“BEST” PRACTICES FOR DISINFECTION OF NON-CRITICAL SURFACES AND EQUIPMENT AND MEDICAL WASTE MANAGEMENT

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LECTURE OBJECTIVES

- Review the CDC Guideline for Disinfection and Sterilization: Focus on role of environmental surfaces
- Review “best” practices for environmental cleaning and disinfection
- Review the use of low-level disinfectants and the activity of disinfectants on key hospital pathogens
- Review medical waste management

“BEST” PRACTICES

- There is limited scientific evidence to inform us on cleaning/disinfecting practices and frequency
- There is little scientific evidence that disinfecting schedules should emphasize certain “high-risk” or “high-touch” sites


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ENVIRONMENTAL CONTAMINATION LEADS TO HAIs

- There is increasing evidence to support the contribution of the environment to disease transmission
- This supports comprehensive disinfecting regimens (goal is not sterilization) to reduce the risk of acquiring a pathogen from the healthcare environment/equipment

DISINFECTION AND STERLIZATION

- EH Spaulding believed that how an object will be disinfected depended on the object's intended use
  - CRITICAL - objects which enter normally sterile tissue or the vascular system or through which blood flows should be sterile
  - SEMICRITICAL - objects that touch mucous membranes or skin that is not intact require a disinfection process (high-level disinfection[HLD]) that kills all microorganisms; however, small numbers of bacterial spores are permissible.
  - NONCRITICAL -objects that touch only intact skin require low-level disinfection

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GUIDELINE FOR DISINFECTION AND STERILIZATION IN HEALTHCARE FACILITIES, 2008

Rutala WA, Weber DJ., HICPAC

Available on CDC web page-www.cdc.gov

CDC Guideline for Disinfection and Sterilization

Rutala, Weber, HICPAC. November 2008. www.cdc.gov

Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008

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William A. Rutala, Ph.D., M.P.H.[1,2], David J. Weber, M.D., M.P.H.[1,2], and the Healthcare Infection Control Practices Advisory Committee (HICPAC)[3]

Blood Pressure Cuff
Non-Critical Patient Care Item

DISINFECTION OF NONCRITICAL PATIENT-CARE DEVICES

- Process noncritical patient-care devices using a disinfectant and concentration of germicide as recommended in the Guideline (IB)
- Disinfect noncritical medical devices (e.g., blood pressure cuff) with an EPA-registered hospital disinfectant using the label's safety precautions and use directions. Most EPA-registered hospital disinfectants have a label contact time of 10 minutes but multiple scientific studies have demonstrated the efficacy of hospital disinfectants against pathogens with a contact time of at least 1 minute (IB)
- Ensure that, at a minimum noncritical patient-care devices are disinfected when visibly soiled and on a regular basis (e.g., once daily or weekly) (II)
- If dedicated, disposable devices are not available, disinfect noncritical patient-care equipment after using on a patient, who is on contact precautions before using this equipment on another patient (IB)


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CLEANING AND DISINFECTION OF ENVIRONMENTAL SURFACES IN HEALTHCARE FACILITIES

- Clean housekeeping surfaces (e.g., floors, tabletops) on a regular basis, when spills occur, and when these surfaces are visibly soiled (II)
- Disinfect (or clean) environmental surfaces on a regular basis (e.g., daily, 3x per week) and when surfaces are visibly soiled (II)
- Follow manufacturers' instructions for proper use of disinfecting (or detergent) products – such as recommended use-dilution, material compatibility, storage, shelf-life, and safe use and disposal (II)
- Clean walls, blinds, and window curtains in patient-care areas when these surfaces are visibly contaminated or soiled (II)
- Prepare disinfecting (or detergent) solutions as needed and replace with fresh solution frequently (e.g., replace floor mopping solution every 3 patient rooms, change no less often than at 60-minute intervals) (IB)

REVIEW THE “BEST” PRACTICES FOR CLEANING AND DISINFECTING

Cleaning and disinfecting is one-step with disinfectant-detergent. No pre-cleaning necessary unless spill or gross contamination. In many cases “best” practices not scientifically determined.

ALL “TOUCHABLE” (HAND CONTACT) SURFACES SHOULD BE WIPED WITH DISINFECTANT

“High touch” objects only recently defined (no significant differences in microbial contamination of different surfaces) and “high risk” objects not epidemiologically defined.

DAILY CLEANING/DISINFECTING PRACTICES

Hota et al. J Hosp Infect 2009;71:123

- Wash hands thoroughly and put on gloves
- Place wet floor sign at door
- Discard disposable items and remove waste and soiled linen
- Disinfect (damp wipe) all horizontal, vertical and contact surfaces with a cotton cloth saturated (or microfiber) with a disinfectant-detergent solution.

DAILY CLEANING/DISINFECTING PRACTICES

Hota et al. J Hosp Infect 2009;71:123

- These surfaces (wipe all surfaces) include, but are not limited to:
  - Bed rails
  - Overbed table
  - Infusion pumps
  - IV poles/Hanging IV poles
  - Nurse call box
  - Monitor cables
  - Telephone
  - Countertops

DAILY CLEANING/DISINFECTING PRACTICES

Hota et al. J Hosp Infect 2009;71:123

- These surfaces include, but not limited to:
  - Soap dispenser
  - Paper towel dispenser
  - Cabinet fronts including handles
  - Visitor chair
  - Door handles inside and outside
  - Sharps container
  - TV remote, bed call remote
  - Bathroom-toilet seat, shower fixtures, flush handle

