

"BEST" PRACTICES FOR SURFACE DISINFECTION

William A. Rutala, PhD, MPH

Director, Hospital Epidemiology, Occupational Health and
Safety; Professor of Medicine and Director, Statewide
Program for Infection Control and Epidemiology

University of North Carolina at Chapel Hill, USA

Disclosure: Advanced Sterilization Products and Clorox

LECTURE OBJECTIVES

- Review the CDC Guideline for Disinfection and Sterilization: Focus on 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
- Discuss options for evaluating environmental cleaning and disinfection
- Review “no touch” methods for room decontamination

"BEST" PRACTICES

- There is little 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



ENVIRONMENTAL CONTAMINATION LEADS TO HAIs

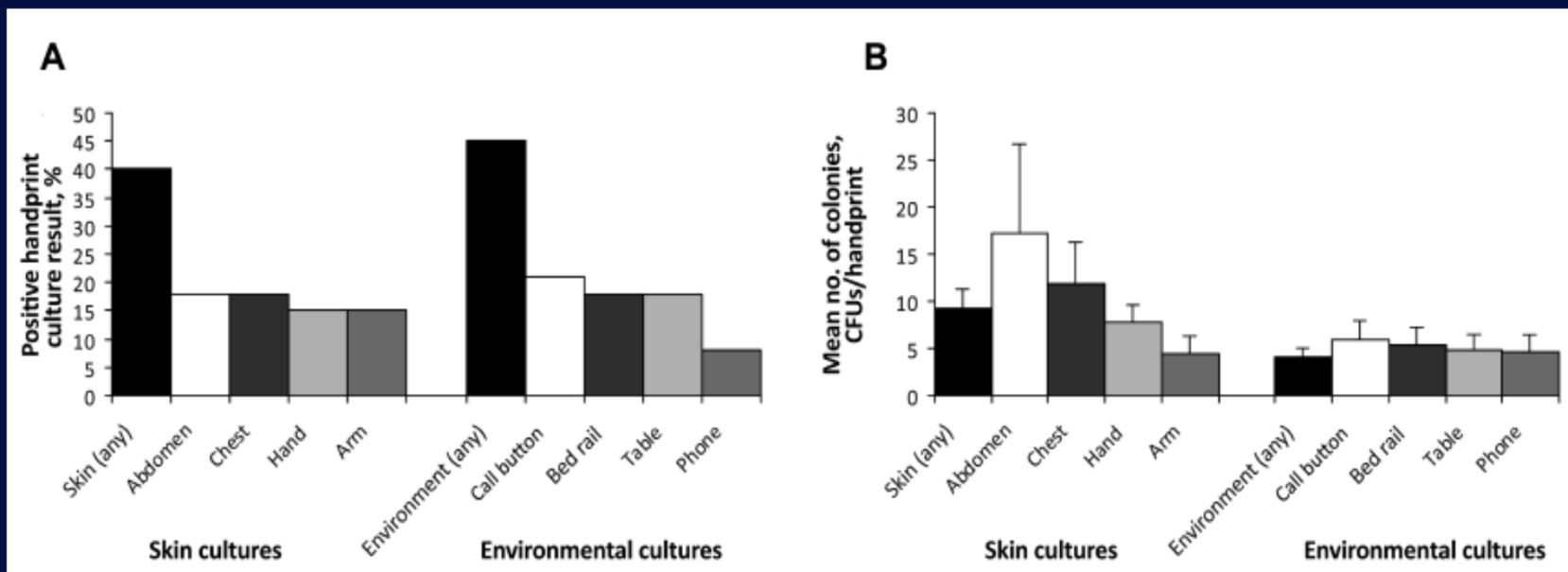
- Microbial persistence in the environment
 - *In vitro* studies and environmental samples
 - MRSA, VRE, AB, CDI
- Frequent environmental contamination
 - MRSA, VRE, AB, CDI
- HCW hand contamination
 - MRSA, VRE, AB, CDI
- Relationship between level of environmental contamination and hand contamination
 - CDI

ENVIRONMENTAL CONTAMINATION LEADS TO HAIS

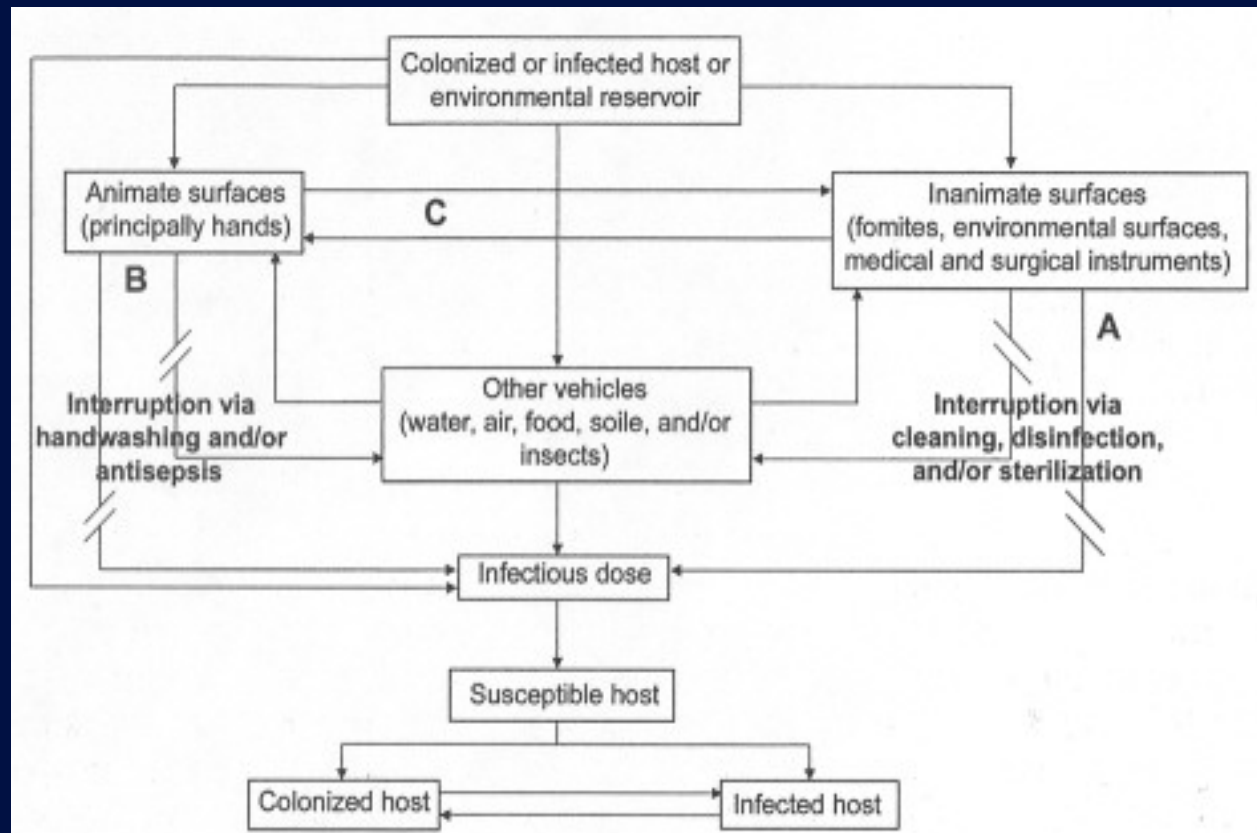
- Person-to-person transmission
 - Molecular link
 - MRSA, VRE, AB, CDI
- Housing in a room previously occupied by a patient with the pathogen of interest is a risk factor for disease
 - MRSA, VRE, CDI
- Improved surface cleaning/disinfection reduces disease incidence
 - MRSA, VRE, CDI

