

GUIDELINE FOR HANDWASHING AND HOSPITAL ENVIRONMENTAL CONTROL, 1985

**Supersedes Guideline for Hospital Environmental Control
Published in 1981**

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RANKING SCHEME FOR RECOMMENDATIONS

CATEGORY I

Measures in Category I are strongly supported by well-designed and controlled clinical studies that show their effectiveness in reducing the risk of nosocomial infections, or are viewed as effective by a majority of expert reviewers. Measures in this category are viewed as applicable for most hospitals—regardless of size, patient population, or endemic nosocomial infection rates.

CATEGORY II

Measures in Category II are supported by highly suggestive clinical studies in general hospitals or by definitive studies in specialty hospitals that might not be representative of general hospitals. Measures that have not been adequately studied but have a logical or strong theoretical rationale indicating probable effectiveness are included in this category. Category II recommendations are viewed as practical to implement in most hospitals.

CATEGORY III

Measures in Category III have been proposed by some investigators, authorities, or organizations, but, to date, lack supporting data, a strong theoretical rationale, or an indication that the benefits expected from them are cost effective. Thus, they are considered important issues to be studied. They might be considered by some hospitals for implementation, especially if the hospitals have specific nosocomial infection problems, but they are *not* generally recommended for widespread adoption.

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Preface

In 1980, the Centers for Disease Control (CDC) began developing a series of guidelines entitled *Guidelines for the Prevention and Control of Nosocomial Infections*. The purpose of the *Guidelines* was twofold: 1) to disseminate advice on how to prevent or control specific nosocomial infection problems and 2) to cover the questions most frequently asked of the Hospital Infections Program staff on different aspects of the hospital's inanimate environment (1). One of the first *Guidelines* to be published was the *Guideline for Hospital Environmental Control*. It was written by Bryan P. Simmons, M.D. in consultation with Thomas M. Hooton, M.D., and George F. Mallison, M.P.H., and in collaboration with a working group consisting of Edward J. Bertz; Mary K. Bruch; Sue Crow, R.N., M.S.N.; William E. Scheckler, M.D.; Harold Laufman, M.D., Ph.D.; Janet K. Schultz, R.N., M.S.N.; Earle H. Spaulding, Ph.D.; and Richard P. Wenzel, M.D.

In February 1981, CDC mailed to each U. S. acute-care hospital Part I of the *Guideline for Hospital Environmental Control*, which contained sections entitled "Antiseptics, Handwashing, and Handwashing Facilities," "Cleaning, Disinfection, and Sterilization of Hospital Equipment," and "Microbiologic Surveillance of the Environment and of Personnel in the Hospital." In October 1981, Part II of the *Guideline for Hospital Environmental Control*, which contained the sections "Housekeeping Services and Waste Disposal," "Laundry Services," "Intensive Care Units," and "Pharmacy," was published. In July 1982, the section on "Cleaning, Disinfection, and Sterilization of Hospital Equipment" was revised. In November 1982, the two parts of the *Guideline* were combined into a single document entitled *Guideline for Hospital Environmental Control*, and copies were mailed to all U.S. acute-care hospitals.

In October 1983, CDC issued a statement entitled "Clarification of Guideline Recommendations on Generic Antiseptic, Disinfectant, and Other Products," which was mailed to all U.S. acute-care hospitals. The statement emphasized that CDC recommendations are not intended to endorse any particular commercial product or to exclude the use of other commercial products containing generic ingredients not mentioned in the *Guideline for Hospital Environmental Control*.

In November 1983, a follow-up statement requested that users delete the portion of the *Guideline for Hospital Environmental Control* that recommended specific generic antimicrobial ingredients for use in health care personnel handwashes and announced that the entire *Guideline* would be comprehensively revised. In June 1984, a draft of the proposed revision was mailed to 150 scientists and infection control professionals for review and comment. Rather than using an expert working group to finalize the content of this *Guideline*, we used the written comments and suggestions which we received from the reviewers to determine the final content of the *Guideline* and the ranking of the recommendations.

This *Guideline* incorporates the above revisions, as well as newly available information; the title has been

changed to *Guideline for Handwashing and Hospital Environmental Control*. It replaces all previous handwashing and environmental control statements issued or published by the Hospital Infections Program, Center for Infectious Diseases, CDC.

MAJOR CHANGES IN THE GUIDELINE

Since this *Guideline* contains many important changes from the original *Guideline for Hospital Environmental Control*, it is important that users read the entire *Guideline* carefully. The major changes in the titles and content of sections are listed below:

1. The section "Handwashing," which replaces the old section entitled "Antiseptics, Handwashing, and Handwashing Facilities," contains updated recommendations for handwashing with plain soaps or detergents and with antimicrobial-containing products. Rather than recommending specific generic ingredients for handwashing with antimicrobial-containing products, the *Guideline* indicates that hospitals may choose from appropriate products in categories defined by the U.S. Food and Drug Administration (FDA), since preparations used to inhibit or kill microorganisms on skin are categorized by an FDA advisory review panel for nonprescription (over-the-counter [OTC]) antimicrobial drug products (2). Manufacturers of antimicrobial-containing products voluntarily submit data to the review panel, which categorizes the products according to their intended use, i.e., antimicrobial soaps, health-care personnel handwashes, patient preoperative skin preparations, skin antiseptics, skin wound cleansers, skin wound protectants, and surgical hand scrubs. Generic antimicrobials for each use category are further divided: Category I (safe and efficacious); Category II (not safe and/or efficacious); and Category III (insufficient data to categorize). Consequently, chemical germicides formulated as antiseptics are categorized by the FDA into groupings by use and efficacy, but they are not regulated or registered in the same fashion as chemical germicides are by the U.S. Environmental Protection Agency (EPA).

Persons responsible for selecting commercially marketed health-care-personnel handwashes can obtain information about categorization of products from the Center for Drugs and Biologics, Division of OTC Drug Evaluation, FDA, 5600 Fishers Lane, Rockville, MD 20857. In addition, information published in the scientific literature, presented at scientific meetings, documented by manufacturers, and obtained from other sources deemed important may be considered.

2. The section "Cleaning, Disinfecting, and Sterilizing of Patient-Care Equipment" has been rewritten. Medical devices, equipment, and materials are divided into three categories (critical, semicritical,

and noncritical) based on the risk of infection involved in their use. Revised recommendations for sterilizing and disinfecting items in these categories are included in this section. Rather than listing specific chemical germicides, the *Guideline* indicates that hospitals may choose from sterilant and disinfectant formulations registered with the EPA, since chemical germicides are regulated and registered by the EPA (3). Manufacturers of chemical germicides formulated as general disinfectants, hospital disinfectants, and disinfectants used in other environments, such as the food industry, are required by EPA to test their formulations using specific protocols for microbicidal efficiency, stability, and toxicity to humans. In past years, the EPA has reserved the right to test and verify formulations of chemical germicides for their specified efficacy; however, in practice only those formulations to be registered as sterilants or sporicides were actually tested. In 1982, the EPA discontinued this testing. Currently, formulations of chemical germicides are registered by the EPA based on data obtained from the manufacturer.

Persons responsible for selecting chemical germicides should keep in mind that the field is highly competitive, and exaggerated claims are often made about the germicidal efficiency of specific formulations. When questions regarding specific claims or use arise, the Disinfectants Branch, Registration Division, Office of Pesticides, EPA, 401 M Street, S.W., Washington, D.C. 20460, can be consulted. As with handwashing products, information in the scientific literature, presented at scientific meetings, documented by manufacturers, and obtained from other sources deemed important may be considered.