DAILY CLEANING/DISINFECTING PRACTICES

Hota et al. J Hosp Infect 2009;71:123

- Spot clean walls (when visually soiled) with disinfectant-detergent and windows with glass cleaner
- Clean and disinfect sink and toilet
- Stock soap and paper towel dispensers
- Damp mop floor with disinfectant-detergent
- Inspect work
- Remove gloves and wash hands

DAILY CLEANING/DISINFECTING PRACTICES

Hota et al. J Hosp Infect 2009;71:123

- Use EPA-registered disinfectant-detergent (if prepared on-site, document correct concentration)
- Cleaned surface should appear visibly wet and should be allowed to air dry at least one minute
- Change cotton mop water containing disinfectant every 3 rooms and after every isolation room
- Change cotton mop head after isolation room and after BBP spills (change microfiber after each room)

DAILY CLEANING/DISINFECTING PRACTICES

Hota et al. J Hosp Infect 2009;71:123

- Cleaning should be from the cleanest to dirtiest areas (the bathroom will be cleaned last followed by the floor)
- Change cleaning cloths after every room and use at least 3 cloths per room; typically 5-7 cloths
- Do not place cleaning cloth back into the disinfectant solution after using it to wipe a surface
- Daily cleaning of certain patient equipment is the responsibility of other HCP (RC, nursing). Surfaces should be wiped with a clean cloth soaked in disinfectant

TERMINAL CLEANING/DISINFECTING PRACTICES

Hota et al. J Hosp Infect 2009;71:123

- "Terminal" or discharge cleaning of non-isolation rooms consists of the same procedure above plus disinfection of bed mattresses and inaccessible items
- Trash can cleaned weekly and when visible soiled
- Do not wash walls, strip and wax floors, or discard wrapped disposable supplies left in drawers

ISOLATION ROOM CLEANING

- ES staff use PPE required by the isolation card
- Same cleaning procedures as for non-isolation rooms (except *C. difficile*, norovirus)
- Do not use a dust mop or counter brush
- Leave the room only when completed (unless requested to leave by nurse or doctor)

Perioperative Practice: Environmental Cleaning

AORN: 2014 Edition (p255-276)

- A multidisciplinary team should develop C/D procedures for managing contamination
- A clean environment should be reestablished after the patient
  - Items used during surgical procedure should be C/D (OR beds, anesthesia carts/machines, positioning devices, Mayo stands)
  - Floors/walls C/D after each surgical procedure if contaminated
- Terminal cleaning performed daily when used
  - C/D all exposed surfaces (anesthesia machine, OR beds, overhead lights, stools, positioning devices, etc)

SHOULD WE CONCENTRATE ON “HIGH TOUCH” OR “HIGH RISK” OBJECTS

No, not only “high risk” (all surfaces).
“High touch” objects only recently defined and “high risk” objects not scientifically defined.

TABLE. Rates of Cleaning for 14 Types of High-Risk Objects

Object	Percentage cleaned		95% CI
	Mean ± SD	Range	
Sink	82 ± 12	57-97	77-88
Toilet seat	76 ± 18	40-98	68-84
Tray table	77 ± 15	53-100	71-84
Bedside table	64 ± 22	23-100	54-73
Toilet handle	60 ± 22	23-89	50-69
Side rail	60 ± 21	25-96	51-69
Call box	50 ± 19	9-90	42-58
Telephone	49 ± 16	18-86	42-56
Chair	48 ± 28	11-100	35-61
Toilet door knobs	28 ± 22	0-82	18-37
Toilet hand hold	28 ± 23	0-90	18-38
Bedpan cleaner	25 ± 18	0-79	17-33
Room door knobs	23 ± 19	2-73	15-31
Bathroom light switch	20 ± 21	0-81	11-30

NOTE. CI, confidence interval.


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"The patient in the next bed is highly infectious. Thank God for these curtains."

Hospital Privacy Curtains

(sprayed “grab area” 3x from 6-8” with 1.4% IHP and allowed 2 minute contact; sampled)

Decontamination of Curtains with Activated HP (1.4%)

Rutala, Gergen, Weber. Am J Infect Control. 2014;42:426-428

CP for:	Before Disinfection CFU/5 Rodacs (#Path)	After Disinfection CFU/5 Rodacs (#Path)	% Reduction
MRSA	330 (10 MRSA)	21*(0 MRSA)	93.6%
MRSA	186 (24 VRE)	4* (0 VRE)	97.9%
MRSA	108 (10 VRE)	2* (0 VRE)	98.2%
VRE	75 (4 VRE)	0 (0 VRE)	100%
VRE	68 (2 MRSA)	2* (0 MRSA)	97.1%
VRE	98 (40 VRE)	1* (0 VRE)	99.0%
MRSA	618 (341 MRSA)	1* (0 MRSA)	99.8%
MRSA	55 (1 VRE)	0 (0 MRSA)	100%
MRSA, VRE	320 (0 MRSA, 0 VRE)	1* (0 MRSA, 0 VRE)	99.7%
MRSA	288 (0 MRSA)	1* (0 MRSA)	99.7%
Mean	2146/10=215 (432/10=44)	33*/10=3 (0)	98.5%

* **All isolates after disinfection were *Bacillus sp;* now treat CP patient curtains at discharge**

TERMINAL CLEANING PRACTICE

- Some hospitals change curtains after Contact Precaution patients
- At UNC Health Care, privacy curtains are changed routinely every 3 months or when visible soiled
- In Contact Precaution rooms, frequently touched surfaces of the curtains should be sprayed with approved disinfectant (e.g., improved HP)
- Vinyl shower curtains are cleaned when visibly soiled or replaced as needed

Cleaning/Disinfection

- ES and nursing need to agree on who is responsible for cleaning what (especially equipment)
- ES needs to know
  - Which disinfectant/detergent to use
  - What concentration would be used (and verified)
  - What contact times are recommended (bactericidal)
  - How often to change cleaning cloths/mop heads
  - How important their job is to infection prevention

