Practical recommendations for routine cleaning and disinfection procedures in healthcare institutions: a narrative review

Executive summary

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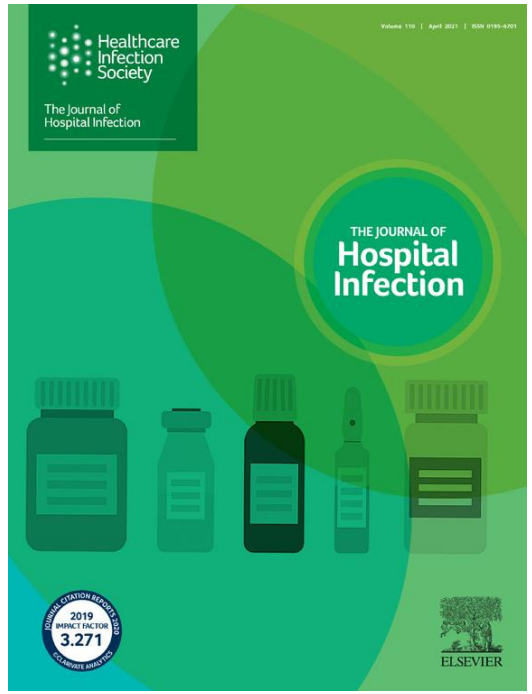
Routine environmental cleaning and disinfection is more than just “wiping”

- New review article summarises essential basics of routine environmental cleaning and disinfection and provides comprehensive insights as well as definitions for the most important topics in this field

- European author board:
  - Prof. Ojan Assadian (Austria)
  - Prof. Stephan Harbarth (Switzerland)
  - Prof. Margreet Vos (Netherlands)
  - Prof. Johannes K. Knobloch (Germany)
  - PhD Angel Asensio (Spain)
  - Prof. Andreas F. Widmer (Switzerland)

- Critically reviewed by Prof. Stephanie Dancer (UK)



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Main Objectives & Scope

- **Focus: practical recommendations for routine environmental cleaning and disinfection on general wards as well as expert guidance for clinically relevant pathogens and outbreak situations**
  - To date there is no universally agreed European or global guideline for routine surface cleaning and disinfection in hospitals available
  - Hand hygiene remains the key to success in combatting Healthcare-associated infections (HAIs), but healthcare hygiene should be seen as multimodal - as a comprehensive process in which different strategies work together

- **Expert guidance based on current national guidelines (KRINKO, CDC, NHS)**
  - Routine environmental cleaning and disinfection on general wards
  - Outbreak situations and clinically relevant pathogens

- **Out of scope**
  - Cleaning and disinfection in high-risk areas
  - Antibiotic stewardship

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Main content

- **Background**
  - Importance of environmental surfaces in transmission of HAIs
  - Positive impact of enhanced environmental cleaning and disinfection protocols as part of multimodal bundle on HAI and/or colonization rates

- **Key components environmental hygiene**
  - Risk Assessment
    - Patient risk profile, surface risk profile, pathogen risk profile
    - Moderate & high-risk areas, high-touch & low-touch surfaces, critical & non-critical surfaces
  - Disinfectants and equipment
  - Cleaning process, assessment of cleanliness
  - Adequate training, feedback and communication

- **Management of clinically relevant pathogens**

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Risk assessment as key component for environmental hygiene

- **Risk assessment involves 3 interdependent cornerstones or risk profiles**:
  - Patient risk profile (vulnerability of patients to infections or colonization)
  - Surface risk profile (probability of contamination with pathogens and potential for exposure and/or indirect transmission; frequency of hand contacts)
  - Pathogen risk profile (persistence, antibiotic resistance, and primary mode of transmission)
- **Definitions and examples for an individual risk analysis:**
  - Moderate- and high-risk areas
  - High-touch and low-touch surfaces
  - Critical and non-critical surfaces
- **Environmental hygiene basics:**
  - Routine and targeted cleaning and disinfection
  - Terminal disinfection