The recommendation against reprocessing and reusing single-use items has been removed. Since there is lack of evidence indicating increased risk of nosocomial infections associated with the reuse of *all* single-use items, a categorical recommendation against *all* types of reuse was not considered justifiable. Rather than recommending for or against reprocessing and reusing single-use items, the *Guideline* indicates that items or devices that cannot be cleaned and sterilized or disinfected without altering their physical integrity and function should not be reprocessed. In addition, reprocessing procedures that result in residual toxicity or compromise the overall safety or effectiveness of the items or devices should be avoided. Arguments for and against reprocessing and reusing single-use items have been summarized in a report from the International Conference on the Reuse of Disposable Medical Devices in the 1980's (4).

3. The section "Microbiologic Sampling" replaces the old section entitled "Microbiologic Surveillance of the Environment and of Personnel in the Hospital." The recommendation for microbiologic sampling of infant formulas prepared in the hospital has been removed, since there is no epidemiologic evidence to show that such sampling reduces the infection rate in hospitals. Information and recommendations for

microbiologic surveillance of personnel have been deleted, since this topic is addressed in the *Guideline for Infection Control in Hospital Personnel* (5).

4. A new section, "Infective Waste," has been added. It contains information about identifying infective waste and recommendations for its handling and disposal.
5. The section "Housekeeping" replaces the old section "Housekeeping Services and Waste Disposal." Recommendations against use of carpets in patient-care areas have been removed, since there is no epidemiologic evidence to show that carpets influence the nosocomial infection rate in hospitals (6); whether to use carpets, therefore, is not considered an infection control issue.
6. The section "Laundry" contains a discussion of and recommendations for both hot-water and reduced-temperature washing.
7. The section "Intensive Care Units" has been deleted, since it primarily dealt with information and recommendations that are covered elsewhere in this *Guideline* and in the *Guideline for Isolation Precautions in Hospitals* (7).
8. The section "Pharmacy" has been deleted from this *Guideline*, since it primarily dealt with recommendations for admixture of parenteral fluids that are contained in the *Guideline for Prevention of Intravascular Infections*.

The recommendations presented in this *Guideline* were chosen primarily for their acknowledged importance to infection control, but other factors, such as the feasibility of implementing them and their potential costs to hospitals, were also considered. Many recommendations are intended to reduce or eliminate expensive practices that are not likely to prevent infections. Some of the recommendations are based on well-documented epidemiologic studies; others are based on a reasonable theoretical rationale, since for many of these practices little or no scientifically valid evidence is available to permit evaluation of their effect on the incidence of infection. Because new studies are constantly revealing pertinent information in this field, users of this *Guideline* should keep informed of other sources. The recommendations presented in this *Guideline* may be modified as necessary for an individual hospital and are not meant to restrict a hospital from developing recommendations that may be more appropriate to its own unique needs. The recommendations have no force of law or regulation.

REFERENCES

1. Haley RW. CDC guidelines on infection control. *Infect Control* 1981;2:1-2.
2. Zanowski P, Jacobs MR. Topical anti-infective products. In: *Handbook of non-prescription drugs*, 7th ed. Washington, D.C. American Pharmaceutical Association, 1982:525-42.
3. Block SS. Federal regulation of disinfectants in the United States. In: *Disinfection, sterilization and preservation*, Block SS, (ed), 3rd ed. Philadelphia: Lea and Febiger, 1983.
4. Proceedings of International Conference on the Reuse of Disposable Medical Devices in the 1980's. 1984 Mar 29-30, Washington, D.C.: Institute for Health Policy Analysis, Georgetown University Medical Center.
5. Williams WW. Guideline for infection control in hospital personnel. *Infect Control* 1983;4:326-49.

6. Anderson RL, Mackel DC, Stoler BS, Mallison GF. Carpeting in hospitals: An epidemiological evaluation. *J Clin Microbiol* 1982;15:408-15.

7. Garner JS, Simmons BP. Guideline for isolation precautions in hospitals. *Infect Control* 1983;4:245-325.

Section 1: Handwashing

INTRODUCTION

Handwashing is the single most important procedure for preventing nosocomial infections. Handwashing is defined as a vigorous, brief rubbing together of all surfaces of lathered hands, followed by rinsing under a stream of water. Although various products are available, handwashing can be classified simply by whether plain soap or detergents or antimicrobial-containing products are used (1). Handwashing with plain soaps or detergents (in bar, granule, leaflet, or liquid form) suspends microorganisms and allows them to be rinsed off; this process is often referred to as mechanical removal of microorganisms. In addition, handwashing with antimicrobial-containing products kills or inhibits the growth of microorganisms; this process is often referred to as chemical removal of microorganisms. Routine handwashing is discussed in this *Guideline*; the surgical hand scrub is discussed in the *Guideline for Prevention of Surgical Wound Infections*.

EPIDEMIOLOGY

The microbial flora of the skin consists of resident and transient microorganisms; the resident microorganisms survive and multiply on the skin and can be repeatedly cultured, while the transient microbial flora represent recent contaminants that can survive only a limited period of time. Most resident microorganisms are found in superficial skin layers, but about 10%-20% can inhabit deep epidermal layers (2,3). Handwashing with plain soaps and detergents is effective in removing many transient microbial flora (4-6). Resident microorganisms in the deep layers may not be removed by handwashing with plain soaps and detergents, but usually can be killed or inhibited by handwashing with products that contain antimicrobial ingredients.

Many resident skin microorganisms are not highly virulent and are not implicated in infections other than skin infections. However, some of these microorganisms can cause infections in patients when surgery or other invasive procedures allow them to enter deep tissues or when a patient is severely immunocompromised or has an implanted device, such as a heart valve. In contrast, the transient microorganisms often found on the hands of hospital personnel can be pathogens acquired from colonized or infected patients and may cause nosocomial infections. Several recent studies have shown that transient and resident hand carriage of aerobic gram-negative microorganisms by hospital personnel may be more frequent than previously thought (7-10). More study on the bacteriology of hands is needed to fully understand the factors that contribute to persistent hand carriage of such microorganisms (11).

CONTROL MEASURES

The absolute indications for and the ideal frequency of handwashing are generally not known because of the lack of well-controlled studies. Listing all circumstances that

may require handwashing would be a lengthy and arbitrary task. The indications for handwashing probably depend on the type, intensity, duration, and sequence of activity. Generally, superficial contact with a source not suspected of being contaminated, such as touching an object not visibly soiled or taking a blood pressure, does not require handwashing. In contrast, prolonged and intense contact with any patient should probably be followed by handwashing. In addition, handwashing is indicated *before* performing invasive procedures, *before* taking care of particularly susceptible patients, such as those who are severely immunocompromised or newborn infants, and *before* and *after* touching wounds. Moreover, handwashing is indicated, even when gloves are used, *after* situations during which microbial contamination of the hands is likely to occur, especially those involving contact with mucous membranes, blood and body fluids, and secretions or excretions, and *after* touching inanimate sources that are likely to be contaminated, such as urine-measuring devices. In addition, handwashing is an important component of the personal hygiene of all hospital personnel, and *handwashing should be encouraged when personnel are in doubt about the necessity for doing so*.

The circumstances that require handwashing are frequently found in high-risk units, because patients in these units are often infected or colonized with virulent or multiply-resistant microorganisms, and are highly susceptible to infection because of wounds, invasive procedures, or diminished immune function. Handwashing in these units is indicated between direct contact with different patients and often is indicated more than once in the care of one patient, for example, after touching excretions or secretions, before going on to another care activity for the same patient.

The recommended handwashing technique depends on the purpose of the handwashing. The ideal duration of handwashing is not known, but washing times of 15 seconds (6) or less (5) have been reported as effective in removing most transient contaminants from the skin. Therefore, for most activities, a vigorous, brief (at least 10 seconds) rubbing together of all surfaces of lathered hands followed by rinsing under a stream of water is recommended. If hands are visibly soiled, more time may be required for handwashing.

