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PREDICT

SAFETY GUIDE

Biosafety and PPE Use

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Purpose: 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.

USAID Disclaimer

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SAFETY GUIDE

Biosafety and PPE Use

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**Adapted from the USAID STOP-AI Training Module: Introduction to PPE*

SECTION 1. LEARNING OBJECTIVES AND CONFIRMATION

After studying this guide, you will be able to:

- Implement basic biosafety precautions.
- Describe the factors to consider for assessing the biological risk of handling animals and collecting samples, and other field and laboratory activities that may have potential zoonoses exposure.
- Identify and describe the functions of each component of PPE.
- Correctly put on PPE.
- Correctly take off PPE.
- Describe the importance of N95 respirator fit.

Confirm you understand the material of this Guide:

When you are familiar with the information in this Guide, take the PREDICT quiz on ***Biosafety and PPE Use***.

The instructions for taking the quiz on ***Biosafety and PPE Use*** may be obtained by contacting your Country Coordinator or David Bunn at dabunn@ucdavis.edu.

SECTION 2. BIOSAFETY OVERVIEW

Personal Safety Responsibilities

- Individuals have 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 medical and hazardous waste disposal procedures consistent with the PREDICT Environmental Compliance Guide.

Responsibilities of the Country Coordinator and Field Supervisors

- Provide and document training of all personnel and students that will participate in PREDICT project activities.
- Ensure compliance with relevant PREDICT or organizational task protocols.
- Ensure compliance with the PREDICT Environmental Compliance Protocol.
- Ensure compliance with local permit requirements and regulations.
- Report injuries/accidents
- Ensure that all personnel are trained on the safe use of field equipment.

General Zoonoses Biosafety Precautions

When handling wild animals in the field there is the potential risk for exposure to zoonotic pathogens. 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 you or others may be exposed to.
- Wear the appropriate PPE based on protocols for the activity and species and as directed by the PI or Field Supervisor.
- Use disposable supplies whenever possible;
- Wash hands and wrists after removing your gloves;
- Don't wear the 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 animals, their wastes, or products are present;
- Wash your hands frequently and practice good hygiene. Avoid touching your hands to your face while working with animals, 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 animals; but for all persons with whom they have contact.
- When seeking medical advice for any illness, inform your physician of your work with animals.
- Make sure a first aid kit is immediately available for all field and laboratory activities.
- Refer to established procedures for how to respond to a bite, cut, puncture or other injury that results in possible zoonoses exposure.

- Refer to established procedures for disinfecting all equipment, samples, cages, and traps.

Hand Washing--Teach and Practice Good Hand Washing Technique

The importance of hand washing cannot be over emphasized to prevent infection and the spread of infectious pathogens.

During the first Ebola virus outbreaks in the 1970s, clinicians in Africa frequently contracted the disease as they worked in field hospitals. Infection among the field clinicians was high, and death averaged about 50% (similar to the patient population), until both were reduced to almost zero by the addition of one new procedure:

HAND WASHING!

Always wash your hands before:

- Handling animals
- Preparing food
- Eating
- Treating wounds or administering medications
- Contact with a sick or injured person or animal
- Inserting or removing contact lenses

Always wash your hands after:

- Touching an animal, samples, waste, products or animal equipment
- Collecting and handling diagnostic samples
- Visiting a wet market or farm
- Working with hunters and handlers of animals or animal products
- 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 contaminated materials

Plan for Washing:

- Plan for washing in the field—bring supplies (water, soap, bucket, paper towels and or sanitizing gels or wipes)
- Plan when you will need to wash to ensure supplies are ready and available

Hand Washing Technique:

- Wet hands with water (turn on water source with paper towel or clean handle during washing process)
- Use liquid, bar or powder soap
- Work up a lather for 15-20 seconds
- Wash lower arms, wrists, and under and around nails

- Rinse hands
- Dry hands with a fresh paper towel
- Turn on water source with paper towel or clean handle during washing process
- Do not take the paper towel with you (dispose of on site or collect in plastic bag).

SECTION 3. ASSESSING BIOSAFETY RISK OF ZONOTIC PATHOGENS AND SELECTING PPE

Factors to Consider for Assessing Biological Risk to Determine Necessary 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 supervising professional to weigh these considerations to determine the appropriate measures to protect humans and animals from infection.

Factors to consider for assessing biological risk to determine necessary PPE include:

1. Pathogenicity of the likely pathogens and estimated infectious dose.
2. Potential exposure opportunities.
3. Potential result of exposure.
4. Natural routes of infection.
5. Stability of the pathogen in the environment.
6. Information available such as animal studies and the general literature on infections and clinical reports.
7. Measures to reduce risk of exposure such as sanitary measures, e.g. food and water hygiene; the control of animal reservoirs or arthropod vectors; the movement of people or animals; and the importation of infected animals or animal products.
8. Local availability of effective prophylaxis or treatment interventions. Prophylaxis may include vaccination or antisera. Availability of effective treatment may include passive immunization and post-exposure vaccination, antibiotics, and chemotherapeutic agents, taking into consideration of the possibility of the emergence of resistant strains.

