Section 4. Biosafety and Personal Protective Equipment (PPE) Use

Objective: To provide principles and general guidelines for the use of Personal Protective Equipment (PPE) to prevent exposure to and transmission of infectious pathogens during PREDICT activities.

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*Adapted from the USAID STOP-AI Training Module: Introduction to PPE
Section 4.1. Learning Objectives and Confirmation

After studying this guide, you will be able to:

- Implement basic biosafety precautions.
- Describe the factors to consider when assessing the biological risk of handling animals and collecting human and animal samples, and other field and laboratory activities that may have potential risk for zoonotic disease exposure.
- Understand factors to consider when choosing appropriate PPE based on identified risks.
- Identify and describe the functions of each component of PPE.
- Correctly put on and take off appropriate PPE for PREDICT sample collection and handling activities in a non-outbreak setting. For collecting samples from hospital and clinic patients and during disease outbreaks, specific PPE components and procedures to put on and take off PPE should be adapted based on the determined risk level.
- Describe the importance of respirator fit and fit testing.

Confirm you understand the material of this guide:
When you are familiar with the information in this guide, take the PREDICT quiz in Section 8.4.3. Biosafety and PPE Use.

Section 4.2. Biosafety Overview

Personal Safety Responsibilities

- Individuals have the primary responsibility for their own health and safety. Nothing substitutes for good training and vigilance.
- Follow safety procedures outlined in PREDICT protocols regarding each activity that involves potential exposure to infectious pathogens.
- Use appropriate safety equipment.
- Report unsafe or hazardous situations, injuries, and accidents immediately to your supervisor or instructor.
- Report any illness to your PREDICT supervisor.
- Participate in required safety training.

Follow PREDICT waste disposal procedures (see Basic Laboratory Safety (Section 6.3.) and Safe Disposal of Carcasses and Infectious Waste Guide (Section 2.5.)) consistent with the PREDICT Environmental Mitigation and Monitoring Plan (Section 2.4.).
Responsibilities of the Country Coordinator and Field Supervisors

- Provide and document training for all personnel who will participate in PREDICT project activities.
- Ensure compliance with relevant PREDICT or organizational task protocols.
- Ensure compliance with the PREDICT Environmental Mitigation and Monitoring Plan.
- Ensure compliance with local permit requirements and regulations.
- Report injuries/accidents and ensure compliance with associated mitigation.
- Ensure that all field personnel are trained on the safe use of field equipment.

General Zoonoses Biosafety Precautions

There is a risk of exposure to pathogens, including zoonotic pathogens, when handling animals, and human and animal samples in the field. Therefore, it is important to implement measures to minimize the risk of pathogen transmission.

The following list of general precautions applies to most situations:

- Inform all who enter potential zoonotic pathogen risk areas of their potential for exposure and the associated risks.
- Review information regarding the zoonotic agents likely to be found in the samples or animals to which you or others may be exposed.
- Wear the appropriate PPE based on protocols for the activity and species and as directed by the Country Coordinator or Field Supervisor.
- Use disposable supplies whenever possible.
- Wash hands and wrists after removing your gloves.
- Don’t wear field or lab clothing or shoes outside of work areas where there may be zoonotic pathogen exposure. Change clothing and shoes before getting into your vehicle.
- Launder contaminated protective clothing at work. Don't take your protective clothing home with you.
- Never eat or drink in areas where human sampling, animals, their wastes, or their products (e.g., blood) are present.
- Wash your hands frequently and practice good hygiene. Avoid touching your face while working with animals, human and animal samples, or other sources of pathogens. Although a normal, healthy adult person may have only mild symptoms of a zoonotic disease, that person may unknowingly spread the disease to others. Unfortunately, animal handlers have “carried home” zoonotic pathogens to their infants with fatal consequences. Therefore, good hygiene is not only to protect the person working directly with human and animal samples; but it is also for all persons and animals with whom they have contact.
- When seeking medical advice for any illness, inform your physician of your work with humans and animals.
- Make sure a first aid kit is immediately available during all field and laboratory activities.
- Refer to established procedures for how to respond to a bite, cut, scratch, puncture or other injury that results in possible zoonosis exposure.
• Refer to established procedures for disinfecting all equipment, samples, cages, and traps according to guidance provided below.

