

Basic principles of **infection control**

When coming into contact with patients, it's vital that we prevent the spread of infection. Learn how to keep your patients safe and minimize your exposure risk.

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A new nurse orienting on your renal unit admits a patient with bed bugs. When she notifies the charge nurse of the patient's infestation to find out the hospital's policy regarding bedbugs, she witnesses an immediate meeting of nursing administration, the infection control officer, and house-keeping—all discussing the steps required to avoid the spread of bed bugs to other patients on the unit. The charge nurse tells her, "I'm glad that I'm not taking care of that patient. Just the thought of bed bugs makes me itch."

The new nurse remembers watching the charge nurse ignore hospital policy

regarding the use of personal protective equipment (PPE) when providing care for a patient with methicillin-resistant *Staphylococcus aureus* (MRSA), stating "Everyone has MRSA." The new nurse wonders why there's a difference in attitude toward the bugs you see versus the "bugs" you don't see, when the bugs you don't see can be fatal to patients.

Healthcare-associated infections (HAIs), also known as nosocomial infections, are infections acquired following admission to a healthcare facility that weren't present before admission. The CDC estimates that 1 in 20 patients will develop an HAI. These

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As nurses, we can serve as leaders in preventing healthcare-associated infections by modeling behaviors to prevent transmission of microorganisms.

infections are contracted by an estimated 1.7 million patients annually and responsible for 99,000 deaths each year. The estimated cost of these infections ranges from \$35.7 to \$45 billion.

All patients are susceptible to HAIs because of potential exposure to microorganisms while in the healthcare setting. And because of frequent contact with patients who harbor these microorganisms, nurses have a higher occupational exposure than other healthcare professionals. As nurses, we can serve as leaders in preventing HAIs by modeling behaviors to prevent transmission of microorganisms between patients, including proper use of PPE, following agency policies, and understanding the vulnerability of our patients.

Chain, chain, chain

You have to understand the chain of infection and ways to disrupt this chain to protect your patients. Links of the chain include the microorganism (causative agent), reservoir, portal of exit, mode of transmission, portal of entry, and susceptible host (see *Chain of infection*).

Link 1: Microorganism (causative agent)

The risk of infection by a microorganism depends on several factors. There are microorganisms that are highly infectious, such as smallpox. But there are also microorganisms that have the potential to infect a limited number of people, such as tuberculosis. Factors that influence the ability of a microorganism to cause infection include the number of microorganisms present, the potency of the microorganism, the ability of the agent to enter the body, the susceptibility of the host, and whether the organism can live in the host's body.

Link 2: Reservoir

Reservoirs are sources of microorganisms, including other humans, plants, animals, or the environment. Reservoirs can also be

food, water, or feces. Humans and other animals can serve as carriers—reservoirs of specific agents with little or no clinical signs of disease. For example, shellfish are reservoirs for hepatitis A and the anopheles mosquito is a carrier of the malaria parasite. The carrier state of a reservoir may be temporary or long term.

Link 3: Portal of exit

The microorganism has to leave the reservoir to establish itself as an infection. The portal of exit depends on the body area where the organism is located. Portals of exit include the gastrointestinal (GI) tract (mouth or anus), respiratory tract (nose or mouth), genitourinary tract (GU) tract (ureteral meatus or urinary diversion), blood (open wound, needle puncture site, or any break in the skin or mucous membranes), and tissue (drainage from a wound).

