
Disinfection and Sterilization: Current Issues and New Technology

William A. Rutala, Ph.D., M.P.H.

**University of North Carolina (UNC) Health
Care System and UNC at Chapel Hill, NC**

Disclosure

This educational activity is brought to you, in part, by Advanced Sterilization Products (ASP) and Ethicon. The speaker receives an honorarium from ASP and Ethicon and must present information in compliance with FDA requirements applicable to ASP.

Disinfection and Sterilization: Current Issues and New Technologies

- Disinfection and sterilization principles
- Emerging issues
 - Critical-prions, Steris System 1 and Steris System 1E
 - Semicritical items-*C. difficile* spores, laryngoscopes, new AERs/HLDs
 - Noncritical-surface disinfection
 - ◆ UV
 - ◆ Hydrogen peroxide vapor
 - ◆ Contact time for surface disinfection
 - ◆ High touch objects

Disinfection and Sterilization

www.cdc.gov Guidelines for D/S in Healthcare Facilities

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Critical Items/Sterilization

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Sterilization of “Critical Objects”

Steam sterilization

Hydrogen peroxide gas plasma

Ethylene oxide

Peracetic acid (0.2%)-chemical sterilization

Ozone

Vaporized hydrogen peroxide

Steam formaldehyde

Ozone

● Advantages

- Used for moisture and heat-sensitive items
- Ozone generated from oxygen and water (oxidizing)
- No aeration because no toxic by-products
- FDA cleared for metal and plastic surgical instruments, including some instruments with lumens

● Disadvantages

- Sterilization chamber small, 4ft³
- Limited use (material compatibility/penetrability/organic material resistance?) and limited microbicidal efficacy data

V-PRO™ 1, Vaporized Hydrogen Peroxide

- Advantages

- Safe for the environment and health care worker; it leaves no toxic residuals
- Fast - cycle time is 55 min and no aeration necessary
- Used for heat and moisture sensitive items (metal and nonmetal devices)

- Disadvantages

- Sterilization chamber is small, about 4.8ft³
- Medical devices restrictions based on lumen internal diameter and length- see manufacturer's recommendations, e.g., SS lumen 1mm diameter, 125mm length
- Not used for liquid, linens, powders, or any cellulose materials
- Requires synthetic packaging (polypropylene)
- **Limited use and limited comparative microbicidal efficacy data**

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Creutzfeldt Jakob Disease (CJD): Disinfection and Sterilization

SHEA GUIDELINE

Guideline for Disinfection and Sterilization of Prion-Contaminated Medical Instruments

William A. Rutala, PhD, MPH; David J. Weber, MD, MPH

EPIDEMIOLOGY OF THE CREUTZFELDT-JAKOB DISEASE PRION

Creutzfeldt-Jakob disease (CJD) is a degenerative neurologic disorder of humans with an incidence in the United States of approximately 1 case per million population per year.¹⁻³ CJD is caused by a proteinaceous infectious agent, or prion. CJD is related to other human transmissible spongiform encephalopathies (TSEs), including kuru (US incidence, 0 [now eradicated]), Gerstmann-Stratssler-Scheinker syndrome (US incidence, 1 case per 40 million population per year), and fatal familial insomnia syndrome (incidence, <1 case per 40 million population per year). Prion diseases elicit no immune response, result in a noninflammatory pathologic process confined to the central nervous system, have an incubation period of years, and usually are fatal within 1 year after diagnosis.

A variant form of CJD (vCJD) has been recognized that is acquired from cattle with bovine spongiform encephalopathy (or "mad cow disease"). As of July 2009, a total of 211 cases of vCJD have been reported worldwide: 165 in the United Kingdom, 25 in France, 5 in Spain, 4 in Ireland, 3 each in the United States and the Netherlands, 2 in Portugal, and 1 each in Italy, Canada, Japan, and Saudi Arabia.⁴⁻⁶ Two of the patients from Ireland, 2 patients from the United States, and 1 patient each from Canada, France, and Japan are believed to have been exposed to bovine spongiform encephalopathy during their past residence in the United Kingdom; the third US patient likely acquired vCJD in Saudi Arabia. Patients

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tains. To date, no evidence for transmission of chronic wasting disease of deer and elk to humans has been identified.⁷⁻¹⁰

TRANSMISSION OF CJD VIA MEDICAL DEVICES

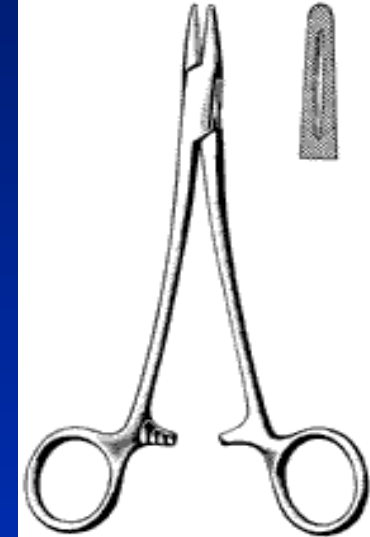
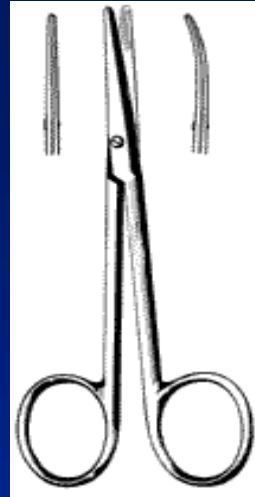
CJD occurs as both a sporadic disease (~85% of cases) and as a familial or inherited disease (~15% of cases). Fewer than 1% of cases of CJD have resulted from healthcare-associated transmission; the majority of these result from the use of contaminated tissues or grafts.¹¹ Iatrogenic CJD has been described in humans in 3 circumstances: in patients for whom contaminated medical equipment was used during intracranial placement of contaminated electroencephalography electrodes (2 cases in Switzerland) or neurosurgical procedures (4 suspected cases: 3 cases in the United Kingdom and 1 case in France), in patients who received hormone therapy with cadaveric human growth hormone or gonadotropin (>190 cases [26 cases in the United States]; since 1985, human growth hormone has been manufactured by the use of recombinant DNA technology, which eliminated this risk), and in patients who received an implant of contaminated grafts from humans (cornea, 2 cases; dura mater, >190 cases [3 cases in the United States for which the risk factor is the Lyodura graft {B. Braun Melsungen} processed before 1987]).¹¹⁻¹⁴ All known instances of iatrogenic CJD have resulted from exposure to infectious brain, pituitary, or eye tissue. Tissue infectivity studies in experimental animals have determined the infectiousness of different body tissues (Table