**Hand Washing - Teach and Practice Good Hand Washing Technique**

*The importance of hand washing in preventing infection and the spread of infectious pathogens cannot be over emphasized.*

**Always wash your hands before:**
- Putting on PPE for handling animals or collecting or handling human and animal samples
- Contact with a sick or injured person or animal
- Treating wounds or administering medications
- Preparing food
- Eating
- Inserting or removing contact lenses

**Always wash your hands after:**
- Taking off PPE
- Touching an animal, human and animal samples, waste, products or animal equipment
- Collecting and handling diagnostic samples
- Visiting field sampling sites or clinics/hospitals
- Preparing foods, especially raw meat or poultry
- Using a toilet
- Changing a diaper
- Blowing your nose, coughing or sneezing into your hands
- Treating wounds
- Touching a sick or injured person
- Touching garbage or other potentially contaminated materials
- Finishing work in the laboratory

**Plan for hand washing:**
- Plan for hand washing in the field by identifying any locations with running water near the site and bringing supplies (i.e., water, soap, bucket, paper towels, hand sanitizing gels and germicidal wipes that contain at least 60% alcohol)
- Plan when you will need to wash to ensure supplies are ready and available

See the WHO guidelines below for proper hand washing technique. If soap and water are not available, use an alcohol-based hand sanitizing gel that contains at least 60% alcohol. These products significantly reduce the number of microbes on the skin and are fast acting. However, they are not effective if hands are visibly dirty. Organic matter and natural oils on hands create a barrier that blocks the effectiveness of the sanitizer. See [http://www.cdc.gov/handwashing/show-me-the-science-hand-sanitizer.html](http://www.cdc.gov/handwashing/show-me-the-science-hand-sanitizer.html) for more information.
How to Handwash?

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the entire procedure: 40-60 seconds

0. Wet hands with water;

1. Apply enough soap to cover all hand surfaces;

2. Rub hands palm to palm;

3. Right palm over left dorsum with interlaced fingers and vice versa;

4. Palm to palm with fingers interlaced;

5. Backs of fingers to opposing palms with fingers interlocked;

6. Rotational rubbing of left thumb clasped in right palm and vice versa;

7. Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;

8. Rinse hands with water;

9. Dry hands thoroughly with a single use towel;

10. Use towel to turn off faucet;

11. Your hands are now safe.

World Health Organization | Patient Safety | SAVE LIVES
A World Alliance for Safer Health Care | Clean Your Hands

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Disinfection of Surfaces and Materials
Dirt and organic matter can protect microbes from decontaminants (antiseptics, chemical germicides and disinfectants). Therefore, precleaning contaminated surfaces as well as reusable supplies, equipment and PPE is important to achieve proper disinfection. Precleaning should be carried out cautiously to avoid exposure to pathogens.

Contact times for disinfectants are specific to the type of solution and the manufacturer. Therefore, it is important to follow the manufacturers’ specifications. Further, solutions used for precleaning and disinfection should be the same or chemically compatible.

There are several types of disinfectants on the market and formulations should be selected for specific needs. High temperatures can degrade chemical disinfectants, so shelf-life may be decreased in areas with high ambient temperatures.

Chlorine bleach or Virkon disinfectant solution are commonly used as general-purpose disinfectants. See the WHO Laboratory Biosafety Manual (http://www.who.int/csr/resources/publications/biosafety/en/Biosafety7.pdf) for frequently used classes of disinfectants, with general information on their applications and safety profiles, as well as recommended dilutions for chlorine-releasing compounds, such as chlorine bleach.

Section 4.3. Assessing Biosafety Risk of Zoonotic Pathogens and Selecting PPE
Key to the practice of biosafety is assessing the risk of infection associated with a specific procedure under specific environmental conditions. There are many considerations in the assessment of risk and it is the job of the supervisor to weigh these considerations to determine the appropriate measures to protect humans and animals from infection.

