ICT presents a review of the basics of personal protective equipment (PPE).

The Occupational Safety and Health Administration (OSHA) defines PPE as “specialized clothing or equipment worn by an employee for protection against infectious materials.” OSHA dictates that employers must supply items of PPE for its employees as well as ensure that the PPE is disposed of properly.

The types of PPE that are used in the healthcare environment are:

1. Gloves: to protect hands
2. Gowns/aprons: to protect skin and/or clothing
3. Masks and respirators to protect mouth/nose
4. Respirators: to protect respiratory tract from airborne infectious agents
5. Goggles: to protect eyes
6. Face shields: to protect face, mouth, nose and eyes

When selecting PPE, consider the following important factors:

1. The type of anticipated exposure, determined by the type of anticipated exposure, such as touch, splashes or sprays, or large volumes of blood or body fluids that might penetrate the PPE.
2. The appropriateness and barrier protection level of the PPE for the task.
3. The fit of the PPE. PPE must fit the individual user, and hospitals must ensure that all PPE are available in sizes appropriate for all healthcare workers.

Face Protection: Masks, Goggles, Face Shields and Respirators

A combination of PPE types is available to protect all or parts of the face from contact with potentially infectious material. The selection of facial PPE is determined by the isolation precautions required for the patient and/or the nature of the patient contact. Masks should fully cover the nose and mouth and prevent fluid penetration. Masks should fit snugly over the nose and mouth. For this reason, masks that have a flexible nose piece and can be secured to the head with string ties or elastic are preferable. Goggles provide barrier protection for the eyes; personal prescription lenses do not provide optimal eye protection and should not be used as a substitute for goggles. Goggles should fit snugly over and around the eyes or personal prescription lenses. When skin protection, in addition to mouth, nose, and eye protection, is needed or desired, for example, when irrigating a wound or suctioning copious secretions, a face shield can be used as a substitute to wearing a mask or goggles. The face shield should cover the forehead, extend below the chin, and wrap around the side of the face.

PPE also is used to protect healthcare workers from infectious aerosols such as Mycobacterium tuberculosis. Respirators that filter the air before it is inhaled should be used for respiratory protection. The most commonly used respirators in healthcare settings are the N95, N99, or N100 particulate respirators. The device has a sub-micron filter capable of excluding particles that are less than 5 microns in diameter. Respirators are approved by the CDC’s National Institute for Occupational Safety and Health. Like other PPE, the selection of a respirator type must consider the nature of the exposure and risk involved. For example, N95 particulate respirators might be worn by healthcare workers entering the room of a patient with tuberculosis. However, if a bronchoscopy is performed on the patient, the healthcare worker might wear a higher level of respiratory protection, such as a powered air-purifying respirator (PAPR).

Body Protection: Gowns

Three factors influence the selection of a gown:

1. The purpose of use. Isolation gowns are generally the preferred PPE for clothing but aprons occasionally are used where limited contamination is anticipated. Gowns should fully cover the torso, fit comfortably over the body, and have long sleeves that fit snugly at the wrist.
2. The material properties of the gown. Isolation gowns are made either of cotton or a spun synthetic material that dictate whether they can be laundered and reused or must be disposed. Cotton and spun synthetic isolation gowns vary in their degree of fluid resistance, another factor that must be considered in the selection of this garb. If fluid penetration is likely, a fluid-resistant gown should be used.
3. The risk involved and whether a clean, rather than sterile gown, can be used. Clean gowns are generally used for isolation. Sterile gowns are only necessary for performing invasive procedures, such as inserting a central line. In this case, a sterile gown would serve the purposes of patient and healthcare worker protection.

The Association for the Advancement of Medical Instrumentation (AAMI) standard, “Liquid Barrier Performance and Classification of Protective
Apparel and Drapes Intended for Use in Health Care Facilities (ANSI/AAMI PB70), addresses the manufacturing of medical gowns’ barrier performance, which is key in preventing fluid and microbial strikethrough. In addition to strikethrough, the standard addresses parameters for flammability resistance and linting, which can serve as a carriage vehicle for microbial particles. At the heart of this AAMI standard are the four levels of barrier protection, ranging from level one, which is the lowest level of protection, to level four, which is the highest level. Utilizing these classification levels, manufacturers label their products according to the level of protection their product provides, and healthcare workers can more easily select the appropriate barrier they need. All gowns and surgical drapes are subject to this classification system. The first classification level is determined by using a test called AATCC 42 – Water Impact Penetration, which measures the material’s resistance to water penetration under single-spray contact. The second classification level is determined by using a test called AATCC 127 – Hydrostatic Head Test, which measures the material’s resistance to water penetration under increasing pressure. The third classification level is determined by testing material using the aforementioned water impact penetration and hydrostatic head tests. To attain level four classification, material must be considered to be impervious, and is subjected to the blood barrier test (ASTM F1670) and the viral barrier test (ASTM F1671).