Transmissible Spongiform Encephalopathies (TSEs) of Humans

- Kuru
- Gertsman-Straussler-Scheinker (GSS)
- Fatal Familial Insomnia (FFI)
- Creutzfeldt-Jakob Disease (CJD)
- Variant CJD (vCJD), 1996 (217 cases, October 2009; 170 UK, 25 France, 5 Spain)

Epidemiology of CJD in the US

- **Degenerative neurologic disorder caused by proteinacious infectious agent**
- **Incidence-one death/million population**
- **No seasonal distribution, no geographic aggregation**
- **Both genders equally affected**
- **Age range 50-80+ years, average 67**
- **Long incubation disease (months-years)**
- **Rapid disease progression after onset (death within 6 mo)**
- **Relatively resistant to conventional disinfection/sterilization**



CJD : potential for secondary spread through contaminated surgical instruments

CJD: Disinfection and Sterilization

Conclusions

- **Critical/Semicritical-devices contaminated with high-risk tissue (brain, spinal cord and eyes) from high-risk patients requires special prion reprocessing**
 - 134°C for 18m (prevacuum)
 - 132°C for 60m (gravity)
 - NaOH and steam sterilization (e.g., 1N NaOH 1h, then 121°C 1h)
- Discard instruments that are impossible to clean
- No low temperature sterilization technology recommended*
- Noncritical-disinfectants (e.g., chlorine, Environ LpH) effective (4 log decrease in LD₅₀ within 1h) and some detergents

*VHP and HP gas plasma (Sterrad NX) reduced prion infectivity but not cleared by FDA; ICHE 2010;31:107

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Steris System 1 (SS1)

- **May 2008, based on significant changes from 1988 to 2002, FDA notified Steris that SS1 “adulterated and misbranded” and FDA has not determined it is safe and effective for label claims.**
- **January 2009, Steris advised customers about steps it was taking in response to FDA concerns (stopped selling SS1 in the US but support it for 2 years)**
- **December 2009, FDA not satisfied with transition of Steris customers to replacements for SS1 issued a notice to healthcare organizations recommending they transition to legally marketed processes within 3-6 months (later extended to 18 months)**

Steris System 1

- February 2010, FDA tells manufacturers (e.g., endoscope) that they must change labeling that their devices can be processed by SS1. Revise labeling to identify legally-marketed devices.
- “Hospitals using SS1 should be figuring out what their next sterilizer will be and how quickly they can switch over” Steven Silverman, Office of Compliance, FDA
- Steris submitted to FDA an updated SS1 in January 2009 but not FDA-cleared

Steris System 1E

FDA cleared 6 April 2010
(available 2nd Qtr FY2011)

Steris System 1E (SS1E)

- **SS1E is a liquid chemical sterilant processing system which can be used to reprocess heat-sensitive reusable critical and semicritical medical devices. FDA, April 2010**
- **Since the rinse water is tap water that has been filtered and exposed to UV, it is not sterile. Therefore, the final processed devices cannot be assured to be sterile. FDA, April 2010**
- **Since the CDC guidelines (and other guidelines) require critical items to be sterile, the SS1E should not be used on critical devices since, by definition, they need to be sterile.**

Steris System 1E (SS1E)

- Thus, heat-sensitive **critical** devices should be sterilized by other validated, FDA-cleared, sterilization processes (i.e., ETO, HP gas plasma, VHP, ozone)
- If the heat-sensitive critical device truly cannot be reprocessed by any other modality than SS1E, the user is left with the decision between not using the device at all or reprocessing it in a SS1E liquid chemical sterilant processing system

UNC Health Care Policy-SS1E

- UNC Health Care will eliminate the use of SS1 over the next several months
- We will use the replacement reprocessor, SS1E, for reprocessing semicritical items that require high-level disinfection
- As a general rule, the Steris System 1E will not be used to reprocess critical items as critical items should be sterile and with SS1E the final processed device cannot be assured to be sterile

UNC Health Care Policy-SS1E

- Thus, heat-sensitive critical devices will be sterilized by other validated, FDA-cleared, sterilization processes such as HP gas plasma, ETO, VHP and ozone
- If a heat-sensitive critical device truly cannot be processed by any other modality than SS1E, then we are left with the decision between not using the device at all or reprocessing it in a SS1E.