The absolute indications for handwashing with plain soaps and detergents versus handwashing with antimicrobial-containing products are not known because of the lack of well-controlled studies comparing infection rates when such products are used. For most routine activities, handwashing with plain soap appears to be sufficient, since soap will allow most transient microorganisms to be washed off (4-6).

Handwashing products for use in hospitals are available in several forms. It is important, however, that the product selected for use be acceptable to the personnel who will use it (6). When plain soap is selected for handwashing, the bar, liquid, granule, or soap-impregnated tissue

form may be used. It is preferable that bar soaps be placed on racks that allow water to drain. Since liquid-soap containers can become contaminated and might serve as reservoirs of microorganisms, reusable liquid containers need to be cleaned when empty and refilled with fresh soap. Completely disposable containers obviate the need to empty and clean dispensers but may be more expensive. Most antimicrobial-containing handwashing products are available as liquids. Antimicrobial-containing foams and rinses are also available for use in areas without easy access to sinks.

In addition to handwashing, personnel may often wear gloves as an extra margin of safety. As with handwashing, the absolute indications for wearing gloves are not known. There is general agreement that wearing sterile gloves is indicated when certain invasive procedures are performed or when open wounds are touched. Nonsterile gloves can be worn when hands are likely to become contaminated with potentially infective material such as blood, body fluids, or secretions, since it is often not known which patients' blood, body fluids, or secretions contain hepatitis B virus or other pathogens. Further, gloves can be worn to prevent gross microbial contamination of hands, such as when objects soiled with feces are handled. When gloves are worn, handwashing is also recommended because gloves may become perforated during use and because bacteria can multiply rapidly on gloved hands.

The convenient placement of sinks, handwashing products, and paper towels is often suggested as a means of encouraging frequent and appropriate handwashing. Sinks with faucets that can be turned off by means other than the hands (e.g., foot pedals) and sinks that minimize splash can help personnel avoid immediate recontamination of washed hands.

Although handwashing is considered the most important single procedure for preventing nosocomial infections, two reports showed poor compliance with handwashing protocols by personnel in medical intensive care units, especially by physicians (12) and personnel taking care of patients on isolation precautions (13). Failure to wash hands is a complex problem that may be caused by lack of motivation or lack of knowledge about the importance of handwashing. It may also be caused by obstacles such as understaffing, inconveniently located sinks, absence of paper towels, an unacceptable handwashing product, or the presence of dermatitis caused by previous handwashing. More study is needed to identify which of these factors, alone or in combination, contribute significantly to the problem of poor compliance with handwashing recommendations.

RECOMMENDATIONS

1. Handwashing Indications

a. In the absence of a true emergency, personnel should *always* wash their hands

1) before performing invasive procedures;
Category I

2) before taking care of particularly susceptible patients, such as those who are severely immunocompromised and newborns; *Category I*

3) before and after touching wounds, whether surgical, traumatic, or associated with an invasive device; *Category I*

4) after situations during which microbial contamination of hands is likely to occur, especially those involving contact with mucous membranes, blood or body fluids, secretions, or excretions;
Category I

5) after touching inanimate sources that are likely to be contaminated with virulent or epidemiologically important microorganisms; these sources include urine-measuring devices or secretion-collection apparatuses; *Category I*

6) after taking care of an infected patient or one who is likely to be colonized with microorganisms of special clinical or epidemiologic significance, for example, multiply-resistant bacteria;
Category I

7) between contacts with different patients in high-risk units. *Category I*

b. Most routine, brief patient-care activities involving *direct* patient contact other than that discussed in 1.a. above, e.g., taking a blood pressure, do not require handwashing. *Category II*.

c. Most routine hospital activities involving *indirect* patient contact, e.g., handing a patient medications, food, or other objects, do not require handwashing.
Category I.

2. Handwashing Technique

For routine handwashing, a vigorous rubbing together of all surfaces of lathered hands for at least 10 seconds, followed by thorough rinsing under a stream of water, is recommended. *Category I*

3. Handwashing with Plain Soap

a. Plain soap should be used for handwashing unless otherwise indicated. *Category II*

b. If bar soap is used, it should be kept on racks that allow drainage of water. *Category II*

c. If liquid soap is used, the dispenser should be replaced or cleaned and filled with fresh product when empty; liquids should not be added to a partially full dispenser. *Category II*

4. Handwashing with Antimicrobial-Containing Products (Health-Care Personnel Handwashes)

a. Antimicrobial handwashing products should be used for handwashing before personnel care for newborns and when otherwise indicated during their care, between patients in high-risk units, and before personnel take care of severely immunocompromised patients. *Category III* (Hospitals may choose from products in the product category defined by the FDA as health-care personnel handwashes. Persons responsible for selecting commercially marketed antimicrobial health-care personnel handwashes can obtain information about categorization of products from the Center for Drugs and Biologics, Division of OTC Drug Evaluation, FDA, 5600 Fishers Lane, Rockville, MD 20857. In addition, information published in the scientific literature, presented at scientific meetings, documented by manufacturers, and obtained from other sources deemed important may be considered.)

- b. Antimicrobial-containing products that do not require water for use, such as foams or rinses, can be used in areas where no sinks are available.

Category III

5. Handwashing Facilities

- a. Handwashing facilities should be conveniently located throughout the hospital. *Category I*
- b. A sink should be located in or just outside every patient room. More than one sink per room may be necessary if a large room is used for several patients. *Category II*
- c. Handwashing facilities should be located in or adjacent to rooms where diagnostic or invasive procedures that require handwashing are performed (e.g., cardiac catheterization, bronchoscopy, sigmoidoscopy, etc.). *Category I*

REFERENCES

1. The tentative final monograph for OTC topical antimicrobial products. Federal Register 1978 Jan 6;43 FR 1210:1211-49 T
2. Price PB. New studies in surgical bacteriology and surgical technique. JAMA 1938;111:1993-6.
3. Ulrich JA. Techniques of skin sampling for microbial contaminants. Hosp Topics 1965;43:121-3.
4. Lowbury EJJ, Lilly HA, Bull JP. Disinfection of hands: removal of transient organisms. Br Med J 1964;2:230-3.
5. Sprunt K, Redman W, Leidy G. Antibacterial effectiveness of routine handwashing. Pediatrics 1973;52:264-71.
6. Ojarvi J. The importance of soap selection for routine hygiene in hospital. J Hyg (Camb) 1981;86:275-83.
7. Knittle MA, Eitzman DV, Bear H. Role of hand contamination of personnel in the epidemiology of gram-negative nosocomial infections. J Pediatr 1975;86:433-7.
8. Larson EL. Persistent carriage of gram-negative bacteria on hands. Am J Infect Control 1981;9:112-9.
9. Adams BG, Marrie TJ. Hand carriage of aerobic gram-negative rods may not be transient. J Hyg (Camb) 1982;89:33-46.
10. Adams BG, Marrie TJ. Hand carriage of aerobic gram-negative rods by health care personnel. J Hyg (Camb) 1982;89:23-31.
11. Larson E. Current handwashing issues. Infect Control 1984;5:15-7.
12. Albert RK, Condie F. Handwashing patterns in medical intensive-care units. N Engl J Med 1981;304:1465-6.
13. Larson E. Compliance with isolation techniques. Am J Infect Control 1983;11:221-5.

Section 2: Cleaning, Disinfecting, and Sterilizing Patient-Care Equipment

INTRODUCTION

Cleaning, the physical removal of organic material or soil from objects, is usually done by using water with or without detergents. Generally, cleaning is designed to remove rather than to kill microorganisms. Sterilization, on the other hand, is the destruction of all forms of microbial life; it is carried out in the hospital with steam under pressure, liquid or gaseous chemicals, or dry heat. Disinfection, defined as the intermediate measures between physical cleaning and sterilization, is carried out with pasteurization or chemical germicides.