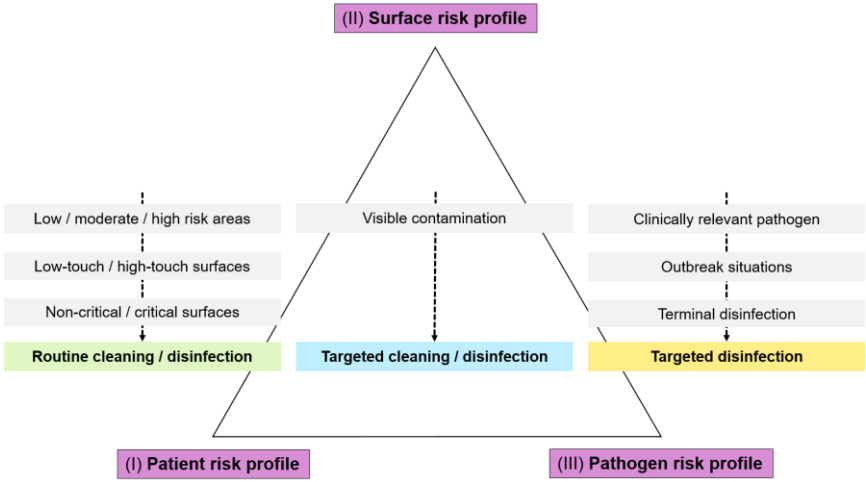

Figure I: Comprehensive overview of the fundamental principle of a risk analysis

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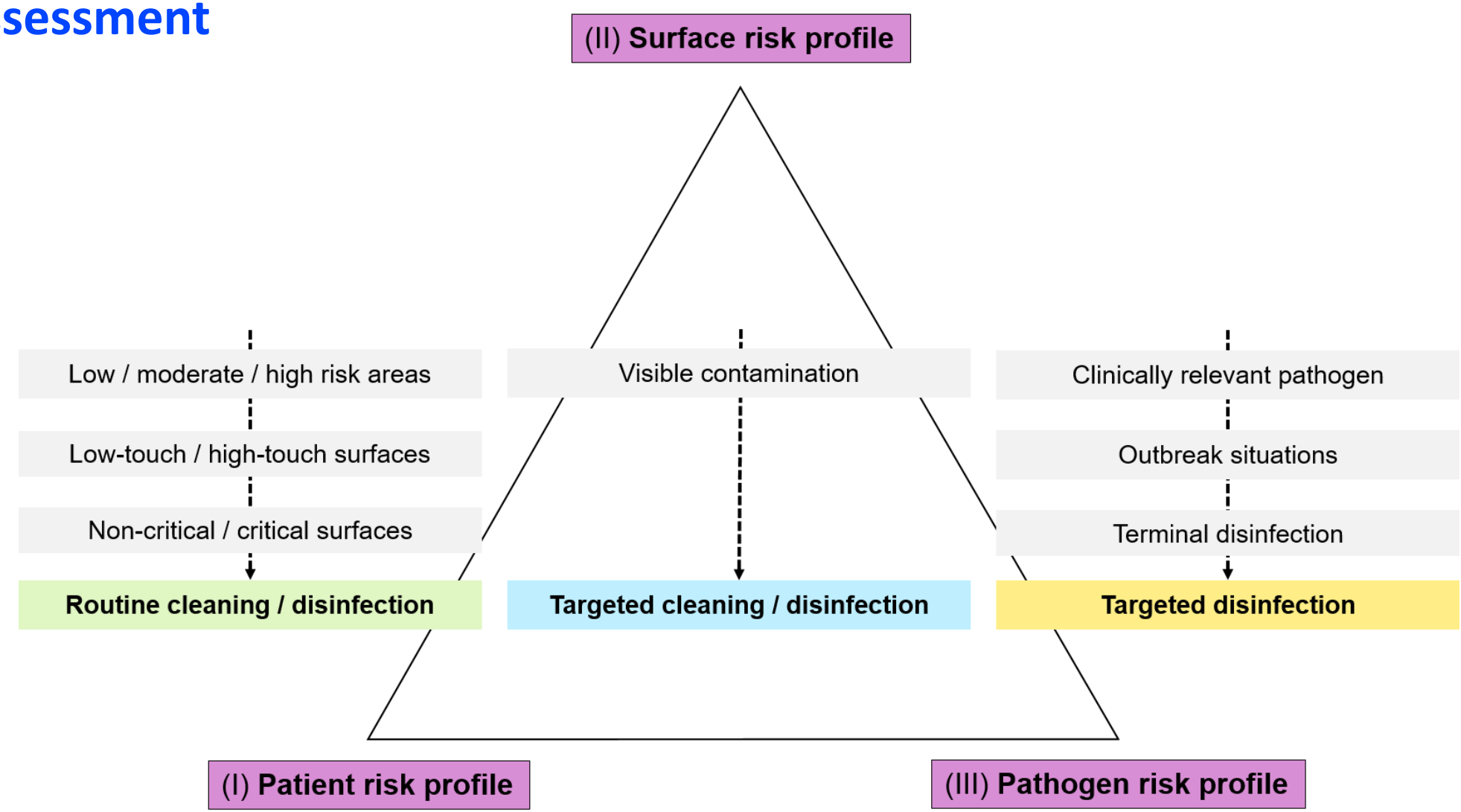
Risk assessment



