Infection prevention: Precautions for preventing transmission of infection

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INTRODUCTION

The risk of transmission of pathogens and subsequent infection in health care facilities is substantial. Pathogens may be transmitted from other patients, the hospital personnel, and/or the hospital environment. The risk is variable and depends on a patient's immune status, the local prevalence of various pathogens, and the infection control practices and antimicrobial stewardship utilized during hospitalization.

This topic will provide an overview of precautions devised to minimize risk for transmission of infection. Additional considerations in the setting of the COVID-19 pandemic are discussed separately. (See "COVID-19: Infection prevention for persons with SARS-CoV-2 infection".)

Issues related to the prevention of other specific infections, prophylaxis after exposure to bloodborne pathogens, and immunizations for health care workers are discussed in detail separately. (See related topics.)

STANDARD PRECAUTIONS

Standard precautions should be followed for the care of all patients (table 1) even when the presence of an infectious agent is not apparent or is thought to be minimal [1,2].

Standard precautions entail [1,3,4]:

- Hand hygiene before and after contact with every patient, regardless of whether gloves are also used. (See 'Hand hygiene' below.)

- Use of gloves, gowns, and eye protection in situations in which exposure to blood or body secretions is possible.

- Use of respiratory hygiene/cough etiquette by patients or health care workers with cough or respiratory secretions; this includes covering the nose and mouth when coughing, disposing of used tissues promptly, and practicing hand hygiene after contact with respiratory secretions. Use of a mask and spatial separation of patients with respiratory symptoms in waiting areas is also warranted.

- Safe injection practices and safe disposal of needles and sharp instruments in impervious containers. (See "Infection control in the outpatient setting", section on 'Safe injection practices'.)

Hand hygiene — Hand hygiene refers to hand washing with soap and water or the use of alcohol-based hand disinfection (table 2). Hand hygiene is the single most important measure to reduce transmission of microorganisms from one person to another or from one site to another on the same patient [5,6]. The primary challenge associated with hand hygiene efficacy is laxity of practice, not a paucity of good products [7-9].

The SAVE LIVES: Clean Your Hands initiative is part of a major global effort led by the World Health Organization (WHO); it includes "My Five Moments for Hand Hygiene," which define the key moments when health care workers should perform hand hygiene [10]:

- Before touching a patient
- Before clean/aseptic procedures
- After body fluid exposure/risk
- After touching a patient
- After touching patient surroundings

Most hospitals and clinics emphasize hand hygiene at the time of room entry and exit and prior to any procedure.

Either soap and water or alcohol-based hand disinfection (AHD) may be used. In most circumstances, we favor AHD because it is more efficient than handwashing with soap and water. Handwashing with soap and water should be used in association with care of patients with known or suspected norovirus or *Clostridioides difficile* infection since alcohol does not kill

C. difficile spores or norovirus. (See "Clostridioides difficile infection: Prevention and control", section on 'Hand hygiene' and "Norovirus", section on 'Prevention and control'.)

Health care worker compliance with hand hygiene is a longstanding challenge. Most studies have shown that hand hygiene compliance improves with monitoring and immediate feedback, although this approach is time and resource consuming [11-14]. Electronic- and video-based monitoring have been employed to monitor compliance, but such monitoring has not gained widespread use because of multiple barriers [9,11,15-17].

Soap and water — Hand hygiene with soap and water should be performed as summarized in the following table (table 2) [1,7,18].

Alcohol-based hand disinfection — AHD is an effective, inexpensive, and practical alternative to soap and water. AHD is faster and easier to perform than hand washing with soap and water; it should be performed at every room entry and exit and prior to any procedure. The use of AHD has been associated with improved hand hygiene compliance rates and reductions in nosocomial infections [19-21].

AHD products have rapid antimicrobial effects and are as effective as chlorhexidine against gram-positive and gram-negative organisms as well as viral pathogens including influenza [19,22]. AHD products do not have activity against norovirus or spore-forming bacteria, including *C. difficile* [20]. (See "Clostridioides difficile infection: Prevention and control", section on 'Hand hygiene'.)

The technique for hand hygiene is summarized in the following table (table 2). The United States Centers for Disease Control and Prevention (CDC) endorses a three-step method for AHD (apply sanitizer and rub both palms together, cover all surfaces, and rub until dry) [18], whereas the WHO endorses a six-step method (apply sanitizer and specifically rub six different aspects of the hands and fingers) [23]. In a randomized trial comparing these two methods among 120 doctors and nurses at an acute care hospital, those assigned to the six-step method had a greater reduction in the bacterial count of their hands but took approximately 8 seconds longer to complete hand hygiene and had lower compliance (65 versus 100 percent) [24]. Hospital transmission or infection rates were not measured. We continue to favor the three-step CDC AHD method because it is practical and the difference in the bacterial count reduction is of uncertain clinical significance.

Prohibiting artificial nails — Health care workers with direct patient contact should have fingernails that are short, clean, and free from false nails and nail polish [7,25-27]. There is an increase in periungual colonization with a variety of pathogens when fingernails are long and when artificial fingernails are worn [7,28,29]. Artificial fingernails and inadequately cleaned

native fingernails have been epidemiologically linked to outbreaks of infection in intensive care unit patients, neonates, and patients undergoing surgery [30-32].

Gloves — Gloves should be worn by health care workers in situations in which exposure to blood or body secretions is possible; they provide a protective barrier for the health care worker as well as the patient [3]. Nonsterile examination gloves are typically used.

Gloves are also a component of contact precautions; in such circumstances, they reduce the likelihood of health care worker colonization with microorganisms from a patient who is colonized or infected with pathogenic organisms. (See 'Isolation precautions' below.)

Wearing gloves does not replace the need for hand hygiene. Gloves may have unapparent tears, and hands predictably become contaminated during glove removal [33-36].

