

Surface Disinfectants and Environmental Impact

Dr. Franz Daschner, Friedberg, Germany

A Webber Training Teleclass

Surface Disinfectants and Environmental Impact

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CONTRA Surface Disinfection? Yes and No!

Contra immediate removal of spillage (blood, urine, etc.) with a disinfectant/detergent?
No

Contra routine surface disinfection?
Yes

Why? Surfaces are very rarely a source of infection

„There is no difference in hospital-acquired infection rates when floors are cleaned with detergent vs. disinfectant“
(W.A. Rutala et al: J Hosp Inf Suppl. A 48, 2001, p. 66)

„1 – 2 hours after floor disinfection identical number of bacteria as prior to disinfection“
(GAJ Ayliffe et al. Brit Med J 2, 1966, p. 442)



Does disinfection of environmental surfaces influence nosocomial infection rates? A systematic review

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Search Strategy

A search of the following electronic databases was undertaken

- Biological Abstracts/ BIOSIS Previews (1980 –1988 / 1989 – 2001)
- Cochrane Library (2001, Issue 4), Cochrane Clinical Trials Register
- HECLINET: Health Care Literature Information Network (1969 – 2000)
- Medline (Ovid, 1966 – 2001; contains HEALTHSTAR)
- Science Citation Index (1991-1996)
- SwetScan (1997 - 2001)
- Web of Science (Science Citation Index Expanded, 1997 – 2001)
- EMBASE (1974 - 2001) and EMBASE alert
- Somed (1978- 2000)

In addition, the world-wide web was screened.



Trial Flow

Potentially relevant articles identified:	2,035
Potentially appropriate articles for review (evaluated to determine relevance to inclusion criteria):	236
Articles describing expert opinion; reviews (Level V)	156
Included studies providing usable information by outcome:	80



Criteria used for assessing strength of evidence

Level I	Meta-analysis based on randomised controlled trials
Level II	Randomised controlled trials
Level IIIa	Non-randomised concurrent cohort comparison between contemporaneous patients who did and did not receive an intervention
Level IIIb	Non-randomised historical cohort comparison between current patients who did receive an intervention and former patients who did not
Level IIIc	Case-control study
Level IV	Case series without control
Level V	Expert judgement, consensus statements, reports



Critical Appraisal of the Articles/Abstracts Retrieved

No. of articles	Level of Evidence						
	I	II	IIIa	IIIb	IIIc	IV	IV
236	0	0	2 ^{10,11}	2 ^{12,13}	0	76	156



Results:

236 scientific articles were identified. None of these described a meta-analysis, systematic review or a randomised controlled trial. Only four articles described completed cohort studies matching the inclusion criteria. None of these studies showed lower infection rates associated with routine disinfection of surfaces (mainly: floors) instead of cleaning with detergent only.



No Routine Surface Disinfection

- Floors
- Bed rails
- Mattresses
- Bath tubs
- Sinks
- Toilets
- Showers



How Do Disinfectants Harm the Environment?

- By causing resistant bacteria (QAV)
- By causing higher tolerance (formaldehyde)
- By killing sensitive bacteria
- By affecting sewage treatment performance
- By forming organic halogen compounds (AOX) (especially sodium hypochlorite)
- By contaminating surface water
- By forming mutagenic substances



How do Disinfectants Harm Personnel and the Environment?

- 0.04 – 0.08 ppm quats in the Ohio river (2)
- 0.01 – 0.004 ppm in other US rivers (2)
- 1.6% of 15,751 health care workers already sensitized to quats (1)

(1) Schnuch A, Uter W, Geier J, Frosch PJ, Rustemeyer T. Contact Allergies in Healthcare Workers. Results from the IVDK. Acta Derm Venereol 1998;78:358-363
 (2) Swisher FD. Surfactant Biodegradation, 2nd Ed. New York: Marcel Decker



Relative Toxicity of Disinfectants to the Environment

Low ↓	High ↑
Oxidants (e.g. peracetic acid, hydrogen peroxide)	Quaternary ammonium compounds
Alcohol	Phenolics
Organic acids	Sodium hypochlorite
Aldehydes	Biguanides



Comparison of Resistance Data 1994 and 2001

	1994 n = 2173	2001 n = 2840
Benzalkoniumchloride >500 µg/ml	0,4 %	1,1 %
Chlorhexidine >100 µg/ml	2,0 %	7,9 %