Chemical germicides can be classified by several systems. We have used the system originally proposed by Spaulding (1) in which three levels of disinfection are defined: high, intermediate, and low (Table 1). In contrast, EPA uses a system that classifies chemical germicides as sporicides, general disinfectants, hospital disinfectants, sanitizers, and others. Formulations registered by the EPA as sporicides are considered sterilants if the contact time is long enough to destroy all forms of microbial life, or high-level disinfectants if contact times are shorter. Chemical germicides registered by the EPA as sanitizers probably fall into the category of low-level disinfectants. Numerous formulations of chemical germicides can be classified as either low- or intermediate-level disinfectants, depending on the specific label claims. For example, some chemical germicide formulations are claimed to be efficacious against *Mycobacterium tuberculosis*; by Spaulding's system, these formulations would be classified at least as intermediate-level disinfectants. However, chemical germicide formulations with specific label claims for effectiveness against *Salmonella choleraesuis*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa* (the challenge microorganisms required for EPA classification as a "hospital disinfectant") could fall into intermediate- or low-level disinfectant categories.

The rationale for cleaning, disinfecting, or sterilizing patient-care equipment can be understood more readily if medical devices, equipment, and surgical materials are divided into three general categories (critical items, semi-critical items, and noncritical items) based on the potential risk of infection involved in their use. This categorization of medical devices also is based on the original suggestions by Spaulding (1).

Critical items are instruments or objects that are introduced directly into the bloodstream or into other normally sterile areas of the body. Examples of critical items are surgical instruments, cardiac catheters, implants, pertinent components of the heart-lung oxygenator, and the blood compartment of a hemodialyzer. Sterility at the time of use is required for these items; consequently, one of several accepted sterilization procedures is generally recommended.

Items in the second category are classified as semicritical in terms of the degree of risk of infection. Examples are noninvasive flexible and rigid fiberoptic endoscopes,

endotracheal tubes, anesthesia breathing circuits, and cystoscopes. Although these items come in contact with intact mucous membranes, they do not ordinarily penetrate body surfaces. If steam sterilization can be used, it is often cheaper to sterilize many of these items, but sterilization is not absolutely essential; at a minimum, a high-level disinfection procedure that can be expected to destroy vegetative microorganisms, most fungal spores, tubercle bacilli, and small nonlipid viruses is recommended. In most cases, meticulous physical cleaning followed by an appropriate high-level disinfection treatment gives the user a reasonable degree of assurance that the items are free of pathogens.

Noncritical items are those that either do not ordinarily touch the patient or touch only intact skin. Such items include crutches, bedboards, blood pressure cuffs, and a variety of other medical accessories. These items rarely, if ever, transmit disease. Consequently, depending on the particular piece of equipment or item, washing with a detergent may be sufficient.

The level of disinfection achieved depends on several factors, principally contact time, temperature, type and concentration of the active ingredients of the chemical germicide, and the nature of the microbial contamination. Some disinfection procedures are capable of producing sterility if the contact times used are sufficiently long; when these procedures are continued long enough to kill all but resistant bacterial spores, the result is high-level disinfection. Other disinfection procedures that can kill many types of viruses and most vegetative microorganisms (but cannot be relied upon to kill resistant microorganisms such as tubercle bacilli, bacterial spores, or certain viruses) are considered to be intermediate- or low-level disinfection (Table 1).

The tubercle bacillus, lipid and nonlipid viruses, and other groups of microorganisms in Table 1 are used in the context of indicator microorganisms that have varying degrees of resistance to chemical germicides and not necessarily because of their importance in causing nosocomial infections. For example, cells of *M. tuberculosis* or *M. bovis*, which are used in routine efficacy tests, are among the most resistant vegetative microorganisms known and, after bacterial endospores, constitute the most severe challenge to a chemical germicide. Thus, a tuberculocidal chemical germicide may be used as a high or intermediate-level disinfectant targeted to many types of nosocomial pathogens but not specifically to control respiratory tuberculosis.

CONTROL MEASURES

Since it is neither necessary nor possible to sterilize all patient-care items, hospital policies can identify whether cleaning, disinfecting, or sterilizing of an item is indicated to decrease the risk of infection. The process indicated for an item will depend on its intended use. Any microorganism, including bacterial spores, that come in contact with

normally sterile tissue can cause infection. Thus, it is important that all items that will touch normally sterile tissues be sterilized. It is less important that objects touching mucous membranes be sterile. Intact mucous membranes are generally resistant to infection by common bacterial spores but are not resistant to many other microorganisms, such as viruses and tubercle bacilli; therefore, items that touch mucous membranes require a disinfection process that kills all but resistant bacterial spores. In general, intact skin acts as an effective barrier to most microorganisms; thus, items that touch only intact skin need only be clean.

Items must be thoroughly cleaned before processing, because organic material (e.g., blood and proteins) may contain high concentrations of microorganisms. Also, such organic material may inactivate chemical germicides and protect microorganisms from the disinfection or sterilization process. For many noncritical items, such as blood pressure cuffs or crutches, cleaning can consist only of 1) washing with a detergent or a disinfectant-detergent, 2) rinsing, and 3) thorough drying.

Steam sterilization is the most inexpensive and effective method for sterilization. Steam sterilization is unsuitable, however, for processing plastics with low melting points, powders, or anhydrous oils. Items that are to be sterilized but not used immediately need to be wrapped for storage. Sterility can be maintained in storage for various lengths of time, depending on the type of wrapping material, the conditions of storage, and the integrity of the package.

Several methods have been developed to monitor steam sterilization processes. One method is to check the highest temperature that is reached during sterilization and the length of time that this temperature is maintained. In addition, heat- and steam-sensitive chemical indicators can be used on the outside of each pack. These indicators do not reliably document sterility, but they do show that an item has not accidentally bypassed a sterilization process. As an additional precaution, a large pack might have a chemical indicator both on the outside and the inside to verify that steam has penetrated the pack.

Microbiological monitoring of steam sterilizers is recommended at least once a week with commercial preparations of spores of *Bacillus stearothermophilus* (a microorganism having spores that are particularly resistant to moist heat, thus assuring a wide margin of safety). If a sterilizer is working properly and used appropriately, the spores are usually killed. One positive spore test (spores not killed) does not necessarily indicate that items processed in the sterilizer are not sterile, but it does suggest that the sterilizer should be rechecked for proper temperature, length of cycle, loading, and use and that the test be repeated. Spore testing of steam sterilization is just one of several methods for assuring adequate processing of patient-care items (Table 2).

Implantable items, such as orthopedic devices, require special handling before and during sterilization; thus, packs containing implantable objects need to be clearly labeled so they will be appropriately processed. To guarantee a wide margin of safety, it is recommended that each load of such items be tested with a spore test and that the sterilized item not be released for use until the

spore test is negative at 48 hours. If it is not possible to process an implantable object with a confirmed 48-hour spore test before use, it is recommended that the unwrapped object receive the equivalent of full-cycle steam sterilization and *not* flash sterilization. Flash sterilization [270°F (132°C) for 3 minutes in a gravity displacement steam sterilizer] is *not* recommended for implantable items because spore tests cannot be used reliably and the margin of safety is lower.

