Complete Summary

GUIDELINE TITLE

Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee.

BIBLIOGRAPHIC SOURCE(S)

Sehulster L, Chinn RY. Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC) [Published errata appear in MMWR Recomm Rep 2003 Oct 24;52(42):1025-6]. MMWR Recomm Rep 2003 Jun 6;52(RR-10):1-42. [419 references] PubMed

GUIDELINE STATUS

This is the current release of the guideline.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Infections associated with exposure to environmental pathogens (e.g. *Aspergillus* spp. and *Legionella* spp.) or airborne pathogens (e.g., *Mycobacterium tuberculosis* and varicella zoster virus) in health-care facilities

Recommendations are *not* associated with infections related to noninfectious adverse events (e.g., sick building syndrome), environmental concerns in the home, infection that results from terrorism, or health-care--associated foodborne illness.

GUIDELINE CATEGORY

Evaluation
Management
Prevention
Risk Assessment

CLINICAL SPECIALTY

Infectious Diseases
Preventive Medicine

INTENDED USERS

Allied Health Personnel
Health Care Providers
Hospitals
Public Health Departments

GUIDELINE OBJECTIVE(S)

- To present evidence-based recommendations for environmental infection control in health-care facilities, describing control measures for preventing infections associated with air, water, or other elements of the environment
- To update the following published guidelines and recommendations:
    - Garner JS, Favero, MS. CDC guideline for handwashing and hospital environmental control (Infect Control 1986; 7:231-43). Replaces sections on microbiologic sampling, laundry, infective waste, and housekeeping.
    - Tablan OC, Anderson LJ, Arden NH, et al., Hospital Infection Control Practices Advisory Committee. Guideline for prevention of nosocomial pneumonia. Infect Control Hosp Epidemiol 1994;15:587--627. Updates and expands environmental infection-control information for aspergillosis and Legionnaires disease; online version incorporates Appendices B, C, and D addressing environmental control and detection of Legionella spp.
    - CDC. Guidelines for preventing the transmission of *mycobacterium tuberculosis* in health-care facilities. MMWR 1994;43(No. RR13). Provides supplemental information on engineering controls.
    - CDC. Recommendations for preventing the spread of vancomycin resistance: recommendations of the Hospital Infection Control Practices Advisory Committee (HICPAC). MMWR 1995;44(No. RR12). Supplements environmental infection-control information from the section, Hospitals with Endemic VRE or Continued VRE Transmission.
    - Garner JS, Hospital Infection Control Practices Advisory Committee. Guideline for isolation precautions in hospitals. Infect Control Hosp Epidemiol 1996;17:53--80. Supplements and updates topics in Part II --- Recommendations for Isolation Precautions in Hospitals (linen and laundry, routine and terminal cleaning, airborne precautions).
    - Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR, Hospital Infection Control Practices Advisory Committee. Guideline for prevention of surgical site infection. Infect Control Hosp Epidemiol

1999;4:250--78. Updates operating room ventilation and surface cleaning/disinfection recommendations from the section, Intraoperative Issues: Operating Room Environment.

- U.S. Public Health Service, Infectious Diseases Society of America, Prevention of Opportunistic Infections Working Group. USPHS/IDSA guidelines for the prevention of opportunistic infections in persons infected with human immunodeficiency virus. Infect Dis Obstet Gynecol 2002; 10:3--64. Supplements information regarding patient interaction with pets and animals in the home.
- CDC, Infectious Diseases Society of America, American Society of Blood and Marrow Transplantation. Guidelines for preventing opportunistic infections among hematopoietic stem cell transplant recipients. Cytotherapy 2001;3:41--54. Supplements and updates the section, Hospital Infection Control.

TARGET POPULATION

Populations working or residing in health-care facilities in the United States, including acute-care hospitals, outpatient surgical centers, urgent care centers, clinics, outpatient dialysis centers, physicians´ offices, and skilled nursing facilities.

This guideline is *not* intended for home health care environments.

INTERVENTIONS AND PRACTICES CONSIDERED

Prevention of airborne infections

1. Construction, monitoring, and use of air-handling systems in health-care facilities (e.g., heating, cooling, and ventilation systems and humidity controls) aimed at reducing microbial contamination and spread
2. Measures for infection control during construction, renovation, remediation, repair, and demolition of health-care facilities
3. Infection control and ventilation requirements for protective environment (PE) rooms
4. Infection control and ventilation requirements for airborne infection isolation (AII) rooms
5. Infection control and ventilation requirements for operating rooms
6. Measures to control other potential infectious aerosol hazards in health-care facilities

Prevention of waterborne infections

1. Controlling the spread of waterborne microorganisms
2. Routine prevention of waterborne microbial contamination within the distribution system
3. Remediation strategies for distribution system repair or emergencies
4. Additional engineering measures as indicated by epidemiologic investigation for controlling waterborne, health-care--associated Legionnaires disease
5. General infection-control strategies for preventing Legionnaires disease
6. Preventing Legionnaires disease in protective environments and transplant units

7. Measures for infection control during construction and operation of cooling towers and evaporative condensers
8. Adherence to standards for preparing and processing dialysis water and dialysate
9. Use and maintenance of ice machines and ice to prevent or reduce microbial contamination
10. Use and maintenance of hydrotherapy tanks and pools to prevent or reduce microbial contamination and spread of infection
11. Cleaning, disinfection, maintenance, and use of miscellaneous medical equipment (e.g., endoscopes, bronchoscopes, dental waterlines and equipment) connected to water systems to prevent microbial contamination

Prevention of infection from environmental surfaces

1. Cleaning and disinfecting strategies for environmental surfaces in patient-care areas
2. Cleaning spills of blood and body substances
3. Vacuuming, cleaning, and maintenance of carpeting and cloth furnishings
4. Care and maintenance of flowers and plants in patient-care areas
5. Pest control
6. Cleaning, disinfecting, and other measures to control special pathogens

Environmental sampling

1. General measures for conducting microbiologic sampling
2. Air, water, and environmental surface sampling

Laundry and bedding

1. Employer responsibilities for laundering contaminated garments
2. Maintenance and use of laundry facilities and equipment for contaminated textiles
3. Routine handling of contaminated laundry
4. Laundry process for contaminated textiles and fabrics
5. Microbiologic sampling of textiles
6. Measures to prevent infection in special laundry situations
7. Cleaning, disinfection, and maintenance of mattresses and pillows
8. Cleaning, disinfection, and maintenance of air-fluidized beds

Preventing infection from animals in health-care facilities

1. General infection-control measures for animal encounters
2. Measures to prevent microbial contamination and infection spread from animal-assisted activities and resident animal programs
3. Protective measures for immunocompromised patients
4. Use of service animals in health-care facilities
5. Measures to avoid contamination and infection when animals are treated in human health-care facilities
6. Measures to avoid contamination and infection from research animals in health-care facilities

Regulated Medical Wastes

1. Designation of categories of regulated medical waste
2. Disposal plan for regulated medical wastes
3. Handling, transporting, and storing regulated medical wastes
4. Treatment and disposal of regulated medical wastes
5. Special precautions for wastes generated during care of patients with rare diseases

MAJOR OUTCOMES CONSIDERED

Not stated

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)
Hand-searches of Published Literature (Secondary Sources)
Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Contributors to this report reviewed primarily English-language manuscripts identified from reference searches using the National Library of Medicine's MEDLINE, bibliographies of published articles, and infection-control textbooks.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Not stated

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

These recommendations represent the views of different divisions within Center for Disease Control and Prevention's (CDC's) National Center for Infectious Diseases and the Healthcare Infection Control Practices Advisory Committee (HICPAC), a 12-member group that advises CDC on concerns related to the surveillance, prevention, and control of health-care–associated infections, primarily in U.S. health-care facilities.

Wherever possible, the recommendations in this report are based on data from well-designed scientific studies. However, certain of these studies were conducted by using narrowly defined patient populations or specific health-care settings (e.g., hospitals versus long-term care facilities), making generalization of findings potentially problematic. Construction standards for hospitals or other health-care facilities may not apply to residential home-care units. Similarly, infection-control measures indicated for immunosuppressed patient care are usually not necessary in those facilities where such patients are not present.

Other recommendations were derived from knowledge gained during infectious disease investigations in health-care facilities, where successful termination of the outbreak was often the result of multiple interventions, the majority of which cannot be independently and rigorously evaluated. This is especially true for construction situations involving air or water.

Other recommendations were derived from empiric engineering concepts and may reflect industry standards rather than evidence-based conclusions. Where recommendations refer to guidance from the American Institute of Architects (AIA), the statements reflect standards intended for new construction or renovation. Existing structures and engineered systems are expected to be in continued compliance with those standards in effect at the time of construction or renovation.

Also, in the absence of scientific confirmation, certain infection-control recommendations that cannot be rigorously evaluated are based on strong theoretic rationale and suggestive evidence. Finally, certain recommendations are derived from existing federal regulations.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

The Healthcare Infection Control Practices Advisory Committee (HICPAC) system for categorizing recommendations has been modified to include a category for engineering standards and actions required by state or federal regulations. Guidelines and standards published by the American Institute of Architects (AIA), American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), and the Association for the Advancement of Medical Instrumentation (AAMI) form the basis of certain recommendations. These standards reflect a consensus of expert opinions and extensive consultation with agencies of the U.S. Department of Health and Human Services. Compliance with these standards is usually voluntary. However, state and federal governments often adopt these

standards as regulations. For example, the standards from AIA regarding construction and design of new or renovated health-care facilities, have been adopted by reference by >40 states. Certain recommendations have two category ratings (e.g., Categories IA and IC or Categories IB and IC), indicating the recommendation is evidence-based as well as a standard or regulation.

Rating Categories

Recommendations are rated according to the following categories:

Category IA. Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.

Category IB. Strongly recommended for implementation and supported by certain experimental, clinical, or epidemiologic studies and a strong theoretic rationale.

Category IC. Required by state or federal regulation, or representing an established association standard. (Note: Abbreviations for governing agencies and regulatory citations are listed where appropriate. Recommendations from regulations adopted at state levels are also noted. Recommendations from AIA guidelines cite the appropriate sections of the standards.)

Category II. Suggested for implementation and supported by suggestive clinical or epidemiologic studies, or a theoretic rationale.

Unresolved issue. No recommendation is offered. No consensus or insufficient evidence exists regarding efficacy.

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Not stated

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Definitions for the strength of recommendation grading (IA-IC, II, and Unresolved issue) are provided at the end of the "Major Recommendations" field.

Recommendations - Air

I. **Air-Handling Systems in Health-Care Facilities**

A. Use American Institute of Architects (AIA) guidelines as minimum standards where state or local regulations are not in place for design and construction of ventilation systems in new or renovated health-care facilities. Ensure that existing structures continue to meet the specifications in effect at the time of construction (The American Institute of Architects and The Facilities Guidelines Institute, 2001). **Category IC** (AIA: 1.1.A, 5.4)

B. Monitor ventilation systems in accordance with engineers' and manufacturers' recommendations to ensure preventive engineering, optimal performance for removal of particulates, and elimination of excess moisture (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Arnow et al., 1991; Streifel, 1999; Pittet et al., 1996; US Environmental Protection Agency, Office of Air and Radiation, and US Department of Health and Human Services, National Institute of Occupational Safety and Health, 1991; Rao, Burge, & Chang, 1996; Beck-Sague et al., 1992; Dooley et al., 1992). **Category IB, IC** (AIA: 7.2, 7.31.D, 8.31.D, 9.31.D, 10.31.D, 11.31.D, Environmental Protection Agency [EPA] guidance)

1. Ensure that heating, ventilation, air conditioning (HVAC) filters are properly installed and maintained to prevent air leakages and dust overloads (Arnow et al., 1991; Pittet et al., 1996; Rao, Burge, & Chang, 1996; Sarubbi et al., 1982). **Category IB**
2. Monitor areas with special ventilation requirements (e.g., airborne infection isolation [AII] or protective environment [PE]) for air changes per hour (ACH), filtration, and pressure differentials (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Beck-Sague et al., 1992; Dooley et al., 1992; Streifel, Stevens, & Rhame, 1987; Hansen, 1997; Bartley, "Ventilation," 2000; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Coronado et al., "Transmission," 1993; Coronado et al., "Nosocomial transmission," 1993; Edlin et al., 1992; Fischl et al., 1992; Ikeda et al., 1995; Jarvis, 1993; Jarvis, 1995; Jereb et al., 1995; Moran et al., 1995; Pearson et al., 1992). **Category IB, IC** (AIA: 7.2.C7, 7.2.D6)
    a. Develop and implement a maintenance schedule for ACH, pressure differentials, and filtration efficiencies by using facility-specific data as part of the multidisciplinary risk assessment. Take into account the age and reliability of the system.
    b. Document these parameters, especially the pressure differentials.
3. Engineer humidity controls into the HVAC system and monitor the controls to ensure adequate moisture removal (The American Institute of Architects and The Facilities Guidelines Institute, 2001). **Category IC** (AIA: 7.31.D9)
    a. Locate duct humidifiers upstream from the final filters.
    b. Incorporate a water-removal mechanism into the system.

c. Locate all duct takeoffs sufficiently downstream from the humidifier so that moisture is completely absorbed.

4. Incorporate steam humidifiers, if possible, to reduce potential for microbial proliferation within the system, and avoid use of cool-mist humidifiers. **Category II**
5. Ensure that air intakes and exhaust outlets are located properly in construction of new facilities and renovation of existing facilities (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Centers for Disease Control and Prevention [CDC], 1997). **Category IC** (AIA: 7.31.D3, 8.31.D3, 9.31.D3, 10.31.D3, 11.31.D3)
   a. Locate exhaust outlets >25 ft from air-intake systems.
   b. Locate outdoor air intakes $\geq$6 ft above ground or $\geq$3 ft above roof level.
   c. Locate exhaust outlets from contaminated areas above roof level to minimize recirculation of exhausted air.
6. Maintain air intakes and inspect filters periodically to ensure proper operation (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Hansen, 1997; Bartley, "Ventilation," 2000; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; CDC, 1997). **Category IC** (AIA: 7.31.D8)
7. Bag dust-filled filters immediately upon removal to prevent dispersion of dust and fungal spores during transport within the facility (Pittet et al., 1996; Ko et al., 1998). **Category IB**
   a. Seal or close the bag containing the discarded filter.
   b. Discard spent filters as regular solid waste, regardless of the area from which they were removed (Ko et al., 1998).
8. Remove bird roosts and nests near air intakes to prevent mites and fungal spores from entering the ventilation system (CDC, 1997; Gage et al., 1970; Vargo, Ginsberg, & Mizrahi, 1983). **Category IB**
9. Prevent dust accumulation by cleaning air-duct grilles in accordance with facility-specific procedures and schedules and when rooms are not occupied by patients (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Streifel, Stevens, & Rhame, 1987; Hansen, 1997; Bartley, "Ventilation," 2000; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997). **Category IC, II** (AIA: 7.31.D10)
10. Periodically measure output to monitor system function; clean ventilation ducts as part of routine HVAC maintenance to ensure optimum performance (The American Institute of Architects and The Facilities Guidelines Institute, 2001; National Air Duct Cleaners Association [NADCA], 2002; US Environmental Protection Agency, Office of Pesticide Programs, 2002). **Category IC, II** (AIA: 7.31.D10)

C. Use portable, industrial-grade high efficiency particulate air (HEPA) filter units capable of filtration rates in the range of 300 to 800 ft^3/min to augment removal of respirable particles as needed (Rutala et al., 1995). **Category II**

1. Select portable HEPA filters that can recirculate all or nearly all of the room air and provide the equivalent of ≥12 ACH ("Guidelines," 1994). **Category II**
2. Portable HEPA filter units placed in construction zones can be used later in patient-care areas, provided all internal and external surfaces are cleaned, and the filter replaced or its performance verified by appropriate particle testing. **Category II**
3. Situate portable HEPA units with the advice of facility engineers to ensure that all room air is filtered ("Guidelines," 1994). **Category II**
4. Ensure that fresh-air requirements for the area are met (Rutala et al., 1995; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], "Ventilation," 1999). **Category II**

D. Follow appropriate procedures for use of areas with through-the-wall ventilation units (The American Institute of Architects and The Facilities Guidelines Institute, 2001). **Category IC** (AIA: 8.31.D1, 8.31.D8, 9.31.D23, 10.31.D18, 11.31.D15)
   1. Do not use such areas as PE rooms (The American Institute of Architects and The Facilities Guidelines Institute, 2001). **Category IC** (AIA: 7.2.D3)
   2. Do not use a room with a through-the-wall ventilation unit as an AII room unless it can be demonstrated that all required AII engineering controls are met (The American Institute of Architects and The Facilities Guidelines Institute, 2001; "Guidelines," 1994). **Category IC** (AIA: 7.2.C3)

