Why you should read this article:

- To enhance your knowledge of the items of personal protective equipment (PPE) available, when these items should be used, and the procedure for putting on and removing these items
- To optimise your use of PPE, thus reducing the risk of infection and preserving patient safety
- To count towards revalidation as part of your 35 hours of CPD, or you may wish to write a reflective account (UK readers)
- To contribute towards your professional development and local registration renewal requirements (non-UK readers)

Use of personal protective equipment in nursing practice

Louise Brown, Julianne Munro and Suzy Rogers

Citation

Abstract
A comprehensive understanding of infection prevention and control is essential for nurses when seeking to protect themselves, patients, colleagues and the general public from the transmission of infection. Personal protective equipment (PPE) – such as gloves, aprons and/or gowns, and eye protection – is an important aspect of infection prevention and control for all healthcare staff, including nurses. Its use requires effective assessment, an understanding of the suitability of various types of PPE in various clinical scenarios, and appropriate application. Understanding the role of PPE will enable nurses to use it appropriately and reduce unnecessary cost, while ensuring that the nurse-patient relationship remains central to care. This article defines PPE and its components, outlines when it should be used and details its optimal application.

Author details
Louise Brown, clinical nurse specialist in infection prevention and control, Burwood Hospital, Christchurch, New Zealand; Julianne Munro, clinical nurse specialist in infection prevention and control, Christchurch Women’s Hospital, Christchurch, New Zealand; Suzy Rogers, clinical nurse specialist in infection prevention and control, Christchurch Hospital, Christchurch, New Zealand

Keywords
bacterial infections, blood-borne viruses, communicable diseases, cross-infection, hand hygiene, health and safety, infection, infection control, infection prevention, occupational health, public health, viral infections

Aims and intended learning outcomes
The aim of this article is to enable nurses to identify clinical circumstances that have the potential for transmission of pathogens. It also aims to enhance nurses’ understanding of the rationale for the use of personal protective equipment (PPE) as part of standard precautions for infection prevention and control. After reading this article and completing the time out activities you should be able to:

- Understand the risk of infection transmission and how PPE is designed to prevent it.
- Identify the essential components of effective PPE.
- Explain how PPE can protect nurses and patients from contact with pathogens.
- Outline the appropriate procedure for application and removal of PPE.

Introduction
PPE acts as a physical barrier that prevents healthcare staff, including nurses, from becoming contaminated with blood and other bodily fluids. These include all bodily secretions and excretions that may be transmitted from direct contact with a patient or the patient’s environment, including infectious airborne particles (Beam et al 2011). PPE also protects patients from the potential transmission of pathogens from the hands or clothing of healthcare staff. Pathogens are biological agents that cause disease or illness to their hosts and are routinely present in healthcare settings (National Health and Medical Research Council (NHMRC) 2010).

PPE has evolved as a means of protecting those in healthcare settings from sprays and splashes of blood and bodily fluids. Mitchell (2014) noted that a gradual evolution in the understanding of how pathogens are transmitted led to the refinement of PPE, which provides protection to patients and healthcare staff. PPE became standard practice when gowns and gloves were recommended in the 1970s, initially by the US Centers for Disease Control and Prevention (CDC) (Segal 2016). The
use of PPE was intensified after the human immunodeficiency virus (HIV) became prevalent in the 1980s and universal precautions were introduced for the care of all patients (Segal 2016). Universal precautions later became known as standard precautions and are used as standard practice by healthcare staff to protect themselves from exposure to blood-borne viruses such as hepatitis B and C. Isolation practices aimed at isolating potentially infectious bodily fluids were introduced in 1987 (Garner 1996). These isolation categories were reviewed and renamed transmission-based precautions by the CDC in 1996 (Garner 1996).

Box 1 details the development of universal precautions, standard precautions and transmission-based precautions.

