Sources of Infection in Long-Term Care Facility - Environmental Issues

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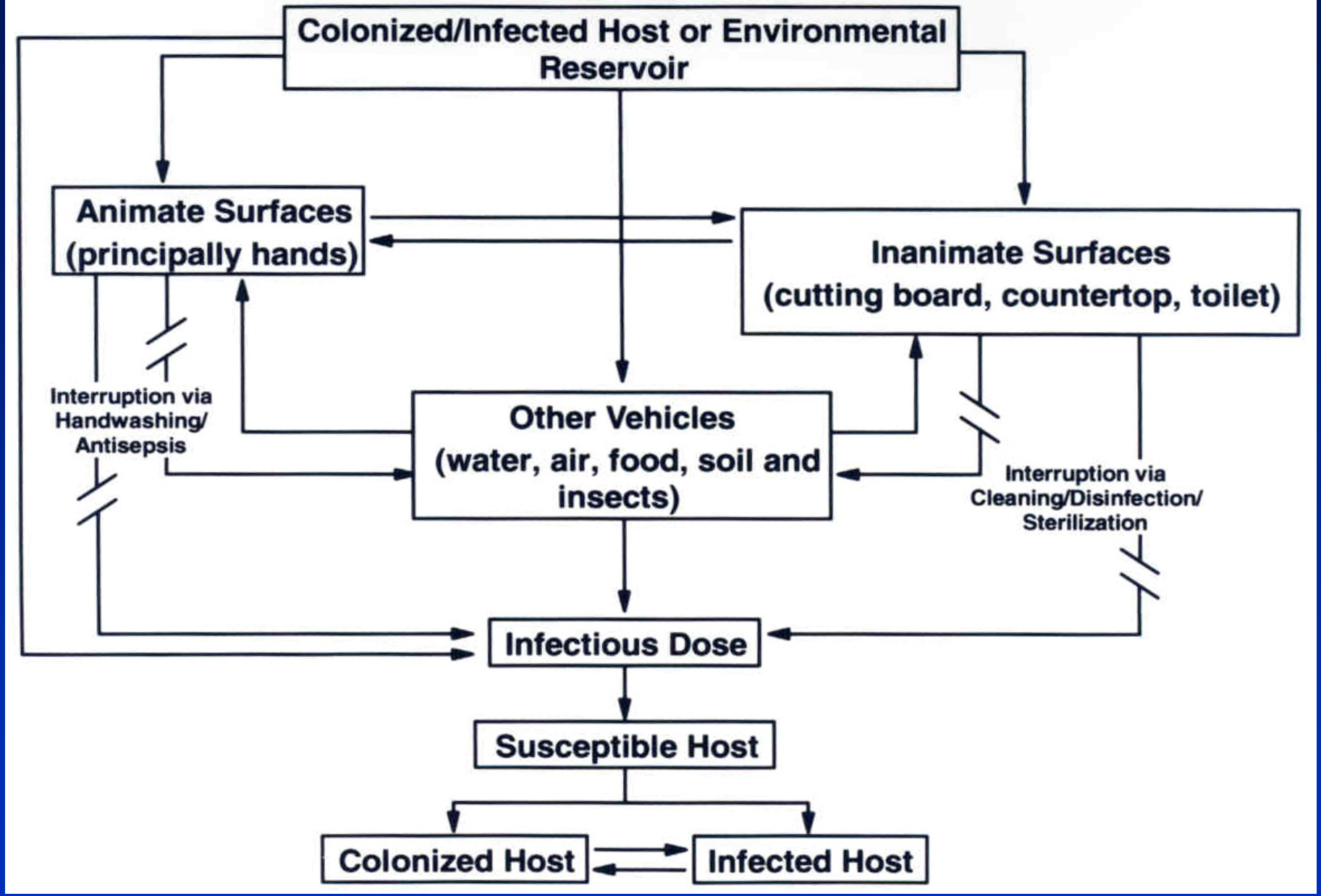
Goal: Review CDC GUIDELINES FOR ENVIRONMENTAL INFECTION CONTROL IN HEALTHCARE FACILITIES, 2003

- Review recommendations for:
  - Air
  - Water
  - Environmental Services
  - Environmental Sampling
  - Animals in Healthcare Facilities
  - Linens and Laundry
  - Regulated Medical Waste

