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Lynne Sehulster, Ph.D.1

Raymond Y.W. Chinn, M.D.2

1Division of Healthcare Quality Promotion

National Center for Infectious Diseases

2HICPAC member

Sharp Memorial Hospital

San Diego, California

The material in this report originated in the National Center for Infectious Diseases, James M. Hughes, M.D., Director; and the Division of Healthcare Quality Promotion, Steven L. Solomon, M.D., Acting Director.

Summary

The health-care facility environment is rarely implicated in disease transmission, except among patients who

are immunocompromised. Nonetheless, inadvertent exposures to environmental

pathogens (e.g.,

Aspergillus spp. and Legionella spp.) or airborne pathogens (e.g.,

Mycobacterium tuberculosis and varicella-zoster virus) can result in adverse patient outcomes and cause illness among health-care workers. Environmental infection-control strategies and engineering controls can effectively prevent these infections. The incidence of health-care--associated infections and pseudo-outbreaks can be minimized by 1) appropriate use of cleaners and disinfectants; 2) appropriate maintenance of medical equipment (e.g.,

automated endoscope reprocessors or hydrotherapy equipment); 3) adherence to water-quality standards for hemodialysis, and to ventilation standards for specialized care environments (e.g., airborne infection isolation rooms, protective environments, or operating rooms); and 4) prompt management of water intrusion into the facility. Routine environmental sampling is not usually advised, except for water quality determinations in hemodialysis settings and other situations where sampling is directed by epidemiologic principles, and results can be applied directly to infection-control decisions.

This report reviews previous guidelines and strategies for preventing environment-associated infections in health-care facilities and offers recommendations. These include 1) evidence-based recommendations supported by studies; 2) requirements of federal agencies (e.g., Food and Drug Administration, U.S. Environmental Protection Agency, U.S. Department of Labor, Occupational Safety and Health Administration, and U.S. Department of Justice); 3) guidelines and standards from

building and equipment professional organizations (e.g., American Institute of

Architects, Association for the Advancement of

Medical Instrumentation, and American Society of Heating, Refrigeration, and Air-Conditioning Engineers); 4)

recommendations derived from scientific theory or rationale; and 5) experienced opinions based upon infection-control and engineering practices. The report also suggests a series of performance measurements as a means to evaluate infection-control efforts.

Introduction

Parameters of the Report

This report, which contains the complete list of recommendations with pertinent references, is Part II of Guidelines for Environmental Infection Control in Health-Care Facilities.

The full four-part guidelines will be available on CDC's Division

of Healthcare Quality Promotion (DHQP) website. Relative to previous CDC guidelines, this report

In the full guidelines, Part I, Background Information: Environmental Infection Control in Health-Care Facilities, provides

a comprehensive review of the relevant scientific literature. Attention is given to engineering and infection-control

concerns during construction, demolition, renovation, and repair of health-care facilities. Use of an infection-control risk assessment is strongly supported before the start of these or any other activities expected to generate dust or water aerosols. Also

reviewed

in Part I are infection-control measures used to recover from catastrophic events (e.g., flooding, sewage spills, loss of electricity and ventilation, or disruption of water supply) and the limited effects of environmental surfaces, laundry, plants,
animals, medical wastes, cloth furnishings, and carpeting on disease transmission in health-care facilities. Part III and Part IV of the full guidelines provide references (for the complete guideline) and appendices, respectively.

Part II (this report) contains 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. These recommendations represent the views of different divisions within 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. In 1999, HICPAC's infection-control focus was expanded from acute-care hospitals to all venues where health care is
provided (e.g., outpatient surgical centers, urgent care centers, clinics, outpatient dialysis centers, physicians' offices, and skilled nursing facilities). The topics addressed in this report are applicable to the majority of health-care facilities in the United States. This report is intended for use primarily by infection-control practitioners, epidemiologists, employee health and safety

personnel, engineers, facility managers, information systems professionals, administrators, environmental service professionals, and architects. Key

recommendations include

Topics outside the scope of this report include 1) noninfectious adverse events (e.g., sick building syndrome),

2) environmental concerns in the home, 3) home health care, 4) terrorism, and 5) health-care--associated foodborne illness. 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.

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:

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. All the recommendations may not reflect the opinions of all reviewers. This report updates the following published guidelines and recommendations:

CDC. Guideline for handwashing and hospital environmental control. MMWR 1998;37(No. 24). 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.

