Discussion: Are current healthcare cleaning guidelines sufficient to fight antimicrobial resistance spread?

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Discussion: Are current healthcare cleaning guidelines sufficient to fight antimicrobial resistance spread?

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1. General guidance

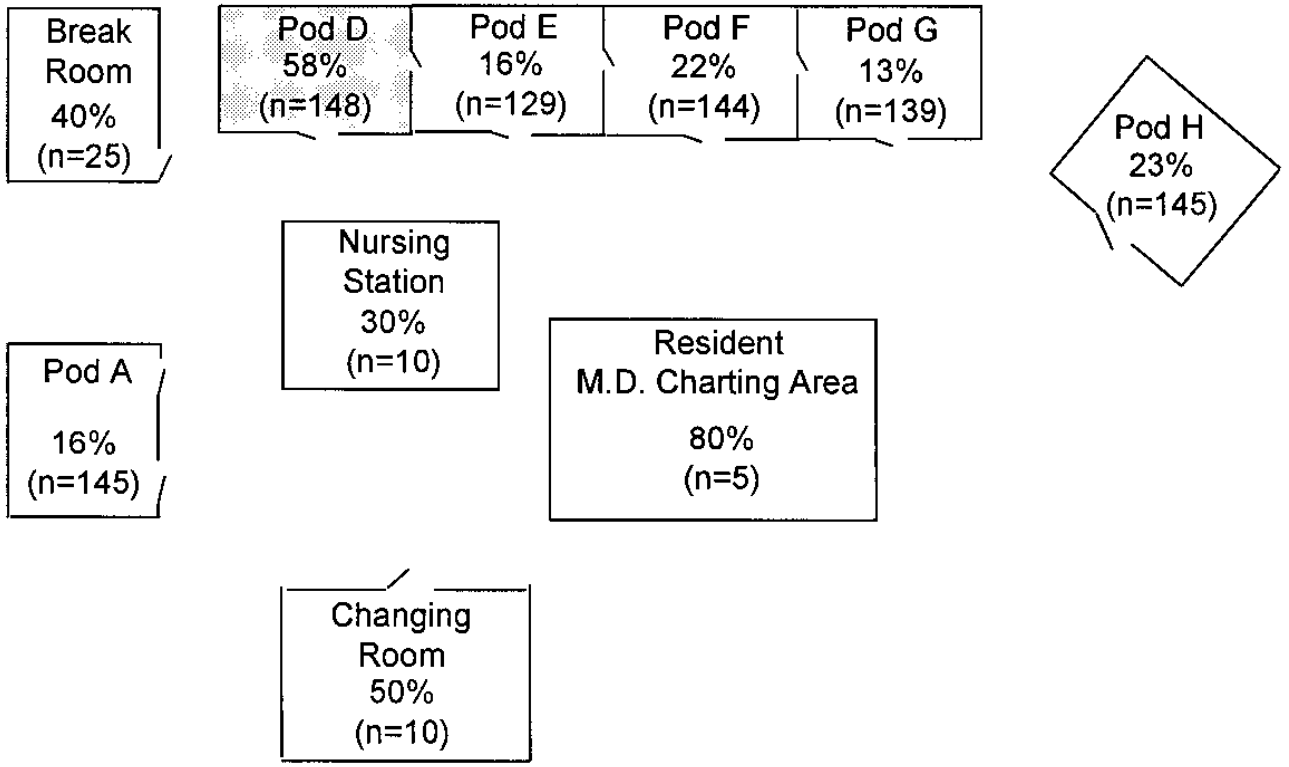
2. Organism specific guidance (*Clostridioides difficile* and *Candidozyma auris*)

3. Other issues

Transfer of a surrogate marker in a NICU

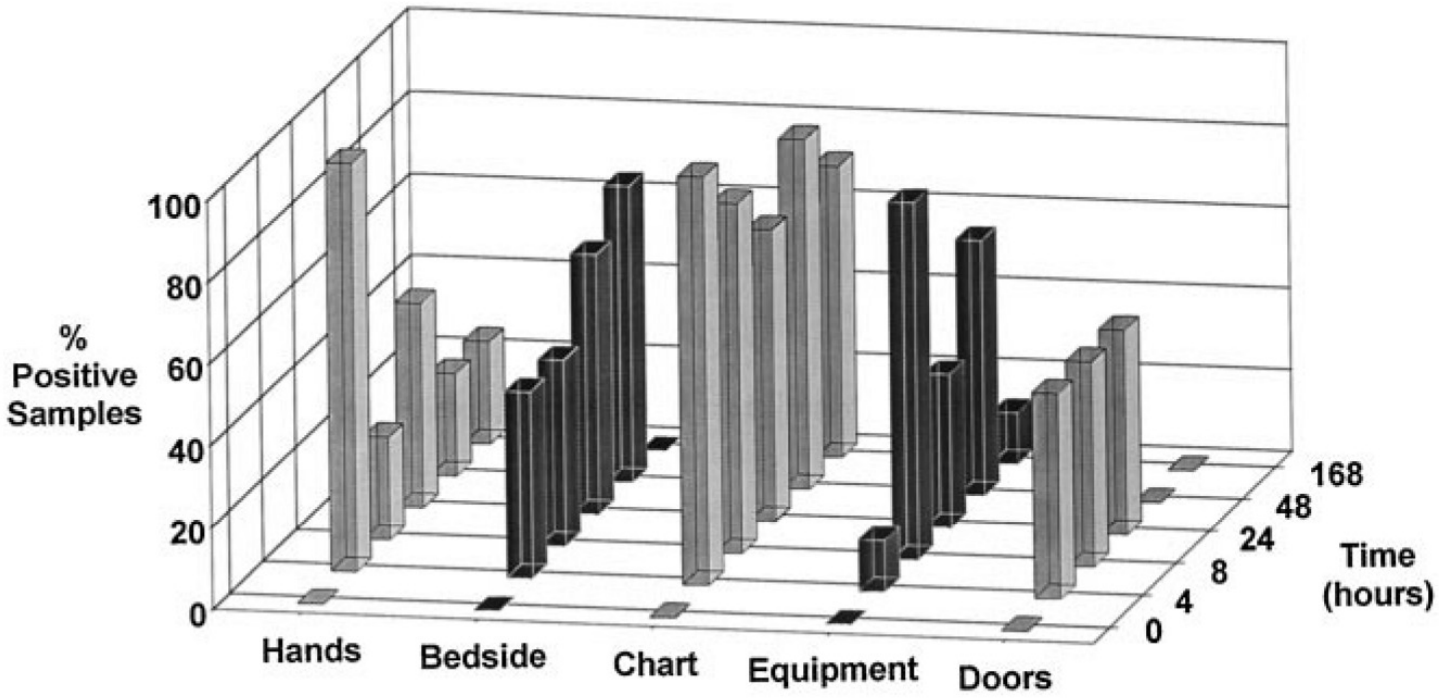
Oelberg *et al*. *Pediatrics* 2000;105:311-315.