How to Safely Don, Use and Remove PPE

Key Points About PPE
• Don before contact with the patient, generally before entering the room
• Use carefully – don’t spread contamination
• Remove and discard carefully, either at the doorway or immediately outside patient room; remove respirator outside room
• Immediately perform hand hygiene

Sequence for Donning PPE
(Note: The combination of the PPE used and the precautions that need to be taken will dictate sequence – be sensible.)
1. Gown
2. Mask or respirator
3. Goggles or face shield
4. Gloves

How to Don a Gown
• Select appropriate type and size
• Opening is in the back
• Secure at neck and waist
• If gown is too small, use two gowns (Gown No. 1 ties in front; gown No. 2 ties in back)

How to Don a Mask
• Place over nose, mouth and chin
• Fit flexible nose piece over nose bridge
• Secure on head with ties or elastic
• Adjust to fit

How to Don a Particulate Respirator
• Select a fit tested respirator
• Place over nose, mouth and chin
• Fit flexible nose piece over nose bridge
• Secure on head with elastic
• Adjust to fit
• Perform a fit check: Inhale – respirator should collapse; exhale – check for leakage around face
The technique for donning a particulate respirator, such as an N95, N99 or N100, is similar to putting on a pre-formed mask with elastic head bands. Key differences, however, are: the need to first select a respirator for which you have been fit tested and fit checking the device before entering an area where there may be airborne infectious pathogens. Be sure to follow the manufacturer's instructions for donning the device.

How to Don Eye and Face Protection
• Position goggles over eyes and secure to the head using the ear pieces or headband
• Position face shield over face and secure on brow with headband
• Adjust to fit comfortably

How to Don Gloves
• Don gloves last
• Select correct type and size
• Insert hands into gloves
• Extend gloves over isolation gown cuffs to provide a continuous barrier protection

How to Use PPE Safely
• Keep gloved hands away from face
• Avoid touching or adjusting other PPE
• Remove gloves if they become torn; perform hand hygiene before donning new gloves
• Limit surfaces and items touched

How to Remove PPE Safely

To remove PPE safely, you must first be able to identify what sites are considered “clean” and what are “contaminated.” In general, the outside front and sleeves of the isolation gown and outside front of the goggles, mask, respirator and face shield are considered “contaminated,” regardless of whether there is visible soil. Also, the outside of the gloves are contaminated. The areas that are considered “clean” are the parts that will be touched when removing PPE. These include inside the gloves; inside and back of the gown, including the ties; and the ties, elastic, or ear pieces of the mask, goggles and face shield.

Sequence for Removing PPE
1. Gloves
2. Face shield or goggles
3. Gown
4. Mask or respirator

Where to Remove PPE
• At doorway, before leaving patient room or in anteroom*
• Remove respirator outside room, after door has been closed*
* Ensure that hand hygiene facilities are available at the point needed (e.g., sink or alcohol-based handrub)

How to Remove Gloves
• Grasp outside edge near wrist
• Peel away from hand, turning glove inside-out
• Hold in opposite gloved hand
• Slide ungloved finger under the wrist of the remaining glove
• Peel off from inside, creating a bag for both gloves
• Discard in appropriate receptacle

How to Remove Goggles or Face Shield
• Grasp ear or head pieces with ungloved hands
• Lift away from face
• Place in designated receptacle for reprocessing or disposal

How to Remove Isolation Gowns
• Unfasten ties
• Peel gown away from neck and shoulder
• Turn contaminated outside toward the inside
• Fold or roll into a bundle
• Discard in appropriate receptacle

How to Remove a Mask
• Untie the bottom, then top ties
• Remove from face
• Discard in appropriate receptacle

How to Remove a Particulate Respirator
• Lift the bottom elastic over your head first
• Then lift off the top elastic
Gloves serve everyone from patient-care providers to housekeeping staff, and operating room personnel. Most patient-care activities require the use of a single pair of non-sterile gloves made of latex, nitrile or vinyl; however, because of allergy concerns, many hospitals have eliminated or limited latex products. Gloves should fit the user’s hands comfortably—they should not be too loose or too tight, and they should not tear or damage easily. Sterile surgical gloves are worn by surgeons and other OR personnel who perform invasive patient procedures and during some surgeries, double-gloving may occur.

