



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

# ARE YOU COVERED? SAFE PRACTICES FOR THE USE OF PERSONAL PROTECTIVE EQUIPMENT

**Author:** Anna Maria Valdez, PhD, RN, CEN, CFRN, CNE, C-NPT, Minneapolis, MN

**Section Editor:** Anna Maria Valdez, PhD, RN, CEN, CFRN, CNE, C-NPT

**CE** Earn Up to 8.5 CE Hours. See page 173.

**E**mergency nurses frequently encounter patients with a known or suspected infectious illness. To prevent the spread of infection and injury, emergency nurses must be well prepared to appropriately select and use personal protective equipment (PPE). Furthermore, emergency nurses must have readily available access to PPE, as well as effective and timely training, including routine fit testing for respiratory protection.<sup>1,2</sup> According to the Occupational Safety & Health Administration (OSHA), when PPE is required, training for health care personnel must include the identification of the correct PPE; how to properly put on (don), wear, and remove (doff) equipment; limitations of PPE; and how to appropriately maintain and dispose of PPE.<sup>3</sup>

## Personal Protective Equipment

PPE is defined by OSHA as “specialized clothing or equipment worn by an employee for protection against infectious materials.”<sup>1</sup> In health care, PPE includes a range of items including but not limited to gloves, gowns/aprons, masks and respirators, goggles, face shields, and foot/leg covers. When selecting PPE, emergency nurses must consider the type of anticipated exposure and be knowledgeable about current standards set forth by the Centers for Disease Control and Prevention (CDC) and organizational policy.<sup>1,2</sup>

## Current PPE and Precaution Recommendations

The CDC sets the standard for PPE selection and use in health care settings within the United States.<sup>1</sup> These standards are based on the type of precautions required to prevent the spread of infection and include standard

Anna Maria Valdez, Member, San Francisco Chapter, is Faculty, School of Nursing, Walden University, Minneapolis, MN.

For correspondence, write: Anna Maria Valdez, PhD, RN, CEN, CFRN, CNE, C-NPT, 1501 Mendocino Ave, Santa Rosa, CA 95401; E-mail: annav409@gmail.com.

J Emerg Nurs 2015;41:154-7.

Available online 19 January 2015  
0099-1767

Copyright © 2015 Emergency Nurses Association. Published by Elsevier Inc. All rights reserved.

<http://dx.doi.org/10.1016/j.jen.2014.11.011>

precautions (formerly termed universal precautions), as well as 3 categories of expanded precautions: contact, droplet, and airborne infection isolation.<sup>2</sup>

## STANDARD PRECAUTIONS

Standard precautions are required any time an infectious agent may be present in a patient’s blood or body fluids. This type of precaution is used for contact with all patients, hence the term “standard precautions.”<sup>2</sup> The amount and type of PPE used for standard precautions depends on the expected exposure that the health care provider will have with the patient. For example, gloves must be worn when contact with blood or bodily fluids is anticipated. During procedures when bodily fluids may splash or spray, health care providers should also be wearing fluid-resistant gowns, a mask and goggles or face shield, and shoe covers.<sup>1</sup>

## CONTACT PRECAUTIONS

Contact precautions are required as an expanded transmission-based precaution when infectious agents may be spread through touch either directly with the patient or indirectly with objects in the environment of care.<sup>1</sup> Examples of illnesses that require contact precautions are norovirus, rotavirus, and *Clostridium difficile*.<sup>4</sup> Patients who are suspected or known to have an illness that can be spread through touch contact need to be placed in a private room or in a room with other persons who have been colonized with the same organism.<sup>1</sup> They also need to be treated with dedicated equipment that can be left in the room. Anyone entering the room who may come in contact with the patient or objects in the room must wear a gown and gloves. PPE, including gowns and gloves, should be removed before leaving the room or in an anteroom if available.<sup>2</sup> As with all patient contact, thorough hand hygiene is critical to prevent the spread of infection.