Transfer of a surrogate marker in a NICU

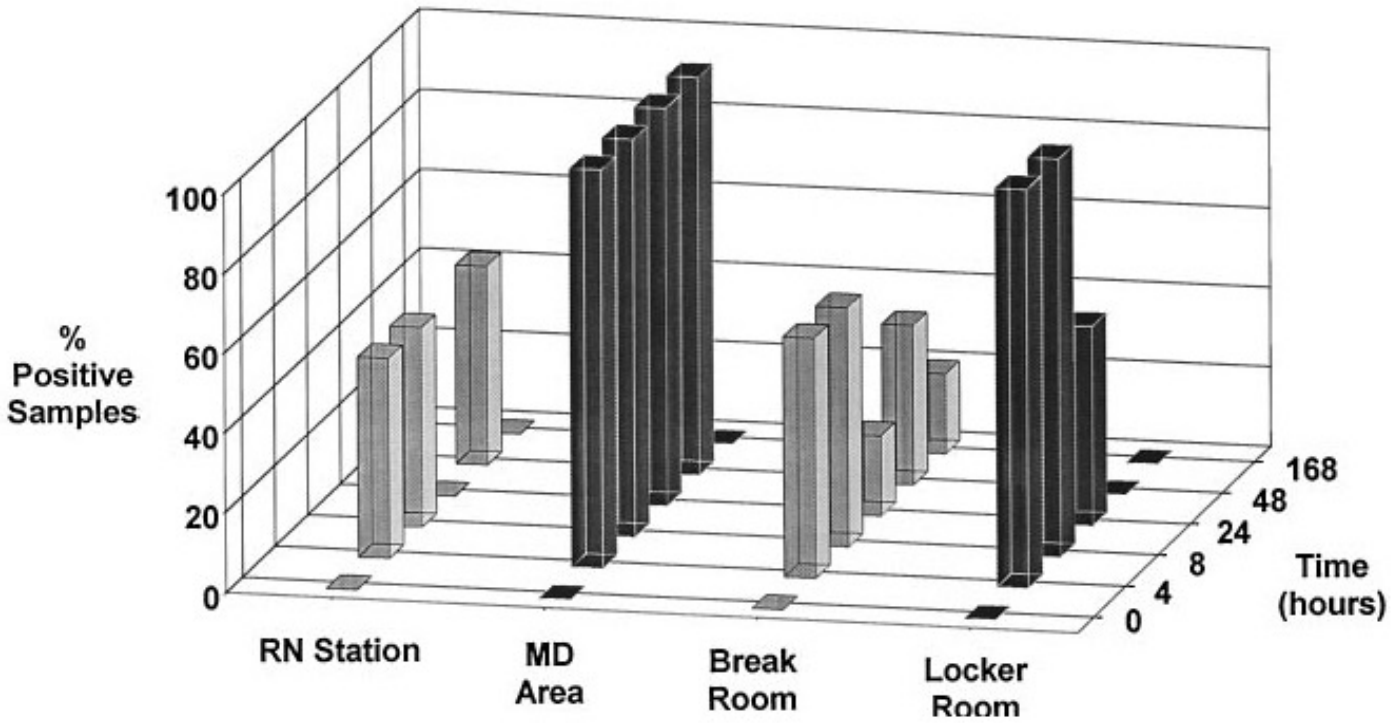


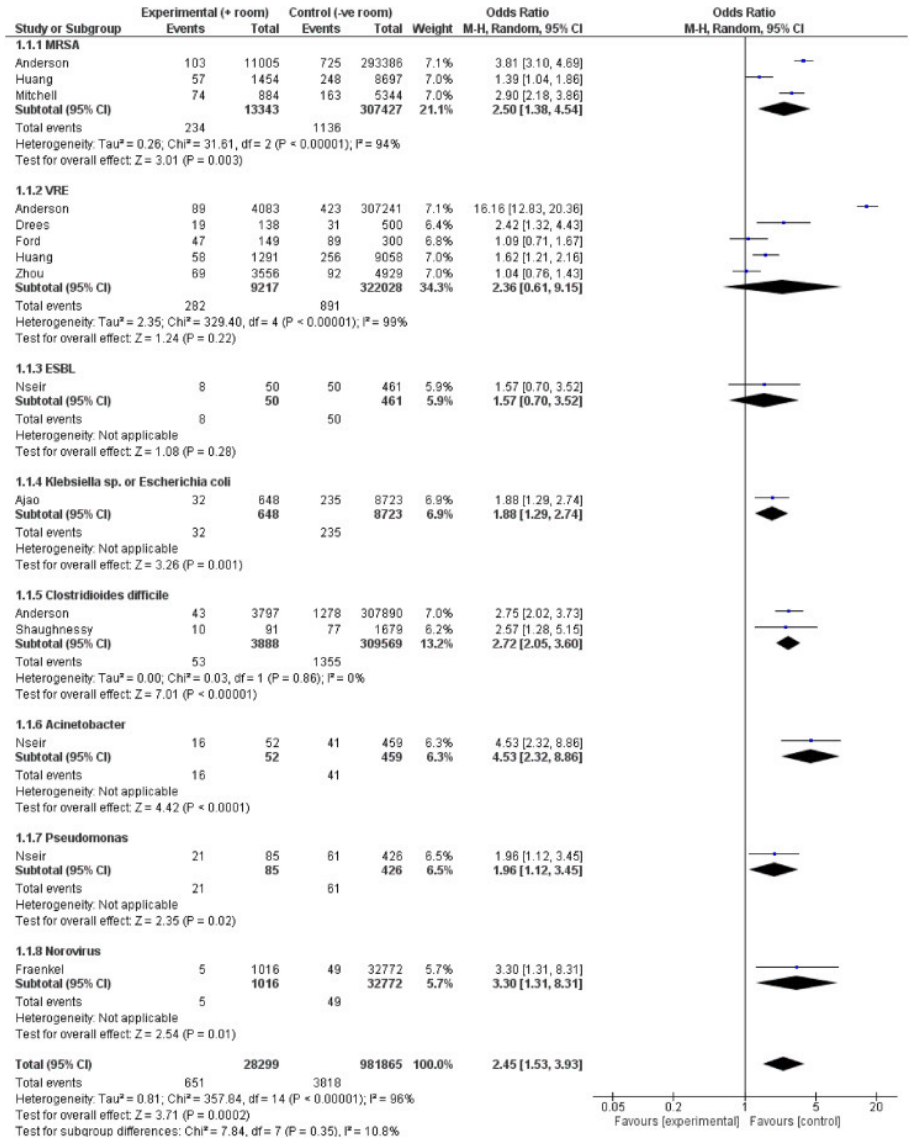
Oelberg *et al*. *Pediatrics* 2000;105:311-315.

Transfer over time: inoculated pod



Contamination over time by location





The MDRO status of the prior room occupant influences acquisition risk

Meta-analysis of studies evaluating the risk of MDRO acquisition for the incoming occupant based on the status of the prior room occupant.

	OR	95% CI
Acinetobacter	4.5	2.3-8.9
Norovirus	3.3	1.3-8.3
C. difficile	2.7	2.0-3.6
MRSA	2.5	1.4-4.5
VRE	2.4	0.6-9.1
Pseudomonas	2.0	1.1-3.4
Klebsiella or *E. coli*	1.9	1.3-2.7
ESBL	1.6	0.7-3.5
Total	2.5	1.5-3.9

Mitchell et al. Infect Dis Health 2023.

1. General guidance

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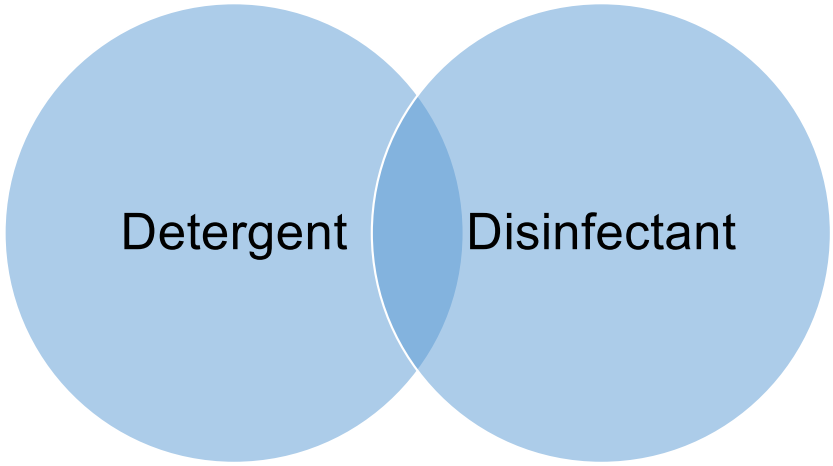
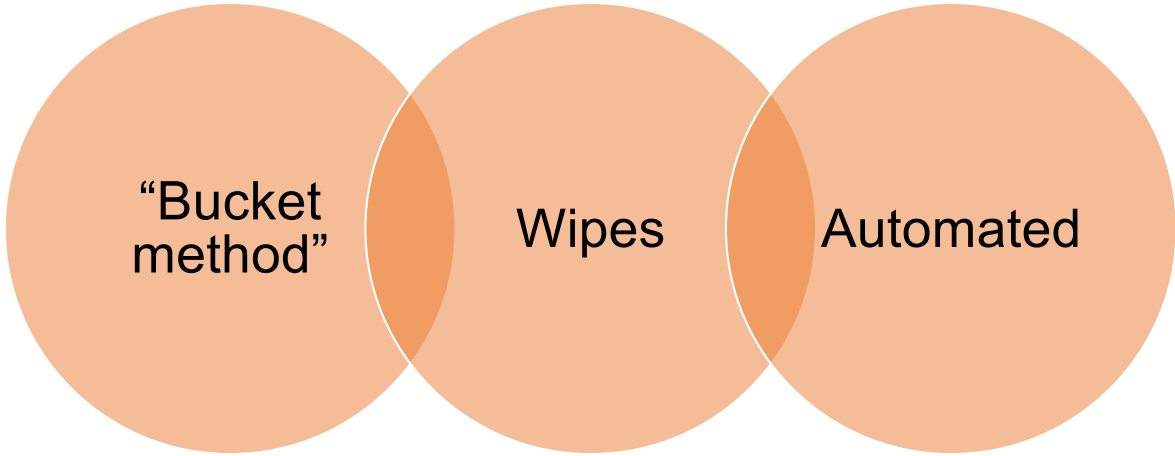
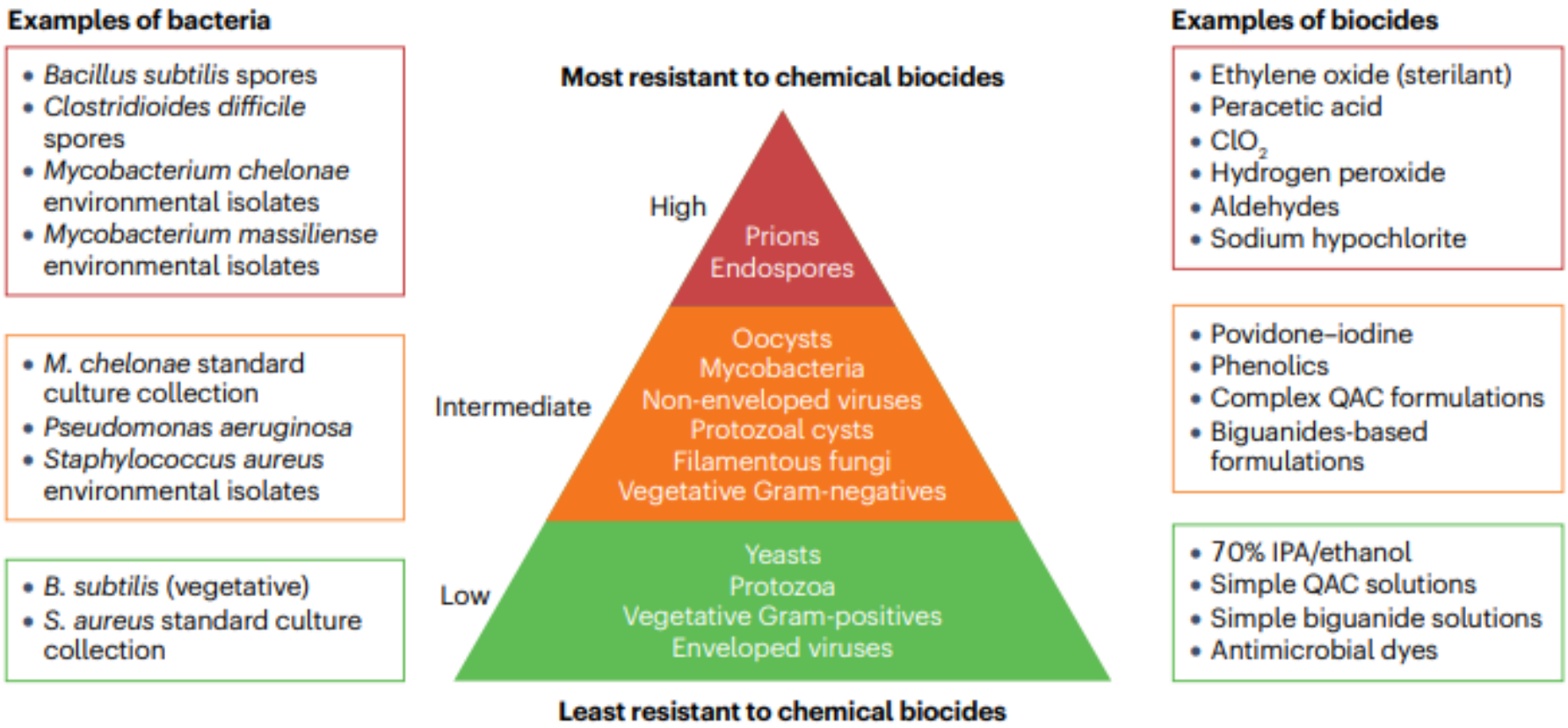
PRODUCT