E. Conduct an infection-control risk assessment (ICRA) and provide an adequate number of AII and PE rooms (if required) or other areas to meet the needs of the patient population (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Arnow et al., 1991; Beck-Sague et al., 1992; Dooley et al., 1992; Coronado et al., "Transmission," 1993; Edlin et al., 1992; Fischl et al., 1992; "Guidelines," 1994; Garner, 1996; "Guidelines," 2000; Flynn et al., 1993; Tabbara & Al Jabarti, 1998; Rhame et al., 1984; Wells, 1955; "Nosocomial transmission," 1991; "Outbreak," 1993). **Category IA, IC** (AIA: 7.2.C, 7.2.D)

F. When ultraviolet germicidal irradiation (UVGI) is used as a supplemental engineering control, install fixtures 1) on the wall near the ceiling or suspended from the ceiling as an upper air unit; 2) in the air-return duct of an AII area; or 3) in designated enclosed areas or booths for sputum induction ("Guidelines," 1994). **Category II**

G. Seal windows in buildings with centralized HVAC systems, including PE areas (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Streifel, 1999; Gerson et al., 1994). **Category IB, IC** (AIA: 7.2.D3)

H. Keep emergency doors and exits from PE rooms closed except during an emergency; equip emergency doors and exits with alarms. **Category II**

I. Develop a contingency plan for backup capacity in the event of a general power failure (Joint Commission on Accreditation of Healthcare Organizations [JCAHO], 2001). **Category IC** (JCAHO: Environment of Care [EC] 1.4)

1. Emphasize restoration of appropriate air quality and ventilation conditions in AII rooms, PE rooms, operating rooms, emergency departments, and intensive care units (The American Institute of Architects and The Facilities Guidelines Institute, 2001; JCAHO, 2001).**Category IC** (AIA: 1.5.A1; JCAHO: EC 1.4)
2. Deploy infection-control procedures to protect occupants until power and systems functions are restored (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Garner, 1996; JCAHO, 2001). **Category IC** (AIA: 5.1, 5.2; JCAHO: EC 1.4)

J. Do not shut down HVAC systems in patient-care areas except for maintenance, repair, testing of emergency backup capacity, or new construction (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Fridkin et al., 1996). **Category IB, IC** (AIA: 5.1, 5.2.B, C)
   1. Coordinate HVAC system maintenance with infection-control staff and relocate immunocompromised patients if necessary (The American Institute of Architects and The Facilities Guidelines Institute, 2001). **Category IC** (AIA: 5.1, 5.2)
   2. Provide backup emergency power and air-handling and pressurization systems to maintain filtration, constant ACH, and pressure differentials in PE rooms, AII rooms, operating rooms, and other critical-care areas (The American Institute of Architects and The Facilities Guidelines Institute, 2001; "Guidelines," 2000; Streifel, 2000). **Category IC** (AIA: 5.1, 5.2)
   3. For areas not served by installed emergency ventilation and backup systems, use portable units and monitor ventilation parameters and patients in those areas (Rutala et al., 1995). **Category II**
   4. Coordinate system startups with infection-control staff to protect patients in PE rooms from bursts of fungal spores (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Streifel, 1999; "Guidelines," 2000; Streifel, 2000). **Category IC** (AIA: 5.1, 5.2)
   5. Allow sufficient time for ACH to clean the air once the system is operational (refer to Table 1 titled "Air changes/hour and time required for airborne contaminant removal efficiencies of 99% and 99.9%" in the original guideline document) (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Rutala et al., 1995). **Category IC** (AIA: 5.1, 5.2)

K. HVAC systems serving offices and administrative areas may be shut down for energy conservation purposes, but the shutdown must not alter or adversely affect pressure differentials maintained in laboratories or critical-care areas with specific ventilation requirements (i.e., PE rooms, AII rooms, operating rooms). **Category II**

L. Whenever possible, avoid inactivating or shutting down the entire HVAC system, especially in acute-care facilities. **Category II**

M. Whenever feasible, design and install fixed backup ventilation systems for new or renovated construction of PE rooms, AII rooms, operating rooms, and other critical-care areas identified by ICRA (The American Institute of Architects and The Facilities Guidelines Institute, 2001). **Category IC** (AIA: 1.5.A1)

II. **Construction, Renovation, Remediation, Repair, and Demolition**

A. Establish a multidisciplinary team that includes infection-control staff to coordinate demolition, construction, and renovation projects and consider proactive preventive measures at the inception; produce and maintain summary statements of the team's activities (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Sarubbi et al., 1982; Hansen, 1997; Bartley, "Ventilation," 2000; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Flynn et al., 1993; Weems et al., 1987; Krasinski et al., 1985; Bartley, "APIC state-of-the-art report," 2000; Walsh & Dixon, 1989). **Category IB, IC** (AIA: 5.1)

B. Educate both the construction team and health-care staff in immunocompromised patient-care areas regarding the airborne infection risks associated with construction projects, dispersal of fungal spores during such activities, and methods to control the dissemination of fungal spores (Hansen, 1997; Bartley, "Ventilation," 2000; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; CDC, 1997; Bartley, "APIC state-of-the-art report," 2000; Johnson et al., 1982; Soumerai et al., 1993; Eisenberg, 1977; Rello et al., 1990; McWhinney et al., 1993). **Category IB**

C. Incorporate mandatory adherence agreements for infection control into construction contracts, with penalties for noncompliance and mechanisms to ensure timely correction of problems (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; CDC, 1997; Bartley, "APIC state-of-the-art report," 2000). **Category IC** (AIA: 5.1)

D. Establish and maintain surveillance for airborne environmental disease (e.g., aspergillosis) as appropriate during construction, renovation, repair, and demolition activities to ensure the health and safety of immunocompromised patients (CDC, 1997; Pannuti et al., 1991; Wingard et al., 1987; Gerson et al., 1984). **Category IB**

1. Using active surveillance, monitor for airborne infections in immunocompromised patients (CDC, 1997; "Guidelines," 2000; Pannuti et al., 1991; Wingard et al., 1987). **Category IB**
2. Periodically review the facility's microbiologic, histopathologic, and postmortem data to identify additional cases (CDC, 1997, "Guidelines," 2000; Pannuti et al., 1991; Wingard et al., 1987). **Category IB**
3. If cases of aspergillosis or other health-care--associated airborne fungal infections occur, aggressively pursue the diagnosis with tissue biopsies and cultures as feasible (Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; CDC, 1997; Bartley, "APIC state-of-the-art report," 2000; Pannuti et al., 1991; Wingard et al., 1987; Gerson et al., 1984). **Category IB**

E. Implement infection-control measures relevant to construction, renovation, maintenance, demolition, and repair (The American Institute of Architects and The Facilities Guidelines Institute, 2001;

Carter & Barr, 1997; Krasinski et al., 1985; Bartley, "APIC state-of-the-art report," 2000; Lentino et al., 1982). **Category IB, IC** (AIA: 5.1, 5.2)

1. Before the project gets under way, perform an ICRA to define the scope of the activity and the need for barrier measures (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Weems et al., 1987; Krasinski et al., 1985; Bartley, "APIC state-of-the-art report," 2000; Lentino et al., 1982). **Category IB, IC** (AIA: 5.1)
    a. Determine if immunocompromised patients may be at risk for exposure to fungal spores from dust generated during the project (Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Weems et al., 1987; Walsh & Dixon, 1989).
    b. Develop a contingency plan to prevent such exposures (Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Weems et al., 1987; Walsh & Dixon, 1989).
2. Implement infection-control measures for external demolition and construction activities (Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Bartley, "APIC state-of-the-art report," 2000; Streifel et al., 1983; Thio et al., 2000). **Category IB**
    a. Determine if the facility can operate temporarily on recirculated air; if feasible, seal off adjacent air intakes.
    b. If this is not possible or practical, check the low-efficiency (roughing) filter banks frequently and replace as needed to avoid buildup of particulates.
    c. Seal windows and reduce wherever possible other sources of outside air intrusion (e.g., open doors in stairwells and corridors), especially in PE areas.
3. Avoid damaging the underground water system (i.e., buried pipes) to prevent soil and dust contamination of the water (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Mermel et al., 1995). **Category IB, IC** (AIA: 5.1)
4. Implement infection-control measures for internal construction activities (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Weems et al., 1987; Krasinski et al., 1985; Bartley, "APIC state-of-the-art report," 2000; Arnow et al., 1978). **Category IB, IC** (AIA: 5.1, 5.2)
    a. Construct barriers to prevent dust from construction areas from entering patient-care areas; ensure that barriers are impermeable to fungal spores and in compliance with local fire codes (The American Institute

of Architects and The Facilities Guidelines Institute, 2001; JCAHO, 2001; Weems et al., 1987; Krasinski et al., 1985; Rello et al., 1990; Kuehn et al., 1995; Mermel et al., 1995; Opal et al., 1986).

b. Seal off and block return air vents if rigid barriers are used for containment (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Carter & Barr, 1997; Bartley, "APIC state-of-the-art report," 2000).

c. Implement dust-control measures on surfaces and divert pedestrian traffic away from work zones (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Weems et al., 1987; Krasinski et al., 1985; Arnow et al., 1978).

d. Relocate patients whose rooms are adjacent to work zones, depending on their immune status, the scope of the project, the potential for generation of dust or water aerosols, and the methods used to control these aerosols (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Arnow et al., 1978; Kuehn et al., 1995).

5. Perform those engineering and work-site related infection-control measures as needed for internal construction, repairs, and renovations (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Weems et al., 1987; Krasinski et al., 1985; Walsh & Dixon, 1989; Arnow et al., 1978; Opal et al., 1986). **Category IB, IC** (AIA: 5.1, 5.2)

a. Ensure proper operation of the air-handling system in the affected area after erection of barriers and before the room or area is set to negative pressure (Tabbara & Al Jabarti, 1998; Streifel, 2000; Bartley, "APIC state-of-the-art report," 2000; Arnow et al., 1978). **Category IB**

b. Create and maintain negative air pressure in work zones adjacent to patient-care areas and ensure that required engineering controls are maintained (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Weems et al., 1987; Krasinski et al., 1985; Walsh & Dixon, 1989; Arnow et al., 1978; Opal et al., 1986).

c. Monitor negative airflow inside rigid barriers (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Association for Professionals in Infection Control and Epidemiology, 1999).

d. Monitor barriers and ensure integrity of the construction barriers; repair gaps or breaks in barrier joints (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Kuehn et al., 1995; Opal et al., 1986; Ottney, 1993).

e. Seal windows in work zones if practical; use window chutes for disposal of large pieces of debris as needed, but ensure that the negative pressure differential for the area is maintained (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Bartley,

"Construction and renovation," 2000; Weems et al., 1987).

f. Direct pedestrian traffic from construction zones away from patient-care areas to minimize dispersion of dust (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Gerson et al., 1994; Weems et al., 1987; Krasinski et al., 1985; Bartley, "APIC state-of-the-art report," 2000; Walsh & Dixon, 1989; Arnow et al., 1978).

g. Provide construction crews with 1) designated entrances, corridors, and elevators wherever practical; 2) essential services (e.g., toilet facilities) and convenience services (e.g., vending machines); 3) protective clothing (e.g., coveralls, footgear, and headgear) for travel to patient-care areas; and 4) a space or anteroom for changing clothing and storing equipment (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Bartley, "APIC state-of-the-art report," 2000).

h. Clean work zones and their entrances daily by 1) wet-wiping tools and tool carts before their removal from the work zone; 2) placing mats with tacky surfaces inside the entrance; and 3) covering debris and securing this covering before removing debris from the work zone (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; Bartley, "APIC state-of-the-art report," 2000).

i. In patient-care areas, for major repairs that include removal of ceiling tiles and disruption of the space above the false ceiling, use plastic sheets or prefabricated plastic units to contain dust; use a negative pressure system within this enclosure to remove dust; and either pass air through an industrial-grade, portable HEPA filter capable of filtration rates of 300 to 800 ft^3/min., or exhaust air directly to the outside (Carter & Barr, 1997; Bartley, "APIC state-of-the-art report," 2000; Arnow et al., 1978; Association for Professionals in Infection Control and Epidemiology, 1999; Finkelstein & Mendelson, 1997).

j. Upon completion of the project, clean the work zone according to facility procedures, and install barrier curtains to contain dust and debris before removing rigid barriers (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter &

Barr, 1997; Weems et al., 1987; Krasinski et al., 1985; Bartley, "APIC state-of-the-art report," 2000).

k. Flush the water system to clear sediment from pipes to minimize waterborne microorganism proliferation (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Mermel et al., 1995).

l. Restore appropriate ACH, humidity, and pressure differential; clean or replace air filters; dispose of spent filters (Streifel, 1999; Pittet et al., 1996; Ko et al., 1998; Streifel, 2000).

F. Use airborne-particle sampling as a tool to evaluate barrier integrity (Streifel, 1999; Overberger, Wadowsky, & Schaper, 1995). **Category II**

G. Commission the HVAC system for newly constructed health-care facilities and renovated spaces before occupancy and use, with emphasis on ensuring proper ventilation for operating rooms, AII rooms, and PE areas (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Overberger, Wadowsky, & Schaper, 1995; Streifel & Marshall, 1998; American Society of Heating, Refrigerating, and Air-Conditioning Engineers [ASHRAE], 1996). **Category IC** (AIA: 5.1; ASHRAE: 1-1996)

H. No recommendation is offered regarding routine microbiologic air sampling before, during, or after construction, or before or during occupancy of areas housing immunocompromised patients (Sarubbi et al., 1982; Weems et al., 1987; Krasinski et al., 1985; Walsh & Dixon, 1989; Arnow et al., 1978; Morey & Williams, 1990; Aisner et al., 1979). **Unresolved issue**

I. If a case of health-care--acquired aspergillosis or other opportunistic environmental airborne fungal disease occurs during or immediately after construction, implement appropriate follow-up measures (Rhame et al., 1984; Weems et al., 1987; McCarty et al., 1986; Klimowski, Rotstein, & Cummings, 1989; Pfundstein, 1997; Rhame et al., 1985). **Category IB**

1. Review pressure-differential monitoring documentation to verify that pressure differentials in the construction zone and in PE rooms are appropriate for their settings (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Rhame et al., 1984; Rhame et al., 1985). **Category IB, IC** (AIA: 5.1)
2. Implement corrective engineering measures to restore proper pressure differentials as needed (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Rhame et al., 1984; Rhame et al., 1985). **Category IB, IC** (AIA: 5.1)
3. Conduct a prospective search for additional cases and intensify retrospective epidemiologic review of the hospital's medical and laboratory records (CDC, 1997; Weems et al., 1987; Klimowski, Rotstein, & Cummings, 1989; Walmsley et al., 1993; Kyriakides et al., 1976). **Category IB**
4. If no epidemiologic evidence of ongoing transmission exists, continue routine maintenance in the area to prevent health-care–acquired fungal disease (CDC, 1997; McCarty et al., 1986). **Category IB**

J. If epidemiologic evidence exists of ongoing transmission of fungal disease, conduct an environmental assessment to find and eliminate the source (Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; CDC, 1997; Gerson et al., 1994; Krasinski et al., 1985; Bartley, "APIC state-of-the-art report," 2000; Walsh & Dixon, 1989; Lentino et al., 1982; Abzug et al., 1992). **Category IB**

1. Collect environmental samples from potential sources of airborne fungal spores, preferably by using a high-volume air sampler rather than settle plates (Arnow et al., 1991; Pittet et al., 1996; Hansen, 1997; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; CDC, 1997; Gerson et al., 1994; Krasinski et al., 1985; Bartley, "APIC state-of-the-art report," 2000; Arnow et al., 1978; Kuehn et al., 1995; Abzug et al., 1992; Sherertz et al., 1987; Aisner et al., 1976; Fox et al., 1990; Barnes & Rogers, 1989; Leenders et al., 1996). **Category IB**
2. If either an environmental source of airborne fungi or an engineering problem with filtration or pressure differentials is identified, promptly perform corrective measures to eliminate the source and route of entry (Krasinski et al., 1985; Lentino et al., 1982). **Category IB**
3. Use an Environmental Protection Agency (EPA)-registered antifungal biocide (e.g., copper-8-quinolinolate) for decontaminating structural materials (Carter & Barr, 1997; Streifel et al., 1983; Opal et al., 1986; Yeager, 1991). **Category IB**
4. If an environmental source of airborne fungi is not identified, review infection-control measures, including engineering controls, to identify potential areas for correction or improvement (Allo et al., 1987; Schleupner & Hamilton, 1980). **Category IB**
5. If possible, perform molecular subtyping of *Aspergillus* spp. isolated from patients and the environment to compare their strain identities (Denning et al., 1990; James et al., 2000; Skladny et al., 1999; Symoens et al., 2000; Diaz-Guerra et al., 2000). **Category II**

