Environmental Disinfection: Novel Technology

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Environmental Disinfection: Novel Technology
Lecture Objectives

- New approaches/equipment room/equipment decontamination
  - New technologies for room/equipment decontamination
    - Monitoring the effectiveness of cleaning
    - Ultraviolet light
    - Hydrogen peroxide
  - Self disinfecting surfaces
  - Disinfectants for room/equipment surfaces

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

KEY PATHOGENS WHERE ENVIRONMENTIAL SURFACES PLAY A ROLE IN TRANSMISSION

- MRSA
- VRE
- *Acinetobacter* spp.
- *Clostridium difficile*
- Norovirus
- Rotavirus
- SARS

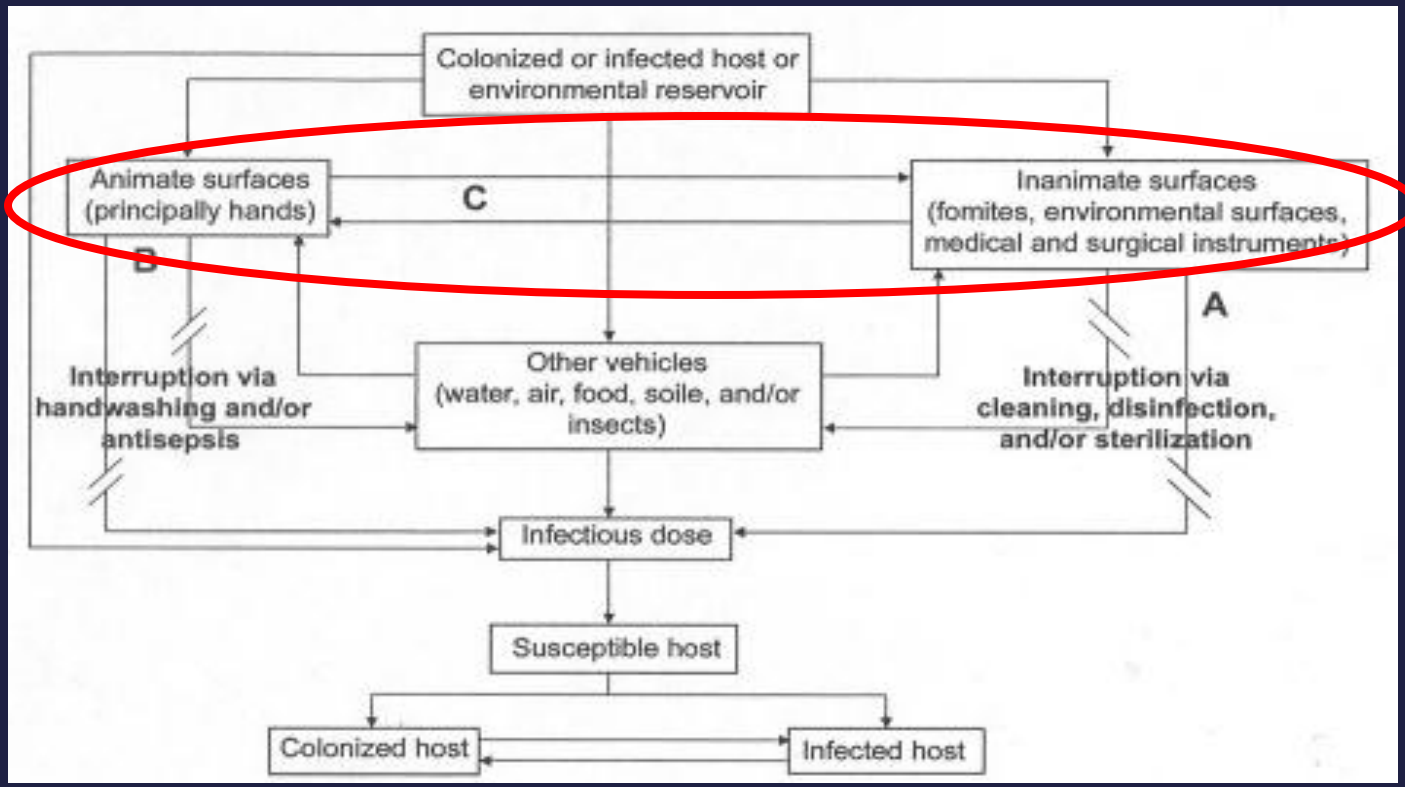
ENVIRONMENTAL CONTAMINATION LEADS TO HAIs

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

ENVIRONMENTAL CONTAMINATION LEADS TO HAIs

- Transmission directly or hands of HCWs
  - 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

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.

ENVIRONMENTAL SURVIVAL OF KEY PATHOGENS ON HOSPITAL SURFACES

Pathogen	Survival Time
S. aureus (including MRSA)	7 days to >12 months
Enterococcus spp. (including VRE)	5 days to >46 months
Acinetobacter spp.	3 days to 11 months
Clostridium difficile (spores)	>5 months
Norovirus (and feline calicivirus)	8 hours to >2 weeks
Pseudomonas aeruginosa	6 hours to 16 months
Klebsiella spp.	2 hours to >30 months

Adapted from Hota B, et al. Clin Infect Dis 2004;39:1182-9 and Kramer A, et al. BMC Infectious Diseases 2006;6:130