UNC Health Care Policy-SS1E

- The decision to use SS1E for a heat-sensitive critical item that cannot be processed by an alternative sterilization process will be made on a case-by-case basis in collaboration with Hospital Epidemiology and Risk Management

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Disinfectants and Antiseptics

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, ~1,200 ppm)
 - Clorox Clean-up, ~1,910 ppm chlorine
 - Tilex, ~25,000 ppm chlorine
 - **Steris 20 sterilant, 0.2% peracetic acid**
 - **Cidex, 2.4% glutaraldehyde**
 - **Cidex-OPA, 0.55% OPA**
 - Wavicide, 2.65% glutaraldehyde
 - Aldahol, 3.4% glutaraldehyde and 26% alcohol

Semicritical Devices

Semicritical Items

- Endoscopes
- Laryngoscopes
- Respiratory therapy equipment
- Anesthesia equipment
- Endocavitary probes
- Tonometers
- Diaphragm fitting rings
- Infrared coagulation devices

Reprocessing of Rigid Laryngoscopes

JHI 2008, 68:101; ICHE 2007, 28:504; AJIC 2007, 35: 536

- Limited guidelines for reprocessing laryngoscope's blades and handles
- Many hospitals consider blade as semicritical (HLD) and handle as noncritical (LLD)
- Blades linked to HAIs; handles not directly linked to HAIs but contamination with blood/OPIM suggest its potential and blade and handle function together
- Ideally, clean then HLD/sterilize blades and handles (UNCHC-blades-Steris, handle [without batteries]-Sterrad)

Contamination of Laryngoscope Handles

J Hosp Infect 2010;74:123

- 55/64 (86%) of the handles deemed “ready for patient use” positive for *S. aureus*, enterococci, *Klebsiella*, *Acinetobacter*

Anesth Analg 2009;109:479

- 30/40 (75%) samples from handles positive (CONS, *Bacillus*, *Streptococcus*, *S. aureus*, *Enterococcus*) after cleaning

AANA J 1997;65:241

- 26/65 (40%) of the handles and 13/65 (20%) of the blades were positive for occult blood. These blades and handles were identified as ready for patient use.

**Errors in designing and reprocessing
semicritical items continue and place
patients at risk of infection**

Automatic Endoscope Reprocessors (AERs)

- Manual cleaning of endoscopes is prone to error.
- **AER Advantages:** automate and standardize reprocessing steps, reduce personnel exposure to chemicals, filtered tap water
- **AER Disadvantages:** failure of AERs linked to outbreaks, does not eliminate precleaning, does not monitor HLD concentration
- **Problems:** incompatible AER (side-viewing duodenoscope); biofilm buildup; contaminated AER; inadequate channel connectors; used wrong set-up or connector MMWR 1999;48:557
- Must ensure exposure of internal surfaces with HLD/sterilant

EVOTECH w/Cleaning Claim



- **Product Definition:**

- **Integrated double-bay AER**
- **Eliminates manual cleaning**
- **Uses New High-Level Disinfectant (HLD) with IP protection**
- **Single-shot HLD**
- **Automated testing of endoscope channels and minimum effective concentration of HLD**
- **Incorporates additional features (LAN, LCD display)**

Reliance™ EPS Endoscope Processing System



Reliance™ DG



Klenzyme®, CIP® 200



Endoscope Processing
Support



Reliance™ PI

Automatic Endoscope Reprocessors

Am Society Gastro Endoscopy, Gastro Endos 2009;69:771

- **EvoTech-integrates cleaning (FDA-cleared claim)** and disinfection. Automated cleaning comparable to manual cleaning. All residual data for cleaning of the internal channels as well as external insertion tube surfaces were below the limit of $<8.5\mu\text{g}/\text{cm}^2$.
- **Reliance**-requires a minimal number of connections to the endoscope channels and uses a control boot (housing apparatus that creates pressure differentials to ensure connectorless fluid flow through all channels that are accessible through the endoscope's control handle channel ports). Data demonstrate that the soil and microbial removal effected by Reliance washing phase was equivalent to that achieved by optimal manual cleaning. Alfa, Olson, DeGagne. AJIC 2006;34:561.

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Noncritical Items/LLD

Low-Level Disinfection for “Noncritical” Objects

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

Accelerated hydrogen peroxide

0.5%

UD=Manufacturer’s recommended use dilution

Surface Disinfection

- Exposure Time
 - CMS surveyors (CA) have been paying closer attention to cleaning the environment, including assurance that hospitals are following manufacturer's directions for disinfectant contact time
 - Hospital cited for using a shorter contact time than manufacturer's directions and appealed based upon published peer-reviewed literature supporting shorter exposure times
 - Appeal denied

Surface Disinfection

- **Exposure Time**

- CDC guideline recommends a contact time of at least 1 minute
- In order to get EPA clearance of the CDC Guideline it was necessary to insert two sentences. “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 FIFRA”

Surface Disinfection

● Exposure Time

- Multiple scientific studies (about 20) have demonstrated the efficacy of hospital disinfectants against pathogens causing HAIs with a contact time of 1 minute
- HCFs can achieve a contact time of 10 minutes by reapplying the disinfectant 5-6 times to the surface as the typical dry time is 1.5-2 minutes
- Equally important as contact time is the application of the disinfectant to the surface or equipment to ensure all contaminated surfaces are wiped
- No data that demonstrate improved infection prevention by a 10 minute contact time versus a 1 minute contact time

***C. difficile*: What's New**

- **Products EPA registered with *C. difficile* spore claim**
 - **Surface disinfectants with *C. difficile* spore claim**
 - ◆ **Virasept- (Ecolab)**
 - ◆ **Ultra Clorox Germicidal Bleach (Clorox)**
 - **One-step wipes with *C. difficile* spore claim**
 - ◆ **Kimtech-4.4%HP and 0.23%PA (Kimberly Clark)**

New Approaches to Room Decontamination

- Environmental contamination with pathogens frequently found in patient rooms
- Poor surface disinfection practices cause a failure in eliminating environmental contamination (terminal disinfection is <50%)
- Inadequate terminal cleaning of rooms occupied by patients with MDR pathogens places the next patient in these rooms at increased risk of acquiring these organisms
- Improved methods of disinfecting the hospital environment are needed