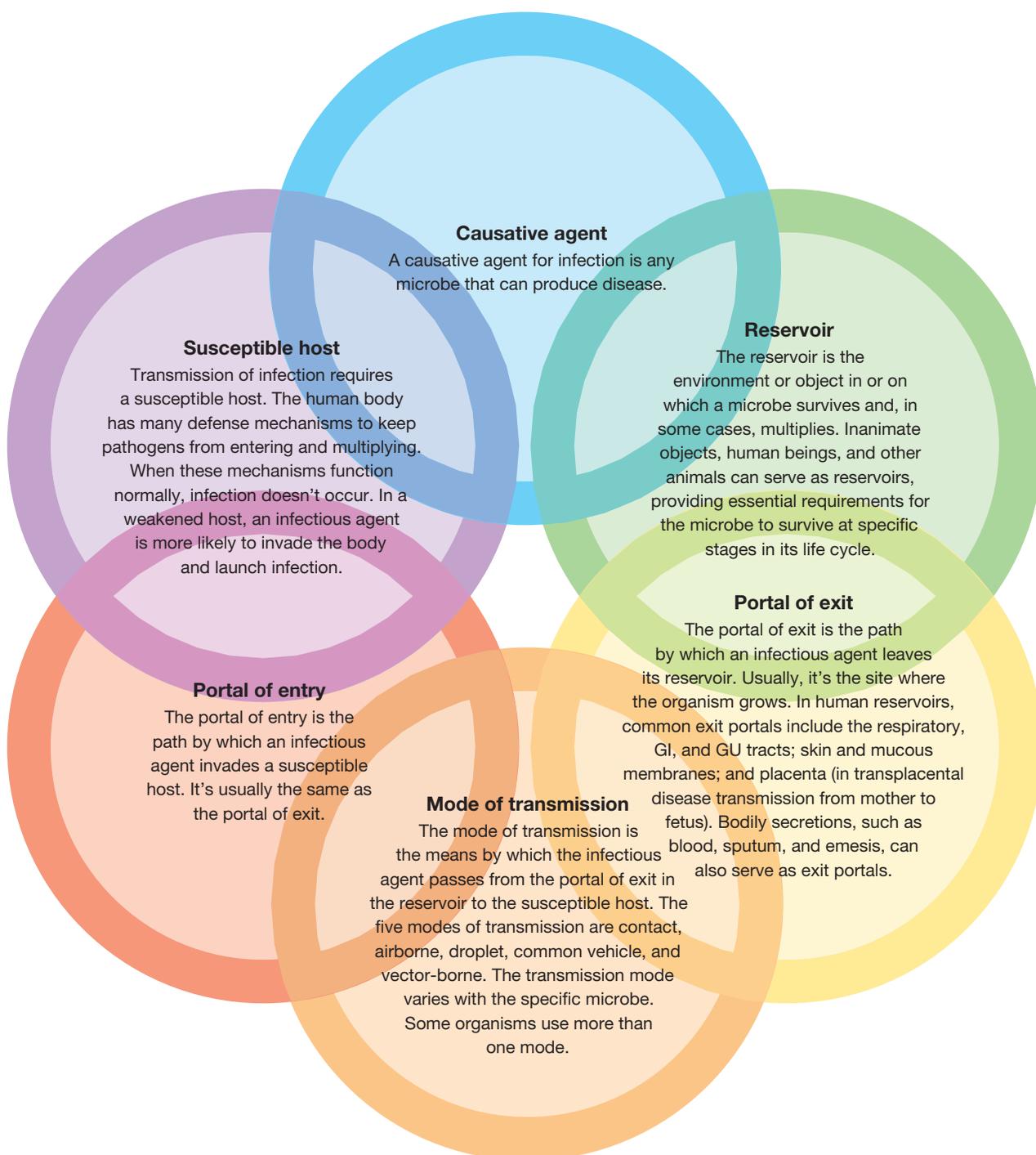
Link 4: Mode of transmission

The microorganism has to have a means of transmission after it leaves its reservoir. There are three methods of transmission: direct, indirect, and airborne.

Direct transmission is through direct transfer from one person to another. This can be through biting, touching, kissing, or sexual intercourse. Sneezing, coughing, spitting, singing, or talking can also transfer microorganisms from one person to another if the person is close to the host and the organism is transferrable by droplet spray into the mucous membranes of the mouth, nose, eye, or conjunctiva.

Indirect transmission can be either vehicle or vector-borne. A vehicle is anything that serves as a way to transfer a microorganism from the host to the susceptible person. Inanimate objects (fomites) such as toys, soiled clothes, eating utensils, handkerchiefs, surgical instruments or dressings, and stethoscopes can serve as vehicles for indirect transmission. Vector-borne transmission is when an animal or insect transports the infectious agent. Transmission occurs when

Chain of infection



the animal or insect either injects saliva through biting or by depositing feces or other materials through broken skin.

