

Personal Protective Equipment (PPE) for Infectious Diseases of High Consequence: General Information

To increase the safety of healthcare workers (HCWs), regular in depth training in the use of PPE must be understood as an integral part of preparedness. Additional *preparedness* challenges relate to the fact that daily routine procedures will be heavily affected by only a single case of an infectious disease of high consequence and that a portion of the workforce will be drawn in to this specialized environment.

Infectious diseases of high consequence (IDHC) are serious threats to human health. Patients develop severe symptoms, require a high level of care, and the case-fatality rates are high. Often, there is no specific prophylaxis or treatment available. IDHC are transmissible from human to human (contagious).

Staff protection with PPE, the isolation of contagious patients, and environmental cleaning are the main measures to keep facilities functional and contain the risk for both HCWs and the community. The setup of PPE required for IDHC goes beyond usual transmission-based precautions. The rationale is to create an extended margin of safety for staff by anticipating unplanned high-exposure situations.

It is important to ensure staff can work in adequate conditions to prevent heat-related illness. This can be prevented by good team management to facilitate adequate rotation, and use of the buddy system.

Standard components for this treatment setting include respiratory protection, eye protection, hand protection, body protection, and foot protection.

Coveralls

Essential features for single-use coveralls for IDHC include a splash-proof cover of the zipper of the coveralls and an incorporated hood.

An integrated foot cover may be advantageous for quicker donning. Where there are concerns of slipping hazards from the integrated foot cover, single-use (disposable) over shoes are available. These are worn over the coveralls.

PPE must fit the height and posture of the user. The user must be able to move around freely without the coveralls being displaced and giving room for fluids to enter the coveralls.

Coveralls should be loose to facilitate ease of removal. If coveralls are an exact fit, the size is too small and may result in difficulty doffing. Coveralls that are at least one size larger should be worn. Sizing charts are available.

Maximum length of time that coveralls can be worn depends on the material from which they are made and on environmental conditions. Coveralls do not lose their ability to protect from the Ebola virus; however, depending on the working conditions they can lead to hyperthermia if worn too long. The estimated safe period for wearing Tyvek® PPE is ~ 2 to 3 hours.

If coveralls are torn, remain calm and proceed to the doffing process.

Helpful hint: Before entering a contaminated zone, test if the coveralls fit by kneeling down and lifting the arms when fully covered by the PPE.



Gloves

Balance tactility (e.g., for medical interventions) and the level of protection (defined by mechanical resistance) in the choice of gloves.

PPE users, including assistants, should always use a minimum of two pairs of gloves.

- **Inner** pair of gloves (**blue**, very extended cuff): covering the skin ('like a second skin')
- **Outer** pair of gloves (**green**, extended cuff): gloves on top of gloves and coveralls ('working gloves')

Glove combinations adapted to specific tasks improve safety and provide the desired tactility or the needed robustness.

Integrated gloves potentially limit the choices for adapting the hand protection to certain activities such as patient procedures or waste management.

Unlike other practices with Oxivir TB, immersion of gloves does not require 1 minute contact time before moving on. One minute contact time is required when used to disinfect equipment and surfaces (this practice is to be maintained). The action of immersing gloves in Oxivir TB solution is to remove bio-burden from the gloves.

Helpful hints:

- Wear different coloured inner/outer gloves to more easily identify if a tear/breach has occurred.
- Outer gloves should be adapted to the tasks the PPE user has to perform.
 - Inner gloves + outer nursing gloves for patient care
 - Inner gloves + outer surgical gloves (sterile if required) for specific interventions
 - Inner gloves + rough outer gloves for waste management or cleaning

Gowns

A long-sleeved, fluid repellent gown minimizes contamination risk from sprays and splashes. *NOTE: these are not the 'regular' isolation gowns. These are fluid repellent and disposable.*

When two gowns are worn (e.g., if an additional gown is required for full coverage of the front and back sides), the inner one (worn similar to a housecoat) should be left untied. The outer one will be removed as per the usual process, while the inner one will be removed by the assistant. Similar to doffing of coveralls, the primary person faces the patient room door and the assistant removes the gown off the primary's shoulders, followed by the sleeves.