**Mean proportion of surfaces disinfected
at terminal cleaning is <50%**

**Terminal cleaning methods ineffective (products
effective practices deficient [**surfaces not wiped**])
in eliminating epidemiologically important
pathogens**

Risk of Acquiring MRSA, VRE, and *C. difficile* from Prior Room Occupants

- Admission to a room previously occupied by an MRSA-positive patient or VRE-positive patient significantly increased the odds of acquisition for MRSA and VRE (although this route is a minor contributor to overall transmission). Arch Intern Med 2006;166:1945.
- Prior environmental contamination, whether measured via environmental cultures or prior room occupancy by VRE-colonized patients, increases the risk of acquisition of VRE. Clin Infect Dis 2008;46:678.
- Prior room occupant with CDI is a significant risk for CDI acquisition. ICACC (K-4194) 2008. Shaughnessy et al.

New Approaches to Room Decontamination after Patient Discharge

Ultraviolet

- UV is electromagnetic radiation with wavelength shorter than visible light
- UV is found in sunlight but ozone layer blocks 98.7%
- 98.7% of the UV light that reaches earth's surface is UVA
- UVC (short wave or germicidal light) has a wavelength range of 280nm-100nm
- UVC photons damage DNA

UV Room Decontamination

Rutala, Gergen, Weber, ICHE 2010;31:1025

- Fully automated, self calibrates, activated by hand-held remote
- Room ventilation does not need to be modified
- Uses UVC (254 nm range) to decontaminate surfaces
- Measures UV reflected from walls, ceilings, floors or other treated areas and calculates the operation 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 (e.g., $36,000\mu\text{Ws}/\text{cm}^2$ RD for spores), will power-down and audibly notify the operator

UV Room Decontamination

- Phase 1-3x3" formica sheets contaminated with $\sim 10^{4-5}$ organisms (MRSA, VRE, MDR-*Acinetobacter*, *C. difficile* spores) were placed in a room, both in direct line-of-sight of the UV device and behind objects (indirect line-of-sight identified by using a laser pointer). Following timed exposure, the growth of the microbes was assessed.
- Phase 2-rooms that housed patients with MRSA or VRE had specified sites sampled before and after UVC irradiation. Following timed exposure, the growth of MRSA, VRE and total colony counts was assessed.

Formica Placement in the Patient Room

- Toilet seat
- Back of head-of-the-bed
- Back-of-computer
- Bedside table (far side)
- Side of sink
- Foot of bed, facing the door
- Bathroom door

Room Decontamination with UV

(Rutala, Gergen, Weber, ICHE 2010;31:1025)

Organism	Direct (log ₁₀ reduction)	Indirect (log ₁₀ reduction)	Total (log ₁₀ reduction)
MRSA (~15m)	4.31	3.85	3.94 (n=50)
VRE (~15m)	3.90	3.29*	3.46 (n=47)
MDR- <i>Acinetobacter</i> (~15m)	4.21	3.79	3.88 (n=47)
<i>C. difficile</i> (~50m)	4.04	2.43*	2.79 (n=45)

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Decontamination of Surfaces in Patient Rooms on Contact Precautions for MRSA

Overall Results	Before UV	After UV	Before UV	After UV
Mean Total CFU/5 Rodacs	384	19		
Pos Rodacs/ Total Rodacs			81/400	2/400
Mean MRSA/ Rodac			37	2

Summary

- UVC radiation was found to reduce >99.9% of vegetative bacteria within 15 minutes and 99.84% for *C. difficile* spores within 50 minutes.
- UVC was more effective when there was a direct line-of-sight to the contaminant but meaningful reduction (3.3-3.9 log₁₀ reduction for bacteria) occurred when the contaminant was not directly exposed to the UVC.
- In MRSA patient rooms, there was a significant reduction in total average CFU per 5 Rodacs (384 CFU pre and 19 CFU post); samples positive for MRSA (81/400 pre and 2/400 post); and the average MRSA per Rodac (37 pre- and 2 post-treatment)

Novel Technologies for Infection Prevention

- Critique and review novel methods of providing infection prevention via disinfection and sterilization
 - UV light
 - Vaporized hydrogen peroxide
 - Other

Hydrogen Peroxide Vapor

- “Microcondensation”-one system forms condensation (from a gas to a liquid phase) that is often invisible to the naked eye. Use 30-35% hydrogen peroxide to generate particles $<1 \mu$.
- “Dry mist”-system produces an aerosol composed of particles $<10 \mu$ containing 5% hydrogen peroxide, <50 ppm phosphoric acid (stabilizer) and <50 ppm silver cations.