Because ethylene oxide gas sterilization is a more complex and expensive process than steam sterilization, it is usually restricted to objects that might be damaged by heat or excessive moisture. Before sterilization, objects also need to be cleaned thoroughly and wrapped in a material that allows the gas to penetrate. Chemical indicators need to be used with each package to show that it has been exposed to the gas sterilization process. Moreover, it is recommended that gas sterilizers be checked at least once a week with commercial preparations of spores, usually *Bacillus subtilis* var. *niger*. Because ethylene oxide gas is toxic, precautions (e.g., local exhaust ventilation) should be taken to protect personnel (2). All objects processed by gas sterilization also need special aeration according to manufacturer's recommendations before use to remove toxic residues of ethylene oxide.

Powders and anhydrous oils can be sterilized by dry heat. Microbiological monitoring of dry heat sterilizers and following manufacturers' recommendations for their use and maintenance usually provides a wide margin of safety for dry heat sterilization.

Liquid chemicals can be used for sterilization and disinfection when steam, gas, or dry heat sterilization is not indicated or available. With some formulations, high-level disinfection can be accomplished in 10-30 minutes, and sterilization can be achieved if exposure is for significantly longer times. Nevertheless, not all formulations are equally applicable to all items that need to be sterilized or disinfected. No formulation can be considered as an "all purpose" chemical germicide. In each case, more detailed information can be obtained from the EPA, descriptive brochures from the manufacturers, peer-review journal articles, and books. The most appropriate chemical germicide for a particular situation can be selected by responsible personnel in each hospital based on the object to be disinfected, the level of disinfection needed, and the scope of services, physical facilities, and personnel available in the hospital. It is also important that the manufacturer's instructions for use be consulted.

Gloves may be indicated to prevent skin reactions when some chemical disinfectants are used. Items subjected to high-level disinfection with liquid chemicals need to be rinsed in *sterile* water to remove toxic or irritating residues and then thoroughly dried. Subsequently, the objects need to be handled aseptically with sterile gloves and towels and stored in protective wrappers to prevent recontamination.

Hot-water disinfection (pasteurization) is a high-level, nontoxic disinfection process that can be used for certain items, e.g., respiratory therapy breathing circuits.

In recent years, some hospitals have considered reusing medical devices labeled disposable or single use only. In general, the primary, if not the sole, motivation for

such reuse is to save money. For example, the disposable hollow-fiber hemodialyzer has been reprocessed and reused on the same patient in hemodialysis centers since the early 1970s. By 1984, 51% of the 1,200 U.S. dialysis centers were using dialyzer reprocessing programs. It has been estimated that this practice saves more than 100 million dollars per year (3). When standard protocols for cleaning and disinfecting hemodialyzers are used, there does not appear to be any significant infection risk to dialysis patients (4). Moreover, the safety and efficacy of dialyzer reuse programs are supported by several major studies (5-7). Few, if any, other medical devices that might be considered candidates for reprocessing have been evaluated in this manner.

Arguments for and against reprocessing and reusing single-use items in the 1980's have been summarized (4). Since there is lack of evidence indicating increased risk of nosocomial infections associated with reusing *all* single-use items, a categorical recommendation against all types of reuse is not considered justifiable. Rather than recommending for or against reprocessing and reuse of all single-use items, it appears more prudent to recommend that hospitals consider the safety and efficacy of the reprocessing procedure of each item or device separately and the likelihood that the device will function as intended after reprocessing. In many instances it may be difficult if not impossible to document that the device can be reprocessed without residual toxicity and still function safely and effectively. Few, if any, manufacturers of disposable or single-use medical devices provide reprocessing information on the product label.

Hydrotherapy pools and immersion tanks present unique disinfection problems in hospitals. It is generally not economically feasible to drain large hydrotherapy pools that contain thousands of gallons of water after each patient use. Typically, these pools are used by a large number of patients and are drained and cleaned every one to two weeks. The water temperature is typically maintained near 37°C. Between cleanings, water can be contaminated by organic material from patients, and high levels of microbial contamination are possible. One method to maintain safe pool water is to install a water filter of sufficient size to filter all the water at least three times per day and to chlorinate the water so that a free chlorine residual of approximately 0.5 mg/l is maintained at a pH of 7.2 to 7.6. Local public health authorities can provide consultation regarding chlorination, alternate halogen disinfectants, and hydrotherapy pool sanitation.

Hubbard and immersion tanks present entirely different problems than large pools, since they are drained after each patient use. All inside surfaces need to be cleaned with a disinfectant-detergent, then rinsed with tap water. After the last patient each day, an additional disinfection step is performed. One general procedure is to circulate a chlorine solution (200-300 mg/l) through the agitator of the tank for 15 minutes and then rinse it out. It is also recommended that the tank be thoroughly cleaned with a disinfectant-detergent, rinsed, wiped dry with clean cloths, and not filled until ready for use.

An alternative approach to control of contamination in hydrotherapy tanks is to use plastic liners and create the "whirlpool effect" without agitators. Such liners make it

possible to minimize contact of contaminated water with the interior surface of the tank and also obviate the need for agitators that may be very difficult to clean and decontaminate.

RECOMMENDATIONS

1. Cleaning

All objects to be disinfected or sterilized should first be thoroughly cleaned to remove all organic matter (blood and tissue) and other residue. *Category I*

2. Indications for Sterilization and High-Level Disinfection

a. Critical medical devices or patient-care equipment that enter normally sterile tissue or the vascular system or through which blood flows should be subjected to a sterilization procedure before each use. *Category I*

b. Laparoscopes, arthroscopes, and other scopes that enter normally sterile tissue should be subjected to a sterilization procedure before each use; if this is not feasible, they should receive at least high-level disinfection. *Category I*

c. Equipment that touches mucous membranes, e.g., endoscopes, endotracheal tubes, anesthesia breathing circuits, and respiratory therapy equipment, should receive high-level disinfection. *Category I*

3. Methods of Sterilization

a. Whenever sterilization is indicated, a steam sterilizer should be used unless the object to be sterilized will be damaged by heat, pressure, or moisture or is otherwise inappropriate for steam sterilization. In this case, another acceptable method of sterilization should be used. *Category II*

b. Flash sterilization [270°F (132°C) for 3 minutes in a gravity displacement steam sterilizer] is not recommended for implantable items. *Category II*

4. Biological Monitoring of Sterilizers

a. All sterilizers should be monitored at least once a week with commercial preparations of spores intended specifically for that type of sterilizer (i.e., *Bacillus stearothermophilus* for steam sterilizers and *Bacillus subtilis* for ethylene oxide and dry heat sterilizers). *Category II*

b. Every load that contains implantable objects should be monitored. These implantable objects should not be used until the spore test is found to be negative at 48 hours. *Category II*

c. If spores are not killed in routine spore tests, the sterilizer should immediately be checked for proper use and function and the spore test repeated. Objects, other than implantable objects, do not need to be recalled because of a single positive spore test unless the sterilizer or the sterilization procedure is defective. *Category II*

d. If spore tests remain positive, use of the sterilizer should be discontinued until it is serviced.

Category I

5. Use and Preventive Maintenance

Manufacturers' instructions should be followed for use and maintenance of sterilizers. *Category II*

6. Chemical Indicators

Chemical indicators that will show a package has been through a sterilization cycle should be visible on the outside of each package sterilized. *Category II*

7. Use of Sterile Items

An item should not be used if its sterility is questionable, e.g., its package is punctured, torn, or wet. *Category I*

8. Reprocessing Single-Use or Disposable Items

a. Items or devices that cannot be cleaned and sterilized or disinfected without altering their physical integrity and function should not be reprocessed. *Category I*

b. Reprocessing procedures that result in residual toxicity or compromise the overall safety or effectiveness of the items or devices should be avoided. *Category I*

REFERENCES

1. Favero MS. Chemical disinfection of medical and surgical materials. In: Block SS, ed. *Disinfection, sterilization and preservation*. 3rd ed. Philadelphia: Lea and Febiger, 1983:469-92.

