Surface Disinfection: New Processes and Products

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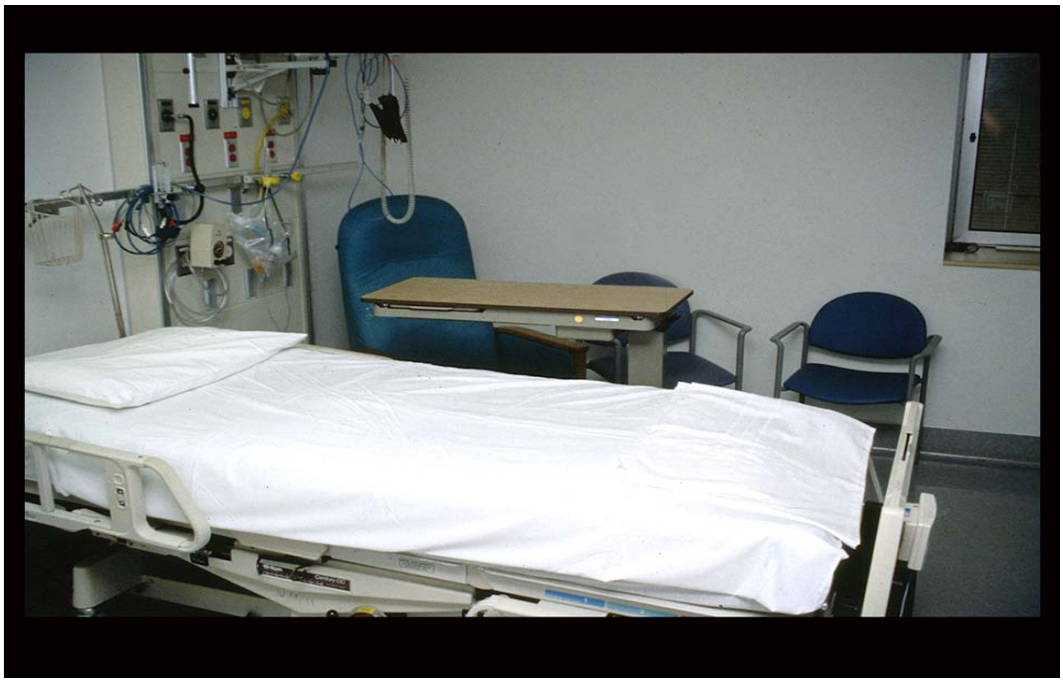
Surface Disinfection: New Processes and Products

- Principles of surface disinfection
- Review the contribution of the noncritical environment to disease transmission
- New processes and products in surface disinfection
  - *C. difficile*
  - Microfiber mops
  - Computer keyboards
  - QUAT reduction
- Provide recommendations for surface disinfection



