IPCNC NEW ZEALAND ANNUAL CONFERENCE

Solving IPC Challenges with Chlorine Dioxide

Jincy Jerry

Infection Prevention & Control · NHS Ayrshire & Arran, Scotland

Formerly Mater Misericordiae University Hospital, Dublin


LIGHTS, CAMERA, PREVENTION!
IPCNC NEW ZEALAND ANNUAL CONFERENCE 2026

One does not simply conquer hidden microbial strongholds.

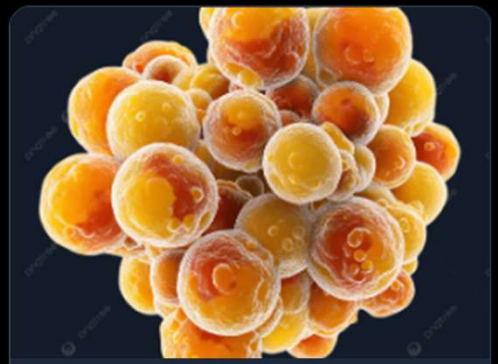
One does not simply walk into Mordor. Its Black Gates are guarded by more than just Orcs. There is evil there that does not sleep

Image Source: AI Generated

Image Source: AI Generated

Meet The Villains

MOST WANTED



S. aureus (MRSA)

"THE GOLDEN MASTERMIND"

Superpower: Biofilm creation & methicillin resistance.

Hideout: Human skin, nares, & medical lines.

HIGH RISK

C. difficile

"THE SPORE SPECIALIST"

Superpower: Indestructible endospores & potent cytotoxins.

Hideout: GI tract & dry inanimate surfaces.

SPORE THREAT

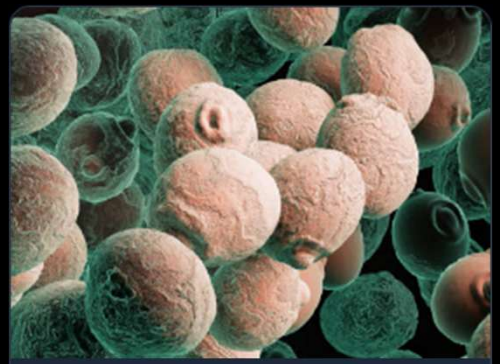
P. aeruginosa

"THE SLIME ARCHITECT"

Superpower: Massive alginate slime matrix & efflux pumps.

Hideout: Sinks, drains, & respiratory kit.

WET HAZARD



C. auris

"THE FUNGAL PHANTOM"

Superpower: Multidrug fungal resistance & persistence.

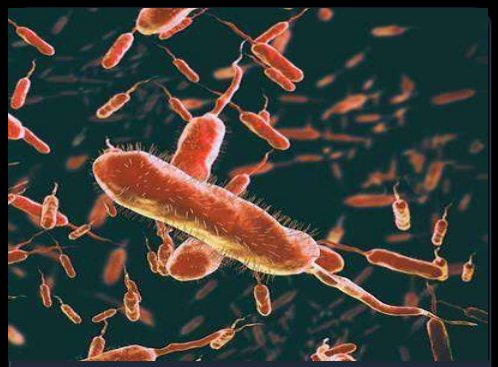
Hideout: Skin folds & healthcare furniture.

EMERGING

Image Source: pngtree.com, www.vecteezy.com, www.istockphoto.com

Meet The Villains

MOST WANTED



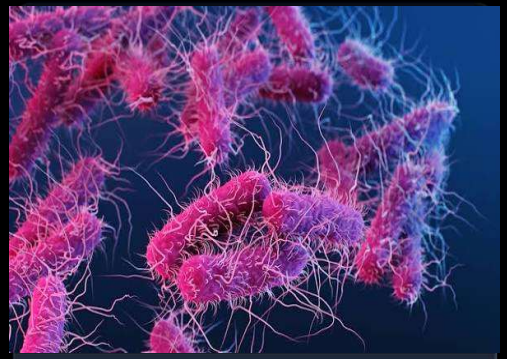
VRE

"The Tough Nut"

Superpower: Vancomycin resistance.

Hideout: GI tract & dry inanimate surfaces.