Gloves should be changed between patient encounters; in some cases, it may be necessary to change heavily contaminated gloves while caring for a single patient to prevent cross-contamination of body sites or contamination of medical equipment.

Masks — Masks should be worn by health care workers caring for patients in the following categories [37]:

- Patients with respiratory secretions, to protect health care workers from patients' infectious material (such as droplets containing blood or body fluids).
- Patients undergoing sterile procedures (including central line insertion, invasive spinal procedures), to protect patients from respiratory droplets generated by health care personnel performing the procedure.

In addition, masks should be worn by patients with respiratory secretions who are coughing if they leave their hospital rooms, to limit spread of infectious secretions to other patients and to health care workers.

Masks should not be confused with particulate respirators that are used to prevent transmission by airborne droplet nuclei of infectious agents such as *Mycobacterium tuberculosis*. (See "Tuberculosis transmission and control in health care settings", section on 'Use of masks'.)

ISOLATION PRECAUTIONS

Isolation precautions used to interrupt or reduce the risk of transmission of pathogens are summarized in the following table (table 1) and in a table prepared by the United States

Centers for Disease Control and Prevention (CDC) [1]. Guidance regarding the duration of precautions for common pathogens is summarized in the table (table 3).

Three isolation categories reflect the major modes of pathogen transmission in nosocomial settings: contact, droplet, and airborne spread [3]. The rooms of patients requiring precautions should be clearly marked with signs containing instructions regarding the type of precautions that must be observed. Ample supplies should be readily available outside the patient room to facilitate adherence, and hospital policies should be enforced [38].

Types

Contact precautions — Contact precautions are used for the care of patients with selected multidrug-resistant bacteria and various enteric and viral pathogens as summarized in the table (table 1). Patients who require contact precautions should be in a private room or in a cohort with other patients who have the same indication for contact precautions [3]. Health care workers should perform hand hygiene and wear gloves upon room entry, even if no direct patient contact is anticipated. Gowns should be worn even if direct contact with the patient or infective material is not anticipated [39]. Upon room exit, gowns and gloves should be removed and hand hygiene should be performed immediately since hands predictably become contaminated during glove removal [36].

Medical equipment should be dedicated to a single patient when possible in order to avoid transfer of pathogens via fomites. Equipment that is not dedicated to a single patient must be cleaned and disinfected before reuse [38]. (See "Infection prevention: General principles", section on 'Medical equipment: Disinfection and sterilization'.)

The association between contact precautions and adverse events (such as diminished frequency and intensity of contact with health care workers, increased likelihood of medication errors, pressure sores, falls, depression and anxiety, and delays in hospital admission and discharge) is uncertain [40]. One randomized trial evaluating the impact of contact precautions on the incidence of adverse patient events noted a trend to fewer adverse events among patients on contact isolation precautions [39]. Other reports describe observational (and mostly retrospective) data and lack statistical power [41-46].

Health care worker compliance with contact isolation precautions is a challenging problem [47]. It is uncertain whether universal decolonization can achieve the same effect as contact isolation for selected pathogens. The strongest data evaluating this issue come from studies performed in intensive care units; this is discussed further separately. (See "Infections and antimicrobial resistance in the intensive care unit: Epidemiology and prevention", section on 'Decolonization/patient bathing'.)

Droplet precautions — Droplets are particles of respiratory secretions ≥5 microns. Droplets remain suspended in the air for limited periods. Transmission is associated with exposure within three to six feet (one to two meters) of the source [1].

Droplet precautions are used for the care of patients with suspected or confirmed infections with *Neisseria meningitidis*, *Bordetella pertussis*, influenza, adenovirus, *Haemophilus influenzae* type b, *Mycoplasma pneumoniae*, rubella, and other pathogens spread by droplets (table 1). Specific precautions for patients with coronavirus disease 2019 (COVID-19) are presented elsewhere. (See "COVID-19: Infection prevention for persons with SARS-CoV-2 infection".)

Many hospitals favor simplifying the approach to isolation precautions for viral respiratory pathogens by placing all patients with suspected viral illness on both contact and droplet precautions.

Respiratory syncytial virus (RSV) may be transmitted by the droplet route but is primarily spread by direct contact with infectious respiratory secretions [48]. Therefore, the most important intervention for prevention of RSV transmission in health care settings is adherence to contact precautions (plus standard precautions) [1,49,50]. The CDC does not recommend droplet precautions for RSV [1]; however, droplet precautions are warranted if the infecting agent is not known, if the patient may be coinfected with other pathogens that require droplet precautions, and/or if there is a chance of exposure to aerosols of infectious respiratory secretions.

Health care workers caring for patients on droplet precautions should wear a surgical mask when they are within six feet of patients [1]. No special air handling systems or higher level respirator masks are required for the care of patients with known or suspected infection due to organisms capable of droplet transmission. The doors of rooms used to house these patients may remain open (in contrast with airborne precautions).

Airborne precautions — Airborne droplet nuclei are particles of respiratory secretions <5 microns. Droplet nuclei can remain suspended in the air for extended periods and thus can be a source of inhalational exposure for susceptible individuals.

Patients on airborne isolation precautions should be placed in a private room with negative air pressure that has a minimum of 6 to 12 air changes per hour. Doors to the isolation rooms must remain closed, and all individuals who enter must wear a respirator with a filtering capacity of 95 percent that allows a tight seal over the nose and mouth. (See "Tuberculosis transmission and control in health care settings", section on 'Airborne infection isolation'.)

- Airborne precautions are warranted for the care of all patients with suspected or confirmed tuberculosis, measles, varicella, and smallpox.

- In the setting of herpes zoster, airborne and contact precautions are warranted for all patients with disseminated zoster and for immunocompromised patients with localized zoster. Immunocompetent patients with localized zoster that can be contained/covered may be managed with standard precautions. Susceptible health care workers should not provide direct care to these patients if immune caregivers are available [51]. (See "Prevention and control of varicella-zoster virus in hospitals".)