2. Fed Reg June 22, 1984. 29 CFR 1910. Occupational Exposure to Ethylene Oxide.

3. Romeo AA. The economics of reuse. In: *Reuse of disposable medical devices in the 1980's*. Proceedings of International Conference on the Reuse of Disposable Medical Devices in the 1980's. The Institute for Health Policy Analysis. Georgetown University Medical Center. 1984 Mar 29-30. Washington, D.C.: Institute for Health Policy Analysis, 1984:43-9.

4. Institute for Health Policy Analysis. Georgetown University Medical Center. *Proceedings of International Conference on the Reuse of Disposable Medical Devices in the 1980's*. March 29-30, 1984. Washington, D.C.

5. Jacobs C, Brunner FP, Chantler C, et al. Combined report on regular dialysis and transplantation in Europe VII. 1976. *Proc Eur Dial Transplant Assoc* 1977;14:3-69.

6. Levin N. Dialyzer re-use in a hospital. *Dial and Transplant* 1980;9(1):40-6.

7. Wing AJ, Brunner FP, Brynger H, et al. Mortality and morbidity of reusing dialyzers. *Br Med J* 1978;2:853-5.

Section 3: Microbiologic Sampling

INTRODUCTION

Before 1970, regularly scheduled culturing of the air and environmental surfaces such as floors, walls, and table tops was widely practiced in U.S. hospitals. By 1970, CDC and the American Hospital Association were advocating that hospitals discontinue routine environmental culturing, since rates of nosocomial infection had not been related to levels of general microbial contamination of air or environmental surfaces, and meaningful standards for permissible levels of microbial contamination of environmental surfaces did not exist (1,2). Between 1970 and 1975, 25% of U.S. hospitals reduced the extent of such routine environmental culturing (3), and this trend has continued.

In the last several years, there has also been a trend toward reducing routine microbiologic sampling for quality control purposes. In 1982, CDC recommended that the disinfection process for respiratory therapy equipment should not be monitored by routine microbiologic sampling (4). Moreover, the recommendation for microbiologic sampling of infant formulas prepared in the hospital has been removed from this *Guideline*, since there is no epidemiologic evidence to show that such quality control testing influences the infection rate in hospitals.

CONTROL MEASURES

The only routine or periodic microbiologic sampling that is recommended is of the water and dialysis fluids used with artificial kidney machines in hospital-based or free standing chronic hemodialysis centers. Microbiologic sampling of dialysis fluids and water used to prepare dialysis fluids is recommended because gram-negative bacteria are able to grow rapidly in water and other fluids associated with the hemodialysis system; high levels of these microorganisms place dialysis patients at risk of pyrogenic reactions, bacteremia, or both (5). It is suggested that the water that is used to prepare dialysis fluid also be sampled periodically, because high levels of bacteria in water often become amplified downstream in a hemodialysis system and are sometimes predictive of bacterial contamination in dialysis fluids. Although it is difficult to determine the exact frequency of such a sampling program in the absence of pyrogenic reactions and bacteremia, sampling water and dialysis fluid monthly appears to be reasonable.

Routine microbiologic sampling of patient-care items purchased as sterile is not recommended because of the difficulty and expense of performing adequate sterility testing with low-frequency contamination.

Microbiologic sampling is indicated during investigation of infection problems if environmental reservoirs are

implicated epidemiologically in disease transmission. It is important, however, that such culturing be based on epidemiologic data and follow a written plan that specifies the objects to be sampled and the actions to be taken based on culture results.

RECOMMENDATIONS

1. Routine Environmental Culturing of Air and Environmental Surfaces

Routine microbiologic sampling of the air and environmental surfaces should not be done. *Category I*

2. Microbiologic Sampling of Dialysis Fluids

Water used to prepare dialysis fluid should be sampled once a month; it should not contain a total viable microbial count greater than 200 colony-forming units (CFU)/ml. The dialysis fluid should be sampled once a month at the end of a dialysis treatment and should contain less than 2,000 CFU/ml. *Category II*

3. Microbiologic Sampling for Specific Problems

Microbiologic sampling, when indicated, should be an integral part of an epidemiologic investigation.

Category I

4. Sampling for Manufacturer-Associated Contamination

a. Routine microbiologic sampling of patient-care objects purchased as sterile is not recommended.

Category I

b. If contamination of a commercial product sold as sterile is suspected, infection control personnel should be notified, suspect lot numbers should be recorded, and items from suspected lots should be segregated and quarantined. Appropriate microbiologic assays may be considered; however, the nearest district office of the FDA, local and state health departments, and CDC should be notified promptly.

Category I

REFERENCES

1. Eickhoff TC. Microbiologic sampling. *Hospitals* 1970;44:86-7.
2. American Hospital Association Committee on Infections Within Hospitals. Statement on microbiologic sampling in the hospital. *Hospitals* 1974;48:125-6.
3. Haley RW, Shachtman RS. The emergence of infection surveillance and control programs in U.S. hospitals: an assessment, 1976. *Am J Epidemiol* 1980;111:574-91.
4. Simmons BP, Wong ES. Guideline for prevention of nosocomial pneumonia. *Infect Control* 1982;3:327-33.
5. Favero MS, Petersen NJ. Microbiologic guidelines for hemodialysis systems. *Dialys Transpl* 1977;6:34-6.

Section 4: Infective Waste

INTRODUCTION

There is no epidemiologic evidence to suggest that most hospital waste is any more infective than residential waste. Moreover, there is no epidemiologic evidence that hospital waste disposal practices have caused disease in the community. Therefore, identifying wastes for which special precautions are indicated is largely a matter of judgment about the relative risk of disease transmission. Aesthetic and emotional considerations may override the actual risk of disease transmission, particularly for pathology wastes.

Since a precise definition of infective waste that is based on the quantity and type of etiologic agents present is virtually impossible, the most practical approach to infective waste management is to identify those wastes that represent a sufficient potential risk of causing infection during handling and disposal and for which some special precautions appear prudent. Hospital wastes for which special precautions appear prudent include microbiology laboratory waste, pathology waste, and blood specimens or blood products. Moreover, the risk of either injury or infection from certain sharp items (e.g., needles and scalpel blades) contaminated with blood also needs to be considered when such items are disposed of. While any item that has had contact with blood, exudates, or secretions may be potentially infective, it is not normally considered practical or necessary to treat all such waste as infective. CDC has published general recommendations for handling infective waste from patients on isolation precautions (1). Additional special precautions may be necessary for certain rare diseases or conditions such as Lassa fever (2). The EPA has published a draft manual (Environmental Protection Agency, Office of Solid Waste and Emergency Response. Draft Manual for Infectious Waste Management, SW-957, 1982. Washington: 1982) that identifies and categorizes other specific types of waste that may be generated in some research-oriented hospitals. In addition to the above guidelines, local and state environmental regulations may also exist.

CONTROL MEASURES

Solid waste from the microbiology laboratory can be placed in steam-sterilizable bags or pans and steam-sterilized in the laboratory. Alternatively, it can be transported in sealed, impervious plastic bags to be burned in a hospital incinerator. A single bag is probably adequate if the bag is sturdy (not easily penetrated) and if the waste can be put in the bag without contaminating the outside of the bag; otherwise, double-bagging is indicated. All slides or tubes with small amounts of blood can be packed in sealed, impervious containers and sent for incineration or steam sterilization in the hospital. Exposure for up to 90 minutes at 250°F (121°C) in a steam sterilizer, depending on the size of the load and type container, may be necessary to assure an adequate sterilization cycle (3,4). After steam sterilization, the residue can be safely handled and discarded with all other nonhazardous hospital solid waste. All containers with more than a few milliliters of blood remaining after laboratory procedures

and/or bulk blood may be steam sterilized, or the contents may be carefully poured down a utility sink drain or toilet.