Based on risk assessment considering the potential factors listed above, the following should be determined by the PREDICT activity supervisor:

1. Level of biosafety risk for the planned activity.
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 or between site visits, that may be required to reduce risk of transmission and provide adequate protection for humans and animals.
4. Whether PREDICT personnel have received recommended vaccinations or prophylaxis before activities that have risks of exposure to zoonoses (i.e. veterinarians and animal handlers should have certain vaccinations on record).

World Health Organization (WHO) Classification of Infective Microorganisms by Risk Group (2004)

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), and presence of appropriate vectors and environmental conditions. Countries usually adopt a similar set of risk categories.

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.

Determining the Appropriate PPE for PREDICT Activities, Species and Assessed Risk

When performing tasks with risk of exposure to zoonotic pathogens (such as handling live or dead animals, collecting, testing, or packaging samples), PREDICT field staff should always wear the appropriate PPE as warranted by the assessed risk. It is the responsibility of the supervising veterinarian or medical specialist to determine the required PPE components for specific activities, based on an established PREDICT protocol or based on their risk assessment according to the considerations in Section 2 above. 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 the Table 1.

Table 1. Minimum PPE to wear for some PREDICT Tasks:

Animal/Task	N95 Respirator	Goggles, Face shield or protective glasses	Gloves*	PPE Coveralls or Dedicated Clothing with washable shoes
Primate handling (Live or carcass)	Yes	Yes	Yes	Yes (either coveralls or dedicated clothing)
Handling rodents or bats (Live or carcass)	Yes	Yes	Yes	Yes (either coveralls or dedicated clothing)
Bat caves	Yes	Yes	Yes	PPE coveralls
Necropsy of sick animals	Yes	Yes	Yes	Yes (either coveralls or dedicated clothing) with apron
Handling of poultry or waterfowl	Yes	Yes	Yes	Yes
Collection of animal feces or urine from the environment	Depends**	Depends	Yes	Depends
Sampling an animal once it has been anesthetized	Recommended if in close contact with the animal during sampling activity	Recommended for those in close contact with the animal during sampling activity	Recommended for the person sampling to prevent needle sticks	Depends

*** 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.**

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

SECTION 4. USE AND DISPOSAL OF PPE

Considerations When Using PPE:

Warning: Persons with chronic respiratory or cardiac conditions, such as asthma, may find it difficult to breath through a mask, such as an N95 or P100 respirator. These persons should not do tasks that require use of a respirator. During training or fieldwork always ask each individual that puts on a mask if they are comfortable breathing through the mask. If they find breathing to be difficult or are experiencing anxiety, they should remove their mask and not participate in any activities that require a respirator.

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 the environmental conditions to avoid the risk of heat exhaustion or heat stroke. Personnel should inform their supervisor if he or she experiences 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 very likely to remove their goggles or mask, exposing themselves to potential pathogens.

Most items in the PPE Kits 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 wildlife equipment, such as cages, crates or farm tools. All personnel should use this area to put on their PPE.

Designate a decontamination and PPE removal site.

Always wear the respirator properly when you are working; don't hang it around your neck. Ensure that there is a tight seal formed around the mask.

If any piece of PPE is torn, it should be changed at the PPE decontamination site as soon as possible.

Planning and Preparations for PPE Use:

1. Prior to going to the field, the level of risk for the field tasks and the appropriate components of PPE needed to safely perform the field tasks should be determined.
2. PPE kits should be assembled for each person that will be involved in the field tasks. Multiple kits per person may be required, based on numbers of animals to be handled, and number of breaks that personnel may take, etc.

3. Prior to going to the field, PPE supplies should be organized. Along with required sets of PPE, supplies should include disinfectants, large disposal bags, and collection bags for equipment (such as plastic goggles, face shields and rubber boots) that will be disinfected for reuse.

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 have not consumed adequate water.

5. Bring additional tape, extra collection and disposal bags. Tape can be used to secure open plastic collection bags to outside of coveralls, secure shoe covers and protective clothing or to seal bags.

5. 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 and discard them (or put reusable items in bags for disinfecting) before taking a break. Put on a new set after the break.
- c. Immediately after using PPE, place them in the red plastic bag (or marked medical waste bag) that you put in the PPE Kits.
- d. The red plastic bags should be sealed and disposed of properly. Follow the instructions of the local officials or person supervising the work on where to place red infectious waste bags when they are full.
- e. Disposal methods (such as burning or burial) may differ by situation or location. Local officials or those supervising the work will likely decide on how best to dispose of used PPE and other disposable items that are likely to be contaminated.