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DISINFECTING NONCRITICAL PATIENT EQUIPMENT AND ENVIRONMENTAL SURFACES

Classification:	Noncritical objects will not come in contact with mucous membranes or skin that is not intact.
Object:	Can be expected to be contaminated with some microorganisms.
Level germicidal action:	Kill vegetative bacteria, fungi and lipid viruses.
Examples:	Bedpans; crutches; bed rails; EKG leads; bedside tables; walls, floors and furniture.
Method:	Low-level disinfection

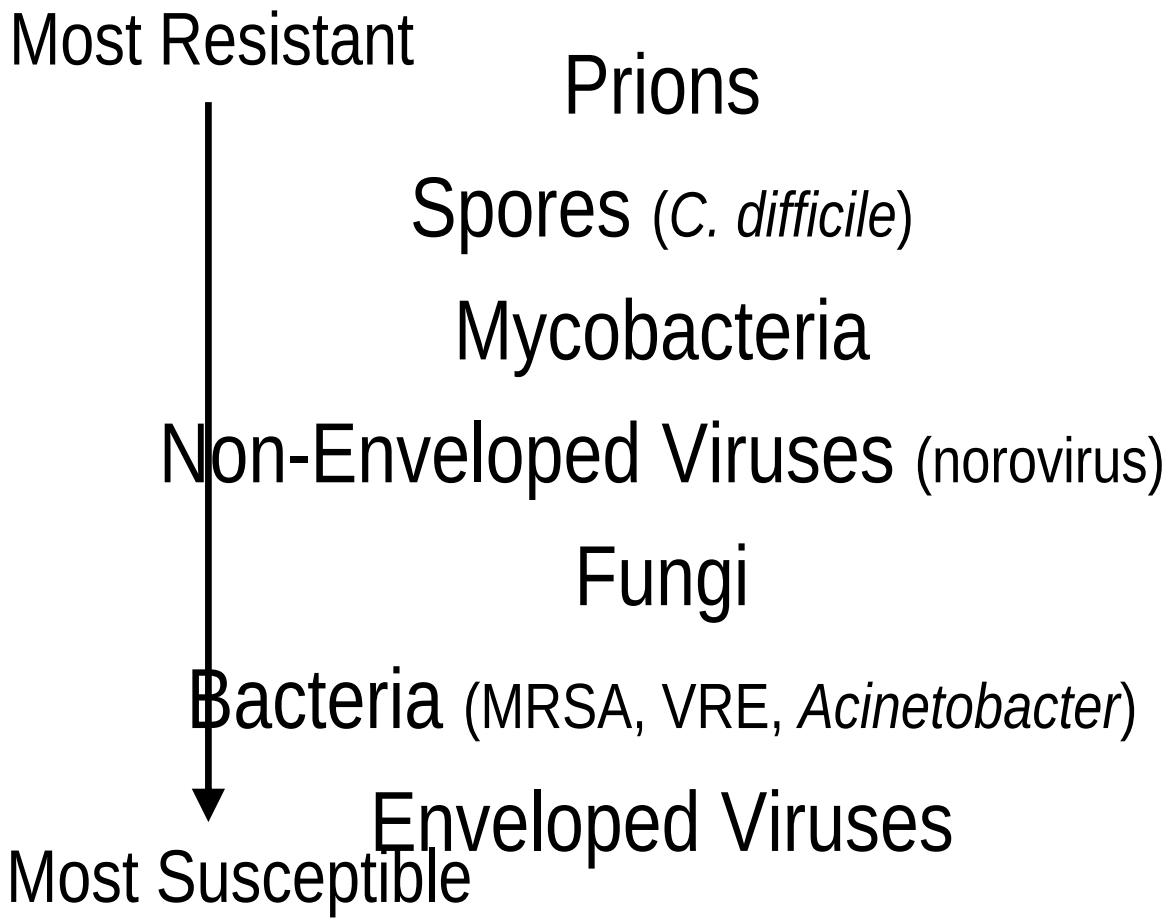
LOW-LEVEL DISINFECTION FOR NONCRITICAL EQUIPMENT AND SURFACES

Exposure time ≥ 1 min

Germicide	Use Concentration
Ethyl or isopropyl alcohol	70-90%
Chlorine	100ppm (1:500 dilution)
Phenolic	UD
Iodophor	UD
Quaternary ammonium (QUAT)	UD
QUAT with alcohol	RTU
Improved hydrogen peroxide (HP)	0.5%, 1.4%
Peracetic acid with HP (*C. difficile*)	UD

UD=Manufacturer's recommended use dilution; others in development/testing-electrolyzed water; polymeric guanidine; cold-air atmospheric pressure plasma (Boyce Antimicrob Res IC 2016. 5:10)

Decreasing Order of Resistance of Microorganisms to Disinfectants/Sterilants



MOST PREVALENT PATHOGENS CAUSING HAI

Rutala, Weber. Infect Control Hosp Epidemiol. 2014;35:855-865

- Most prevent pathogens causing HAI (~75% easy to kill)
  - *S. aureus* (15.6%)
  - *E. coli* (11.5%)
  - Coag neg Staph (11.4%)
  - *Klebsiella* (8.0%)
  - *P. aeruginosa* (8.0%)
  - *E. faecalis* (6.8%)
  - *C. albicans* (5.3%)
  - *Enterobacter* sp. (4.7%)
  - Other *Candida* sp (4.2%)
  - *C. difficile* in top 2-3 past 5 years
- Common causes of outbreaks and ward closures (relatively hard to kill)
  - *C. difficile* spores
  - Norovirus
  - Rotavirus
  - Adenovirus

