

Infections Acquired in Health Care Facilities

Chapter 147 | Part 5: Infectious Diseases

KEY CLINICAL POINTS

- 1 Health care–associated infections (HAIs) affect at least 3% of hospitalized patients at any given time.
- 2 *C. difficile* infection is the most frequent hospital-acquired infection in the United States; antibiotic stewardship is the first-line prevention measure.
- 3 *Candida auris* is a multidrug-resistant species adapted to the health care environment that survives on surfaces and requires sporicidal disinfectants (e.g., bleach) for cleaning.
- 4 Asymptomatic bacteriuria should not be treated in non-pregnant patients to avoid a vicious cycle of escalating antimicrobial use and resistance.
- 5 Ventilator-associated pneumonia (VAP) occurs in up to 10% of ventilated patients and is preventable by limiting invasive device use and following evidence-based bundles.
- 6 Transmission-based precautions (contact, droplet, airborne) are categorized by the WHO and CDC based on pathogen transmission modes (e.g., airborne for TB, measles, COVID-19).
- 7 *C. difficile* spores are hardy and survive in the health care environment; handwashing with soap and water is preferred over alcohol-based gels for removal.
- 8 Patients with suspected or confirmed tuberculosis must be managed with airborne precautions using N95 respirators or powered air-purifying respirators (PAPRs).
- 9 *C. auris* screening is recommended for patients transferred from long-term care facilities via PCR or culture, with isolation pending results.
- 10 Avian influenza A (H5N1) has a case fatality rate of ~50% and requires contact and airborne precautions plus eye protection for prevention.

DEFINITION & OVERVIEW

- **HAIs:** Infections acquired in health care facilities are termed health care–associated infections (HAIs) or nosocomial infections.
- **Prevalence:** HAIs affect at least 3% of hospitalized patients at any given time.
- **Timing Criteria:**

→ Infections occurring within the first 48–72 h after admission → considered community acquired or attributed to the transferring institution.

→ Infections occurring after 48–72 h → classified as health care associated (nosocomial).

- **Transmission Routes:**
 - Contaminated surfaces
 - Health care personnel
 - Respiratory routes

- Altered microbiota from antibiotics
 - **Risk Factors:**
 - Colonized patients act as reservoirs for resistant organisms.
 - Immunocompromised patients and those with invasive devices are at higher risk.
 - **Prevention Components:**
 - Hand hygiene and environmental cleaning.
 - Infection prevention programs: surveillance, isolation protocols, device infection reduction, outbreak control, and mandatory reporting to CDC via National Healthcare Safety Network (NHSN).
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EPIDEMIOLOGY

- **Trends:** Pre-pandemic rates of some nosocomial infections were declining but reversed during the COVID-19 pandemic.
 - **Resistance:** Multidrug-resistant infections (e.g., ESBL, *C. auris*) have increased in incidence.
 - ***C. difficile*:** Most frequent hospital-acquired infection in the U.S.
 - ***C. auris*:** Incidence rose sharply during the pandemic; requires sporicidal disinfectants for control.
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ETIOLOGY & PATHOPHYSIOLOGY

- **Transmission Dynamics:**
 - Colonization pressure (proportion of colonized patients in a ward) increases resistant organism spread.
 - ***C. difficile*:** Spores are hardy, survive long on surfaces, and require soap-and-water hand hygiene for removal.
 - ***C. auris*:** Survives on surfaces and resists some disinfectants, necessitating bleach-based cleaning.
 - **Waterborne Pathogens:** (e.g., *Legionella*) thrive in stagnant plumbing; pose risks to immunosuppressed patients.
 - **Protective Isolation:** Required for high-risk patients (e.g., stem cell transplant recipients) using rooms with HEPA filtration.
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CLINICAL FEATURES

- ***C. difficile* colitis:** Ranges from mild diarrhea to toxic megacolon.
 - ***C. auris*:** Causes multidrug-resistant candidiasis in hospitals and long-term care facilities.
 - **Tuberculosis (TB):** Requires airborne precautions with N95 respirators or PAPRs.
 - **Asymptomatic Bacteriuria:** Often leads to inappropriate antimicrobial use in catheterized patients.
 - **Ventilator-Associated Pneumonia (VAP):** Prolongs ICU stays; preventable by limiting device use.
 - **Catheter-associated UTIs:** More common in elderly females and critically ill patients.
 - **Avian influenza A (H5N1):** Case fatality rate of ~50%; requires contact/airborne precautions plus eye protection.
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DIFFERENTIAL DIAGNOSIS

- **Colonization vs. Infection:** Critical distinction for management.