PROCEDURE





Maillard & Pascoe. Nature Rev Microbiol 2024.

English cleaning / disinfection recommendations

- Under *Standard Infection Control Precautions*, routine disinfection of the environment is not routinely recommended in the manual, aside from routine disinfection of sanitary fittings using chlorine.
- Under *Transmission Based Precautions*, disinfection of hospital surfaces during the stay of the patient and at the time of their transfer or discharge is recommended.
  - The manual makes a specific recommendation that chlorine should be used for daily and discharge surface disinfection.

National Infection Control Policy Manual

Limitations of a “detergent only” approach

- Patients with unidentified infection risks
- Challenges of cleaning complex and intricate environment
- Dry surface biofilms
- Limited reduction in pre-post studies
- Evidence that they spread contamination around
- Emerging evidence of detergent-related surface damage
- Evidence that moving to routine disinfection reduces transmission risk

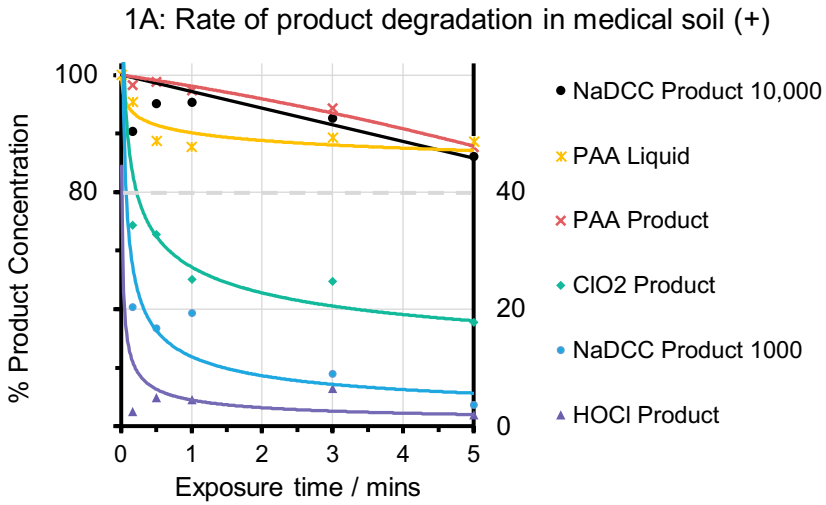
Kiernan et al. J Hosp Infect 2024.

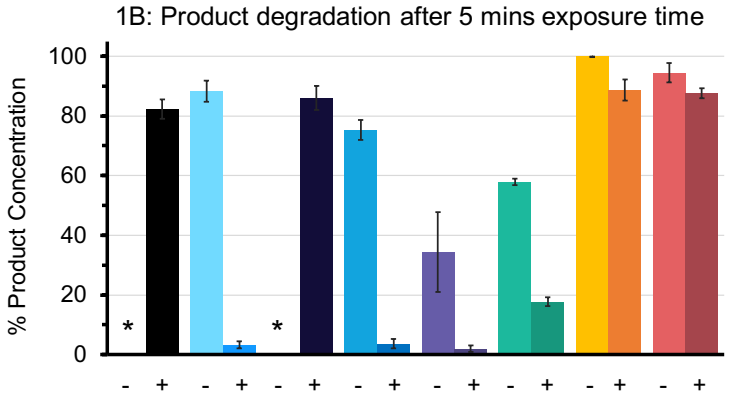
Limitations of a chlorine-based disinfectants

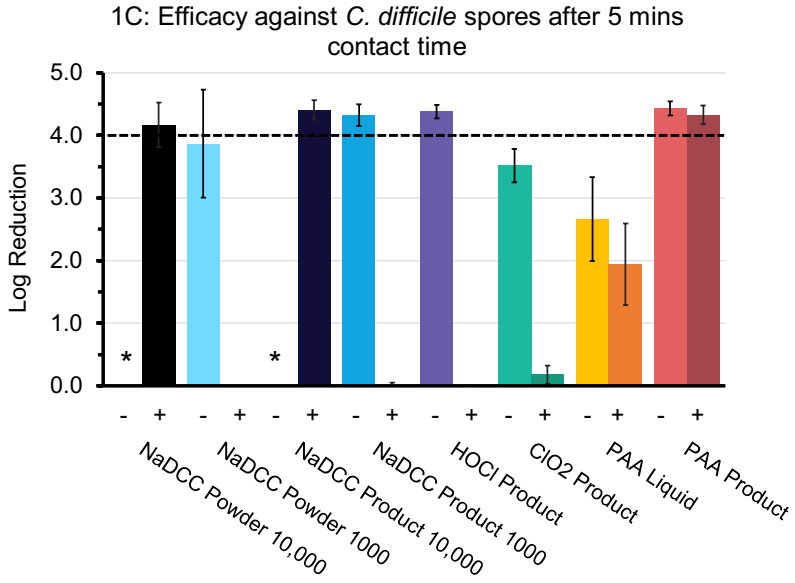
- Many are not sporicidal when tested correctly
- Inactivation when exposed to soiling
- Poor environmental profile
- Material compatibility
- Staff exposure
- Majority of patients on TBPs don’t require chlorine

Kiernan et al. J Hosp Infect 2024.

Impact of soiling



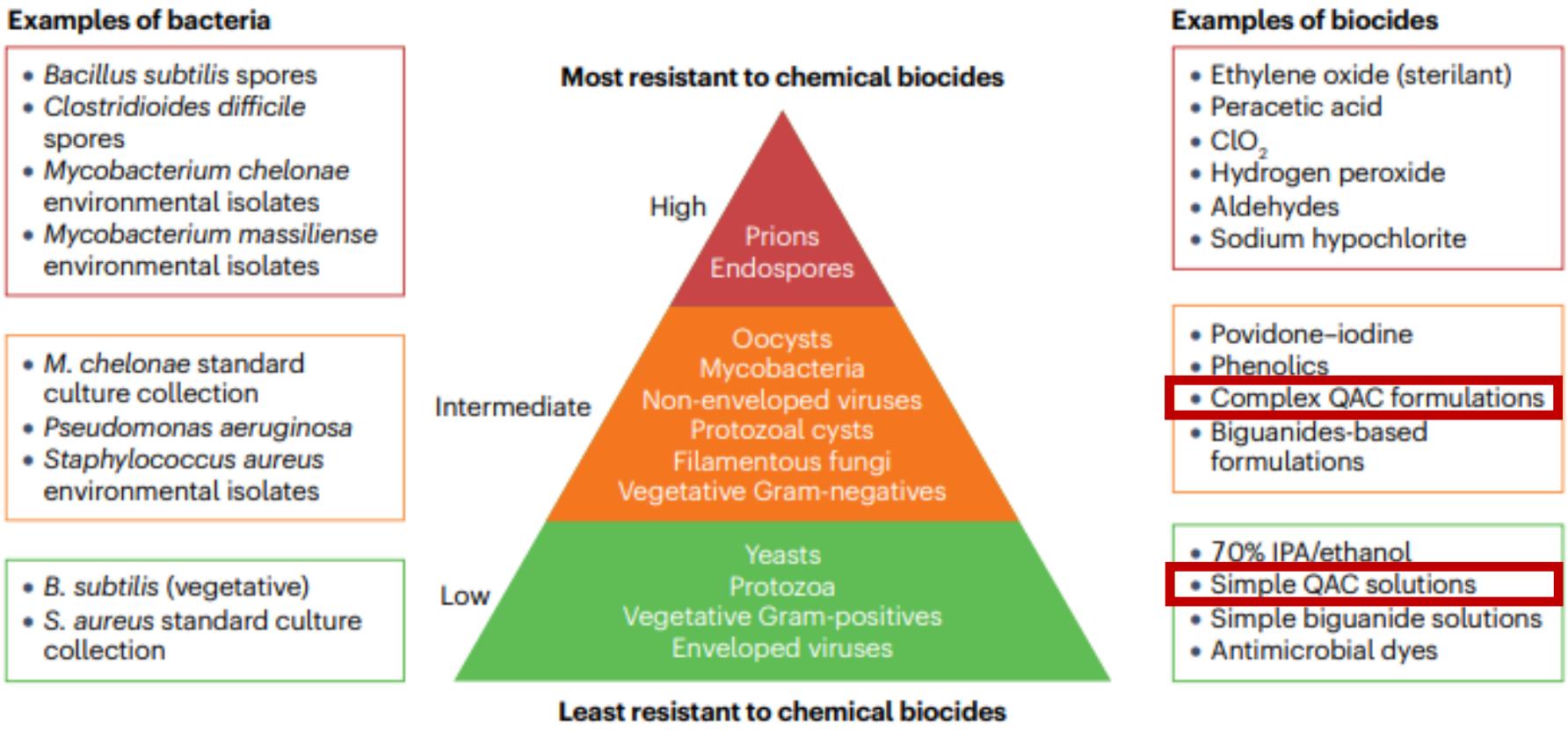




Brown et al. J Hosp Infect 2024.