The emergence of severe acute respiratory syndrome (SARS) in 2003 emphasised the importance of PPE, particularly because 20% of those infected were healthcare staff (Rajakurana et al 2017). Transmission of SARS continued despite the use of droplet, contact and airborne precautions (Box 1), which indicated that the virus remained on the surface of PPE itself and that healthcare staff were self-contaminating during the removal of PPE.

The Ebola virus disease outbreak in West Africa in 2015 killed more healthcare staff than any previous Ebola outbreak (Fischer et al 2015). With no licensed vaccine, effective antiviral therapies or prophylactic agents available, the outbreak underlined the role of and reliance on PPE, as well as the importance of its appropriate use and removal (Fischer et al 2015).

While most nurses are not routinely exposed to such devastating pathogens in their patient populations, the same principles of PPE apply. Of particular concern, in the past decade, has been the global spread of multidrug-resistant organisms, including methicillin-resistant Staphylococcus aureus (MRSA), extended-spectrum beta-lactamase-producing Enterobacteriaceae; carbapenemase-producing organisms; and vancomycin-resistant Enterococci (Huttner et al 2013). There also remains an ever-present possibility of novel influenza A strains being created through mutation and viral shift among wild avian species, ruminants (such as goats, sheep and cattle) and swine, which carry a risk of pandemics if transmitted to humans (Uyeki et al 2017).

**Box 1. Development of universal precautions, standard precautions and transmission-based precautions**

**Universal precautions**

- In the early 1980s, healthcare staff and researchers developed an improved understanding of the risks of the spread of blood-borne pathogens from one person to another. By 1987, the US Centers for Disease Control (CDC) had introduced procedures to manage blood and bodily fluids, which were called universal precautions and applied to all patients regardless of their infection status (CDC 1988)
- Isolation was also implemented in 1987 to isolate moist and potentially infectious bodily fluids, mainly through the use of gloves, but without the requirement to wash the hands after glove removal unless they were visibly soiled

**Standard precautions**

- Standard precautions were developed in 1996 to combine the main elements of universal and isolation precautions into a single set of precautions
- Standard precautions apply to all blood, bodily fluids, secretions, excretions (except sweat), non-intact skin and mucous membranes
- The core elements of standard precautions comprise: handwashing after patient contact; the use of barrier precautions such as gloves, gowns and facial protection to prevent mucocutaneous contact; and minimal manual manipulation of sharp instruments and devices, and disposal of these items in puncture-resistant containers

**Transmission-based precautions**

- Dedicated isolation facilities began to appear in the late 1800s and a technique known as barrier nursing and cubic isolation began in 1910, which meant that infectious patients could be cared for in general areas. In the 1970s, seven isolation categories: strict, respiratory, protective, enteric, wound and skin, discharge, and blood were developed, based primarily on the routes of transmission. These categories underwent several changes including the advent of ‘body substance isolation’ in 1987 in response to the human immunodeficiency virus (HIV) epidemic
- In addition to the changes to standard precautions, isolation precautions were reviewed and renamed transmission-based precautions by the CDC in 1996
- Three categories of transmission-based precaution were introduced – contact, droplet and airborne – based on the transmission route of the infectious disease (Siegel et al 2007):
  - Contact transmission requires direct contact with the patient or indirect contact with the patient environment
  - Droplet transmission requires that large respiratory particles come into contact with the mucous surfaces of the recipient
  - Airborne transmission occurs when extremely small particles of an infectious agent remain in the air and are infective over time
- Standard precautions are used in addition to these transmission-based precautions (Garner 1996, Amoran and Omuru 2013)

**Importance of infection prevention**

For healthcare staff, including nurses, the main modes of exposure to pathogens are contact, droplet or airborne (Box 1). In Australia, the NHMRC (2010) guidelines for the prevention and control of infection state that healthcare staff and patients are the most likely source of pathogens, as well as being the most common susceptible hosts. In some cases, healthcare-acquired infections are serious or life-threatening. Visitors and individuals in peripheral healthcare roles, such as support staff, may also be at risk of infection and transmission (NHMRC 2010).