FREQUENCY OF ACQUISITION OF MRSA ON GLOVED HANDS AFTER CONTACT WITH SKIN AND ENVIRONMENTAL SITES

No significant difference on contamination rates of gloved hands after contact with skin or environmental surfaces (40% vs 45%; $p=0.59$)



TRANSMISSION MECHANISMS INVOLVING THE SURFACE ENVIRONMENT



Rutala WA, Weber DJ. In: "SHEA Practical Healthcare Epidemiology" (Lautenbach E, Woeltje KF, Malani PN, eds), 3rd ed, 2010.

DISINFECTION AND STERILIZATION

- 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 but high numbers of bacterial spores
 - **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

CATEGORIZATION OF RECOMMENDATIONS

Category	Definition
Category IA	Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.
Category IB	Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies, and a strong theoretical rationale.
Category II	Suggested for implementation and supported by suggestive clinical or epidemiologic studies or by a theoretical rationale.
No recommendation	Unresolved issue. Practices for which insufficient evidence or no consensus exists regarding efficacy.

OCCUPATIONAL HEALTH AND EXPOSURE

- Inform each worker of the possible health effects of his or her exposure to infectious agents (e.g., HBV) and/or chemicals (e.g., cleaning products). The information should be consistent with OSHA requirements and identify the areas and tasks in which potential exists for exposure (II)
- Educate HCP in the selection and proper use of personal protective equipment (PPE) (II)
- Ensure HCP wear appropriate PPE to avoid exposure to infectious agents or chemicals through the respiratory system, skin, or mucous membranes of the eyes, nose, or mouth. PPE may include gloves, gowns, masks, and eye protection. The exact type of PPE depends on the infectious or chemical agent and anticipated duration of exposure (II)
- Exclude HCP with weeping dermatitis of hands from direct contact with patient-care equipment (IB)

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)

CLEANING/DISINFECTING NONCRITICAL ITEMS/SURFACES

- Some persons have recommended that cleaning frequencies should be based on risk stratification matrix
 - Probability of contamination
 - Potential for exposure
 - Vulnerability of patient
- Complex
- Data do not support this stratification

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.

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 (**cover 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, remove and clean curtains, or discard wrapped disposable supplies left in drawers

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

CONTAMINATION OF HOSPITAL CURTAINS

Trillis et al. 2008. ICHE 29:1074

42% of privacy curtains contaminated with VRE, 22% MRSA and 4% *C. difficile*



FIGURE. Rates of recovery of healthcare-associated pathogens from 50 hospital privacy curtains by 3 culture methods. For methicillin-resistant *Staphylococcus aureus* (MRSA), broth enrichment cultures were not performed. For *Clostridium difficile*, direct plating cultures were not performed. VRE, vancomycin-resistant enterococci.

TERMINAL CLEANING PRACTICE

- Some hospitals change curtains after Contact Precaution patients
- Cubicle curtains are changed routinely every 6 months or when visible soiled
- In Contact Precaution rooms, frequently touched surfaces of the curtains should be sprayed with approved disinfectant (e.g., HP, improved HP)
- Vinyl shower curtains are cleaned when visibly soiled or replaced as needed

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)

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

PROPERTIES OF AN IDEAL DISINFECTANT

Rutala, 1995. Modified from Molinari 1987.

- **Broad spectrum**-wide antimicrobial spectrum
- **Fast acting**-should produce a rapid kill
- **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
- Residual effect on treated surface-leave an antimicrobial film on treated surface
- **Easy to use**
- Odorless-pleasant or no odor
- Economical-cost should not be prohibitively high
- Soluble (in water) and stable (in concentrate and use dilution)
- Cleaner (good cleaning properties) and nonflammable

LOW-LEVEL DISINFECTION FOR NONCRITICAL EQUIPMENT AND SURFACES

Exposure time \geq 1 min

Germicide

Use Concentration

Ethyl or isopropyl alcohol

70-90%

Chlorine

100ppm (1:500 dilution)

Phenolic

UD

Iodophor

UD

Quaternary ammonium

UD

Improved hydrogen peroxide

0.5%, 1.4%

UD=Manufacturer's recommended use dilution

IMPROVED HYDROGEN PEROXIDE SURFACE DISINFECTANT

- Advantages
 - 30 sec -1 min bactericidal and virucidal claim (fastest non-bleach contact time)
 - 5 min mycobactericidal claim
 - Safe for workers (lowest EPA toxicity category, IV)
 - Benign for the environment; noncorrosive; surface compatible
 - One step cleaner-disinfectant
 - No harsh chemical odor
 - EPA registered (0.5% RTU, 1.4% RTU, wet wipe)
- Disadvantages
 - More expensive than QUAT

BACTERICIDAL ACTIVITY OF DISINFECTANTS (\log_{10} reduction) WITH A CONTACT TIME OF 1m WITH/WITHOUT FCS. Rutala et al. ICHE. In press