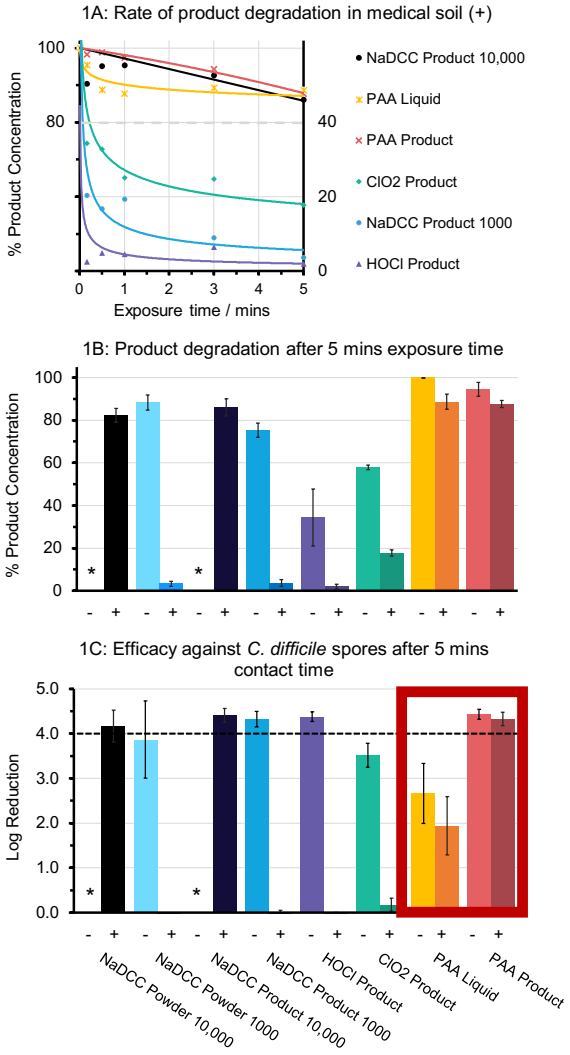
* = not tested

The importance of formulation



Maillard & Pascoe. Nature Rev Microbiol 2024.

Importance of formulation

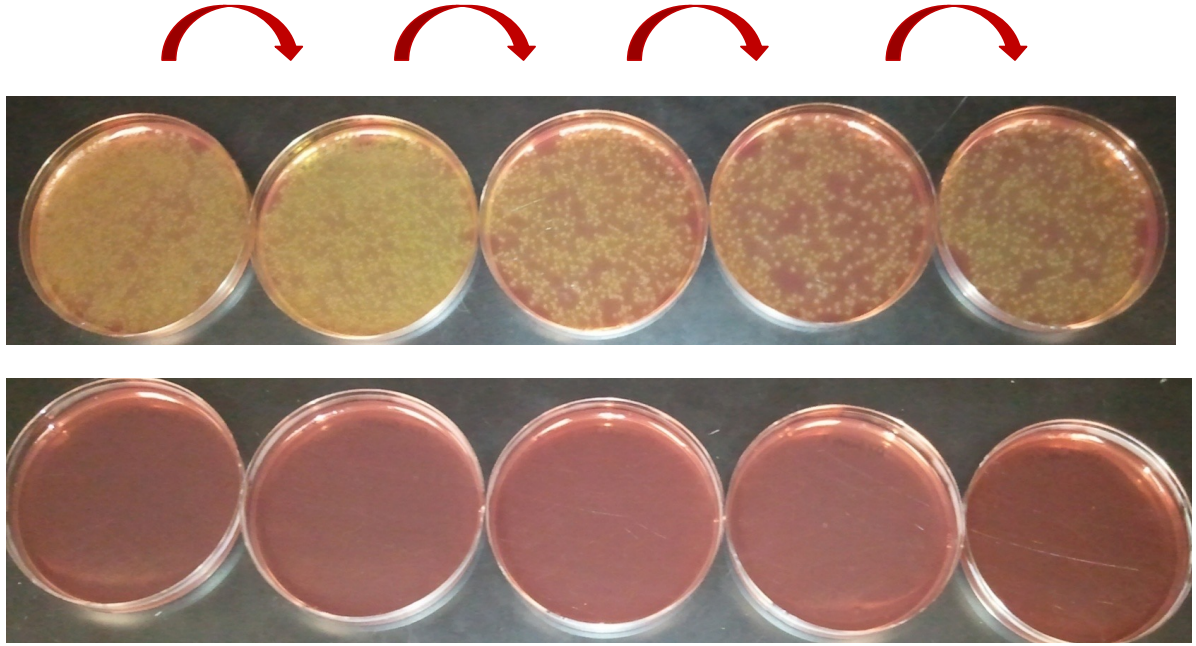


Brown et al. J Hosp Infect 2024 (accepted)

* = not tested

Non-sporicidal products transfer spores from contaminated to clean surfaces

Transfer of *C. difficile* spores by nonsporicidal wipes



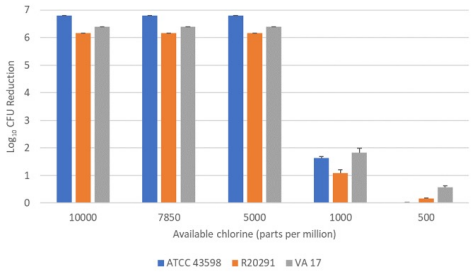
Non-sporicidal wipe

Bleach wipe

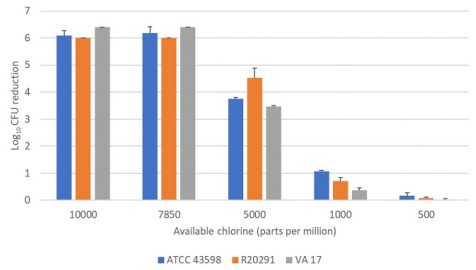
Cadnum JL. Infect Control Hosp Epidemiol 2013;34:441-2.

Sodium hypochlorite efficacy against *C difficile* – contact time and concentration are important

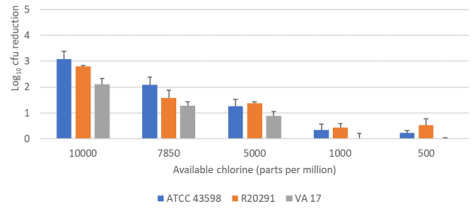
- Recommended:
  - 7800 ppm
  - 3-minute contact time
- Minimal reduction if insufficient contact time (1 minute) or low concentration (500 or 1000 ppm)
- UK guidelines: 1000 ppm with 10-minute contact time



10 min



5 min



1 min

Cadnum JL. Comment on the effectiveness of sodium hypochlorite against *C difficile* spores. Microbiology 2024; EPA List K. *C. difficile*.

United States: CDC guidance on cleaning and disinfection

- Standard operating procedures (SOPs)
- Education
- Direct observation of performance
- Sporicidal disinfectant if *C. difficile* rates are high
- All hospitals encouraged to develop programs to monitor terminal room cleaning

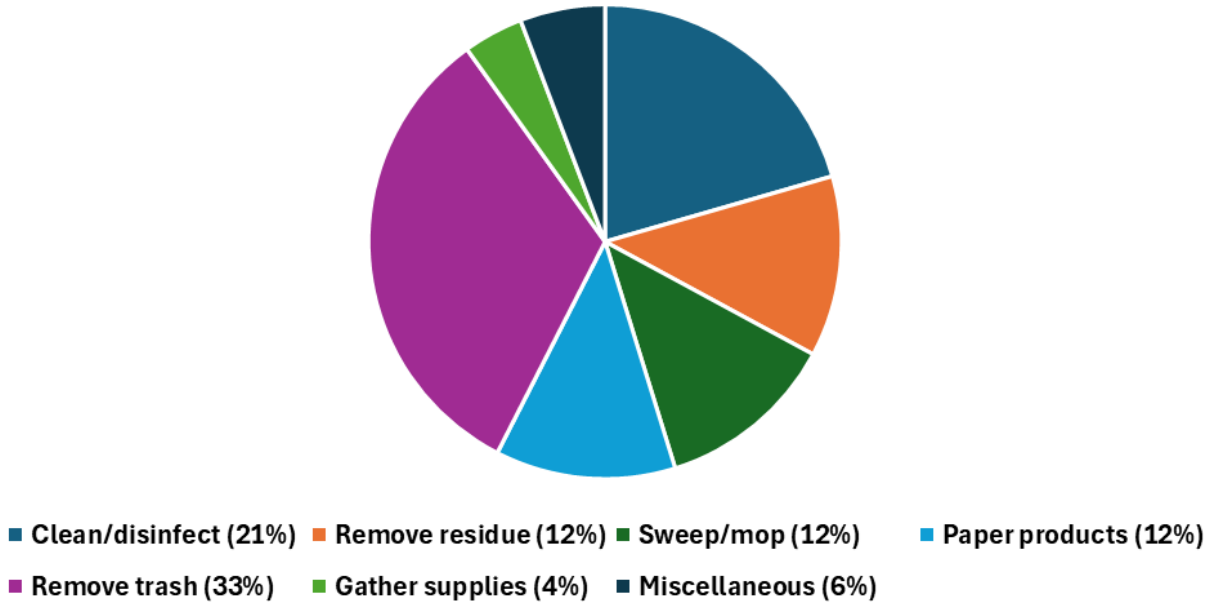
1. Healthcare Infection Control Practices Advisory Committee (HICPAC). Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008;
2. Centers for Disease Control and Prevention. Best practices for environmental cleaning in global healthcare facilities with limited resources. https://www.cdc.gov/infection control/media/pdfs/Guideline-Disinfection-H.pdf
3. Guh A, Carling P, Environmental evaluation workgroup. Options for evaluating environmental cleaning. 2010.