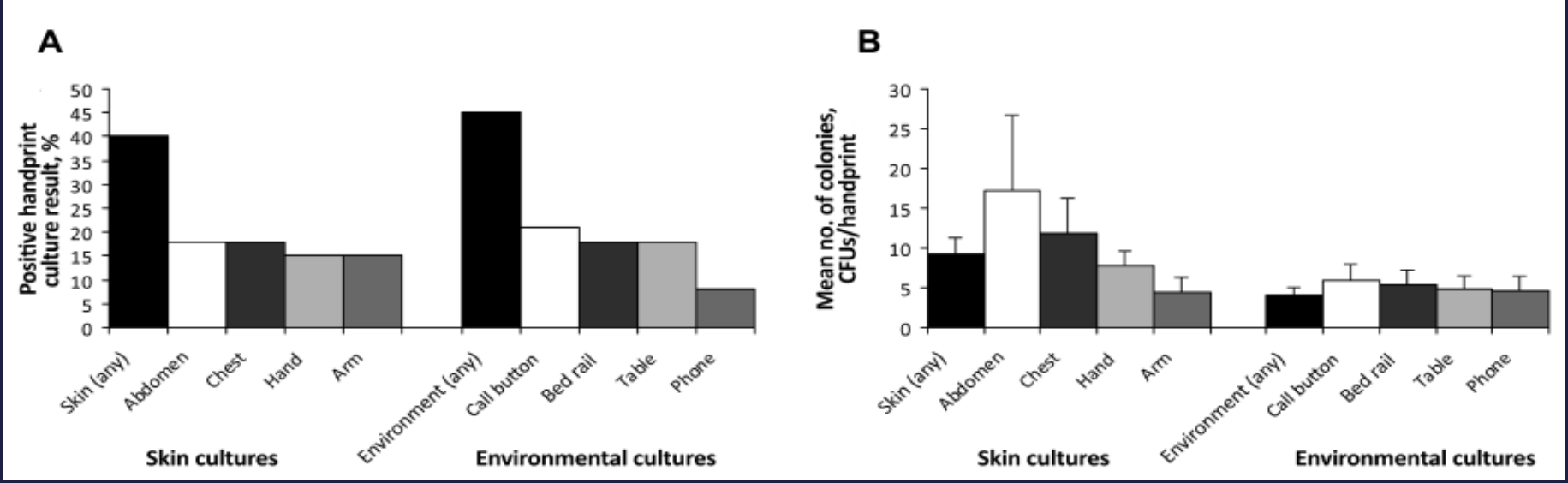
ENVIRONMENTAL CONTAMINATION ENDEMIC AND EPIDEMIC MRSA

	Outbreak	Endemic				Site estimated mean§
	Rampling et al[27]*	Boyce et al[48]*	Sexton et al[51]†	Lemmen et al[50]*‡	French et al[64]*	
Floor	9%	50–55%	44–60%	24%	..	34·5%
Bed linen	..	38–54%	44%	34%	..	41%
Patient gown	..	40–53%	..	34%	..	40·5%
Overbed table	..	18–42%	64–67%	24%	..	40%
Blood pressure cuff	13%	25–33%	..	..	..	21%
Bed or siderails	5%	1–30%	44–60%	21%	43%	27%
Bathroom door handle	..	8–24%	..	12%¶	..	14%
Infusion pump button	13%	7–18%	..	30%	..	19%
Room door handle	11%	4–8%	..	23%	59%	21·5%‖
Furniture	11%	..	44–59%	19%	..	27%
Flat surfaces	7%	..	32–38%	..	..	21·5%
Sink taps or basin fitting	..	..	..	14%	33%	23·5%
Average quoted**	11%	27%	49%	25%	74%	37%

Dancer SJ et al. Lancet ID 2008;8(2):101-13

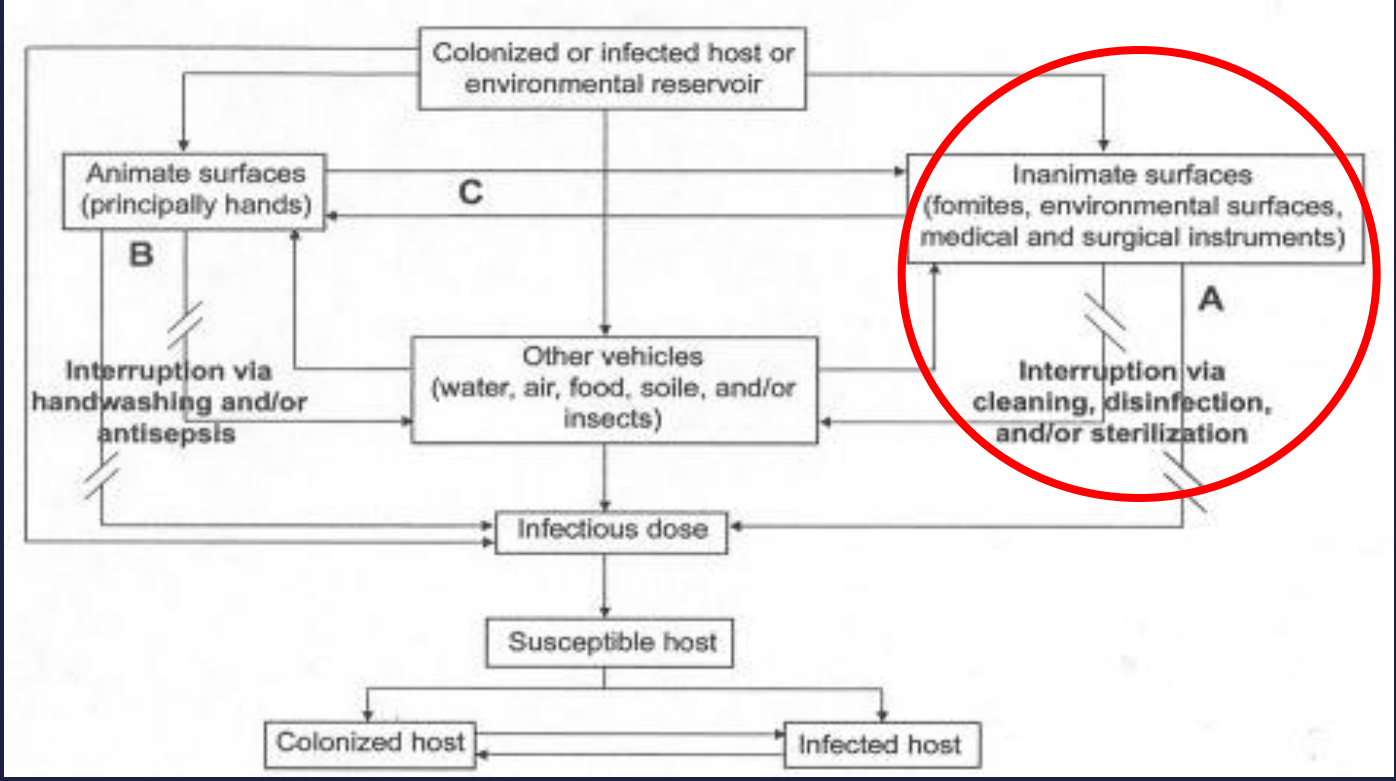
FREQUENCY OF ACQUISITION OF MRSA ON GLOVED HANDS AFTER CONTACT WITH SKIN AND ENVIRONMENTAL SITES