Airborne transmission can include droplets or dust. Evaporated droplets and dust particles containing the infectious agent can remain in the air for long periods. *Clostridium difficile* and *Mycobacterium tuberculosis* are examples of microorganisms that can become airborne.

Link 5: Portal of entry

The microorganism must enter the body before a person can be infected. The portal of entry to the susceptible host is

generally the same as the portal of exit from the host.

Link 6: Susceptible host

Any impairment of the body's natural defenses makes an individual a susceptible host who's at risk for infection. Risk factors include:

- age (very young and very old)
- immune suppression treatment for cancer or organ transplant
- immune deficiency conditions
- chronic disorders, such as chronic obstructive pulmonary disease and end-stage renal disease, and disorders that require immunosuppressive therapy, such as rheumatoid arthritis, Crohn disease, and multiple sclerosis.

However, you should expect that any hospitalized patient is at risk for infection because of the physical stress of illness or surgery and the prevalence of microorganisms, including HAIs.

Taking precautions

As a nurse, you must know how to protect yourself and your patients from exposure to harmful pathogens by understanding your organization's infection control policies and following them. These include standard precautions (hand hygiene, PPE, injection safety, environmental cleaning, and respiratory hygiene/cough etiquette) and transmission-based precautions (contact, droplet, and airborne).

Standard precautions

Standard precautions are guidelines that were established to break the chain of infection and reduce the risk of pathogen transmission in hospitals. Standard precautions apply to blood and body fluids, secretions and excretions (except sweat), nonintact skin, and mucous membranes. Following standard precautions not only protects patients, but also healthcare workers.

Hand hygiene is the number one weapon in preventing the spread of microorganisms



consider this

Ebola

Ebola virus disease (EVD) is a rare, but deadly, disease that wasn't diagnosed in the United States until 2014. Four cases were confirmed between September and October, including three healthcare workers who were exposed while caring for EVD patients in the United States and in the African nation of Guinea.

Because of the impact that EVD can potentially have in the United States, the CDC established guidelines for the care of these patients, including a tiered approach to prevent serious outbreaks in the United States. This includes the establishment of frontline healthcare facilities, EVD assessment hospitals, and EVD treatment centers. Although the risk of exposure in the United States is minimal, thorough assessment and identification of persons who've traveled to parts of the world where EVD is prevalent are imperative to prevent the spread of this disease, as is strict adherence to infection control guidelines specific to EVD.

The disease is spread through direct contact with the blood or body fluids of a person who's sick with EVD or objects that have been contaminated with the virus. The CDC issued guidance for agencies with suspected cases of EVD, which includes the importance of training, practice, competence, and observation of healthcare workers regarding the donning and doffing of PPE.

All healthcare workers involved in the care of EVD patients must have training in the proper use of PPE equipment, specifically in donning and doffing the PPE selected by the facility. No skin should be exposed while working in the PPE. A trained observer must supervise every step of the PPE donning/doffing procedure to ensure that the established protocols have been followed.

Although the confirmed cases of EVD in the United States didn't result in an epidemic, such as has occurred in parts of Africa, they created an awareness of the importance of following infection control policy. For more information about EVD and the guidelines established by the CDC, visit: <http://www.cdc.gov/vhf/ebola/index.html>.

and includes alcohol-based hand rubs and hand washing with soap and water. Alcohol-based hand rubs containing 60% to 95% alcohol are the preferred method for decontaminating hands, except when hands are visibly soiled or when a patient has infectious diarrhea. *C. difficile* and norovirus aren't affected by alcohol-based hand rubs; soap and water should be used in suspected or confirmed cases of infectious diarrhea.

Hand hygiene should be performed before and after contact with a patient; immediately after touching blood, body fluids, nonintact skin, mucous membranes, or contaminated items (even when gloves are worn during contact); and immediately after removing gloves. Hand hygiene should also be performed when moving from contaminated body sites to clean body sites during patient care, before eating, after using the restroom, and after handling equipment in the vicinity of the patient. In addition to maintaining strict hand hygiene practices, patients and their family members should also be taught the importance of washing their hands.