Factors to Consider when Assessing Biological Risk of Procedures to Determine Necessary PPE
1. Species to be handled and sampled.
2. Pathogens likely to be present in these species/samples.
3. Pathogenicity of these pathogens (see WHO classification of infective microorganisms by risk group below).
4. Potential exposure opportunities and routes of infection for the pathogens given the planned activity.
5. Potential result of exposure to the pathogens.
7. Information available in the literature, including animal studies and clinical reports that would help inform on risk.
8. Measures to reduce the risk of exposure, such as sanitary measures (e.g., food and water hygiene) and control of animal reservoirs or arthropod vectors, the movement of people or animals, and the importation of infected animals or animal products.
9. Local availability of effective prophylaxis and treatment. Prophylaxis may include vaccination or antisera. Treatment options may include passive immunization and post-
exposure vaccination, antibiotics, and chemotherapeutic agents, taking into consideration the possibility of the emergence of resistant strains.

Based on the risk assessment considering the factors listed above, the following should be determined by the PREDICT activity supervisor (often Country Coordinators):

1. Hazards and risk of exposure.
2. Appropriate PPE required to implement the activity safely and to prevent transmission of infectious pathogens. (Components of PPE to consider are discussed later in this document).
3. Special procedures, such as disinfection procedures between handling individual animals and people or between site visits, that may be required to reduce risk of transmission and provide adequate protection for humans and animals.
4. Vaccinations or prophylaxis required for PREDICT personnel before the activity.


WHO provides the guidelines below for classifying biological risk categories, based on pathogenicity of the organism and modes of transmission and host range of the organism. These primary factors are affected by existing levels of immunity, density and movement of host population (human or animal), presence of appropriate vectors and environmental conditions, and availability of effective preventive measures and treatment. Countries usually adopt a similar set of risk categories. The WHO risk group classification was developed for laboratory work. See [http://www.absa.org/riskgroups/](http://www.absa.org/riskgroups/) for more information and a link to the Risk Group Database where information on risk can be obtained for specific microbes and/or microbe families.

The WHO risk categories are:

**WHO Risk Group 1** (no or low individual and community risk) -- A microorganism that is unlikely to cause human disease or animal disease.

**WHO Risk Group 2** (moderate individual risk, low community risk) -- A pathogen that can cause human or animal disease but is unlikely to be a serious hazard to laboratory workers, the community, livestock or the environment. Laboratory exposures may cause serious infection, but effective treatment and preventative measures are available and the risk of spread of infection is limited.

**WHO Risk Group 3** (high individual risk, low community risk) -- A pathogen that usually causes serious human or animal disease but does not ordinarily spread from one infected individual to another. Effective treatment and preventive measures are available.

**WHO Risk Group 4** (high individual and community risk) -- A pathogen that usually causes serious human or animal disease and that can be readily transmitted from one individual to another, directly or indirectly. Effective treatment and preventive measures are not usually available.
Appropriate PPE for PREDICT Activities

While PREDICT field staff will be working in very different environments with varying levels of biological risk, there are some tasks for which *minimum PPE requirements* have been established and detailed in Table 1.

<table>
<thead>
<tr>
<th>Taxa/Task</th>
<th>Respirator (N95 or respirator with comparable filtering rating)</th>
<th>Goggles, Face shield or protective glasses</th>
<th>Gloves*</th>
<th>PPE Coveralls or Dedicated Clothing with washable shoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling human and animal specimens</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (either PPE or coveralls or dedicated clothing)</td>
</tr>
<tr>
<td>Handling primates (live or carcass)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (either PPE or coveralls or dedicated clothing)</td>
</tr>
<tr>
<td>Handling rodents or bats (live or carcass)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (either PPE or coveralls or dedicated clothing)</td>
</tr>
<tr>
<td>Sampling in bat caves</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>PPE coveralls</td>
</tr>
<tr>
<td>Sampling or necropsy of sick/dead animals</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (either PPE or coveralls or dedicated clothing)</td>
</tr>
<tr>
<td>Sampling bushmeat</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (either PPE or coveralls or dedicated clothing)</td>
</tr>
<tr>
<td>Handling poultry or waterfowl</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (either PPE or coveralls or dedicated clothing)</td>
</tr>
<tr>
<td>Handling livestock</td>
<td>Depends**</td>
<td>Depends**</td>
<td>Yes</td>
<td>Yes (either PPE or coveralls or dedicated clothing)</td>
</tr>
<tr>
<td>Sampling apparently healthy humans</td>
<td>Depends***</td>
<td>Depends***</td>
<td>Yes</td>
<td>Depends***</td>
</tr>
<tr>
<td>Collection of animal feces or urine from the environment</td>
<td>Depends****</td>
<td>Depends****</td>
<td>Yes</td>
<td>Depends****</td>
</tr>
<tr>
<td>Sampling an animal once it has been anesthetized</td>
<td>Recommended if in close contact with the animal during sampling activity</td>
<td>Recommended for those in close contact with the animal during sampling activity</td>
<td>Yes</td>
<td>Yes (either PPE or coveralls or dedicated clothing)</td>
</tr>
</tbody>
</table>
Table Definitions