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PROPERTIES OF AN IDEAL DISINFECTANT

Rutala, Weber. Infect Control Hosp Epidemiol. 2014;35:855-865

- Broad spectrum-wide antimicrobial spectrum
- Fast acting-should produce a rapid kill
- Remains Wet-meet listed kill/contact times with a single application
- Not affected by environmental factors-active in the presence of organic matter
- Nontoxic-not irritating to user
- Surface compatibility-should not corrode instruments and metallic surfaces
- Persistence-should have sustained antimicrobial activity
- Easy to use
- Acceptable odor
- Economical-cost should not be prohibitively high
- Soluble (in water) and stable (in concentrate and use dilution)
- Cleaner (good cleaning properties) and nonflammable

Key Considerations for Selecting the Ideal Disinfectant for Your Facility

Rutala, Weber. Infect Control Hosp Epidemiol. 2014;35:855-865

Consideration	Question to Ask	Score (1-10)
Kill Claims	Does the product kill the most prevalent healthcare pathogens	
Kill Times and Wet-Contact Times	How quickly does the product kill the prevalent healthcare pathogens. Ideally, contact time greater than or equal to the kill claim.	
Safety	Does the product have an acceptable toxicity rating, flammability rating	
Ease-of-Use	Odor acceptable, shelf-life, in convenient forms (wipes, spray), water soluble, works in organic matter, one-step (cleans/disinfects)	
Other factors	Supplier offer comprehensive training/education, 24-7 customer support, overall cost acceptable (product capabilities, cost per compliant use, help standardize disinfectants in facility)	

Note: Consider the 5 components shown, give each product a score (1 is worst and 10 is best) in each of the 5 categories, and select the product with the highest score as the optimal choice (maximum score is 50).

Quaternary ammonium compounds

(e.g., didecyl dimethyl ammonium bromide, dioctyl dimethyl ammonium bromide)
Rutala, Weber. Am J Infect Control 2013;41:S36-S41

Advantages

- Bactericidal, fungicidal, virucidal against enveloped viruses (e.g., HIV)
- Good cleaning agents
- EPA registered
- Surface compatible
- Persistent antimicrobial activity when undisturbed
- Inexpensive (in dilutable form)
- Not flammable

Disadvantages

- Not sporicidal
- In general, not tuberculocidal and virucidal against non-enveloped viruses
- High water hardness and cotton/gauze can make less microbicidal
- A few reports documented asthma as result of exposure to benzalkonium chloride
- Affected by organic matter
- Multiple outbreaks ascribed to contaminated benzalkonium chloride

Alcohol

Rutala, Weber. Am J Infect Control 2013;41:S36-S41

Advantages

- Bactericidal, tuberculocidal, fungicidal, virucidal
- Fast acting
- Non-corrosive
- Non-staining
- Used to disinfect small surfaces such as rubber stoppers on medication vials
- No toxic residue

Disadvantages

- Not sporicidal
- Affected by organic matter
- Slow acting against non-enveloped viruses (e.g., norovirus)
- No detergent or cleaning properties
- Not EPA registered
- Damage some instruments (e.g., harden rubber, deteriorate glue)
- Flammable (large amounts require special storage)
- Evaporates rapidly making contact time compliance difficult
- Not recommended for use on large surfaces
- Outbreaks ascribed to contaminated alcohol

Quat/Alcohol vs Quat

Rutala et al. Antimicrob Agents Chemother 2006. 50:1419-1424

- Adenovirus is a hardy virus that is relatively resistant to disinfectants
- Quat about <0.5 $\log_{10}$ reduction against adenovirus with 1m exposure time
- Accelerated hydrogen peroxide (0.5%) demonstrates ~0.7 $\log_{10}$ reduction against adenovirus with 1m exposure time
- Quat/Alcohol demonstrates a ~4 $\log_{10}$ reduction against adenovirus with 1m exposure time
- Chlorine (~5000ppm) demonstrates a ~5 $\log_{10}$ reduction against adenovirus with 1m exposure time
- Quat/Alcohol has improved virucidal activity compared to Quat and accelerated hydrogen peroxide

Improved Hydrogen Peroxide

Rutala, Weber. Am J Infect Control 2013;41:S36-S41

Advantages

- Bactericidal, tuberculocidal, fungicidal, virucidal
- Fast efficacy
- Easy compliance with wet-contact times
- Safe for workers (lowest EPA toxicity category, IV)
- Benign for the environment
- Surface compatible
- Non-staining
- EPA registered
- Not flammable

Disadvantages

- More expensive than most other disinfecting actives
- Not sporicidal at low concentrations

Sodium Hypochlorite

Rutala, Weber. Am J Infect Control 2013;41:S36-S41

Advantages

- Bactericidal, tuberculocidal, fungicidal, virucidal
- Sporicidal
- Fast acting
- Inexpensive (in dilutable form)
- Not flammable
- Unaffected by water hardness
- Reduces biofilms on surfaces
- Relatively stable (e.g., 50% reduction in chlorine concentration in 30 days)
- Used as the disinfectant in water treatment
- EPA registered

Disadvantages

- Reaction hazard with acids and ammonias
- Leaves salt residue
- Corrosive to metals (some ready-to-use products may be formulated with corrosion inhibitors)
- Unstable active (some ready-to-use products may be formulated with stabilizers to achieve longer shelf life)
- Affected by organic matter
- Discolors/stains fabrics
- Potential hazard is production of trihalomethane
- Odor (some ready-to-use products may be formulated with odor inhibitors). Irritating at high concentrations.

