“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

Environmental Contamination Leads to HAIs

Weber, Kanamori, Rutala. Curr Op Infect Dis .2016.29:424-431

- Evidence environment contributes
- EPI-MRSA, VRE, *C. difficile*
- Surfaces are contaminated-~25%
- EIP survive days, weeks, months
- Contact with surfaces results in hand contamination
- Disinfection reduces contamination
- Disinfection (daily) reduces HAIs
- Rooms not adequately cleaned

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

Disinfection of Noncritical Surfaces Bundle

NL Havill AJIC 2013;41:S26-30

- Develop policies and procedures
- Select cleaning and disinfecting products
- Educate staff to environmental services and nursing
- Monitor compliance (thoroughness of cleaning, product use) and feedback
- Implement “no touch” room decontamination technology and monitor compliance

Disinfection of Noncritical Surfaces Bundle

- Develop policies and procedures
  - Environmental cleaning and disinfection is an integral part of preventing transmission of pathogens
  - In addition to identifying products and procedures, ensure standardization of cleaning throughout the hospital
    - Some units utilize ES to clean pieces of equipment (e.g., vital sign machines, IV pumps); some units use patient equipment, and some units utilize nursing staff.
    - Multidisciplinary group to create a standardized plan for cleaning patient rooms and pieces of patient equipment throughout the hospital

Blood Pressure Cuff
Non-Critical Patient Care Item

Surface Disinfection

Noncritical Patient Care

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

- Disinfecting Noncritical Patient-Care Items
  - Process noncritical patient-care equipment with a EPA-registered disinfectant at the proper use dilution and a contact time of at least 1 min. *Category IB*
  - Ensure that the frequency for disinfecting noncritical patient-care surfaces be done minimally when visibly soiled and on a regular basis (such as after each patient use or once daily or once weekly). *Category IB*


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Surface Disinfection

Environmental Surfaces

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

- Disinfecting Environmental Surfaces in HCF
  - Disinfect (or clean) housekeeping surfaces (e.g., floors, tabletops) on a regular basis (e.g., daily, three times per week), when spills occur, and when these surfaces are visibly soiled. *Category IB*
  - Use disinfectant for housekeeping purposes where: uncertainty exists as to the nature of the soil on the surfaces (blood vs dirt); or where uncertainty exists regarding the presence of multi-drug resistant organisms on such surfaces. *Category II*

It appears that not only is disinfectant use important but how often is important

Daily disinfection vs clean when soiled

Daily Disinfection of High-Touch Surfaces

Kundrapu et al. ICHE 2012;33:1039

Daily disinfection of high-touch surfaces (vs cleaned when soiled) with sporicidal disinfectant (PA) in rooms of patients with CDI and MRSA reduced acquisition of pathogens on hands after contact with surfaces and of hands caring for the patient. Daily disinfection less hand contamination.

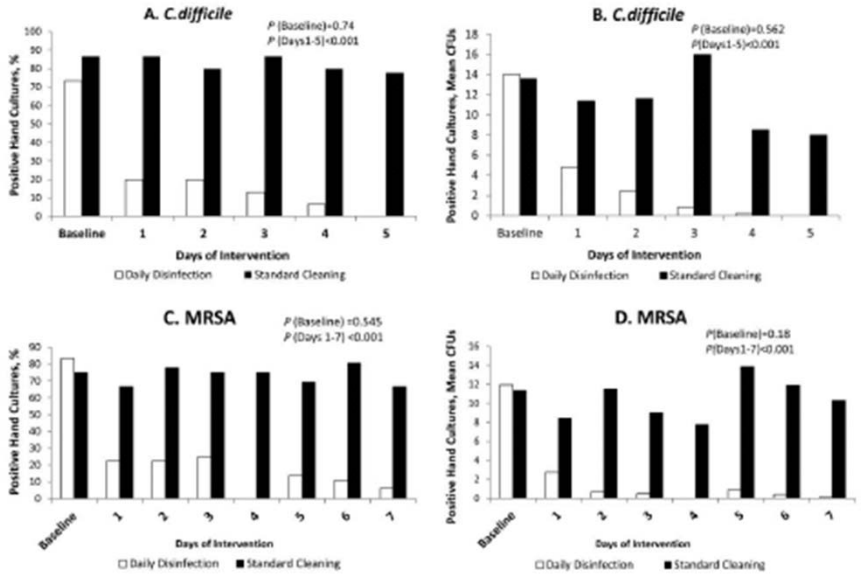

FIGURE 1. Effect of daily disinfection of high-touch environmental surfaces on acquisition of *Clostridium difficile* and methicillin-resistant *Staphylococcus aureus* (MRSA) on gloved hands of investigators after contact with the surfaces. *A*, Percentage of positive *C. difficile* cultures; *B*, mean number of *C. difficile* colony-forming units acquired; *C*, percentage of positive MRSA cultures; *D*, mean number of MRSA colony-forming units acquired.