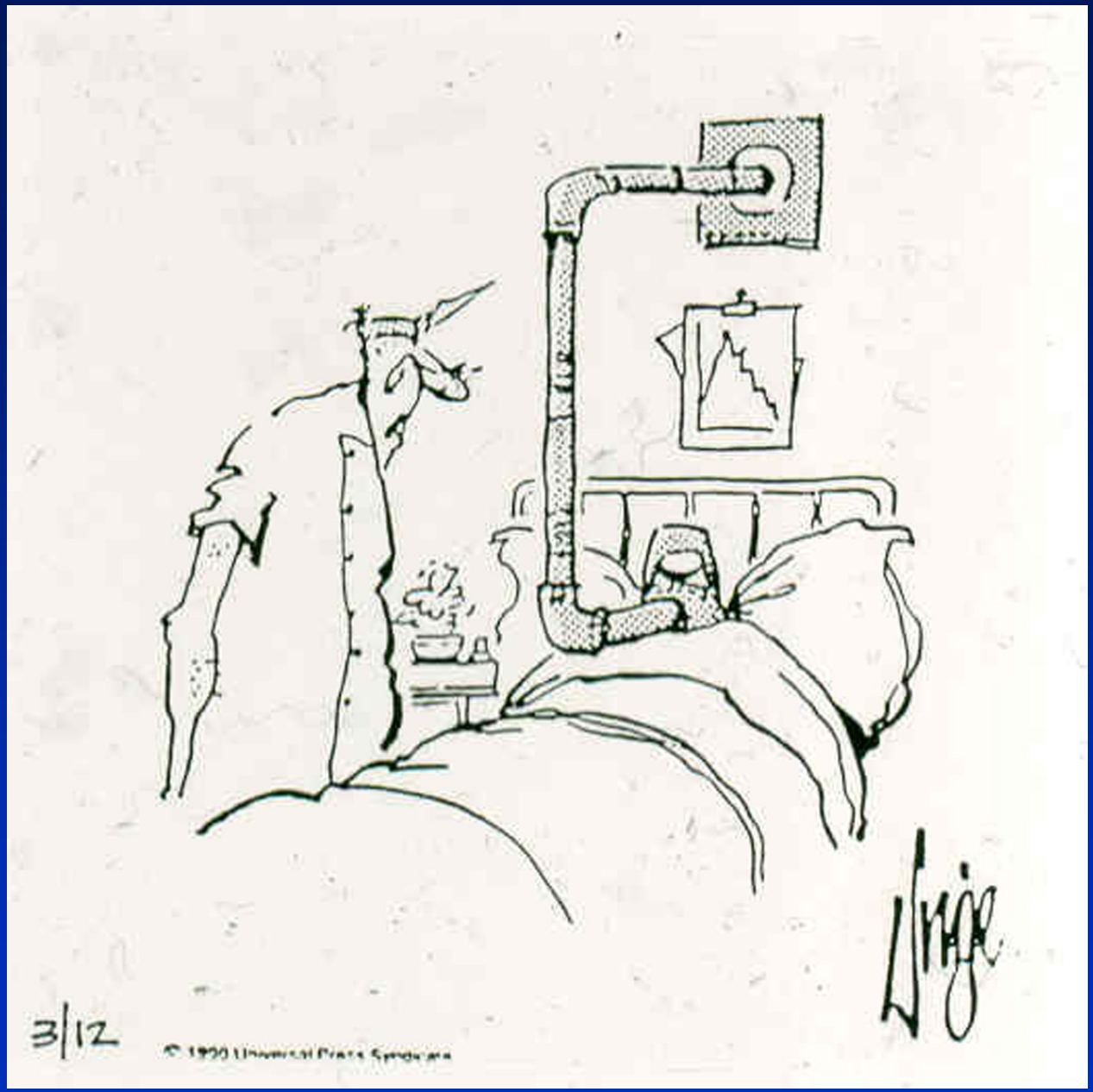
CDC GUIDELINES

- Ranking of Recommendations
  - Category IA-strongly recommended and strongly

    supported by studies
  - Category IB-strongly recommended and supported by some studies and strong theoretical rationale
  - Category IC-required by regulatory agencies
  - Category II-suggested for implementation



Transmission of infectious agents via animate and inanimate surfaces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AIRBORNE/DROPLET HAIs: FUNGI