Improved hydrogen peroxide is significantly superior to standard HP at same concentration and superior or similar to the QUAT tested

Organism	Oxivir-0.5%	0.5% HP	Clorox HC HP Cleaner- Dis 1.4%	1.4% HP	3.0% HP	A456-II QUAT
MRSA	>6.6	<4.0	>6.5	<4.0	<4.0	5.5
VRE	>6.3	<3.6	>6.1	<3.6	<3.6	4.6
MDR- <i>Ab</i>	>6.8	<4.3	>6.7	<4.3	<4.3	>6.8
MRSA, FCS	>6.7	NT	>6.7	NT	<4.2	<4.2
VRE, FCS	>6.3	NT	>6.3	NT	<3.8	<3.8
MDR- <i>Ab</i> , FCS	>6.6	NT	>6.6	NT	<4.1	>6.6

Decreasing Order of Resistance of Microorganisms to Disinfectants/Sterilants

Most Resistant

Prions

Spores (*C. difficile*)

Mycobacteria

Non-Enveloped Viruses (*norovirus*)

Fungi

Bacteria (*MRSA, VRE, Acinetobacter*)

Enveloped Viruses

Most Susceptible

C. difficile spores



DISINFECTANTS

No measurable activity (1 *C. difficile* strain, J9; spores at 20 min)

- Vesphene (phenolic)
- 70% isopropyl alcohol
- 95% ethanol
- 3% hydrogen peroxide
- Clorox disinfecting spray (65% ethanol, 0.6% QUAT)
- Lysol II disinfecting spray (79% ethanol, 0.1% QUAT)
- TBQ (0.06% QUAT); QUAT may increase sporulation capacity- (Lancet 2000;356:1324)
- Novaplus (10% povidone iodine)
- Accel (0.5% hydrogen peroxide)

Rutala W, Weber D, et al. 2006

DISINFECTANTS AND ANTISEPSIS

C. difficile spores at 10 and 20 min, Rutala et al, 2006

- ~4 log₁₀ reduction (3 *C. difficile* strains including BI-9)
 - Clorox, 1:10, ~6,000 ppm chlorine (but not 1:50)
 - Clorox Clean-up, ~19,100 ppm chlorine
 - Tilex, ~25,000 ppm chlorine
 - Steris 20 sterilant, 0.35% peracetic acid
 - Cidex, 2.4% glutaraldehyde
 - Cidex-OPA, 0.55% OPA
 - Wavicide, 2.65% glutaraldehyde
 - Aldahol, 3.4% glutaraldehyde and 26% alcohol

C. difficile CONTROL MEASURES

Orenstein et al. ICHE 2011;32:1137

- In units with high endemic *C. difficile* infection rates or in an outbreak setting, use dilute solutions of 5.25-6.15% sodium hypochlorite (e.g., 1:10 dilution of bleach) for routine disinfection. (Category II).
- We now use chlorine solution in all CDI rooms for routine daily and terminal cleaning (use to use QUAT in patient rooms with sporadic CDI). One application of an effective product covering all surfaces to allow a sufficient wetness for > 1 minute contact time. Chlorine solution normally takes 1-3 minutes to dry.
- For semicritical equipment, glutaraldehyde (20m), OPA (12m) and peracetic acid (12m) reliably kills *C. difficile* spores using normal exposure times

INACTIVATION OF MURINE AND HUMAN NOROVIRUSES

Disinfectant, 1 min	MNV Log ₁₀ Reduction	HNV Log ₁₀ Reduction
70% Ethanol	>4 (3.3 at 15sec)	2
70% Isopropyl alcohol	4.2	2.2
65% Ethanol + QUAT	>2	3.6
79% Ethanol + QUAT	3.4	3.6
Chlorine (5,000ppm)	4	3
Chlorine (24,000ppm)	2.4	4.3
Phenolic, QUAT, Ag, 3% H ₂ O ₂	≤1	≤1 (2.1 QUAT)
0.5% Accel H ₂ O ₂	3.9	2.8