* When handling live animals that pose a bite or scratch risk, it is recommended that leather gloves be worn above nitrile gloves for added protection. Nitrile gloves are more puncture resistant than latex and may reduce the risk of exposure from a bite or scratch. In many cases chemical restraint (anesthesia) is recommended to prevent injury to either the handler or the animal during sample collection.

** It is recommended to use a respirator, full protective clothing and eye protection when in contact with livestock suspected of harboring a biohazardous agent and pregnant livestock or livestock recently giving birth, and upon entering and/or working in abattoir settings or other settings where livestock are being slaughtered and/or butchered.

*** For routine sample collection from apparently healthy people, gloves are recommended. For collecting samples from hospital and clinic patients and during outbreaks, PPE should be adapted based on the determined risk level.

**** In some cases, such as during the collection of urine underneath a colony of fruit bats roosting in trees where there is a high risk of aerosolizing of excreta and microbial agents, then it is recommended to use a respirator (N95 respirator is recommended as the minimum level of protection), full protective clothing and eye protection.

**Higher Risk Taxa**
Below is a summary of special biosafety considerations for some of the key groups of species (bats, rodents, and non-human primates) to be handled as part of PREDICT activities.

Rodents, bats, non-human primates and other wild species may harbor pathogens that are transmittable to, and highly pathogenic in, humans. When handling these rodents, bats or non-human primates, careful consideration needs to be given to conscientious use of PPE, good personal hygiene (i.e., hand washing), safety training, and application of good animal handling and sampling techniques to minimize exposure to infection or injury.

In the event of an injury while handling animals that pose risk of zoonotic pathogen exposure, appropriate first aid must be applied. The risk of infection can be significantly reduced with immediate and thorough scrubbing of the wound with soap or antiseptic.

**Vaccination to prevent rabies infection:** Personnel who are handling animals that are known reservoirs for rabies (i.e., bats and dogs) should be immunized against rabies virus according to World Health Organization and CDC recommendations.

Investigators should familiarize themselves with known biohazards specific to species under study and with the procedures for the isolation and control of zoonotic pathogens.
Specific considerations with regard to working with rodents, bats and non-human primates are discussed below:

**Rodents**
Wild rodents have the potential to carry a variety of zoonotic bacteria and viruses that can be passed on to those handling them. Because of the serious consequences of becoming infected, personnel must always follow good personal hygiene and animal handling procedures and use the provided PPE to protect against exposure.

Special Precautions:
- Wear the minimum PPE for handling rodents including an N95 mask, eye-protection, gloves and coveralls, or clean dedicated clothing.
- Personnel who are handling animals should be immunized against rabies virus according to the World Health Organization and CDC recommendations.

**Bats**
Exposure to wild bat roosts (in caves or trees), handling of bats in the field or handling bat excreta (urine or feces) presents a potential for exposure to zoonotic pathogens. Rabies, Nipah virus, Ebola virus, and the fungal disease histoplasmosis are examples of zoonotic pathogens carried by some bat species. Bat bites, scratches and wound and mucous membrane exposure to bat saliva are the ways in which rabies can be transmitted. Spores of histoplasmosis can be present in soil and debris enriched with bird and bat droppings. When this dry soil is disturbed, spores can become airborne and cause infection by inhalation.