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



Stiefel U, et al. ICHE 2011;32:185-187

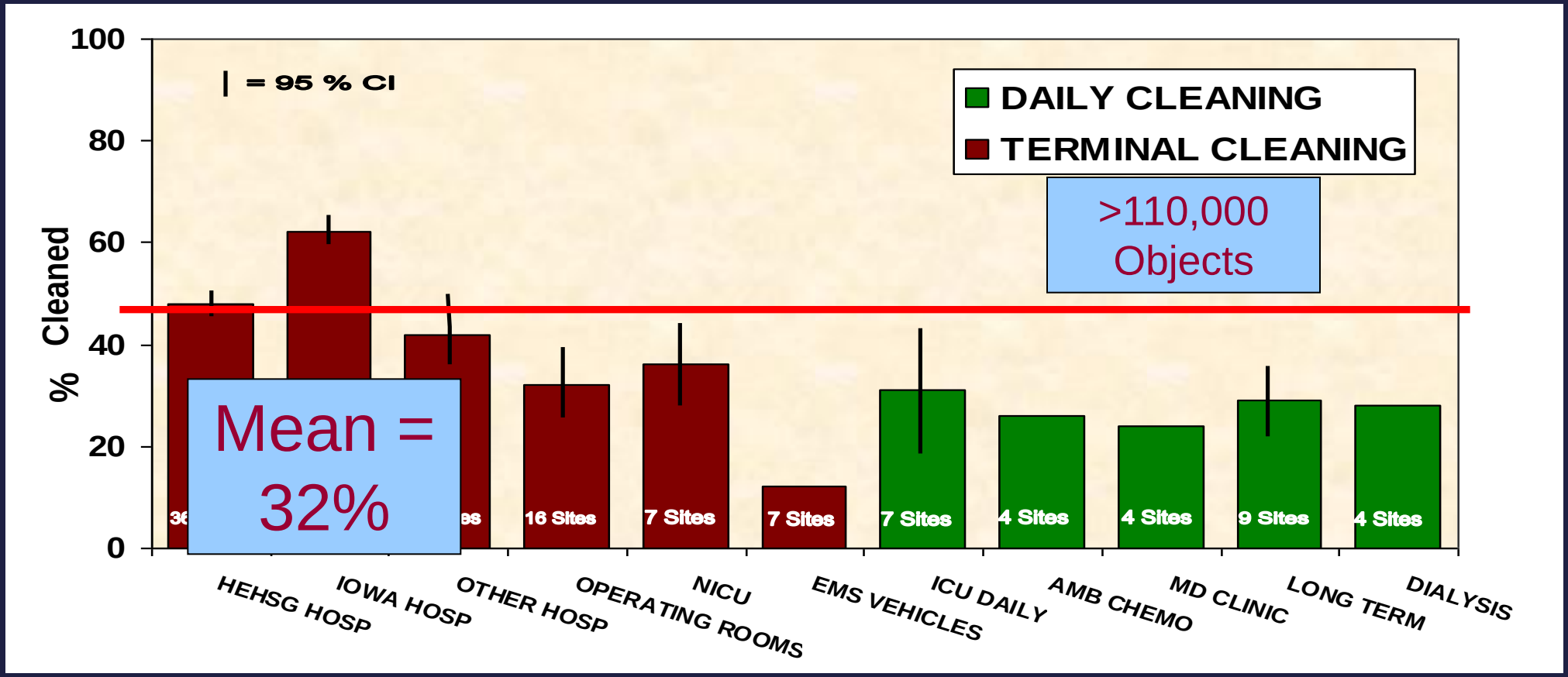
TRANSMISSION MECHANISMS INVOLVING THE SURFACE ENVIRONMENT



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

Thoroughness of Environmental Cleaning

Carling et al. ECCMID, Milan, Italy, May 2011



EVALUATION OF HOSPITAL ROOM ASSIGNMENT AND ACQUISITION OF CDI

- Study design: Retrospective cohort analysis, 2005-2006
- Setting: Medical ICU at a tertiary care hospital
- Methods: All patients evaluated for diagnosis of CDI 48 hours after ICU admission and within 30 days after ICU discharge
- Results (acquisition of CDI)
  - Admission to room previously occupied by CDI = 11.0%
  - Admission to room not previously occupied by CDI = 4.6% (p=0.002)

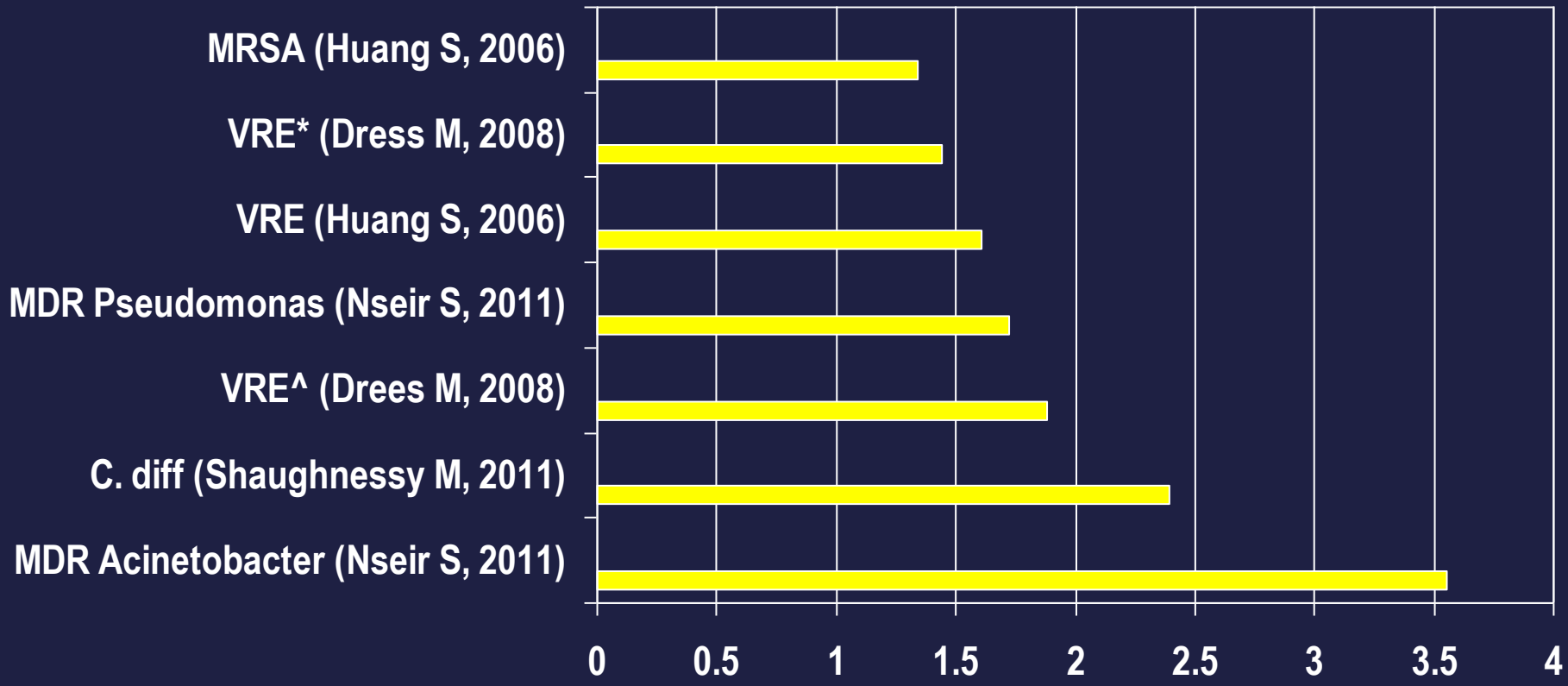
Shaughnessy MK, et al. ICHE 2011;32:201-206

TABLE 3. Multivariate Analysis of Risk Factors for Acquisition of *Clostridium difficile* Infection (CDI)

Risk factor	HR (95% CI)	*P*
Prior room occupant with CDI	2.35 (1.21–4.54)	.01
Greater age	1.00 (0.99–1.01)	.71
Higher APACHE III score	1.00 (1.00–1.01)	.06
Proton pump inhibitor use	1.11 (0.44–2.78)	.83
Antibiotic exposure		
Norfloxacin	0.38 (0.05–2.72)	.33
Levofloxacin	1.08 (0.67–1.73)	.75
Ciprofloxacin	0.49 (0.15–1.67)	.23
Fluoroquinolones	1.17 (0.72–1.91)	.53
Clindamycin	0.45 (0.14–1.42)	.17
Third- or fourth-generation cephalosporins	1.17 (0.76–1.79)	.48
Carbapenems	1.05 (0.63–1.75)	.84
Piperacillin-tazobactam	1.31 (0.82–2.10)	.27
Other penicillin	0.47 (0.23–0.98)	.04
Metronidazole	1.31 (0.83–2.07)	.24
Vancomycin		
Oral	1.38 (0.32–5.89)	.67
Intravenous	1.55 (0.88–2.73)	.13
Aminoglycosides	1.27 (0.78–2.06)	.35
Multiple (≥3 antibiotic classes)	1.28 (0.75–2.21)	.37

NOTE. APACHE, Acute Physiology and Chronic Health Evaluation; CI, confidence interval; HR, hazard ratio.