## DROPLET PRECAUTIONS

Droplet precautions are necessary when infectious pathogens can travel from the respiratory tract of the patient over short distances (usually less than 3 ft, but the distance can extend up to 10 ft).<sup>2</sup> Transmission of infection through droplet exposure generally occurs when a patient sneezes, coughs,

talks, or undergoes invasive procedures such as endotracheal intubation or suctioning.<sup>2</sup> Examples of infections that can be spread through droplet exposure include influenza, *Bordetella pertussis*, respiratory syncytial virus, and severe acute respiratory syndrome–associated coronavirus.<sup>1,2</sup> In addition to taking other appropriate standard precautions, emergency nurses should be wearing a face mask when in close proximity to patients requiring droplet precautions.<sup>2</sup>

#### AIRBORNE ISOLATION PRECAUTIONS

According to the CDC, “airborne transmission occurs by dissemination of either airborne droplet nuclei or small particles in the respirable size range containing infectious agents that remain infective over time and distance.”<sup>2</sup> In addition to proper use of PPE, controlling the spread of infectious agents that can be transmitted via an airborne route requires special air handling and ventilation systems. Examples of infections spread through airborne transmission include *Mycobacterium tuberculosis*, rubeola virus (measles), and varicella–zoster virus (chickenpox). Patients with suspected or known infection that can be transmitted via the airborne route should be placed in an airborne isolation infection room, and health care providers must wear respiratory protection certified by the National Institute for Safety and Health at N95 or higher when they enter the patient’s room.<sup>2</sup>

#### COMPLEX TRANSMISSION PRECAUTIONS

Infectious agents may fall into several transmission categories and require a combination of precautions to prevent the spread of infection. One example of an infectious illness that requires health care providers to adhere to multiple levels of precautions is the Ebola virus disease (EVD). Health care providers who are caring for a patient with known or suspected EVD must adhere to standard, contact, and droplet precautions.<sup>5</sup> Recently the CDC issued revised standards for EVD precautions, which include detailed guidance on the types of PPE required during patient care and strategies for ensuring safe practice.<sup>6</sup> Because of the complex and detailed nature of the guidance on caring for a patient with known or suspected EVD, emergency nurses should seek information about precautions and PPE standards directly from the CDC Web page at <http://www.cdc.gov/vhf/ebola/hcp/index.html>. Emergency nurses can also gain current and accurate information about how to safely triage and screen patients for EVD, manage their care, and select and utilize PPE by accessing the ENA Ebola resource page located at <http://www.ena.org/about/media/ebola/Pages/default.aspx>.

### Strategies to Minimize Risk and Prevent Injury

The intent of PPE is to prevent harm to the health care provider; however, the use of PPE is not without risk, especially when wearing PPE that limits movement or when wearing respirators. Risk of injury from the use or misuse of PPE can be addressed by implementing safety strategies in the emergency setting. Examples of strategies that can be used to prevent injury include strict adherence to infection control precautions, hands-on and in situ training, and staffing that supports safe care.

#### STRICT ADHERENCE TO PRECAUTIONS AND APPROPRIATE PPE USE

To prevent the spread of infection, emergency nurses must follow appropriate infection control precautions and use PPE as recommended by the CDC and organizational policy. In a study by Nichol et al,<sup>7</sup> it was found that fewer than half of the nurses involved in the study met adherence standards for the recommended use of PPE. This finding is also supported by a literature review conducted by Gammon et al,<sup>8</sup> who found that compliance with infection control precautions is unacceptably low among health care providers. In addition, Nichols et al<sup>7</sup> found that emergency nurses were 60% less likely to report adherence with infection control procedures than were critical care nurses.<sup>7</sup> This finding is supported by an observational study by Creedon et al,<sup>9</sup> who found that compliance with hand washing was lower in the emergency setting than in other areas of the hospital. Known barriers to achieving optimal compliance include lack of training, time constraints, and lack of readily available PPE.<sup>7,8</sup> Emergency nurses and organizational leadership should explore ways to improve adherence to infection control procedures in the emergency setting. Considering that the total number of infectious illness outbreaks have been increasing since 1980,<sup>10</sup> and with the recent emergence of infectious illnesses in the United States, including EVD and enterovirus D68, the need for strict adherence to infection control protocols cannot be overstated.