Special Precautions:
- When working around bats in enclosed spaces, such as in a cave, wear at a minimum an N95 respirator, goggles, gloves and Tyvek coveralls (or dedicated long-sleeved clothing).
- Personnel who are handling animals such as bats should be immunized against rabies virus and be aware of appropriate post exposure prophylaxis in the case of bites according to World Health Organization and CDC recommendations.

**Non-Human Primates**
Non-human primates may be infected with a number of potentially serious zoonoses. For example, all macaque monkeys and their fluids should be considered to be infected with **Herpes Simian B virus**. Marmosets, although they do not carry the herpes B virus, can carry other disease agents that affect humans such as lymphocytic choriomeningitis virus and **Trypanosoma cruzii**, the cause of Chagas’ disease. It is critical that work with non-human primates be done while wearing the appropriate personal protective equipment and with the well-established safe protocols and procedures.
Special Precautions:

- Personnel must follow strict hygiene procedures. Frequent and thorough hand washing, although too often overlooked by the staff, is critical to physically remove bacterial contamination and prevent ingestion exposure.
- PREDICT personnel must wear the minimum PPE for handling non-human primates including an N95 mask, eye-protection, gloves and coveralls or clean dedicated clothing.

Section 4.4. Use and Disposal of PPE

Considerations When Using PPE

Personnel wearing PPE may experience heat stress and general discomfort in hot or humid environments. It is important to remain hydrated by drinking adequate water before and after wearing PPE. Length of time wearing full PPE should be limited, based on environmental conditions, to avoid the risk of heat exhaustion or heat stroke. Personnel should inform their supervisor(s) if they experience severe discomfort during animal capture or sampling activities, so that they may take a break.

When workers are heat-stressed, uncomfortable, or unable to see out of their fogged goggles, they are more likely to remove their goggles or mask in risky environments, exposing themselves to potential pathogens.

Most PPE items to be worn during PREDICT activities are disposable and designed to be used only once, and should be properly disposed of as medical waste after each use. Plastic goggles and rubber boots may be re-used, but must be disinfected between each use.

Designate a clean area for putting on PPE. It should ideally be a clean area away from any potentially contaminated animal equipment, such as cages, crates, or farm tools. All personnel should use this area to put on their PPE. Also, designate a decontamination and PPE removal site.

Always wear the respirator properly when you are working. Ensure that there is a tight seal formed around the mask and never hang it around your neck.

When wearing coveralls, ensure there is no exposed skin between your sleeves and gloves. If any piece of PPE is torn, it should be changed at the PPE decontamination site as soon as possible following the steps outlined in the section on how to take off PPE.

It is beneficial to have a colleague confirm that PPE is properly worn. Working in teams when putting on and removing PPE can help avoid mistakes and react immediately if accidents occur.
Planning and Preparations for PPE Use

1. Prior to going to the field, the level of risk for the field tasks and the appropriate PPE needed to safely perform the field tasks should be determined.
2. PPE kits should be assembled for each person who will be involved in the field tasks. Multiple kits per person may be required, based on the number of animals to be handled, the number of breaks that personnel may take, and to account for potential tears in gloves and coveralls, etc.
3. Prior to going to the field, PPE supplies should be organized. Along with required sets of PPE, supplies should include disinfectants, alcohol-based hand sanitizing gel and germicidal wipes, large color coded bags for infectious waste disposal according to national codification, and collection bags for equipment (such as plastic goggles, face shields and rubber boots) that will be disinfected for re-use.
4. Bottled water should be available for consumption before and after use of PPE. PPE can be very hot, and personnel are more likely to suffer heat stress if they do not consume adequate amounts of water.
5. Bring additional tape and extra collection and disposal bags. Tape can be used to secure shoe covers and protective clothing and seal bags.
6. Plan for disposing of PPE:
   a. An area for removing PPE should be identified. This area should be away from the contaminated area and away from animals. All personnel should use this area to remove their PPE.
   b. Remove all of your PPE carefully, following the recommended steps for PPE removal (below) and discard them (or put reusable items in bags for disinfection) before taking a break. Put on a new set after the break.
   c. Immediately after removing PPE, place it directly into the color coded infectious waste bag (or marked biohazard waste bag).
   d. Color coded infectious waste bags should be sealed and properly disposed. Follow the instructions of the local official or person supervising the work on where to dispose infectious waste bags when they are full.
   e. Disposal methods (such as burning or burial) may differ by situation or location. Local officials and/or those supervising the work will likely decide on how best to dispose of used PPE and other disposable items that are potentially contaminated. For guidelines, see PREDICT Safety Guide: Laboratory Operations, Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA) Ch. 8: Healthcare Waste: Generation, Handling, Treatment and Disposal (http://www.encapafrica.org/egssaa/medwaste.pdf); and WHO Safe Management of Wastes from Health-Care Activities (http://www.who.int/water_sanitation_health/medicalwaste/wastemanag/en/).