- Airborne and contact precautions are also required for patients with severe acute respiratory syndrome (SARS) and COVID-19 who are undergoing aerosol-generating procedures (eg, endotracheal intubation) [52-54]. Some guideline panels also recommend airborne precautions for those undergoing routine care [55]. Although these pathogens are transmitted predominantly by droplet spread (and probably direct contact), airborne transmission may also occur, especially during aerosol-generating procedures. More detailed discussions of infection control precautions for patients with SARS and COVID-19 are discussed elsewhere. (See "Severe acute respiratory syndrome (SARS)", section on 'Infection control' and "COVID-19: Infection prevention for persons with SARS-CoV-2 infection".)

Patients in respiratory isolation who require transport outside their isolation rooms for medical procedures should wear surgical masks that cover the mouth and nose during transport. Procedures for these patients should be scheduled at times when they can be performed rapidly and when occupation of waiting areas is minimal [56].

Precaution duration — Timing for discontinuation of contact, droplet, and/or airborne precautions varies by organism and is based on expert guidance [57]. Guidance for discontinuation of precautions for several common organisms is provided in the table (table 3).

In addition, these issues are discussed further separately:

- (See "Methicillin-resistant Staphylococcus aureus (MRSA) in adults: Prevention and control", section on 'Contact precautions'.)

- (See "Vancomycin-resistant enterococci: Epidemiology, prevention, and control", section on 'Infection control'.)

- (See "Clostridioides difficile infection: Prevention and control", section on 'Infection control'.)

- (See "Infection control measures for prevention of seasonal influenza", section on 'Isolation precautions'.)

- (See "Prevention and control of varicella-zoster virus in hospitals".)

OTHER CLINICAL INFECTION CONTROL ISSUES

Patient bathing — In intensive care units (ICUs), patient bathing with chlorhexidine gluconate (an antiseptic agent with broad-spectrum activity against many organisms) reduces the rate of hospital-acquired bloodstream infections and the risk of colonization acquisition with drug-resistant organisms. This issue is discussed further separately. (See "Infections and antimicrobial resistance in the intensive care unit: Epidemiology and prevention", section on 'Decolonization/patient bathing'.)

For hospitalized patients in general medical and surgical units (eg, outside of the ICU), thus far, there are insufficient data to support routine use of patient bathing with chlorhexidine gluconate [58-60]. In a cluster-randomized trial including more than 330,000 patients in 53 hospitals in the United States over a 21-month intervention period, no difference in the rate of hospital-acquired infection was observed among patients in units randomized to receive universal chlorhexidine bathing plus mupirocin for methicillin-resistant *S. aureus* (MRSA) carriers compared with patients in units who received standard care [60]. However, in post-hoc analysis of decolonized patients with medical devices (including central venous catheters, accessed ports, midline catheters, and lumbar drains), reductions in rates of MRSA and vancomycin-resistant enterococci (VRE) infection and all-cause bacteremia were observed (37 and 31 percent, respectively). Patients with medical devices constituted 10 percent of the standard care population studied but were responsible for 37 percent of positive MRSA and VRE cultures and 56 percent of all-cause bloodstream infections. Further prospective study regarding benefit of decolonization for patients with medical devices is needed.

Single-patient rooms — Separating infected patients from non-infected patients to prevent transmission is a core concept in infection prevention that is utilized in outpatient and inpatient settings throughout the world. In inpatient settings, patients with highly contagious or devastating infections such as tuberculosis, measles, Ebola, and pertussis are routinely isolated from other patients and placed in single-patient rooms. Occupation of individual patient rooms may also decrease the rate of colonization and infection with hospital-acquired organisms.

In an analysis of rates of colonization and infection with multidrug-resistant organisms in a hospital transitioning from multi-bed to new individual patient rooms, single-patient rooms

were associated with decreased rates of VRE and MRSA colonization and VRE infection [61]. However, there was no decrease in rates of *C. difficile* or MRSA infection. Effective use of contact precautions may obviate the benefit of single-patient rooms for some organisms. In a trial conducted in the medical and surgical wards of 16 Dutch hospitals, use of contact precautions in multiple-bed rooms compared with contact precautions in single-bed rooms resulted in similar rates of transmission of extended-spectrum beta-lactamase-producing Enterobacteriaceae (7 versus 4 percent, respectively), although the trial was underpowered to detect small differences [62]. Rates of transmission were higher in multi-patient rooms during the time period before contact precautions were instituted, which suggests a benefit of contact precautions.

Attire for health care personnel — Several studies have demonstrated that clothing and paraphernalia of health care personnel (including white coats, nursing uniforms, ties, stethoscopes, badges, and mobile phones) can become contaminated with pathogens (such as *S. aureus*, vancomycin-resistant enterococci, *C. difficile*, and gram-negative bacilli) during the course of patient care [27,63-70]. For example, stethoscopes are routinely contaminated by complex microbial communities, including important potentially pathogenic organisms such as *S. aureus*, *Pseudomonas*, and *Acinetobacter* spp [71]. The areas of attire with the heaviest colonization are those most frequently touched by hands.

Thus far, no studies have demonstrated an association between contamination of clothing and transmission of pathogens to patients, and no studies have demonstrated any clinical impact associated with minimizing attire contamination or utilizing a "bare below the elbow" policy [72-75]. We agree with the suggestions by the Society for Healthcare Epidemiology of America to reduce the possible but unproven risk of pathogen transmission through attire [76]:

- Health care personnel should be provided with sufficient white coats to allow for frequent cleaning.
- Attire should be laundered daily in hot water, preferably with bleach.
- Shared equipment (such as stethoscopes) or other personal items (such as pagers and cell phones) that come into direct contact with the patient or environment should be disinfected. (See "Infection prevention: General principles", section on 'Medical equipment: Disinfection and sterilization'.)
- When possible, a "bare below the elbows" policy may be reasonable (eg, use of short sleeves, no wristwatch or jewelry, no ties).