Processing "Noncritical" Patient Care Objects

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 or detergent cleaning

Low-Level Disinfection for "Noncritical" Objects

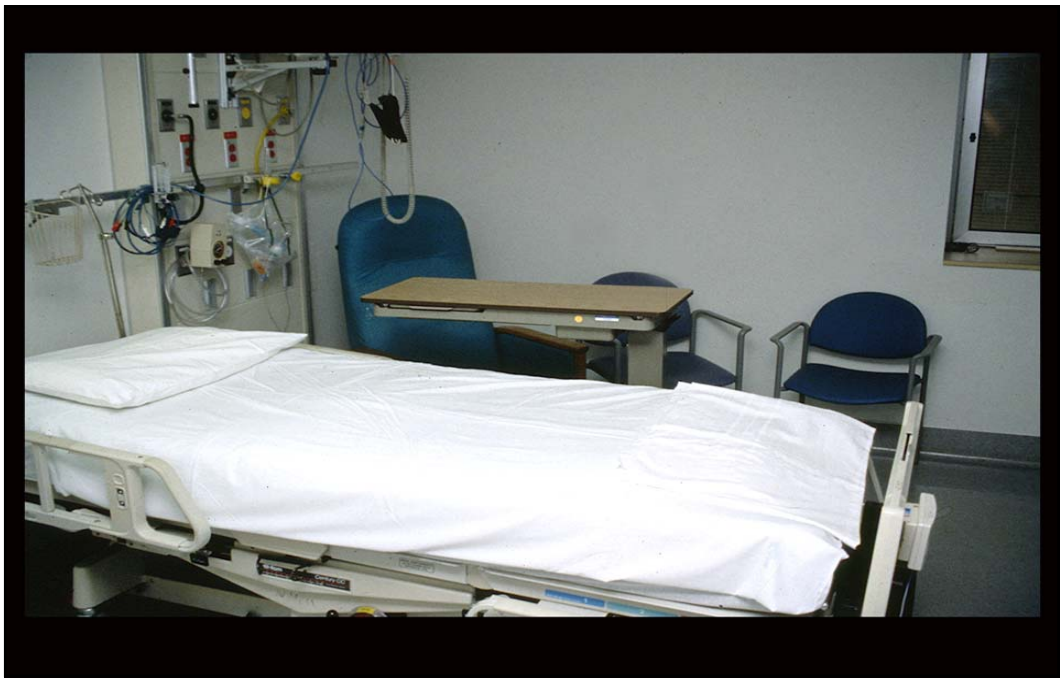
Exposure time ≥ 1 min

Germicide	Use Concentration
Ethyl or isopropyl alcohol	70-90%
Chlorine	100ppm (1:500 dilution)
Phenolic	UD
Iodophor	UD
Quaternary ammonium	UD

UD=Manufacturer's recommended use dilution

Surface Disinfection

- Noncritical Surfaces
  - Housekeeping surfaces (floors, bedside tables)
    - May play a theoretical but less significant role in disease transmission
    - Disinfectants/detergents or detergents may be used
  - Medical equipment surfaces (BP cuff, stethoscopes)
    - May frequently become contaminated with patient material
    - Repeatedly touched by health care personnel
    - Disinfectant/detergent may be used



Role of the Environment in Transmission

Pathogens implicated in transmission via contaminated noncritical surfaces

- Bacteria
  - Oxacillin-resistant *Staphylococcus aureus*
  - Vancomycin-resistant *Enterococcus spp*.
  - *Clostridium difficile*
  - *Acinetobacter* and *P. aeruginosa*
- Viruses
  - Rotavirus
  - Norovirus
  - SARS coronavirus

Role of the Environment In Transmission

Hota B, Clin Inf Dis 2004;39:1182

Pathogen	Survival	Environmental Data
C. difficile	Months (spores)	3+
VRE	Days to weeks	3+
MRSA	Days to weeks	2-3+
Acinetobacter	33 days	2-3+
P. aeruginosa	7 h	1+

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Clostridium difficile

C. difficile

- *C. difficile* is responsible for 15-25% of cases of antibiotic-associated diarrhea and for virtually all cases of antibiotic-associated pseudomembrananous colitis.
- Costs approx $3,669 per case or $1.1 billion per year
- Overall mortality is 10-15%
- Over past 2 years, a new strain appears to be more virulent
- Patients can be contaminated from environmental surfaces, shared instrumentation, hospital personnel hands and infected roommates Clin Microbiol Infect 2001;7:405; Clin Micro Rev 2004;17:863

Environmental Contamination

C. difficile

- 25% (117/466) of cultures positive (<10 CFU) for *C. difficile*. >90% of sites positive with incontinent patients. Samore et al. Am J Med 1996;100:32.
- 31.4% of environmental cultures positive for *C. difficile*. Kaatz et al. Am J Epid 1988;127:1289.
- 9.3% (85/910) of environmental cultures positive (floors, toilets, toilet seats) for *C. difficile*. Kim et al. J Inf Dis 1981;143:42.
- 29% (62/216) environmental samples were positive for *C. difficile*. 8% (7/88) culture-negative patient, 29% (11/38) positive cultures in rooms occupied by asymptomatic patients and 49% (44/90) in rooms with patients who had CDAD. NEJM 1989;320:204
- 10% (110/1086) environmental samples were positive for *C. difficile* in case-associated areas and 2.5% (14/489) in areas with no known cases. Fekety et al. Am J Med 1981;70:907.