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Cleaning & disinfection process

- **Cleaning & disinfection process**
  - Equipment (e.g. disposable or reusable mops and pre-soaked wipes, ergonomic aspects)
  - ´No-touch´ technologies (e.g. H_2O_2, UV-C, ozone)
  - Advantages and disadvantages of common disinfectants and active ingredients (alcohol, chlorine, aldehyde, amine, oxidatives, phenolic, quaternary ammonium compounds)

- **Cleaning & disinfection process and adequate training**
  - 4-Step protocol ´Look, Plan, Clean, Let dry´ (adapted from Dancer & Kramer, J Hosp Infect 2018)
  - Adequate staffing ratio, remuneration, equipment
  - Training, supervision, team communication, adult learning theory

- **Assessment of cleanliness**
  - Direct observation and subsequent feedback
  - ATP bioluminescence assays
  - Microbiological sampling
  - Fluorescent markers

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Cleaning & disinfection process

- Table I, part I: General overview of chemical disinfectants used for environmental disinfection

	Alcohol	Aldehyde	Amine	Chlorine	Oxidative	Phenol	QACs
Antimicrobial spectrum*	+ - ++*	++	+/-	++	++	++	+/-
Speed of action*	++	-	-	+ - ++*	+ - ++*	-	-
Sporicidal activity**	None	Yes	None	Yes	Yes	None	None
Skin compatibility	+	-	-	-	-	-	+
Readily biodegradability****	++	+	+	++	++	+	+
Inactivation in presence of proteins	Yes	Yes	None	Yes	Yes	None	None

++ very good
+ good
+/- intermediate
- basic (antimicrobial spectrum)
- low (speed of action, skin compatibility)

* depending on formulation (e.g. pH concentration and co-formulants can influence efficacy)
** depending on active ingredient and concentration
**** readily biodegradability: ability of a chemical compound to decompose after interactions with biological/ organic elements

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Cleaning & disinfection process

- Table I, part II: General overview of chemical disinfectants used for environmental disinfection

	Alcohol	Aldehyde	Amine	Chlorine	Oxidative	Phenol	QACs
Material compatibility	May harden rubber and cause deterioration of glues and translucent polymers	Good	Corrosive to metals, rubber and may cause deterioration of polymers and silicones	Corrosive to metals	May be corrosive to metals	May be absorbed by rubber and leaves residual film	Good
Typical indication	Small environmental surfaces and insensitive medical device surfaces	Environmental surfaces and medical devices	Environmental surfaces and medical devices	Environmental surfaces and water treatment	Environmental surfaces and medical devices	Rarely used	Environmental surfaces and medical devices
Limitations	Flammable***	Potential strong allergen and respiratory irritation	/	Short shelf life and strong odour; occupational health issues for users; formation of by-products possible; respiratory irritation	Respiratory irritation	Not suitable for nurseries or food contact surfaces	Potential irritant

*** comply with fire safety regulations

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Cleaning & disinfection process and adequate training

- Table II: General principles of cleaning

Start from least soiled to most soiled areas and from higher to lower levels.
Clean nearest to the patient (e.g. bedside table) first and furthest from the patient (e.g. bathroom) last.
Prioritize cleaning of hand-touch sites and work through a checklist.
Wipe systematically, e.g. in an S shape, without going over the same area twice.
Follow the principle ‘one wipe, one site, one direction’.
Use a clean/different cloth or wipe for each patient zone (e.g. bed) and throw away wipes/cloths or dispose them for reprocessing after each site or when visibly dirty.
Do not double-dip cloths or leave cloths soaking in solution.
Be aware of cross-contamination (e.g. between gloves and cloths) and frequently change cloths.
Use detergent to remove soil and disinfectant to kill germs.
Remove soil with detergent before using disinfectant if required.
Use freshly prepared cleaning fluids according to manufacturer’s instructions and change frequently to avoid cross-contamination.
Clean bathrooms after cleaning the patient room: start with sink, then the grid; continue with shower/bath, and clean toilet last. Always use new cloth between sink, shower/bath, and toilet.
Floor cleaning should be performed last.
Place warning signs before starting floor cleaning and warn passers-by verbally when floors are wet.