Immunocompromised patients — Special interventions are warranted for patients undergoing hematopoietic cell transplantation to minimize exposure to invasive fungal infections such as aspergillosis. These include high-efficiency particulate air filtration of incoming air, positive room air pressure relative to corridors, directed room air flow, ventilation systems that provide at least 12 air changes per hour, dust control measures, and the prohibition of flowers and potted plants in patient rooms. (See "Overview of infections following hematopoietic cell transplantation".)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Infection control".)

SUMMARY AND RECOMMENDATIONS

- The goal of infection control is to prevent and reduce rates of nosocomial infection. Types of precautions for preventing transmission of infection include standard precautions and isolation precautions. (See 'Introduction' above.)
- Standard precautions should be followed for the care of all patients; refer to the following table (table 1) and the table prepared by the United States Centers for Disease Control and Prevention. They include hand hygiene before and after every patient contact, use of gloves, gowns, and eye protection (for situations in which exposure to body fluids is possible), use of respiratory hygiene/cough etiquette, and safe disposal of sharp instruments in impervious containers. (See 'Standard precautions' above.)
- Hand hygiene refers to hand washing with soap and water or the use of alcohol-based hand disinfection (AHD) (table 2). Hand hygiene is the single most important measure to reduce transmission of microorganisms from one person to another or from one site to another on the same patient. Wearing gloves does not replace the need for hand hygiene. (See 'Hand hygiene' above and 'Gloves' above.)
- Either soap and water or AHD may be used in most circumstances; we favor AHD because it is more efficient than handwashing with soap and water. Hand washing with soap and water should be used in association with care of patients with known or suspected *Clostridioides difficile* infection or norovirus. (See 'Hand hygiene' above.)

- Three isolation categories reflect the major modes of pathogen transmission in nosocomial settings: contact, droplet, and airborne spread. The types of precaution(s) warranted for care of patients with known or suspected pathogens are summarized in the following table (table 1). (See 'Isolation precautions' above.)

  - Contact precautions – Health care workers should perform hand hygiene and wear gloves upon room entry, even if no direct patient contact is anticipated. Gowns should be worn if there is likely to be direct contact with the patient or any infective material. (See 'Contact precautions' above.)

  - Droplet precautions – Health care workers should wear a mask when within six feet of patients on droplet precautions. No special air handling systems or higher level respirator masks are required, and the door may remain open. (See 'Droplet precautions' above.)

  - Airborne precautions – Patients requiring airborne isolation precautions should be placed in an airborne infection isolation room, which should be a private room with negative air pressure and a minimum of 6 to 12 air changes per hour. The door must remain closed, and all individuals who enter must wear a respirator with a filtering capacity of 95 percent that allows a tight seal over the nose and mouth. (See 'Airborne precautions' above.)

- Guidance for discontinuation of precautions for several common organisms is provided in the table (table 3). (See 'Precaution duration' above.)

- For hospitalized patients in general medical and surgical units (eg, outside of the intensive care unit), thus far, there are insufficient data to support routine use of bathing with chlorhexidine gluconate. Issues related to patient bathing in intensive care units are discussed further separately. (See 'Patient bathing' above and "Infections and antimicrobial resistance in the intensive care unit: Epidemiology and prevention", section on 'Decolonization/patient bathing'.)

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REFERENCES

1. United States Center for Disease Control and Prevention. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf (Accessed on December 15, 2020).
2. Rathore MH, Jackson MA, COMMITTEE ON INFECTIOUS DISEASES. Infection Prevention and Control in Pediatric Ambulatory Settings. Pediatrics 2017; 140.
3. Garner JS. Guideline for isolation precautions in hospitals. The Hospital Infection Control Practices Advisory Committee. Infect Control Hosp Epidemiol 1996; 17:53.
4. Whitehouse JD, Sexton DJ, Kirkland KB. Infection control: past, present, and future issues. Compr Ther 1998; 24:71.
5. Pittet D, Allegranzi B, Sax H, et al. Evidence-based model for hand transmission during patient care and the role of improved practices. Lancet Infect Dis 2006; 6:641.
6. Luangasanatip N, Hongsuwan M, Limmathurotsakul D, et al. Comparative efficacy of interventions to promote hand hygiene in hospital: systematic review and network meta-analysis. BMJ 2015; 351:h3728.
7. Boyce JM, Pittet D, Healthcare Infection Control Practices Advisory Committee, HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Society for Healthcare Epidemiology of America/Association for Professionals in Infection Control/Infectious Diseases Society of America. MMWR Recomm Rep 2002; 51:1.
8. Gould DJ, Chudleigh JH, Moralejo D, Drey N. Interventions to improve hand hygiene compliance in patient care. Cochrane Database Syst Rev 2007; :CD005186.
9. Kovacs-Litman A, Muller MP, Powis JE, et al. Association Between Hospital Outbreaks and Hand Hygiene: Insights from Electronic Monitoring. Clin Infect Dis 2021; 73:e3656.
10. World Health Organization. SAVE LIVES: Clean Your Hands: WHO's global annual campaign http://www.who.int/gpsc/5may/en/ (Accessed on December 06, 2011).
11. Boyce JM. Hand hygiene compliance monitoring: current perspectives from the USA. J Hosp Infect 2008; 70 Suppl 1:2.
12. Walker JL, Sistrunk WW, Higginbotham MA, et al. Hospital hand hygiene compliance improves with increased monitoring and immediate feedback. Am J Infect Control 2014; 42:1074.