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

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. Cleaning and disinfecting is one-step with disinfectant-detergent. No pre-cleaning necessary unless spill or gross contamination.

Evaluation of Hospital Floors as a Potential Source of Pathogen Dissemination

Koganti et al. ICHE 2016. 37:1374; Deshpande et al. AJIC 2017. 45:336.

- Effective disinfection of contaminated surfaces is essential to prevent transmission of epidemiologically-important pathogens
- Efforts to improve disinfection focuses on touched surfaces
- Although floors contaminated, limited attention because not frequently touched
- Floors are a potential source of transmission because often contacted by objects that are then touched by hands (e.g., shoes, socks)
- Non-slip socks contaminated with MRSA, VRE (Mahida, J Hosp Infect. 2016;94:273

Recovery of Nonpathogenic Viruses from Surfaces and Patients on Days 1, 2, and 3 After Inoculation of Floor Near Bed

Koganti et al. ICHE 2016. 37:1374

- Found that a nonpathogenic virus inoculated onto floors in hospital rooms disseminated rapidly to the footwear and hands of patients and to high-touch surfaces in the room
- The virus was also frequently found on high-touch surfaces in adjacent rooms and nursing stations
- Contamination in adjacent rooms in the nursing station suggest HCP contributed to dissemination after acquiring the virus during contact with surfaces or patients
- Studies needed to determine if floors are source of transmission

Disinfection of Noncritical Surfaces Bundle

- Develop policies and procedures
  - Standardize C/D patient rooms and pieces of equipment throughout the hospital
  - All touchable hand contact surfaces wiped with disinfection daily, when spills occur and when the surfaces are visibly soiled.
  - All noncritical medical devices should be disinfected daily and when soiled
  - Clean and disinfectant sink and toilet
  - Damp mop floor with disinfectant-detergent
  - If disinfectant prepared on-site, document correct concentration
  - Address treatment time/contact time for wipes and liquid disinfectants (e.g., treatment time for wipes is the kill time and includes a wet time via wiping as well as the undisturbed time).

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Effective Surface Decontamination