HIGH RESISTANCE



ESBL (E. coli/K. pneumoniae)

“The Shield Breaker”

Superpower: Enzymatic destruction of penicillins & cephalosporins via plasmid swapping.

Hideout: Urinary tract, gut microbiota, & shared medical equipment.

PLASMID THREAT

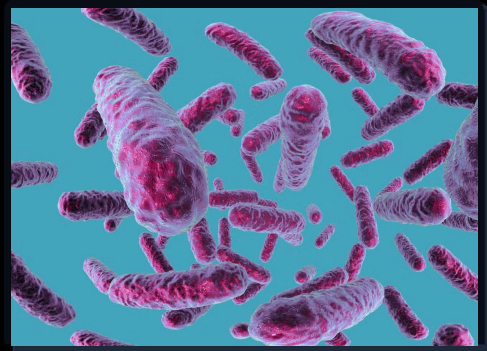
A. baumannii (CRAB)

"THE DUST SURVIVOR"

Superpower: Desiccation tolerance & rapid acquisition of multidrug resistance mechanisms.

Hideout: hospital dust, ventilator tubing, & intensive care surfaces.

PERSISTENT



CPE

“The Final Boss”

Superpower: Produces enzymes that neutralize carbapenems — our antibiotics of last resort.

Hideout: Gut microbiota, invasive devices, healthcare furniture

CRITICAL ALERT

Image Source: iStock

Meet The Hero

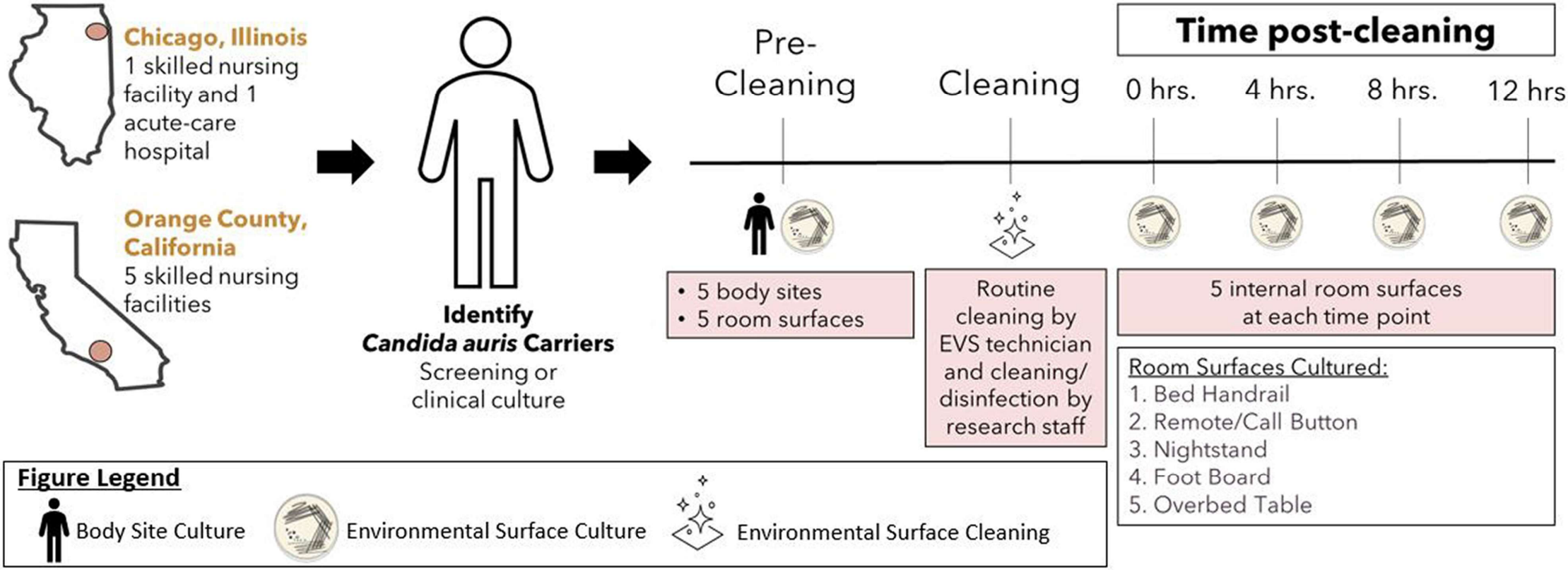
Chlorine Dioxide

Image Source: iStock


Scene 1


2022


San Francisco, California
Chicago, Illinois
0 145 290 580 870
Miles
N
W
E
S



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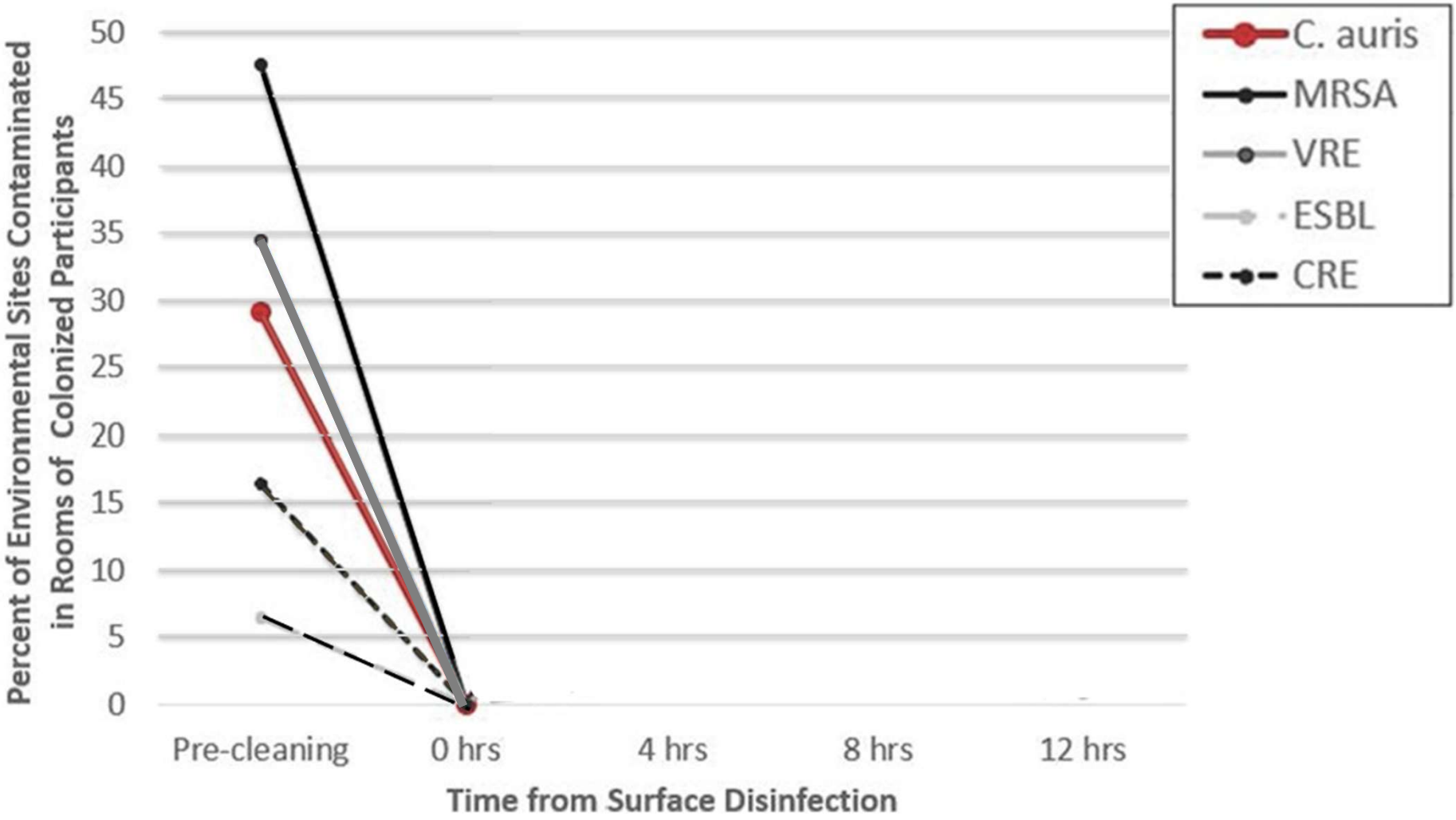