13. Gavrieli E, Drach-Zahavy A, Tal I, et al. The effects of immediate and delayed feedback on hand hygiene compliance. Antimicrob Resist Infect Control 2015; 4:P287.
14. Srigley JA, Furness CD, Baker GR, Gardam M. Quantification of the Hawthorne effect in hand hygiene compliance monitoring using an electronic monitoring system: a retrospective cohort study. BMJ Qual Saf 2014; 23:974.
15. Ward MA, Schweizer ML, Polgreen PM, et al. Automated and electronically assisted hand hygiene monitoring systems: a systematic review. Am J Infect Control 2014; 42:472.
16. Armellino D, Hussain E, Schilling ME, et al. Using high-technology to enforce low-technology safety measures: the use of third-party remote video auditing and real-time feedback in healthcare. Clin Infect Dis 2012; 54:1.
17. Pineles LL, Morgan DJ, Limper HM, et al. Accuracy of a radiofrequency identification (RFID) badge system to monitor hand hygiene behavior during routine clinical activities. Am J Infect Control 2014; 42:144.
18. United States Centers for Disease Control and Prevention. When & How to Wash Your Hands. http://www.cdc.gov/handwashing/when-how-handwashing.html (Accessed on September 15, 2016).
19. Voss A, Widmer AF. No time for handwashing!? Handwashing versus alcoholic rub: can we afford 100% compliance? Infect Control Hosp Epidemiol 1997; 18:205.
20. Gordin FM, Schultz ME, Huber RA, Gill JA. Reduction in nosocomial transmission of drug-resistant bacteria after introduction of an alcohol-based handrub. Infect Control Hosp Epidemiol 2005; 26:650.
21. Pittet D, Hugonnet S, Harbarth S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. Infection Control Programme. Lancet 2000; 356:1307.
22. Grayson ML, Melvani S, Druce J, et al. Efficacy of soap and water and alcohol-based hand-rub preparations against live H1N1 influenza virus on the hands of human volunteers. Clin Infect Dis 2009; 48:285.
23. World Health Organization. Clean hands protect against infection. http://www.who.int/gpsc/clean_hands_protection/en/ (Accessed on April 26, 2016).
24. Reilly JS, Price L, Lang S, et al. A Pragmatic Randomized Controlled Trial of 6-Step vs 3-Step Hand Hygiene Technique in Acute Hospital Care in the United Kingdom. Infect Control Hosp Epidemiol 2016; 37:661.
25. Rubin DM. Prosthetic fingernails in the OR. A research study. AORN J 1988; 47:944.

26. Loveday HP, Wilson JA, Pratt RJ, et al. epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. J Hosp Infect 2014; 86 Suppl 1:S1.
27. Tacconelli E, Cataldo MA, Dancer SJ, et al. ESCMID guidelines for the management of the infection control measures to reduce transmission of multidrug-resistant Gram-negative bacteria in hospitalized patients. Clin Microbiol Infect 2014; 20 Suppl 1:1.
28. Pottinger J, Burns S, Manske C. Bacterial carriage by artificial versus natural nails. Am J Infect Control 1989; 17:340.
29. McNeil SA, Phelps A, Barnes AL, Kauffman CA. The effect of fingernail length on microbial c olonization of the hands of healthcare workers [abstract]. 39th Annual IDSA, October 25-28, San Francisco, CA.
30. Moolenaar RL, Crutcher JM, San Joaquin VH, et al. A prolonged outbreak of Pseudomonas aeruginosa in a neonatal intensive care unit: did staff fingernails play a role in disease transmission? Infect Control Hosp Epidemiol 2000; 21:80.
31. Parry MF, Grant B, Yukna M, et al. Candida osteomyelitis and diskitis after spinal surgery: an outbreak that implicates artificial nail use. Clin Infect Dis 2001; 32:352.
32. Passaro DJ, Waring L, Armstrong R, et al. Postoperative Serratia marcescens wound infections traced to an out-of-hospital source. J Infect Dis 1997; 175:992.
33. Emergency Care Research Institute. Special Report: Reuse of single-use medical devices: Ma king informed decisions. Plymouth Meeting, PA: ECRI; 1997:1.
34. Alrawi S, Houshan L, Satheesan R, et al. Glove reinforcement: an alternative to double gloving. Infect Control Hosp Epidemiol 2001; 22:526.
35. Fuller C, Savage J, Besser S, et al. "The dirty hand in the latex glove": a study of hand hygiene compliance when gloves are worn. Infect Control Hosp Epidemiol 2011; 32:1194.
36. Doebbeling BN, Pfaller MA, Houston AK, Wenzel RP. Removal of nosocomial pathogens from the contaminated glove. Implications for glove reuse and handwashing. Ann Intern Med 1988; 109:394.
37. Offeddu V, Yung CF, Low MSF, Tam CC. Effectiveness of Masks and Respirators Against Respiratory Infections in Healthcare Workers: A Systematic Review and Meta-Analysis. Clin Infect Dis 2017; 65:1934.
38. Muto CA, Jernigan JA, Ostrowsky BE, et al. SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of Staphylococcus aureus and enterococcus. Infect Control Hosp Epidemiol 2003; 24:362.

39. Croft LD, Harris AD, Pineles L, et al. The Effect of Universal Glove and Gown Use on Adverse Events in Intensive Care Unit Patients. Clin Infect Dis 2015; 61:545.

40. Sprague E, Reynolds S, Brindley P. Patient Isolation Precautions: Are They Worth It? Can Respir J 2016; 2016:5352625.

41. Dashiell-Earp CN, Bell DS, Ang AO, Uslan DZ. Do physicians spend less time with patients in contact isolation?: a time-motion study of internal medicine interns. JAMA Intern Med 2014; 174:814.

42. Morgan DJ, Pineles L, Shardell M, et al. The effect of contact precautions on healthcare worker activity in acute care hospitals. Infect Control Hosp Epidemiol 2013; 34:69.

