
- Face shield or goggles
- Face mask (N95 respirator)
- Hood

Although aerosol generating procedures are not common in the ETU, an N95 respirator is typically used. The N95 respirator, in conjunction with a face shield or goggles, a face mask, and a hood for protection. Healthcare workers should also wash hands frequently and not touch their heads near their mouths, noses or eyes.

There will be differences in PPE and protocols depending on the ETU. For example, the head covering might be a hood attached to a suit, or a separate hood. Eye protection might be goggles or a face shield. The mask used in your ETU might be an N95 respirator or just a surgical mask. As long as mucous membranes are protected, and chances for transfer of virus to your face are minimized, you will greatly reduce your risk of infection, regardless of the equipment you are wearing.
There are at least two types of protective suits commonly used in West Africa. They can be with or without built-in hoods. You might see them referred to by the brand names Tyvek® and Tychem®. Both repel liquids and aerosols. Tychem® is coated to enhance barrier protection against liquids. This makes it hotter to work in, and heat strain is a greater concern. In most suits, you can typically work for less than one hour before heat strain becomes a risk. In some ETUs, gowns may be used in place of suits. In all ETUs, a waterproof apron is used, which might be disposable or reusable.

Use PPE that is standard in the ETU where you work. The PPE used should provide maximum protection for mucous membranes and reduce the chances for getting virus on your skin. Safety is attained through rigorous adherence to systematic infection prevention and control practices. Your goal should be to consistently adhere to the specific detailed steps of PPE donning, and especially doffing, regardless of the style of PPE. Donning should be done with your buddy, the person who will be working in the ETU with you, to ensure you have no exposed skin or PPE tears. Clearly, doffing is a high-risk activity; you should not do it alone. Your ETU should have a doffing coach who directs you as you remove the PPE step by step.

As noted before, the primary infection prevention and control principle when donning PPE is to ensure mucous membranes and skin are covered. Remember how many pieces of PPE you need so you always have everything available before donning. Follow the recommended order when donning. This will aid in what is known as muscle memory as well as adherence to the correct PPE. It is also important to have a trained observer to oversee the donning process for all healthcare workers. Ask your buddy to also visually inspect your suit and PPE integrity. And finally, memorize your appearance in the mirror after donning PPE to reinforce adherence to correct practices.
Removing, or doffing, PPE is the time when mistakes are easy to make, and they can have severe consequences. Therefore, you should rely on a trained coach to assist you through the doffing process. While you may be hot and eager to remove PPE, it is critical that you carefully remove PPE following directions. Do not rush. The process can take up to 20 minutes.

You will be heavily contaminated when you leave the ETU, even if you have no visible body fluids or blood on your PPE. When doffing, the idea is that dirty surfaces should only touch dirty surfaces, and clean surfaces should only touch other clean surfaces.

Remove the most contaminated PPE first. This is why you should start by removing your apron and outer gloves. Protect your eyes and mucous membranes. Close your eyes when removing anything from your head. Be aware that the doffing sequence may vary based on whether the mask and face shield are worn under the hood (WHO protocol) or placed over the hood (MSF protocol). With the WHO protocol the hood is removed before the mask and face shield; in the MSF protocol the hood is removed after. Keep your gloved hands clean by performing hand hygiene with 0.5% chlorine solution after each step. This helps you remove PPE without spreading contamination. Always use your gloved hands to grasp the back corner of your mask - not the front - to remove it.

Certain mistakes are easy to make in the ETU. An example is uncovering your wrists with vigorous movement when the suit slides up your wrist. Tall people are particularly prone to this. Adjusting goggles should never be done in the ETU because your gloves will be contaminated. Also removing goggles too early during doffing is a dangerous mistake because you might contaminate your face and mucous membranes.
Other problems can arise from circumstances beyond your control, but you must think before addressing them. Sometimes small flies or bugs come in through holes on the side of the goggles or under the face mask and it’s natural to reach for your goggles to deal with this annoyance. Don’t do it. Always consider your hands to be contaminated.

Eyeglasses can fall off when removing the goggles. Let them fall, and figure out what to do with the help of your doffing coach. An eyeglass strap can help you avoid pulling your glasses off accidentally.

We’ll now talk about injection safety as an element of healthcare precautions.
Before talking specifically about phlebotomies, it is important to discuss the extreme care needed while using needles and sharps in the high-risk zone of the ETU.

It is critical to adhere to some general rules.

- Dispose of used sharps in puncture-proof and sealed containers.
- Never recap sharps.
- Never direct the point of a used needle toward anyone, including yourself.
- Do not remove used needles from disposable syringes.
- Do not bend, break, or otherwise manipulate used needles by hand.
- Never carry used sharps in your hands.
- Position sharps container at location of procedure.

Understanding the importance of safety measures when handling needles and sharps will help in performing phlebotomies in the ETU.