There have been few controlled clinical studies evaluating the role of PPE in reducing the risk of healthcare-acquired infections (Pratt et al 2001). However, in 2001, a nurse-led multidisciplinary team was commissioned by the Department of Health in the UK to provide national evidence-based guidelines for the prevention of healthcare-acquired infections,
known as the ‘epic project’ (Pratt et al 2001). These guidelines were updated in 2007 (epic2) (Pratt et al 2007) and in 2014 (epic3) (Loveday et al 2014). The epic3 (Loveday et al 2014) guidelines identified the use of PPE as one of five primary interventions, alongside hospital environmental hygiene, hand hygiene, safe use and disposal of sharps, and principles of asepsis.

**Transmission of pathogens**

Healthcare staff’s hands are a significant factor in the transmission of pathogens to patients or environmental surfaces. However, one systematic review of hand hygiene practice noted that healthcare staff continue to find compliance with hand hygiene procedures challenging (Akanji et al 2017). Disrupting the points of contact in the chain of transmission is an important strategy in preventing transmission of healthcare-acquired infections. For example, the epic3 (Loveday et al 2014) guidelines recommend the use of alcohol-based hand rubs by healthcare staff to decontaminate their hands before and after direct patient contact and clinical care – except when an individual’s hands are visibly soiled or potentially contaminated with bodily fluids, and when caring for patients with vomiting or diarrhoea, where soap and water must be used.

Although the epic3 (Loveday et al 2014) guidelines did not identify robust evidence that uniforms or work clothing are associated with healthcare-acquired infection, the guidelines acknowledge that optimal practice is to minimise any potential risk to healthcare staff and patients. Mitchell et al’s (2015) literature review implicated contaminated textiles – specifically healthcare uniforms – as a source of transmission of pathogens.

Suboptimal removal of PPE such as aprons or gowns can contaminate nurses and the environment. Point-of-care equipment that is moved between patients, such as glucometers and portable patient-monitoring equipment, can also be a vehicle for transmission. Therefore, it is essential that nurses are able to undertake a risk assessment to ascertain whether PPE is required, as well as being confident in putting on and removing PPE safely.

**Indications and risk assessment**

Information on a patient’s infectious status or potential colonisation with a pathogen may not always be available to nurses. Therefore, it is expected that nurses routinely use barrier methods when there is potential for transmission of pathogens by hands or through their clothing. The selection of appropriate PPE before undertaking any clinical intervention is based on the nature of the interaction and what the likely mode or modes of transmission are, along with awareness of known or possible infectious agents (Siegel et al 2007, NHMRC 2010). The use of PPE is divided into two specific clinical situations (NHMRC 2010, CDC 2017):

- **Standard precautions** – all patients are treated as though blood and bodily fluids are potentially infected with blood-borne viruses regardless of infectious status.
- **Transmission-based precautions** – at least one transmissible pathogen is suspected or known to be present. Specific PPE is required to protect against cross-infection of the known pathogens in addition to the use of PPE for standard precautions. For example, in the case of a patient with influenza, attending nurses would be required to wear a mask. Both standard and transmission-based precautions comprise the following components (Loveday et al 2014):
  - Gloves – generally non-sterile gloves are indicated as part of standard precautions.
  - Gowns.
  - Aprons.
  - Masks.
  - Eye protection, such as goggles or a face shield.

**TIME OUT 2**

A nursing student in your clinical area asks you to explain standard precautions and transmission-based precautions. Prepare a brief presentation that you could give to nursing students that outlines the role of each of these precautions in infection prevention and control.

**Key points**

- Personal protective equipment (PPE) acts as a physical barrier that prevents healthcare staff, including nurses, from becoming contaminated with blood and other bodily fluids. These include bodily secretions and excretions that may be transmitted from direct contact with a patient or the patient’s environment, including infectious airborne particles (Beam et al 2011)

- The selection of the appropriate PPE before undertaking any clinical intervention is based on the nature of the interaction and what the likely mode or modes of transmission are, along with awareness of known or possible infectious agents (Siegel et al 2007, National Health and Medical Research Council 2010)

- An understanding of the principles of organism transmission, alongside effective risk assessment and appropriate selection of PPE, can avoid unnecessary PPE use and reduce wastage

**Optimal practice when using personal protective equipment**

Table 1 outlines the optimal selection of PPE.