- **Asymptomatic Bacteriuria:** Should not be treated in non-pregnant patients.
- **C. auris:** Requires PCR/culture screening for patients transferred from other facilities.
- **Nosocomial Legionnaires disease:** Necessitates outbreak investigation and water testing.
- **Emerging Pathogens:** TB, mpox, and others require specific transmission precautions.

DIAGNOSTIC APPROACH

1. Surveillance & Monitoring:

- Outcomes: Surgical site infections, C. difficile infections.
- Process measures: Hand hygiene compliance, central line care.
- NHSN reporting: Standardized infection ratios (observed/predicted infections).
- Automated systems: Electronic health record integration for real-time data.

2. Laboratory & Environmental Assessment:

- Automated systems require human input for accuracy.
- Whole genome sequencing: Gold standard for outbreak investigations.
- Legionnaires disease: Requires water testing and environmental cultures during outbreaks.

3. Specific Diagnostic Testing:

- C. auris: PCR/culture screening for patients transferred from long-term care facilities.
- TB: Preemployment screening using interferon-γ release assays (over tuberculin skin tests).
- Urine Culture Stewardship (Table 147-2):
- Educate on asymptomatic bacteriuria and appropriate indications.
- Require documentation of symptoms at time of order.
- Implement alerts to discourage testing when asymptomatic (except pregnancy, urologic procedures).
- Use pyuria threshold (>10 white blood cells per high-power field) for nonneutropenic patients.
- Educate on collection/storage; avoid collection from bags or long-standing catheters.

6.1 Surveillance Methods

- **Outcomes:** Surgical site infections, C. difficile infections.
- **Process measures:** Hand hygiene compliance, central line care.
- **NHSN reporting:** Standardized infection ratios (observed/predicted infections).
- **Automated systems:** Electronic health record integration for real-time data.

6.2 Diagnostic Criteria & Testing

- **C. auris:** PCR/culture screening for transferred patients.
- **TB:** Interferon-γ release assay for preemployment screening.
- **Legionnaires disease:** Water testing and environmental cultures during outbreaks.

MANAGEMENT & TREATMENT

1. Prevention Bundles (Table 147-1):

- **Surgical Site Infections:**

→ Treat active infections prior to surgery.

- Administer prophylactic antibiotics within 1 h before surgery; discontinue immediately after.
- Wear surgical attire covering hair, mouth, and nose.
- Perform hand hygiene with an antiseptic agent.
- Use chlorhexidine/alcohol for site antisepsis.
- Clip hair (do not shave) to avoid skin microtrauma.
- Maintain operating room asepsis; ensure positive pressure, 20–60% humidity, and ≥ 20 air changes per hour.

– **Ventilator-Associated Pneumonia:**

- Attempt to avoid intubation using high-flow nasal oxygen or noninvasive positive-pressure ventilation.
- Elevate head of bed to 30–45 degrees.
- Brush teeth daily.
- Use aseptic care for all respiratory equipment; avoid tap water for rinsing.
- Promote earlier extubation: minimize sedation, provide early exercise/mobilization, provide early enteral feeding, assess readiness daily.

– **Catheter-Associated Urinary Tract Infection:**

- Place indwelling catheters only when strictly necessary (e.g., obstruction, not convenience).
- Use aseptic equipment and technique for insertion/instrumentation.
- Minimize urinary tract instrumentation and manipulation of catheter systems; avoid irrigation.
- Reevaluate need for catheter daily.
- Use alternatives: bladder scans, condom catheters, intermittent catheterization.