Components of PPE Kits

1. Coveralls, dedicated clothing and shoes, and aprons – for high-risk tasks, full coverage may be warranted. In that case, Tyvek or Tychem coveralls, shoe covers or boots, and an apron may be used. For lower-risk tasks, just an apron and/or dedicated clothing and shoes may be appropriate. An apron should be a disposable type that is properly disposed of together with
gloves and masks after each use. Dedicated clothing (e.g., cotton coveralls) at the work site should be removed and laundered after each use.

Regarding the use of Tyvek or Tychem coveralls:

- Wear these coveralls to protect your skin and/or clothing against contamination when in contact with human samples, animal droppings, dust, animal urine or droppings, or animal fluids such as blood, saliva, and mucous.
- The synthetic material Tyvek is water resistant and Tychem is water proof, so even if the coveralls get dirty or wet, they will offer protection. Tychem offers more protection from liquids and should be considered in situations with high risk of exposure to blood-borne pathogens (e.g., hemorrhagic disease, EVD outbreak investigations).
- You can wear your dedicated shoes and clothing under the coveralls.

2. Shoe Covers or Washable Rubber Boots

- Because pathogens in human and animal samples including feces, secretions, or blood can easily contaminate your footwear, it is important to have disposable shoe covers or rubber boots that can be disinfected.
- The shoe covers provided in some PPE kits fit over your coverall feet, or over your shoes.
- Rubber boots may be worn with dedicated pants pulled over the top of them. If using PPE coveralls with rubber boots, purchase the coveralls without feet (or cut the feet off) and pull the pant legs of the coveralls over the top of the boots.
- A footbath should be prepared with either chlorine bleach or Virkon disinfectant. This can be used to disinfect boots and other footwear upon leaving the field site. A boot brush should be available for scrubbing surfaces of footwear prior to using the footbath. It is critical to remove all organic material from footwear prior to disinfection to ensure effectiveness of disinfectants.

3. N95 Respirator

- N95 respirators (masks) protect you from inhaling droplet or aerosolized pathogens into your nose and lungs. Surgical masks are not respirators. They do not protect against aerosol and small droplets. They filter out large-size particles in the air and offer protection from large droplets and direct contact.
- There are several different models, styles, and sizes of N95 and comparable respirators that fit a variety of face shapes and sizes. Each person requiring a respirator for PREDICT activities should be individually fit tested to identify a respirator that appropriately and comfortably fits her or his face.
- Respirators with exhalation valves are generally more comfortable as the exhalation valve prevents resistance to exhalation when the filters load with dust.
- See Section 4.5 on respirator use to learn more about respirators and fit testing.
4. Goggles and Face Shields
- Goggles protect your eyes from splashes and liquids.
- They are adjustable to ensure the best fit. Adjust the head strap before putting on all of the PPE. The goggles should fit snugly over and around your eyes.
- Personal glasses are not a substitute for goggles or safety glasses; if you wear eyeglasses, the goggles or safety glasses should be placed over them.
- If ordering goggles, be sure to order fog-free goggles. If they are not fog-free, they are likely to fog up in a few minutes, rendering them useless. If all you have are non-fog-free (regular) goggles, you may rub a little soapy water on the inside of the lens prior to use to reduce fogging.
- Goggles (and rubber boots) are one of the few components that may be re-used if disinfected properly after each use.

5. Gloves
- Nitrile gloves are best for use for infectious agent exposure protection. Gloves are a component of minimum PPE required for sample collection and handling tasks conducted under PREDICT.
- Two pairs of nitrile gloves are recommended when using sharps.
- Heavy rubber gloves or leather gloves may be required when handling animals and can be worn over the nitrile gloves. PREDICT teams have good success with Hexarmor Hercules 400R6E gloves.