- *Aspergillus*
- *Zygomycetes*
  - *Mucoraceae*
    - *Rhizomucor*
    - *Rhizopus*
    - *Absidia*

AIRBORNE FUNGAL OUTBREAKS

Requirements

- Susceptible host
- Reservoir
- Source
- Infecting dose inhaled (most dependent on concentration of fungi in the air)

INVASIVE ASPERGILLUS: RISK FACTORS

- Bone marrow transplantation
- Solid organ transplant: Liver, kidney, lung
- Hematologic malignancy, especially with neutropenia
- Corticosteroids, especially high-dose
- Chronic granulomatous disease
- Extensive burn wounds
- Late stage HIV infection

INVASIVE ZYGOMYCETES: RISK FACTORS

- Diabetes mellitus, especially with ketoacidosis
- Solid organ transplant
- Bone marrow transplantation
- Severe underlying disease
- Hematologic malignancy
- Wounds, especially extensive burns

AIRBORNE FUNGAL OUTBREAKS

Outside - 16

- Pigeon excreta 2
- Pigeon excreta/moss 1
- Intrinsic contamination bandage material 1 2
- Roof helipad 1
- Unknown 10

Inside - 25

- Dust above false ceiling fireproof material 1
- Dust above false ceiling 6
- Contaminated filter 4
- Potted plants 2
- Vacuum cleaner 1
- Stockinette 1
- Unknown 10

MECHANISM OF INFECTION

- Inside Source - 25
  - Peritoneal dialysis - 1
  - Construction, renovation - 9
    - (Dust above false ceiling/fireproofing material - 6)
  - Contaminated ventilation system - 8
    - (Changing filters - 1)
    - (Exhaust fan shut down - 1)
    - (Contaminated room air conditioner - 2)
  - Miscellaneous: Arm board - 2, potted plants - 2, vacuum cleaner/specimen transport system 1, stockinette 1, kitchen 1

WATER AS A SOURCE OF NOSOCOMIAL OUTBREAKS

WATER RESERVOIRS

- Potable water
- Sinks
- Faucet aerators
- Showers
- Tub immersion
- Toilets
- Dialysis water
- Ice and ice machines
- Water baths
- Flowers
- Eye wash stations

LEGIONELLA: EPIDEMIOLOGY

- 10,000 - 40,000 cases/yr US (1-5% of adult pneumonia)
- Reservoir: Ubiquitous in aquatic environments
- Associated with devices that produce potable or non-potable water aerosols (e.g., cooling towers, evaporative condensers, showers, faucets, decorative water fountains, whirlpool baths, ice machines, medication nebulizers, nasogastric feedings diluted in tap water)
- Transmission: Inhalation of aerosols (no person-to-person transmission)

CDC GUIDELINES :CONTROLLING WATERBORNE MICROORGANISMS

- Water Systems in HCF
  - Hot water temp at the outlet at the highest temp allowable, preferable >124^{0}F (IC)
  - When state regulations do not allow hot water temp >120^{0}F, chlorinate the water or periodically increase >150^{0}F (II)
  - Water disruptions: post signs and do not drink tap water (IB, IC)

LEGIONELLA: CONTROL MEASURES

- Establish surveillance system (IB)
- No recommendation on culturing water in HCF that do not have patients at high-risk for *Legionella* (transplant)(unresolved issue)
- One laboratory-confirmed case of *Legionella,* or two cases suspected, conduct epidemiological and investigation (IB).

ICE AND ICE MACHINES

Control Measures

- Do not handle ice by hand (II)
- Use scoop to dispense ice and keep scoop on chain (II)
- Do not store pharmaceuticals or medical solutions on ice intended for consumption (IB)
- Limit access to ice-storage chests (II)
- Clean and disinfect ice-storage chests on a regular basis (eg, monthly)(II)

HYDROTHERAPY TANKS AND POOLS

- Used in hospitals for physical therapy for cleaning of burn wounds and birthing
- Skin infections have occurred related to water immersion
  - “Hot tube” folliculitis
  - Cellulitis (rare)
- Typical pathogens
  - Folliculitis: *Pseudomonas aeruginosa*
  - Cellulitis: *Citrobacter*

HYDROTHERAPY TANKS AND POOLS

- Drain after each patient, and disinfect surfaces and components per recommendations (II)
- Add disinfectant to the water: 15 ppm in small hydrotherapy tanks and 2-5 ppm in whirlpools (II)
- Disinfect after using tub liners (II)
- No recommendation for antiseptic in water during hydrotherapy session (unresolved)