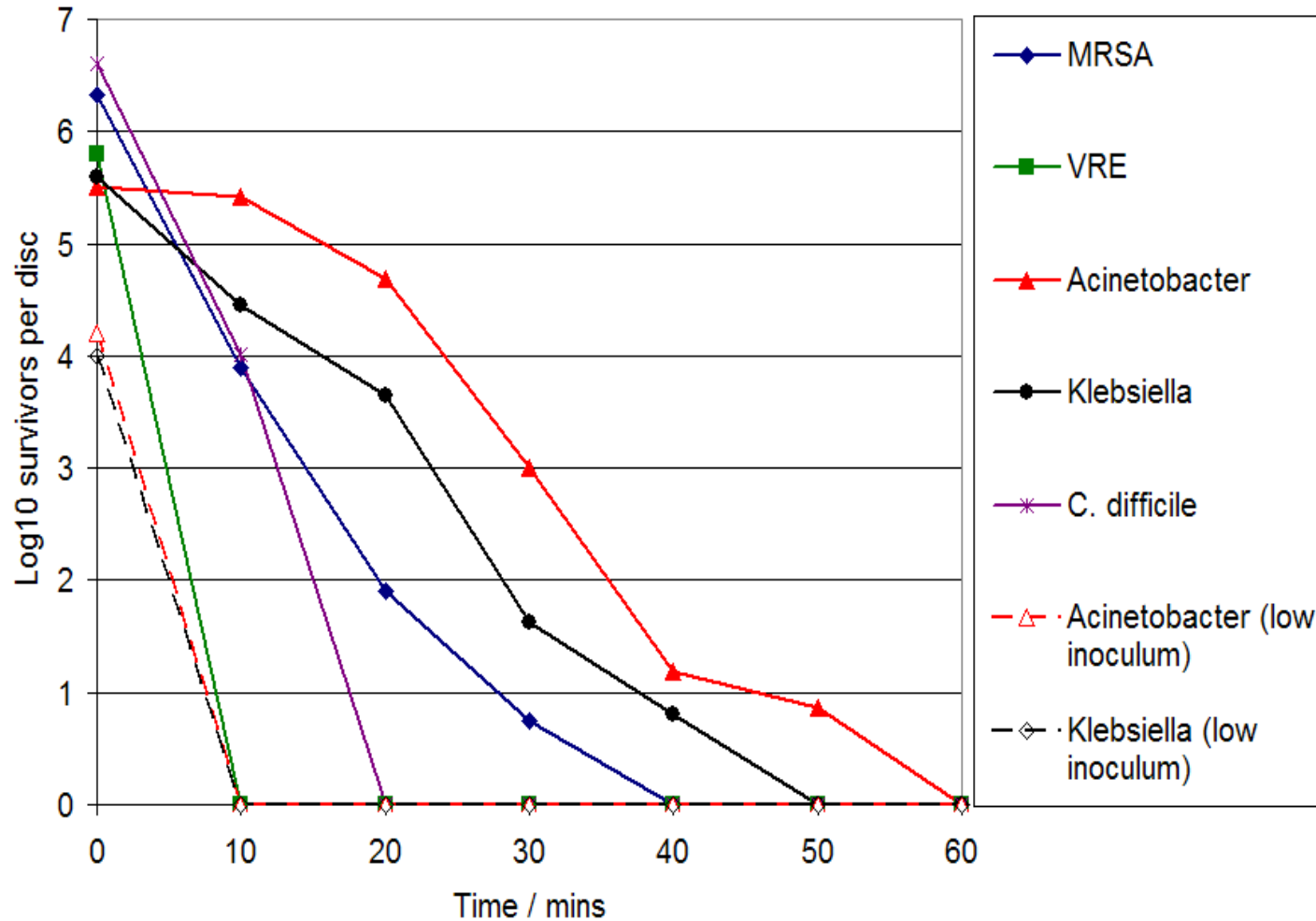
Vaporized Hydrogen Peroxide Decontamination

- Otter, French. J Clin Microbiol 2009;47:205. Spores/bacteria
- Barbut et al. ICHE 2009;30:517. *C. difficile*
- Bartels MD et al. J Hosp Infect 2008;70:35. MRSA
- Boyce JM et al. ICHE 2008;29:723. *C. difficile*
- Shapey S et al. J Hosp Infect 2008;70:136. *C. difficile*
- Hardy KJ et al. J Hosp Infect 2007;66:360. MRSA
- Hall L et al. J Clin Microbiol 2007;45: 810. *M. tuberculosis*

Vaporized Hydrogen Peroxide Decontamination

- Bates CJ, Pearse R. J Hosp Infect 2005;61:364. *S. marcescens*
- Johnston MD et al. J Microbiol Methods 2005;60:403. *C. botulinum*
- French GL et al. J Hosp Infect 2004;57:31. MRSA
- Heckert RA et al. Appl Environ Microbiol 1997;63:3916. Viruses
- Klapes NA et al. Appl Environ Microbiol 1990;56;503. *Bacillus* spores/Prototype HPV generator

HPV *in vitro* Efficacy



Decontamination with Hydrogen Peroxide Vapor

Boyce et al: ICHE 2008;29:723

- 5 wards with a high incidence of *C. difficile*
- HPV was injected into sealed wards and individual patient rooms using generators until approx 1 micron film of HP was achieved on the surface
- 11/43 (25.6%) surface samples yielded *C. difficile* compared to 0/27 (0%) after HPV decontamination
- The incidence of nosocomial CDI was significantly lower during the intervention period (2.28 to 1.28/1000 patient days)
- Conclusion: HPV was efficacious in eradicating *C. difficile* from contaminated surfaces