<table>
<thead>
<tr>
<th>PPE Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloves</td>
<td>Generally non-sterile gloves are indicated as part of standard precautions.</td>
</tr>
<tr>
<td>Gowns</td>
<td>Necessary for care involving potential infection with blood-borne viruses.</td>
</tr>
<tr>
<td>Aprons</td>
<td>Wear when there is potential for transmission of pathogens.</td>
</tr>
<tr>
<td>Masks</td>
<td>Required for care involving potential infection with blood-borne viruses.</td>
</tr>
<tr>
<td>Eye protection</td>
<td>Necessary for care involving potential infection with blood-borne viruses.</td>
</tr>
</tbody>
</table>

**Optimal practice when using PPE involves the following** (Loveday et al 2014, Canterbury District Health Board 2018):

- The nurse should undertake a risk assessment of the level of anticipated exposure to bodily fluids to decide which items of PPE are required. This depends on the task or situation and the potential type of bodily fluids and pathogens the nurse might be exposed to. Table 2 details the PPE required when undertaking various healthcare activities.
- The PPE used should be appropriate, fit for purpose and suitable for the person using or wearing it.
- Once the task is completed, the nurse should remove any PPE and dispose of it immediately. PPE must not be left on environmental surfaces or removed in such a way as to contaminate the wearer’s hands unnecessarily.
- Nurses must ensure that they avoid contaminating clothing, skin and the environment while removing PPE.
Nurses should ensure that any PPE supplies are located close to the point of use in all clinical areas to enable quick and easy access.

PPE is usually considered single use only, for example gloves, gowns and aprons should be used where appropriate and never reused. The packaging of any PPE should display a single-use symbol. However, some items of PPE, such as wipeable visors or goggles, can be cleaned and disinfected after use and subsequently reused.