Components of PPE Kits:

1. Coveralls, dedicating clothing, and aprons – for high-risk tasks, full coverage may be warranted. In that case, Tyvek coveralls may be used. For lower-risk tasks, just an apron and/or dedicated clothing may be appropriate. An apron should be a disposable type that is properly disposed of 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 coveralls:

- Wear these coveralls to protect your skin and/or clothing against contamination when in contact with animal droppings, dust animal urine or droppings, or animal fluids such as blood, saliva, and mucous.
- The synthetic material Tyvek is water resistant, so even if the coveralls get dirty or wet, they will still protect you.
- You can wear your regular shoes and clothing under the coveralls.

2. Shoe Covers or Washable Rubber Boots--

- Because pathogens in animal feces, secretions or blood can easily contaminate your footwear, it is important 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 street shoes.
- Rubber boots may be worn over coverall feet, or with dedicated pants pulled over the top of them.
- A footbath should be prepared with either chlorine bleach or Virkon disinfectant that can be used to disinfect boots and other footwear upon leaving the field site. A boot brush should be available for scrubbing upper surfaces of footwear.
-

3. N95 Respirator vs. Surgical Mask

- The N95 Respirator (mask) protects you from inhaling the droplet or aerosolized pathogens into your nose and lungs. Whereas, the surgical mask only protects you from droplet size material and contact contamination.
- Ideally, all personnel using N95 masks should be fit tested to make sure they can wear a mask with a proper seal. (A video on test fitting is available for viewing.) If you have facial hair, it is unlikely that you can properly fit an N95 respirator.

- Do not use, or provide N95 respirators to others, 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 have trouble breathing wearing a respirator, they should go to the PPE removal site and remove their respirator.
- Always wear the respirator when you are working; don't hang it around your neck.

4. Goggles & Face Shields



- Goggles protect your eyes from splashes and liquids.
- They should fit snugly over and around your eyes.
- The goggles in your PPE Kit are adjustable to ensure the best fit. Adjust the head strap before putting on all of your PPE.
- 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 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

A Nitrile or latex glove is used for infectious agent exposure protection. Leather or heavy rubber gloves may be worn over Nitrile or latex gloves to protect against animal bites or scratches.

For exposure protection:

Latex



Nitrile (Preferred*)



*Some people are allergic to Latex.

- Gloves are part of minimum PPE for any kind of sampling collecting tasks that will be conducted under PREDICT. Gloves may be nitrile, latex, or rubber.
- Two pairs of nitrile or latex gloves are recommended when using sharps. In the USAID kit described in this guide there are two pairs, a white or clear pair and a pair that is usually of a different color.
- Heavy rubber gloves or leather gloves may be required when handling live animals.

6. Disinfecting Wipes or Spray Solution-- for disinfecting gloves or hands.

- Germicidal wipes or disinfectant spray solutions may be used to clean your outer gloves before removing them.
- Alcohol wipes or spray may be used to clean skin that may have accidentally been contaminated.
- It is recommended to wash or use disinfectant solution on your hands after gloves have been removed, regardless of contamination.

7. Infectious Waste Bag—plan to have bags for safe disposal of PPE and other medical waste.

- A red medical waste bag (or otherwise labeled 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.
- Tie the bag at the top and leave it at the designated collection site or place in a container for transport to a proper disposal site.
- Spray outside of disposal bag with disinfectant once closed and tied.

- 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 biohazardous waste should be contained and returned to a medical center for autoclaving or incineration.

Procedure for Putting on PPE

The procedures below cover putting on and taking off full PPE. However, all of the components of PPE discussed below are not necessary or even appropriate for all tasks. For instance, Tyvek coveralls and aprons are not necessary for many tasks.

- 1. 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 it up coveralls or button up clothing.



- 2. Shoe Covers or Boots go on SECOND.** Shoe covers fit over the coverall feet.



3. **Respirator or Surgical Mask goes on THIRD.** Remember that 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. ***Warning: If persons have difficulty breathing or experience anxiety with a mask, they should remove the mask and not participate in activities that require a respirator.***



4. **Goggles go on after the Respirator.** The goggles should fit snugly over and around your eyes. The goggle straps should be adjusted to fit your head before you begin putting on the PPE.

Once the respirator and goggles are in place, pull the hood on your coveralls over your head (or the put on the separate head cover if the coveralls do not have a hood).



- 5. Tie on the Apron Over the coveralls or your dedicated clothing.** Place the apron over your head and then tie it in the back.



- 6. Put on the Gloves.** If there are two pairs of gloves in your PPE kit, put on both pairs.



Procedure for Removing PPE:

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

- 1. Remove and dispose of the apron.**



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



- 3. Remove the outer boot** by holding the top and rolling it off of your foot. Place it in the biohazard bag.