6. Disinfecting Wipes and Alcohol-based Hand Sanitizing Gel (at least 60% alcohol) -- for disinfecting gloves and hands.
- Disinfecting wipes that contain at least 60% alcohol should be used to clean your gloves and other PPE before removing them.
- Alcohol-based wipes or hand sanitizing gel can be used to clean areas of skin that may have been contaminated. It is critical to remove organic material before using sanitizers to ensure effectiveness of disinfectant.
- It is recommended that you ALWAYS disinfect and wash your hands after removing gloves, regardless of contamination.
   - A color coded infectious waste bag (or otherwise labeled biohazard bag) should be available at the field site for containing and disposing of used PPE items.
   - As soon as you remove a contaminated item, place it in the infectious waste bag.
   - Do not overfill bags and ensure they can be closed and tied.
   - Tie the bag at the top and spray the outside of the bag with disinfectant once it is closed and tied. Wet waste should be double-bagged to prevent leakage.
   - Leave it at the designated collection site or place it in a secure container for transport to a proper disposal site.
   - Containers should be constructed to contain all contents and prevent leakage of fluids during handling, storage, and transport.
   - It is strongly recommended that field teams do not burn or bury medical waste at the field site. Incomplete burning may leave infectious or dangerous materials, and animals or children may dig up buried waste. All bio-hazardous waste should be contained and returned to a medical center for autoclaving or incineration. See Section 2.5 Safe Disposal of Carcasses and Infectious Waste Guide for information regarding guidelines for waste disposal.

Procedure for Putting on PPE
All of the components of PPE discussed below are not necessary or appropriate for all PREDICT tasks. For instance, Tyvek or Tychem coveralls and aprons are not necessary for many PREDICT tasks. However, when investigating disease outbreaks or other potentially high-risk situations, the PPE and donning and doffing procedures may be substantially enhanced to reduce risk of exposure. See http://www.cdc.gov/vhf/ebola/hcp/ppe-training/index.html for CDC Guidelines for Personal Protective Equipment (PPE) Donning and Doffing Procedures during management of Ebola virus disease cases.

1. Wash your hands and/or disinfect them with alcohol-based hand sanitizing gel prior to putting on PPE.

2. Coveralls or dedicated clothing go on FIRST. Always start with the coveralls (which should be big and loose to fit over clothing and not restrict movement) or dedicated clothing. Be certain to zip up coveralls or button up clothing.
3. **Shoe covers or boots go on SECOND.** Shoe covers fit over the coverall feet. Pant legs of dedicated clothing and coveralls should fit over the boots.

4. **Respirator or surgical mask goes on THIRD.** Of the equipment to be worn around the head and face, the mask or respirator is always first on and last off. On a mask with a metal nose clip, be sure to form the clip around the nose for a nice fit. Any time you put on a respirator, perform a seal check by inhaling sharply. If there is air leakage around the edges of the mask, readjust to ensure a proper seal.

5. **Goggles go on after the respirator.** Goggles should fit snugly over and around your eyes. Goggle straps should be adjusted to fit your head.

Once the respirator and goggles are in place, pull the hood on your coveralls over your head (or put on the separate head cover if the coveralls do not have a hood).
6. **Tie on the apron over the coveralls or your dedicated clothing.** Place the apron over your head and then tie it in the back.

7. **Put on two pairs of gloves.** The inner glove should go under the sleeve of the coverall to prevent exposed skin between the coverall and the glove. Coveralls with finger loops that secure the sleeve over the first pair of gloves are ideal to avoid exposure of the wrist area (or you can make a small cut in the coverall sleeve and introduce your thumb). Otherwise, tape the coverall sleeve to the inner glove. Put the second pair of gloves on over the first pair and extend the gloves over the coverall cuffs.
Procedure for Removing PPE

After completing your work, assume the exterior of the PPE is contaminated. The goal of correct removal of PPE is to minimize contact between your clothes and skin and the contaminated outer surfaces of the PPE.