Table 1. Optimal selection of personal protective equipment

<table>
<thead>
<tr>
<th>Equipment type</th>
<th>When to wear</th>
<th>General advice</th>
<th>Example scenarios for standard precautions</th>
<th>Example scenarios for transmission-based precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gloves</strong></td>
<td>Worn if potential exposure to blood and bodily fluids is anticipated</td>
<td>Change gloves if torn or heavily contaminated. Ensure gloved hands do not come into contact with the wearer’s face. Gloves should always be extended to cover the wrist of an isolation gown if the nurse is wearing both. When removing gloves, the nurse should be aware that the outside of the glove is contaminated; therefore, a non-touch technique should be used to remove gloves and hand hygiene should be undertaken immediately after removal. Gloves should be placed directly into a bin and not left in the clinical environment.</td>
<td>The patient is excreting bodily fluids from any orifice and the nurse is in close personal contact with them and will be touching either the patient or the environment. The nurse is emptying a bedpan. The nurse is taking a blood specimen.</td>
<td>The nurse is in close contact or in the environment of a patient with a known multidrug-resistant pathogen or transmissible gastrointestinal pathogen; therefore, potential transfer of pathogens onto the nurse’s hands from the patient and/or environment is a concern.</td>
</tr>
<tr>
<td><strong>Fluid-repellent aprons and gowns</strong></td>
<td>Worn if potential exposure to blood and bodily fluids is anticipated</td>
<td>Disposable aprons are recommended when the nurse is undertaking a patient care activity in which there is potential for splashes or sprays of blood or bodily fluids. Gowns are only required when there is a likelihood of extensive splashes or sprays of blood or bodily fluids.</td>
<td>The nurse is in close contact with the patient or equipment that may lead to contamination of their uniform or clothing with pathogens, or when there is a risk of contamination with blood and bodily fluids, for example: The nurse is emptying an indwelling device. The nurse is suctioning a patient.</td>
<td>The nurse is applying cream to a patient who is positive for methicillin-resistant Staphylococcus aureus (MRSA) and has extensive moist eczema that has broken down; a gown is appropriate because the potential for substantial contamination is high and a robust barrier is required.</td>
</tr>
<tr>
<td><strong>Masks with or without face shield</strong></td>
<td>Worn to protect the mouth and nose from inhalation of respiratory droplets or splashing or spraying of bodily fluids into the mouth or nose.</td>
<td>Surgical masks should be changed after 20 minutes or when wet. Masks should be secured by ties or ear loops. A flexible band should be fitted to the nose bridge. Mask should fit comfortably on the face and below the chin. Masks should be discarded directly into a waste bin after use and never left hanging around the wearer’s neck.</td>
<td>The nurse is in close proximity to a patient who is vomiting, sneezing or coughing. The nurse is undertaking or assisting in a procedure where exposure to splashes or sprays of moist substances may be involved, such as bronchoscopy, suctioning or tracheostomy care.</td>
<td>The patient is subject to droplet precautions because of suspected or confirmed influenza. The patient is vomiting and is suspected to be infected with a gastrointestinal pathogen such as norovirus. The patient is subject to airborne precautions because of suspected or confirmed pulmonary tuberculosis.</td>
</tr>
<tr>
<td><strong>Eye protection</strong></td>
<td>Worn to protect the mucous membranes of the eyes or face from exposure to splashing or spraying of bodily fluids.</td>
<td>Goggles alone protect the eyes, whereas face shields attached to surgical masks protect the eyes and face.</td>
<td>Emptying indwelling devices where there may be a risk of splashing or spraying of bodily fluids, for example emptying an indwelling catheter.</td>
<td>Transmission-based precautions do not require the use of goggles or face shields unless there is a risk of blood or bodily fluids exposure as per standard precautions; the nurse should assess the requirement under standard precautions.</td>
</tr>
</tbody>
</table>

(Adapted from Siegel et al 2007)
» Manufacturer’s instructions must always be followed. Stocks of PPE should be stored above the floor in a designated clean and dry storage area to ensure they are not contaminated before use. PPE should not be stored in potentially ‘unclean’ areas such as utility rooms. Any PPE that has an expiry date should be stored inside its original packaging to ensure the expiry date is visible and the integrity of the PPE is maintained.

**TIME OUT 3**

Does your healthcare organisation or clinical area have a policy for the effective disposal of PPE? If so, access this policy and familiarise yourself with the appropriate disposal procedure for the various types of PPE, for example gloves, aprons and masks.

**TIME OUT 4**

List the healthcare activities and clinical procedures when you should and should not wear disposable non-sterile gloves. What resources should guide your knowledge in this area?