RELATIVE RISK OF PATHOGEN ACQUISITION IF PRIOR ROOM OCCUPANT INFECTED



* Prior room occupant infected; ^Any room occupant in prior 2 weeks infected

Thoroughness of Environmental Cleaning

Carling et al. ECCMID, Milan, Italy, May 2011

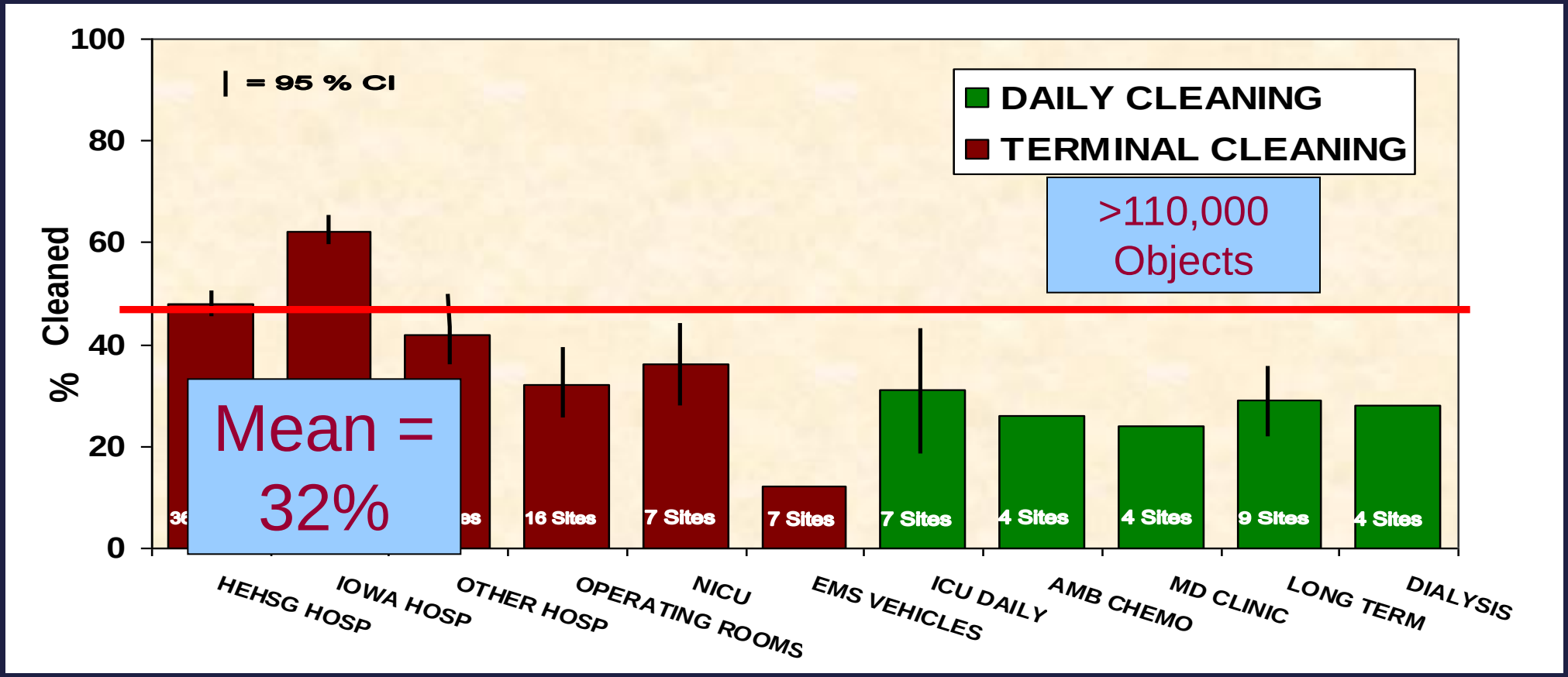


TABLE. Rates of Cleaning for 14 Types of High-Risk Objects

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.

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.

ENVIRONMENTAL CONTAMINATION LEADS TO HAIs
Suboptimal Cleaning

- 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

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/cm^2-pass; can be costly and pathogen specific
- Fluorescent marker-transparent, easily cleaned, environmentally stable marking solution that fluoresces when exposed to an ultraviolet light (applied by IP unbeknown to EVS, after EVS cleaning, markings are reassessed)

DAZO Solution (AKA – Goo)

Target After Marking

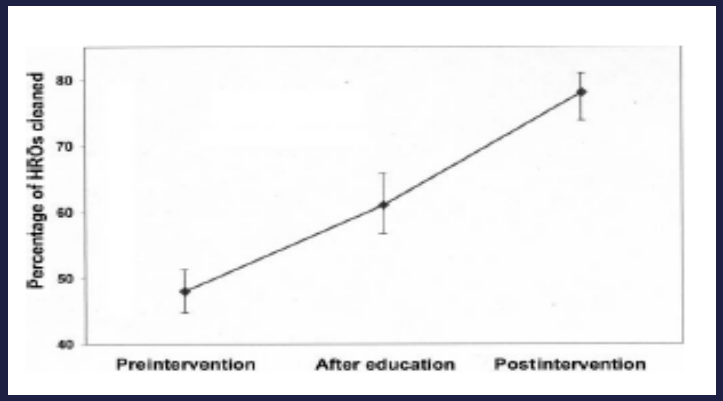
Target Enhanced

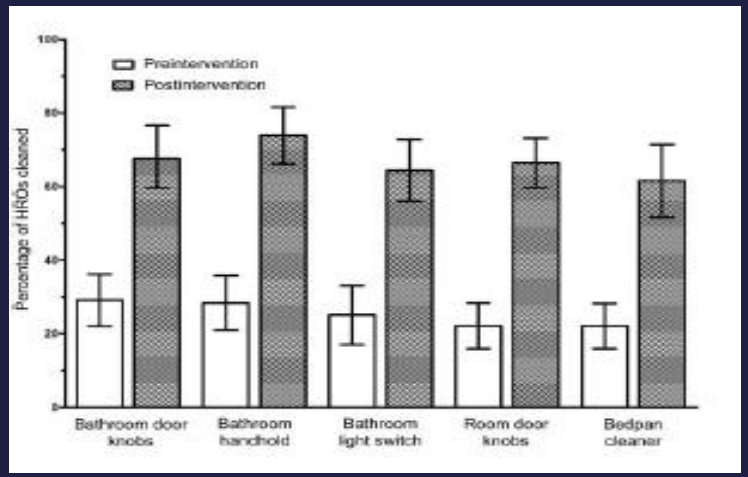
Marked Or Instrument

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 → luciferace 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.

THE ROLE OF THE ENVIRONMENT IN DISEASE TRANSMISSION

- Over the past decade there has been a growing appreciation that environmental contamination makes a contribution to HAI with MRSA, VRE, *Acinetobacter*, norovirus and *C. difficile*
- Inadequate terminal cleaning of rooms occupied by patients with MDR pathogens places the next patients in these rooms at increased risk of acquiring these organisms
- Surface disinfection practices are currently not effective in eliminating environmental contamination…what else can we do?