#### TRAINING AND FIT TESTING

Comprehensive training on infection control protocols and the proper use of PPE is a critical component of safe care delivery in the emergency setting. Nichol et al<sup>7</sup> found that fewer than half of the nurses observed in their study demonstrated competence when using an N95 respirator. Another finding in this study was that only half of the participants reported having received recent training or fit testing. Participants that had been trained and fit tested in

the prior 2 years were 1.66 times more likely to report adherence with recommended use of PPE.<sup>7</sup>

The CDC recommends that health care providers receive repeated training and demonstrate competency in performing all Ebola-related infection control practices and procedures, including donning and doffing proper PPE before engaging in patient care activities.<sup>11</sup> This guidance can be applied for all types of infection control precautions and is particularly important when N95 or powered air-purifying respirators (PAPRs) are used.<sup>12</sup> The use of respirators, particularly PAPRs, requires comprehensive training to ensure competency,<sup>12</sup> and failure to properly use this equipment could place the emergency nurse at risk for acquiring an airborne infection. According to the CDC, another area of PPE training that should receive special focus is the doffing procedure. Historically, this part of the PPE sequence may not have been emphasized in the training process, but recent cases of the acquisition of EVD by nurses have demonstrated that doffing PPE is a high-risk period that requires careful attention to detail, monitoring by a trained observer, and a designated space for equipment removal.<sup>11</sup>

In addition to understanding how to properly select and use PPE, emergency nurses need to have practice in using PPE in realistic patient care situations. The use of PPE can affect clinical performance by limiting manual dexterity, impairing hearing and communication, and causing discomfort for the user.<sup>12–15</sup> Hands-on practice allows the user to be better prepared to provide safe patient care while wearing PPE. A strategy that can be used to prepare health care providers to provide safe care in the emergency setting is the use of in situ simulation training sessions.<sup>16,17</sup> In situ simulation is a team-based training process that involves the use of a standardized scenario in the practice environment using actual unit staff, equipment, and resources.<sup>15</sup> Regular practice using PPE in realistic simulation scenarios will aid members of the emergency care team in developing and maintaining competency.

## STAFFING CONSIDERATIONS

Safe staffing patterns should be considered when planning care for patients with infectious illness. The CDC recommends that health care providers have adequate time to properly don and doff equipment before engaging in patient care. When engaged in the care of a patient with EVD, this donning and doffing procedure should be monitored by a trained observer.<sup>10</sup>

Radanovich et al<sup>13</sup> conducted a study on respirator tolerance in health care providers and found that a significant portion of the study participants were unable

to tolerate wearing a respirator for an 8-hour shift, even with break periods. Shenal et al<sup>15</sup> also found that health care workers experienced increasing discomfort when wearing respiratory protection over a prolonged period. When health care providers are wearing PAPRs and full-body coverage, especially when they are engaged in complex patient care activities, the period in PPE that is tolerable may be even shorter. Planning should be in place to ensure that health care providers have adequate periods of rest without wearing PPE. In complex care situations, such as the care of a patient with EVD, providers may require extended rest periods to prevent heat stress, fatigue, and dehydration.

The United States Department of Health and Human Services<sup>18</sup> lists psychological stress, heat stress, and dehydration as risks associated with the use of PPE during chemical emergencies. To minimize the risk of injury, first responders are advised to obtain baseline vital signs and weight prior to donning equipment and after doffing equipment, hydrate before and after using PPE, monitor total time in PPE, and minimize time in PPE when possible (especially when wearing the highest levels of protection).<sup>18</sup> Given the similarities in PPE that are recommended for the care of patients with EVD and the types of PPE used during chemical and biological hazards, it may be prudent to integrate these safety measures into organizational policies and procedures for the use of PAPRs in the care of patients with EVD. This step would require additional staff to assess providers before and after use of PPE; however, the “trained observer” recommended by the CDC could be used in this capacity.

## Implications for Emergency Nurses

Emergency nurses work in a hazardous environment. To minimize the risk of injury, emergency nurses must maintain competency in infection control measures and the use of PPE. The CDC and John Hopkins Medicine have created a Web-based training program for the safe donning and doffing of PPE that can be accessed online at <http://www.cdc.gov/vhf/ebola/hcp/ppe-training/index.html>. Although this type of training is important, emergency nurses should also advocate for regular hands-on training with PPE to ensure competency with equipment and supplies available in their work setting. Emergency nurses should ensure that they have been fit tested for an N95 respirator and know the appropriate size to use when providing patient care. Finally, emergency nurses can minimize risk of injury by committing to strict adherence to infection control standards.