Phenolics

Rutala, Weber. Am J Infect Control 2013;41:S36-S41

Advantages

- Bactericidal, tuberculocidal, fungicidal, virucidal
- Inexpensive (in dilutable form)
- Non-staining
- Not flammable
- EPA registered

Disadvantages

- Not sporicidal
- Absorbed by porous materials and irritate tissue
- Depigmentation of skin caused by certain phenolics
- Hyperbilirubinemia in infants when phenolic not prepared as recommended

ALL “TOUCHABLE” (HAND CONTACT) SURFACES SHOULD BE WIPED WITH DISINFECTANT

“High touch” objects only recently defined (no significant differences in microbial contamination of different surfaces) and “high risk” objects not epidemiologically defined.

Effective Surface Decontamination

Product and Practice = Perfection

MICROBIAL BURDEN ON ROOM SURFACES AS A FUNCTION OF FREQUENCY OF TOUCHING

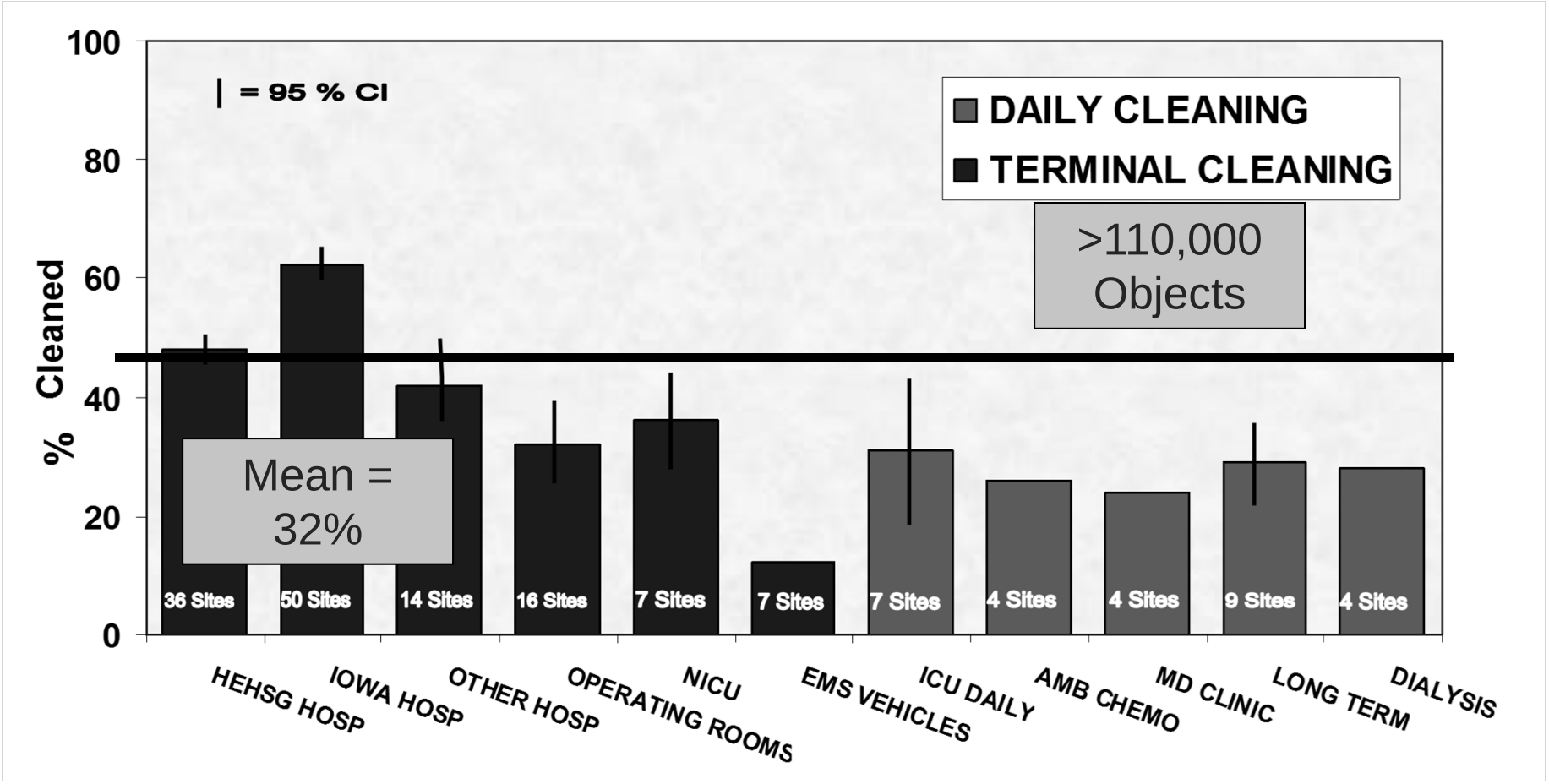
Huslage K, Rutala WA, Weber DJ. ICHE. 2013;34:211-212

Surface	Prior to Cleaning	Post Cleaning (mean)
	Mean CFU/RODAC (95% CI)	Mean CFU/RODAC (95% CI)
High	71.9 (46.5-97.3)	9.6
Medium	44.2 (28.1-60.2)	9.3
Low	56.7 (34.2-79.2)	5.7

- The level of microbial contamination of room surfaces is similar regardless of how often they are touched both before and after cleaning
- Therefore, all surfaces that are touched must be cleaned and disinfected