Environmental Disinfection: Novel Technology
Lecture Objectives

- New approaches/equipment room/equipment decontamination
  - New technologies for room/equipment decontamination
    - Monitoring the effectiveness of cleaning
    - Ultraviolet light
    - Hydrogen peroxide
  - Self disinfecting surfaces
  - Disinfectants for room/equipment surfaces

NEW APPROACHES TO ROOM DECONTAMINATION

Touch (Wiping) vs No-Touch (Mechanical)

No Touch

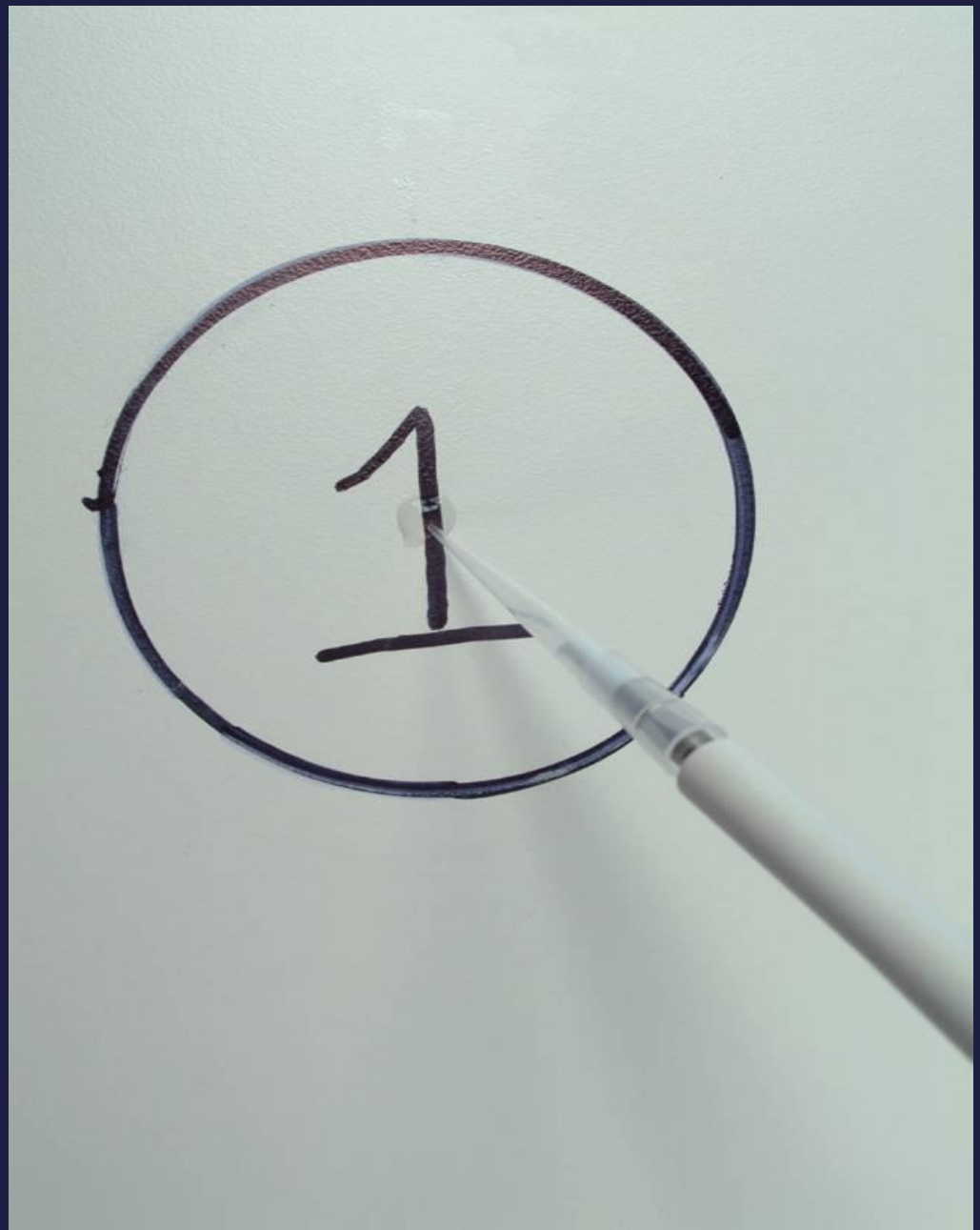
(supplements but do not replace surface cleaning/disinfection)

UV-Light Emitting Device

UV Room Decontamination

Rutala, Gergen, Weber, ICHE. 2010:31:1025-1029

- Fully automated, self calibrates, activated by hand-held remote
- Room ventilation does not need to be modified
- Uses UV-C (254 nm range) to decontaminate surfaces
- Measures UV reflected from walls, ceilings, floors or other treated areas and calculates the operation total dosing/time to deliver the programmed lethal dose for pathogens.
- UV sensors determines and targets highly-shadowed areas to deliver measured dose of UV energy
- After UV dose delivered (36,000µWs/cm^2 for spore, 12,000µWs/cm^2 for bacteria), will power-down and audibly notify the operator
- Reduces colony counts of pathogens by >99.9% within 20 minutes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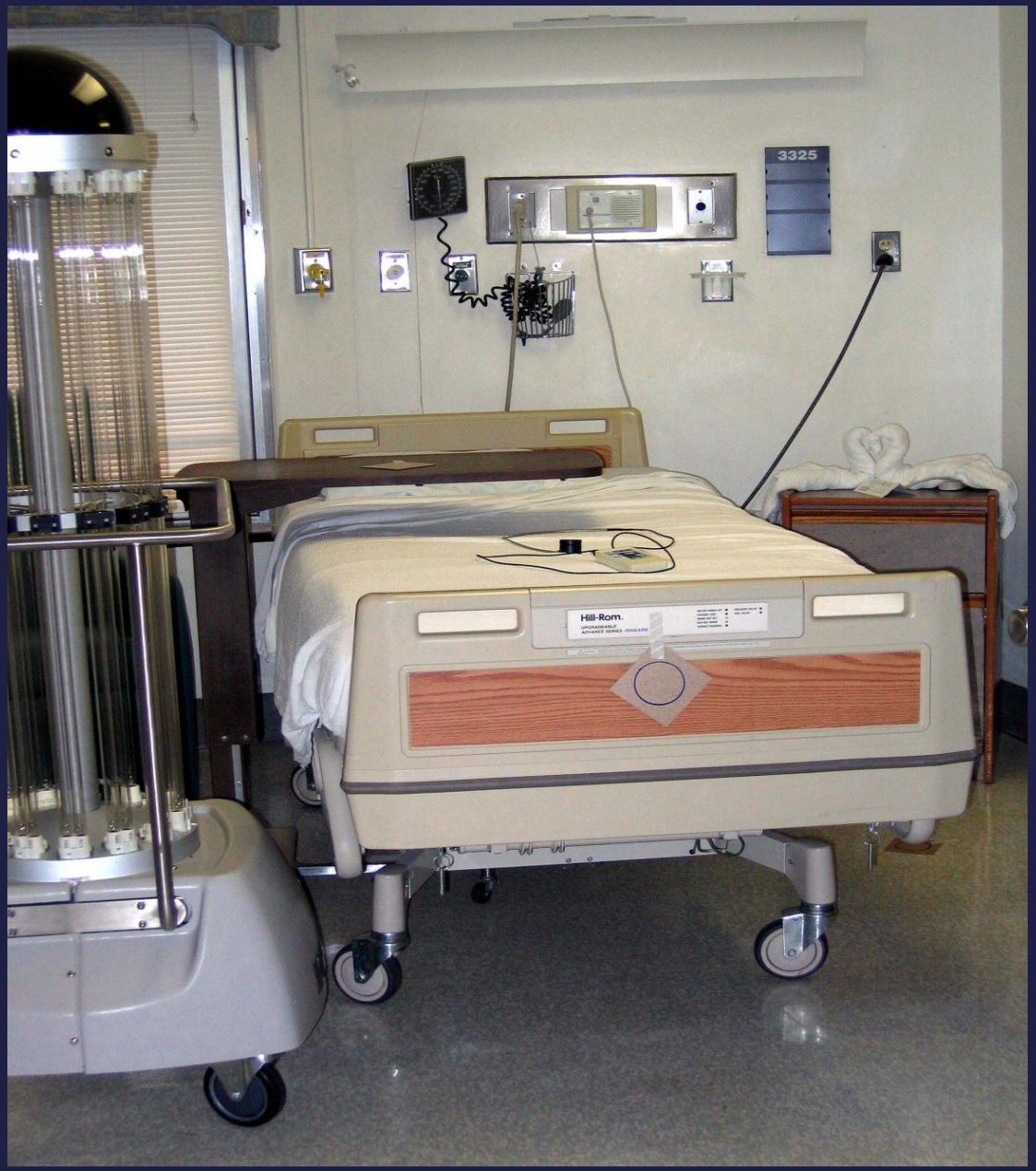
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Hill-Rom