Role of the Environment

C. difficile

- The presence of *C. difficile* on the hands correlated with the density of environmental contamination. Samore et al. Am J Med 1996;100:32.
  - 0-25% environmental sites positive-0% hand cultures positive
  - 26-50% environmental sites positive-8% hand cultures positive
  - >50% environmental sites positive-36% hand cultures positive
- 59% of 35 HCWs were *C. difficile* positive after direct contact with culture-positive patients.
- *C. difficile* incidence data correlated significantly with the prevalence of environmental *C. difficile*. Fawley et al. Epid Infect 2001;126:343.
- Environmental contamination does not play a major role in nosocomial CDAD in some endemic situations. Cohen et al. Clin Infect Dis 1997;24:889.

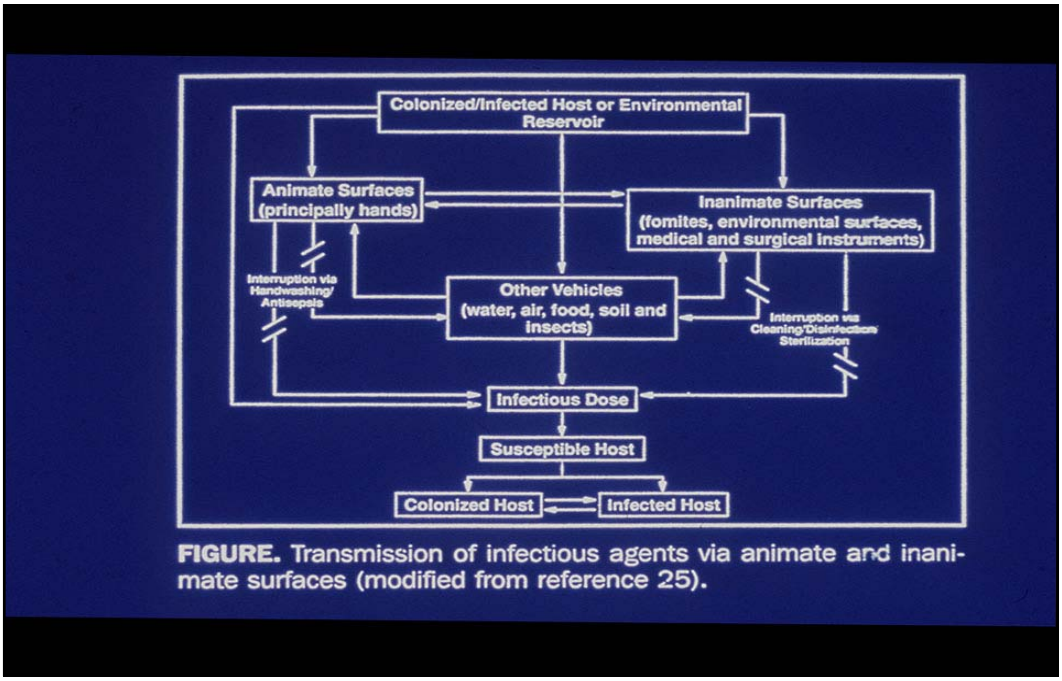


FIGURE. Transmission of infectious agents via animate and inanimate surfaces (modified from reference 25).

Effect of Hypochlorite on Environmental Contamination and Incidence of *C. difficile*

- Use of chlorine (500-1600 ppm) decreased surface contamination and the outbreak ended. Mean CFU/positive culture in outbreak 5.1, reduced to 2.0 with chlorine. Kaatz et al. Am J Epid 1988;127:1289.
- In an intervention study, the incidence of CDAD for bone marrow transplant patients decreased significantly, from 8.6 to 3.3 cases per 1000 patient days after the environmental disinfection was switched from QUAT to 1:10 hypochlorite solution in the rooms of patients with CDAD. No reduction in CDAD rates was seen among NS-ICU and medicine patients for whom baseline rates were 3.0 and 1.3 cases per 1000-patient days. Mayfield et al. Clin Inf Dis 2000;31:995.