Thoroughness of Environmental Cleaning

Carling P. AJIC 2013;41:S20-S25



Wipes

Cotton, Disposable, Microfiber, Cellulose-Based, Nonwoven Spunlace

WIPES

Rutala, Weber. Infect Control Hosp Epidemiol. 2014;35:855-865

- Wipes-cotton, disposable, microfiber, nonwoven spunlace
- Wipe should have sufficient wetness to achieve the disinfectant contact time. Discontinue use of the wipe if no longer leaves the surface visible wet for $\geq$ 1 minute.
- When the wipe is visibly soiled, flip to a clean/unused side and continue until all sides of the wipe have been used (or get another wipe)
- Dispose of the wipe/cloth wipe appropriately
- Do not re-dip a wipe into the clean container of pre-saturated wipes

DISPOSABLE WIPES

Rutala, Weber. Infect Control Hosp Epidemiol. 2014;35:855-865

- Wetness-ideally, stays wet long enough to meet EPA-registered contact times (e.g., bacteria-1 minute).
- Surface Coverage-premoistened wipe keeps surface area wet for 1-2 minutes (e.g., 12”x12” wipes keep 55.5 sq ft wet for 2m; 6”x5” equipment wipe keeps 6.7 sq ft wet for 2m). Wipe size based on use from small surfaces to large surfaces like mattress covers
- Durable substrate-will not easily tear or fall apart
- Top-keep closed or wipes dry out

Surface Disinfection: Treatment Time (Wipes/Sprays) versus Contact Time (Liquids)

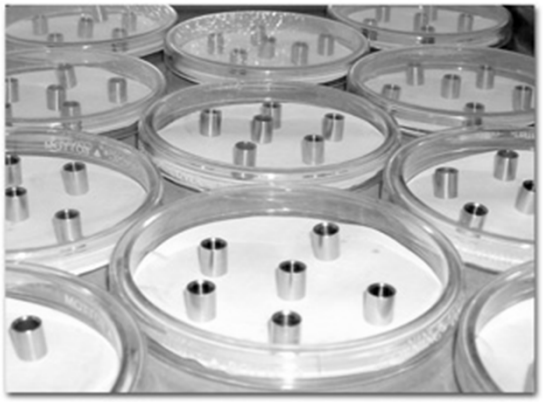
Dilutable liquid disinfectant-contact time is "wet" time

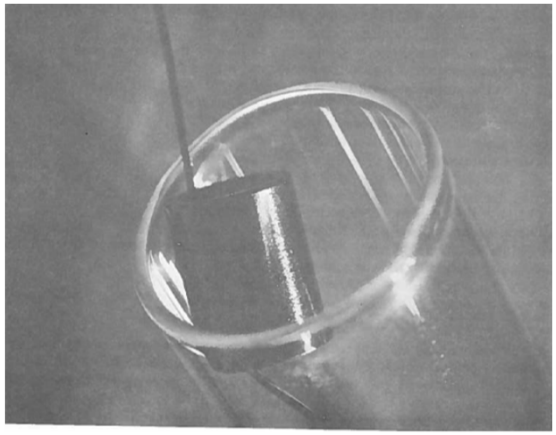
Wipes/Sprays-treatment time is undisturbed time ("wet" time is not relevant)

Surface Disinfection:

Treatment Time (Wipes/Sprays) versus Contact Time (Liquids)

Rutala, Weber. Submitted for publication





- Registration test for liquid disinfectants is the AOAC Use-Dilution Method (UDM).
- SS cylinders are inoculated with the test organism (*S. aureus, S. choleraesuis, P. aeruginosa*) and then dried. After drying, the cylinder is transferred to a disinfectant tube and immersed in the disinfectant for the contact time (e.g., 5 minutes).
- Thus, for liquid disinfectants tested by the UDM, the contact time should be the “wet” time (not undisturbed time).

Surface Disinfection:

Treatment Time (Wipes/Sprays) versus Contact Time (Liquids)

Rutala, Weber. Submitted for publication. Photos James Clayton.

- Registration test for wipe is EPA Disinfectant Towelette Test
- Treatment time is equal to combination of physical removal and inactivation caused by the disinfectant regardless of the surface appearance (i.e. wet or dry)
- Thus, if disinfectant wipe has a registration time of 1 minute, then the surface should be allowed to remain undisturbed for the registration time of 1 minute (i.e. wet time is not relevant)

LECTURE OBJECTIVES

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Medical Waste Problem

- Perceived threat of AIDS via medical waste
- Beach wash-ups of “medical waste”
- Overly restrictive medical waste rules and increase in volume of regulated medical waste
- Options for medical waste treatment and disposal diminishing

Definitions

Hospital waste (solid waste) refers to all waste (biological or nonbiological) which are discarded and not intended for further use (e.g., administrative waste, dietary waste)

Medical waste refers to materials generated as a result of patient diagnosis, treatment, or immunization (e.g., soiled dressing, intravenous tubing)

Regulated medical waste (“infectious” waste) refers to that portion of medical waste which could transmit an infectious disease (e.g., microbiological waste, sharps)

Total Hospital Waste Generated per Patient by Bed Size

Rutala, Odette, Samsa. JAMA;262:1635-1640

Hospital Beds	Median lb/Bed/Day		Median lb/Patient/Day	
	N	Total	N	Total
<100	90	5.72	69	11.30
100-299	108	10.36	84	15.79
300-499	40	12.51	32	18.47
>500	27	12.86	23	16.95
Combined	265	9.21	208	15.28

Regulated Medical Waste

The CDC, EPA, and states define medical waste as regulated (“infectious”)

When it is suspected to contain potentially hazardous levels of microorganisms

Factors Necessary for Induction of Disease

- Dose
- Resistance of host
- Portal of entry
- Presence of a pathogen
- Virulence

Medical Waste

Plausible Transmission Routes

Rutala, Mayhall. Infect Control Hosp Epidemiol 1992;13:38-48

- Virtually nonexistent - respiratory, urinary or gastrointestinal tract or mucous membrane of the mouth, eyes, nose.
- Why? Waste must contain pathogens -> person must come in direct contact -> inject, ingest, or injury must follow the contact thereby creating portal of entry -> an infectious dose must enter susceptible host via portal of entry -> agent causes infection.
- Rare - "Sharps" have an intrinsic capability to disrupt the skin's integrity and introduce infectious agents.