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Management of clinically relevant pathogens

- Table III, part I: Examples of clinically relevant pathogens, required disinfection efficacy and practical recommendations

	Organism	Required efficacy	Practical recommendations
Bacteria	• *S. aureus*, MSSA and other non-drug-resistant staphylococci and enterococci • *E. coli* • *K. pneumoniae* and other non-drug-resistant Enterobacteriaceae	S	Standard cleaning/disinfection procedure*,**
Bacteria	• *N. meningitidis*	S	Disinfection of isolation rooms*** & terminal room disinfection
Bacteria causing gastroenteritis or respiratory tract infections	• *Nontyphoidal Salmonella spp.*, *Campylobacter spp.* or *Shigella spp.* • *S. pneumoniae*, *B. pertussis*	S	Disinfection of isolation rooms*** & terminal room disinfection
Multidrug-resistant bacteria	• *S. aureus*, MRSA • Vancomycin-resistant enterococci (VRE) • Multidrug-resistant Gram-negative bacilli (MDRGNB)	S	Disinfection of isolation rooms & terminal room disinfection; consider complementary decontamination (UV-C, H_2O_2 vaporization) for some species or during outbreaks (e.g. VRE, *Acinetobacter baumannii*)

* according to risk assessment
** always disinfect high-touch surfaces and visible contamination
*** when isolation precautions are indicated
S: standard efficacy for application in healthcare institutions (bactericidal activity EN 13727, yeasticidal activity EN 13624)

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Management of clinically relevant pathogens

- Table III, part II: Examples of clinically relevant pathogens, required disinfection efficacy and practical recommendations

	Organism	Required efficacy	Practical recommendations
Mycobacteria	• *M. tuberculosis*	(S); change to T/M	Without visible contamination, standard cleaning/disinfection procedure may be sufficient*
Spore-forming bacteria	• *C. difficile*	change to SP	Disinfection of isolation rooms & terminal room disinfection; consider complementary decontamination (UV-C, H_2O_2 vaporization) during outbreaks
Fungi	• *C. albicans* • *C. auris*	S	Standard cleaning/disinfection procedure*, ** Disinfectant with proven yeasticidal efficacy may be sufficient*

* according to risk assessment
** always disinfect high-touch surfaces and visible contamination
S: standard efficacy for application in healthcare institutions (bactericidal activity EN 13727, yeasticidal activity EN 13624)
SP: sporicidal activity against *C. difficile*-spores (EN 17126)
T/M: tuberculocidal activity (*M. terrae* EN 14348, mycobactericidal EN 14348);

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	Organism	Required efficacy	Practical recommendations
Enveloped viruses **Enveloped viruses causing respiratory tract infections**	• Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) • Hepatitis B virus (HBV) • Human immunodeficiency virus (HIV) • Respiratory syncytial virus (RSV) • Influenza viruses (A-C)	S incl. envV	Standard cleaning/disinfection procedure*, ** Disinfection of isolation rooms & terminal room disinfection
Non-enveloped viruses causing gastroenteritis or respiratory tract infections	• Norovirus • Adenovirus	change to lsV	Disinfection of isolation rooms & terminal room disinfection Disinfectant with proven lsV or V efficacy

* according to risk assessment
** always disinfect high-touch surfaces and visible contamination
S: standard efficacy for application in healthcare institutions (bactericidal activity EN 13727, yeasticidal activity EN 13624)
envV: virucidal activity against enveloped viruses (EN 14776)
lsv: limited spectrum virucidal activity (EN 14476)
V: virucidal activity (EN 14476)

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  - The content of the article describes exclusively the opinion of the experts. The sponsor had no influence on the content of the article.
  - The sponsor has additionally covered the costs of making this publication available in open access format.