K. If air-supply systems to high-risk areas (e.g., PE rooms) are not optimal, use portable, industrial-grade HEPA filters on a temporary basis until rooms with optimal air-handling systems become available (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Bartley, "Construction and renovation," 2000; Harvey, 1998; Infection Control Focus Group, 1998; Carter & Barr, 1997; CDC, 1997; Bartley, "APIC state-of-the-art report," 2000). **Category II**

III. **Infection Control and Ventilation Requirements for PE rooms**

A. Minimize exposures of severely immunocompromised patients (e.g., solid-organ transplant patients or allogeneic neutropenic patients) to activities that might cause aerosolization of fungal spores (e.g., vacuuming or disruption of ceiling tiles) ("Guidelines," 2000; Weems et al., 1987; Walsh & Dixon, 1989; Morey & Williams, 1990). **Category IB**

B. Minimize the length of time that immunocompromised patients in PE are outside their rooms for diagnostic procedures and other activities ("Guidelines," 2000; Thio et al., 2000). **Category IB**

C. Provide respiratory protection for severely immunocompromised patients when they must leave PE for diagnostic procedures and other activities; consult the most recent revision of the CDC's *Guideline for Prevention of Health-Care--Associated Pneumonia* for information regarding the appropriate type of respiratory protection. (CDC, 1997; "Guidelines," 2000). **Category II**

D. Incorporate ventilation engineering specifications and dust-controlling processes into the planning and construction of new PE units (refer to Figure 1 titled "Example of positive-pressure room control for protection from airborne environmental microbes" in the original guideline document). **Category IB, IC**

1. Install central or point-of-use HEPA filters for supply (incoming) air (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Arnow et al., 1991; CDC, 1997; Weems et al., 1987; McWhinney et al., 1993; Overberger, Wadowsky, & Schaper, 1995; Kyriakides et al., 1976; Sherertz et al., 1987; Barnes & Rogers, 1989; Siegler & Kennedy, 1999; Breton et al., 1998; Guarro et al., 2000; Burton et al., 1972; Buckner et al., 1978; Murray et al., 1988; "Control of airborne fungal spores," 1989; Rhame, 1986). **Category IB, IC** (AIA: 5.1, 5.2, 7.2.D)
2. Ensure that rooms are well-sealed by 1) properly constructing windows, doors, and intake and exhaust ports; 2) maintaining ceilings that are smooth and free of fissures, open joints, and crevices; 3) sealing walls above and below the ceiling; and 4) monitoring for leakage and making any necessary repairs (The American Institute of Architects and The Facilities Guidelines Institute, 2001; CDC, 1997; Gerson et al., 1994; Murray et al., 1988; "Control of airborne fungal spores," 1989). **Category IB, IC** (AIA: 7.2.D3)
3. Ventilate the room to maintain $\geq$12 ACH (The American Institute of Architects and The Facilities Guidelines Institute, 2001; CDC, 1997; "Guidelines," 2000; Murray et al., 1988; "Control of airborne fungal spores," 1989; ASHRAE, "1999 handbook," 1999). **Category IC** (AIA: 7.2.D)
4. Locate air supply and exhaust grilles so that clean, filtered air enters from one side of the room, flows across the patient's bed, and exits from the opposite side of the room (The American Institute of Architects and The Facilities Guidelines Institute, 2001; CDC, 1997; Murray et al., 1988; "Control of airborne fungal spores," 1989). **Category IC** (AIA: 7.31.D1)
5. Maintain positive room air pressure ($\geq$2.5 Pa [0.01-inch water gauge]) in relation to the corridor (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Streifel, 1999; CDC, 1997; Murray et al., 1988; "Control of airborne fungal spores," 1989). **Category IB, IC** (AIA: Table 7.2)
6. Maintain airflow patterns and monitor these on a daily basis by using permanently installed visual means of detecting airflow in new or renovated construction, or by using other visual methods (e.g., flutter strips or smoke tubes) in existing PE

units. Document the monitoring results (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Bartley, "Construction and renovation," 2000). **Category IC** (AIA: 7.2.D6)

7. Install self-closing devices on all room exit doors in PE rooms (The American Institute of Architects and The Facilities Guidelines Institute, 2001). **Category IC** (AIA: 7.2.D4)

E. Do not use laminar air flow systems in newly constructed PE rooms (Buckner et al., 1978; "Control of airborne fungal spores," 1989). **Category II**

F. Take measures to protect immunocompromised patients who would benefit from a PE room and who also have an airborne infectious disease (e.g., acute varicella zoster virus [VZV] infection or tuberculosis).

1. Ensure that the patient's room is designed to maintain positive pressure.
2. Use an anteroom to ensure appropriate air-balance relationships and provide independent exhaust of contaminated air to the outside, or place a HEPA filter in the exhaust duct if the return air must be recirculated (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Murray et al., 1988) (refer to Figure 2 titled "Example of airborne infection isolation [AII] room with anteroom and neutral anteroom"). **Category IC** (AIA: 7.2.D1, A7.2.D)
3. If an anteroom is not available, place the patient in AII and use portable, industrial-grade HEPA filters to enhance filtration of spores in the room (Rutala et al., 1995). **Category II**

G. Maintain backup ventilation equipment (e.g., portable units for fans or filters) for emergency provision of required ventilation for PE areas and take immediate steps to restore the fixed ventilation system (The American Institute of Architects and The Facilities Guidelines Institute, 2001; "Guidelines," 2000; Streifel, 2000). **Category IC** (AIA: 5.1)

IV. Infection-Control and Ventilation Requirements for AII Rooms

A. Incorporate certain specifications into the planning and construction or renovation of AII units (The American Institute of Architects and The Facilities Guidelines Institute, 2001; "Guidelines," 1994; Murray et al., 1988; "Control of airborne fungal spores," 1989; Mahoney et al., 1979) (refer to Figure 3 "Example of negative-pressure room control for airborne infection isolation" in the original guideline document). **Category IB, IC**

1. Maintain continuous negative air pressure (2.5 Pa [0.01 inch water gauge]) in relation to the air pressure in the corridor; monitor air pressure periodically, preferably daily, with audible manometers or smoke tubes at the door (for existing AII rooms), or with a permanently installed visual monitoring mechanism. Document the results of monitoring (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Murray et al., 1988; "Control of airborne fungal spores," 1989). **Category IC** (AIA: 7.2.C7, Table 7.2)
2. Ensure that rooms are well-sealed by properly constructing windows, doors, and air-intake and exhaust ports; when monitoring indicates air leakage, locate the leak and make necessary repairs (The American Institute of Architects and The

Facilities Guidelines Institute, 2001; Buckner et al., 1978; Murray et al., 1988). **Category IB, IC** (AIA: 7.2.C3)

3. Install self-closing devices on all AII room exit doors (The American Institute of Architects and The Facilities Guidelines Institute, 2001). **Category IC** (AIA: 7.2.C4)
4. Provide ventilation to ensure $\geq$12 ACH for renovated rooms and new rooms, and $\geq$6 ACH for existing AII rooms (The American Institute of Architects and The Facilities Guidelines Institute, 2001; "Guidelines," 1994; Mahoney et al., 1979). **Category IB, IC** (AIA: Table 7.2)
5. Direct exhaust air to the outside, away from air-intake and populated areas. If this is not practical, air from the room can be recirculated after passing through a HEPA filter (The American Institute of Architects and The Facilities Guidelines Institute, 2001; "Guidelines," 1994). **Category IC** (AIA: Table 7.2)

B. Where supplemental engineering controls for air cleaning are indicated from a risk assessment of the AII area, install UVGI units in the exhaust air ducts of the HVAC system to supplement HEPA filtration or install UVGI fixtures on or near the ceiling to irradiate upper room air ("Guidelines," 1994). **Category II**

C. Implement environmental infection-control measures for persons with diagnosed or suspected airborne infectious diseases.
   1. Use AII rooms for patients with or suspected of having an airborne infection who also require cough-inducing procedures, or use an enclosed booth that is engineered to provide 1) $\geq$12 ACH; 2) air supply and exhaust rate sufficient to maintain a 2.5 Pa (0.01-inch water gauge) negative pressure difference with respect to all surrounding spaces with an exhaust rate of $\geq$50 ft^3/min; and 3) air exhausted directly outside away from air intakes and traffic or exhausted after HEPA filtration before recirculation (The American Institute of Architects and The Facilities Guidelines Institute, 2001; "Guidelines," 1994; Ehrenkranz & Kicklighter, 1972; Calder et al., 1991; Jereb et al., 1993). **Category IB, IC** (AIA: 7.15.E, 7.31.D23, 9.10, Table 7.2)
   2. Although airborne spread of viral hemorrhagic fever (VHF) has not been documented in a health-care setting, prudence dictates placing a VHF patient in an AII room, preferably with an anteroom, to reduce the risk of occupational exposure to aerosolized infectious material in blood, vomitus, liquid stool, and respiratory secretions present in large amounts during the end stage of a patient's illness (Monath, 1991; "Update," 1995; Weber & Rutala, 2001). **Category II**
      a. If an anteroom is not available, use portable, industrial-grade HEPA filters in the patient's room to provide additional ACH equivalents for removing airborne particulates.
      b. Ensure that health-care workers wear face shields or goggles with appropriate respirators when entering the rooms of VHF patients with prominent cough, vomiting, diarrhea, or hemorrhage ("Update," 1995).

3. Place smallpox patients in negative pressure rooms at the onset of their illness, preferably using a room with an anteroom, if available (Garner, 1996). **Category II**

D. No recommendation is offered regarding negative pressure or isolation for patients with *Pneumocystis carinii* pneumonia (Gerberding, 1998; Vargas et al., 2000; Walzer, 2000). **Unresolved issue**.

E. Maintain backup ventilation equipment (e.g., portable units for fans or filters) for emergency provision of ventilation requirements for AII rooms, and take immediate steps to restore the fixed ventilation system (The American Institute of Architects and The Facilities Guidelines Institute, 2001; "Guidelines," 1994; Streifel, 2000). **Category IC** (AIA: 5.1)

V. **Infection-Control and Ventilation Requirements for Operating Rooms**

A. Implement environmental infection-control and ventilation measures for operating rooms.

1. Maintain positive-pressure ventilation with respect to corridors and adjacent areas (The American Institute of Architects and The Facilities Guidelines Institute, 2001; CDC, "Guideline," 1999; Lidwell, 1986). **Category IB, IC** (AIA: Table 7.2)
2. Maintain $\geq$15 ACH, of which $\geq$3 ACH should be fresh air (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Nichols, 1992; Clark et al., 1985). **Category IC** (AIA: Table 7.2)
3. Filter all recirculated and fresh air through the appropriate filters, providing 90% efficiency (dust-spot testing) at a minimum (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Babb, Lynam, & Ayliffe, 1995). **Category IC** (AIA: Table 7.3)
4. In rooms not engineered for horizontal laminar airflow, introduce air at the ceiling and exhaust air near the floor (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Lidwell, 1986; Laufman, 1986). **Category IC** (AIA: 7.31.D4)
5. Do not use ultraviolet (UV) lights to prevent surgical-site infections (Lidwell, 1986; B´erard & Gandon, 1964; Charnley, 1964; Lidwell et al., 1982; Hill et al., 1981; Ha´eri & Wiley, 1980; Collis & Steinhaus, 1976; Taylor, Bannister, & Leeming, 1995). **Category IB**
6. Keep operating room doors closed except for the passage of equipment, personnel, and patients, and limit entry to essential personnel (Ayliffe, 1991; Choux et al., 1992). **Category IB**

B. Follow precautionary procedures for infectious tuberculosis (TB) patients who also require emergency surgery ("Guidelines," 1994; "Respiratory protection," 1998; Langevin, Rand, & Layton, 1999). **Category IB, IC**

1. Use an N95 respirator approved by the National Institute for Occupational Safety and Health without exhalation valves in the operating room ("Respiratory protection," 1998; "Occupational exposure to tuberculosis," 1997). **Category IC** (Occupational Safety and Health Administration [OSHA]; 29 Code of Federal Regulations [CFR] 1910.134,139)
2. Intubate the patient in either the AII room or the operating room; if intubating the patient in the operating room, do not

allow the doors to open until 99% of the airborne contaminants are removed (refer to Table 1 titled "Air changes/hour and time required for airborne-contaminant removal efficiencies of 99% and 99.9%" in the original guideline document) ("Guidelines," 1994; Clark et al., 1985). **Category IB**

3. When anesthetizing a patient with confirmed or suspected TB, place a bacterial filter between the anesthesia circuit and patient's airway to prevent contamination of anesthesia equipment or discharge of tubercle bacilli into the ambient air (Langevin, Rand, & Layton, 1999; Aranha-Creado et al., 1997). **Category IB**
4. Extubate and allow the patient to recover in an AII room ("Guidelines," 1994; Clark et al., 1985). **Category IB**
5. If the patient has to be extubated in the operating room, allow adequate time for ACH to clean 99% of airborne particles from the air (refer to Table 1 titled "Air changes/hour and time required for airborne-contaminant removal efficiencies of 99% and 99.9%" in the original guideline document), because extubation is a cough-producing procedure ("Guidelines," 1994; Clark et al., 1985). **Category IB**

C. Use portable, industrial-grade HEPA filters temporarily for supplemental air cleaning during intubation and extubation for TB patients who require surgery (Rutala et al., 1995; "Guidelines," 1994; Clark et al., 1985). **Category II**

1. Position the units appropriately so that all room air passes through the filter; obtain engineering consultation to determine the appropriate placements ("Guidelines," 1994). **Category II**
2. Switch the portable unit off during the surgical procedure. **Category II**
3. Provide fresh air as per ventilation standards for operating rooms; portable units do not meet the requirements for the number of fresh ACH (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Rutala et al., 1995; Burroughs, 1997). **Category II**

D. If possible, schedule TB patients as the last surgical cases of the day to maximize the time available for removal of airborne contamination. **Category II**

E. No recommendation is offered for performing orthopedic implant operations in rooms supplied with laminar airflow (Babb, Lynam, & Ayliffe, 1995; B'erard & Gandon, 1964). **Unresolved issue**

F. Maintain backup ventilation equipment (e.g., portable units for fans or filters) for emergency ventilation of operating rooms, and take immediate steps to restore the fixed ventilation system (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Streifel, 2000; "Occupational exposure to tuberculosis," 1997; Anderson et al., 1996). **Category IB, IC** (AIA: 5.1)

VI. Other Potential Infectious Aerosol Hazards in Health-Care Facilities

A. In settings where surgical lasers are used, wear appropriate personal protective equipment (PPE), including N95 or N100 respirators, to minimize exposure to laser plumes ("Respiratory protection," 1998; National Institute for Occupational Safety and Health, 1996; "Recommended practices," 1998). **Category IC** (OSHA; 29 CFR 1910.134,139)

B. Use central wall suction units with in-line filters to evacuate minimal laser plumes (National Institute for Occupational Safety and Health, 1996; "Recommended practices," 1998; Hughes & Hughes, 1998; Capizzi, Clay, & Battey, 1998). **Category II**

C. Use a mechanical smoke evacuation system with a high-efficiency filter to manage the generation of large amounts of laser plume, when ablating tissue infected with human papilloma virus (HPV) or performing procedures on a patient with extrapulmonary TB ("Guidelines," 1994; "Recommended practices," 1998; Hughes & Hughes, 1998; "Surgical smoke," 1997; "Surgical smoke," 1999; "Stationary surgical smoke," 2001). **Category II**

Recommendations – Water

I. **Controlling the Spread of Waterborne Microorganisms**

A. Practice hand hygiene to prevent the hand transfer of waterborne pathogens, and use barrier precautions (e.g., gloves) as defined by other guidelines (Garner, 1996; Villarino et al., 1992; Seifert, Strate, & Pulverer, 1995; Yu, 1979; Go et al., 1994; Boyce & Pittet, 2002). **Category IA**

B. Eliminate contaminated water or fluid environmental reservoirs (e.g., in equipment or solutions) wherever possible (Villarino et al., 1992; Burdge, Nakielna, & Noble, 1993). **Category IB**