43. Karki S, Leder K, Cheng AC. Patients under contact precautions have an increased risk of injuries and medication errors: a retrospective cohort study. Infect Control Hosp Epidemiol 2013; 34:1118.

44. Day HR, Morgan DJ, Himelhoch S, et al. Association between depression and contact precautions in veterans at hospital admission. Am J Infect Control 2011; 39:163.

45. Catalano G, Houston SH, Catalano MC, et al. Anxiety and depression in hospitalized patients in resistant organism isolation. South Med J 2003; 96:141.

46. McLemore A, Bearman G, Edmond MB. Effect of contact precautions on wait time from emergency room disposition to inpatient admission. Infect Control Hosp Epidemiol 2011; 32:298.

47. Dhar S, Marchaim D, Tansek R, et al. Contact precautions: more is not necessarily better. Infect Control Hosp Epidemiol 2014; 35:213.

48. Hall CB. Nosocomial respiratory syncytial virus infections: the "Cold War" has not ended. Clin Infect Dis 2000; 31:590.

49. Leclair JM, Freeman J, Sullivan BF, et al. Prevention of nosocomial respiratory syncytial virus infections through compliance with glove and gown isolation precautions. N Engl J Med 1987; 317:329.

50. Madge P, Paton JY, McColl JH, Mackie PL. Prospective controlled study of four infection-control procedures to prevent nosocomial infection with respiratory syncytial virus. Lancet 1992; 340:1079.

51. United States Centers for Disease Control and Prevention. Preventing Varicella-Zoster Virus (VZV) Transmission from Zoster in Healthcare Settings. http://www.cdc.gov/shingles/hcp/hc-settings.html (Accessed on October 04, 2016).

52. Wilder-Smith A, Low JG. Risk of respiratory infections in health care workers: lessons on infection control emerge from the SARS outbreak. Southeast Asian J Trop Med Public Health

2005; 36:481.

53. Public Health Guidance for Community-Level Preparedness and Response to Severe Acute Respiratory Syndrome (SARS) http://www.cdc.gov/ncidod/sars/guidance/I/index.htm (Accessed on December 06, 2011).
54. Lynch JB, Davitkov P, Anderson DJ, et al. Infectious Diseases Society of America Guidelines on Infection Prevention for Health Care Personnel Caring for Patients with Suspected or Known COVID-19. Clin Infect Dis 2020.
55. Centers for Disease Control and Prevention. Interim infection prevention and control recommendations for healthcare personnel during the coronavirus disease 2019 (COVID-19) pandemic. Available at: https://www.cdc.gov/coronavirus/2019-nCoV/hcp/infection-control.html (Accessed on December 29, 2020).
56. Jensen PA, Lambert LA, Iademarco MF, et al. Guidelines for preventing the transmission of Mycobacterium tuberculosis in health-care settings, 2005. MMWR Recomm Rep 2005; 54:1.
57. Banach DB, Bearman G, Barnden M, et al. Duration of Contact Precautions for Acute-Care Settings. Infect Control Hosp Epidemiol 2018; 39:127.
58. Xiao G, Chen Z, Lv X. Chlorhexidine-based body washing for colonization and infection of methicillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococcus: an updated meta-analysis. Infect Drug Resist 2018; 11:1473.
59. Lowe CF, Lloyd-Smith E, Sidhu B, et al. Reduction in hospital-associated methicillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococcus with daily chlorhexidine gluconate bathing for medical inpatients. Am J Infect Control 2017; 45:255.
60. Huang SS, Septimus E, Kleinman K, et al. Chlorhexidine versus routine bathing to prevent multidrug-resistant organisms and all-cause bloodstream infections in general medical and surgical units (ABATE Infection trial): a cluster-randomised trial. Lancet 2019; 393:1205.
61. McDonald EG, Dendukuri N, Frenette C, Lee TC. Time-Series Analysis of Health Care-Associated Infections in a New Hospital With All Private Rooms. JAMA Intern Med 2019; 179:1501.
62. Kluytmans-van den Bergh MFQ, Bruijning-Verhagen PCJ, Vandenbroucke-Grauls CMJE, et al. Contact precautions in single-bed or multiple-bed rooms for patients with extended-spectrum β-lactamase-producing Enterobacteriaceae in Dutch hospitals: a cluster-randomised, crossover, non-inferiority study. Lancet Infect Dis 2019; 19:1069.
63. Wilson JA, Loveday HP, Hoffman PN, Pratt RJ. Uniform: an evidence review of the microbiological significance of uniforms and uniform policy in the prevention and control of healthcare-associated infections. Report to the Department of Health (England). J Hosp Infect 2007; 66:301.

64. Wiener-Well Y, Galuty M, Rudensky B, et al. Nursing and physician attire as possible source of nosocomial infections. Am J Infect Control 2011; 39:555.

65. Treakle AM, Thom KA, Furuno JP, et al. Bacterial contamination of health care workers' white coats. Am J Infect Control 2009; 37:101.

66. Lopez PJ, Ron O, Parthasarathy P, et al. Bacterial counts from hospital doctors' ties are higher than those from shirts. Am J Infect Control 2009; 37:79.

67. Gaspard P, Eschbach E, Gunther D, et al. Meticillin-resistant Staphylococcus aureus contamination of healthcare workers' uniforms in long-term care facilities. J Hosp Infect 2009; 71:170.

68. Brady RR, Verran J, Damani NN, Gibb AP. Review of mobile communication devices as potential reservoirs of nosocomial pathogens. J Hosp Infect 2009; 71:295.

69. Kotsanas D, Scott C, Gillespie EE, et al. What's hanging around your neck? Pathogenic bacteria on identity badges and lanyards. Med J Aust 2008; 188:5.

70. Longtin Y, Schneider A, Tschopp C, et al. Contamination of stethoscopes and physicians' hands after a physical examination. Mayo Clin Proc 2014; 89:291.