## REFERENCES

1. Centers for Disease Control and Prevention. Guidance for the use and selection of personal protective equipment (PPE) in healthcare settings. <http://www.cdc.gov/hai/pdfs/ppe/ppeslides6-29-04.pdf>. Accessed December 11, 2014.
2. Siegel JD, Rhineheart E, Jackson M, Chiarello L, the Healthcare Infection Control Practices Committee. 2007 Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings. <http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf>. Accessed December 11, 2014.
3. Occupational Safety & Health Administration. Personal protective equipment. <https://www.osha.gov/Publications/OSHA3151.html>. Accessed December 11, 2014.
4. Centers for Disease Control and Prevention. Basic infection control and prevention plan for outpatient oncology settings: transmission-based precautions. <http://www.cdc.gov/HAI/settings/outpatient/basic-infection-control-prevention-plan-2011/transmission-based-precautions.html>. Updated November 9, 2011, Accessed December 11, 2014.
5. Centers for Disease Control and Prevention. Ebola (Ebola virus disease): when caring for suspect or confirmed patients with Ebola. <http://www.cdc.gov/vhf/ebola/hcp/patient-management-us-hospitals.html>. Updated December 2, 2014, Accessed December 11, 2014.
6. Centers for Disease Control and Prevention. Ebola (Ebola virus disease): information for healthcare workers and settings. <http://www.cdc.gov/vhf/ebola/hcp/index.html>. Updated December 2, 2014, Accessed December 11, 2014.
7. Nichol K, McGeer A, Bigelow P, O'Brien-Pallas L, Scott J, Holness DL. Behind the mask: determinants of nurse's adherence to facial protective equipment. *Am J Infect Control*. 2013;41:8-13.
8. Gammon J, Morgan-Samuel H, Gould D. A review of the evidence for suboptimal compliance of healthcare practitioners to standard/universal infection control precautions. *J Clin Nurs*. 2008;17(2):157-167.
9. Creedon S, Slevin B, De Souza V, et al. Hand hygiene compliance: exploring variations in practice between hospitals. *Nurs Times*. 2008;104:32-35.
10. Smith KF, Goldberg M, Rosenthal S, et al. Global rise in human infectious disease outbreaks. *J R Soc Interface*. 2014;11(101). 20140950.
11. Centers for Disease Control and Prevention. Guidance on personal protective equipment to be used by healthcare workers during management of patients with Ebola Virus Disease in U.S. hospitals, including procedures for putting on (donning) and removing (doffing). <http://www.cdc.gov/vhf/ebola/hcp/procedures-for-ppe.html>. Updated November 10, 2014, Accessed December 11, 2014.
12. Tompkins DM, Kerchberger JP. Personal protective equipment for care of pandemic influenza patients: a training workshop for the powered air purifying respirator. *Anesth Analg*. 2010;111(4):933-945.
13. Radanovich LJ, Cheng J, Shenal BV, Hodgson M, Bender BS. Respiratory tolerance in health care workers. *JAMA*. 2009;301(1):36-38.
14. Bunyan D, Ritchie L, Jenkins D, Coia JE. Respiratory and facial protection: a critical review of recent literature. *Am J Infect Control*. 2013;85:165-169.
15. Shenal BV, Radanovich LJ, Cheng J, Hodgson M, Bender BS. Discomfort and exertion associated with prolonged wear of respiratory protection in a health care setting. *J Occup Environ Hyg*. 2012;9(1):59-64.
16. Wheeler DK, Geis G, Mack EH, LeMaster T, Patterson MD. High-reliability emergency response teams in the hospital: improving quality and safety using in situ simulation training. *BMJ Qual Saf*. 2013;22:507-514.
17. Patterson DM, Geis GL, Falcone RA, LeMaster T, Wears RL. In situ simulation: detection of safety threats and teamwork training in a high risk emergency department. *BMJ Qual Saf*. 2013;22:468-77.
18. United States Department of Health and Human Services. Personal protective equipment. <http://chemm.nlm.nih.gov/ppe.htm#medical>. Updated October 31, 2014, Accessed December 11, 2014.