**Adherence to personal protective equipment procedures**

Some studies have noted that the adherence of healthcare staff to

| Table 2. Personal protective equipment required when undertaking various healthcare activities |
|-----------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|------------------|
| Activity                   | Aprons and/or gowns – depending on risk of significant splashing or exposure to blood or bodily fluids | Face, eye and/or mouth protection, such as surgical masks and goggles | Gloves |
| Contact with intact skin. No visible blood or bodily fluids; rashes | No                                                                  | No                                                                      | No               |
| Sterile procedures         | Yes                                                                 | Risk assessment*                                                      | Sterile gloves   |
| Contact with wounds or skin lesions | Yes                                                                | Risk assessment*                                                      | Yes              |
| Cleaning up urine or faeces | Yes                                                                 | Risk assessment*                                                      | Yes              |
| Potential exposure to blood or other bodily fluids, for example undertaking suctioning, cleaning-up spillages or taking specimens | Yes                                                                | Risk assessment*                                                      | Yes              |
| Venepuncture               | No                                                                  | No                                                                      | Yes              |
| Vaginal examination        | Risk assessment*                                                    | No                                                                      | Yes              |
| Applying topical lotions or creams | No                                                               | No                                                                      | Yes              |
| Touching patients with unknown skin rash | Risk assessment*                                                      | No                                                                      | Yes              |
| Emptying or changing urinary catheter bags, urinals or bedpans | Yes                                                                | Yes                                                                     | Yes              |
| Handling specimens         | Yes                                                                 | Risk assessment*                                                      | Yes              |
| Handling used equipment, for example a toilet chair | Risk assessment*                                                      | No                                                                      | Yes              |
| Handling used instruments  | Yes                                                                 | Risk assessment*                                                      | Yes              |
| Using disinfectants and cleaning agents | Yes                                                               | Risk assessment*                                                      | Yes              |
| General cleaning of clinical areas | Risk assessment*                                                      | Risk assessment*                                                      | Risk assessment* |
| Bed-making or dressing patients | No                                                                | No                                                                      | Risk assessment* |
| Oral care                  | Risk assessment*                                                    | Risk assessment*                                                      | Yes              |
| Feeding patient            | Risk assessment*                                                    | No                                                                      | Risk assessment* |
| General housework          | Risk assessment*                                                    | No                                                                      | Risk assessment* |
| Handling waste             | Risk assessment*                                                    | Risk assessment*                                                      | Yes              |

*Review clinical activity and decide whether there is potential for contact with blood or bodily fluids
(Adapted from Canterbury District Health Board 2018)
PPE procedures is suboptimal, despite their knowledge of the potential transmission of pathogens (Beam et al 2011, Mitchell et al 2013, Zellmer et al 2015). Possible barriers to adherence included low perception of risk among healthcare staff, time pressures, fatigue, inadequate training and education, and a lack of supplies of PPE (Beam et al 2011, Mitchell et al 2013). Errors in removing PPE are also frequently reported and put healthcare staff at risk of self-contamination (Mitchell et al 2013). Common errors in putting on and removing PPE include: not tying the back of gowns properly; gowns and gloves coming into contact with uniforms and bare hands following removal and before disposal; and touching the front of surgical masks during disposal (Zellmer et al 2015).

Training in the appropriate use of PPE is most effective when it includes a requirement for healthcare staff to demonstrate proficiency; conversely, suboptimal education contributes to suboptimal PPE practice (John et al 2016). A demonstrative approach to education is often not practised in some areas; however, for example in the authors’ healthcare facility, there has been a move to online learning packages for newly recruited healthcare staff who have limited opportunities for infection prevention and control education in clinical areas. Providing robust education on the use of PPE remains a challenge. The use of pictorial guides has been found to be a useful resource for healthcare staff since they can simplify complex information (Drews and Doig 2014). Developing pictorial PPE flip charts or downloading pictorial guides from internationally recognised sources such as the World Health Organization (www.who.int/csr/resources/publications/PPE_EN_A1sl.pdf?ua=1) or the CDC (www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf) may be useful in communicating to colleagues how to safely put on and remove PPE.

Putting on and removing personal protective equipment

While the sequence of putting on PPE is not vitally important because it is clean when opened, there is a recommended procedure (CDC 2016). The nurse should decontaminate their hands, then, ensuring they use the appropriate PPE, put on the PPE according to the following sequence (CDC 2016):

- Apron or gown.
- Mask or respirator.
- Eye protection.
- Gloves.

When removing PPE, the correct sequence, as follows, is important because the nurse is effectively ‘contaminated’ (Loveday et al 2014):

- Gloves – decontaminate hands after removing.
- Apron or gown.
- Eye protection.
- Mask or respirator.
- Decontaminate hands again once all the PPE has been disposed of.

Nurses should ensure that they follow the correct procedure when removing individual items of PPE, as outlined in Box 2.