The CDC recommends scrubbing hands for at least 20 seconds, using soap, water, and friction, and paying special attention to the areas between fingers, the backs of hands, underneath fingernails, and the thumbs. Humming the "Happy Birthday" song twice or the "Alphabet" song or "Twinkle, Twinkle Little Star" once can help count the time. Alcohol-based hand rubs should be rubbed into all surfaces of the hands until dry.

PPE includes gloves, gowns, masks, respirators, and eyewear that create barriers to protect skin, clothing, mucous membranes, and the respiratory tract from infectious organisms. The item selected depends on the infectious agent, the type of interaction, and the method of microorganism transmission.

Gloves should be worn when touching blood, body fluids, nonintact skin, mucous membranes, and contaminated items, and

Donning and doffing PPE

Proper donning and doffing of PPE protects your clothing and skin from exposure to harmful microorganisms.

Donning PPE

- The gown should fully cover the torso from the neck to the knees, the arms to the wrist, and wrap around the back. It should be tied at the neck and the waist.
- Nonsterile gloves should be used for isolation and should cover the wrist of the isolation gown. They should be put on after the gown, if one is used. Select the glove size according to your hand size.
- The mask's ties or elastic bands should be secured at the back of the head and at the neck. The flexible noseband should be fitted to the bridge of the nose. The mask should fit snugly to the face and extend below the chin. If a respirator is needed, you should be fitted to ensure proper size and fit.
- The goggles and face shield should be adjusted to fit the face.
- After the PPE is in place, you should work from clean to dirty and limit the surfaces touched. Keep your hands away from your face. The equipment should be changed if torn or heavily contaminated. Perform hand hygiene before and after putting on PPE.

Doffing PPE

- Remove all PPE before leaving the patient room or anteroom. Remember that the outside of all equipment is considered contaminated.
- To remove gloves, grasp the outside of one glove in the palm of the opposite hand and peel off. Hold the removed glove in the gloved hand, while sliding fingers of the ungloved hand under the remaining glove at the wrist and peeling off.
- To remove goggles and face shield, handle by the clean headband or earpieces.
- Remove the gown by unfastening neck and waist ties and peeling it from each shoulder toward the same hand, turning the gown inside out. Hold the removed gown away from the body, roll it into a bundle, and discard.
- Without touching the front of the mask, remove the mask or respirator by grasping the ties/elastics.

for any activities involving vascular access. A face shield or mask and goggles should be worn if you anticipate a splash or spray of blood or body fluids that might come in contact with your nose, eyes, or mouth. If you expect your skin or clothing might be exposed to body fluids or blood, wear a gown. Knowing how to put on and remove PPE can help prevent cross-contamination (see *Donning and doffing PPE*).

To promote *injection safety*, gloves should be worn when administering

injections. Puncture-proof disposal systems are recommended to dispose of uncapped needles and sharps. Never recap needles following administration of medication to reduce your risk of being stuck with an unclean needle. You should engage a needle safety device immediately after performing an injection.

Environmental cleaning includes medical equipment and environmental surfaces. Any reusable equipment, including stethoscopes, bandage scissors, and hemostats, that's used on multiple patients must be cleaned between each patient contact, following organizational policy, with a broad-spectrum antimicrobial agent such as chlorhexidine—a commonly used antimicrobial agent for disinfecting topical and hard surfaces in healthcare agencies. It's effective against Gram-positive and Gram-negative bacteria and fungi. Nursing staff should work closely with environmental services to ensure that rooms are thoroughly cleaned and disinfected between patients to prevent the spread of infection through inanimate objects.

Respiratory hygiene and cough etiquette are infection control measures that should be implemented when contact is made with a patient who might have an upper respiratory infection. Patients with signs and symptoms of a respiratory infection should be taught to cover their mouth and nose with a tissue when coughing or sneezing and dispose of the tissue in the nearest trash



consider this

MRSA

MRSA is a multidrug-resistant organism (MDRO) that's labeled as a "superbug" because it's resistant to many antibiotics. The first case in the United States was identified in Boston in 1968. Although it isn't possible to predict which patients will contract HAIs, as healthcare professionals we can't make the assumption that "everyone has MRSA" because this puts all patients at risk, especially if an exposure to MRSA or any other MDRO in the hospital by a patient who's immunocompromised might result in that patient's death.