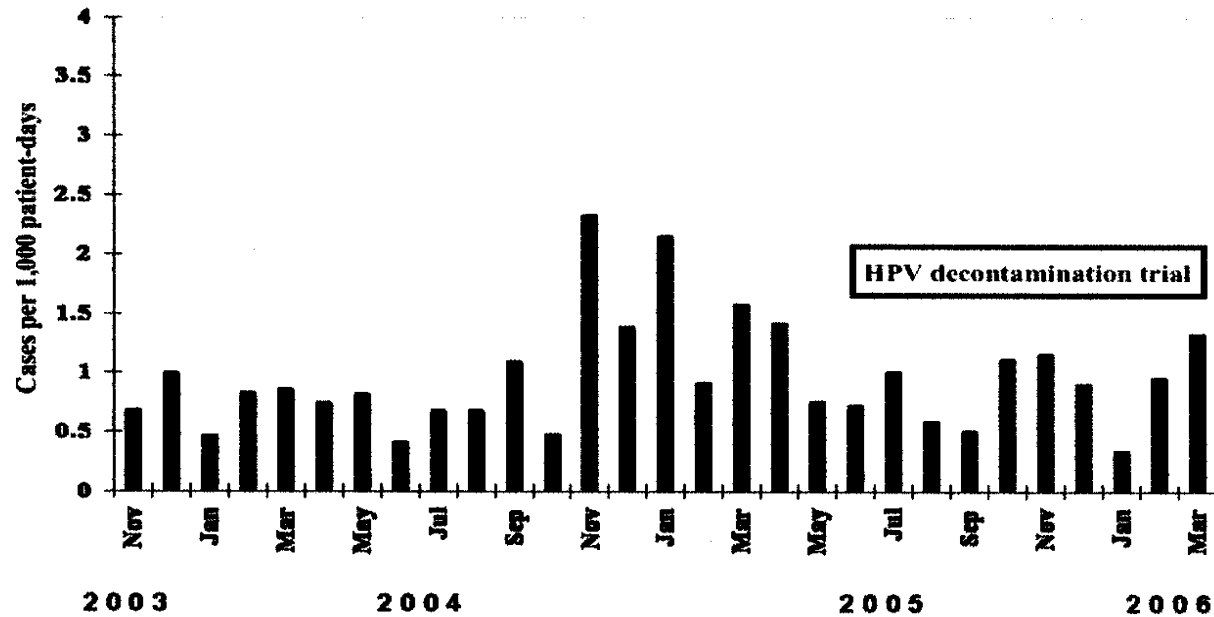


FIGURE 1. Hospital-wide incidence of nosocomial *Clostridium difficile*-associated disease, November 2003 through March 2006. HPV, hydrogen peroxide vapor.

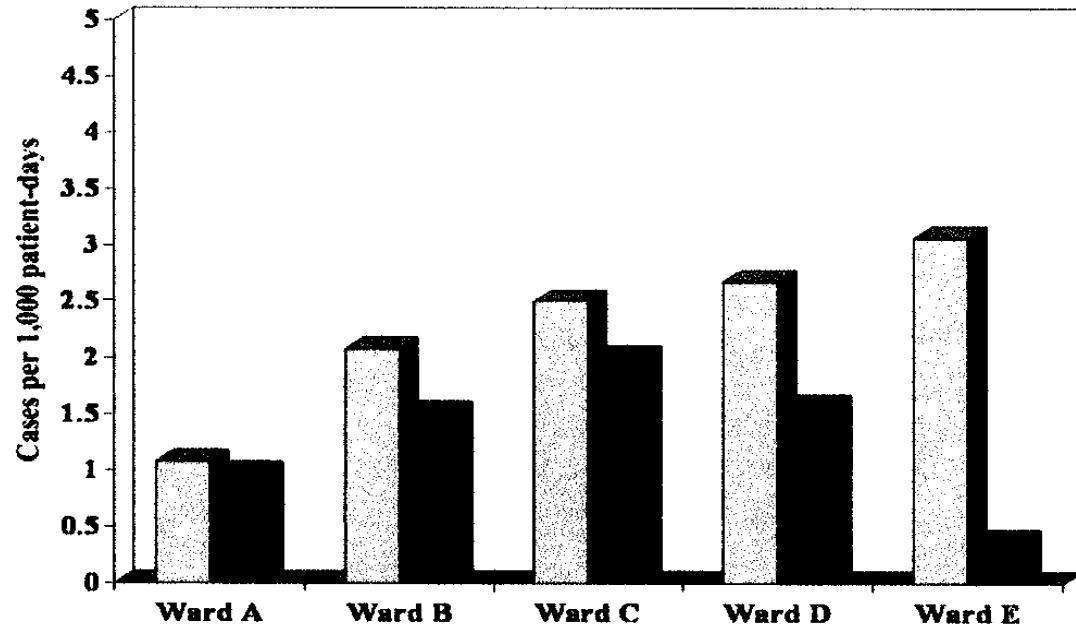


FIGURE 2. Incidence of nosocomial *Clostridium difficile*-associated disease on 5 wards (A–E) that underwent intensive hydrogen peroxide vapor decontamination, during the preintervention period (gray bars; June 2004 through March 2005) and the intervention period (black bars; June 2005 through March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

Feasibility of Routinely Using HPV

Otter et al: ICHE 2009;30:574

- Used HPV to decontaminate selected rooms (e.g., MRSA, VRE, *C. difficile* [70% of rooms], norovirus, *Acinetobacter*, other MDROs)
- HPV requires room be vacated, cleaned of dirt (effectiveness reduced by dirt), and sealed
- 1656 rooms decontaminated with HPV over 22 month; 1194 “missed rooms” (58% staff not in hospital; 21% lack of notification)
- Total time from room vacated until ready for the next patient was 270 min (cycle 140 min) for HPV and 67 min for bleach cleaning
- Despite the greater time for decontamination, HPV decontamination is feasible in a busy hospital

Summary

- HPV systems significantly reduced the contamination with *C. difficile* and other pathogens
- Studies done with concentration of pathogens (6-7 log₁₀ CFU) considerably higher than encountered in the hospital environment
- Equipment or surfaces difficult to disinfect or escapes disinfection can be effectively decontaminated
- Studies shown benefits in controlling outbreaks and reducing infections
- HPV provides an alternative to traditional decontamination methods such as surface disinfection

Quantitative Approach to Defining High Touch Surfaces in Hospitals

Patient Area Cleaning/Disinfecting

Carling et al. ICHE 2008;29:1 and ICHE 2008;29:1035

- Monitor cleaning performance using an invisible fluorescent targeting method. Rooms (14 high-risk objects) were marked and evaluated after terminal cleaning.
- Results: 20,646 environmental surfaces (14 types of objects) were evaluated in 36 hospitals. **Mean proportion of objects cleaned was 48%.** Following education and process improvement feedback, cleaning improved to 77%.
- Conclusion: Substantial opportunity for improving terminal cleaning/disinfecting activities.