ENVIRONMENTAL SURFACES

- Disinfect non-critical medical equipment surfaces with a EPA-registered hospital disinfectant (II)
- Keep housekeeping surfaces visibly clean using an EPA-registered disinfectant (II) or detergent and water
- Clean walls, blinds, and window curtains when visibly soiled (II)
- Do not do disinfectant fogging (IB)
- Clean/disinfectant blood spills per OSHA (IC)
- Prepare cleaning solutions daily or as needed (II)

CARPETS

- Carpets are heavily colonized with potential pathogens (10^5 bacteria/sq in)
- No evidence that carpets influence healthcare- associated infections
- **Control measures:** avoid in high-traffic zones in patient-care areas or where spills are likely (IB), clean carpet periodically (II)

FLOWERS

- Flower vases and potted plants are heavily colonized with potential pathogens
  - Vase water colonized with 10^7 - 10^{10} bacteria/ml
- No outbreaks directly linked to flower vases or potted plants
- **Control Measures:** Flowers and potted plants need not be restricted from immunocompetent patients (II); designate the care of flowers and potted plants to staff not involved in patient care (II)

Role of Surfaces in Transmission

Pathogens implicated in transmission via contaminated noncritical surfaces. Patients C/I with these pathogens contaminate the environment and these pathogens survive in the environment.

- Bacteria
  - Methicillin-resistant *Staphylococcus aureus*
  - Vancomycin-resistant *Enterococcus spp*.
  - *Clostridium difficile*
  - *Acinetobacter* and *P. aeruginosa*
- Viruses
  - Rotavirus
  - Norovirus
  - SARS coronavirus