Key Terms

Airborne infection isolation (AII) refers to the isolation of patients infected with organisms spread via airborne

droplet nuclei <5 µm in diameter. This isolation area receives numerous air changes per hour (ACH) (>12 ACH for new construction as of 2001;
>6 ACH for construction before 2001), and is under negative pressure, such that the direction of the air flow is from the outside adjacent space (e.g., the corridor) into the room. The air in an AII room is preferably exhausted to
the outside, but may be recirculated provided that the return air is filtered through a high-efficiency particulate air (HEPA) filter. The use of personal respiratory protection is also indicated for persons entering these rooms when caring for TB or
smallpox patients and for staff who lack immunity to airborne viral diseases (e.g., measles or varicella zoster virus [VZV] infection). Protective environment (PE) Immunocompromised patients AAMIAssociation for the Advancement of Medical Instrumentation

ACHair changes per hour

AERautomated endoscope reprocessor

AHJauthority having jurisdiction

AIAAmerican Institute of Architects

AIIairborne infection isolation

ANSIAmerican National Standards Institute

ASHRAE American Society of Heating, Refrigeration, and Air-Conditioning Engineers

BMBLBiosafety in Microbiological and Biomedical Laboratories (CDC/National Institutes of Health)

CFRCode of Federal Regulations

CJDCreutzfeldt-Jakob disease

CPLcompliance document (OSHA)

DFAdirect fluorescence assay

DHHSU.S. Department of Health and Human Services

DOTU.S. Department of Transportation

EC environment of care

EPAU. S. Environmental Protection Agency

FDAU.S. Food and Drug Administration

HBVhepatitis B virus

HEPAhigh efficiency particulate air

HIVhuman immunodeficiency virus

HSCThematopoietic stem cell transplant

HVACheating, ventilation, air conditioning

ICRAinfection-control risk assessment

JCAHO Joint Commission on Accreditation of Healthcare Organizations

NaOHsodium hydroxide

NTMnontuberculous mycobacteria

OSHAOccupational Safety and Health Administration

PE protective environment

PPEpersonal protective equipment

TB tuberculosis

USCUnited States Code

USDAU.S. Department of Agriculture

UV ultraviolet

UVGIultraviolet germicidal irradiation

VHFviral hemorrhagic fever

VREvancomycin-resistant Enterococcus

VRSAvancomycin-resistant Staphylococcus aureus

VZVvaricella zoster virus

Recommendations for Environmental Infection Control in Health-Care Facilities

Rationale for Recommendations

As in previous CDC guidelines, each recommendation is categorized on the basis of

existing scientific data,

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

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 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. Category IB. Category IC. Category II. Unresolved issue. I. Air-Handling Systems in Health-Care Facilities

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

III. Infection Control and Ventilation Requirements for PE rooms

IV. Infection-Control and Ventilation Requirements for AII Rooms

V. Infection-Control and Ventilation Requirements for Operating Rooms

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

I. Controlling the Spread of Waterborne Microorganisms

II. Routine Prevention of Waterborne Microbial

Contamination Within the Distribution System

III. Remediation Strategies for Distribution System Repair or Emergencies

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

V. General Infection-Control Strategies for Preventing Legionnaires Disease

VI. Preventing Legionnaires Disease in Protective Environments and Transplant Units

VII. Cooling Towers and Evaporative Condensers

VIII. Dialysis Water Quality and Dialysate

IX. Ice Machines and Ice

X. Hydrotherapy Tanks and Pools

XI. Miscellaneous Medical Equipment Connected to Water Systems

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

II. Cleaning Spills of Blood and Body Substances

III. Carpeting and Cloth Furnishings

IV. Flowers and Plants in Patient-Care Areas

V. Pest Control

VI. Special Pathogens

I. General Information

II. Air, Water, and Environmental Surface Sampling

I. Employer Responsibilities

II. Laundry Facilities and Equipment

III. Routine Handling of Contaminated Laundry

IV. Laundry Process

V. Microbiologic Sampling of Textiles

VI. Special Laundry Situations

VII. Mattresses and Pillows

VIII. Air-Fluidized Beds

I. General Infection-Control Measures for Animal Encounters

II. Animal-Assisted Activities and Resident Animal Programs

III. Protective Measures for Immunocompromised Patients

IV. Service Animals

V. Animals as Patients in Human Health-Care Facilities

VI. Research Animals in Health-Care Facilities

I. Categories of Regulated Medical Waste

II. Disposal Plan for Regulated Medical Wastes

III. Handling, Transporting, and Storing Regulated Medical Wastes

IV. Treatment and Disposal of Regulated Medical Wastes

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

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