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.

Quantitative Approach to Defining High-Touch Surfaces

Huslage, Rutala, Sickbert-Bennett, Weber, ICHE 2010;31:850

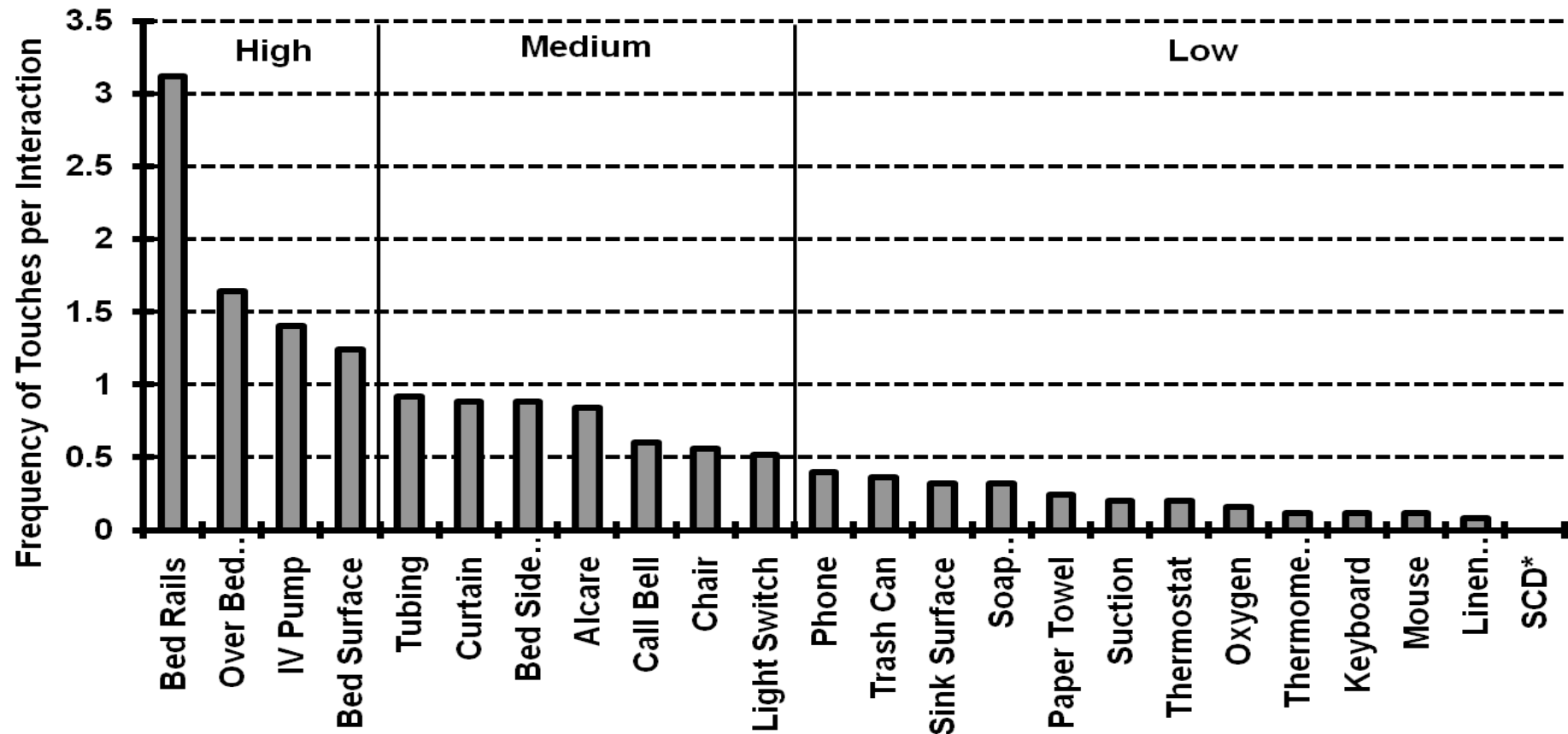
- CDC EIC guideline makes a Category II recommendation to clean and disinfect high-touch surfaces (e.g., doorknobs, bed rails, light switches, and surfaces in and around toilet in patients' rooms) on a more frequent schedule than minimal-touch surfaces.
- No one has quantitatively assessed frequency of HCW contact with different room surfaces.
- Over 18 months, HCW were observed while providing routine care to a patient to ascertain the frequency of contact with surfaces on the immediate environment of the patient.
- 50 interactions were observed in 5 ICUs and 7 general medical/surgical floors at UNC Health Care.