Public Health Implications of Medical Waste

Rutala, Mayhall. Infect Control Hosp Epidemiol 1992;13:38-48

Epidemiologic Evidence

- Only medical waste associated with infectious disease transmission is contaminated sharps.
- All reports of transmission of infectious agents by sharps occurred in health care setting.
- No evidence that a member of the public or a waste industry worker has ever acquired infection from medical waste (one exception).
- No infectious risks associated with any type of medical waste treatment method to include sanitary landfill disposal.

Public Health Implications of Medical Waste

Rutala, Mayhall. Infect Control Hosp Epidemiol 1992;13:38-48

Microbiologic Quality

- Household waste contains on average 100x more microorganisms with pathogenic potential for humans than medical waste.
- Common nosocomial pathogens (i.e. *P. aeruginosa, Klebsiella* spp, *Enterobacter* spp, *Proteus* spp) were detected more frequently from household waste than from hospital waste.

Regulated Medical Waste

The CDC, EPA, and states define medical waste as regulated (“infectious”)

When it is suspected to contain potentially hazardous levels of microorganisms

Medical Waste Regulations

- State - designation, transportation, storage and treatment
- Federal (OSHA) - education, labeling, use of PPE

Types of Solid Waste Designated as Infectious and Recommended Disposal Methods

Rutala, Mayhall. Infect Control Hosp Epidemiol 1992;13:38-48

Centers for Disease Control

Source/Type	Infectious Waste	Disposal Method
Microbiological	Yes	S,I
Blood and blood products	Yes	S,I, Sew
Pathological	Yes	Yes
Sharps (especially needles)	Yes	S,I
Contaminated animal carcasses (carcasses)	Yes	S,I
Isolation	No	---
Other (surgical waste, dialysis, contaminated lab waste)	No	---

Abbreviations: S-steam; I-incineration; Sew-sanitary sewer.

Compliance with CDC and EPA Recommendations for Treatment of Regulated Medical Waste

Rutala, Odette, Samsa. JAMA;262:1635-1640

Type of Medical Waste	CDC	USH%	EPA	USH%
Microbiological	S,I	98.1	S,I,TI,C	98.1
Blood	S,I,SEW	95.9	S,I,SEW,C	95.9
Pathology	I	92.6	I,SW,CB	92.6
Sharps	S,I	92.5	S,I	92.5
Isolation	---	---	S,I	85.9
Cont. animal carcasses	I	89.1	I,SW	89.1
Contaminated laboratory	---	---	Optional	87.0
Surgery	---	---	Optional	78.2
Autopsy	---	---	Optional	89.9
Dialysis	---	---	Optional	68.6
Contaminated equipment	---	---	Optional	ND
Overall		82.3		75.1

Regulated Waste: OSHA

- Contaminated sharps
- Pathological and microbiological wastes containing blood or OPIM
- Liquid or semi-liquid blood or OPIM
- Contaminated items that would release blood or OPIM in a liquid or semi-liquid state if compressed
- Items caked with dried blood or OPIM that are capable of releasing these materials during handling

Regulated Waste: OSHA

- Can OSHA and states adopt uniform definitions of RMW?
  - OSHA rules and state rules address two different concerns
  - OSHA rule addresses waste management in the workplace to ensure worker safety
  - State waste management rules ensure storage, shipping, and treatment/disposal practices that protect the environment and public health

Segregation of Medical Waste by US Hospitals

95% segregate regulated medical waste from non-regulated medical waste

96% use labeled or color-coded bags

Collection and Containment of US Hospital Waste

Collection	
Housekeeping (82%), maintenance (4%) or both (7%) transfer wastes to on-site storage or processing site (at least daily)	92%
Container	
Leakproof wastebaskets	95%
Plastic bags as wastebasket liners	99%

Transporting Waste Within US Hospitals

Transfer Carts - used to transport waste within the hospital	95%
Gravity Chutes - allows for vertical transfer	13%
Pneumatic chutes - vacuum source to propel wastes	2%

Storage

- No single requirement for storage of infectious waste in terms of time and temperature but most states do have regulations
- NC - if not shipped within seven days of generation, medical waste must be refrigerated.

Compaction

- Advantages
  - Decreases the volume of waste 4-5 times
  - Decreases size of storage facilities
  - Decreases cost of transporting waste
- Disadvantage
  - May interfere with the effectiveness of certain treatment processes

Medical Waste Management:
Environmentally Responsible Healthcare

- Treatment of regulated medical waste (RMW)
  - Properly define RMW
  - Rational definition could save millions in treatment costs
  - Reduce waste now treated as RMW (e.g., incineration)
    - Know what happens to facility's wastes and how treated
    - Locate "red bags" strategically to capture RMW
  - Encourage segregation of properly defined RMW

Treatment of Medical Waste by US Hospitals

Rutala, Odette, Samsa. JAMA;262:1635-1640

	Infectious (%)		Treatment/Disposal Methods (%)				
Waste Category	Yes	No	I	SL	S	Sew	Other
Microbiological	99	1	70	11	38	2	1
Human blood	94	6	64	11	21	26	1
Pathological	96	4	93	3	6	2	1
Isolation	94	6	79	17	9	2	0
Sharps	99	1	82	15	13	0	1

Incineration

Ash Residue:	Controlled-air incinerators produce a sterile ash
Air Emissions:	No difference between bacteria in stack emissions and ambient air. Chemicals (CO, metals, acid gases, dioxins, furans) emitted from hospital or municipal incinerators

EPA's Proposed Incineration Emission Limits

- New set of medical waste incineration regulations
- Regulates Hosp/Med/Inf Waste Incinerators
- Mandated by the Clean Air Act Amendments of 1990
- Regulations will substantially reduce emissions (dioxins, CO, Pb, Hg)
- EPA estimates regulations would close 50-80% of existing medical waste incinerators.