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

		UV-C line of sight						
		Total		Direct		Indirect		
Organism	Inoculum	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)	*P*
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 *A. baumannii*	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
C. difficile 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

Rutala WA, Gergen MF, Weber DJ. Infect Control Hosp Epidemiol 2010;31:1025-9

EFFECTIVENESS OF UV ROOM DECONTAMINATION

Nerandzic et al. BMC Infect Dis 2010;8:197

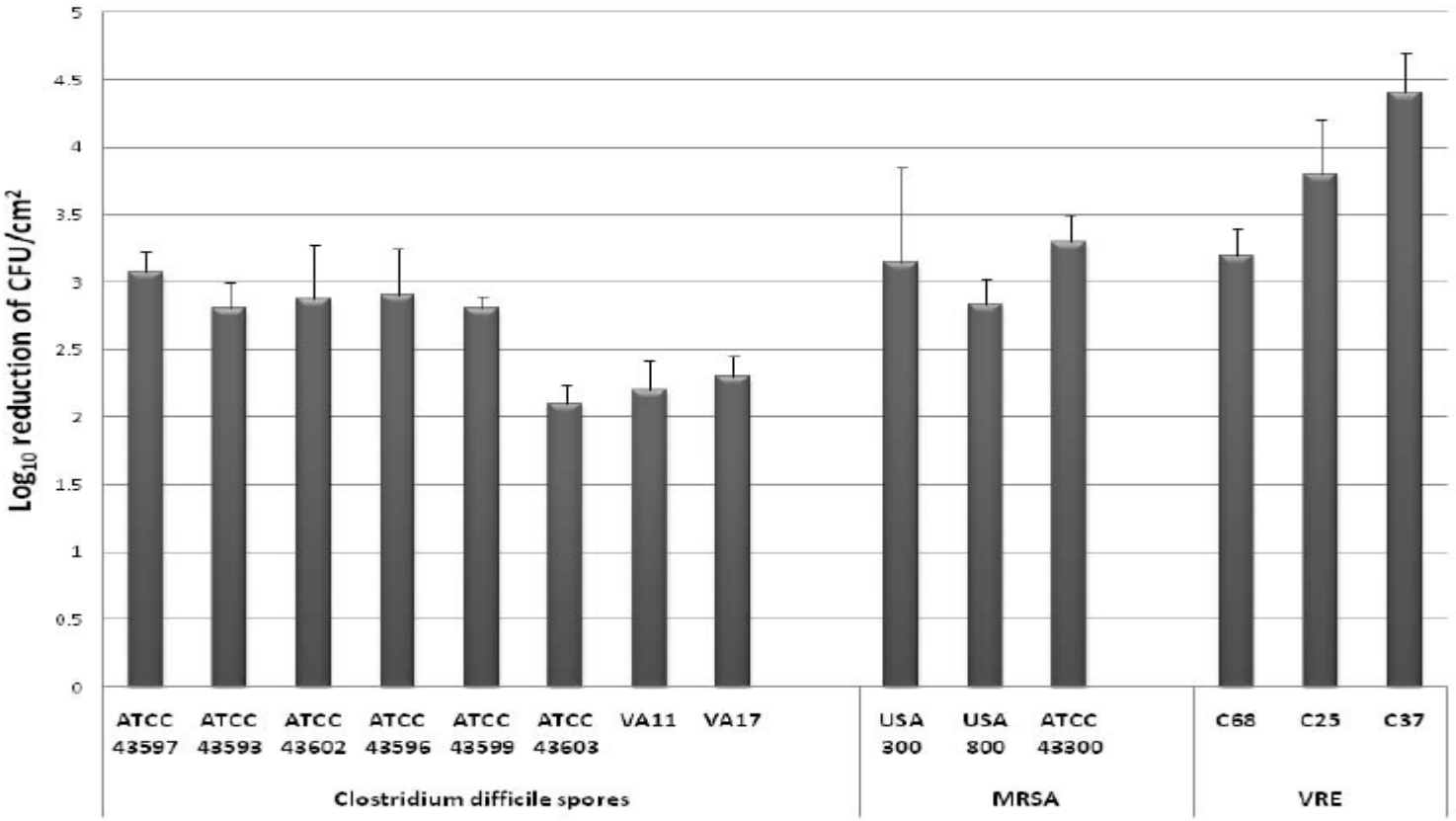


Figure 2 Mean reduction (log_{10}colony-forming units [CFU]/cm^2) in recovery of multiple strains of *Clostridium difficile*, methicillin-resistant *Staphylococcus aureus* (MRSA), and vancomycin-resistant *Enterococcus* (VRE) from laboratory bench top surfaces after the use of the Tru-D device. For each pathogen, the inoculum applied to the bench top was adjusted such that 10^3 to 10^5 CFU were recovered from the positive control specimens. The Tru-D device was operated at a reflected dose of 22,000 μWs/cm^2 for ~45 minutes.

ROOM DECONTAMINATION WITH UV, HP

- Issues-Room decontamination time; where the occupancy is high and fast patient turnaround time is critical
  - Room decontamination with UV is 15-25 minutes for vegetative bacteria and 50 minutes for *C. difficile* spores
  - HP room decontamination takes approximately 2.5 hours

Rapid Hospital Room Decontamination Using UV Light With a Nanostructured Reflective Coating

- Assessed the time required to kill HAI pathogens in a room with standard white paint (3-7% UV reflective) versus walls coated with an agent formulated to be reflective to UV-C wavelengths (65% UV reflective)
- Coating/painted uses nanoscale metal oxides whose crystal structures are reflective to UV-C
- Coating is white in appearance and can be applied with a brush or roller in the same way as any common interior latex paint
- Cost to coat walls used in this study was estimated to be <$300.