C. Clean and disinfect sinks and wash basins on a regular basis by using an EPA-registered product as set by facility policies. **Category II**

D. Evaluate for possible environmental sources (e.g., potable water) of specimen contamination when waterborne microorganisms (e.g., nontuberculous mycobacteria [NTM]) of unlikely clinical importance are isolated from clinical cultures (e.g., specimens collected aseptically from sterile sites or, if postprocedural, colonization after use of tap water in patient care) (Cox, deBorja, & Bach, 1997; Hoy, Rolston, & Hopfer, 1987; Stine et al., 1987; Bennett et al., 1994). **Category IB**

E. Avoid placing decorative fountains and fish tanks in patient-care areas; ensure disinfection and fountain maintenance if decorative fountains are used in public areas of the health-care facility (Hlady et al., 1993). **Category IB**

II. **Routine Prevention of Waterborne Microbial Contamination Within the Distribution System**

A. Maintain hot water temperature at the return at the highest temperature allowable by state regulations or codes, preferably $\geq$124 degrees F ($\geq$51 degrees C), and maintain cold water temperature at <68 degrees F (<20 degrees C) (CDC, 1997; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000). **Category IC** (States; ASHRAE: 12:2000)

B. If the hot water temperature can be maintained at $\geq$124 degrees F ($\geq$51 degrees C), explore engineering options (e.g., installing preset thermostatic valves in point-of-use fixtures) to help minimize the risk of scalding (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000). **Category II**

C. When state regulations or codes do not allow hot water temperatures above the range of 105 to 120 degrees F (40.6 to 49 degrees C) for hospitals or 95 to 110 degrees F (35 to 43.3 degrees C) for nursing

care facilities or when buildings cannot be retrofitted for thermostatic mixing valves, follow either of these alternative preventive measures to minimize the growth of *Legionella* spp. in water systems. **Category II**

1. Periodically increase the hot water temperature to ≥150 degree F (≥66 degrees C) at the point of use (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000). **Category II**
2. Alternatively, chlorinate the water and then flush it through the system (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Snyder et al., 1990; Ezzeddine et al., 1989). **Category II**

D. Maintain constant recirculation in hot-water distribution systems serving patient-care areas (The American Institute of Architects and The Facilities Guidelines Institute, 2001). **Category IC** (AIA: 7.31.E.3)

III. **Remediation Strategies for Distribution System Repair or Emergencies**

A. Whenever possible, disconnect the ice machine before planned water disruptions. **Category II**

B. Prepare a contingency plan to estimate water demands for the entire facility in advance of significant water disruptions (i.e., those expected to result in extensive and heavy microbial or chemical contamination of the potable water), sewage intrusion, or flooding (Joint Commission on Accreditation of Healthcare Organizations [JCAHO], 2001; Joint Commission on Accreditation of Healthcare Organizations [JCAHO], 2000). **Category IC** (JCAHO: EC 1.4)

C. When a significant water disruption or an emergency occurs, adhere to any advisory to boil water issued by the municipal water utility (Juranek et al., 1995). **Category IB, IC** (Municipal order)

1. Alert patients, families, staff, and visitors not to consume water from drinking fountains, ice, or drinks made from municipal tap water, while the advisory is in effect, unless the water has been disinfected (e.g., by bringing to a rolling boil for ≥1 minute) (Juranek et al., 1995). **Category IB, IC** (Municipal order)
2. After the advisory is lifted, run faucets and drinking fountains at full flow for ≥5minutes, or use high-temperature water flushing or chlorination (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Juranek et al., 1995). **Category IC, II** (Municipal order; ASHRAE: 12:2000)

D. Maintain a high level of surveillance for waterborne disease among patients after a boil water advisory is lifted. **Category II**

E. Corrective decontamination of the hot water system might be necessary after a disruption in service or a cross-connection with sewer lines has occurred.

1. Decontaminate the system when the fewest occupants are present in the building (e.g., nights or weekends) (CDC, 1997; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000). **Category IC** (ASHRAE: 12:2000)
2. If using high-temperature decontamination, raise the hot-water temperature to 160 to 170 degrees F (71 to 77 degrees C) and maintain that level while progressively flushing each outlet

around the system for ≥5 minutes (CDC, 1997; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000). **Category IC** (ASHRAE: 12:2000)

3. If using chlorination, add enough chlorine, preferably overnight, to achieve a free chlorine residual of ≥2 mg/L (≥2 ppm) throughout the system (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000). **Category IC** (ASHRAE: 12:2000)
    a. Flush each outlet until chlorine odor is detected.
    b. Maintain the elevated chlorine concentration in the system for ≥2 (but ≤24 hrs).
4. Use a thorough flushing of the water system instead of chlorination if a highly chlorine-resistant microorganism (e.g., *Cryptosporidium* spp.) is suspected as the water contaminant. **Category II**

F. Flush and restart equipment and fixtures according to manufacturer's instructions. **Category II**

G. Change the pretreatment filter and disinfect the dialysis water system with an EPA-registered product to prevent colonization of the reverse osmosis membrane and downstream microbial contamination (Tokars et al., 2000). **Category II**

H. Run water softeners through a regeneration cycle to restore their capacity and function. **Category II**

I. If the facility has a water-holding reservoir or water-storage tank, consult the facility engineer or local health department to determine whether this equipment needs to be drained, disinfected with an EPA-registered product, and refilled. **Category II**

J. Implement facility procedures to manage a sewage system failure or flooding (e.g., arranging with other health-care facilities for temporary transfer of patients or provision of services), and establish communications with the local municipal water utility and the local health department to ensure that advisories are received in a timely manner after release (Joint Commission on Accreditation of Healthcare Organizations [JCAHO], 2001; Joint Commission on Accreditation of Healthcare Organizations [JCAHO], 2000). **Category IC** (JCAHO: EC 1.4; Municipal order)

K. Implement infection-control measures during sewage intrusion, flooding, or other water-related emergencies.
    1. Relocate patients and clean or sterilize supplies from affected areas. **Category II**
    2. If hands are not visibly soiled or contaminated with proteinaceous material, include an alcohol-based hand rub in the hand hygiene process 1) before performing invasive procedures; 2) before and after each patient contact; and 3) whenever hand hygiene is indicated (Boyce & Pittet, 2002). **Category II**
    3. If hands are visibly soiled or contaminated with proteinaceous material, use soap and bottled water for handwashing (Boyce & Pittet, 2002). **Category II**
    4. If the potable water system is not affected by flooding or sewage contamination, process surgical instruments for sterilization according to standard procedures. **Category II**

5. Contact the manufacturer of the automated endoscope reprocessor (AER) for specific instructions on the use of this equipment during a water advisory. **Category II**

L. Remediate the facility after sewage intrusion, flooding, or other water-related emergencies.
   1. Close off affected areas during cleanup procedures. **Category II**
   2. Ensure that the sewage system is fully functional before beginning remediation so contaminated solids and standing water can be removed. **Category II**
   3. If hard-surfaced equipment, floors, and walls remain in good repair, ensure that these are dry within 72 hours; clean with detergent according to standard cleaning procedures. **Category II**
   4. Clean wood furniture and materials (if still in good repair); allow them to dry thoroughly before restoring varnish or other surface coatings. **Category II**
   5. Contain dust and debris during remediation and repair as outlined in air recommendations (Air: IIG 4, 5). **Category II**

M. Regardless of the original source of water damage (e.g., flooding versus water leaks from point-of-use fixtures or roofs), remove wet, absorbent structural items (e.g., carpeting, wallboard, and wallpaper) and cloth furnishings if they cannot be easily and thoroughly cleaned and dried within 72 hours (e.g., moisture content $\leq$20% as determined by moisture meter readings); replace with new materials as soon as the underlying structure is declared by the facility engineer to be thoroughly dry (Arnow et al., 1991; Streifel, 2000; Vujanovic, Smoragiewicz, & Krzysztyniak, 2001; Vesper et al., 2000). **Category IB**

IV. **Additional Engineering Measures as Indicated by Epidemiologic Investigation for Controlling Waterborne, Health-Care--Associated Legionnaires Disease**

A. When using a pulse or one-time decontamination method, superheat the water by flushing each outlet for $\geq$5 minutes with water at 160 to 170 degrees F (71 to 77 degrees C) or hyperchlorinate the system by flushing all outlets for $\geq$5 minutes with water containing $\geq$2 mg/L ($\geq$2 ppm) free residual chlorine using a chlorine-based product registered by the EPA for water treatment (e.g., sodium hypochlorite [chlorine bleach]) (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Ezzeddine et al., 1989; Best et al., 1983; Meenhorst et al., 1985; Johnston et al., 1987; Muraca, Yu, & Goetz, 1990). **Category IB**

B. After a pulse treatment, maintain both the heated water temperature at the return and the cold water temperature per the recommendation (Water: II A) wherever practical and permitted by state codes, or chlorinate heated water to achieve 1 to 2 mg/L (1--2 ppm) free residual chlorine at the tap by using a chlorine-based product registered by the EPA for water treatment (e.g., sodium hypochlorite [bleach]) (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Johnson et al., 1985; Marrie et al., "Nosocomial legionnaires' disease," 1991; Marrie et al., 1992; Department of Health and Social Security and the Welsh Office, 1991; Helms et al., 1988). **Category IC** (States; ASHRAE: 12:2000)

C. Explore engineering or educational options (e.g., install preset thermostatic mixing valves in point-of-use fixtures or post warning signs at each outlet) to minimize the risk of scalding for patients, visitors, and staff. **Category II**

D. No recommendation is offered for treating water in the facility's distribution system with chlorine dioxide, heavy-metal ions (e.g., copper or silver), monochloramines, ozone, or ultraviolet (UV) light (Edelstein et al., 1982; Muraca, Stout, & Yu, 1987; Domingue et al., 1988; Landeen, Yahya, & Gerba, 1989; Matulonis, Rosenfeld, & Shadduck, 1993; Liu et al., 1994; Margolin, 1997; Freije, 1996; Lin et al., 1998; Biurrun et al., 1999; Goetz & Yu, 1997; Stout et al., 1998; Walker et al., 1995; Hambidge, 2001; Rohr et al., 1999; Cunliffe, 1990; Kirmeyer et al., 1993; Kool, Carpenter, & Fields, 1999; Kool et al., 1999). **Unresolved issue**

V. General Infection-Control Strategies for Preventing Legionnaires Disease

A. Conduct an infection-control risk assessment of the facility to determine if patients at risk or severely immunocompromised patients are present (CDC, 1997; Kool et al., 1998; Le Saux et al., 1989). **Category IB**

B. Implement general strategies for detecting and preventing Legionnaires disease in facilities that do not provide care for severely immunocompromised patients (i.e., facilities that do not have hematopoietic stem cell transplant [HSCT] or solid-organ transplant programs) (see Appendix in the original guideline document) (CDC, 1997; Kool et al., 1998; Le Saux et al., 1989). **Category IB**

1. Establish a surveillance process to detect health-care--associated Legionnaires disease (CDC, 1997; Kool et al., 1998; Le Saux et al., 1989). **Category IB**
2. Inform health-care personnel (e.g., infection control, physicians, patient-care staff, engineering) regarding the potential for Legionnaires disease to occur and measures to prevent and control health-care--associated legionellosis (Marrie et al., "Nosocomial legionnaires' disease," 1991; Kugler et al., 1983). **Category IB**
3. Establish mechanisms to provide clinicians with laboratory tests (e.g., culture, urine antigen, direct fluorescence assay [DFA], and serology) for the diagnosis of Legionnaires disease (CDC, 1997; Kool et al., 1998). **Category IB**

C. Maintain a high index of suspicion for health-care--associated Legionnaires disease, and perform laboratory diagnostic tests for legionellosis on suspected cases, especially in patients at risk who do not require a PE for care (e.g., patients receiving systemic steroids; patients aged $\geq$65 years; or patients with chronic underlying disease [e.g., diabetes mellitus, congestive heart failure, or chronic obstructive lung disease]) (CDC, 1997; Marrie et al., "Nosocomial legionnaires' disease," 1991; Le Saux et al., 1989; Marston, Lipman, & Breiman, 1994; Haley et al., 1979; Jimenez et al., 1991; Bock et al., 1978; Kirby et al., 1980; Brady, 1989; Muder et al., 1983). **Category IA**

D. Periodically review the availability and clinicians' use of laboratory diagnostic tests for Legionnaires disease in the facility; if clinicians' use of the tests on patients with diagnosed or suspected pneumonia is limited, implement measures (e.g., an educational campaign) to

enhance clinicians' use of the test(s) (Haley et al., 1979). **Category IB**

E. If one case of laboratory-confirmed, health-care--associated Legionnaires disease is identified, or if two or more cases of laboratory-suspected, health-care-associated Legionnaires disease occur during a 6-month period, certain activities should be initiated (Stout et al., 1998; Kool et al., 1998; Kugler et al., 1983; Haley et al., 1979; Garbe et al., 1985; Hanrahan et al., 1987). **Category IB**
   1. Report the cases to state and local health departments where required. **Category IC** (States)
   2. If the facility does not treat severely immunocompromised patients, conduct an epidemiologic investigation, including retrospective review of microbiologic, serologic, and postmortem data to look for previously unidentified cases of health-care--associated Legionnaires disease, and begin intensive prospective surveillance for additional cases (CDC, 1997; Stout et al., 1998; Kool et al., 1998; Kugler et al., 1983; Haley et al., 1979; Garbe et al., 1985; Hanrahan et al., 1987). **Category IB**
   3. If no evidence of continued health-care--associated transmission exists, continue intensive prospective surveillance for $\geq$2 months after the initiation of surveillance (CDC, 1997; Stout et al., 1998; Kool et al., 1998; Kugler et al., 1983; Haley et al., 1979; Garbe et al., 1985; Hanrahan et al., 1987). **Category IB**

F. If there is evidence of continued health-care--associated transmission (i.e., an outbreak), conduct an environmental assessment to determine the source of *Legionella* spp. (Garbe et al., 1985; Hanrahan et al., 1987; Arnow et al., 1982; Mastro et al., 1991; Dondero et al., 1980; O'Mahony et al., 1990; Breiman et al., 1990; Breiman et al., 1991; Struelens et al., 1992). **Category IB**
   1. Collect water samples from potential aerosolized water sources (refer to Box 1 titled "Potential sampling sites for *Legionella* spp. in health-care facilities" and Box 2 titled "Procedures for collecting and processing environmental specimens for *Legionella* spp" in the original guideline document) (Barbaree et al., 1987). **Category IB**
   2. Save and subtype isolates of *Legionella* spp. obtained from patients and the environment (Johnston et al., 1987; Garbe et al., 1985; Hanrahan et al., 1987; Arnow et al., 1982; Mastro et al., 1991; Dondero et al., 1980; O'Mahony et al., 1990; Breiman et al., 1990; Breiman et al., 1991; Struelens et al., 1992; Schoonmaker, Heimberger, & Birkhead, 1992). **Category IB**
   3. If a source is identified, promptly institute water system decontamination measures per recommendations (see Water IV) (Muraca, Yu, & Goetz, 1990; Knirsch et al., 2000). **Category IB**
   4. If *Legionella* spp. are detected in $\geq$1 culture (e.g., conducted at 2-week intervals during 3 months), reassess the control measures, modify them accordingly, and repeat the decontamination procedures; consider intensive use of techniques used in the initial decontamination, or a combination

of superheating and hyperchlorination (CDC, 1997; Knirsch et al., 2000; "Sustained transmission of nosocomial Legionnaires Disease," 1997). **Category IB**

G. If an environmental source is not identified during a Legionnaires disease outbreak, continue surveillance for new cases for ≥2 months. Either defer decontamination pending identification of the source of *Legionella* spp. or proceed with decontamination of the hospital's water distribution system, with special attention to areas involved in the outbreak. **Category II**

H. No recommendation is offered regarding routine culturing of water systems in health-care facilities that do not have patient-care areas (i.e., PE or transplant units) for persons at high risk for *Legionella* spp. infection (see Appendix of the original guideline) (Best et al., 1983; Johnson et al., 1985; Marrie et al., 1992; Muder et al., 1983; Alary & Joly, 1992; Yu et al., 1987; Tobin, Swann, & Bartlett, 1981). **Unresolved issue**

I. No recommendation is offered regarding the removal of faucet aerators in areas for immunocompetent patients. **Unresolved issue**

J. Keep adequate records of all infection-control measures and environmental test results for potable water systems. **Category II**

VI. Preventing Legionnaires Disease in Protective Environments and Transplant Units

A. When implementing strategies for preventing Legionnaires disease among severely immunocompromised patients housed in facilities with HSCT or solid-organ transplant programs, incorporate these specific surveillance and epidemiologic measures in addition to the steps outlined previously (see Appendix in the original guideline document).