Box 2. Procedure for removing individual items of personal protective equipment

Gloves
- Remember that the outside of the glove is contaminated
- Grasp the outside of the glove with the opposite gloved hand; peel the glove off
- Hold the removed glove in the gloved hand
- Slide fingers of the ungloved hand under the remaining glove at the wrist
- Peel the second glove off over the first glove
- Discard both gloves in a waste container

Eye protection - goggles or face shield
- Remember that the outside of the goggles or face shield is contaminated
- When removing the goggles or face shield, hold the item by the handle, head band or ear pieces
- Place the goggles or face shield in a reprocessing receptacle for reuse, or a waste container

Gown
- Remember that the gown front and sleeves are contaminated
- Unfasten the ties of the gown
- Pull the gown away from the neck and shoulders, touching the inside of the gown only
- Turn the gown inside out
- Fold or roll the gown into a bundle and discard into a waste container

Apron
- Aprons can be removed in a similar way to gowns, or by pulling down from the top and breaking the neck loop, or rolling up from the bottom and pulling away from the body to break the waist ties

Mask or respirator
- Remember that the front of the mask or respirator is contaminated
- Grasp the bottom of the mask or respirator, then the ties or elastic, and remove
- Discard the mask or respirator into a waste container

It is important to undertake appropriate hand hygiene procedures between any of the removal steps if the hands become contaminated and immediately after removing any item of personal protective equipment.

(Adapted from Centers for Disease Control and Prevention 2016)

TIME OUT 5

Reflect on the sequence for applying and removing personal protective equipment outlined in this article. Do you follow this sequence in your practice? If not, what steps could you take to adapt your practice?

Overuse of personal protective equipment

Since PPE mainly comprises single-use items, preventing excess waste is a priority. There are financial implications to the overuse of PPE. In New Zealand, waste from healthcare facilities is charged by weight, therefore reductions in unnecessary waste reduce healthcare costs. Wastage from excess use of PPE can be avoided by appropriate assessment of need. Verlee et al (2014) calculated the cost of isolation in a US hospital per inpatient day as: $34.22 for contact precautions (gloves, gowns, healthcare staff time); $3.80 for droplet precautions (mask); and $33.74 for airborne precautions (N95 mask – so named because the respirator blocks 95% of airborne particles).
An understanding of the principles of organism transmission, alongside effective risk assessment and appropriate selection of PPE, can avoid unnecessary PPE use and reduce wastage. Nurses and patients are becoming increasingly aware of the environmental effect of the single-use items of PPE, and there is increasing concern about levels of plastic in the environment; however, there is a lack of literature regarding the long-term effects of PPE disposal into landfill (Nichols and Mukonoweshuro 2016). Sustainability initiatives, such as improving waste management, are becoming a priority in healthcare, and waste audits can assess waste management practices and identify areas for improvement (Kagoma et al 2012, Public Health England 2014, Thiel et al 2015, Macpherson and Hill 2017). Nursing procedures involve a high level of waste production; however, nurses also have a responsibility to reduce the effects of waste (Macpherson and Hill 2017, Royal College of Nursing 2018). By understanding the appropriate use of PPE, nurses are optimally placed to make informed choices about the resources they use and how this can reduce the amount of waste that is released into the environment (Kagoma et al 2012). Wastage related to the overuse of PPE is an area that would benefit from further research.

Conclusion

Understanding the rationale behind the use of PPE enables nurses to choose the appropriate method when undertaking patient care. It is essential for nurses to understand the role, types and appropriate use of PPE. Effective use of PPE protects nurses, patients and healthcare facilities from the spread of transmissible pathogens. It is also important that nurses are aware of the risk of exposure to transmissible pathogens from direct or indirect contact with blood or bodily fluids, the environment and equipment. Nurses should be aware of PPE requirements and be able to undertake appropriate risk assessments, as well as using their clinical reasoning when deciding whether or not to use PPE.

TIME OUT 6

Consider how the use of personal protective equipment relates to The Code: Professional Standards of Practice and Behaviour for Nurses, Midwives and Nursing Associates (Nursing and Midwifery Council 2018) or, for non-UK readers, the requirements of your regulatory body.