- 4. Remove the outer glove** and place them in the biohazard bag.



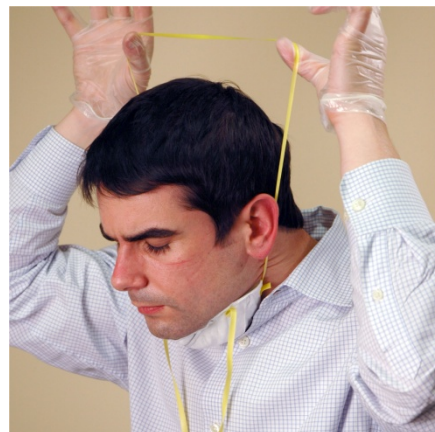
5. **Unzip and roll down the coveralls** until they are inside out and place them in the infectious waste bag.



6. Remove the goggles by the strap and place them in the infectious waste bag.



7. Remove the respirator by grabbing the top and then the bottom elastic bands, and pull them up over your head. Place the respirator in the red infectious waste bag.



8. Remove the inside gloves and place them in the infectious waste bag.



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



10. Wipe your hands with a disinfectant wipe or solution and dispose of it in the biohazard bag.



11. Wash your hands and wrists using running water or have a bucket of water poured over your hands, and you are ready to go.



If PPE is compromised, falls off, rips or is removed while handling or exposed to biological hazardous materials or viruses, inform your supervisor to determine if prophylaxis is indicated.

Proper Hand Washing with PPE

After removing PPE you should thoroughly wash your hands and wrists.

How to wash your hands and wrists correctly:

Wet your hands with water and apply soap. Use clean, running water or have someone pour the water if using a bucket.

Rub hands together to make a lather and scrub all surfaces of your hands and wrists.

Continue rubbing hands and wrists for 20 seconds.



Rinse hands and wrists well under running water or have someone pour the water.

Air dry your hands, or use a towel if you have one.

WHEN TO WASH YOUR HANDS WHILE USING PPE

Before putting on your PPE

Before putting on your gloves or respirator and again after taking a work break

Before and after changing your respirator

After taking off your gloves and the rest of your PPE, and placing them in the red waste bag

Any other time your ungloved hands have come into contact with potentially infected animals, equipment or surfaces.

SECTION 5. USE OF THE N95 RESPIRATOR

Warning: If persons have difficulty breathing or experience anxiety with a mask, they should remove the mask and not participate in activities that require a respirator.

N95 particulate respirator-- Here are a few things you should know about it:

- Respirators are designed to fit adults; it is not recommended that children use them.
- Using N95 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.
- N95 respirators must be made to fit each face. An N95 respirator that has not been fitted properly can leave unprotected gaps between the respirator and your face, and these gaps will impair the respirator's effectiveness.
- Facial hair or unusual facial features make it difficult to fit N95 respirators properly. N95 respirators cannot be worn effectively on men with beards or unshaven faces.
- When N95 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 strict hand-washing procedures and gloves.
- Respirators should be discarded and replaced after 4-6 hours of use. The other PPE can remain on for the duration of your activities.
- 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.
- N95 respirators should not be hung around your neck when working. Always wear them when working.



Respirator Use Review:

Review the following sentences and then find the numbered word or phrase in the box below that correctly completes the statement. Write the number of that word or phrase in the blank space in the statement.

A. Respirators are designed to fit adults. Their use by _____ is not recommended.

B. The use of the N95 respirator by itself will not fully protect you from being infected by highly pathogenic avian influenza. It must be _____.

C. N95 respirators must be made to fit each _____.

D. An N95 respirator that has not been fitted properly can leave unprotected gaps between the respirator and your face. These gaps will impair the respirator's _____.

E. _____ make it difficult to fit N95 respirators properly. N95 respirators cannot work effectively with beards or unshaven faces.

F. N95 respirators lose their protective properties and must be changed when they become _____.

G. Your respirator is splashed and becomes wet. Before changing putting on a new one, you should always _____.

H. Surgical masks are not _____. Surgical masks are designed to protect patients from contaminants generated by the person wearing the mask – usually a nurse, doctor, or other health care worker. Masks filter out large-size particles in the air, but they offer little protection against avian influenza virus.

I. Respirators should be discarded and replaced if _____, even if all the other PPE equipment is ok.

J. N95 respirators should not be _____. Always wear them when working.

Choose the correct answers 1-10 to match with questions A-J.	
1. Wet from saliva or respiratory secretions	6. Used in combination with the rest of the PPE kit
2. Hung around the neck while working	7. Effectiveness
3. Respirators	8. Children
4. Wash your hands using strict hand washing procedures	9. It becomes difficult to breath
5. Facial hair or unusual facial features	10. Face

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