Rutala WA, Folan MP, Tallon LA, Lyman WH, Park GW, Sobsey MD, Weber DJ. 2007

GUIDELINE FOR THE PREVENTION OF NOROVIRUS OUTBREAKS IN HEALTHCARE, HICPAC, 2011

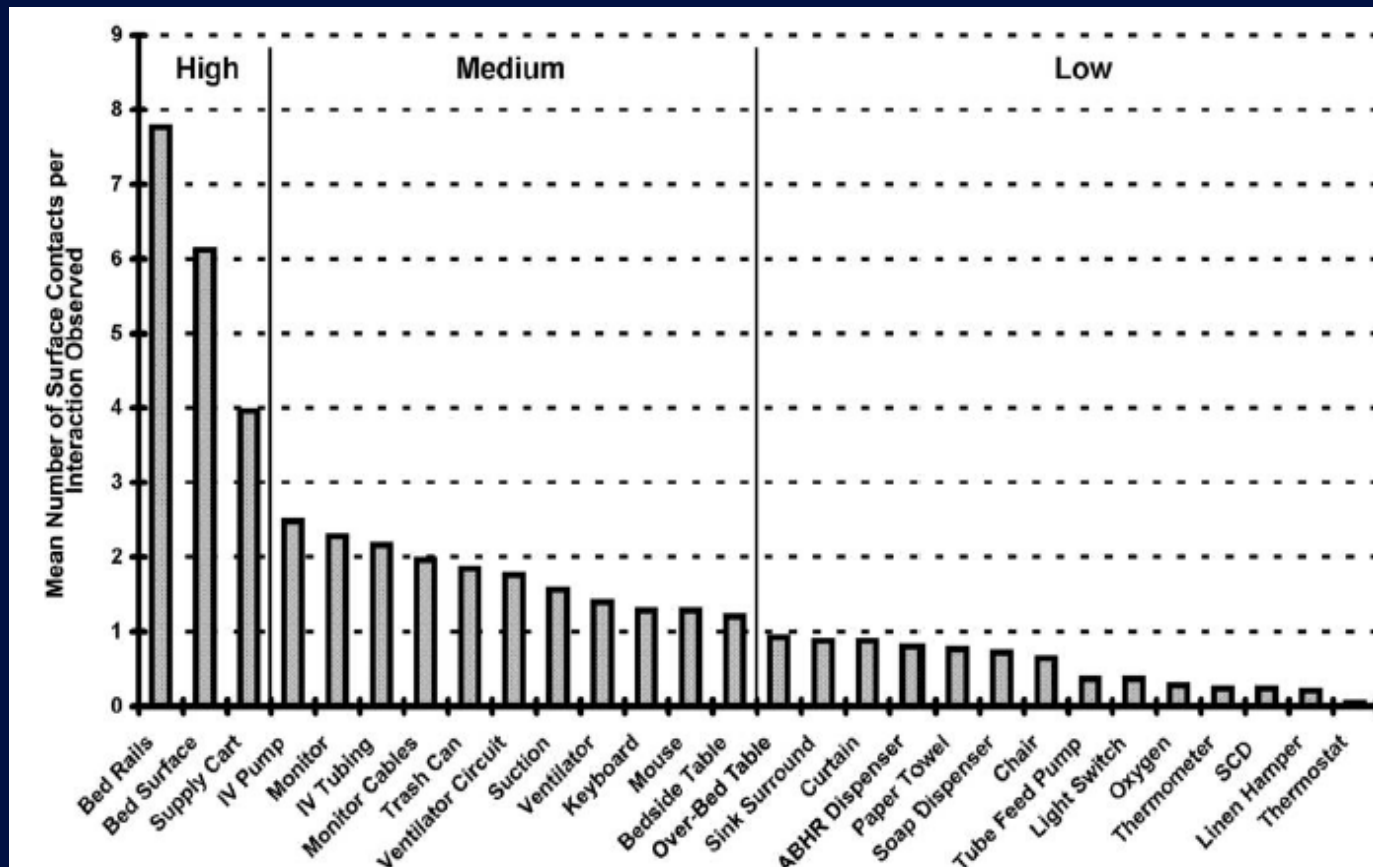
- Avoid exposure to vomitus or diarrhea. Place patients with suspected norovirus on Contact Precautions in a single room (IB)
 - Continue Precautions for at least 48 hours after symptom resolution (IB)
 - Use longer isolation times for patients with comorbidities (II) or <2 yrs (II)
- Consider minimizing patient movements within a ward (II)
 - Consider restricting movement outside the involved ward unless essential (II)
 - Consider closure of wards to new admissions (II)
- Exclude ill personnel (IB)
- During outbreaks, use soap and water for hand hygiene (IB)
- Clean and disinfect patient care areas and frequently touched surfaces during outbreaks 3x daily using EPA approved healthcare product (IB)
- Clean surfaces and patient equipment prior to disinfection. Use product with an EPA approved claim against norovirus (IC)

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.

DEFINING HIGH TOUCH SURFACES

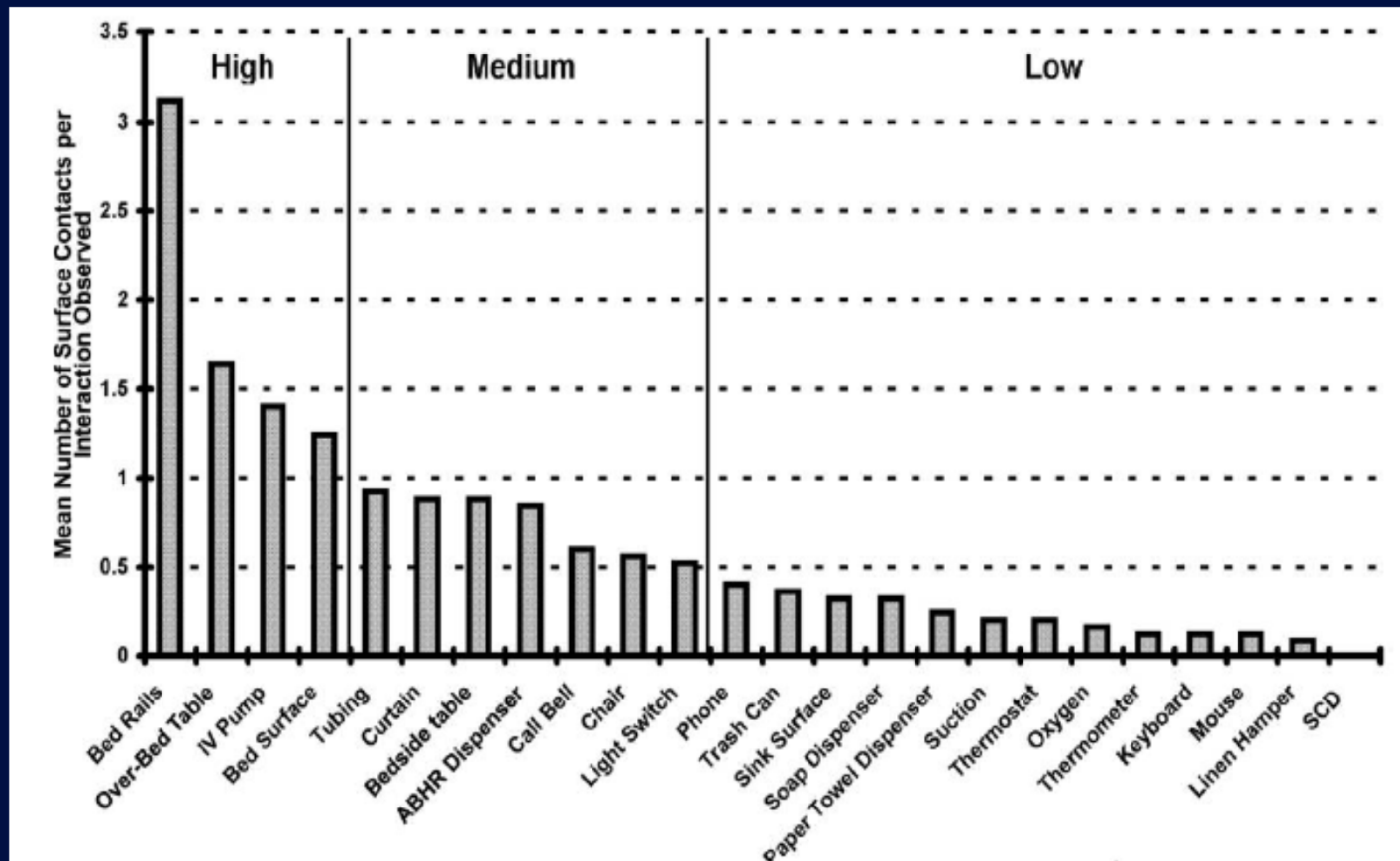
ICU



Huslage K, Rutala WA, Sickbert-Bennett E, Weber DJ. ICHE 2010;31:850-853

DEFINING HIGH TOUCH SURFACES

Non-
ICU



Huslage K, Rutala WA, Sickbert-Bennett E, Weber DJ. ICHE 2010;31:850-853



Microbiologic Assessment of High, Medium and Low Touch Surfaces. Huslage, Rutala, Gergen, Weber. Unpublished 2012