UV Reflective Coating

Rutala, Gergen, Tande, Weber. 2012

With the nanoscale reflective coating, cycle times were 5-10m (~80% reduction) which would substantially reduce the turnover time of the room

Line-of-Sight	MRSA w/coating	MRSA no coating	*C. difficile* w/coating	*C. difficile* no coating
Cycle Time	5m03s	25m13s	9m24s	43m42s
Direct	4.70 (n=42)	4.72 (n=33)	3.28 (n=39)	3.42 (n=33)
Indirect	4.45 (n=28)	4.30 (n=27)	2.42 (n=31)	2.01 (n=27)
Total	4.60 (n=70)	4.53 (n=60)	2.91 (n=70)	2.78 (n=60)

Hydrogen Peroxide Vapor/Aerosol Decontamination

Hydrogen Peroxide Vapor/Aerosol Decontamination

- Glosair (formerly Sterinis)
  - Fine mist by aerosolizing solution of 5% HP, <50 ppm silver
- Steris
  - Vaporized HP from 35% HP
- Bioquell
  - HP vapor from 35% HP

ROOM DECONTAMINATION UNITS

Rutala, Weber. ICHE. 2011;32:743

UV and HP systems have been demonstrated to be effective against various healthcare-associated pathogens

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	Stenusil (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 *Bacillus atrophaeus* BIs; ~4-$\log_{10}$ reduction in *Clostridium difficile*[a] and incomplete inactivation in situ	Inactivation of *Geobacillus stearothermophilus* BIs	Inactivation of *G. stearothermophilus* BIs; >6-$\log_{10}$ reduction in *C. difficile*[a] in vitro and complete inactivation in situ	1.7–4-$\log_{10}$ reduction in *C. difficile*[a] in situ
Evidence of clinical impact	None published	None published	Significant reduction in the incidence of *C. difficile*	None published

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

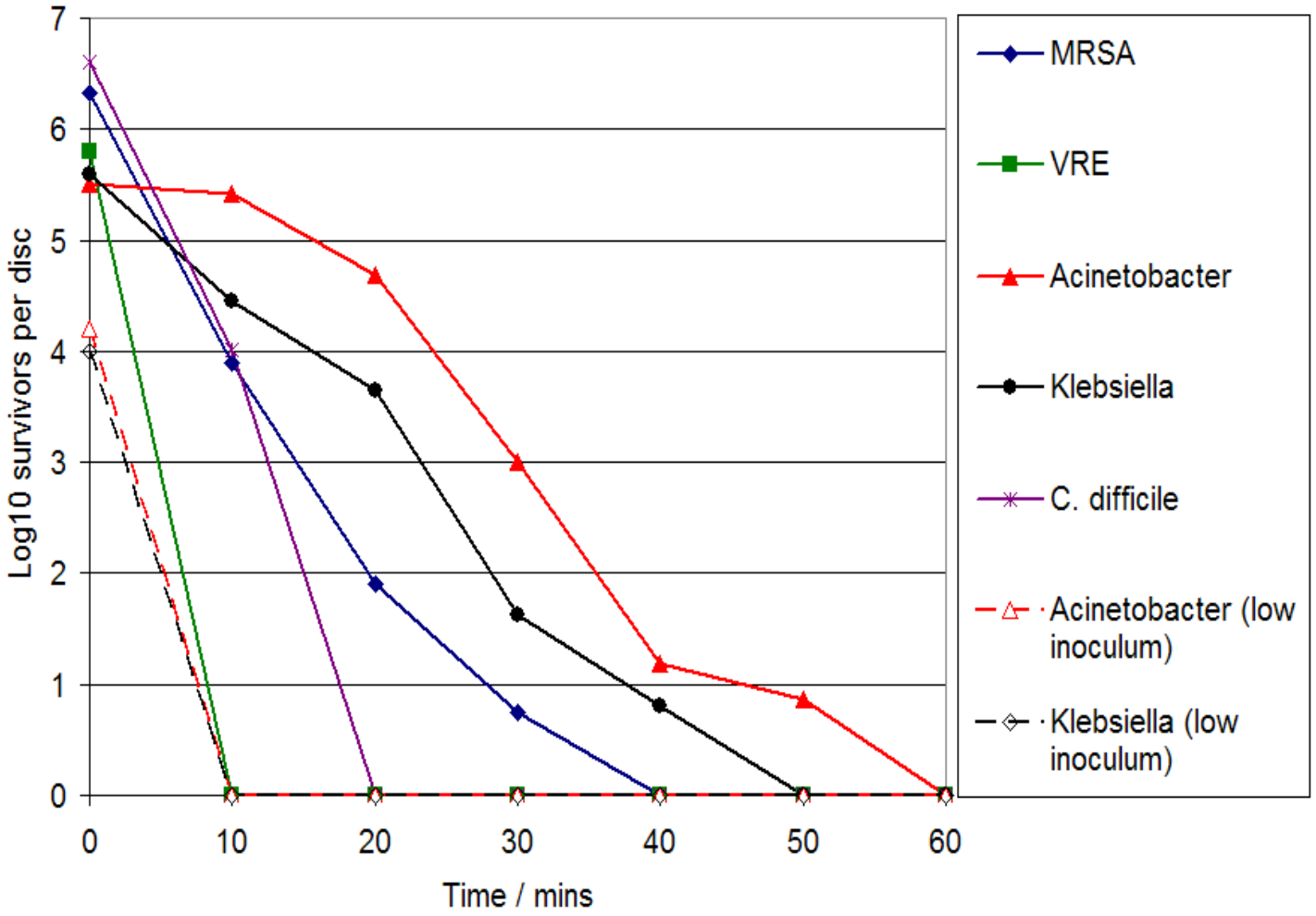
[a] All *C. difficile* experiments were done with *C. difficile* spores.

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	*Serratia*	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	*C. difficile*	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	*C. difficile*	48/203-24%	7/203-3%	88
Barbut, 2009	HP dry mist	*C. difficile*	34/180-19%	4/180-2%	88
Otter, 2010	VHP	GNR	10/21-48%	0/63-0%	100

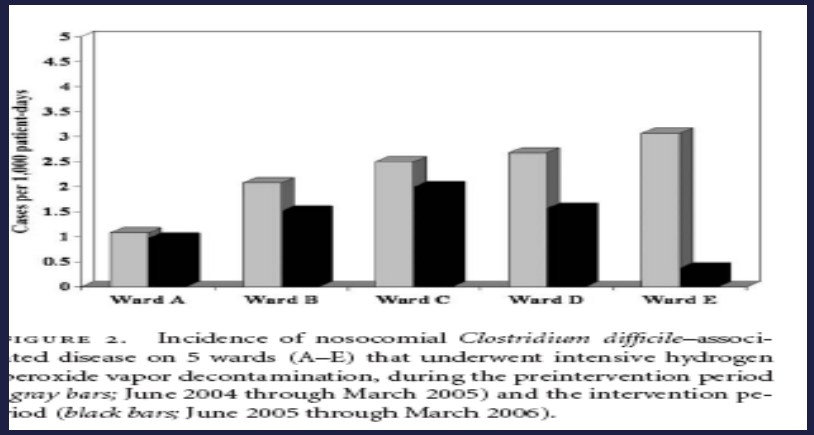
HPV *in vitro* Efficacy



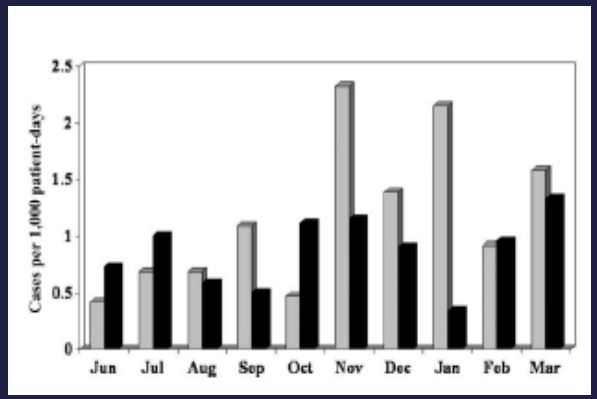
Otter and French. *J Clin Microbiol* 2009;47:205-207.