1. **Wipe off any visible contamination of the PPE** using germicidal or alcohol-based wipes and dispose of the used wipe in the infectious waste bag.

2. **Remove and dispose of the apron** in the infectious waste bag.

3. **Wipe off outer gloves with a germicidal wipe and dispose of the used wipe** in the infectious waste bag.

4. **Remove boots or remove shoe covers** by holding the top and rolling them off of your feet. Place the shoe covers in the infectious waste bag. Place the boots in the equipment collection bag for disinfection and re-use.
5. Remove the outer gloves and place them in the infectious waste bag. Using one gloved hand, grasp the outside of the opposite glove near the wrist. Pull and peel the glove inside-out and away from the hand. Hold the removed glove in the opposite gloved hand. Then, slide one or two fingers of the ungloved hand under the wrist of the remaining glove. Peel glove off from the inside, creating a bag for both gloves. Dispose of the gloves in the infectious waste bag.

6. Disinfect your inner gloves with alcohol-based hand sanitizing gel.
7. **Unzip and roll down the coveralls** until they are inside out and place them in the infectious waste bag.

8. **Disinfect gloves with alcohol-based hand sanitizing gel.**

9. **Remove the goggles** by the strap and place them in the infectious waste bag or equipment collection bag for disinfection and re-use if re-usable. Re-usable goggles can be disinfected using a chlorine bleach solution.
10. Disinfect gloves with alcohol-based hand sanitizing gel.

11. Close the biohazard bag by tying the corners of the top of the bag together.

12. Remove the respirator by grabbing the top and then the bottom elastic bands, and pulling the bands up over your head or by grabbing the nose and pulling forward and then off. Place the respirator in a second clean red infectious waste bag.


14. Remove the inside gloves using the procedures listed in #5 above and place them in the second infectious waste bag. Dispose of infectious waste bags according to guidelines in Section 4, #6 e above.
15. Disinfect your hands with alcohol-based hand sanitizing gel.

16. Wash your hands and wrists using soap and running water (from a tap or poured) following the guidelines presented in Section 2.

If PPE is compromised, falls off, rips or is removed while you are handling or are exposed to biological hazardous materials, stop your current activity, remove PPE in the designated area, and wash or disinfect the exposed skin/surfaces. In addition, immediately inform your supervisor to determine if prophylaxis is indicated.

Section 4.5. Respirator Use

- Using respirators alone will not fully protect you from acquiring an infection – the respirator must be used in combination with all of the other PPE components.
- Each person using respirators must be fit tested to identify a respirator that he or she can comfortably and securely wear. Fit testing is a process that takes approximately 15-20 minutes to complete and should be performed for each member of the field team before he or she uses any respirators in the field. Qualitative fit test kits are available for purchase through 3M. A video on fit testing is available online at https://www.youtube.com/watch?v=7IAsoU6h-8g. After passing a fit test with a respirator, you should always use the same make, model, style, and size of respirator that was found during the fit test process to create an effective seal around your face. If you have facial hair, it is unlikely that you can properly fit a disposable particulate respirator. Workers who cannot ensure a proper fit because of facial hair or other fit limitations should consider a loose-fitting (i.e., helmeted or hooded) powered air purifying respirator equipped with high-efficiency filters. More information on respirators and respiratory protection can be found at: https://www.osha.gov/SLTC/etools/respiratory/index.html.
- Do not use or provide others with respirators without instruction on the health risks associated with them. For example, workers with respiratory problems may not be able to wear these respirators. Anytime someone indicates they are having trouble breathing while wearing a respirator, they should go to the PPE removal site and remove their respirator.
• When disposable particulate respirators become wet from saliva, sweat, or respiratory secretions, they lose their protective properties and must be changed.
• If a respirator is splashed and becomes wet, it should be changed using gloves and the gloves disinfected or washed following hand washing procedures.
• Respirators should be discarded and replaced after 4-6 hours of use.
• Respirators should not be hung around your neck when working. Always wear them when working.

Section 4.6. References


Drazenovich, N., 2006. Biological Safety & Medical Waste Management Training Module. Environmental Health and Safety, University of California, Davis,

USAID. 2009. USAID STOP-AI Training Module: Introduction to PPE.


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