– **Catheter-Associated Central Line Infections (Table 147-5):**

- Optimize nurse-to-patient ratio.
- Consider alternatives (e.g., peripheral IV, midline catheter).
- Insertion: Use checklist, hand hygiene, maximum sterile barrier precautions, chlorhexidine-alcohol antisepsis, ultrasound guidance, and all-inclusive kits.
- Site selection: Subclavian is least prone; femoral is most prone in ICU.
- Maintenance: Daily chlorhexidine gluconate baths for ICU patients; scrub hub with alcohol; cleanse site with chlorhexidine-based antiseptic every dressing change (minimum every 7 days); use disinfectant caps and chlorhexidine-impregnated dressings; reevaluate need daily.

2. Transmission-Based Precautions:

- **Contact:** Gowns/gloves for *C. auris*, MRSA.
- **Droplet:** Masks for influenza, pertussis.
- **Airborne:** N95 respirators for TB, measles.

3. Prophylaxis & Specific Pathogen Management:

- **C. difficile:** Fidaxomicin (200 mg PO BID) or vancomycin (125 mg PO QID); use bleach-based cleaning for environmental control.

- **Legionnaires disease:** Water management plans; maintain water temperature >60°C and <20°C to prevent *L. pneumophila* growth.
- **TB prophylaxis:** Isoniazid for latent infection.

7.1 Prevention Bundles

- **Hand hygiene compliance:** >95%.
- **VAP prevention:** Head-of-bed elevation (30–45°).
- **ICU management:** Daily sedation interruption and spontaneous breathing trials.

7.2 Transmission-Based Precautions

- **Contact precautions:** Gowns/gloves for *C. auris*, MRSA.
- **Droplet precautions:** Masks for influenza, pertussis.
- **Airborne precautions:** N95 respirators for TB, measles.

7.3 Prophylaxis & Specific Pathogen Management

- **TB prophylaxis:** Isoniazid for latent infection.
- **Legionnaires disease:** Water temperature >60°C and <20°C to prevent *L. pneumophila* growth.
- ***C. difficile*:** Fidaxomicin (200 mg PO BID) or vancomycin (125 mg PO QID).

COMPLICATIONS & PROGNOSIS

- **General HAIs:** Increase morbidity/mortality, especially from antimicrobial-resistant infections.
- ***C. difficile*:** Can progress to toxic megacolon or perforation.
- **VAP:** Increases ICU mortality by 2–3×.
- **Catheter-associated bloodstream infections:** Triple in-hospital death risk.
- **Outbreak Risk:** TB and mpox require isolation to prevent widespread transmission.

SPECIAL POPULATIONS

- **Pandemic preparedness:** Stockpiling PPE, rapid testing infrastructure.
- **Vaccine hesitancy:** Address via public health campaigns.
- **Bioterrorism threats:** ACAM2000 and MVA-BN vaccines for smallpox/mpox.
- **Rabies prophylaxis:** Rabies immune globulin + vaccine for high-risk exposures.

KEY PEARLS & CLINICAL TRAPS

- **Asymptomatic bacteriuria:** Do NOT treat in non-pregnant patients.
- ***C. difficile* hygiene:** Use soap and water, NOT alcohol-based gels for hand hygiene.
- **TB precautions:** Must use N95 respirators or PAPRs.
- **VAP prevention:** 80% attributable to adherence to bundles.
- ***C. auris* control:** Requires bleach-based cleaning for environmental surfaces.
- **HCP Immunizations (Table 147-3):**
 - COVID-19: Non-live, all HCP.
 - Hepatitis B: Non-live or Live; 2-dose (Heplisav-B) or 3-dose series.

- Varicella: Live (2 doses) or Non-live (if no immunization in past 10 years).
- Meningococcal: Men ACWY (every 5 years) and MenB (every 2–3 years).

REFERENCE TABLES

TABLE 147-1

Evidence-Based Bundled Measures to Reduce the Risk of Select Device- and Procedure-Related Infections Prevention of...