1. Maintain a high index of suspicion for legionellosis in transplant patients even when environmental surveillance cultures do not yield legionellae (Kool et al., 1998; Chow & Yu, 1998). **Category IB**
2. If a case occurs in a severely immunocompromised patient, or if severely immunocompromised patients are present in high-risk areas of the hospital (e.g., PE or transplant units) and cases are identified elsewhere in the facility, conduct a combined epidemiologic and environmental investigation to determine the source of *Legionella* spp. (Kool et al., 1998; Knirsch et al., 2000). **Category IB**

B. Implement culture strategies and potable water and fixture treatment measures in addition to those previous outlined (Water: V). **Category II**

1. Depending on state regulations on potable water temperature in public buildings (Mandel et al., 1993), hospitals housing patients at high risk for health-care--associated legionellosis should either maintain heated water with a minimum return temperature of ≥124 degrees F (≥51 degrees C) and cold water at <68 degrees F (<20 degrees C), or chlorinate heated water to achieve 1 to 2 mg/L (1--2 ppm) of free residual chlorine at the tap (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Snyder et al., 1990; Ezzeddine et al., 1989; Johnson et al., 1985; Marrie et al., 1992; Department of Health and Social Security

and the Welsh Office, 1991; Helms et al., 1988; Hirani & Macfarlane, 1997). **Category II**

2. Periodic culturing for legionellae in potable water samples from HSCT or solid-organ transplant units can be performed as part of a comprehensive strategy to prevent Legionnaires disease in these units ("Guidelines," 2000; Snyder et al., 1990; Kool et al., 1998; Patterson et al., 1997). **Category II**
3. No recommendation is offered regarding the optimal methodology (i.e., frequency or number of sites) for environmental surveillance cultures in HSCT or solid-organ transplant units. **Unresolved issue**
4. In areas with patients at risk, when *Legionella* spp. are not detectable in unit water, remove, clean, and disinfect shower heads and tap aerators monthly by using a chlorine-based, EPA-registered product. If an EPA-registered chlorine disinfectant is not available, use a chlorine bleach solution (500--615 ppm [1:100 v/v dilution]) (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Kool, Carpenter, & Fields, 1999). **Category II**

C. If *Legionella* spp. are determined to be present in the water of a transplant unit, implement certain measures until *Legionella* spp. are no longer detected by culture.

1. Decontaminate the water supply as outlined previously (Water: IV) (CDC, 1997; "Guidelines," 2000; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Muraca, Yu, & Goetz, 1990; Knirsch et al., 2000). **Category IB**
2. Do not use water from the faucets in patient-care rooms to avoid creating infectious aerosols ("Guidelines," 2000; Marrie et al., "Control of endemic nosocomial Legionnaires' disease," 1991). **Category IB**
3. Restrict severely immunocompromised patients from taking showers ("Guidelines," 2000; Marrie et al., "Control of endemic nosocomial Legionnaires' disease," 1991). **Category IB**
4. Use water that is not contaminated with *Legionella* spp. for HSCT patients' sponge baths ("Guidelines," 2000; Marrie et al., "Control of endemic nosocomial Legionnaires' disease," 1991). **Category IB**
5. Provide patients with sterile water for tooth brushing, for drinking, and for flushing nasogastric tubing during legionellosis outbreaks ("Guidelines," 2000; Marrie et al., "Control of endemic nosocomial Legionnaires' disease," 1991). **Category IB**

D. Do not use large-volume room air humidifiers that create aerosols (e.g., by Venturi principle, ultrasound, or spinning disk) unless they are subjected to high-level disinfection and filled only with sterile water (CDC, 1997; "Guidelines," 2000; Arnow et al., 1982; Zuravleff et al., 1983). **Category IB**

VII. Cooling Towers and Evaporative Condensers

A. When planning construction of new health-care facilities, locate cooling towers so that the drift is directed away from the air-intake system, and design the towers to minimize the volume of aerosol drift

(American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Dondero et al., 1980; "Environmental health aspects," 1993). **Category IC** (ASHRAE 12-2000)

B. Implement infection-control procedures for operational cooling towers (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Dondero et al., 1980; Bhopal & Barr, 1990). **Category IC** (ASHRAE 12-2000)
   1. Install drift eliminators (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000; Dondero et al., 1980; Bhopal & Barr, 1990). **Category IC** (ASHRAE 12-2000)
   2. Use an effective EPA-registered biocide on a regular basis (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000). **Category IC** (ASHRAE 12-2000)
   3. Maintain towers according to manufacturers' recommendations, and keep detailed maintenance and infection-control records, including environmental test results from legionellosis outbreak investigations (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. [ASHRAE], 2000). **Category IC** (ASHRAE 12-2000)

C. If cooling towers or evaporative condensers are implicated in health-care--associated legionellosis, decontaminate the cooling-tower system (Garbe et al., 1985; Dondero et al., 1980; "Environmental health aspects," 1993; "Epidemiology, prevention and control," 1990). **Category IB**

VIII. **Dialysis Water Quality and Dialysate**

A. Adhere to current Association for the Advancement of Medical Instrumentation (AAMI) standards for quality-assurance performance of devices and equipment used to treat, store, and distribute water in hemodialysis centers (both acute and maintenance [chronic] settings) and for the preparation of concentrates and dialysate (Bolan et al., 1985; Lowry et al., 1990; Favero et al., 1974; Favero et al., 1975; Favero & Peterson, 1997; Association for the Advancement of Medical Instrumentation and American National Standards Institute, *Hemodialysis systems*, 1993; Association for the Advancement of Medical Instrumentation, American National Standards Institute, *Reuse of hemodialyzers*, 1993; Petersen et al., 1978; Dawids & Vejlsgaard, 1976; Kidd, 1964; Klein et al., 1990; Man et al., 1998). **Category IA, IC** (AAMI: American National Standards Institute [ANSI]/AAMI RD5:1992, ANSI/AAMI RD47:1993)

B. No recommendation is offered regarding whether more stringent requirements for water quality should be imposed in hemofiltration and hemodiafiltration. **Unresolved issue**

C. Conduct microbiologic testing specific to water in dialysis settings (Association for the Advancement of Medical Instrumentation and American National Standards Institute, *Hemodialysis systems*, 1993; Association for the Advancement of Medical Instrumentation, American National Standards Institute, *Reuse of hemodialyzers*, 1993; Association for the Advancement of Medical Instrumentation, 2001; Bland, 1995; Arduino et al., 1991). **Category IA, IC** (AAMI: ANSI/AAMI RD5:1992, ANSI/AAMI RD47:1993, RD62:2001)

1. Perform bacteriologic assays of water and dialysis fluids at least once a month and during outbreaks by using standard quantitative methods (Association for the Advancement of Medical Instrumentation, 2001; Bland, 1995; Arduino et al., 1991). **Category IA, IC** (AAMI: ANSI/AAMI RD62:2001)
    a. Assay for heterotrophic, mesophilic bacteria (e.g., *Pseudomonas* spp).
    b. Do not use nutrient-rich media (e.g., blood agar or chocolate agar).
2. In conjunction with microbiologic testing, perform endotoxin testing on product water used to reprocess dialyzers for multiple use (Association for the Advancement of Medical Instrumentation and American National Standards Institute, *Hemodialysis systems*, 1993; Association for the Advancement of Medical Instrumentation, American National Standards Institute, *Reuse of hemodialyzers*, 1993; Bland et al., 1987; Raij, Shapiro, & Michael, 1973; Bommer, Becker, & Urbaschek, 1996; Arduino & Favero, 1998). **Category IA, IC** (AAMI: ANSI/AAMI RD5:1992, ANSI/AAMI RD47:1993)
3. Ensure that water does not exceed the limits for microbial counts and endotoxin concentrations (refer to Table 2 titled "Microbiologic limits for hemodialysis fluids" in the original guideline document) (Association for the Advancement of Medical Instrumentation and American National Standards Institute, *Hemodialysis systems*, 1993; Association for the Advancement of Medical Instrumentation, American National Standards Institute, *Reuse of hemodialyzers*, 1993; Petersen et al., 1978). **Category IA, IC** (AAMI: ANSI/AAMI RD5:1992, ANSI/AAMI RD47:1993)

D. Disinfect water distribution systems in dialysis settings at least weekly (Favero et al., 1974; Favero et al., 1975; Favero & Petersen, 1997; Petersen et al., 1978; Association for the Advancement of Medical Instrumentation, 2001). **Category IA, IC** (AAMI: ANSI/AAMI RD62:2001)

E. Wherever practical, design and engineer water systems in dialysis settings to avoid incorporating joints, dead-end pipes, and unused branches and taps that can harbor bacteria (Favero et al., 1974; Favero et al., 1975; Favero & Petersen, 1997; Petersen et al., 1978; Association for the Advancement of Medical Instrumentation, 2001). **Category IA, IC** (AAMI: ANSI/AAMI RD62:2001)

F. When storage tanks are used in dialysis systems, they should be routinely drained, disinfected with an EPA-registered product, and fitted with an ultrafilter or pyrogenic filter (membrane filter with a pore size sufficient to remove particles and molecules $\geq$1 kilodalton) installed in the water line distal to the storage tank (Association for the Advancement of Medical Instrumentation, 2001). **Category IC** (AAMI: ANSI/AAMI RD62:2001)

IX. Ice Machines and Ice

A. Do not handle ice directly by hand, and wash hands before obtaining ice. **Category II**

B. Use a smooth-surface ice scoop to dispense ice (Koepke & Christopher, 1965; "Outbreak," 1987). **Category II**

1. Keep the ice scoop on a chain short enough that the scoop cannot touch the floor or keep the scoop on a clean, hard surface when not in use (Koepke & Christopher, 1965; "Outbreak," 1987). **Category II**
2. Do not store the ice scoop in the ice bin. **Category II**

C. Do not store pharmaceuticals or medical solutions on ice intended for consumption; use sterile ice to keep medical solutions cold, or use equipment specifically manufactured for this purpose ("Outbreak," 1987; Crow, Corpe, & Smith, 1961). **Category IB**

D. Machines that dispense ice are preferred to those that require ice to be removed from bins or chests with a scoop (Stout, Yu, & Muraca, 1985; Manangan et al., 1998). **Category II**

E. Limit access to ice-storage chests, and keep container doors closed except when removing ice ("Outbreak," 1987). **Category II**

F. Clean, disinfect, and maintain ice-storage chests on a regular basis. **Category II**
1. Follow the manufacturer's instructions for cleaning. **Category II**
2. Use an EPA-registered disinfectant suitable for use on ice machines, dispensers, or storage chests in accordance with label instructions. **Category II**
3. If instructions and EPA-registered disinfectants suitable for use on ice machines are not available, use a general cleaning/disinfecting regimen (Refer to Box 3 titled "General steps for cleaning and maintaining ice machines, dispensers, and storage chests" in the original guideline document) ("Outbreak," 1987). **Category II**
4. Flush and clean ice machines and dispensers if they have not been disconnected before anticipated lengthy water disruptions. **Category II**

G. Install proper air gaps where the condensate lines meet the waste lines. **Category II**

H. Conduct microbiologic sampling of ice, ice chests, and ice-making machines and dispensers where indicated during an epidemiologic investigation ("Outbreak," 1987; Cannon et al., 1991; Khan et al., 1994). **Category IB**

X. **Hydrotherapy Tanks and Pools**

A. Drain and clean hydrotherapy equipment (e.g., Hubbard tanks, tubs, whirlpools, whirlpool spas, or birthing tanks) after each patient's use, and disinfect equipment surfaces and components by using an EPA-registered product in accordance with the manufacturer's instructions. **Category II**

B. In the absence of an EPA-registered product for water treatment, add sodium hypochlorite to the water:
1. Maintain a 15-ppm chlorine residual in the water of small hydrotherapy tanks, Hubbard tanks, and tubs (Schmidt, Cooney, & Foy, 1975). **Category II**
2. Maintain a 2- to 5-ppm chlorine residual in the water of whirlpools and whirlpool spas (McCandlish & Renfrew, 1993). **Category II**
3. If the pH of the municipal water is in the basic range (e.g., when chloramine is used as the primary drinking water disinfectant in the community), consult the facility engineer

regarding the possible need to adjust the pH of the water to a more acidic level before disinfection, to enhance the biocidal activity of the chlorine (White, 1992). **Category II**

C. Clean and disinfect hydrotherapy equipment after using tub liners. **Category II**

D. Clean and disinfect inflatable tubs unless they are single-use equipment. **Category II**

E. No recommendation is offered regarding the use of antiseptic chemicals (e.g., chloramine-T) in the water during hydrotherapy sessions. **Unresolved issue**

F. Conduct a risk assessment of patients before their use of large hydrotherapy pools, deferring patients with draining wounds or fecal incontinence from pool use until their condition resolves. **Category II**

G. For large hydrotherapy pools, use pH and chlorine residual levels appropriate for an indoor pool as provided by local and state health agencies. **Category IC** (States)

H. No recommendation is offered regarding the use in health-care settings of whirlpool or spa equipment manufactured for home or recreational use. **Unresolved issue**

XI. **Miscellaneous Medical Equipment Connected to Water Systems**

A. Clean, disinfect, and maintain AER equipment according to the manufacturer's instructions and relevant scientific literature to prevent inadvertent contamination of endoscopes and bronchoscopes with waterborne microorganisms (Muscarella, "Automatic flexible," 2000; Muscarella, 1998; Muscarella, "Déjà vu," 2000; Gubler, Salfinger, & von Graevenitz, 1992; Fraser et al., 1992). **Category IB**

1. To rinse disinfected endoscopes and bronchoscopes, use water of the highest quality practical for the system's engineering and design (e.g., sterile water or bacteriologically filtered water [water filtered through 0.1 to 0.2-micrometer filters]) (Muscarella, 1998; Gubler, Salfinger, & von Graevenitz, 1992; Fraser et al., 1992; Muscarella, 2002). **Category IB**
2. Dry the internal channels of the reprocessed endoscope or bronchoscope by using a proven method (e.g., 70% alcohol followed by forced-air treatment) to lessen the potential for proliferation of waterborne microorganisms and to help prevent biofilm formation (Cooke et al., 1998; Allen JI et al., 1987; Michele et al., 1997; US Food and Drug Administration, CDC, 1999; Alvarado & Reichelderfer, 2000). **Category IB**

B. Use water that meets nationally recognized standards set by the EPA for drinking water (<500 CFU/mL for heterotrophic plate count) for routine dental treatment output water (CDC, *Statement from CDC regarding biofilm*, 1999; "Recommended infection control," 1993; Office of Safety and Asepsis Procedures Research Foundation, 2000; US Environmental Protection Agency, 1999). **Category IC** (EPA: 40 CFR 1 Part 141, Subpart G)

C. Take precautions to prevent waterborne contamination of dental unit water lines and instruments.

1. After each patient, discharge water and air for a minimum of 20 to 30 seconds from any dental device connected to the dental water system that enters a patient's mouth (e.g., handpieces, ultrasonic scalers, or air/water syringes) ("Recommended infection control," 1993; Bagga et al., 1984). **Category II**

2. Consult with dental water-line manufacturers to 1) determine suitable methods and equipment to obtain the recommended water quality; and 2) determine appropriate methods for monitoring the water to ensure quality is maintained ("Recommended infection control," 1993; Shearer, 1996). **Category II**
3. Consult with the dental unit manufacturer regarding the need for periodic maintenance of antiretraction mechanisms (Bagga et al., 1984; Shearer, 1996). **Category IB**

Recommendations – Environmental Services

I. **Cleaning and Disinfecting Strategies for Environmental Surfaces in Patient-Care Areas**

A. Select EPA-registered disinfectants, if available, and use them in accordance with the manufacturer's instructions (Garner & Favero, 1986; US Environmental Protection Agency, 1972; Mallison, 1984). **Category IC** (EPA: 7 United States Code [USC] section 136 et seq.)