No correlation between touch frequency and microbial contamination

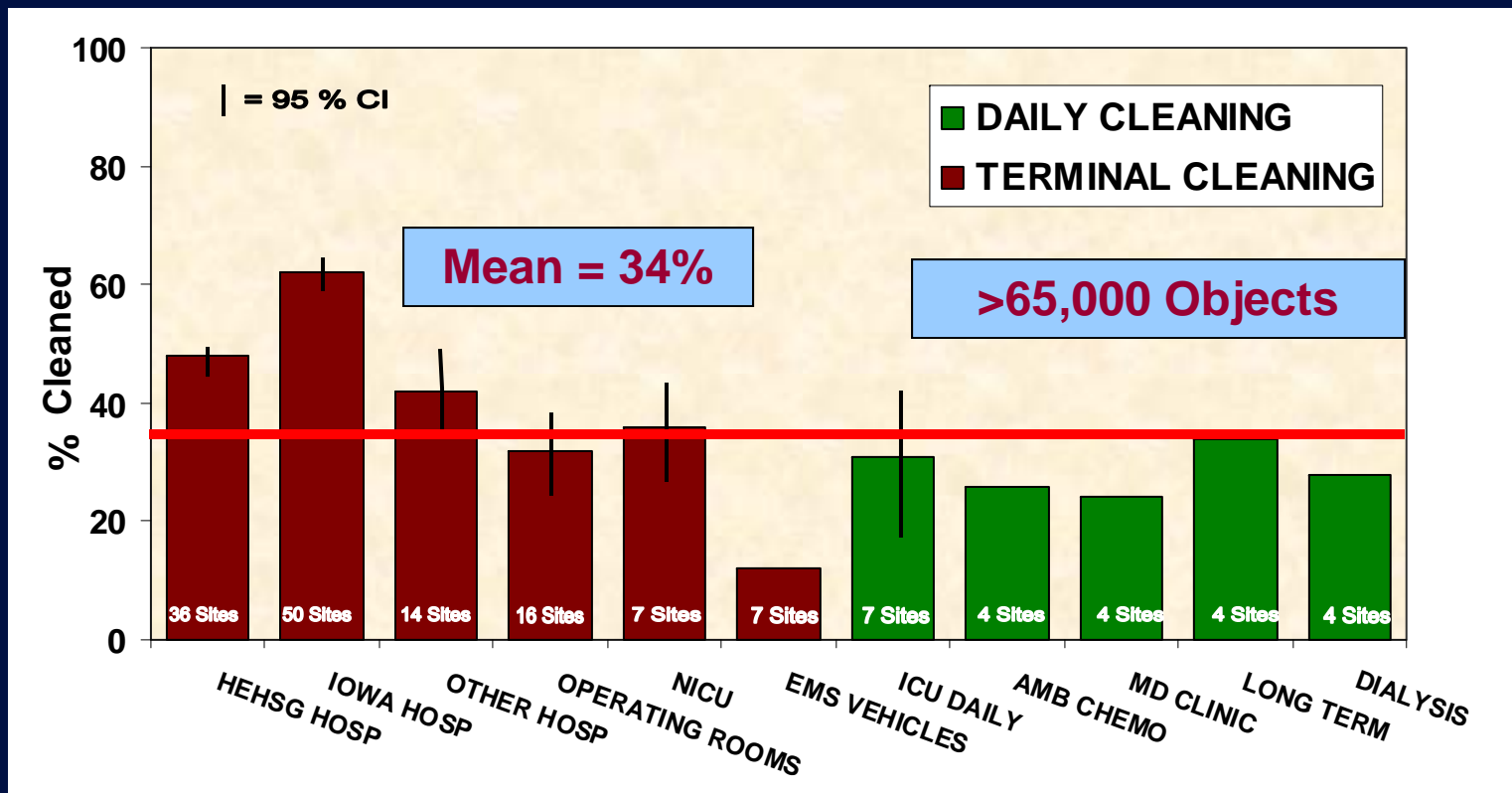
Surface	Before Cleaning Mean CFU/Rodac	After Cleaning Mean CFU/Rodac	Significance
High	71.9 (CI 46.5-97.3)	9.6	High=Low High>Medium
Medium	44.2 (CI 28.1-60.2)	9.3	Medium=Low
Low	56.7 (CI 34.2-79.2)	5.7	

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

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

NOTE. CI, confidence interval.

Thoroughness of Environmental Cleaning



Effective Surface Decontamination

Practice and Product

EFFECTIVENESS OF DISINFECTANTS AGAINST MRSA AND VRE

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

Product	Log ₁₀ Reductions							
	VSE		VRE		MSSA		MRSA	
	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.

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

SURFACE DISINFECTION

Effectiveness of Different Methods

Technique (with cotton)	MRSA Log ₁₀ Reduction (QUAT)
Saturated cloth	4.41
Spray (10s) and wipe	4.41
Spray, wipe, spray (1m), wipe	4.41
Spray	4.41
Spray, wipe, spray (until dry)	4.41
Disposable wipe with QUAT	4.55
Control: detergent	2.88

Rutala, Gergen, Weber. Unpublished data.