Product and Practice = Perfection

LOW-LEVEL DISINFECTION FOR NONCRITICAL EQUIPMENT AND SURFACES

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

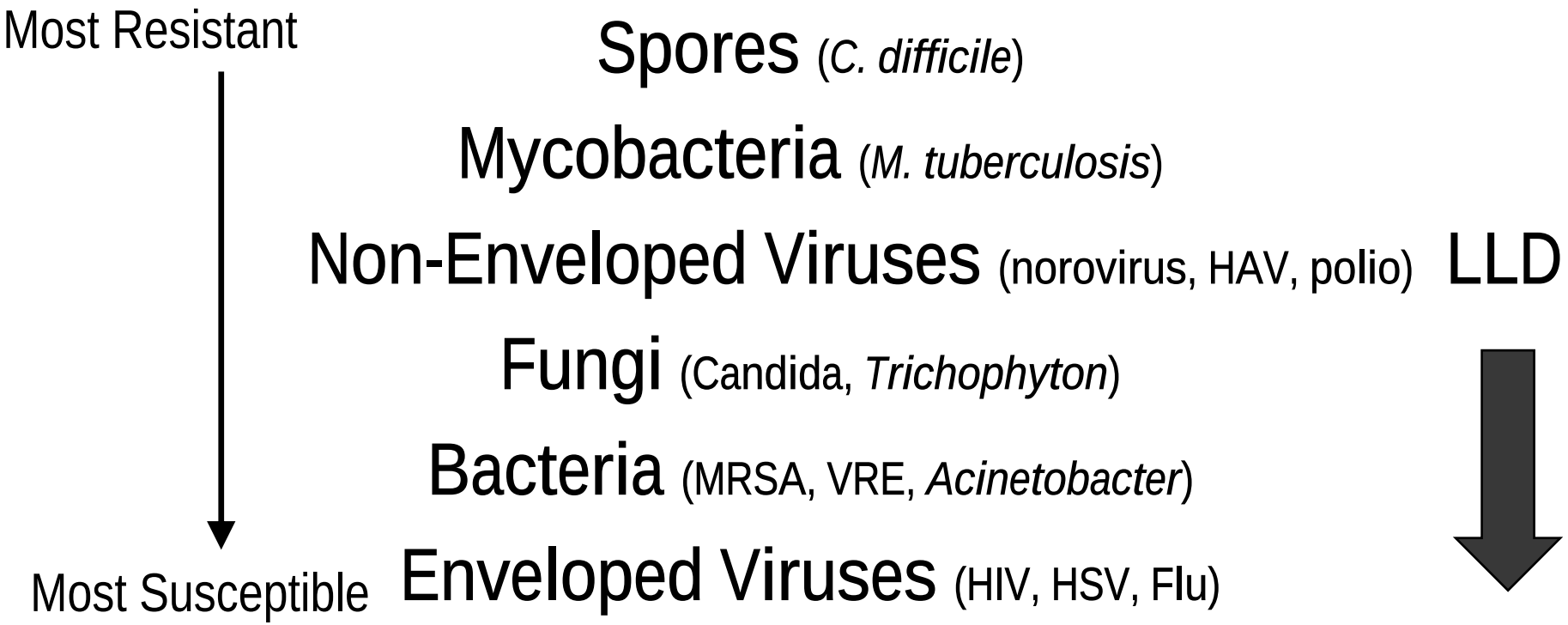
Exposure time ≥ 1 min

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)

Microbiological Disinfectant Hierarchy

Rutala WA, Weber DJ, HICPAC. www.cdc.gov



MOST PREVALENT PATHOGENS CAUSING HAI

Rutala, Weber. Infect Control Hosp Epidemiol. 2014;35:855-865; Weiner et al ICHE 2016;37:1288

- Most prevent pathogens causing HAI (easy to kill)
  - *E. coli* (15.4%)
  - *S. aureus* (11.8%)
  - *Klebsiella* (7.7%)
  - Coag neg Staph (7.7%)
  - *E. faecalis* (7.4%)
  - *P. aeruginosa* (7.3%)
  - *C. albicans* (6.7%)
  - *Enterobacter* sp. (4.2%)
  - *E. faecium* (3.7%)
- Common causes of outbreaks and ward closures (relatively hard to kill)
  - *C. difficile* spores
  - Norovirus
  - Rotavirus
  - Adenovirus

EFFECTIVENESS OF DISINFECTANTS AGAINST MRSA AND VRE

Rutala WA, et al. *Infect Control Hosp Epidemiol* 2000;21:33-38

TABLE 2
DISINFECTANT ACTIVITY AGAINST ANTIBIOTIC-SUSCEPTIBLE AND ANTIBIOTIC-RESISTANT BACTERIA

	Log_{10} Reductions							
	VSE		VRE		MSSA		MRSA	
Product	0.5 min	5 min	0.5 min	5 min	0.5 min	5 min	0.5 min	5 min
Vesphene IIse	>4.3	>4.3	>4.8	>4.8	>5.1	>5.1	>4.6	>4.6
Clorox	>5.4	>5.4	>4.9	>4.9	>5.0	>5.0	>4.6	>4.6
Lysol Disinfectant	>4.3	>4.3	>4.8	>4.8	>5.1	>5.1	>4.6	>4.6
Lysol Antibacterial	>5.5	>5.5	>5.5	>5.5	>5.1	>5.1	>4.6	>4.6
Vinegar	0.1	5.3	1.0	3.7	+1.1	+0.9	+0.6	2.3

Abbreviations: MRSA, methicillin-resistant *Staphylococcus aureus;* MSSA, methicillin-susceptible *S aureus;* VRE, vancomycin-resistant *Enterococcus;* VSE, vancomycin-susceptible *Enterococcus.* Data represent mean of two trials (n=2). Values preceded by ">" represent the limit of detection of the assay. Assays were conducted at a temperature of 20°C and a relative humidity of 45%. Results were calculated as the log of Nd/No, where Nd is the titer of bacteria surviving after exposure and No is the titer of the control.

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Surface Disinfection:

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

Rutala, Weber. ICHE 2018;39

INFECTION CONTROL & HOSPITAL EPIDEMIOLOGY MARCH 2018, VOL. 39, NO. 3

COMMENTARY

Surface Disinfection: Treatment Time (Wipes and Sprays) Versus Contact Time (Liquids)

William A. Rutala, PhD, MPH;[1] David J. Weber, MD, MPH[1,2]

(See the article by Rutala W, Weber DJ, Selection of the ideal disinfectant. *Infect Control Hosp Epidemiol* 2014;35:855–865.)