B. Do not use high-level disinfectants/liquid chemical sterilants for disinfection of either noncritical instruments and devices or any environmental surfaces; such use is counter to label instructions for these toxic chemicals (Favero & Bond, 2001; Association for Professionals in Infection Control and Epidemiology, 1996; Stingeni, Lapomarda, & Lisi, 1995; Ashdown et al., 1998; Busch & Werner, 1974; US Food and Drug Administration). **Category IC** (Food and Drug Administration [FDA]: 21 CFR 801.5, 807.87.e)

C. Follow manufacturers' instructions for cleaning and maintaining noncritical medical equipment. **Category II**

D. In the absence of a manufacturer's cleaning instructions, follow certain procedures.
   1. Clean noncritical medical equipment surfaces with a detergent/disinfectant. This may be followed by an application of an EPA-registered hospital disinfectant with or without a tuberculocidal claim (depending on the nature of the surface and the degree of contamination), in accordance with germicide label instructions (Association for Professionals in Infection Control and Epidemiology, 1996). **Category II**
   2. Do not use alcohol to disinfect large environmental surfaces (Favero & Bond, 2001). **Category II**
   3. Use barrier protective coverings as appropriate for noncritical surfaces that are 1) touched frequently with gloved hands during the delivery of patient care; 2) likely to become contaminated with blood or body substances; or 3) difficult to clean (e.g., computer keyboards) ("Recommended infection control," 1993). **Category II**

E. Keep housekeeping surfaces (e.g., floors, walls, tabletops) visibly clean on a regular basis and clean up spills promptly (Favero & Bond, 1991). **Category II**
   1. Use a one-step process and an EPA-registered hospital detergent/disinfectant designed for general housekeeping purposes in patient-care areas where 1) uncertainty exists as to the nature of the soil on the surfaces (e.g., blood or body fluid

contamination versus routine dust or dirt); or 2) uncertainty exists regarding the presence of multidrug resistant organisms on such surfaces (Mallison, 1984; Association for Professionals in Infection Control and Epidemiology, 1996; Chou, 2000; Rutala & Weber, 2000). **Category II**

2. Detergent and water are adequate for cleaning surfaces in nonpatient-care areas (e.g., administrative offices). **Category II**
3. Clean and disinfect high-touch surfaces (e.g., doorknobs, bed rails, light switches, and surfaces in and around toilets in patients' rooms) on a more frequent schedule than minimal-touch housekeeping surfaces. **Category II**
4. Clean walls, blinds, and window curtains in patient-care areas when they are visibly dusty or soiled (Garner & Favero, 1986; Ayliffe et al., 1967; Dancer, 1999; Schmidt, Coleman, & Mallison, 1984). **Category II**

F. Do not perform disinfectant fogging in patient-care areas (Garner & Favero, 1986; Mallison, 1980). **Category IB**

G. Avoid large-surface cleaning methods that produce mists or aerosols or disperse dust in patient-care areas ("Guidelines," 2000; Weems et al., 1987; Walsh & Dixon, 1989; Morey & Williams, 1990). **Category IB**

H. Follow proper procedures for effective uses of mops, cloths, and solutions. **Category II**

1. Prepare cleaning solutions daily or as needed, and replace with fresh solution frequently according to facility policies and procedures (Chou, 2000; Rutala & Weber, 2000). **Category II**
2. Change the mop head at the beginning of each day and also as required by facility policy, or after cleaning up large spills of blood or other body substances. **Category II**
3. Clean mops and cloths after use and allow to dry before reuse; or use single-use, disposable mop heads and cloths (Ayliffe et al., 1967; Walter & Kundsin, 1960; Scott & Bloomfield, "The survival and transfer," 1990; Scott & Bloomfield, "Investigations of the effectiveness," 1990). **Category II**

I. After the last surgical procedure of the day or night, wet vacuum or mop operating room floors with a single-use mop and an EPA-registered hospital disinfectant (CDC, "Guideline," 1999). **Category IB**

J. Do not use mats with tacky surfaces at the entrances to operating rooms or infection-control suites (CDC, "Guideline," 1999). **Category IB**

K. Use appropriate dusting methods for patient-care areas designated for immunocompromised patients (e.g., HSCT patients) ("Guidelines," 2000; Rhame et al., 1984; Chou, 2000). **Category IB**

1. Wet-dust horizontal surfaces daily by moistening a cloth with a small amount of an EPA-registered hospital detergent/disinfectant ("Guidelines," 2000; Rhame et al., 1984; Chou, 2000). **Category IB**
2. Avoid dusting methods that disperse dust (e.g., feather-dusting) (Rhame et al., 1984). **Category IB**

L. Keep vacuums in good repair and equip vacuums with HEPA filters for in use areas with patients at risk ("Guidelines," 2000; Rhame et al., 1984; Chou, 2000; Brown, Schatzle, & Gable 1980). **Category IB**

M. Close the doors of immunocompromised patients' rooms when vacuuming, waxing, or buffing corridor floors to minimize exposure to airborne dust ("Guidelines," 2000; Rhame et al., 1984; Brown, Schatzle, & Gable 1980). **Category IB**

N. When performing low- or intermediate-level disinfection of environmental surfaces in nurseries and neonatal units, avoid unnecessary exposure of neonates to disinfectant residues on these surfaces by using EPA-registered germicides in accordance with manufacturers' instructions and safety advisories (US Environmental Protection Agency, 1972; Wysowski et al., 1978; Doan, Keith, & Shennan, 1979; American Academy of Pediatrics [AAP] & American College of Obstetricians and Gynecologists [ACOG], 1997). **Category IB, IC** (EPA: 7 USC section 136 et seq.)
   1. Do not use phenolics or any other chemical germicide to disinfect bassinets or incubators during an infant's stay (US Environmental Protection Agency, 1972; Wysowski et al., 1978; Doan, Keith, & Shennan, 1979; American Academy of Pediatrics [AAP] & American College of Obstetricians and Gynecologists [ACOG], 1997). **Category IB**
   2. Rinse disinfectant-treated surfaces, especially those treated with phenolics, with water (Wysowski et al., 1978; Doan, Keith, & Shennan, 1979; American Academy of Pediatrics [AAP] & American College of Obstetricians and Gynecologists [ACOG], 1997). **Category IB**

O. When using phenolic disinfectants in neonatal units, prepare solutions to correct concentrations in accordance with manufacturers' instructions, or use premixed formulations (US Environmental Protection Agency, 1972; Wysowski et al., 1978; Doan, Keith, & Shennan, 1979; American Academy of Pediatrics [AAP] & American College of Obstetricians and Gynecologists [ACOG], 1997). **Category IB, IC** (EPA: 7 USC section 136 et seq.)

II. **Cleaning Spills of Blood and Body Substances**

A. Promptly clean and decontaminate spills of blood or other potentially infectious materials ("Occupational exposure to bloodborne pathogens," 1991; Spire et al., 1984; Martin, McDougal, & Loskoski, 1985; Hanson et al., 1989; Bloomfield, Smith-Burchnell, & Dalgleish, 1990; Druce et al., 1995; Van Bueren et al., 1995; Prince et al., 1993). **Category IB, IC** (OSHA: 29 CFR 1910.1030 section d.4.ii.A)

B. Follow proper procedures for site decontamination of spills of blood or blood-containing body fluids ("Occupational exposure to bloodborne pathogens," 1991; Spire et al., 1984; Martin, McDougal, & Loskoski, 1985; Hanson et al., 1989; Bloomfield, Smith-Burchnell, & Dalgleish, 1990; Druce et al., 1995; Van Bueren et al., 1995; Prince et al., 1993). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.ii.A)
   1. Use protective gloves and other PPE appropriate for this task ("Occupational exposure to bloodborne pathogens," 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.3.i, ii)
   2. If the spill contains large amounts of blood or body fluids, clean the visible matter with disposable absorbent material, and discard the used cleaning materials in appropriate, labeled containers ("Occupational exposure to bloodborne pathogens," 1991; Druce et al., 1995; Van Bueren et al., 1995; "Recommendations for prevention," 1987; Sattar &

Springthorpe, 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.iii.B)

3. Swab the area with a cloth or paper towels moderately wetted with disinfectant, and allow the surface to dry ("Occupational exposure to bloodborne pathogens," 1991; "Recommendations for prevention," 1987). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.ii.A)

C. Use germicides registered by the EPA for use as hospital disinfectants and labeled tuberculocidal or registered germicides on the EPA Lists D and E (i.e., products with specific label claims for HIV or hepatitis B virus [HBV]) in accordance with label instructions to decontaminate spills of blood and other body fluids ("Occupational exposure to bloodborne pathogens," 1991; "Recommendations for prevention," 1987; US Department of Labor, Occupational Safety and Health Administration, 1997). **Category IC** (OSHA 29 CFR 1910.1030 section d.4.ii. A memorandum 2/28/97; compliance document [CPL] 2-2.44D [11/99])

D. An EPA-registered sodium hypochlorite product is preferred, but if such products are not available, generic sodium hypochlorite solutions (e.g., household chlorine bleach) may be used.

1. Use a 1:100 dilution (500--615 ppm available chlorine) to decontaminate nonporous surfaces after cleaning a spill of either blood or body fluids in patient-care settings "Recommendations for prevention," 1987; Weber et al., 1999). **Category IB**
2. If a spill involves large amounts of blood or body fluids, or if a blood or culture spill occurs in the laboratory, use a 1:10 dilution (5,000--6,150 ppm available chlorine) for the first application of germicide before cleaning (Favero & Bond, 1991; "Recommendations for prevention," 1987). **Category IB**

III. **Carpeting and Cloth Furnishings**

A. Vacuum carpeting in public areas of health-care facilities and in general patient-care areas regularly with well-maintained equipment designed to minimize dust dispersion (Chou, 2000). **Category II**

B. Periodically perform a thorough, deep cleaning of carpeting as determined by facility policy by using a method that minimizes the production of aerosols and leaves little or no residue (Gerson et al., 1994). **Category II**

C. Avoid use of carpeting in high-traffic zones in patient-care areas or where spills are likely (e.g., burn therapy units, operating rooms, laboratories, or intensive care units) (Gerson et al., 1994; Suzuki et al., 1984; Richet et al., 1989). **Category IB**

D. Follow appropriate procedures for managing spills on carpeting.

1. Spot-clean blood or body substance spills promptly ("Occupational exposure to bloodborne pathogens," 1991; "Recommendations for prevention," 1987; Weber et al., 1999; US Department of Labor, Occupational Safety and Health Administration, 1994). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.ii.A, interpretation)
2. If a spill occurs on carpet tiles, replace any tiles contaminated by blood and body fluids or body substances (US Department of Labor, Occupational Safety and Health Administration, 1994).

Category IC (OSHA 29 CFR 1910.1030 section d.4.ii interpretation)

E. Thoroughly dry wet carpeting to prevent the growth of fungi; replace carpeting that remains wet after 72 hours ("Guidelines," 2000; Vesper et al., 2000). **Category IB**

F. No recommendation is offered regarding the routine use of fungicidal or bactericidal treatments for carpeting in public areas of a health-care facility or in general patient-care areas. **Unresolved issue**

G. Do not use carpeting in hallways and patient rooms in areas housing immunosuppressed patients (e.g., PE areas) ("Guidelines," 2000; Gerson et al., 1994). **Category IB**

H. Avoid using upholstered furniture and furnishings in high-risk patient-care areas and in areas with increased potential for body substance contamination (e.g., pediatrics units) ("Guidelines," 2000). **Category II**

I. No recommendation is offered regarding whether upholstered furniture and furnishings should be avoided in general patient-care areas. **Unresolved issue**

1. Maintain upholstered furniture in good repair. **Category II**
2. Maintain the surface integrity of the upholstery by repairing tears and holes. **Category II**
3. If upholstered furniture in a patient's room requires cleaning to remove visible soil or body substance contamination, move that item to a maintenance area where it can be adequately cleaned with a process appropriate for the type of upholstery and nature of the soil. **Category II**

IV. Flowers and Plants in Patient-Care Areas

A. Flowers and potted plants need not be restricted from areas for immunocompetent patients (Taplin & Mertz, 1973; Kates et al., 1991; Bartzokas, Holley, & Sharp, 1975; Siegman-Igra et al., 1986). **Category II**

B. Designate care and maintenance of flowers and potted plants to staff not directly involved with patient care (Kates et al., 1991). **Category II**

C. If plant or flower care by patient-care staff is unavoidable, instruct the staff to wear gloves when handling plants and flowers and perform hand hygiene after glove removal (Kates et al., 1991). **Category II**

D. Do not allow fresh or dried flowers, or potted plants, in patient-care areas for immunosuppressed patients ("Guidelines," 2000; Walsh & Dixon, 1989; Taplin & Mertz, 1973; Lass-Florl et al., 2000). **Category II**

V. Pest Control

A. Develop pest-control strategies, with emphasis on kitchens, cafeterias, laundries, central sterile supply areas, operating rooms, loading docks, construction activities, and other areas prone to infestations (Burgess, 1984; Lukin, 1989; Bruesch, 1994). **Category II**

B. Install screens on all windows that open to the outside; keep screens in good repair (Lukin, 1989). **Category IB**

C. Contract for routine pest control service by a credentialed pest-control specialist who will tailor the application to the needs of a health-care facility (Bruesch, 1994). **Category II**

D. Place laboratory specimens (e.g., fixed sputum smears) in covered containers for overnight storage (Allen BW, 1987; Laszlo, 2000). **Category II**

VI. **Special Pathogens**

A. Use appropriate hand hygiene, personal protective equipment (PPE) (e.g., gloves), and isolation precautions during cleaning and disinfecting procedures (Boyce & Pittet, 2002; Association for Professionals in Infection Control and Epidemiology, 1996; "Recommendations for preventing," 1995; Gerding et al., 1995). **Category IB**

B. Use standard cleaning and disinfection protocols to control environmental contamination with antibiotic-resistant, gram-positive cocci (e.g., methicillin-resistant *Staphylococcus aureus*, vancomycin-intermediate *Staphylococcus aureus*, or vancomycin-resistant *Enterococcus* [VRE]) ("Recommendations for preventing," 1995; Weber & Rutala, 1997; Lai et al., 1998; Byers et al., 1998). **Category IB**

1. Pay close attention to cleaning and disinfection of high-touch surfaces in patient-care areas (e.g., bed rails, carts, charts, bedside commodes, bed rails, doorknobs, or faucet handles) ("Recommendations for preventing," 1995; Weber & Rutala, 1997; Lai et al., 1998; Byers et al., 1998). **Category IB**
2. Ensure compliance by housekeeping staff with cleaning and disinfection procedures ("Recommendations for preventing," 1995; Weber & Rutala, 1997; Lai et al., 1998; Byers et al., 1998). **Category IB**
3. Use EPA-registered chemical germicides appropriate for the surface to be disinfected (e.g., either low- or intermediate-level disinfection) as specified by the manufacturer's instructions (US Environmental Protection Agency, 1972; Byers et al., 1998; Bradley & Fraise, 1996; Anderson et al., 1997; Saurina, Landman, & Quale, 1997; Rutala et al., 1997; Sehulster & Anderson, 1998). **Category IB, IC** (EPA: 7 USC section 136 et seq.)
4. When contact precautions are indicated for patient care, use disposable patient-care items (e.g., blood pressure cuffs) wherever possible to minimize cross-contamination with multiple-resistant microorganisms (Layton et al., 1993). **Category IB**
5. Follow these same surface-cleaning and disinfecting measures for managing the environment of vancomycin-resistant *Staphylococcus aureus* (VRSA) patients (Weber & Rutala, 1997; Lai et al., 1998; Byers et al., 1998; Sehulster & Anderson, 1998). **Category II**

C. Environmental-surface culturing can be used to verify the efficacy of hospital policies and procedures before and after cleaning and disinfecting rooms that house patients with vancomycin-resistant *Enteroccus* (VRE) ("Recommendations for preventing," 1995; Karanfil et al., 1992; Boyce et al., 1994; Rhinehart et al., 1990; Livornese et al., 1992; Zervos et al., 1987). **Category II**

1. Obtain prior approval from infection-control staff and the clinical laboratory before performing environmental-surface culturing. **Category II**

2. Infection-control staff, with clinical laboratory staff consultation, must supervise all environmental culturing. **Category II**

D. Thoroughly clean and disinfect environmental and medical equipment surfaces on a regular basis by using EPA-registered disinfectants in accordance with manufacturers' instructions (US Environmental Protection Agency, 1972; Association for Professionals in Infection Control and Epidemiology, 1996; Gerding et al., 1995; Worsley, 1998). **Category IB, IC** (EPA: 7 USC section 136 et seq.)