Gloves protect healthcare workers against contact with infectious pathogens and other potentially infectious material; however, once contaminated, gloves can become a means for spreading infection to yourself, others and environmental surfaces. But gloves can cause skin irritation and trigger allergies in healthcare workers as well as in patients. There are a number of adverse effects that can be caused by gloves, including latex allergies; the formation of granulomas and adhesions in surgical patients from the introduction of powder into the surgical site from gloves; the incidence of allergic reaction from glove powder that has become aerosolized; and the incidence of contact dermatitis, a condition in which the skin of hands cracks and these tiny fissures can allow bacteria to grow. Latex allergy can be associated with several kinds of skin irritation. Irritant contact dermatitis is inflammation that occurs when the skin’s surface becomes dry and irritated from non-glove sources, including frequent handwashing. When chapped, dry, irritated skin comes in contact with glove powder and latex gloves, the HCW can experience painful stinging and burning sensations and the skin can become red. Continual exposure can make the skin crusty with bumps and scabs that may peel or form cracks. A reaction to the chemical additives used during the manufacturing process of gloves is what triggers allergic contact dermatitis, a skin rash with occasional oozing blisters which can form approximately 24 to 48 hours after contact.

Do’s and Don’ts of Glove Use

- Work “from clean to dirty” (touch clean body sites or surfaces before touching dirty or heavily contaminated areas)
- Limit opportunities for “touch contamination” (don’t touch your face or adjust PPE with contaminated gloves, and don’t touch environmental surfaces except as necessary during patient care)
- Change gloves appropriately (during use if torn and when heavily soiled; after use on each patient
- Discard in an appropriate receptacle (never wash or reuse disposable gloves)

When to Use PPE

Standard Precautions

- Previously called Universal Precautions
- Assumes blood and body fluid of any patient could be infectious
- Recommends PPE and other infection control practices to prevent transmission in any healthcare setting
- Decisions about PPE use determined by type of clinical interaction with patient

Standard Precautions is an outgrowth of Universal Precautions. Universal Precautions was first recommended in 1987 to prevent the transmission of bloodborne pathogens to healthcare personnel. In 1996, the application of the concept was expanded and renamed “Standard Precautions.” Standard Precautions is intended to prevent the transmission of common infectious agents to healthcare personnel, patients and visitors in any healthcare setting. During care for any patient, one should assume that an infectious agent could be present in the patient’s blood or body fluids, including all secretions and excretions except tears and sweat. Therefore appropriate precautions, including use of PPE, must be taken. Whether PPE is needed, and if so, which type, is determined by the type of clinical interaction with the patient and the degree of blood and body fluid contact that can be reasonably anticipated and by whether the patient has been placed on isolation precautions such as Contact or Droplet Precautions or Airborne Infection Isolation.

PPE for Standard Precautions

- Gloves – Use when touching blood, body fluids, secretions, excretions, contaminated items; for touching mucus membranes and non-intact skin
- Gowns – Use during procedures and patient care activities when contact of clothing/exposed skin with blood/body fluids, secretions, or excretions is anticipated
- Mask and goggles or a face shield – Use during patient-care activities likely to generate splashes or sprays of blood, body fluids, secretions or excretions

Under Standard Precautions, gloves should be used when touching blood, body fluids, secretions, excretions, or contaminated items and for touching mucous membranes and non-intact skin. A gown should be used during procedures and patient-care activities when contact of clothing and/or exposed

Hand Hygiene

- Perform hand hygiene immediately after removing PPE; if hands become visibly contaminated during PPE removal, wash hands before continuing to remove PPE
- Wash hands with soap and water or use an alcohol-based handrub

Discard in appropriate receptacle

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Discard in appropriate receptacle
skin with blood, body fluids, secretions, or excretions is anticipated. Aprons are sometimes used as PPE over scrubs, such as in hemodialysis centers when inserting a needle into a fistula. A mask and goggles or a face shield should be used during patient-care activities that are likely to generate splashes and sprays of blood, body fluids, secretions or excretions.

PPE for Expanded Precautions

• Expanded Precautions include:
  – Contact Precautions
  – Droplet Precautions
  – Airborne Infection Isolation

In some instances, healthcare personnel are required to wear PPE in addition to that recommended for Standard Precautions. The three Expanded Precaution categories (formerly called Transmission-Based Precautions) where this applies are Contact and Droplet Precautions and Airborne Infection Isolation.

Use of PPE for Expanded Precautions

• Contact Precautions – Gown and gloves for contact with patient or environment of care (e.g., medical equipment, environmental surfaces)
• In some instances these are required for entering patient’s environment
• Droplet Precautions – Surgical masks within 3 feet of patient
• Airborne Infection Isolation – Particulate respirator*

*Negative pressure isolation room also required

Contact Precautions requires gloves and gown for contact with the patient and/or the environment of care; in some instances, use of this PPE is recommended for even entering the patient’s environment. Droplet Precautions requires the use of a surgical mask, and Airborne Infection Isolation requires that only a respirator be worn.

Source: CDC. Guidance for the Selection and Use of Personal Protective Equipment (PPE) in Healthcare Settings