Waste from the pathology laboratory is customarily incinerated at the hospital. Although no national data are available, in one state 96% of the hospitals surveyed reported that they incinerate pathology waste (5). Any hospital incinerator should be capable of burning, within applicable air pollution regulations, the actual waste materials to be destroyed. Improper incineration of waste with high moisture and low energy content, such as pathology waste, can lead to emission problems.

Disposables that can cause injury, such as scalpel blades and syringes with needles, should be placed in puncture-resistant containers. Ideally, such containers are located where these items are used. Syringes and needles can be placed intact directly into the rigid containers for safe storage until terminal treatment. To prevent needle-stick injuries, needles should not be recapped, purposely bent, or broken by hand. When some needle-cutting devices are used, blood may be aerosolized or splattered onto environmental surfaces; however, currently no data are available from controlled studies examining the effect, if any, of the use of these devices on the incidence of needle-transmissible infections.

It is often necessary to transport or store infective waste within the hospital prior to terminal treatment. This can be done safely if proper and common-sense procedures are used. The EPA draft manual mentioned above contains guidelines for the storage and transport, both on-site and off-site, of infective waste. For unique and specialized problems, this manual can be consulted.

RECOMMENDATIONS

1. Identification of Infective Waste

- a. Microbiology laboratory wastes, blood and blood products, pathology waste, and sharp items (especially needles) should be considered as potentially infective and handled and disposed of with special precautions. *Category II*
- b. Infective waste from patients on isolation precautions should be handled and disposed of according to the current edition of the *Guideline for Isolation Precautions in Hospitals*. (This recommendation is not categorized since the recommendations for isolation precautions are not categorized.)

2. Handling, Transport, and Storage of Infective Waste

- a. Personnel involved in the handling and disposal of infective waste should be informed of the potential health and safety hazards and trained in the appropriate handling and disposal methods. *Category II*
- b. If processing and/or disposal facilities are not available at the site of infective waste generation (i.e., laboratory, etc.) the waste may be safely transported in sealed impervious containers to another hospital area for appropriate treatment. *Category II*
- c. To minimize the potential risk for accidental transmission of disease or injury, infective waste awaiting

terminal processing should be stored in an area accessible only to personnel involved in the disposal process. *Category III*

3. Processing and Disposal of Infective Waste

- a. Infective waste, in general, should either be incinerated or should be autoclaved prior to disposal in a sanitary landfill. *Category III*
- b. Disposable syringes with needles, scalpel blades, and other sharp items capable of causing injury should be placed intact into puncture-resistant containers located as close to the area in which they were used as is practical. To prevent needle-stick injuries, needles should not be recapped, purposely bent, broken, or otherwise manipulated by hand. *Category I*
- c. Bulk blood, suctioned fluids, excretions, and secretions may be carefully poured down a drain connected to a sanitary sewer. Sanitary sewers may also be used for the disposal of other infectious wastes capable of being ground and flushed into the sewer.

Category II (Special precautions may be necessary for certain rare diseases or conditions such as Lassa fever (2).)

REFERENCES

1. Garner JS, Simmons BP. Guideline for isolation precautions in hospitals. *Infect Control* 1983;4:245-325.
2. Centers for Disease Control. Viral hemorrhagic fever: initial management of suspected and confirmed cases. *MMWR (suppl)* 1983;32:275-405.
3. Rutala WA, Stiegel MM, Sarubbi FA. Decontamination of laboratory microbiological waste by steam sterilization. *Appl Environ Microbiol* 1982;43:1311-6.
4. Lauer JL, Battles DR, Vesley D. Decontaminating infectious laboratory waste by autoclaving. *Appl Environ Microbiol* 1982;44:690-4.
5. Rutala WA, Sarubbi FA. Management of infectious waste from hospitals. *Infect Control* 1983;4:198-203.

Section 5: Housekeeping

INTRODUCTION

Although microorganisms are a normal contaminant of walls, floors, and other surfaces, these environmental surfaces rarely are associated with transmission of infections to patients or personnel. Therefore, extraordinary attempts to disinfect or sterilize these environmental surfaces are rarely indicated. However, routine cleaning and removal of soil are recommended. Recommendations for cleaning in the rooms of patients on isolation precautions have been published (1).

CONTROL MEASURES

Cleaning schedules and methods vary according to the area of the hospital, type of surface to be cleaned, and the amount and type of soil present. Horizontal surfaces (for example, bedside tables and hard-surfaced flooring) in patient-care areas are usually cleaned on a regular basis, when soiling or spills occur, and when a patient is discharged. Cleaning of walls, blinds, and curtains is recommended only if they are visibly soiled. Disinfectant fogging is an unsatisfactory method of decontaminating air and surfaces and is not recommended.

Recommendations against use of carpets in patient-care areas have been removed from this *Guideline*, since there is no epidemiologic evidence to show that carpets influence the nosocomial infection rate in hospitals (2). Carpets, however, may contain much higher levels of microbial contamination than hard-surfaced flooring and can be difficult to keep clean in areas of heavy soiling or spillage; therefore, appropriate cleaning and maintenance procedures are indicated.

Disinfectant-detergent formulations registered by the EPA can be used for environmental surface cleaning, but the actual physical removal of microorganisms by scrubbing is probably as important, if not more so, than any antimicrobial effect of the cleaning agent used. Therefore, cost, safety, and acceptability by housekeepers can be the main criteria for selecting any such registered agent. The manufacturers' instructions for appropriate use should be followed.

Special precautions for cleaning incubators, mattresses, and other nursery surfaces with which neonates

have contact have been recommended (3), since inadequately diluted solutions of phenolics used for such cleaning and poor ventilation have been associated with hyperbilirubinemia in newborns (4).

RECOMMENDATIONS

1. **Choice of Cleaning Agent for Environmental Surfaces in Patient-Care Areas**
Any hospital-grade disinfectant-detergent registered by the EPA may be used for cleaning environmental surfaces. Manufacturers' instructions for use of such products should be followed. *Category II*
2. **Cleaning of Horizontal Surfaces in Patient-care Areas**
 - a. Uncarpeted floors and other horizontal surfaces, e.g., bedside tables, should be cleaned regularly and if spills occur. *Category II*
 - b. Carpeting should be vacuumed regularly with units designed to efficiently filter discharged air, cleaned if spills occur, and shampooed whenever a thorough cleaning is indicated. *Category II*
3. **Cleaning Walls, Blinds, and Curtains**
Terminal cleaning of walls, blinds, and curtains is not recommended unless they are visibly soiled. *Category II*
4. **Disinfectant fogging**
Disinfectant fogging should not be done. *Category I*

REFERENCES

1. Garner JS, Simmons BP. Guideline for isolation precautions in hospitals. *Infect Control* 1983;4:245-325.
2. Anderson RL, Mackel DC, Stoler ES, Mallison GF. Carpeting in hospitals: An epidemiological evaluation. *J Clin Microbiol* 1982;15:408-15.
3. American Academy of Pediatrics, American College of Obstetricians and Gynecologists. Guidelines for perinatal care. Evanston, Illinois, Washington, D.C.: AAP, ACOG, 1983.
4. Wysowski DK, Flynt JW, Goldfield M, et al. Epidemic neonatal hyperbilirubinemia and use of a phenolic disinfectant detergent. *Pediatrics* 1978;61:165-70.

Section 6: Laundry

INTRODUCTION

Although soiled linen has been identified as a source of large numbers of pathogenic microorganisms, the risk of actual disease transmission appears negligible. Rather than rigid rules and regulations, hygienic and common-sense storage and processing of clean and soiled linen are recommended. Guidelines for laundry construction and operation for health care facilities have been published (1,2).