In 2014, we published a paper on the "Selection of the Ideal Disinfectants."[1] Disinfectant selection (ie, disinfectant product) is 1 of 2 essential components for effective disinfection. The other component, the practice, is the thorough application of the disinfectant such that the disinfectant contacts all contaminated surfaces. This practice should include proper training of hospital staff, especially environmental services and nursing staff, and adherence to the manufacturer's label instructions. The combi-

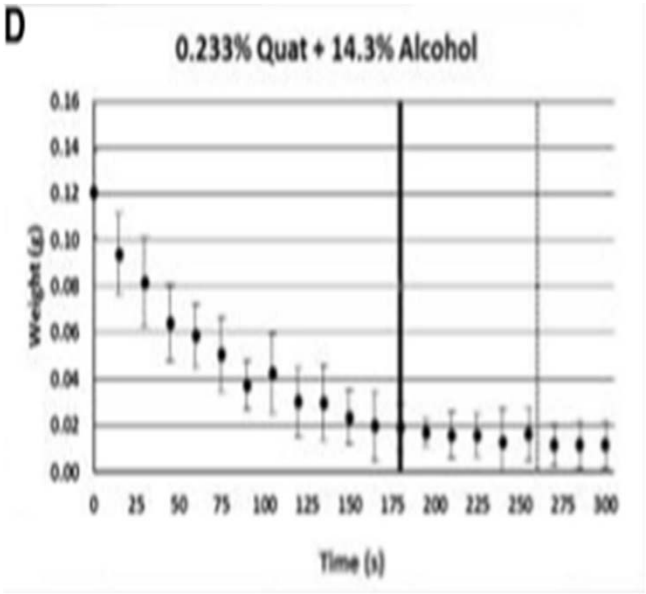
The EPA position is this: "By law, all applicable label instructions on EPA-registered products must be followed. If the user selects exposure conditions that differ from those on the EPA-registered product label, the user assumes liability from any injuries resulting from off-label use and is potentially subject to enforcement action under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)."[1,3] According to this position, contact or kill times for the organisms listed on the label must be followed. Currently, EPA-registered disinfectants are available with contact times of 1–4 minutes against most

The term "wetness" is controversial. Based on EPA test, treatment time is the kill time and includes a wet time via wiping as well as the undisturbed time. Duration of wet time is not relevant.

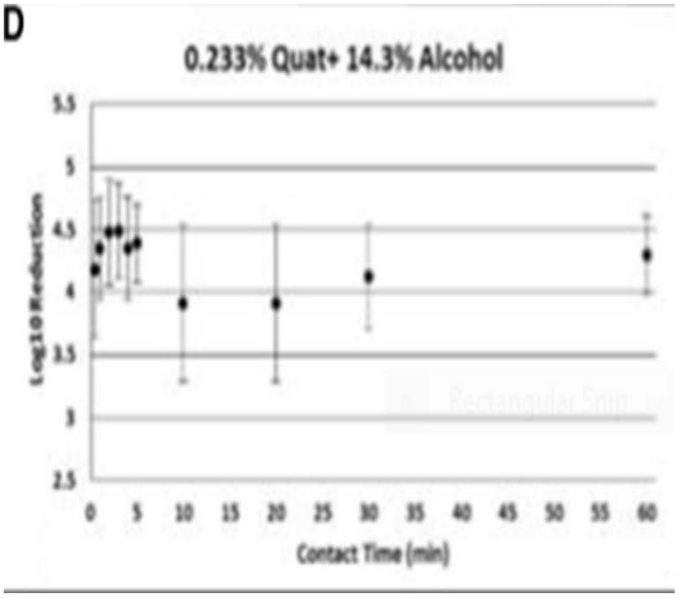
Bactericidal (*S. aureus*) Efficacy of EPA-Registered Towelettes

West, Teska, Oliver, AJIC, 2018

- Drying time curve based on surface wetness; bold-contact time (180s); dashed-dry (~260s)



- Wet time Is not crucial for complete disinfection (wet or dry ~4.5 $\log_{10}$ reduction); 30s for $\log_{10}$ reduction



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Thoroughness of Environmental Cleaning

Carling and Herwaldt. Infect Control Hosp Epidemiol 2017;38:960–965

Hospitals can improve their thoroughness of terminal room disinfection through fluorescent monitoring