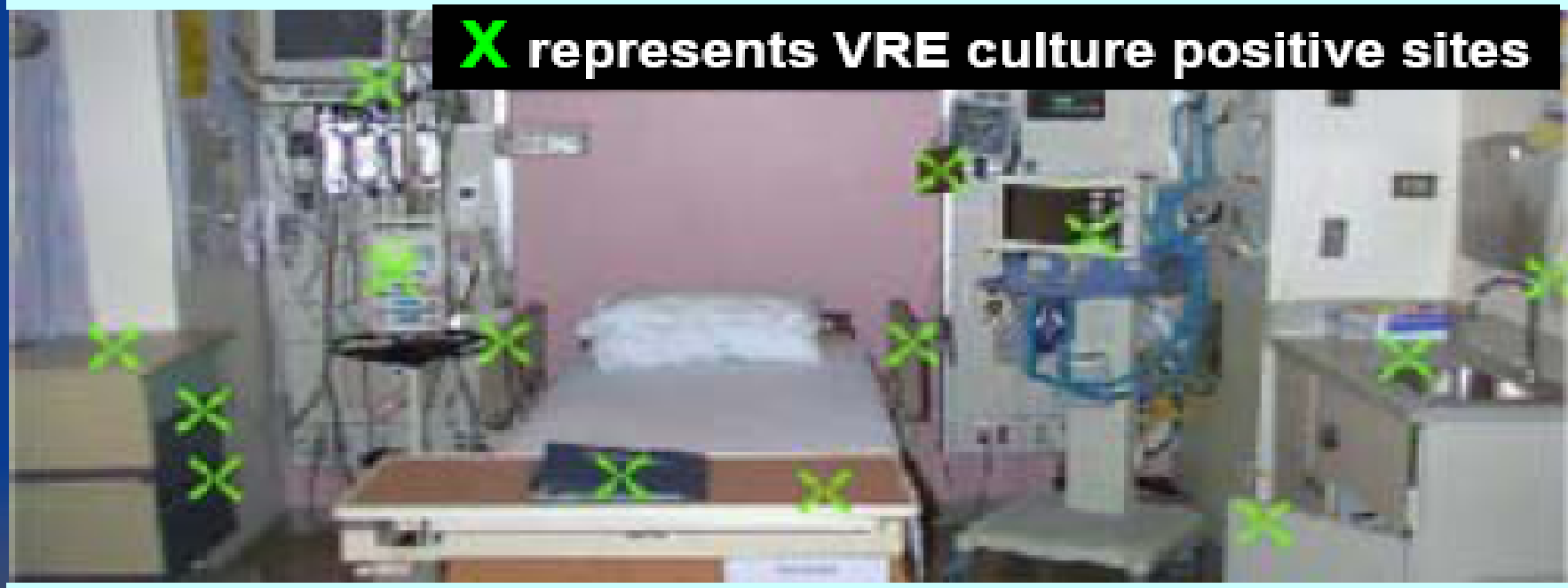
Environmental Contamination
MRSA

- 27% of 350 surfaces sampled in the rooms of affected patients were contaminated with MRSA. When patients had MRSA in a wound or urine, 36% of surfaces were contaminated. Boyce et al. ICHE 1997;18:622.
- 74% of 359 swabs taken before cleaning yielded MRSA. French et al. J Hosp Infect 2004;57:31

C. difficile Environmental Contamination

- Frequency of sites found contaminated~10->50% from 13 studies-Stethoscopes, bed frames/rails, call buttons, sinks, hospital charts, toys, floors, windowsills, commodes, toilets, bedsheets, scales, blood pressure cuffs, phones, door handles, electronic thermometers, flow-control devices for IV catheter, feeding tube equipment, bedpan hoppers
- *C. difficile* spore load is low; 7 studies assessed the spore load and most found <10 colonies on surfaces found to be contaminated. Two studies reported >100; one reported a range of “1->200” and one study sampled several sites with a sponge and found 1,300 colonies *C. difficile*.

The Inanimate Environment Can Facilitate Transmission



~ Contaminated surfaces increase cross-transmission ~

Abstract: The Risk of Hand and Glove Contamination after Contact with a VRE (+) Patient Environment. Hayden M, ICAAC, 2001, Chicago, IL.

VRE ENVIRONMENTAL SURVIVAL

- Enterococcus
- Countertops: *E. faecalis* = 5 d, *E. faecium* = 7 d
- Bedrails = 24 hours
- Telephone handpieces = 60 minutes
- Stethoscopes = 30 minutes
- Gloved and ungloved fingers >60 minutes

Noskin G, et al. ICHE 1995;16:577-581.

VRE SURFACE DISINFECTION

Cleaning Method	Exp. Runs (mean CFU)	% Reduction
Dry Cloth	2 (431)	89.4
Wet Cloth	2 (408)	99.6
Spray Cloth (QUAT)	2 (32)	100
Immersed Cloth (QUAT), 1 min	4 (481)	99.8

SPECIAL PATHOGENS

- Ensure compliance with disinfection procedures (IB)
- Pay special attention to cleaning and disinfecting high-touch surfaces (carts, charts, bedrails) (IB)
- Use appropriate handwashing and PPE during cleaning and disinfecting procedures (IB)

MICROBIOLOGIC SAMPLING OF THE ENVIRONMENT

- Targeted microbiological sampling
  - Support of an investigation of an outbreak
  - Research
  - Monitor a potentially hazardous environmental condition
  - Quality assurance

MICROBIOLOGIC SAMPLING OF THE ENVIRONMENT

- History
  - Pre-1970, hospitals regularly cultured air and surfaces
  - By 1970, AHA advocated discontinuation because HAI not associated with levels of microbes in the air and surfaces; not cost-effective
  - In 1981, CDC recommended targeted sampling

    (eg, sterilizers and dialysis water)

MICROBIOLOGIC SAMPLING OF THE ENVIRONMENT

- Do not conduct random microbiological sampling of air, water, and surfaces (IB)
- When indicated, conduct microbiologic sampling as part of an epidemiologic investigation (IB)
- Limit microbiologic sampling for QA to: biological monitoring, dialysis water, or evaluation of infection control measures (IB)

MICROBIOLOGIC SAMPLING OF THE ENVIRONMENT

- Select a high-volume sampler if level of microbial contamination are expected to be low (II)
- When sampling water, choose media and incubation temp to facilitate recovery (II)
- When conducting environmental sampling, document departures from standard methods (II)

LAUNDRY AND BEDDING

- Although fabrics in healthcare facilities can be a source of large numbers of microorganisms 10^6-10^8 CFU/100 cm^2, the risk of disease transmission during the laundry process appears to be negligible
- OSHA defines contaminated laundry as “soiled with blood or OPIM or may contain sharps”