Routine objective monitoring is recommended

- Fluorescent markers
  - Thoroughness of cleaning
- ATP bioluminescence
  - Organic material (bacteria, food, bodily secretions)

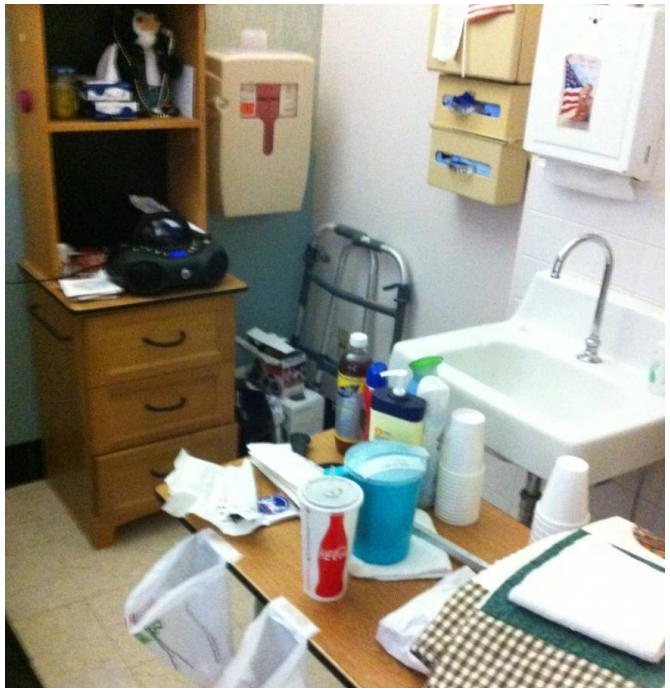
Deshpande A, Donskey CJ. Practical Approaches for Assessment of Daily and Post-discharge Room Disinfection in Healthcare Facilities. Curr Infect Dis Rep 2017; CDC. Best practices for environmental cleaning in global healthcare facilities with limited resources. https://www.cdc.gov/infection control/media/pdfs/Guideline-Disinfection-H.pdf; Guh A, Carling P, Environmental evaluation workgroup. Options for evaluating environmental cleaning. 2010.

Daily room cleaning is suboptimal – “trash and dash”



Miscellaneous includes preparing to clean, organizing cart, cleaning common work areas

Daily cleaning?



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Clostridium difficile infection:

How to deal with the problem

C. difficile guidance (abridged)

- 6.1 Environmental cleaning of rooms or bed spaces of C. difficile patients should be carried out at least daily using chlorine-containing cleaning agents (at least 1,000 ppm available chlorine).
- 6.2 All commodes, toilets and bathroom areas of CDI patients should be cleaned after each use with chlorine-containing cleaning agents (at least 1,000 ppm available chlorine).
- 6.3 All clinical areas should be regularly assessed for cleanliness and results fed back to clinical and cleaning teams.
- 6.4 Terminal cleaning…should be thorough. All areas should be cleaned using chlorine-containing cleaning agents (at least 1,000 ppm available chlorine), and the curtains should be changed. Consideration should be given to the use of vaporised hydrogen peroxide to provide total disinfection of the environment/equipment in single rooms/isolation wards.
- 6.5 The ward environment should not be cluttered.
- 6.7 Routine environmental screening for C. difficile is not recommended, but may be useful to ascertain whether cleaning standards are suboptimal, notably in the outbreak or hyperendemic setting.
- 6.8 Trusts should ensure, through their directors of nursing and human resources, that each clinical area is covered by an infection control link practitioner, whose role and job description should include training, auditing and feeding back to staff on cleaning, isolation, hand hygiene and personal protective clothing practices.

United States: Strategies to prevent *C. difficile* infections in acute care hospitals (Essential Practices)

- Adequately clean and disinfect equipment and environment of CDI patients
  - Develop and implement protocols
  - Dedicate noncritical patient care items
- Assess adequacy of room cleaning
  - Work with environmental services - establish process
  - Consider use of sporicidal agent if cleaning deemed adequate and ongoing transmission

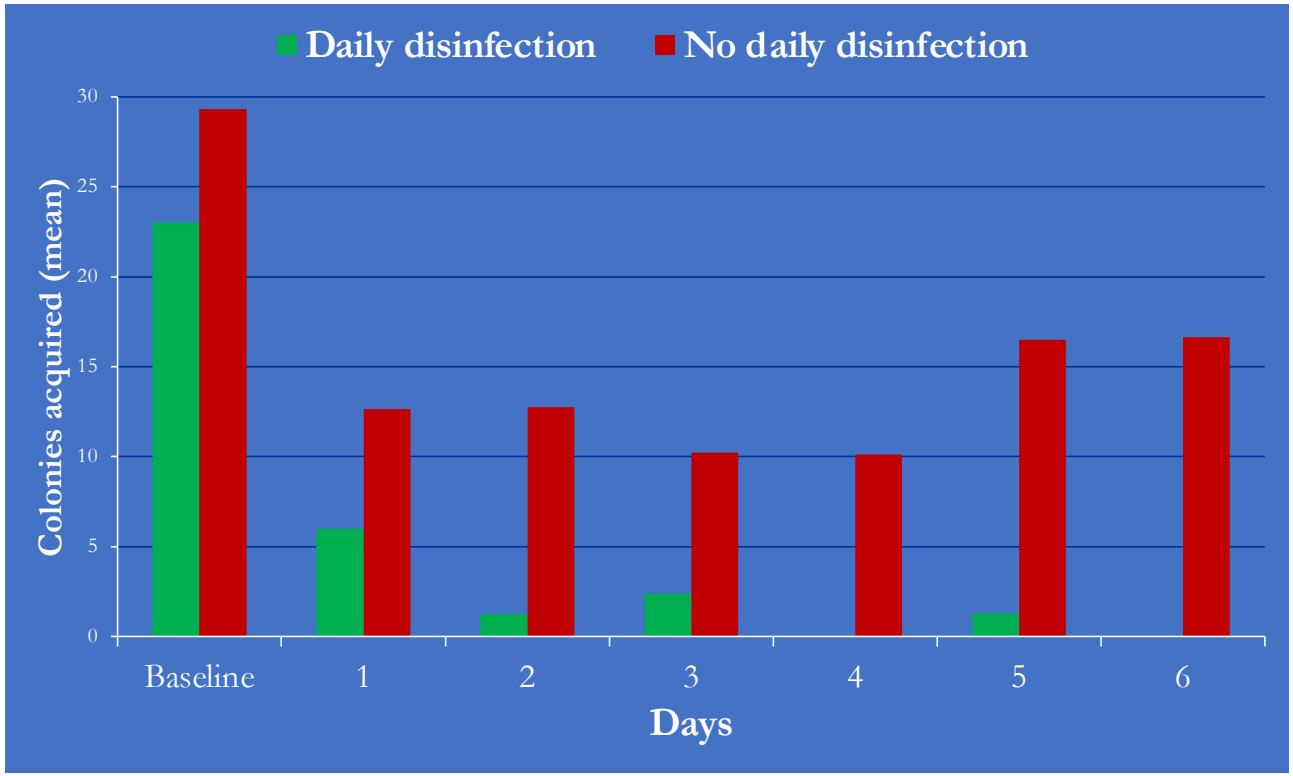
Kociolek LK. SHEA/IDSA/APIC Practice Recommendation: Strategies to prevent *C. difficile* infections in acute-care hospitals: 2022 Update. ICHE 2023.

Strategies to prevent *C. difficile* infections in acute care hospitals (Additional Practices)

- Use an EPA approved sporicidal disinfectant
  - Location: CDI rooms, non-CDI rooms, common spaces, type, and frequency of use
  - Frequency: daily or only terminal
  - Type of product

Kociolek LK. SHEA/IDSA/APIC Practice Recommendation: Strategies to prevent *C. difficile* infections in acute-care hospitals: 2022 Update. ICHE 2023.