TIME OUT 7

Now that you have completed the article, reflect on your practice in this area and consider writing a reflective account.

Additional References

<table>
<thead>
<tr>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>References</td>
</tr>
</tbody>
</table>
Personal protective equipment

TEST YOUR KNOWLEDGE BY COMPLETING THIS MULTIPLE-CHOICE QUIZ

1. Personal protective equipment (PPE) refers to:
   a) A physical barrier that prevents healthcare staff from being contaminated with blood and other bodily fluids
   b) Specially designed clothing that protects healthcare staff from physical attack
   c) A screen that separates healthcare staff from patients who have infectious diseases
   d) A personal alarm carried by healthcare staff in case of physical attack

2. Which of the following is not a type of precaution against infective pathogens?
   a) Universal precautions
   b) Transmission-based precautions
   c) Standard precautions
   d) Basic precautions

3. What are the three categories of transmission-based precaution?
   a) Contact, droplet, airborne
   b) Contact, blood-borne, airborne
   c) Blood-borne, contact, droplet
   d) Airborne, blood-borne, droplet

4. The outbreak of severe acute respiratory syndrome (SARS) in 2003 outlined the importance of PPE because:
   a) More people were killed than in any other infectious outbreak
   b) A significant number of those infected were healthcare staff
   c) There was insufficient PPE available to healthcare staff treating the disease
   d) Limited amounts of vaccine were available

5. Which area of the body is particularly significant in the transmission of pathogens from healthcare staff to patients?
   a) Mouth
   b) Eyes
   c) Hands
   d) Nasal cavities

6. What are the primary components of PPE?
   a) Gloves, full-body protective suit, eye protection
   b) Gloves, gowns, protective footwear, eye protection
   c) Gloves, gowns, hairnet, eye protection
   d) Gloves, gowns, aprons, masks, eye protection

7. Gloves should be worn when:
   a) Undertaking any clinical procedure that involves patient contact
   b) Contact with healthcare-related equipment such as walking frames, hoists or wheelchairs is anticipated
   c) Potential exposure to blood and bodily fluid is anticipated
   d) Undertaking any clinical procedure that involves contact with the patient’s immediate environment

8. The purpose of eye protection is to protect the mucous membrane of the eye from:
   a) Fluids such as disinfectants used in clinical procedures
   b) Splashing or spraying of bodily fluid
   c) Needlestick injury
   d) Airborne pathogens

9. Where should stocks of PPE be stored?
   a) Above the floor in a designated clean and dry area
   b) A fridge with a temperature of 2-8°C
   c) A designated trolley
   d) Above the floor in a designated clean and dry storage area

10. Which of the following is a major risk factor for self-contamination with healthcare-related pathogens?
    a) Out-of-date PPE
    b) Errors in removing PPE
    c) Errors in putting on PPE
    d) Ill-fitting PPE

How to complete this quiz

This multiple-choice quiz will help you to test your knowledge. It comprises ten questions that are broadly linked to the CPD article. There is one correct answer to each question.

- You can test your subject knowledge by attempting the questions before reading the article, and then go back over them to see if you would answer any differently.
- You might like to read the article before trying the questions.

Subscribers making use of their RCNi Portfolio can complete this and other quizzes online and save the result automatically. Alternatively, you can cut out this page and add it to your professional portfolio. Don’t forget to record the amount of time taken to complete it.

Further multiple-choice quizzes are available at rcn.com/cpd/test-your-knowledge

This multiple-choice quiz was compiled by Jason Beckford-Ball

The answers to this multiple-choice quiz are:

1. a 2. d 3. a 4. b 5. c 6. a 7. d 8. a 9. c 10. c

This activity has taken me ___ minutes/hours to complete. Now that I have read this article and completed this assessment, I think my knowledge is:

Excellent  Good  Satisfactory  Unsatisfactory  Poor

As a result of this I intend to:

________________________________________________________________________________________