Disinfectants and Antiseptics

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

- ~4 $\log_{10}$ reduction (3 *C. difficile* strains including BI-9)
  - Clorox, 1:10, ~6,000 ppm chlorine (but not 1:50)
  - Clorox Clean-up, ~1,910 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

Disinfectants and Antiseptics

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

- No measurable activity (1 *C. difficile* strain, J9)
  - CHG
  - 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)

Control Measures

C. difficile

- Handwashing (soap and water) , contact precautions, and meticulous environmental cleaning (disinfect all surfaces) with an EPA-registered disinfectant should be effective in preventing the spread of the organism. McFarland et al. NEJM 1989;320:204.
- 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)

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 500-1000]); 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?

Effectiveness of Microfiber Mop

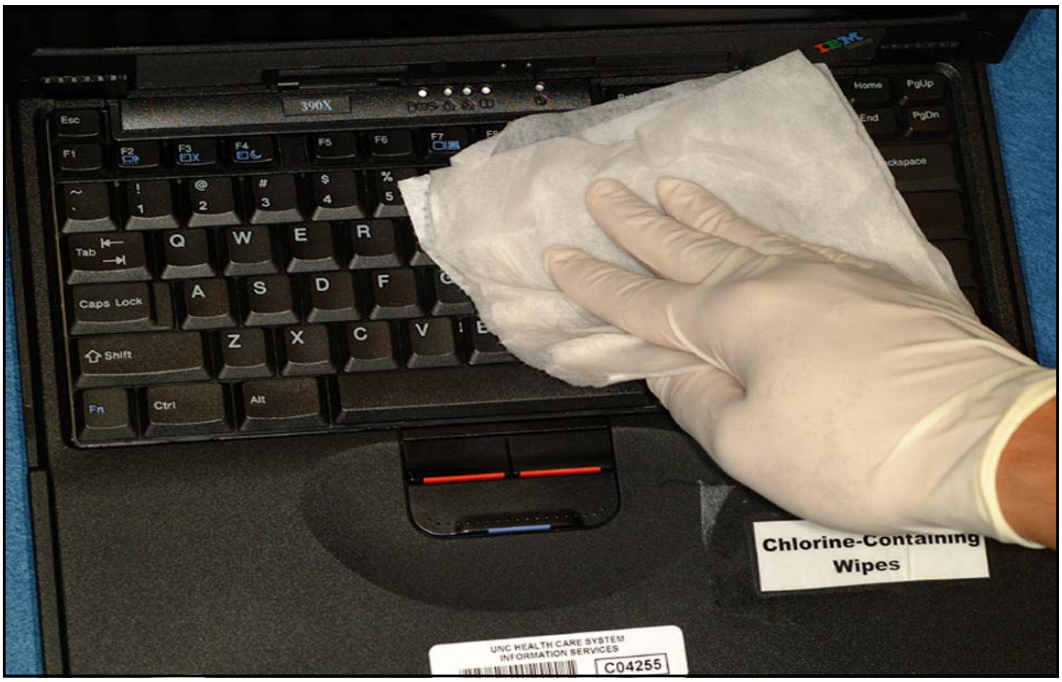
- Test conditions with a EPA-registered disinfectant: compared routine mop and bucket; microfiber mop and bucket; microfiber mop and system bucket. Twenty-four replicates per condition.
- Conducted RODAC sampling before and after floor disinfection (5 samples per room)
- New disinfectant solution for each test condition
- Dry time varied from 2 (routine mop and bucket)-8 (microfiber mop and bucket) minutes

Effectiveness of Microfiber Mop

Disinfectant-regular mop	95%
Disinfectant-Microfiber system	95%
Disinfectant-Microfiber mop and regular mop bucket	88%
Detergent-regular mop	68%

Noncritical Patient Equipment
Computer Keyboards

- Degree of microbial contamination
- Efficacy of disinfectant wipes
- Cosmetic and functional effects of disinfectants on appearance of the letters or the keyboards