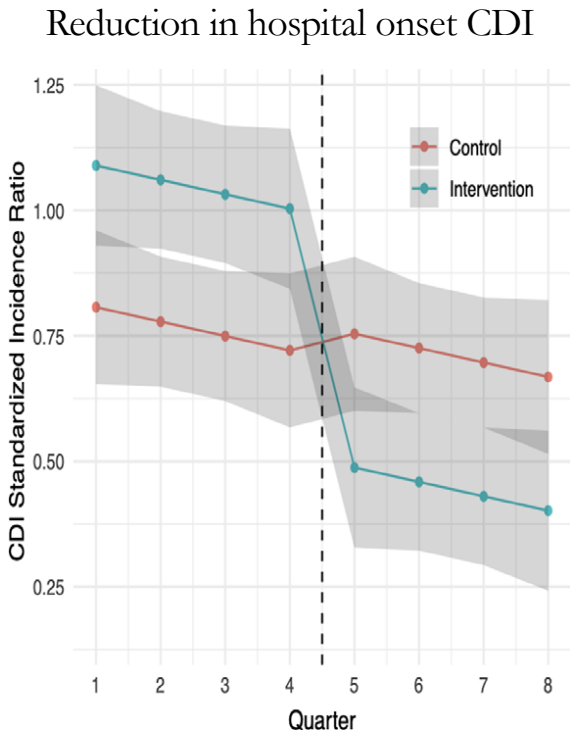
Daily sporicidal disinfection of high-touch surfaces reduced hand contamination



Kundrapu S. Daily disinfection of high-touch surfaces in isolation rooms to reduce the risk for contamination of healthcare workers' hands. ICHE 2012;33:1039-42.

Routine use of sporicidal disinfectants in all patient rooms

- 8 hospitals switched to use of a peracetic acid disinfectant in all patient rooms + fluorescent marker monitoring
- Reduction in CDI in intervention but not control hospitals



Carling PC. Mitigating hospital-onset *C difficile*: The impact of an optimized environmental hygiene program in 8 hospitals. ICHE 2023;44:440-446.

Strategies to prevent *C. difficile* infections in acute care hospitals (Unresolved issues)

- Touchless technologies (hydrogen peroxide vapor, UV-C)

Kociolek LK. SHEA/IDSA/APIC Practice Recommendation: Strategies to prevent *C. difficile* infections in acute-care hospitals: 2022 Update. ICHE 2023.

Cluster randomized trials of UV-C show modest or no reduction in HAIs

Setting	Findings
Nine hospitals[1,2]	Decrease in MDROs and hospital-wide CDI (11%) and VRE (44%) when UV added to quat but not when added to bleach
4 cancer wards & 1 organ transplant unit[3]	No reduction in new VRE infections or *C. difficile* infections
15 wards in 2 hospitals (pulsed xenon devices)[4]	No reduction in clinical cultures positive for environmentally implicated HAIs (VRE, MRSA, resistant GNB) and CDI

1. Anderson DJ. Enhanced terminal room disinfection and acquisition and infection caused by multidrug-resistant organisms and *C difficile* (the Benefits of Enhanced Terminal Room Disinfection study): a cluster-randomised, multicentre, crossover study. Lancet 2017; 2. Anderson DJ. Effectiveness of targeted enhanced terminal room disinfection on hospital-wide acquisition and infection with multidrug-resistant organisms and *C difficile*: a secondary analysis of a multicentre cluster randomised controlled trial with crossover design (BETR Disinfection). Lancet Infect Dis 2018; 3. Rock C. Ultraviolet-C Light Evaluation as Adjunct Disinfection to Remove Multi-Drug Resistant Organisms. Clin Infect Dis 2021; 4. Dhar S. Lowering the Acquisition of Multidrug-Resistant Organisms (MDROs) With Pulsed-xenon (LAMP) Study: A Cluster-Randomized, Controlled, Double-Blinded, Interventional Crossover Trial. Clin Infect Dis 2024.

Guidance

Candidozyma auris: guidance for acute healthcare settings

Candidozyma auris (C.auris): laboratory investigation, management and infection prevention and control of cases.

From: UK Health Security Agency

Published 27 June 2016

Last updated 21 August 2025 — See all updates

C. auris guidance – equipment

- Use single-use and disposable equipment wherever possible.
- Assign dedicated, reusable non-invasive equipment to the isolation room or cohort area.
- Ensure thorough cleaning and disinfection of care equipment is performed in accordance with the manufacturer's instructions, including adherence to recommended contact times for disinfectant solutions.
- Pay particular attention to the cleaning and disinfection of reusable equipment from the bed space, including mobile equipment and equipment personally owned by healthcare workers, that may act as a reservoir for cross-transmission of C. auris.

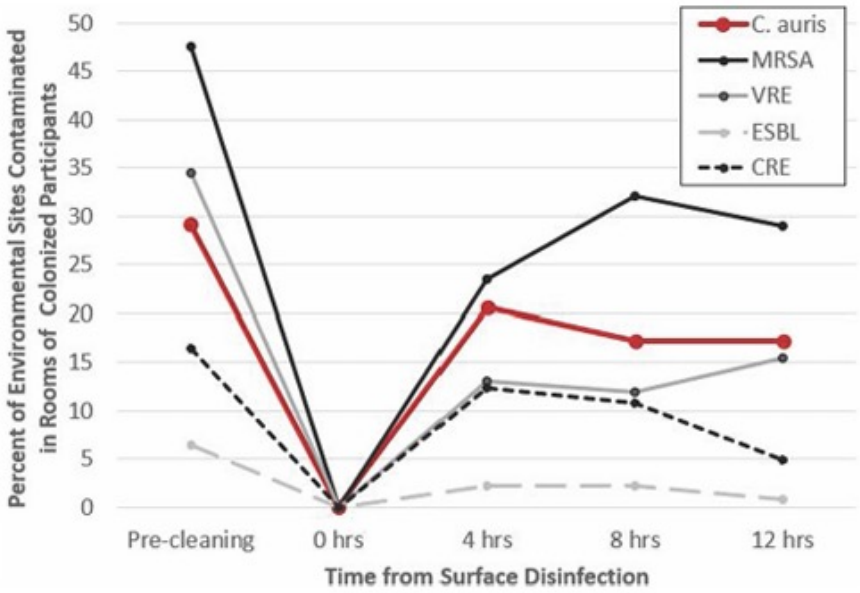
C. auris guidance – environment

- Perform thorough cleaning of the care environment prior to disinfection.
- Develop local cleaning and disinfection policies tailored to the level of contamination and case load, focusing on frequently touched surfaces.
- Use 1,000 ppm of available chlorine, or an alternative effective disinfectant, following the recommended contact times.
- Avoid using quaternary ammonium compounds due to insufficient evidence of efficacy against *C. auris*.
- Use hydrogen peroxide vapour and ultraviolet light systems only as supplementary measures, not as replacements for full cleaning and disinfection.
- Review cleaning and disinfection practices in outbreak settings to identify and implement improvements.
- Perform terminal cleaning and disinfection of all surfaces in the patient's environment as detailed in the NIPCM.

United States: Environmental cleaning recommendations for *C. auris*

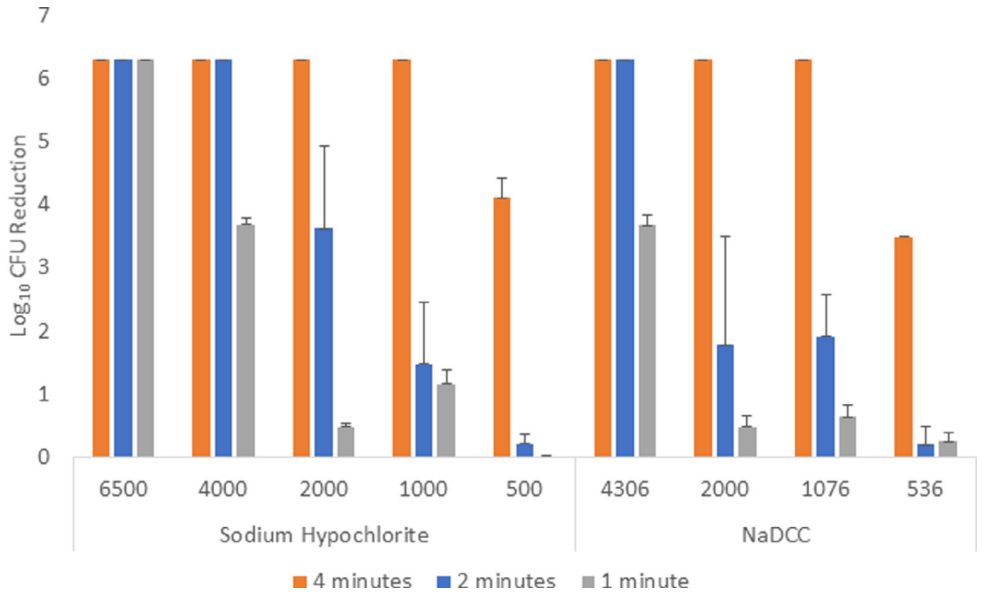
- Environmental disinfection
  - Use agents with EPA claim against *C. auris* (List P)
  - No-touch devices (only as an adjunct)
  - At least daily and post-discharge
- Educate personnel and audit performance

Rapid recontamination of surfaces after cleaning rooms of *Candida auris* patients



Sansom SE. Rapid Environmental Contamination with *C. auris* and Multidrug-Resistant Bacterial Pathogens Near Colonized Patients. Clin Infect Dis 2023:ciad752; Alhmidi H. Shedding of MRSA by colonized patients during procedures and care activities. Infect Control Hosp Epidemiol 2019;40:328-32.;

Know your disinfectants: Dilute chlorine-based disinfectants require adequate contact time for *C. auris*



NaDCC = sodium dichloroisocyanurate

Kumar J.A Are reduced concentrations of chlorine-based disinfectants effective against *Candida auris*? Am J Infect Control 2020;48:448-450 (>4,000 ppm chlorine effective against *C auris* with 1 minute contact time; lower concentrations only effective with 4-minute contact time).