Practice* NOT Product

*surfaces not wiped

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WIPERS

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

DISPOSABLE WIPES

- **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

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OPTIONS FOR EVALUATING ENVIRONMENTAL CLEANING

Guh, Carling. December 2010. CDC

- Joint effort of ES and IC
- Responsibilities of ES staff and other staff for cleaning surfaces clearly defined
- Education of ES staff to define expectations
- Development of measures for monitoring
- Interventions to optimize cleaning
- Report results to ICC and facility leadership

MONITORING THE EFFECTIVENESS OF CLEANING

Cooper et al. AJIC 2007;35:338

- Visual assessment-not a reliable indicator of surface cleanliness
- ATP bioluminescence-measures organic debris (each unit has own reading scale, <250-500 RLU)
- Microbiological methods-<2.5CFUs/cm²-pass; can be costly and pathogen specific
- Fluorescent marker

DAZO Solution (AKA – Goo)



TARGET ENHANCED



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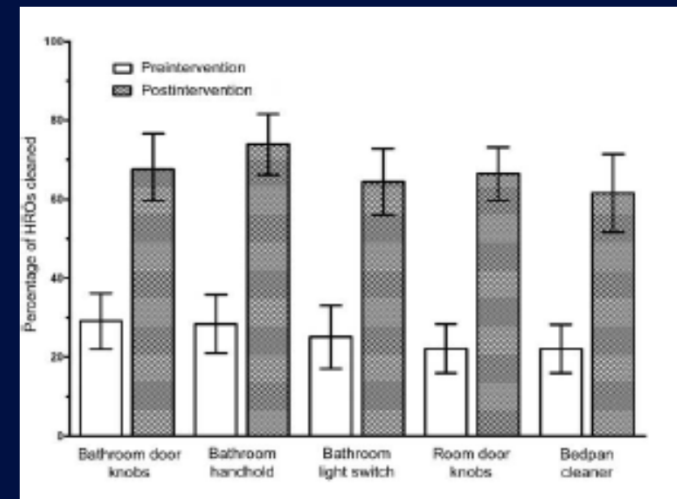
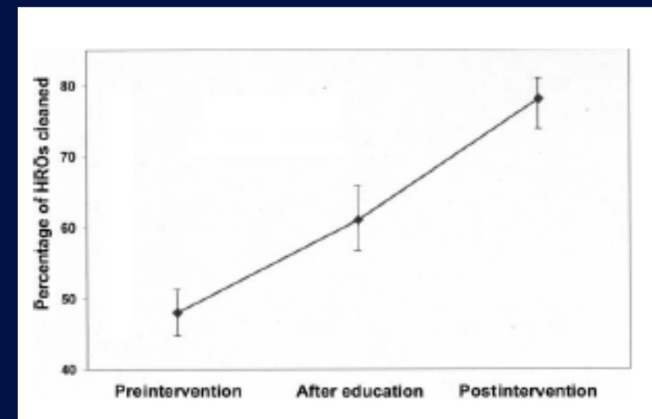
NOTE. CI, confidence interval.

TERMINAL ROOM CLEANING: DEMONSTRATION OF IMPROVED CLEANING

- Evaluated cleaning before and after an intervention to improve cleaning
- 36 US acute care hospitals
- Assessed cleaning using a fluorescent dye
- Interventions
 - Increased education of environmental service workers
 - Feedback to environmental service workers

†Regularly change “dotted” items to prevent targeting objects

Carling PC, et al. ICHE 2008;29:1035-41



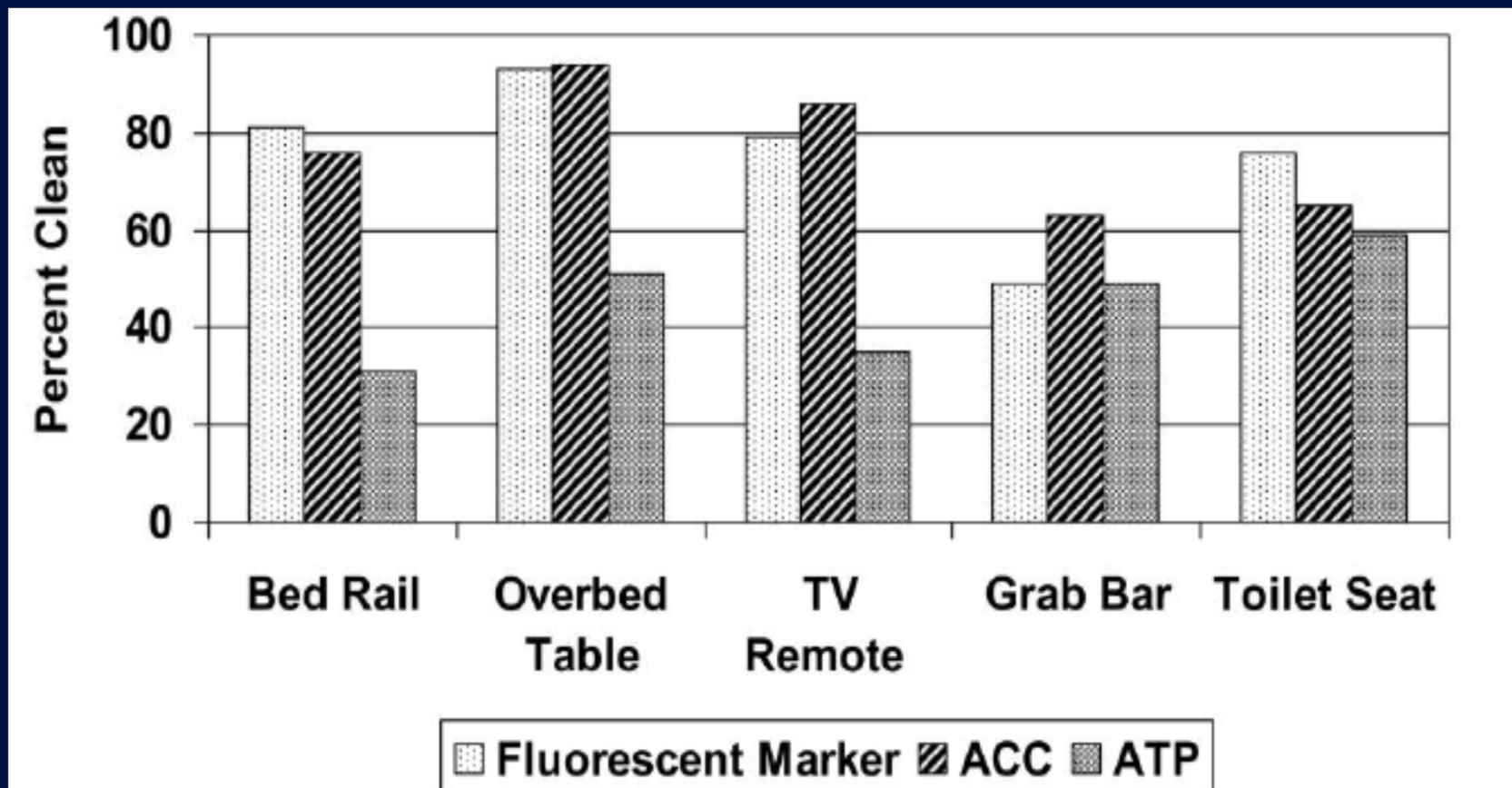
SURFACE EVALUATION USING ATP BIOLUMINESCENCE

Swab surface → Luciferase tagging of ATP → Hand held luminometer



Used in the commercial food preparation industry to evaluate surface cleaning before reuse and as an educational tool for more than 30 years.