- Prevention of Surgical Site Infections
 - Treat active infections prior to surgery Administer prophylactic antibiotics within 1 h before surgery and discontinue immediately after surgery Wear surgical attire that covers hair, mouth, and nose Perform hand hygiene with an antiseptic agent Perform antisepsis of the surgical site with chlorhexidine/alcohol solutions whenever possible If hair must be removed, clip rather than shave (to avoid skin microtrauma) Implement operating room asepsis, minimizing movement into and out of the room Maintain operating room air at positive pressure, with moderate humidity (20–60%) and at least 20 air changes per hour
- Prevention of Ventilator-Associated Pneumonia
 - Attempt to avoid intubation using high-flow nasal oxygen or noninvasive positive-pressure ventilation Elevate head of bed to 30–45 degrees to reduce risk from gastric contents Brush teeth daily Use aseptic care of all respiratory care equipment Avoid use of tap water for rinsing any respiratory care equipment Follow strategies to promote earlier extubation:
 - Minimize sedation
 - Provide early exercise and mobilization
 - Provide early enteral feeding
 - Assess readiness for extubation on a daily basis
- Prevention of Catheter-Associated Urinary Tract Infection
 - Place indwelling catheters only when strictly necessary, e.g., to relieve obstruction, and not for convenience Use aseptic equipment and technique for catheter insertion and urinary tract instrumentation Minimize urinary tract instrumentation Minimize manipulation of or entry into urinary catheter systems, and avoid catheter irrigation Reevaluate daily the need for continued use of an indwelling urinary catheter in each patient Use alternative methods to avoid indwelling catheters, e.g., bladder scans, condom catheters, intermittent catheterization
- Prevention of Catheter-Associated Central Line Infections
 - Optimize nurse-to-patient ratio Consider alternatives to central line (e.g., peripheral IV, midline catheter) Catheter insertion
 - Use a checklist to ensure adherence to insertion bundle
 - Use hand hygiene
 - Use maximum sterile barrier precautions and aseptic technique
 - Use chlorhexidine-alcohol antisepsis to prepare the site
 - Use ultrasound guidance
 - Use an all-inclusive catheter insertion kit
 The subclavian vein is least prone and the femoral vein most prone to infection in the intensive care unit (ICU) setting Catheter maintenance
 - Administer daily chlorhexidine gluconate baths to ICU patients with central lines
 - Scrub the hub with alcohol
 - Cleanse the catheter site with chlorhexidine-based antiseptic with every dressing change, at a minimum every 7 days (earlier if site is soiled or dressing disrupted)
 - Use disinfectant caps
 - Apply chlorhexidine-impregnated dressings
 - Reevaluate daily the need for continued use of each central line in each patient

TABLE 147-2

Diagnostic Stewardship Examples Urine culture

KEY FOCUS AREAS

Urine culture

- Educate clinicians on asymptomatic bacteriuria and appropriate indications to suspect urinary tract infection.
- Require documentation of patient symptoms at the time of urine culture order placement.
- Implement alerts to discourage testing when patient is asymptomatic, with exceptions (pregnancy, urologic procedures, etc.).
- Consider algorithms that incorporate pyuria threshold (>10 white blood cells per high-power field) to proceed to culture in nonneutropenic patients.
- Educate clinicians on appropriate methods for urine collection, storage, and transport for voided and catheterized urine. Avoid collection from the bag or a catheter that has been in place for an extended time.

TABLE 147-3

Health Care Personnel Immunizations

VACCINE	VACCINE TYPE	ELIGIBILITY	RECOMMENDATIONS
COVID-19	Non-live	All HCP	Per latest CDC recommendations
	Non-live	All HCP	
Hepatitis B	Non-live	HCP without serologic evidence of immunity or past infection	Two-dose series (Heplisav-B) or three-dose series (Engerix-B, PreHevbrio, or Recombivax HB)
	Live	HCP without serologic evidence of immunity or past infection	
Varicella	Live	HCP without serologic evidence of immunity, clinician-verified history, or serologic evidence of past infection	Two doses at a 4-week interval
	Non-live	HCP without immunization in past 10 years Pregnant HCP	
Meningococcal	Non-live	Laboratory workers with potential exposure	Men ACWY (booster every 5 years) and MenB (booster at 1 year and every 2–3 years thereafter)

TABLE 147-4

Estimated Risk of Bloodborne Pathogen Transmission from Percutaneous Injury PATHOGEN Hepatitis B a Hepatitis C HIV b a...

PATHOGEN	RISK
Hepatitis Ba	6–30%
HIVb	0.3%