1. General guidance

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3. Other issues

Factors affecting biocide effectiveness

Biocide	Application	Microbe
• Type / mechanism of action • Concentration • Formulation	• Dilution • Delivery method • Contact time • Soiling • Surface type • Interactions	• Structure (e.g. spores) • Reduced susceptibility • Metabolic state (e.g. VNC) • Community (e.g. biofilm)

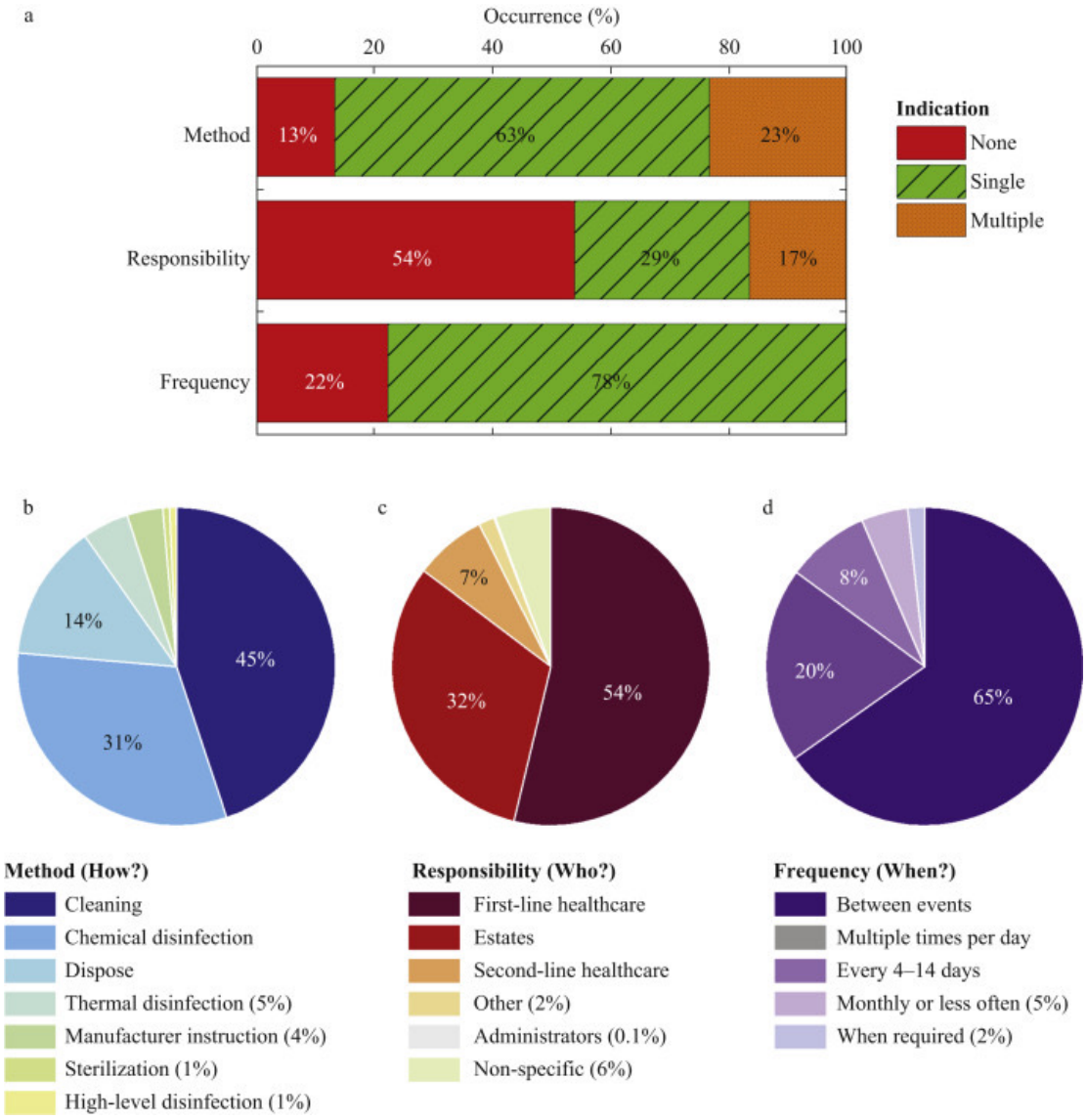
Maillard & Pascoe. Nature Rev Microbiol 2024.

Shared medical equipment

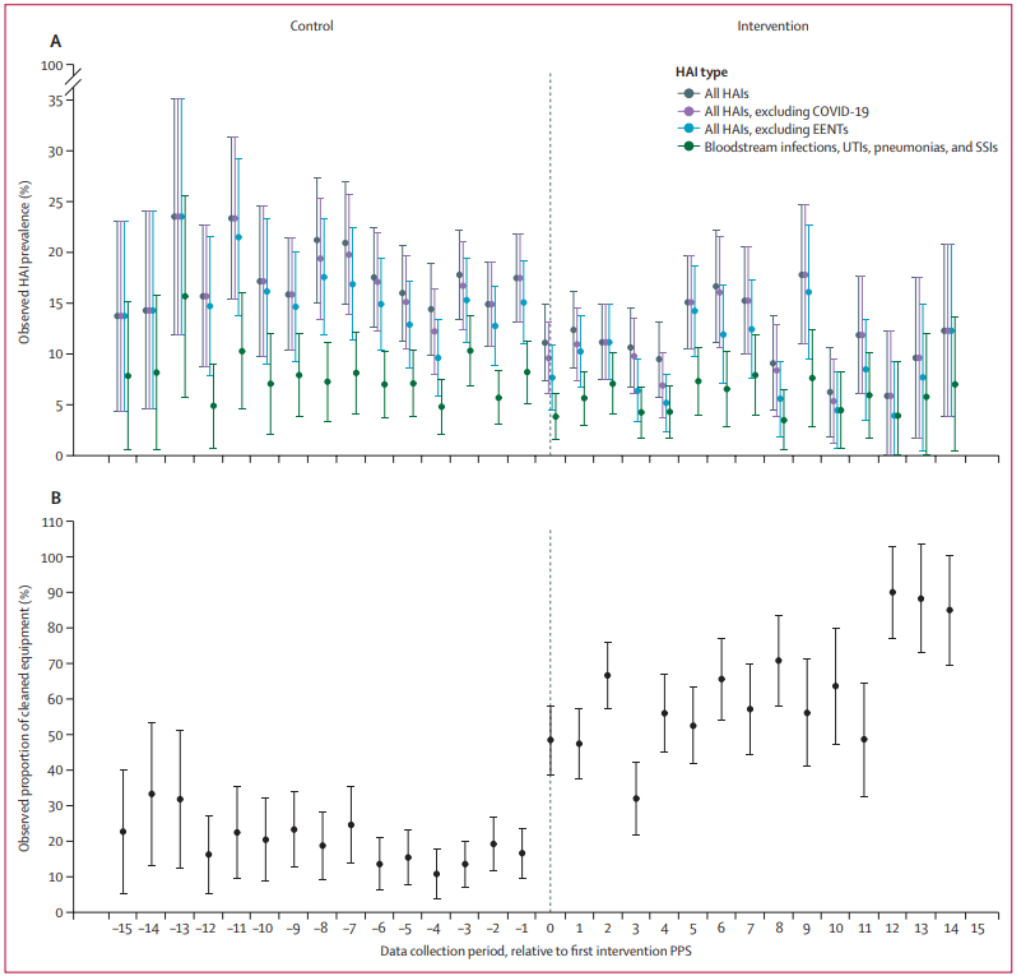
What do we call these things? “SNCOs” (shared non-critical objects)

- BP cuffs
- Clipboards
- etc.

Analysis of decontamination protocols for SNCOs from 35 acute care hospitals.



Castelli et al. J Hosp Infect 2022

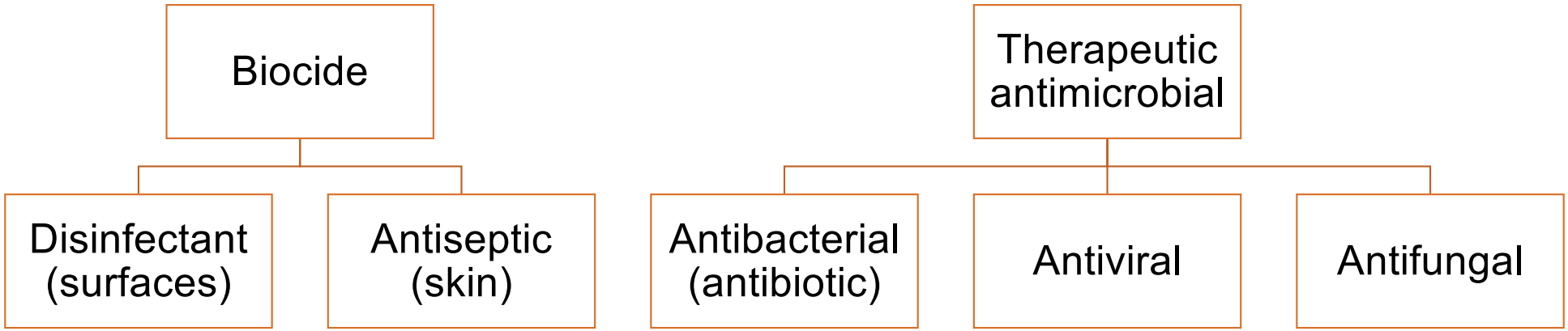


Shared medical equipment

Stepped-wedge cluster randomised controlled trial of 3 hours additional hours cleaning each day of shared mobile medical equipment.