CONTROL MEASURES

Soiled linen can be transported in the hospital by cart or chute. Bagging linen is indicated if chutes are used, since improperly designed chutes can be a means of spreading microorganisms throughout the hospital (3). Recommendations for handling soiled linen from patients on isolation precautions have been published (4).

Soiled linen may or may not be sorted in the laundry before being loaded into washer/extractor units. Sorting before washing protects both machinery and linen from the effects of objects in the linen and reduces the potential for recontamination of clean linen that sorting after washing requires. Sorting after washing minimizes the direct exposure of laundry personnel to infective material in the soiled linen and reduces airborne microbial contamination in the laundry (5). Protective apparel and appropriate ventilation (2) can minimize these exposures.

The microbicidal action of the normal laundering process is affected by several physical and chemical factors (5). Although dilution is not a microbicidal mechanism, it is responsible for the removal of significant quantities of microorganisms. Soaps or detergents loosen soil and also have some microbicidal properties. Hot water provides an effective means of destroying microorganisms, and a temperature of at least 71°C (160°F) for a minimum of 25 minutes is commonly recommended for hot-water washing. Chlorine bleach provides an extra margin of safety. A total available chlorine residual of 50-150ppm is usually achieved during the bleach cycle. The last action performed during the washing process is the addition of a mild acid to neutralize any alkalinity in the water supply, soap, or detergent. The rapid shift in pH from approximately 12 to 5 also may tend to inactivate some microorganisms.

Recent studies have shown that a satisfactory reduction of microbial contamination can be achieved at lower water temperatures of 22-50°C when the cycling of the washer, the wash formula, and the amount of chlorine bleach are carefully monitored and controlled (6,7). Instead of the microbicidal action of hot water, low-temperature laundry cycles rely heavily on the presence of bleach to reduce levels of microbial contamination.

Regardless of whether hot or cold water is used for washing, the temperatures reached in drying and especially during ironing provide additional significant microbicidal action.

RECOMMENDATIONS

1. Routine Handling of Soiled Linen

- a. Soiled linen should be handled as little as possible and with minimum agitation to prevent gross microbial contamination of the air and of persons handling the linen. *Category II*
- b. 1) All soiled linen should be bagged or put into carts at the location where it was used; it should *not* be sorted or prerinsed in patient-care areas. *Category II*
2) Linen soiled with blood or body fluids should be deposited and transported in bags that prevent leakage. *Category II*
- c. If laundry chutes are used, linen should be bagged, and chutes should be properly designed. *Category II*

2. Hot-Water Washing

If hot water is used, linen should be washed with a detergent in water at least 71°C (160°F) for 25 minutes. *Category II*

3. Low-Temperature Water Washing

If low temperature (<70°C) laundry cycles are used, chemicals suitable for low-temperature washing at proper use concentration should be used. *Category II*

4. Transportation of Clean Linen

Clean linen should be transported and stored by methods that will ensure its cleanliness. *Category II*

REFERENCES

1. U.S. Department of Health and Human Services. Guidelines for construction and equipment of hospital and medical facilities. Washington: Government Printing Office, July 1984. DHHS publication No. (HRS-M-HF) 84-1.
2. Joint Committee on Health Care Laundry Guidelines. Guidelines for healthcare linen service. Mallandale, FL: Textile Rental Services Association of America, 1983; TRSA publication no. 71482.
3. Hughes HG. Chutes in hospitals. *J Can Hosp Asso* 1964;41:56-7.
4. Garner JS, Simmons BP. Guideline for isolation precautions in hospitals. *Infect Control* 1983;4:245-325.
5. Walter WG, Schillinger JE. Bacterial survival in laundered fabrics. *Appl Microbiol* 1975;29:368-73.
6. Christian RR, Manchester JT, Mellor MT. Bacteriological quality of fabrics washed at lower-than-standard temperatures in a hospital laundry facility. *Appl Env Microbiol* 1983;45:591-7.
7. Blaser MJ, Smith PF, Cody HJ, Wang WL, LaForce FM. Killing of fabric-associated bacteria in hospital laundry by low-temperature washing. *J Infect Dis* 1984;149:48-57.

Table 1. Levels of Disinfection According to Type of Microorganism

Levels	Vegetative	Bacteria	Spores	Fungi ¹	Viruses	
		Tubercle Bacillus			Lipid & Medium size	Nonlipid & Small
High	+ ²	+	+ ³	+	+	+
Intermediate	+	+	± ⁴	+	+	±
Low	+	-	-	±	+	-

¹Includes asexual spores but not necessarily chlamydo spores or sexual spores.

²Plus sign indicates that a killing effect can be expected when the normal use-concentrations of chemical disinfectants or pasteurization are properly employed; a negative sign indicates little or no killing effect.

³Only with extended exposure times are high-level disinfectant chemicals capable of actual sterilization.

⁴Some intermediate-level disinfectants can be expected to exhibit some sporicidal action.

⁵Some intermediate-level disinfectants may have limited virucidal activity.

Table 2. Methods of Assuring Adequate Processing and Safe Use of Medical Devices

Object and Classification	Example	Method	Comment
PATIENT-CARE OBJECTS			
Critical			
Sterilized in the hospital	Surgical instruments and devices; trays and sets	<ol style="list-style-type: none"> 1. Thoroughly clean objects and wrap or package for sterilization. 2. Follow manufacturer's instructions for use of each sterilizer or use recommended protocol. 3. Monitor time-temperature charts. 4. Use commercial spore preparations to monitor sterilizers. 5. Inspect package for integrity and for exposure of sterility indicator before use. 6. Use before maximum safe storage time has expired if applicable. 	Sterilization processes are designed to have a wide margin of safety. If spores are not killed, the sterilizer should be checked for proper use and function; if spore tests remain positive, discontinue use of the sterilizer until properly serviced. Maximum safe storage time of items processed in the hospital varies according to type of package or wrapping material(s) used; follow manufacturer's instructions for use and storage times.
Purchased as sterile	Intravenous fluids; irrigation fluids; normal saline; trays and sets	<ol style="list-style-type: none"> 1. Store in safe, clean area. 2. Inspect package for integrity before use. 3. Use before expiration date if one is given. 4. Culture only if clinical circumstances suggest infection related to use of the item. 	Notify the Food and Drug Administration, local and state health departments, and CDC if intrinsic contamination is suspected.
Semicritical			
Should be free of vegetative bacteria. May be subjected to high-level disinfection rather than sterilization process	Respiratory therapy equipment and instruments that will touch mucous membranes	<ol style="list-style-type: none"> 1. Sterilize or follow a protocol for high-level disinfection. 2. Bag and store in safe, clean area. 3. Conduct quality control monitoring after any important changes in the disinfection process. 	Bacterial spores may survive after high-level disinfection, but these usually are not pathogenic. Microbiologic sampling can verify that a high-level disinfection process has resulted in destruction of vegetative bacteria; however, this sampling is not routinely recommended.
Non critical			
Usually contaminated with some bacteria	Bedpans; crutches; rails; EKG leads	<ol style="list-style-type: none"> 1. Follow a protocol for cleaning or, if necessary a low-level disinfection process. 	
Water-produced or treated	Water used for hemodialysis fluids	<ol style="list-style-type: none"> 1. Assay water and dialysis fluids monthly. 2. Water should not have more than 200 bacteria/ml and dialysis fluids not more than 2000 bacteria/ml. 	Gram-negative water bacteria can grow rapidly in water and dialysis fluids and can place dialysis patients at risk of pyrogenic reactions or septicemia. These water sources and pathways should be disinfected routinely.

★ U.S. GOVERNMENT PRINTING OFFICE: 1996 549-180/40031

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