Disinfection of Computer Keyboards

- All tested products were effective (>95%) in removing and/or inactivating the test pathogens (MRSA, *P. aeruginosa*). No functional/cosmetic damage after 300 wipes.
- Disinfectants included: 3 quaternary ammonium compounds, 70% isopropyl alcohol, phenolic, chlorine (80ppm)
- At present, recommend that keyboards be disinfected daily (for 5 sec) and when visibly soiled

SANIWIPES

0 WIPES

300 WIPES

TABLE 3. Sustained Efficacy of Disinfectants Applied to Keyboard Against Vancomycin-Resistant *Enterococcus* Species

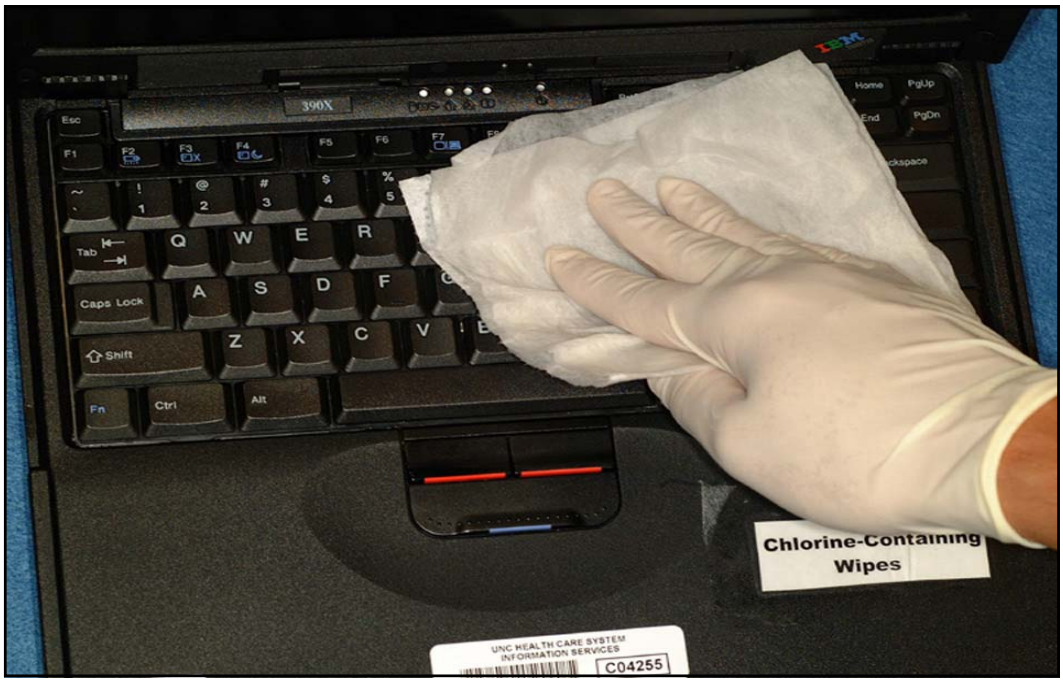
	Efficacy of Disinfectant, by Time of Microbial Challenge and Duration of Disinfectant Exposure, %					
	Challenge at 6 Hours		Challenge at 24 Hours		Challenge at 48 Hours	
Disinfectant	10-min Exposure	60-min Exposure	10-min Exposure	60-min Exposure	10-min Exposure	60-min Exposure
Alcohol	3.05	5.67	12.58	3.31	10.89	5.59
CaviWipes	100.00	100.00	100.00	100.00	100.00	100.00
Clorox Disinfecting Wipes	100.00	100.00	100.00	100.00	100.00	100.00
Sani-Cloth Plus	100.00	100.00	100.00	100.00	100.00	100.00
Sterile water	0.00	0.28	9.69	0.00	0.00	9.09

NOTE. Efficacy was calculated as the percentage difference in the number of colony-forming units on the treated keys, compared with the number of colony-forming units on the control keys. Challenge times are hours since disinfectant exposure.