N95 Respirators

An N95 NIOSH-approved respirator protects the user from inhaling airborne hazards. It can filter out 95% of airborne particles 0.3 microns or larger in size. To do this, the N95 respirator must have an adequate fit and seal to your face. N95 respirators must be seal checked each time they are applied. To ensure this seal, the PPE user's face must be clean shaven.

Laughing, yawning, grimacing, coughing and sneezing may alter the seal of the respirator so another seal-check may be necessary. Sneezing inside the N95 is possible; just do not touch the N95 with your hands.

A PPE user with a runny nose while wearing an N95 is also not problematic, providing N95 is not touched.

The key consideration for how long a N95 respirator can be worn is if it is safe and remains able to protect you from respiratory hazards. The respirator should be changed or discarded when it becomes damaged or deformed; no longer forms an effective seal to the face; becomes wet or visibly dirty; breathing through it becomes more difficult; or it becomes contaminated with blood or other bodily fluids from patients. This has been found to be approximately 2 hours in healthcare settings dependent on activities performed.

These respirators are designed to be worn for 8 hours. There is extensive experience in industrial settings, including very dusty settings, indicating 8 hours of continuous or intermittent use is a safe duration from the standpoint of respirator function.

It is of utmost importance to remove the N95 respirator with caution. Do not wear eyeglasses over the N95 straps; this differs from the regular procedure for placement of glasses when wearing an N95. The same applies during removal of respirator (i.e., do not remove glasses). If staff choose not to wear their glasses into the isolation area, a magnifying glass or magnifying sheet could be used in the space, and then disposed as biomedical waste.

Face Shields/Hoods

A full face shield must be worn. Most face shields are secured with elastic straps. Wearing face shields over the hood prevents liquids from soaking through to the skin via the elastic strap and also ensures a close fit of the hood, avoiding gaps between hood and face shield.

Face shields with attached bibs are also available. This face shield is for use by staff who have unprotected areas of the neck when wearing the standard full face shield and coveralls. The bib shall be secured to the outside of the coveralls to ensure the neck is protected. These face shields are applied and removed in the same manner as the standard full face shields.

Also available for staff who still have unprotected areas of the neck when wearing the standard full face shield and coveralls are hoods with bibs. These are applied underneath the coveralls; the coveralls hood is applied over this one.

Leg/Shoe Covers

Single-use (disposable), fluid-resistant or impermeable boot covers offer protection from splashes and sprays. Boot/shoe covers should allow for ease of movement and not present a slip hazard to the worker. These are to be worn over closed toe and heel shoes.

The assistant removes the boot/shoe covers by slowly and firmly pulling away from the primary's foot while the primary balances self carefully, stabilizing self if necessary. Avoid contact with scrubs.

Preparing to Work with PPE for Infectious Diseases of High Consequence

Helpful hints

- Wearing makeup is not recommended as it impairs user comfort due to facial sweat.
- Consider using the toilet before putting on the PPE.
- Drink 1–2 litres of water before putting on the PPE to prevent dehydration. Profuse sweating is unavoidable while working with PPE so this won't cause the HCW to need to use the toilet.
- Fasting is not recommended before working with PPE.
- Check PPE items before starting the donning process; look for damage and irregularities like holes and cracks.

Donning and Doffing

Did you know:

- **Donning**: putting **on** the PPE
- **Doffing**: taking **off** the PPE

Basic Principles in Donning and Doffing

There are many different ways of putting on and removing PPE. There is no gold standard on how to do this. It is more important to understand the rationale behind the chosen approach for donning and doffing. The most critical aspects in the process are how to avoid disease transmission to HCWs and avoid self-contamination while doffing.

Consequently, both processes, donning and doffing, need **active assistance**. In addition, allocating sufficient time for donning and doffing – while simultaneously avoiding distractions – is essential. PPE components must be donned properly and in precise order to create an integrated protection system.

The exiting PPE user has only minimum activities to perform and will receive targeted instruction and assistance. It is important the primary stands still while remaining in a relaxed, yet stable, position.

The primary is completely guided and assisted. This has the advantage of avoiding the need to manipulate PPE on potentially contaminated body areas without having direct sight. Additionally, the primary may be fatigued or distracted by the recent interaction with the patient.

Re-check materials both at the beginning and end of the donning process to add another layer of safety.