Quantitative Approach to Defining High-Touch Surfaces

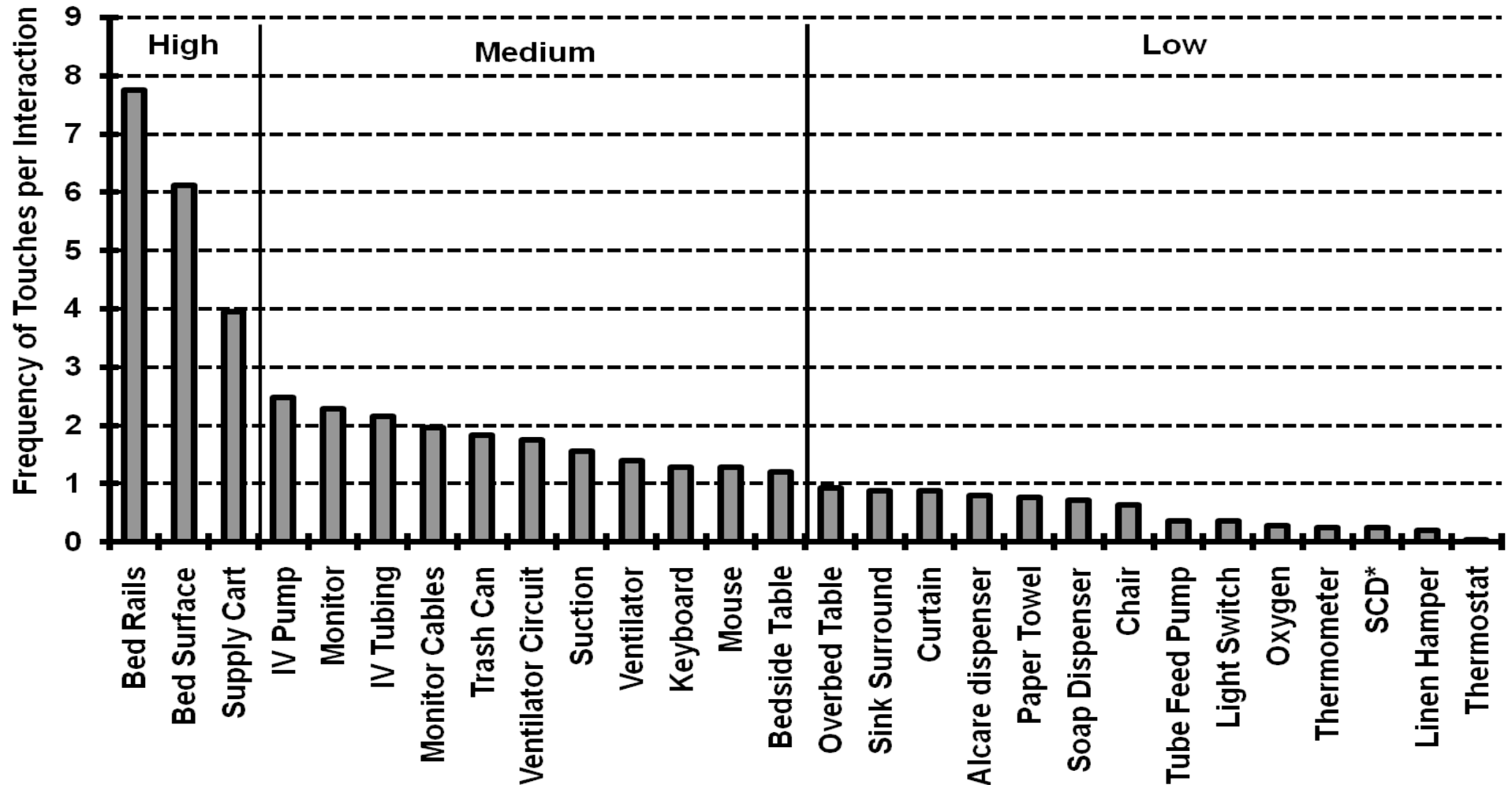
Huslage, Rutala, Sickbert-Bennett, Weber, ICHE 2010;31:850

- Contact (21) and non-Contact rooms (29) were observed
- 1490 surface contacts were recorded
 - ICU accounted for 1109 (74%)
 - Floor accounted for 381 (26%)
- 3 surfaces (bed rail, bed surface, supply cart) in the ICU setting that were considered high touch (> 3 contacts per interaction) and accounted for 40% of the touches
- 4 surfaces (bed rails, overbed tables, IV pumps, bed surface) in the floor setting were considered high touch (>1 contact per interaction) and accounted for 49% of the touches
- Highest contact item in both settings was the bed rails

Average frequency of contact for twenty-four surfaces on general medical surgical floors



Average frequency of contact for twenty-eight surfaces in the ICU setting



Quantitative Approach to Defining High-Touch Surfaces

Huslage, Rutala, Sickbert-Bennett, Weber, ICHE 2010;31:850

Summary

- Five surfaces were defined as “High Touch” surfaces in hospitals: the bed rails; the bed surface; the supply cart; the over-bed table; and the IV pump
- While it is desirable that all environmental surfaces be routinely disinfected, surfaces that are not likely contaminated or frequently touched such as thermostats may not warrant as much concern.
- All surfaces should be disinfected at terminal cleaning

Disinfection and Sterilization: What's New Summary

- UV and HPV are effective and significantly reduced the contamination with *C. difficile*, MRSA, VRE, MDROs and other pathogens
- Ideally, clean then HLD/sterilize laryngoscope blades and handles
- Five surfaces were defined as “High Touch” surfaces in hospitals: the bed rails; the bed surface; the supply cart; the over-bed table; and the IV pump

Disinfection and Sterilization: What's New Summary

- A SHEA Guideline provides recommendations for processing prion-contaminated patient care equipment and environmental surfaces
- In general, the Steris System 1E should not be used on critical devices since, by definition, they need to be sterile and with SS1E the final processed devices cannot be assured to be sterile.

Disinfection and Sterilization: Current Issues and New Technologies

- Disinfection and sterilization principles
- Emerging issues
 - Critical-prions, Steris System 1 and Steris System 1E
 - Semicritical items-*C. difficile* spores, laryngoscopes, new AERs/HLDs
 - Noncritical-surface disinfection
 - ◆ UV
 - ◆ Hydrogen peroxide vapor
 - ◆ Contact time for surface disinfection
 - ◆ High touch objects

Thank you