E. Advise families, visitors, and patients regarding the importance of hand hygiene to minimize the spread of body substance contamination (e.g., respiratory secretions or fecal matter) to surfaces (Association for Professionals in Infection Control and Epidemiology, 1996). **Category II**

F. Do not use high-level disinfectants (i.e., liquid chemical sterilants) on environmental surfaces; such use is inconsistent with label instructions because of the toxicity of the chemicals (Garner & Favero, 1986; Favero & Bond, 2001; Association for Professionals in Infection Control and Epidemiology, 1996; US Food and Drug Administration). **Category IC** (FDA: 21 CFR 801.5, 807.87.e)

G. Because no EPA-registered products are specific for inactivating *Clostridium difficile* spores, use hypochlorite-based products for disinfection of environmental surfaces in accordance with guidance from the scientific literature in those patient-care areas where surveillance and epidemiology indicate ongoing transmission of *C. difficile* (Association for Professionals in Infection Control and Epidemiology, 1996; Gerding et al., 1995; Worsley, 1998). **Category II**

H. No recommendation is offered regarding the use of specific EPA-registered hospital disinfectants with respect to environmental control of *C. difficile*. **Unresolved issue**

I. Apply standard cleaning and disinfection procedures to control environmental contamination with respiratory and enteric viruses in pediatric-care units and care areas for immunocompromised patients (Chou, 2000; Lloyd-Evans, Springthorpe, & Sattar, 1986). **Category IC** (EPA: 7 USC section 136 et seq.)

J. Clean surfaces that have been contaminated with body substances; perform low- to intermediate-level disinfection on cleaned surfaces with an EPA-registered disinfectant in accordance with the manufacturer's instructions (US Environmental Protection Agency, 1972; "Occupational exposure to bloodborne pathogens," 1991; Lloyd-Evans, Springthorpe, & Sattar, 1986). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.ii.A; EPA: 7 USC section 136 et seq.)

K. Use disposable barrier coverings as appropriate to minimize surface contamination. **Category II**

L. Develop and maintain cleaning and disinfection procedures in patient-care areas to control environmental contamination with agents of Creutzfeldt-Jakob disease (CJD), for which no EPA-registered product exists. **Category II**

1. In the absence of contamination with central nervous system tissue, extraordinary measures (e.g., use of 2N sodium hydroxide [NaOH] or applying full-strength sodium hypochlorite) are not needed for routine cleaning or terminal disinfection of a room housing a confirmed or suspected CJD

patient (Favero & Bond, 2001; Rutala & Weber, 2001). **Category II**

2. After removing gross tissue from the surface, use either 1N NaOH or a sodium hypochlorite solution containing approximately 10,000- to 20,000 ppm available chlorine (dilutions of 1:5 to 1:3 v/v, respectively, of U.S. household chlorine bleach; contact the manufacturers of commercially available sodium hypochlorite products for advice) to decontaminate operating room or autopsy surfaces with central nervous system or cerebral spinal fluid contamination from a diagnosed or suspected CJD patient (Favero & Bond, 2001; Kimberlin et al., 1983; "Precautions," 1986; Taylor, 1991; Budka et al., 1995; Ironside & Bell, 1996; World Health Organization [WHO], 1999). **Category II**
    a. The contact time for the chemical used during this process should be 30 min to 1 hour (Taylor, 1991; Budka et al., 1995; World Health Organization [WHO], 1999).
    b. Blot up the chemical with absorbent material and rinse the treated surface thoroughly with water.
    c. Discard the used, absorbent material into appropriate waste containers.
3. Use disposable, impervious covers to minimize body substance contamination to autopsy tables and surfaces (Budka et al., 1995; World Health Organization [WHO], 1999). **Category II**

M. Use standard procedures for containment, cleaning, and decontamination of blood spills on surfaces as previously described (Environmental Services: II) ("Occupational exposure to bloodborne pathogens," 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.ii.A)

1. Wear PPE appropriate for a surface decontamination and cleaning task ("Occupational exposure to bloodborne pathogens," 1991; Rutala & Weber, 2001). **Category IC** (OSHA 29 CFR 1910.1030 Â§ d.3.i, ii)
2. Discard used PPE by using routine disposal procedures or decontaminate reusable PPE as appropriate ("Occupational exposure to bloodborne pathogens," 1991; Rutala & Weber, 2001). **Category IC** (OSHA 29 CFR 1910.1030 Â§ d.3.viii)

Recommendations – Environmental Sampling

I. **General Information**

A. Do not conduct random, undirected, microbiologic sampling of air, water, and environmental surfaces in health-care facilities (Garner & Favero, 1986; Bond & Sehulster, 2003). **Category IB**

B. When indicated, conduct microbiologic sampling as part of an epidemiologic investigation or during assessment of hazardous environmental conditions to detect contamination or verify abatement of a hazard (Garner & Favero, 1986; Bond & Sehulster, 2003). **Category IB**

C. Limit microbiologic sampling for quality assurance purposes to 1) biologic monitoring of sterilization processes; 2) monthly cultures of

water and dialysate in hemodialysis units; and 3) short-term evaluation of the impact of infection-control measures or changes in infection-control protocols (Garner & Favero, 1986; Bond & Sehulster, 2003). **Category IB**

II. **Air, Water, and Environmental Surface Sampling**

A. When conducting any form of environmental sampling, identify existing comparative standards and fully document departures from standard methods (Bond & Sehulster, 2003; Clesceri, Greenberg, & Eaton, 1998; Buttner, Willeke, & Grinshpun, 1997; Jensen, 1998; International Organization for Standardization, 1995). **Category II**

B. Select a high-volume air sampling device if anticipated levels of microbial airborne contamination are expected to be low (Buttner, Willeke, & Grinshpun, 1997; Jensen, 1998; Streifel, 1992; Wolf et al., 1964). **Category II**

C. Do not use settle plates to quantify the concentration of airborne fungal spores (Streifel, 1992). **Category II**

D. When sampling water, choose growth media and incubation conditions that will facilitate recovery of waterborne organisms (Clesceri, Greenberg, & Eaton, 1998). **Category II**

E. When using a sample/rinse method for sampling an environmental surface, develop and document a procedure for manipulating the swab, gauze, or sponge in a reproducible manner so that results are comparable (International Organization for Standardization, 1995). **Category II**

F. When environmental samples and patient specimens are available for comparison, perform the laboratory analysis on the recovered microorganisms down to the species level at a minimum, and beyond the species level if possible (Bond & Sehulster, 2003). **Category II**

Recommendations – Laundry and Bedding

I. **Employer Responsibilities**

A. Employers must launder workers' personal protective garments or uniforms that are contaminated with blood or other potentially infectious materials ("Occupational exposure to bloodborne pathogens," 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.3.iv)

II. **Laundry Facilities and Equipment**

A. Maintain the receiving area for contaminated textiles at negative pressure compared with the clean areas of the laundry in accordance with AIA construction standards in effect during the time of facility construction (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Wagner, 1966; Hambraeus & Malmborg, 1982; McDonald & Pugliese, 1999). **Category IC** (AIA: 7.23.B1, B2)

B. Ensure that laundry areas have handwashing facilities and products and appropriate PPE available for workers (The American Institute of Architects and The Facilities Guidelines Institute, 2001; "Occupational exposure to bloodborne pathogens," 1991). **Category IC** (AIA: 7.23.D4; OSHA: 29 CFR 1910.1030 section d.2.iii)

C. Use and maintain laundry equipment according to manufacturers' instructions (Barrie et al., 1994; Legnani & Leoni, 1997). **Category II**

D. Do not leave damp textiles or fabrics in machines overnight (Barrie et al., 1994). **Category II**

E. Disinfection of washing and drying machines in residential care is not needed as long as gross soil is removed from items before washing and proper washing and drying procedures are used. **Category II**

III. **Routine Handling of Contaminated Laundry**

A. Handle contaminated textiles and fabrics with minimum agitation to avoid contamination of air, surfaces, and persons (Garner, 1996; "Occupational exposure to bloodborne pathogens," 1991; Joint Committee on Healthcare Laundry Guidelines, 1999; Greene, 1970). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.iv)

B. Bag or otherwise contain contaminated textiles and fabrics at the point of use ("Occupational exposure to bloodborne pathogens," 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.iv)

1. Do not sort or prerinse contaminated textiles or fabrics in patient-care areas ("Occupational exposure to bloodborne pathogens," 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.iv)
2. Use leak-resistant containment for textiles and fabrics contaminated with blood or body substances ("Occupational exposure to bloodborne pathogens," 1991; Joint Committee on Healthcare Laundry Guidelines, 1999). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.iv)
3. Identify bags or containers for contaminated textiles with labels, color coding, or other alternative means of communication as appropriate ("Occupational exposure to bloodborne pathogens," 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.iv)

C. Covers are not needed on contaminated textile hampers in patient-care areas. **Category II**

D. If laundry chutes are used, ensure that they are properly designed, maintained, and used in a manner to minimize dispersion of aerosols from contaminated laundry (Association for the Advancement of Medical Instrumentation, 2000; Hughes, 1964; Michaelsen, 1965; Hoeh, 1982; Whyte, Baird, & Annand, 1969). **Category IC** (AAMI: ANSI/AAMI ST65:2000)

1. Ensure that laundry bags are closed before tossing the filled bag into the chute. **Category II**
2. Do not place loose items in the laundry chute. **Category II**

E. Establish a facility policy to determine when textiles or fabrics should be sorted in the laundry facility (i.e., before or after washing) (Taylor, 1988; Walter & Schillinger, 1975). **Category II**

IV. **Laundry Process**

A. If hot-water laundry cycles are used, wash with detergent in water $\geq$160 degrees F ($\geq$71 degrees C) for $\geq$25 minutes (The American Institute of Architects and The Facilities Guidelines Institute, 2001; Garner & Favero, 1986). **Category IC** (AIA: 7.31.E3)

B. No recommendation is offered regarding a hot-water temperature setting and cycle duration for items laundered in residence-style health-care facilities. **Unresolved issue**

C. Follow fabric-care instructions and special laundering requirements for items used in the facility (Belkin, 1998). **Category II**

D. Choose chemicals suitable for low-temperature washing at proper use concentration if low-temperature (<160 degrees F [<70 degrees C]) laundry cycles are used (Blaser et al., 1984; Jaska & Fredell, 1980; Battles & Vesley, 1981; Christian, Manchester, & Mellor, 1983; Smith et al., 1987; Tompkins, Johnson, & Fittall, 1988). **Category II**

E. Package, transport, and store clean textiles and fabrics by methods that will ensure their cleanliness and protect them from dust and soil during interfacility loading, transport, and unloading (Garner & Favero, 1986). **Category II**

V. **Microbiologic Sampling of Textiles**

A. Do not conduct routine microbiologic sampling of clean textiles (Garner & Favero, 1986; Ayliffe, Collins, & Taylor, 1982). **Category IB**

B. Use microbiologic sampling during outbreak investigations if epidemiologic evidence indicates a role for health-care textiles and clothing in disease transmission (Ayliffe, Collins, & Taylor, 1982). **Category IB**

VI. **Special Laundry Situations**

A. Use sterilized textiles, surgical drapes, and gowns for situations requiring sterility in patient care (CDC, "Guideline," 1999). **Category IB**

B. Use hygienically clean textiles (i.e., laundered, but not sterilized) in neonatal intensive care units (American Academy of Pediatrics [AAP] & American College of Obstetricians and Gynecologists [ACOG], 1997; Meyer et al., 1981). **Category IB**

C. Follow manufacturers' recommendations for cleaning fabric products, including those with coated or laminated surfaces. **Category II**

D. Do not use dry cleaning for routine laundering in health-care facilities (Wagg, 1965; Bates et al., 1993; Oehnel, 1971). **Category II**

E. Use caution when considering use of antimicrobial mattresses, textiles, and clothing as replacements for standard bedding and other fabric items; EPA has not approved public health claims asserting protection against human pathogens for such treated items (US Environmental Protection Agency, 2003). **Category II**

F. No recommendation is offered regarding using disposable fabrics and textiles versus durable goods. **Unresolved issue**

VII. **Mattresses and Pillows**

A. Keep mattresses dry; discard them if they remain wet or stained, particularly in burn units (Fujita et al., 1981; Grubb & Watson, 1982; Sherertz & Sullivan, 1985; Ndawula & Brown, 1991; O'Donoghue & Allen, 1992; Weernink et al., 1995). **Category IB**

B. Clean and disinfect mattress covers by using EPA-registered disinfectants that are compatible with the materials to prevent the development of tears, cracks, or holes in the covers (Fujita et al., 1981; Grubb & Watson, 1982; Sherertz & Sullivan, 1985; Ndawula & Brown, 1991; O'Donoghue & Allen, 1992; Weernink et al., 1995). **Category IB**

C. Maintain the integrity of mattress and pillow covers. **Category II**

1. Replace mattress and pillow covers if they become torn or otherwise in need of repair. **Category II**
2. Do not stick needles into a mattress through the cover. **Category II**

D. Clean and disinfect moisture-resistant mattress covers between patient use by using an EPA-registered product (Fujita et al., 1981;

Grubb & Watson, 1982; Sherertz & Sullivan, 1985; Ndawula & Brown, 1991; O'Donoghue & Allen, 1992; Weernink et al., 1995). **Category IB**

E. If using a mattress cover completely made of fabric, change these covers and launder between patient use (Fujita et al., 1981; Grubb & Watson, 1982; Sherertz & Sullivan, 1985; Ndawula & Brown, 1991; O'Donoghue & Allen, 1992; Weernink et al., 1995). **Category IB**

F. Launder pillow covers and washable pillows in the hot-water cycle between patients or when they become contaminated with body substances (Weernink et al., 1995). **Category IB**

VIII. **Air-Fluidized Beds**

A. Follow manufacturers' instructions for air-fluidized bed maintenance and decontamination. **Category II**

B. Change the polyester filter sheet at least weekly or as indicated by the manufacturer (Scheidt & Drusin, 1983; Freeman et al., 1994; Clancy, 1993; Clancy, 1994). **Category II**

C. Clean and disinfect the polyester filter sheet thoroughly, especially between patients, using an EPA-registered product (Scheidt & Drusin, 1983; Freeman et al., 1994; Clancy, 1993; Clancy, 1994). **Category IB**

D. Consult the facility engineer to determine the proper placement of air-fluidized beds in negative-pressure rooms (Jacobsen, Gurevich, & Cunha, 1993). **Category II**

Recommendations – Animals in Health-Care Facilities

I. **General Infection-Control Measures for Animal Encounters**

A. Minimize contact with animal saliva, dander, urine, and feces (Tips to remember, 2003; Duncan, 2000; Murray, Ferguson, & Morrison, 1983). **Category II**

B. Practice hand hygiene after any animal contact (Boyce & Pittet, 2002; Garner & Favero, 1986). **Category II**

1. Wash hands with soap and water, especially if hands are visibly soiled or contaminated with proteinaceous material (Boyce & Pittet, 2002). **Category II**
2. Use either soap and water or alcohol-based hand rubs when hands are not visibly soiled or contaminated (Boyce & Pittet, 2002). **Category II**

II. **Animal-Assisted Activities and Resident Animal Programs**

A. Avoid selection of nonhuman primates and reptiles in animal-assisted activities, animal-assisted therapy, or resident animal programs (Delta Society, 1996; Fox, 1975; Ostrowski et al., 1998). **Category IB**

B. Enroll animals that are fully vaccinated for zoonotic diseases and that are healthy, clean, well-groomed, and negative for enteric parasites or otherwise have completed recent anthelmintic treatment under the regular care of a veterinarian (Delta Society, 1996; Saylor, 1998). **Category II**

C. Enroll animals that are trained with the assistance or under the direction of persons who are experienced in this field (Delta Society, 1996). **Category II**

D. Ensure that animals are controlled by persons trained in providing activities or therapies safely, and who know the animal's health status and behavior traits (Delta Society, 1996; Saylor, 1998). **Category II**

E. Take prompt action when an incident of biting or scratching by an animal occurs during an animal-assisted activity or therapy.
   1. Remove the animal permanently from these programs (Delta Society, 1996). **Category II**
   2. Report the incident promptly to appropriate authorities (e.g., infection-control staff, animal program coordinator, or local animal control personnel) (Delta Society, 1996). **Category II**
   3. Promptly clean and treat scratches, bites, or other breaks in the skin. **Category II**

F. Perform an ICRA and work actively with the animal handler before conducting an animal-assisted activity or therapy to determine whether the session should be held in a public area of the facility or in individual patient rooms (Delta Society, 1996; Saylor, 1998). **Category II**

G. Take precautions to mitigate allergic responses to animals. **Category II**
   1. Minimize shedding of animal dander by bathing animals <24 hours before a visit (Delta Society, 1996). **Category II**
   2. Groom animals to remove loose hair before a visit, or use a therapy animal cape (Draper, Gerber, & Layng, 1990). **Category II**