North Carolina Medical Waste Rules

Steam Sterilization

- 250^{o}F for 45 min or other effective combination.
- Unit should have time-temperature recorder and pressure gauge.
- Biological monitoring at least weekly; log maintained and shall include type of indicator used, date, time and result of test.

Sanitary Landfill

- Untreated medical waste could be discarded in sanitary landfills provided workers do not have contact
- Studies demonstrate
  - Bacteria and viruses are reduced by thermal inactivation, antimicrobial characteristics of leachate and absorption to organic material
  - Household waste is more microbially contaminated and it is discarded in sanitary landfills
- Unavailable, reaching capacity, or restricted to untreated medical waste

Needle Disposal

"Needles should not be recapped, purposely bent or broken by hand, removed from disposal syringes, or otherwise manipulated by hand. After they are used, disposable syringes and needles, scalpel blades, and other sharp items should be placed in puncture-resistant containers for disposal; the puncture-resistant containers should be located as close as practical to the use area."

Centers for Disease Control, MMWR August 21, 1987

Suctioned Fluids Disposal Treatment

Sanitary sewer - suctioned fluids may be carefully poured down a drain connected to a sanitary sewer (CDC, 1985)

Incineration - suction canister may be tightly capped, bagged (coded) and incinerated.

Sanitary landfill - suction canister fluid may be treated with liquid treatment system and sent to sanitary landfill (2/3 states)

Sanitary landfill - suction canisters may be tightly capped, bagged and sent to a sanitary landfill (a few states).

Medical Waste Management: Treatment

- Goal of treatment is to reduce microbial load
- Changes that impact treatment of RMW
  - Incineration (new emission standards)
  - Alternative treatment technologies

    Some states allow alternatives, other states not
  - Autoclave

Medical Waste Management: Treatment

- Alternative technologies
  - Volume of medical waste reduced by equipment (grinders, shredders, hammermills) that pulverize and shred waste
  - Reduce volume by about 80%
  - Disinfect in the process (e.g.chemicals, heat, steam, microwaves, electrothermal radiation)

Alternative Medical Waste Treatment Technologies

- Microwaving - thermal decontamination
- Electro-thermal radiation - macrowaves
- Infrared heating
- Pyrolysis - heating (1000^{o}F-6000^{o}F) in absence of oxygen
- Plasma burners - electrical arcs used to create plasmas in range of 2500^{o} to 10000^{o}C

Alternative Medical Waste Treatment Technologies (cont)

- Chemical processes
  - Bleach decontamination with shredding
  - Shredding followed by chlorine dioxide treatment
  - Shredding followed by wet oxidation at 212^{0}F, pH 0.
  - Polymers with disinfectants solidify and decontaminate
- Irradiation processes
  - Gamma radiation such as cobalt 60
  - Electron beam radiation

Adapted from ASHMM handout by Lawrence G. Doucet, P.E.

Medical Waste Regulations

- State - designation, transportation, storage and treatment
- Federal (OSHA) - education, labeling, use of PPE

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

Medical Waste Minimization

Recycling/Reuse/Reduction

- Corrugated boxes and paper products
- Aluminum, glass, and plastic from defined areas
- Recovery/redistillation of laboratory solvents (e.g., alcohol, xylene, toluene)
- Source reduction-replace single use items with reusable items

Infectious Risks Associated with Recycling Hospital Waste

- No infectious risks associated with recycling hospital waste
- Presently, recycling efforts have generally focused on nonpatient contact sources of waste such as glass, scrap metal, aluminum cans, cardboard and packaging material
- From an infectious disease perspective, only a few items generated in the health-care setting are not likely candidates for recycling (e.g. sharps)

Waste Management:
How to be Friendly to the Environment

- Recycling in healthcare
  - Internal forces: employee requests, environment, public image, proactive posture
  - External forces: state/national solid waste laws, local government regulations, air quality regulations
  - Example: NC
    - 1989-GS established recycling goal of 25% by 1993
    - 1991-Amended to waste reduction and 40% by 2001
    - 1995-Amended so County government selects own goal
    - Orange county selected a reduction goal of 45%

LECTURE OBJECTIVES

- Review the CDC Guideline for Disinfection and Sterilization: Focus on role of environmental surfaces
- Review “best” practices for environmental cleaning and disinfection
- Review the use of low-level disinfectants and the activity of disinfectants on key hospital pathogens
- Review medical waste management

BEST PRACTICES FOR SURFACE DISINFECTION AND MEDICAL WASTE

- The contaminated surface environment in hospital rooms is important in the transmission of healthcare-associated pathogens (MRSA, VRE, *C. difficile*, *Acinetobacter*).
- Disinfection of noncritical environmental surfaces/equipment is an essential component of Infection prevention
- Disinfection should render surfaces and equipment free of pathogens in sufficient numbers to cause human disease. Follow CDC D/S guideline.
- When determining the optimal disinfecting product, consider the 5 components (kill claims/time, safety, ease of use, others)
- Comply with federal (OSHA) and state medical waste regulations

THANK YOU!
www.disinfectionandsterilization.org