Reduction in the Release of QUATS

Mac Dougall and Morris. Infection Control Today. June 2006.

- Issue: Do wipers (cotton, cellulose, nonwoven spunlace) consume/bind QUAT and release less QUAT when disinfecting patient rooms
- Method: Fluid samples were collected from the wipers and tested at predetermined points to detect QUAT available from the wiper for surface disinfection



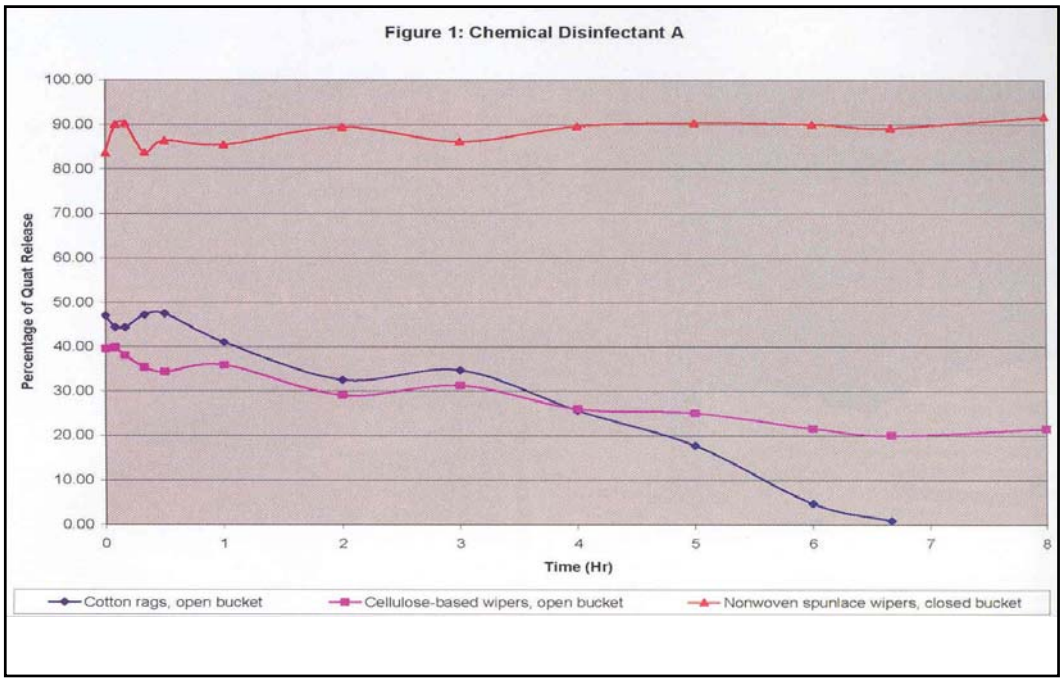


Figure 1: Chemical Disinfectant A
Percentage of Quat Release
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0
1
2
3
4
5
6
7
8
Time (Hr)
Cotton rags, open bucket
Cellulose-based wipers, open bucket
Nonwoven spunlace wipers, closed bucket