COMPARISON OF DIFFERENT METHODS OF ASSESSING TERMINAL ROOM CLEANING PRACTICES



ACC, aerobic colony count; ATP, adenosine triphosphate Boyce JM, et al. ICHE 2011;32:1187

LECTURE OBJECTIVES

- Review the CDC Guideline for Disinfection and Sterilization: Focus on 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
- Discuss options for evaluating environmental cleaning and disinfection
- Review “no touch” methods for room decontamination

NEW APPROACHES TO ROOM DECONTAMINATION



ROOM DECONTAMINATION UNITS

Rutala, Weber. ICHE. 2011;32:743

TABLE 1. Comparison of Room Decontamination Systems That Use UV Irradiation and Hydrogen Peroxide (HP)

	Sterinis	Steris	Bioquell	Tru-D
Abbreviation	DMHP (dry mist HP)	VHP (vaporized HP)	HPV (HP vapor)	UV-C
Active agent	Stenusul (5% HP, <50 ppm silver cations)	Vaprox (35% HP)	35% HP	UV-C irradiation at 254 nm
Application	Aerosol of active solution	Vapor, noncondensing	Vapor, condensing	UV irradiation, direct and reflected
Aeration (removal of active agent from enclosure)	Passive decomposition	Active catalytic conversion	Active catalytic conversion	Not necessary
Sporicidal efficacy	Single cycle does not inactivate <i>Bacillus atrophaeus</i> BIs; ~4-log ₁₀ reduction in <i>Clostridium difficile</i> ^a and incomplete inactivation in situ	Inactivation of <i>Geobacillus stearothermophilus</i> BIs	Inactivation of <i>G. stearothermophilus</i> BIs; >6-log ₁₀ reduction in <i>C. difficile</i> ^a in vitro and complete inactivation in situ	1.7–4-log ₁₀ reduction in <i>C. difficile</i> ^a in situ
Evidence of clinical impact	None published	None published	Significant reduction in the incidence of <i>C. difficile</i>	None published

NOTE. Adapted from Otter and Yezli.¹⁸ BIs, biological indicators; VRE, vancomycin-resistant *Enterococcus*.

^a All *C. difficile* experiments were done with *C. difficile* spores.



EFFECTIVENESS OF UV ROOM DECONTAMINATION

TABLE 1. UV-C Decontamination of Formica Surfaces in Patient Rooms Experimentally Contaminated with Methicillin-Resistant *Staphylococcus aureus* (MRSA), Vancomycin-Resistant *Enterococcus* (VRE), Multidrug-Resistant (MDR) *Acinetobacter baumannii*, and *Clostridium difficile* Spores

Organism	Inoculum	UV-C line of sight						P
		Total		Direct		Indirect		
		No. of samples	Decontamination, log ₁₀ reduction, mean (95% CI)	No. of samples	Decontamination, log ₁₀ reduction, mean (95% CI)	No. of samples	Decontamination, log ₁₀ reduction, mean (95% CI)	
MRSA	4.88 log ₁₀	50	3.94 (2.54–5.34)	10	4.31 (3.13–5.50)	40	3.85 (2.44–5.25)	.06
VRE	4.40 log ₁₀	47	3.46 (2.16–4.81)	15	3.90 (2.99–4.81)	32	3.25 (1.97–4.62)	.003
MDR <i>A. baumannii</i>	4.64 log ₁₀	47	3.88 (2.59–5.16)	10	4.21 (3.27–5.15)	37	3.79 (2.47–5.10)	.07
<i>C. difficile</i> spores	4.12 log ₁₀	45	2.79 (1.20–4.37)	10	4.04 (3.71–4.37)	35	2.43 (1.46–3.40)	<.001

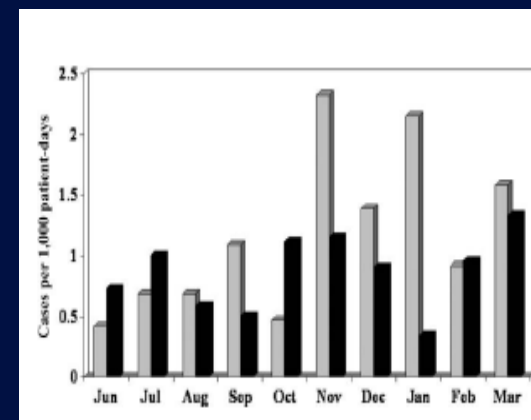
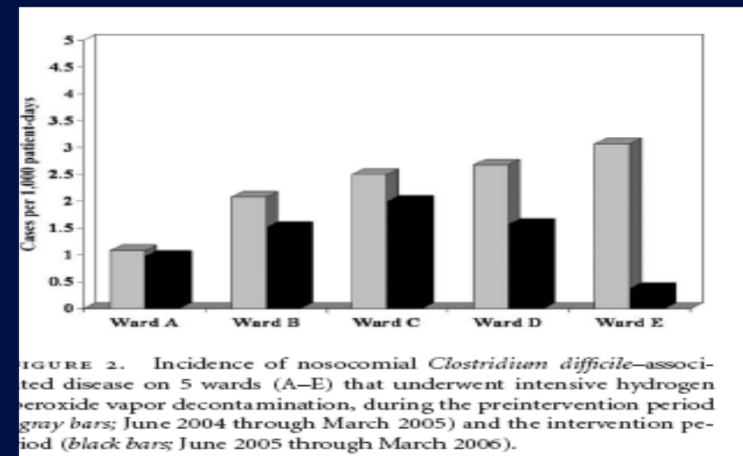
HP FOR DECONTAMINATION OF THE HOSPITAL ENVIRONMENT

Falagas, et al. J Hosp Infect. 2011;78:171.