71. Knecht VR, McGinniss JE, Shankar HM, et al. Molecular analysis of bacterial contamination on stethoscopes in an intensive care unit. Infect Control Hosp Epidemiol 2019; 40:171.

72. Jacob G. Uniforms and workwear: An evidence base for developing local policy. http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_078435.pdf (Accessed on October 04, 2016).

73. Burden M, Cervantes L, Weed D, et al. Newly cleaned physician uniforms and infrequently washed white coats have similar rates of bacterial contamination after an 8-hour workday: a randomized controlled trial. J Hosp Med 2011; 6:177.

74. Bearman GM, Rosato A, Elam K, et al. A crossover trial of antimicrobial scrubs to reduce methicillin-resistant Staphylococcus aureus burden on healthcare worker apparel. Infect Control Hosp Epidemiol 2012; 33:268.

75. Burger A, Wijewardena C, Clayson S, Greatorex RA. Bare below elbows: does this policy affect handwashing efficacy and reduce bacterial colonisation? Ann R Coll Surg Engl 2011; 93:13.

76. Bearman G, Bryant K, Leekha S, et al. Healthcare personnel attire in non-operating-room settings. Infect Control Hosp Epidemiol 2014; 35:107.

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GRAPHICS

Types of precautions for infection control[1]

Type of precaution	Selected patients	Major specifications
Standard	All patients	Perform hand hygiene before and after every patient contact.* Gloves, gowns, eye protection as required. Safe disposal or cleaning of instruments and linen. Cough etiquette: Patients and visitors should cover their nose or mouth when coughing, promptly dispose used tissues, and practice hand hygiene after contact with respiratory secretions.
Contact¶	Colonization of any bodily site with multidrug-resistant bacteria (MRSA, VRE, drug-resistant gram-negative organisms) Enteric infections (Norovirus, *Clostridioides difficile**, *Escherichia coli* O157:H7) Viral infections (HSV, VZV, RSVΔ, parainfluenza, enterovirus, rhinovirus◇, certain coronaviruses [eg, SARS-CoV-2, MERS-CoV]) Scabies Impetigo Noncontained abcesses or decubitus ulcers (especially for *Staphylococcus aureus* and group A *Streptococcus*)§	**In addition to standard precautions:** Private room preferred; cohorting allowed if necessary. Gloves required upon entering room. Change gloves after contact with contaminated secretions. Gown required if clothing may come into contact with the patient or environmental surfaces or if the patient has diarrhea. Minimize risk of environmental contamination during patient transport (eg, patient can be placed in a gown). Noncritical items should be dedicated to use for a single patient if possible.
Droplet¶	**Known or suspected:** *Neisseria meningitidis* *Haemophilus influenzae* type B *Mycoplasma pneumoniae*	**In addition to standard precautions:** Private room preferred; cohorting allowed if necessary. Wear a mask when within 3 feet of the patient. Mask the patient during transport.

	Bordetella pertussis Group A *Streptococcus*[§] Diphtheria Pneumonic plague Influenza Rubella Mumps Adenovirus Parvovirus B19 Rhinovirus[◇] Certain coronaviruses[¥]	Cough etiquette: Patients and visitors should cover their nose or mouth when coughing, promptly dispose used tissues, and practice hand hygiene after contact with respiratory secretions.
Airborne	**Known or suspected:** Tuberculosis Varicella Measles Smallpox Certain coronaviruses[¥] Ebola[‡]	**In addition to standard precautions:** Place the patient in an AIIR (a monitored negative pressure room with at least 6 to 12 air exchanges per hour). Room exhaust must be appropriately discharged outdoors or passed through a HEPA filter before recirculation within the hospital. A certified respirator must be worn when entering the room of a patient with diagnosed or suspected tuberculosis. Susceptible individuals should not enter the room of patients with confirmed or suspected measles or chickenpox. Transport of the patient should be minimized; the patient should be masked if transport within the hospital is unavoidable. Cough etiquette: Patients and visitors should cover their nose or mouth when coughing, promptly dispose used tissues, and practice hand hygiene after contact with respiratory secretions.

This system of isolation precautions is recommended by the United States Healthcare Infection Control Practices Advisory Committee.

MRSA: methicillin-resistant *S. aureus*; VRE: vancomycin-resistant enterococci; HSV: herpes simplex virus; VZV: varicella-zoster virus; RSV: respiratory syncytial virus; SARS-CoV: severe acute respiratory syndrome coronavirus; MERS-CoV: Middle East Respiratory Syndrome coronavirus; AIIR: airborne infection isolation room; HEPA: high-efficiency particulate aerator.

* Alcohol-based hand disinfectant is an acceptable alternative to soap and water in all situations EXCEPT in the setting of norovirus and *C. difficile* infection, for which soap and water should be used.

¶ Many hospitals favor simplifying the approach to isolation precautions for viral respiratory pathogens by placing all patients with suspected viral illness on both contact and droplet precautions.

Δ RSV may be transmitted by the droplet route but is primarily spread by direct contact with infectious respiratory secretions. Droplet precautions are not routinely warranted but are appropriate if the infecting agent is not known, if the patient may be coinfected with other pathogens that require droplet precautions, and/or if there is a chance of exposure to aerosols of infectious respiratory secretions.

◇ The most important route of transmission for rhinovirus is via droplets; contact precautions should be added if copious moist secretions and close contact are likely to occur (eg, young infants).

§ Patients with invasive group A streptococcal infection associated with soft tissue involvement warrant both droplet precautions and contact precautions. Droplet precautions alone are warranted for patients with streptococcal toxic shock or streptococcal pneumonia, as well as for infants and young children in the setting of pharyngitis or scarlet fever. Droplet and contact precautions may be discontinued after the first 24 hours of antimicrobial therapy.