- In adjusted results, all HAIs reduced from 14·9% (95% CI 10·4 to 19·4) in the control phase to 9·8% (6·1 to 14·1) in the intervention phase (OR 0·62, 95% CI 0·45 to 0·80; p=0·00056).
- These results correspond to an absolute difference of –5·2 percentage points (95% CI –8·2 to –2·3) and a relative difference of –34·5 percentage points (–50·3 to –17·5)

Browne et al. Lancet Infect Dis 2024.


Biocide
Disinfectant (surfaces)
Antiseptic (skin)
Therapeutic antimicrobial
Antibacterial (antibiotic)
Antiviral
Antifungal

Biocides vs. therapeutic antimicrobials

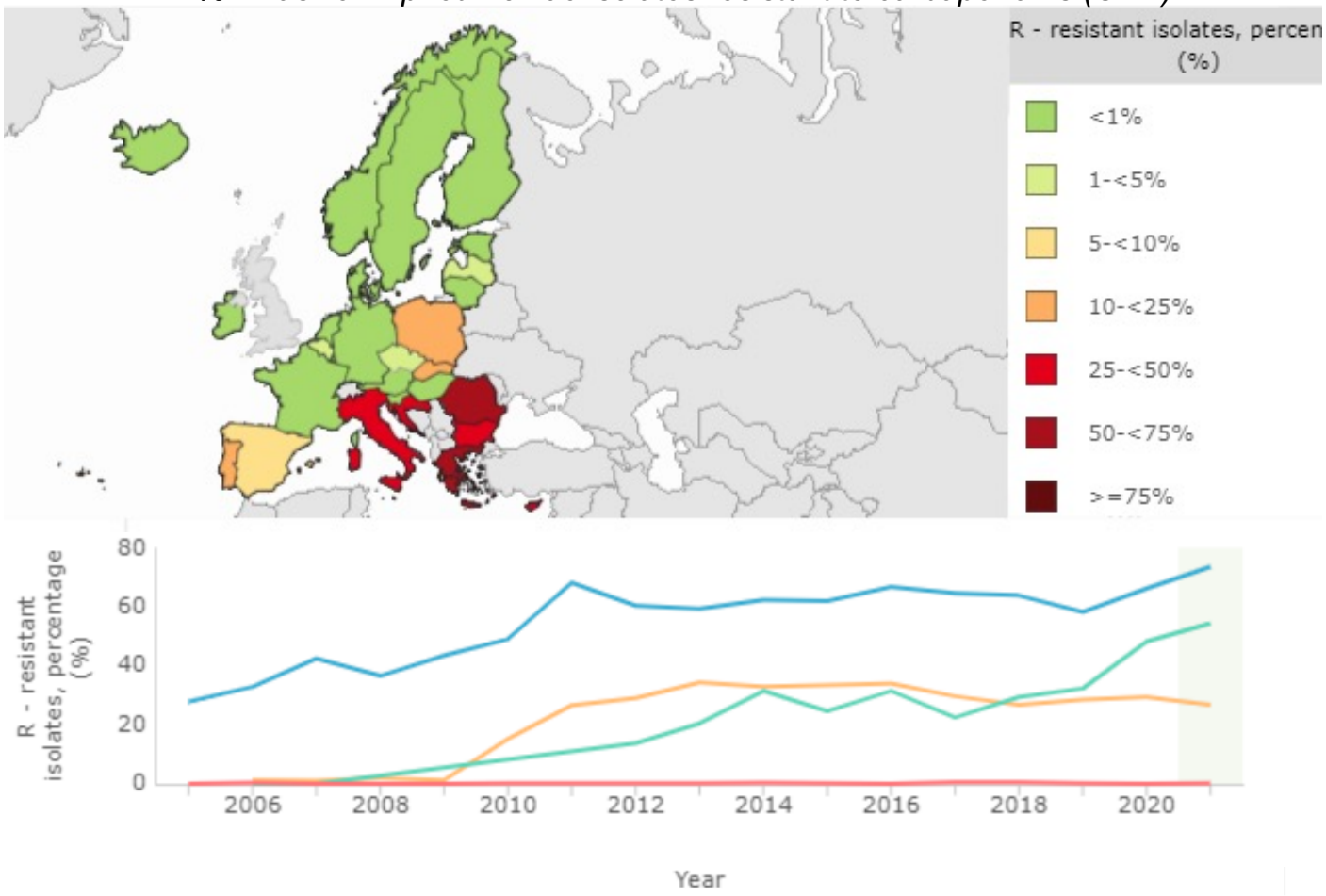
Feature	Biocide	Therapeutic antimicrobial
Mechanism of action	Multiple cellular targets	Single process or structure
“Resistance”	Tolerance or reduced susceptibility	Resistance halts therapy
Measurement of “resistance”	No agreed methodology or breakpoints	Defined methodology and breakpoints
Mechanism of “resistance”	Intrinsic or acquired	Intrinsic or acquired

Why I'm not too worried about reduced susceptibility to biocides

Biocide reduced susceptibility	Therapeutic antimicrobial resistance (AMR)
Subtle and difficult to measure	Barn door
Few examples of clinically significant issues	We are running out
Have been using for decades without "failures"	New therapeutic antimicrobials don't last long
We can "formulate our way out"	Formulation isn't a way out

Why I'm <u>really</u> worried about resistance to therapeutic antimicrobials (aka AMR)

% invasive K. pneumoniae isolates resistant to carbapenems (CRE)



ECDC 2023.

1). New technologies

- Hand-held fogging device that delivers a mist of quaternary ammonium compound
- EPA registered disinfectant
- Purchased by some Cleveland area schools

Cadnum JL. Truth in advertising? Evaluation of the FOGMASTER JR for decontamination of surfaces contaminated with MRSA and VRE. SHEA meeting.

How should we evaluate new decontamination technologies?

- Lab testing (microbiologic plausibility)
- EPA or FDA registration
- Real-world testing
  - Decrease environmental contamination
  - +/- Decrease infections
- Guidelines (CDC, SHEA, APIC)

Donskey CJ. Decontamination devices in health care facilities: Practical issues and emerging applications. Am J Infect Control 2019;47S:A23-A28.

2). Cluster of *C. difficile* infection cases on a medicine ward?

- A. “Deep” clean of rooms on the ward
- B. Case-control study to look for shared exposures
- C. Screen for asymptomatic carriage

Should we use routine real-time whole genome sequencing to guide infection prevention interventions?

- EDS-HAT (Enhanced detection system for healthcare-associated transmission)
  - Real-time sequencing of HAIs detected transmission missed by surveillance-> interventions, cost savings
    - Wound care team – VRE and *C. difficile* transmission
    - Contaminated ventilators
    - EEG equipment - MRSA

Sundermann AJ. Real-Time Genomic Surveillance for Enhanced Healthcare Outbreak Detection and Control: Clinical and Economic Impact. Clin Infect Dis 2025; Lee AS. Defining the Role of the Environment in the Emergence and Persistence of vanA VRE in an ICU: A Molecular Epidemiological Study. Infect Control Hosp Epidemiol 2018.

Can less costly and labor-intensive typing methods be used?

Date	Sample name	Ribotype
7/4/2025	4b2512	F027
7/29/2025	4b2528	F106
7/30/2025	4b2529	F002
7/16/2025	4b2517	F001
7/25/2025	4b2522	F078-126
7/31/2025	4b2531	F014-020

Multiple *C. difficile* cases on a medical ward: PCR ribotyping demonstrated that all isolates were different (no transmission)

3). Can we do more to incorporate sustainability into cleaning and disinfection?

- Healthcare - 5% percent of total CO_2 emissions (US – 9%)
- Plastics
  - Greenhouse gas emissions
  - Adverse environmental effects
- US healthcare waste/pollution -loss of ~388,000 life years

Lee PS. Greening Infection Prevention and Control: Multifaceted Approaches to a Sustainable Future. Open Forum Infect Dis 2024; Smith M. Infection Prevention, PlanetaryHealth, and Single-Use Plastics. JAMA 2023; Chung JW. Estimate of the carbon footprint of the US health care sector. JAMA 2009;302:1970-2.

Ready-to-use wipes versus chlorine-releasing tablets

Discussion: Are current healthcare cleaning guidelines sufficient to fight antimicrobial resistance spread?

Jon Otter PhD FRCPath,
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OCTOBER

2 ... Sustainable Healthcare and IPC: Can They Co-Exist? (an IFIC teleclass)
Afro-European Teleclass With Dr. Graham Pike, UK, and Profa. Dra. Camila Quartim de Moraes Bruna, Brazil

7 ... Clean Hospitals Day 2025: Human Factors and Collaboration
Afro-European Teleclass With Dr. Alexandra Peters, Switzerland, and Dr. Martina Močenić, Croatia

15 ... What Can Knowing Something About the Evolution of *Clostridium difficile* Teach Us About IPAC?
Australasian Teleclass With Prof. Thomas Riley, Australia

23 ... Discussion: Are Current Healthcare Cleaning Guidelines Sufficient to Fight Antimicrobial Resistance Spread?
With Dr. Jon Otter, UK & Dr. Curtis Donskey, US

28 ... Research Priorities to Strengthen Environmental Cleaning in Healthcare Facilities: the CLEAN Group Consensus
Afro-European Teleclass With Dr. Giorgia Gon, UK

NOVEMBER

11 ... The Use of Faecal Microbiota Transplant as Treatment for *Clostridium difficile*
Afro-European Teleclass With Simon Goldenberg, UK

13 ... Solve the LTC Outbreak!
With Steven J. Schweon

19 ... Special Lecture for World Toilet Day

DECEMBER

4 ... What's On a Surface Doesn't Stay On a Surface - The Dynamics and Risk of Microbial Resuspension From Surfaces
With Prof. Charles Gerba, US

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