Incidence of Resistance Against Antiseptics With Clinical Isolates of Gram-Negative Nosocomial Strains (n = 2840)

Disinfectant	MIC	% resistant	in use concentration
Benzalkonium- chlorid	>300 µg/ml	4,5 %	500-1000 µg/ml
	>500 µg/ml	1,1 %	
Chlorhexidin	>300 µg/ml	0,6 %	500-1000 µg/ml



Resistance to Antiseptics, Disinfectants and Preservatives has been Described to:

- Acridines
- Methylene blue
- Phenolics
- Quaternary ammonium compounds, especially benzalkonium chloride
- Chlorhexidine
- Triclosan
- Formaldehyde
- Chloramine

„There are current concerns about the usage of quaternary ammonium compounds, chlorhexidine and triclosan and possible bacterial resistance to them and to antibiotics“

„It is thus essential that disinfectants should be employed only when necessary and then only with the full appreciation of the factors influencing their activity and of the mechanisms involved in bacterial insusceptibility.“

A.D. Russell, Bacterial adaption and resistance to antiseptics, disinfectants and preservatives is not a new phenomenon. J Hosp Inf 2004, 57, 97-104



Routine Disinfection of Patients Environmental Surfaces. Myth or Reality? (1)

- „There is no direct link between nosocomial infection rate and use of disinfectants to clean ward-floors.“
- „A total of 1,117 patients was studied and we observed no change in the incidence of nosocomial infections during the 4 months of the trial.“

S.Dahran et al :J Hosp Infect 42, 1999, p. 113.



Routine Disinfection of Patients Environmental Surfaces. Myth or Reality? (2)

- „Uncontrolled routine disinfection of environmental surfaces does not necessarily make it safe for the patient and could seed the environment with potential pathogens.“
- „We have decided to do away with routine disinfection of ward-floors.“
- „Not any significant change in nosocomial bloodstream infection rates or in colonisation due to MRSR.“

S.Dahran et al :J Hosp Infect 42, 1999, p. 113.



Do we need to disinfect floors in intensive care units?

	6 months Disinfection	6 months Just cleaning
Patients	475	464
Nosocomial infections	74	72
% nosocomial infections	15.6	15.5
Average length of stay	24.7 days	22.3 days

F.D. Daschner et al.: Dt Med Wochenschr 105, 1980, p. 325



Floor Disinfection in Operation Theatres?

	OP I	OP II
	No floor disinfection in the morning Floor disinfection only after septic OP No floor disinfection after OP-programme	Floor disinfection in the morning Floor disinfection after each operation Floor disinfection after OP-programme
Bacteria/25cm ² floor	11.7	2.24
Bacterial count/25cm ² horizontal surfaces	6.98	5.86
Aseptic operations	778	756
% wound infection	2.2	2.9

D.O. Weber et al.: Archives Surgery 111, 1976, p. 484



Guideline Sweden:

Att förebygga infektioner i varden II Ett kunskapsunderlag. Socialstyrelsens rapport 1998:12

„In some countries floors and other surfaces in hospitals are being routinely disinfected. It is however, scientifically proven, that this is not necessary.“

„Only surfaces contaminated with blood, stool, urine or other potentially contaminated material should be disinfected.“



Guideline Netherlands

Guideline Cleaning and Disinfection in Rooms, Furniture and Articles

„Very important of the guidelines is, that the indications are given when disinfection is necessary. Indications for disinfection are strictly limited.

By example daily disinfecting of floors and walls is not indicated, only in case of contamination with blood, other excreta or specific micro-organisms.“

Staatstoelzicht op de Volksgezondheid, NL, January 2001



Guideline Finland

Dr. J. Ojajärvi (21.11.2000) Finland: „We believe that microbes on the floor have little to do with infections. Therefore we have gradually decreased the use of disinfectants on the surfaces in health care and actually got rid of routine use for more than 10 years ago. The floors are cleaned with ordinary household methods and when necessary wiped using detergents and water. Disinfectants are used only in case of spillage. We first wipe the spillage off from the surface with paper and gloved hand. The gloves and the paper are then discarded. Thereafter the surface is disinfected with disinfectant using concentrations recommended for the disinfection of dirty surfaces.“