¥ Refer to UpToDate topics on coronaviruses, including SARS-CoV, SARS-CoV-2, and MERS-CoV, for specific information on infection control precautions.

‡ Refer to the UpToDate topic on prevention of Ebola virus infection for full discussion of infection control issues.

Reference:

1. *Siegel JD, Rhinehart E, Jackson M, et al. 2007 Guideline for isolation precautions: preventing transmission of infectious agents in health care settings. Am J Infect Control 2007; 35:S65.*

Graphic 50001 Version 26.0

Hand-hygiene technique

When decontaminating hands with an alcohol-based hand rub, apply product to palm of one hand and rub hands together, covering all surfaces of hands and fingers, until hands are dry. Follow the manufacturer's recommendations regarding the volume of product to use.
When washing hands with soap and water, wet hands first with water, apply an amount of product recommended by the manufacturer to hands, and rub hands together vigorously for at least 20 seconds, covering all surfaces of the hands and fingers. Rinse hands with water and dry thoroughly with a disposable towel. Use towel to turn off the faucet.
Liquid, bar, leaflet, or powdered forms of plain soap are acceptable when washing hands with soap and water. When bar soap is used, small bars of soap and soap racks that facilitate drainage should be used.
Multiple-use cloth towels of the hanging or roll type are not recommended for use in health care settings.

Data from:

1. *Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Centers for Disease Control and Prevention. Morbidity and Mortality Weekly Report 2002; 51(RR-16):1.*
2. *Centers for Disease Control and Prevention. When & How to Wash Your Hands. Available at: http://www.cdc.gov/handwashing/when-how-handwashing.html (Accessed on October 11, 2019).*

Graphic 77676 Version 7.0

Duration of infection control precautions for acute care settings

Pathogen	Guidance for precaution discontinuation	Reference
Methicillin-resistant *Staphylococcus aureus* (MRSA)	Following completion of antibiotic therapy as needed, contact precautions may be discontinued after documentation of 1 to 3 negative weekly surveillance cultures.* Extension of contact precautions may be warranted for patients with a draining wound, ongoing respiratory secretions associated with MRSA infection, or other evidence implicating risk of ongoing transmission.	[1,6]
Vancomycin-resistant enterococcus (VRE)	Following completion of antibiotic therapy as needed, contact precautions may be discontinued after documentation of 1 to 3 negative weekly stool or rectal swab surveillance cultures.* Extension of contact precautions may be warranted for patients who are highly immunosuppressed, are receiving broad-spectrum antibiotic therapy (without VRE activity), or receiving care in protected environments (such as burn units) or in institutions with high VRE rates.	[1,6]
Clostridioides difficile	Continue contact precautions for at least 48 hours after resolution of diarrhea. Since persistent shedding of spores is common[3], extension of contact precautions beyond resolution of diarrhea (eg, for remainder of hospitalization) is warranted in some situations, such as for incontinent patients.	[1,3]
Multi-drug resistant gram-negative (MDR-GN) pathogens		
Extended-spectrum beta-lactamase (ESBL) and other MDR-GN pathogens	Continue precautions for duration of hospitalization. Guidelines recommend assessing discontinuation of precautions on a case-by-case basis related to time since onset of infection, need for ongoing antibiotic use, negative rectal screening samples, and specific pathogen (as an example, transmission risk of ESBL-positive *Escherichia coli* may be relatively limited).	[1]
Carbapenem-resistant enterobacteriaceae (CRE) and Extremely drug-resistant gram negative (XDR-GN) pathogens	Maintain as long as patients are hospitalized or in a congregate living setting.	[1]

Influenza	In immunocompetent hosts, the duration of droplet precautions is 7 days after illness onset or until 24 hours after resolution of fever and respiratory symptoms, whichever is longer. The optimal duration for immunocompromised hosts is uncertain.	[2]
Varicella zoster virus (VZV) infection		
Localized zoster	Airborne and contact precautions should be continued until lesions are dry and crusted. For immunocompetent patients whose lesions can be covered, standard precautions are sufficient **if** health care provider(s) are immune.	[4,5]
Disseminated zoster	Airborne and contact precautions should be continued until lesions are dry and crusted.	[4,5]
Herpes simplex virus (HSV) infection	Contact precautions should be continued until lesions are dry and crusted.	[4]

* If the screening culture is performed within a year of the infection, most institutions require 3 negative cultures (off of antibiotics). If the screening culture is performed more than 1 year after resolution of the infection, most institutions require 1 negative culture (off of antibiotics).[1,5]

References:

1. *Banach DB, Bearman G, Barnden M, et al. Duration of contact precautions for acute-care settings. Infect Control Hosp Epidemiol 2018; 39:127.*
2. *Centers for Disease Control and Prevention. Prevention strategies for seasonal influenza in healthcare settings. http://www.cdc.gov/flu/professionals/infectioncontrol/healthcaresettings.htm (Accessed on April 8, 2019).*
3. *Bobulsky GS, Al-Nassir WN, Riggs MM, et al. Clostridium difficile skin contamination in patients with C. difficile-associated disease. Clin Infect Dis 2008; 46:447.*
4. *Siegel JD, Rhinehart E, Jackson M, et al. 2007 guideline for isolation precautions: preventing transmission of infectious agents in health care settings. Am J Infect Control 2007; 35:S65.*
5. *United States Centers for Disease Control and Prevention. Preventing varicella-zoster virus (VZV) transmission from zoster in healthcare settings. https://www.cdc.gov/shingles/hcp/hc-settings.html (Accessed on April 8, 2019).*
6. *Huckabee CM, Huskins WC, Murray PR. Predicting clearance of colonization with vancomycin-resistant Enterococci and methicillin-resistant Staphylococcus aureus by use of weekly surveillance cultures. J Clin Microbiol 2009; 47:1229.*

Graphic 120919 Version 2.0

Contributor Disclosures

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