During the doffing process it is important to proceed calmly and systematically, and maintain eye contact with the monitor and assistant while they talk you through (monitor) and assist with (assistant) doffing to avoid mistakes. The doffing process needs continuous quality control and must be adapted to the PPE components in use, in order to minimize contamination risks during removal.

Monitors and assistants always need to follow a checklist outlining the established procedures for donning and doffing.

If required, adjust PPE **before** entering patient room/anteroom.

Assistant

Donning and doffing PPE without assistance is unsafe and may result in HCW contamination. During the donning process, the assistant should perform hand hygiene before starting.

During doffing in the designated units, the assistant must wear assistant PPE and immerse gloves in accordance with the established procedure. If the assistant is entering the patient room (e.g., break relief), full 'primary' PPE is required.

Inspecting the PPE Components

Once the primary dons full PPE, the assistant or monitor should verify there are no damaged areas, irregularities in the material, and no open gaps.

If PPE components are displaced during this inspection, they must be repositioned before entering the patient care area.

Doffing (Removing PPE)

Assisting the primary actively in the doffing process is essential for preventing him/her from manipulating PPE on potentially contaminated body areas without having direct sight. This is even more crucial when it comes to parts of the doffing process requiring fine motor skills, such as opening the flaps and zipper.

During doffing: the primary should only move on command to avoid contamination. The primary should not use their hands while PPE is being removed by the assistant.

All PPE is considered contaminated during removal; therefore risk of contamination is always present.

PPE Inspection – Assistant

Before starting the doffing process, the assistant should look for visibly contaminated areas or cuts. Additional disinfection with a disinfecting wipe should be considered. Use increased diligence to avoid environmental or self-contamination if visibly contaminated areas or cuts/tears are present.

Working with IDHC PPE

Wearing PPE heavily affects work routines.

Starting with the first step, the donning process requires full attention, long before starting to care for the patient.

The biggest challenge for many HCWs dealing with IDHC is a change of mindset: from patient focus and patient care activities to self-protection, the protection of other staff members, and the prevention of spread to the community.

In addition to the physical constraints (heat, dehydration, and intensive duty rosters), there are several psychological aspects to prepare for:

- Full clinical pictures of IDHC like EVD may be traumatic, even for experienced HCWs.
- The normal patient-HCW model of interaction/communication is disrupted.
 - One reason lies in the 'depersonalization' of the HCW who is now completely masked, which may be perceived as threatening.
 - Communication is hampered by N95 respirators and coverall hoods.

- The fear of undetected contamination or secondary transmission to relatives and friends results in increased stress levels for HCWs.

The main principle for working in these areas: Always work in a team in order to provide the necessary amount of assistance and monitoring.

Active assistance is mandatory during the donning and the doffing process. The primary must be able to fully trust the assistant. Training to get used to these procedures is very important. The 'buddy system', established as an essential safety mechanism in scuba diving, is important for staff working with PPE and IDHC. Never work alone.

Helpful hints

- Never adjust any of PPE components while in the patient environment (including the anteroom).
- Consider learning some breathing and relaxation exercises when preparing for working under PPE.
- The working time under PPE for IDHC may be limited to two hours maximum, even in an air-conditioned environment.

When working with EVD PPE, 'hand hygiene' becomes 'glove hygiene'. Hand/glove hygiene should be performed:

- Before putting on gloves/wearing PPE (i.e. before entering the isolation room/area) (hand hygiene)
- Before performing clean/aseptic procedures (glove hygiene)
- After any exposure/risk to/from the patient's bodily fluids (glove hygiene)
- After touching (actually or potentially) contaminated surfaces/items/equipment in the patient's surroundings (glove hygiene); and
- After removing the PPE and exiting the anteroom (hand hygiene).

Incident Management and Reporting

Be prepared that incidents such as needlestick and sharps injuries can happen at any time.

Helpful hints

- If an incident occurs, do not act on impulse, instead reflect on what happened and assess (i.e., think first) before acting.
- If PPE must be removed ensure the doffing process is followed.
- Ask the assistant and monitor what they noticed, immediately report what happened, and follow safe processes to address.
- Ask them to help, and act calmly.
- Ensure the monitor documents what was observed

Displaced PPE Components

Some PPE components such as the face shield or the N95 respirator can be displaced during work, which compromises safety of the HCW.

Consider going to the doffing area and asking for assistance to have the components of the PPE readjusted (by the assistant in PPE).