Room Decontamination With VHP

- Study design
  - **Before and after study of VHP**
- Outcome
  - ***C. difficile* incidence**
- Results
  - **VHP 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)**



IGURE 2. Incidence of nosocomial *Clostridium difficile*–associated disease on 5 wards (A–E) that underwent intensive hydrogen peroxide vapor decontamination, during the preintervention period (*gray bars*; June 2004 through March 2005) and the intervention period (*black bars*; June 2005 through March 2006).



Boyce JM, et al. ICHE 2008;29:723-729

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    - Hydrogen peroxide
  - Self disinfecting surfaces
  - Disinfectants for room/equipment surfaces

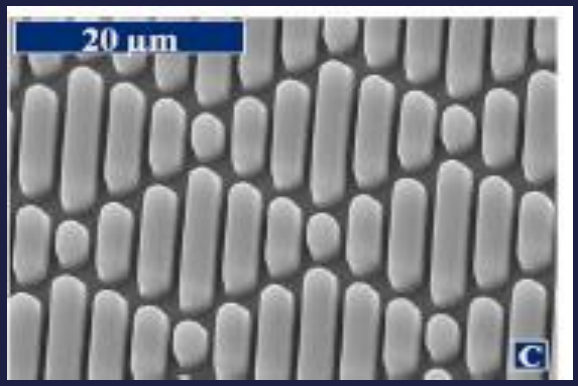
SELF DISINFECTING SURFACES

- Surface impregnated with a “heavy” metal
  - **Silver**
  - **Copper**
- Surface impregnated with a germicide
  - **Triclosan**
  - **Antimicrobial surfactant/quaternary ammonium salt?**
  - **Organosilane products?**
- Altered topography
  - **Sharklet pattern**
- Light-activated antimicrobial coating

Weber DJ, Rutala WA. ICHE 2012;33:10-13

SELF DISINFECTING SURFACES

Copper coated overbed table



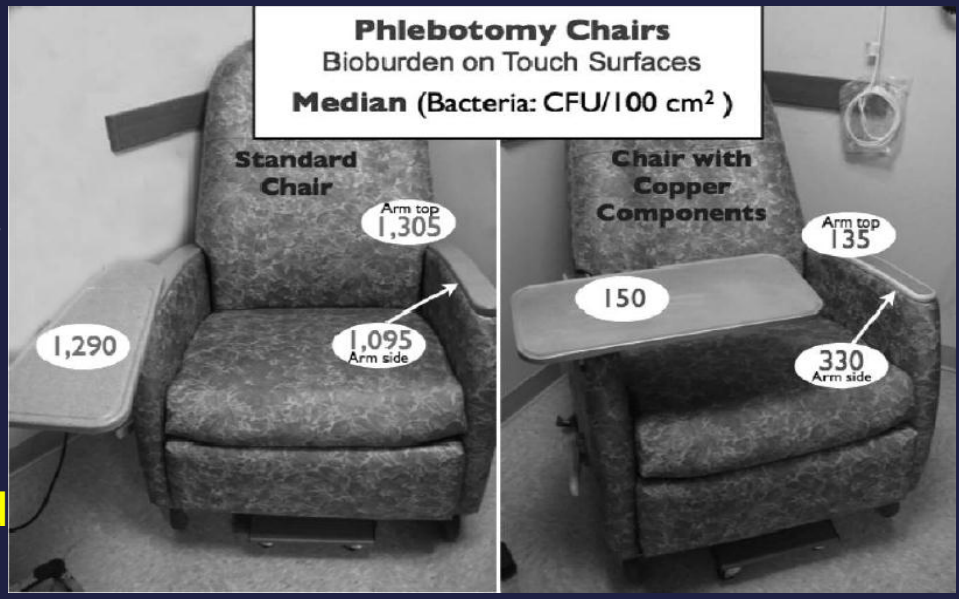
Sharklet Pattern

Antimicrobial effects of silver

Triclosan pen

EVALUATION OF PHLEBOTOMY CHAIR WITH COPPER COATED ARMS AND TRAYS

- Study design: Cross-over design
- Location: Outpatient ID clinic
- Methods:
  - Solid copper alloy (90% Cu) inlaid across arm tops and trays of phlebotomy chair (comparator = wood arms and plastic tabletop)
  - Cultures obtained 2x/week, mid-afternoon
- Results:
  - Median reduction in aerobic bacteria of 88% and 90%, trays & arms, respectively
  - Percent of surfaces with <2.5 CFU/cm^2: copper 62%, noncopper 10%



Rai S, et al. ICHE 2012;33:200-201

Enhancing Patient Safety Through Copper Surfaces
M Schmidt et al. IFIC, October 2012

- Three hospital (NY, 2 SC) study to evaluate the potential value (reduced bacterial burden, HAIs) of antimicrobial copper applied to 6 touch surfaces in ICUs
- 83% reduction in bacterial burden
- Significant decrease in the incidence of HAI/colonization by MRSA and VRE
- Warrants further consideration when published to fully appreciate the potential benefit and optimization of the risk reduction

Environmental Disinfection: Novel Technology
Lecture Objectives

- New approaches/equipment room/equipment decontamination
  - New technologies for room/equipment decontamination
    - Monitoring the effectiveness of cleaning
    - Ultraviolet light
    - Hydrogen peroxide
  - Self disinfecting surfaces
  - Disinfectants for room/equipment surfaces

DISINFECTION AND STERILIZATION

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

- 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**

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	UD
Improved hydrogen peroxide (HP)	0.5%, 1.4%

UD=Manufacturer's recommended use dilution

IMPROVED HYDROGEN PEROXIDE (HP) 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. 2012;33:1159

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

Organism	IHP-0.5%	0.5% HP	IHP Cleaner-Dis 1.4%	1.4% HP	3.0% HP	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-*Ab*	>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-*Ab*, FCS	>6.6	NT	>6.6	NT	<4.1	>6.6

Hospital Privacy Curtains

(pre- and post-intervention study; sampled curtain, sprayed "grab area" 3x from 6-8" with 1.4% IHP and allowed 2 minute contact; sampled curtain)

Decontamination of Curtains with Activated HP (1.4%)

Rutala, Gergen, Weber. 2012

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 with IHP

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Environmental Disinfection: Novel Technology
Conclusions

- MRSA, VRE, *C. difficile*, MDR-*Acinetobacter* comprise a growing reservoir of epidemiologically important pathogens that have an environmental mode of transmission
- Effective surface disinfection essential to eliminate the environment as a source for transmission of HA pathogens.
- Monitoring the effectiveness of cleaning may improve thoroughness and reduce microbial contamination
- UV and HP systems have been demonstrated to be effective against various HA pathogens (including *C. difficile* spores) and offer an option for room decontamination

THANK YOU!

www.disinfectionandsterilization.org