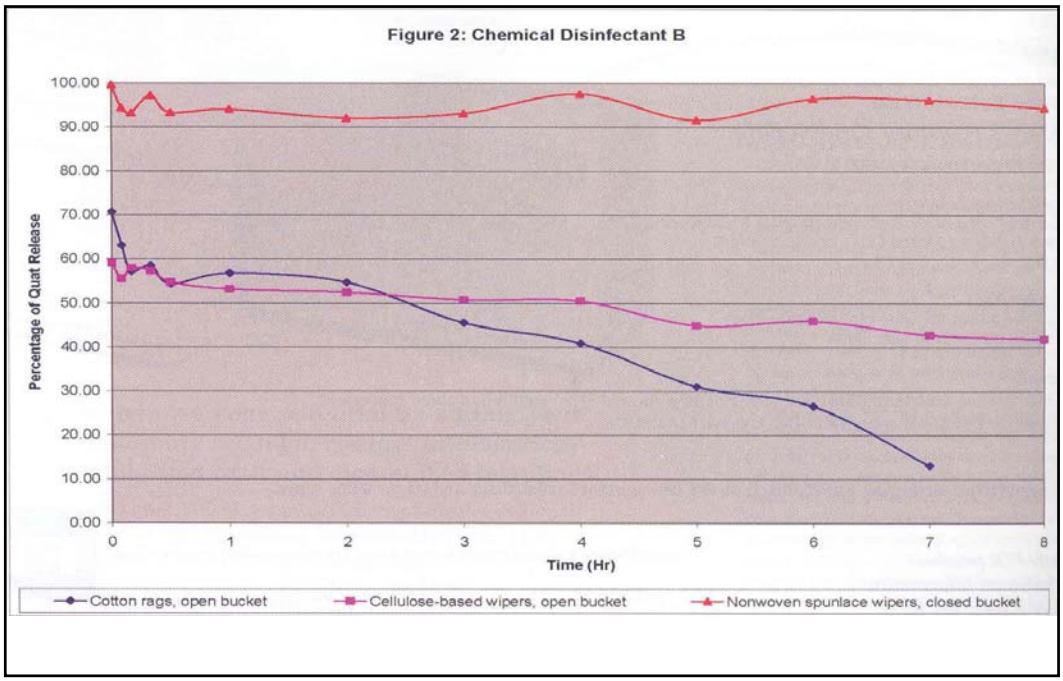


Figure 2: Chemical Disinfectant B
Percentage of Quat Release
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0
1
2
3
4
5
6
7
8
Time (Hr)
Cotton rags, open bucket
Cellulose-based wipers, open bucket
Nonwoven spunlace wipers, closed bucket

Reduction in the Release of QUATS

Mac Dougall and Morris. Infection Control Today. June 2006.

- Results
  - Nonwoven spunlace wipers released an average 90% of the original chemical concentration at 8h
  - Cellulose-based wiper was 21% of the original concentration at 8h
  - Cotton wiper was 5% of the original concentration at 6h
- Conclusions
  - Select wiping material that is compatible with disinfectants
  - Select wiping material and disinfectant that release an effective concentration of the disinfectant to the surface
  - Nothing until verified (unique to these QUATS; what affect does reduced concentration have on removal/inactivation of microbes from a surface)

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Surface Disinfection
Noncritical Patient Care-CDC, 2006

- 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. Category IB
  - Disinfect non-critical patient-care equipment after using it on a patient who is on contact precautions before using this equipment on another patient. Category IB

Surface Disinfection
Environmental Surfaces-CDC, 2006

- 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
  - Clean walls, blinds, and window curtains in patient-care areas when these surfaces are visibly contaminated or soiled. Category II

Surface Disinfection
Environmental Surfaces-CDC, 2006

- Disinfecting Environmental Surfaces in HCF
  - Prepare disinfecting (or detergent) solutions as needed and replace these with fresh solution frequently (e.g., replacing mopping solution every three rooms) according to the facility's policy. Category IB
  - Decontaminate mop heads and cleaning cloths regularly to prevent contamination (e.g., launder and dry at least daily). Category IB
  - Use disinfectant for housekeeping purposes when uncertain if cleaning personnel not able to: distinguish soiled areas containing blood from dirt; or determine when MDROs are likely in the environment. Category IB

Surface Disinfection
Environmental Surfaces-CDC, 2006

- Disinfecting Environmental Surfaces in HCF
  - Detergent and water are adequate for cleaning surfaces in nonpatient-care areas (e.g., administrative offices). Category II
  - Wet-dust horizontal surfaces regularly (e.g, daily, three times per week) using cloths moistened with an EPA-registered hospital disinfectant (or detergent) and a contact time of at least 1 minute. Category IB
  - Do not use disinfectants to clean infant bassinets and incubators while these items are occupied. If disinfectants (e.g., phenolics) are used for the terminal cleaning of infant bassinets and incubators, the surfaces of these items should be rinsed thoroughly with water and dried before these items are reused. Category IB

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Thank you

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Reference

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