Author, Year	HP System	Pathogen	Before HPV	After HPV	% Reduction
French, 2004	VHP	MRSA	61/85-72%	1/85-1%	98
Bates, 2005	VHP	<i>Serratia</i>	2/42-5%	0/24-0%	100
Jeanes, 2005	VHP	MRSA	10/28-36%	0/50-0%	100
Hardy, 2007	VHP	MRSA	7/29-24%	0/29-0%	100
Dryden, 2007	VHP	MRSA	8/29-28%	1/29-3%	88
Otter, 2007	VHP	MRSA	18/30-60%	1/30-3%	95
Boyce, 2008	VHP	<i>C. difficile</i>	11/43-26%	0/37-0%	100
Bartels, 2008	HP dry mist	MRSA	4/14-29%	0/14-0%	100
Shapey, 2008	HP dry mist	<i>C. difficile</i>	48/203-24%; 7	7/203-3%; 0.4	88
Barbut, 2009	HP dry mist	<i>C. difficile</i>	34/180-19%	4/180-2%	88
Otter, 2010	VHP	GNR	10/21-48%	0/63-0%	100

ROOM DECONTAMINATION WITH HPV

- Study design
 - Before and after study of HPV
- Outcome
 - *C. difficile* incidence
- Results
 - HPV decreased environmental contamination with *C. difficile* ($p < 0.001$), rates on high incidence floors from 2.28 to 1.28 cases per 1,000 pt days ($p = 0.047$), and throughout the hospital from 1.36 to 0.84 cases per 1,000 pt days ($p = 0.26$)



UV ROOM DECONTAMINATION

Rutala, Weber. ICHE. 2011;32:744

UV irradiation

Advantages

Reliable biocidal activity against a wide range of healthcare-associated pathogens

Room surfaces and equipment decontaminated

Room decontamination is rapid (~15 minutes) for vegetative bacteria

Effective against *Clostridium difficile*, although longer exposure is required (~50 minutes)

HVAC system does not need to be disabled, and the room does not need to be sealed

UV light is residual-free and does not give rise to health or safety concerns

No consumable products so costs include only capital equipment and staff time

Good distribution in the room of UV energy via an automated monitoring system

Disadvantages

All patients and staff must be removed from the room before decontamination

Decontamination can be accomplished only at terminal disinfection (ie, cannot be used for daily disinfection) because the room must be emptied of people

Capital equipment costs are substantial

Does not remove dust and stains, which are important to patients and visitors; hence, cleaning must precede UV decontamination

Sensitive to use parameters (eg, wavelength, UV dose delivered)

Requires that equipment and furniture be moved away from walls

Studies have not been conducted to demonstrate whether use of UV room decontamination decreases the incidence of healthcare-associated infections

HP ROOM DECONTAMINATION

Rutala, Weber. ICHE. 2011;32:743

HP systems

Advantages

Reliable biocidal activity against a wide range of healthcare-associated pathogens

Room surfaces and equipment decontaminated

Effective against *C. difficile*

Useful for disinfecting complex equipment and furniture

Does not require that furniture and equipment be moved away from the walls

HP is residual-free and does not give rise to health or safety concerns (aeration unit converts HP into oxygen and water)

Uniform distribution in the room via an automated dispersal system

Demonstrated to reduce healthcare-associated infections (ie, *C. difficile*)

Disadvantages

All patients and staff must be removed from the room before decontamination

HVAC system must be disabled to prevent unwanted dilution of HP during use, and doors must be closed with gaps sealed by tape

Decontamination can be accomplished only as terminal disinfection (ie, cannot be used for daily disinfection) because the room must be emptied of people

Capital equipment costs are substantial

Decontamination requires ~3–5 hours

Does not remove dust and stains, which are important to patients and visitors; hence, cleaning must precede HP decontamination

Sensitive to use parameters (eg, HP concentration)

ENVIRONMENTAL CONTAMINATION LEADS TO HAIs

Summary

- 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

BEST PRACTICES FOR ROOM DISINFECTION

- Follow the **CDC Guideline** for Disinfection and Sterilization with regard to choosing an appropriate germicide and best practices for environmental disinfection
- Appropriately **train environmental service workers** on proper use of PPE and clean/disinfection of the environment
- Have environmental service workers **use checklists to ensure all room surfaces are cleaned/disinfected**
- Assure that **nursing and environmental service have agreed** what items (e.g., sensitive equipment) are to be clean/disinfected by nursing and what items (e.g., environmental surfaces) are to be cleaned/disinfected by environmental service workers. Staff must have sufficient time. Increasing workload compromising infection control activities.
- **Use a method (e.g., fluorescent dye, ATP) to ensure proper cleaning**
- **If data show benefit, consider use of HP/UV during outbreaks, after CP pts**

LECTURE OBJECTIVES

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disinfectionandsterilization.org

THANK YOU!!



Microfiber Cleaning

- Pad contains fibers (polyester and polyamide) that provide a cleaning surface 40 times greater than conventional string mops
- Proposed advantages: reduce chemical use and disposal (disinfectant solution not changed after every third room, clean microfiber per room [washing lifetime 500-1000x]); light (~5 lb less than string mop) and ergonomic; reduce cleaning times.
- Does the microfiber provide the same or better removal of microorganisms on surfaces?

Microfiber Efficacy and Use

- $> 2\log_{10}$ reduction for microbial removal. Smith et al. JHI. 2011;78:182
- Currently, we use the microfiber mops for the floors with a disinfectant. We use several cotton, washcloths per room for elevated surfaces but are transitioning to microfiber cloths
- We use a disinfectant because cleaning implements such as microfiber can cross-contaminate the environment when a disinfectant is not incorporated or is depleted
- Instructions of preparation, use, and washing should be followed to maximize cloth performance

Touchscreen Cleaning

- Follow the manufacturer's recommendations
- Prepare the cleaning solution according to the manufacturer's instructions (e.g., alcohol, glutaraldehyde, mild soap, phenolic)
- Wet a clean, soft cloth with the selected cleaning solution
- Remove excess liquid from the cloth and squeeze damp
- Wipe exposed surfaces (do not allow liquid to enter interior)
- Remove any soap residue by gently wiping with clean cloth
- QUATS are not recommended by some manufacturers