Environmental Sampling

- Situations
  - Quality assurance such as assuring that equipment or systems have performed to specifications
  - Support of an investigation of an outbreak of disease or infections if environmental reservoir is implicated
  - Research purposes using a well-designed and controlled experimental method
  - Monitor a potentially hazardous environmental condition

ANIMALS

- General Infection Control
  - Minimize contact with animal saliva, urine, feces (II)
  - Practice hand hygiene after animal contact (II)
- Protection for Immunocompromised Patients
  - Conduct a case-by-case assessment to determine animal contact is appropriate (II)
  - No recommendation on pet visits to terminally IC patients outside their PE units (unresolved)

ANIMALS

- Service Animals
  - Avoid the use of nonhuman primates/reptiles (IB)
  - Allow service animals unless the animal creates a threat to other persons or interferes with the provision of services (IC)
  - If separated from handler, designate a responsible person to supervise (II)

ANIMALS

- Pet Visitation, Pet Therapy
  - Enroll animals that are fully vaccinated, healthy, clean, negative for enteric pathogens (II)
  - Ensure the animals are trained and supervised (II)
  - Conduct pet therapy in a public area of the facility (II)
  - Use routine cleaning protocols for surfaces (II)
  - Restrict animals from access to patients-care areas, ORs, isolation, PE, places where people eat (II)

LAUNDRY AND BEDDING

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LAUNDRY AND BEDDING

- If hot-water laundry cycles are used, wash with detergent in water at least 160^{o}F for at least 25 min (IC)
- If low-temperature (<160^{o}F) cycles are used, use chemicals suitable for low temperature washing at proper use concentration (II)
- Package, transport and store clean fabrics by methods that ensure their cleanliness (II)

LAUNDRY AND BEDDING

- Bag or contain contaminated laundry at the point of use (IC)
- Do not sort or pre-rinse fabrics at the point of use (IC)
- Do not conduct routine microbiological sampling of clean linens (IB)
- Use sterilized linens, drapes, and gowns for situations requiring sterility (IB)

LAUNDRY AND BEDDING

- Clean and disinfect mattress covers by using disinfectants that are compatible (IB)
- Keep mattresses dry (IB)
- Replace mattress if they become torn (II)
- Air-fluidized beds: change the polyesters filter sheet at least weekly (II); clean/disinfect the polyester filter thoroughly, especially between patients (IB)

CDC GUIDELINES:REGULATED MEDICAL WASTE (RMW)

- Major categories of RMW: microbiology; pathology; bulk blood; sharps (II)
- Develop a plan for collection and disposal of RMW (IC)
- Sharps into puncture-resistant containers (IC)
- Biosafety levels 1 and 2 should autoclave on-site (II); BL 3 must autoclave/incinerate (II)
- Decontaminate blood VHF before disposal (IC)


Ohmeda Modulus II Plus
Anesthesia System

North Carolina Medical Waste Rules

Regulated Medical Waste Definitions

Microbiological - cultures and stocks of infectious agents

Pathological - human tissues, organs and body parts; carcasses and body parts of animals exposed to pathogens

Blood - liquid blood, serum, plasma, other blood products, emulsified human tissue, spinal fluids, and pleural and peritoneal fluids; in individual containers in volumes greater than 20 ml (bloody gauze, used gloves, tubing and dressings are not regulated medical waste).

North Carolina Medical Waste Rules

- Definition - “sharps” means and includes needles, syringes with attached needles, capillary tubes, slides, cover slips and scalpel blades.
- Requirement - sharps will be placed in a container which is rigid, leakproof when in an upright position and puncture-resistant. Contained sharps shall not be compacted prior to off-site transportation.
- Treatment - none required. The package may be disposed with general solid waste.

North Carolina Medical Waste Rules

Regulated Medical Waste Treatment*

Microbiological - incineration, steam sterilization or chemical treatment

Pathological - incineration

Blood and body fluids in individual containers in volumes greater than 20 ml - incineration or sanitary sewage systems, provided the sewage treatment authority is notified.

*Other methods of treatment shall require approval by the Division of Solid Waste Management

REFERENCES

- Weber DJ, Rutala WA. Environmental issues and nosocomial infections. In: Prevention and Control of Nosocomial Infections. Ed: Wenzel RP. 3rd Edition. Williams & Wilkins, 1997.
- CDC HICPAC Guidelines for Environmental Infection Control in Healthcare Facilities, 2003. MMWR. 52: RR-10:1-44.

QUESTIONS