For more information about MRSA, visit <http://www.cdc.gov/mrsa>.

container as soon as possible. These patients should also perform hand hygiene with alcohol-based rubs, soap and water, or an antiseptic hand wash after being exposed to respiratory secretions or contaminated materials or objects.

Healthcare facilities should ensure adequate and readily accessible supplies of tissues and hand hygiene stations. Visual alerts should be posted in facility entrances to remind patients and visitors to inform healthcare professionals of respiratory signs and symptoms. Patients with respiratory symptoms should be masked to contain respiratory secretions.

Transmission-based precautions

Use transmission-based precautions in addition to standard precautions when the standard precautions aren't enough to protect you from communicable disease transmission. There are three types of transmission-based precautions: contact, droplet, and airborne.

Contact precautions are used in addition to standard precautions when caring for patients with known or suspected diseases that are spread by direct or indirect contact. Contact precautions include gloving and gowning when in contact with the patient, objects, and surfaces within the patient's environment. All reusable items should be cleaned and disinfected according to organizational policy, and disposable items should be thrown away immediately after being used.

Droplet precautions require the use of a surgical mask in addition to standard precautions when you're within 3 ft (6 ft for smallpox) of a patient known to have or suspected of having a disease spread by droplets. These include influenza, pertussis, and meningococcal disease. Healthcare personnel should observe droplet precautions when examining a patient with respiratory symptoms, especially if the patient has a fever. These precautions should remain in effect until it's determined that the



symptoms aren't caused by an infection that requires droplet precautions.

Airborne precautions are used in addition to standard precautions when in contact with patients with known or suspected diseases spread by fine particles transmitted by air currents, such as tuberculosis, measles, and severe acute respiratory syndrome. You must wear a National Institute for Occupational Safety and Health certified, fit-tested N-95 respirator just before entry into an area shared with a patient suspected or known to have one of these diseases. Because there are several sizes of N-95 respirator, healthcare personnel must be fit tested according to organizational policy or at least every 2 years to be sure you're using the correct size. If eye protection is needed, wear goggles or a face shield during all contact with the patient, not just if you predict splashes or sprays.

Implementing standard and contact precautions doesn't guarantee that patients won't contract an HAI, especially if members of the healthcare team don't follow those policies. My students have heard that "they have to follow contact precautions because they're students." What does it convey to students that they have to follow hospital policy but staff members don't?

Overcoming barriers

The behavior of the charge nurse at the beginning of this article wasn't in compliance with standard precautions. In my practice as an RN, I've heard "everyone has MRSA" as a way to explain noncompliance with infection control policy in many healthcare facilities. This is vastly different from the attitude toward MRSA when patients were first diagnosed over 40 years ago. What caused the change?

Many studies have shown that compliance with standard precautions, including hand hygiene, is low. Reported barriers to compliance with standard precautions include emergency situations, availability of equipment, patients' discomfort, time

consider this

Measles

As a result of a multi-state outbreak of measles that started in December 2014, healthcare professionals have been advised by the CDC to consider measles when examining patients who present with fever, malaise, cough, coryza (an upper respiratory infection), conjunctivitis, and Koplik spots (small, white spots that look like tiny grains of white sand that occur on the inside of the cheeks early in the course of measles). A maculopapular rash usually is present approximately 14 days after exposure to an infected person and spreads from the head to the trunk and lower extremities.

The CDC estimates that approximately 90% of susceptible individuals will develop measles after close contact with a person who has measles. The disease is spread when an infected person breathes, coughs, or sneezes; through direct contact with infectious droplets; or by airborne contact. Measles patients should be isolated for 4 days after developing a rash.

Those at greatest risk for complications from measles include infants and children younger than age 5, adults older than age 20, pregnant women, and immunocompromised individuals. Complications include acute encephalitis, which can result in permanent brain damage; respiratory or neurologic complications; and subacute sclerosing panencephalitis, which is a fatal disease of the central nervous system that can develop 7 to 10 years after measles infection.