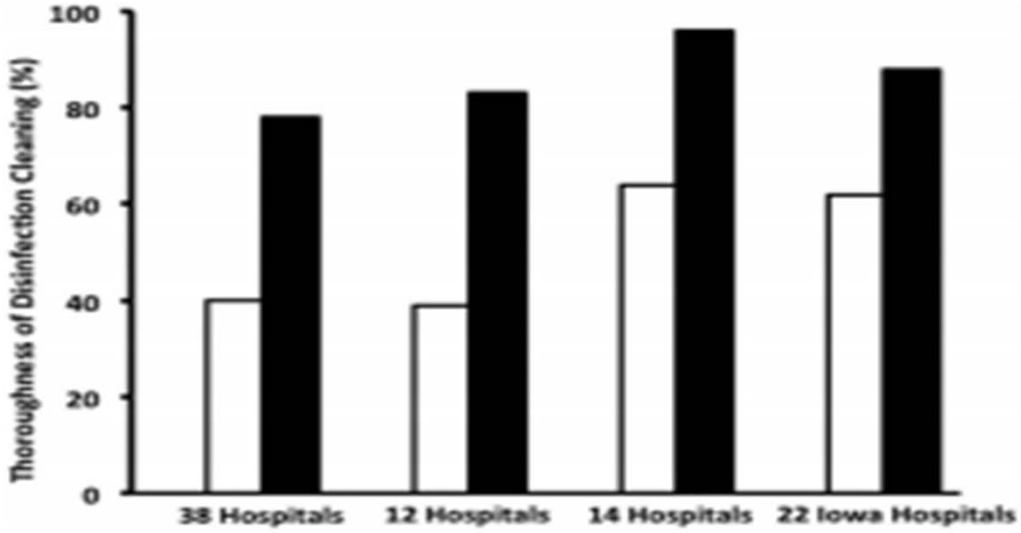

FIGURE 4. A comparison of the results of the 3 previously published multisite studies compared with results from the Iowa project. White bars represent the average baseline TDCs and black bars represent the average final TDCs for sites that completed each study.

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These interventions (effective surface disinfection, thoroughness indicators) not enough to achieve consistent and high rates of cleaning/disinfection

No Touch

(supplements but do not replace surface cleaning/disinfection)

“NO TOUCH” APPROACHES TO ROOM DECONTAMINATION

(UV/VHP~20 microbicidal studies, 12 HAI reduction studies; will not discuss technology with limited data)

Weber, Kanamori, Rutala. Curr Op Infect Dis 2016;29:424-431; Weber, Rutala et al. AJIC; 2016:44: e77-e84; Anderson et al. Lancet 2017;389:805-14; Anderson et al. Lancet Infect Dis 2018;June 2018.

Enhanced Disinfection Leading to Reduction of Microbial Contamination and a Decrease in Patient Col/Infection

Anderson et al. Lancet 2017;289:805; Rutala et al. ICHE In press.

	Standard Method		Enhanced method	
	Quat	Quat/UV	Bleach	Bleach/UV
EIP (mean CFU per room)[a]	60.8	3.4	11.7	6.3
Reduction (%)		94	81	90
Colonization/Infection (rate)[a]	2.3	1.5	1.9	2.2
Reduction (%)		35	17	4

All enhanced disinfection technologies were significantly superior to Quat alone in reducing EIPs. Comparing the best strategy with the worst strategy (i.e., Quat vs Quat/UV) revealed that a reduction of 94% in EIP (60.8 vs 3.4) led to a 35% decrease in colonization/infection (2.3% vs 1.5%). Our data demonstrated that a decrease in room contamination was associated with a decrease in patient colonization/infection. First study which quantitatively described the entire pathway whereby improved disinfection decreases microbial contamination which in-turn reduced patient colonization/infection.

This technology (“no touch”-e.g., UV/HP) should be used (capital equipment budget) for terminal room disinfection (e.g., after discharge of patients on Contact Precautions).

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How Will We Prevent Infections Associated with the Environment?

- Implement evidence-based practices for surface disinfection
  - Evidence-based policies
  - Ensure use of safe and effective (against emerging pathogens such as *C. auris* and CRE) low-level disinfectants
  - Ensure thoroughness of cleaning (new thoroughness technology)
- Use “no touch” room decontamination technology proven to reduce microbial contamination on surfaces and reduction of HAIs at terminal/discharge cleaning
- Use new continuous room decontamination technology that continuously reduces microbial contamination

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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. 1989; 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. 1989. 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

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).

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. 1989. 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 substantially reduced 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

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).

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

- 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

Summary

- 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