Guideline UK

Revised guidelines for the control of methicillin-resistant *Staphylococcus aureus* in hospitals

Cleaning and Disinfection: „The side-room in which an MRSA-patient has been cared for should be cleaned after the patient's discharge according to the local disinfection policy, with special attention to horizontal surfaces and dust-collecting areas. Hot water and detergent are usually satisfactory. Decisions whether a disinfectant is needed should be made by the ICT. Pillows and mattress covers should be checked for damage. Therapy beds need special cleaning (Category II).“

Journal of Hospital Infection (1998) 39: 253-290



Sterilization or Disinfection of Patient-Care Equipment: HIV-Related

„Extraordinary attempts to disinfect walls, floors or other environmental surfaces are not necessary. However, cleaning and removal of soil should be done routinely.“

CDC, 23.11.2000



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Household cleaning and surface disinfection: new insights and strategies

M. Exner, V. Vacata, B. Hornel, E. Dietlein, J. Gebel

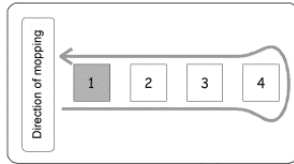


Figure 1: Scheme of the mop sweep through four test fields areas. Field 1 is contaminated with 0.05 mL of *S. aureus* (3×10^7 cfu/mL), areas 2-4 are germ-free surfaces. The arrow shows the cleaning sweep with the mop.

J Hosp Infection (2004) 56, 570-575

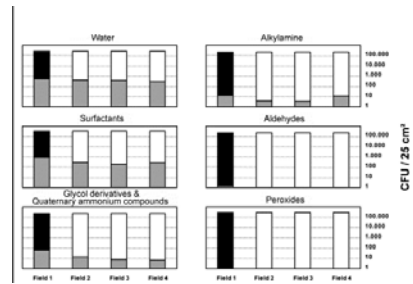
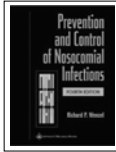


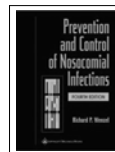
Fig 2: Log₁₀ colony-forming units for initial level of contamination (black, Field 1) and residual contamination (grey, Fields 1-4) and disseminated of *S. aureus* contamination (grey, Fields 2-4) in cfu/25cm² following the application of cleaning or disinfection procedures

J Hosp Infection (2004) 56, 570-575



„Noncritical Items“

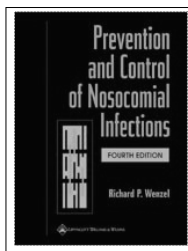
„Noncritical items are those that come in contact with intact skin but not mucous membranes. Intact skin acts as an effective barrier to most microorganisms, and sterility is not critical. Examples of noncritical items are bedpans, blood pressure cuffs, crutches, bed rails, linens, some food utensils, bedside tables, patient furniture, and floors. In contrast to critical items and some semicritical items, most noncritical reusable items can be cleaned ...“



„The Environment As A Source of Nosocomial Infections“

Surfaces

„Housekeeping surfaces (bedside tables, computer keyboards) may lead to the transmission of potential pathogens if they are not cleaned between use by different patients ...“



William A. Rutala
David J. Weber



Surface disinfectants

- Harm bacteria, which they should do
- Harm people, which they should not do
- Harm the environment, which is the worst
Bacteria (resistance!, biodegradation!)
People (drinking water)

Do not use surface disinfectants, unless absolutely necessary and scientifically proven!



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Other 2005 Teleclasses

For more information, refer to
www.webbertraining.com/schedule.cfm

- **April 12** – Methods for Testing Hand Disinfectants, with Dr. Manfred Rotter
Sponsored by Deb Hand Hygiene www.deb.co.uk
- **April 21** – Creutzfeldt-Jakob Disease: Recommendations for Disinfection and Sterilization with Dr. William Rutala
- **April 28** – Overcoming the Resistance of Biofilms with Dr. Peter Gilbert
Sponsored by Virox Technologies Inc. www.virox.com
- **May 19** – Antiseptic Practice & Procedure with Susan Crow
Sponsored by 3M Canada www.3m.ca
- **May 26** – Canadian Response to West Nile Virus with Dr. Paul Sockett

Questions? Contact Paul Webber paul@webbertraining.com