The first principle of a blood draw in the ETU is to limit phlebotomies to the absolute minimum necessary.

Before entering the high-risk zone to perform a phlebotomy, ensure all supplies have been gathered and all sample tubes and containers are labeled.

Before attempting a blood draw, assess the safety risk to yourself versus the potential benefit to the patient. There are situations when you should not attempt a blood draw - for example, when only inadequate PPE is available, or when the patient is combative.

Be sure you have adequate light. Two staff members are needed for the blood draw. One will perform the procedure, and the other will assist in handling the specimen and controlling the patient.

Also, establish how the sample will be transported out of the high-risk zone. Ensure there is a designated lab ready to receive the specimen and they are aware a sample is coming.
The equipment you will need to have within easy reach includes a sharps container. If there is not one already near the patient’s bed, place one there for safety. Have a labeled sample tube, preferably a plastic tube, available. Know the blood sampling system. Note most facilities in West Africa do not have auto-locking IVs or needles. You will need a single-use tourniquet, and a skin antiseptic wipe consisting of either 70% ethanol or iodine. You will also need a gauze pad and adhesive bandage to cover the site after blood is drawn. Have ready a labeled sealable bag and biohazard bag for transport, and a 0.5% chlorine solution sprayer.

When preparing to perform a phlebotomy, start by conducting a risk assessment by asking the following questions of yourself and your buddy:

- Is it safe to draw blood from the patient? (Are they agitated, restless, or combative?)
- Where is the sharps container located?
- Where is the handwashing station?
- What is the protocol for a needlestick injury?

Whenever possible, it is preferable to have the patient sit in a chair for the procedure for safety and to reduce risk of contamination. This is only done if the patient is able to move unassisted or can be moved without risk to the healthcare worker. Sometimes the cots in the ETU are on the floor. The floor or cot could be covered in contaminated materials such as feces, vomit, or blood.

Discuss the procedure with the patient. Then set up the blood draw area so equipment is easily within reach.
To perform a phlebotomy, cleanse the skin where you will be inserting the needle.

Hold the arm distal to the insertion site with one hand and place the needle into the vein with the other. Assure your hand and your buddy’s hands are not near the needle insertion site.

Ask your buddy to give you the labeled blood collection tube. Collect blood in the specimen tube and apply pressure to the site.

Discard the needle immediately into a sharps container. On the next slide we will discuss sharps containers in the ETU. For now, it important to perform the next step in the phlebotomy procedure and have your buddy spray the specimen tube with 0.5% chlorine solution, bag the specimen, then spray the bag.

Bandage the needle entry site. If the patient bleeds profusely, hold pressure for five minutes and then secure the bandage and instruct the patient to keep pressure on the site.

Sharps containers in the ETU are also a concern. Used sharps should be immediately placed in a designated container.

Puncture-resistant containers are best but often not available. For example, cardboard containers are used in some MSF facilities so the container and waste can be more easily incinerated.

Ensure containers for sharps are placed as close as possible to the immediate area where the objects are being used to limit the distance between use and disposal. Ensure the containers remain upright at all times. If the sharps container is not nearby, place sharps in a kidney dish or similar container to carry to the sharps container. Never carry sharps in your hands. Replace the containers when they are three quarters full, and when appropriate, seal the containers with a lid. Never force additional sharps into the container to make room. Also, never leave sharps on the floor and make sure others don’t do it. Sharps on the floor can make you stumble and fall.

Ensure the containers are placed in an area not easily accessible to visitors, particularly children. For example, containers should not be placed on floors, or on the lower shelves in areas where children might have access.
Once the blood specimen is obtained, have your buddy spray the inside and the outside of a sealable labeled bag with 0.5% chlorine solution. Then place the specimen bag into a biohazard bag which is also sprayed. The bag should be transported to the lab using the protocol determined for your ETU. Do not recap needles. Ensure all sharps are in a sharps container, and collect disposable materials and place in a waste container. All healthcare workers involved must wash gloved hands in 0.5% chlorine solution.

In summary, successful infection prevention and control in the ETU requires care, attention to detail and protocol, and cooperation among staff.

The ETU in a resource-limited setting is a higher-risk environment than a U.S. hospital. Infection prevention and control principles must balance best feasible patient care with maintaining healthcare worker safety. All personnel in a single facility should adhere to the same infection prevention and control rules. WHO, MSF, and CDC infection prevention and control guidelines are updated frequently and might differ slightly. But all are based on experience, the clinical care environment, science, and expert opinion.

The key to protecting your health is consistent adherence to infection prevention and control practices and appropriate use of PPE.

Whenever you are in the ETU, carefully observe the actions of other healthcare workers as well as your own, and don’t hesitate to bring any actions that increase risk to the attention of your buddy, supervisor, or team.