Measles was declared eliminated in the United States in 2000, but controversy surrounding immunization has reduced the numbers of children receiving the vaccine in recent years. There's no antiviral therapy for measles; only treatment to alleviate symptoms. The best way to prevent the disease is through immunization, which is approximately 97% effective in preventing measles after two doses.

For more information about measles and the recent measles outbreak, visit <http://www.cdc.gov/measles/index.html>.

constraints, provision of nursing care to children, psychological factors, working experience as a nurse, and physician influence.

In emergency situations, nurses report that they have to make the decision to take the time to use PPE versus taking care of the patient, despite the chance that they'll be exposed to microorganisms. Nurses have stated that they neglect their own safety to save a patient.

Nonavailability of equipment can occur for several reasons. The first is that the required equipment isn't available because supplies weren't ordered. The second reason is that the equipment is located too far away from where it's needed. Nurses have also encountered a lack of equipment because it wasn't restocked after all supplies were used

on an earlier shift. Nurses should evaluate that all required equipment is available to carry out standard precautions and ensure that supplies are restocked as needed.

Some nurses state that they don't use PPE for a patient in contact isolation because of patient discomfort. They don't want the patient to feel uncomfortable because of the potential negative impact of seeing his or her nurses in gloves, gowns, and face shields. When I used a gown and gloves to care for a patient early in my career, a nurse came in, asked why I was doing so, and said, "This poor man!" as though I was harming him psychologically. Like the nurse with whom I worked, other nurses have indicated that patients may feel offended. They feel that the use of PPE will have a negative impact on their patients' psychological stress.

Lack of time and nursing personnel have also been used as reasons for noncompliance. Nurses who are taking care of multiple patients have said that the amount of time it takes to put on a gown when caring for multiple patients is a barrier.

When providing care to children, nurses have stated that they're reluctant to use PPE because they don't want the children or their relatives to have negative feelings that may be associated with the use of PPE. These nurses indicate they understand that standard precautions apply to all patients, but still report that providing nursing care to children is a barrier.

Psychological factors play a part in a nurse's decision not to follow standard precautions. In the beginning of this article, a new nurse had noticed that her mentor

didn't use PPE when caring for a patient with MRSA. If all nurses on a unit are out of compliance with standard or contact precautions, the behavior may start to affect younger nurses' compliance. If nurses honestly believe that they aren't at risk for developing an infection or passing a microorganism from one patient to another who's a susceptible host, this belief indicates a professional and institutional culture that can be difficult to change. The statement I've heard most often is, "This is the way they teach you in school, and this is the way we do it in the real world."

Experienced nurses may believe that they aren't at risk because they're more capable of avoiding the risk of transmission than less-experienced nurses. However, experienced nurses serve as role models for less-experienced staff members and must model safe behavior, which will help change a culture of noncompliance.

Lastly, it may be difficult for nurses to model proper infection control practices when physicians go from room to room without following standard precautions. A colleague recently stated that she was surprised when a physician followed contact precautions while rounding on a patient. This behavior should be standard procedure, regardless of position in the healthcare system. Nurses must be willing to act as patient advocates and insist that physicians and other members of the healthcare team follow standard and transmission-based precautions, if needed, when they make their rounds.

Many facilities have anonymous reporting systems in place for any nurse who's uncomfortable confronting a peer who demonstrates unsafe practice. However, the best and most immediate way to initiate change is to address noncompliance as soon as the behavior is seen. Any deviation from policy regarding standard precautions, or any other aspect of infection control, should be reported to your facility's infection control officer, who can provide valuable resources for continuing education of staff.



on the web

- **CDC: Chain of infection:** <http://www.cdc.gov/opphss/csels/dsepd/ss1978/lesson1/section10.html>
- **CDC: Example of safe donning and removal of PPE:** http://www.cdc.gov/hicpac/2007IP/2007ip_fig.html
- **Institute for Healthcare Improvement: How-to guide: Improving hand hygiene:** http://www.shea-online.org/Assets/files/IHI_Hand_Hygiene.pdf

Powerful impact

As nurses, we have the ability to impact the lives of our patients in many ways. Patients trust us to make decisions that will keep them safe from harm, including infection. We have the power to change the culture of noncompliance and reduce the number of HAIs. ■

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