H. Use routine cleaning protocols for housekeeping surfaces after therapy sessions. **Category II**

I. Restrict resident animals, including fish in tanks, from access to patient-care areas, food-preparation areas, dining areas, laundry, central sterile supply areas, sterile and clean supply storage areas, medication preparation areas, operating rooms, isolation areas, and PE areas. **Category II**

J. Establish a facility policy for regular cleaning of fish tanks, rodent cages, bird cages, and any other animal dwellings and assign this cleaning task to a nonpatient-care staff member; avoid splashing tank water or contaminating environmental surfaces with animal bedding. **Category II**

III. **Protective Measures for Immunocompromised Patients**

A. Advise patients to avoid contact with animal feces, saliva, urine, or solid litter box material ("1999 USPHS/IDSA guidelines," 1999). **Category II**

B. Promptly clean and treat scratches, bites, or other wounds that break the skin ("1999 USPHS/IDSA guidelines," 1999). **Category II**

C. Advise patients to avoid direct or indirect contact with reptiles ("Reptile-associated salmonellosis," 1999). **Category IB**

D. Conduct a case-by-case assessment to determine if animal-assisted activities or animal-assisted therapy programs are appropriate for immunocompromised patients (Saylor, 1998). **Category II**

E. No recommendation is offered regarding permitting pet visits to terminally ill immunocompromised patients outside their PE units. **Unresolved issue**

IV. **Service Animals**

A. Avoid providing facility access to nonhuman primates and reptiles as service animals (Ostrowski et al., 1998; "Reptile-associated salmonellosis," 1999). **Category IB**
B. Allow service animals access to the facility in accordance with the Americans with Disabilities Act of 1990, unless the presence of the animal creates a direct threat to other persons or a fundamental alteration in the nature of services (Duncan, 2000; US Department of Justice, 1990). **Category IC** (U.S. Department of Justice: 28 CFR section 36.302)
C. When a decision must be made regarding a service animal's access to any particular area of the health-care facility, evaluate the service animal, patient, and health-care situation on a case-by-case basis to determine whether significant risk of harm exists and whether reasonable modifications in policies and procedures will mitigate this risk (US Department of Justice, 1990). **Category IC** (U.S. Department of Justice: 28 CFR section 36.208)
D. If a patient must be separated from his or her service animal while in the health-care facility 1) ascertain from the person what arrangements have been made for supervision or care of the animal during this period of separation; and 2) make appropriate arrangements to address the patient's needs in the absence of the service animal. **Category II**

V. **Animals as Patients in Human Health-Care Facilities**

A. Develop health-care facility policies to address the treatment of animals in human health-care facilities.
    1. Use the multidisciplinary team approach to policy development, including public media relations efforts to disclose and discuss these activities. **Category II**
    2. Exhaust all veterinary facility, equipment, and instrument options before undertaking the procedure. **Category II**
    3. Ensure that the care of the animal is supervised by a licensed veterinarian. **Category II**
B. When animals are treated in human health-care facilities, avoid treating animals in operating rooms or other patient-care areas where invasive procedures are performed (e.g., cardiac catheterization laboratories or invasive nuclear medicine areas). **Category II**
C. Schedule the animal procedure for the last procedure of the day in the area, at a time when human patients are not scheduled to be in the vicinity. **Category II**
D. Adhere strictly to standard precautions. **Category II**
E. Clean and disinfect environmental surfaces thoroughly by using an EPA-registered product in the room after the animal has been removed. **Category II**
F. Allow sufficient ACH to clean the air and help remove airborne dander, microorganisms, and allergens (refer to Table 1 titled "Air changes/hour and time required for airborne-contaminant removal efficiencies of 99% and 99.9%" in the original guideline document). **Category II**
G. Clean and disinfect using EPA-registered products or sterilize equipment that has been in contact with the animal; or use disposable equipment. **Category II**

H. If reusable medical or surgical instruments are used in an animal procedure, restrict future use of these instruments to animals only. **Category II**

VI. **Research Animals in Health-Care Facilities**

A. Use animals obtained from quality stock, or quarantine incoming animals to detect zoonotic diseases. **Category II**

B. Treat sick animals or remove them from the facility. **Category II**

C. Provide prophylactic vaccinations, as available, to animal handlers and contacts at high risk. **Category II**

D. Ensure proper ventilation through appropriate facility design and location (US Department of Agriculture). **Category IC** (U.S. Department of Agriculture [USDA]: 7 USC 2131)

1. Keep animal rooms at negative pressure relative to corridors (US Department of Agriculture). **Category IC** (USDA: 7 USC 2131)
2. Prevent air in animal rooms from recirculating elsewhere in the health-care facility (US Department of Agriculture). **Category IC** (USDA: 7 USC 2131)

E. Keep doors to animal research rooms closed. **Category II**

F. Restrict access to animal facilities to essential personnel. **Category II**

G. Establish employee occupational health programs specific to the animal research facility, and coordinate management of postexposure procedures specific to zoonoses with occupational health clinics in the health-care facility (CDC & National Institutes of Health, 1993; US Department of Labor, Occupational Safety and Health Administration). **Category IC** (U.S. Department of Health and Human Services [DHHS]: Biosafety in Microbiological and Biomedical Laboratories [BMBL]; OSHA: 29 CFR 1910.1030.132-139)

H. Document standard operating procedures for the unit (CDC & National Institutes of Health, 1993). **Category IC** (DHHS: BMBL)

I. Conduct routine employee training on worker safety concerns relevant to the animal research facility (e.g., working safely with animals, animal handling) (CDC & National Institutes of Health, 1993; US Department of Labor, Occupational Safety and Health Administration). **Category IC** (DHHS: BMBL; OSHA: 29 CFR 1910.1030.132--139)

J. Use precautions to prevent development of animal-induced asthma in animal workers (CDC & National Institutes of Health). **Category IC** (DHHS: BMBL)

Recommendations – Regulated Medical Wastes

I. **Categories of Regulated Medical Waste**

A. Designate the following as major categories of medical waste that require special handling and disposal precautions: 1) microbiology laboratory wastes [e.g., cultures and stocks of microorganisms]; 2) bulk blood, blood products, blood, and bloody body fluid specimens; 3) pathology and anatomy waste; and 4) sharps [e.g., needles and scalpels] (Garner & Favero, 1986). **Category II**

B. Consult federal, state, and local regulations to determine if other waste items are considered regulated medical wastes ("Occupational exposure," 1991; US Department of Transportation, 1998; US Postal Service, 2003). **Category IC** (States; OSHA: 29 CFR 1910.1030

section g.2.1; Department of Transportation [DOT]: 49 CFR 171-180; US Postal Service: CO23.8)

II. **Disposal Plan for Regulated Medical Wastes**

A. Develop a plan for the collection, handling, predisposal treatment, and terminal disposal of regulated medical wastes ("Occupational exposure to bloodborne pathogens," 1991; Greene, Miele, & Slavik, 1994). **Category IC** (States; OSHA: 29 CFR 1910.1030 section g.2.i)

B. Designate a person or persons as responsible for establishing, monitoring, reviewing, and administering the plan. **Category II**

III. **Handling, Transporting, and Storing Regulated Medical Wastes**

A. Inform personnel involved in handling and disposal of potentially infective waste of possible health and safety hazards; ensure that they are trained in appropriate handling and disposal methods ("Occupational exposure to bloodborne pathogens," 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section g.2.i)

B. Manage the handling and disposal of regulated medical wastes generated in isolation areas by using the same methods used for regulated medical wastes from other patient-care areas (Garner & Favero, 1986). **Category II**

C. Use proper sharps disposal strategies ("Occupational exposure to bloodborne pathogens" 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.iii.A)

1. Use a sharps container capable of maintaining its impermeability after waste treatment to avoid subsequent physical injuries during final disposal ("Occupational exposure to bloodborne pathogens," 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.iii.A)
2. Place disposable syringes with needles, including sterile sharps that are being discarded, scalpel blades, and other sharp items into puncture-resistant containers located as close as practical to the point of use ("Occupational exposure to bloodborne pathogens," 1991). **Category IC** (OSHA: 29 CFR 1910.1030 section d.4.iii.A)
3. Do not bend, recap, or break used syringe needles before discarding them into a container (Garner, 1996; "Occupational exposure to bloodborne pathogens," 1991; National Institute for Occupational Safety and Health, 1999). **Category IC** (OSHA: 29 CFR 1910.1030 section d.2.vii and section d.2.vii.A)

D. Store regulated medical wastes awaiting treatment in a properly ventilated area inaccessible to vertebrate pests; use waste containers that prevent development of noxious odors. **Category IC** (States)

E. If treatment options are not available at the site where the medical waste is generated, transport regulated medical wastes in closed, impervious containers to the on-site treatment location or to another facility for treatment as appropriate. **Category IC** (States)

IV. **Treatment and Disposal of Regulated Medical Wastes**

A. Treat regulated medical wastes by using a method (e.g., steam sterilization, incineration, interment, or an alternative treatment technology) approved by the appropriate authority having jurisdiction (AHJ) (e.g., state, Indian Health Service, or Veterans Administration) before disposal in a sanitary landfill. **Category IC** (States, AHJ)

B. Follow precautions for treating microbiologic wastes (e.g., amplified cultures and stocks of microorganisms) (CDC & National Institutes of Health). **Category IC** (DHHS: BMBL)
    1. Biosafety level 4 laboratories must inactivate microbiologic wastes in the laboratory by using an approved inactivation method (e.g., autoclaving) before transport to and disposal in a sanitary landfill (CDC & National Institutes of Health). **Category IC** (DHHS: BMBL)
    2. Biosafety level 3 laboratories must inactivate microbiologic wastes in the laboratory by using an approved inactivation method (e.g., autoclaving) or incinerate them at the facility before transport to and disposal in a sanitary landfill (CDC & National Institutes of Health, 1993). **Category IC** (DHHS: BMBL)

C. Biosafety levels 1 and 2 laboratories should develop strategies to inactivate amplified microbial cultures and stocks onsite by using an approved inactivation method (e.g., autoclaving) instead of packaging and shipping untreated wastes to an offsite facility for treatment and disposal (CDC & National Institutes of Health, 1993; Weber, Boudreau, & Mortimer, 1998; Johnson et al., 2000; Emery et al., 1992). **Category II**

D. Laboratories that isolate select agents from clinical specimens must comply with federal regulations for receipt, transfer, management, and appropriate disposal of these agents (US Department of Health and Human Services & CDC, 1996). **Category IC** (DHHS: 42 CFR 72 section 72.6.i.1.iii)

E. Sanitary sewers may be used for safe disposal of blood, suctioned fluids, ground tissues, excretions, and secretions, provided that local sewage discharge requirements are met and that the state has declared this to be an acceptable method of disposal (CDC, 1988). **Category II**

V. Special Precautions for Wastes Generated During Care of Patients with Rare Diseases

A. When discarding items contaminated with blood and body fluids from VHF patients, contain these regulated medical wastes with minimal agitation during handling (Garner, 1996; "Update," 1995). **Category II**

B. Manage properly contained wastes from areas providing care to VHF patients in accordance with recommendations for other isolation areas (Regulated Medical Waste: III B) (Garner, 1996; "Update," 1995; Garner & Favero, 1986). **Category II**

C. Decontaminate bulk blood and body fluids from VHF patients by using approved inactivation methods (e.g., autoclaving or chemical treatment) before disposal (Garner, 1996; "Update," 1995). **Category IC, II** (States)

D. When discarding regulated medical waste generated during the routine (i.e., nonsurgical) care of Creutzfeldt-Jakob disease (CJD) patients, contain these wastes and decontaminate them by using approved inactivation methods (e.g., autoclaving or incineration) appropriate for the medical waste category (e.g., blood, sharps, or pathological waste) (Garner, 1996; Garner & Favero, 1986; Favero & Bond, 2001; Rutala & Weber, 2001). **Category IC, II** (States)

E. Incinerate medical wastes (e.g., central nervous system tissues or contaminated disposable materials) from brain autopsy or biopsy procedures of diagnosed or suspected CJD patients (Budka et al., 1995; World Health Organization [WHO], 1999). **Category IB**

Definitions:

The HICPAC system for categorizing recommendations has been modified to include a category for engineering standards and actions required by state or federal regulations. Guidelines and standards published by the American Institute of Architects (AIA), American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), and the Association for the Advancement of Medical Instrumentation (AAMI) form the basis of certain recommendations. These standards reflect a consensus of expert opinions and extensive consultation with agencies of the U.S. Department of Health and Human Services. Compliance with these standards is usually voluntary. However, state and federal governments often adopt these standards as regulations. For example, the standards from AIA regarding construction and design of new or renovated health-care facilities, have been adopted by reference by >40 states. Certain recommendations have two category ratings (e.g., Categories IA and IC or Categories IB and IC), indicating the recommendation is evidence-based as well as a standard or regulation.

Rating Categories

Recommendations are rated according to the following categories:

Category IA. Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.

Category IB. Strongly recommended for implementation and supported by certain experimental, clinical, or epidemiologic studies and a strong theoretic rationale.

Category IC. Required by state or federal regulation, or representing an established association standard. (Note: Abbreviations for governing agencies and regulatory citations are listed where appropriate. Recommendations from regulations adopted at state levels are also noted. Recommendations from AIA guidelines cite the appropriate sections of the standards.)

Category II. Suggested for implementation and supported by suggestive clinical or epidemiologic studies, or a theoretic rationale.

Unresolved issue. No recommendation is offered. No consensus or insufficient evidence exists regarding efficacy.

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

REFERENCES SUPPORTING THE RECOMMENDATIONS

References open in a new window

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are evidence-based wherever possible. However, certain recommendations are derived from empiric infection-control or engineering principles, theoretic rationale, or experience gained from events that cannot be readily studied (e.g., floods).

The type of supporting evidence is identified and graded for each recommendation (see "Major Recommendations").

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

- Environmental infection-control strategies and engineering controls can effectively prevent infections from environmental pathogens or airborne pathogens.
- The incidence of health-care--associated infections and pseudo-outbreaks can be minimized.

POTENTIAL HARMS

None stated

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

- All the recommendations may not reflect the opinions of all reviewers.
- Wherever possible, the recommendations in this report are based on data from well-designed scientific studies. However, certain of these studies were conducted by using narrowly defined patient populations or specific health-care settings (e.g., hospitals versus long-term care facilities), making generalization of findings potentially problematic. Construction standards for hospitals or other health-care facilities may not apply to residential home-care units. Similarly, infection-control measures indicated for immunosupressed patient care are usually not necessary in those facilities where such patients are not present.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

Performance Measurements

Infections caused by the microorganisms described in this guideline are rare events, and the effect of these recommendations on infection rates in a facility may not be readily measurable. Therefore, the following steps to measure performance are suggested to evaluate these recommendations:

1. Document whether infection-control personnel are actively involved in all phases of a health-care facility's demolition, construction, and renovation. Activities should include performing a risk assessment of the necessary types of construction barriers, and daily monitoring and documenting of the presence of negative airflow within the construction zone or renovation area.
2. Monitor and document daily the negative airflow in airborne infection isolation (AII) rooms and positive airflow in protective environment (PE) rooms, especially when patients are in these rooms.
3. Perform assays at least once a month by using standard quantitative methods for endotoxin in water used to reprocess hemodialyzers, and for heterotrophic and mesophilic bacteria in water used to prepare dialysate and for hemodialyzer reprocessing.
4. Evaluate possible environmental sources (e.g., water, laboratory solutions, or reagents) of specimen contamination when nontuberculous mycobacteria (NTM) of unlikely clinical importance are isolated from clinical cultures. If environmental contamination is found, eliminate the probable mechanisms.
5. Document policies to identify and respond to water damage. Such policies should result in either repair and drying of wet structural or porous materials within 72 hours, or removal of the wet material if drying is unlikely within 72 hours.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Staying Healthy

IOM DOMAIN

Effectiveness
Safety

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Sehulster L, Chinn RY. Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC) [Published errata appear in MMWR Recomm Rep 2003 Oct 24;52(42):1025-6]. MMWR Recomm Rep 2003 Jun 6;52(RR-10):1-42. [419 references] PubMed

ADAPTATION

Not applicable: The guideline was not adapted from another source.

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Healthcare Infection Control Practices Advisory Committee (HICPAC)

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

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GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

Electronic copies: Available from the Centers for Disease Control and Prevention (CDC) Web site:

- HTML format
- Portable Document Format (PDF)

Print copies: Available from the Centers for Disease Control and Prevention, MMWR, Atlanta, GA 30333. Additional copies can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325; (202) 783-3238.

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

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