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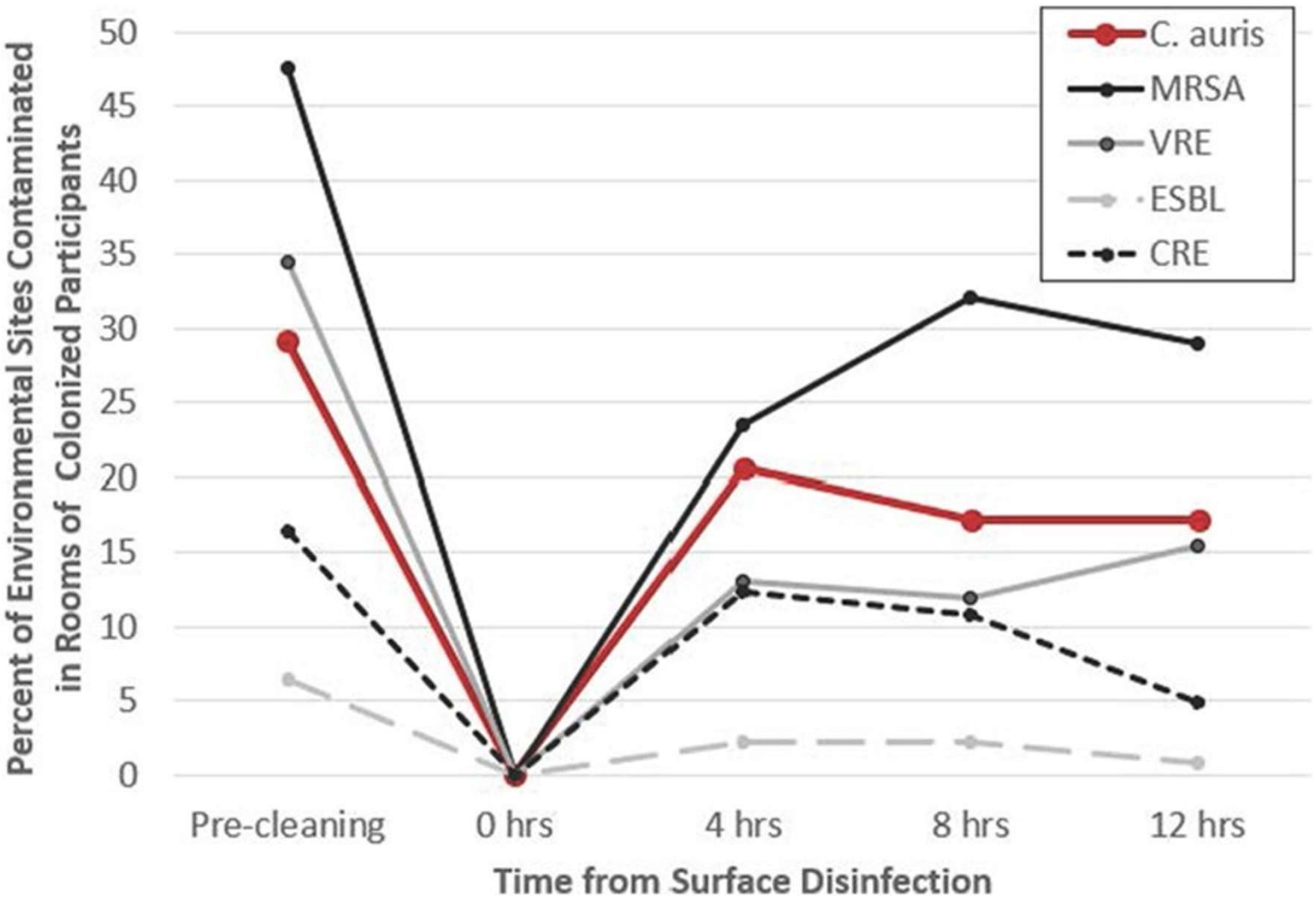


21% of room surfaces were contaminated by **4-hours post-disinfection**.

Higher number of colonized body sites was associated with higher odds of environmental contamination.

For each bacterial organism, surface contamination is evaluated among persons who were co-colonized with C. auris and that organism.

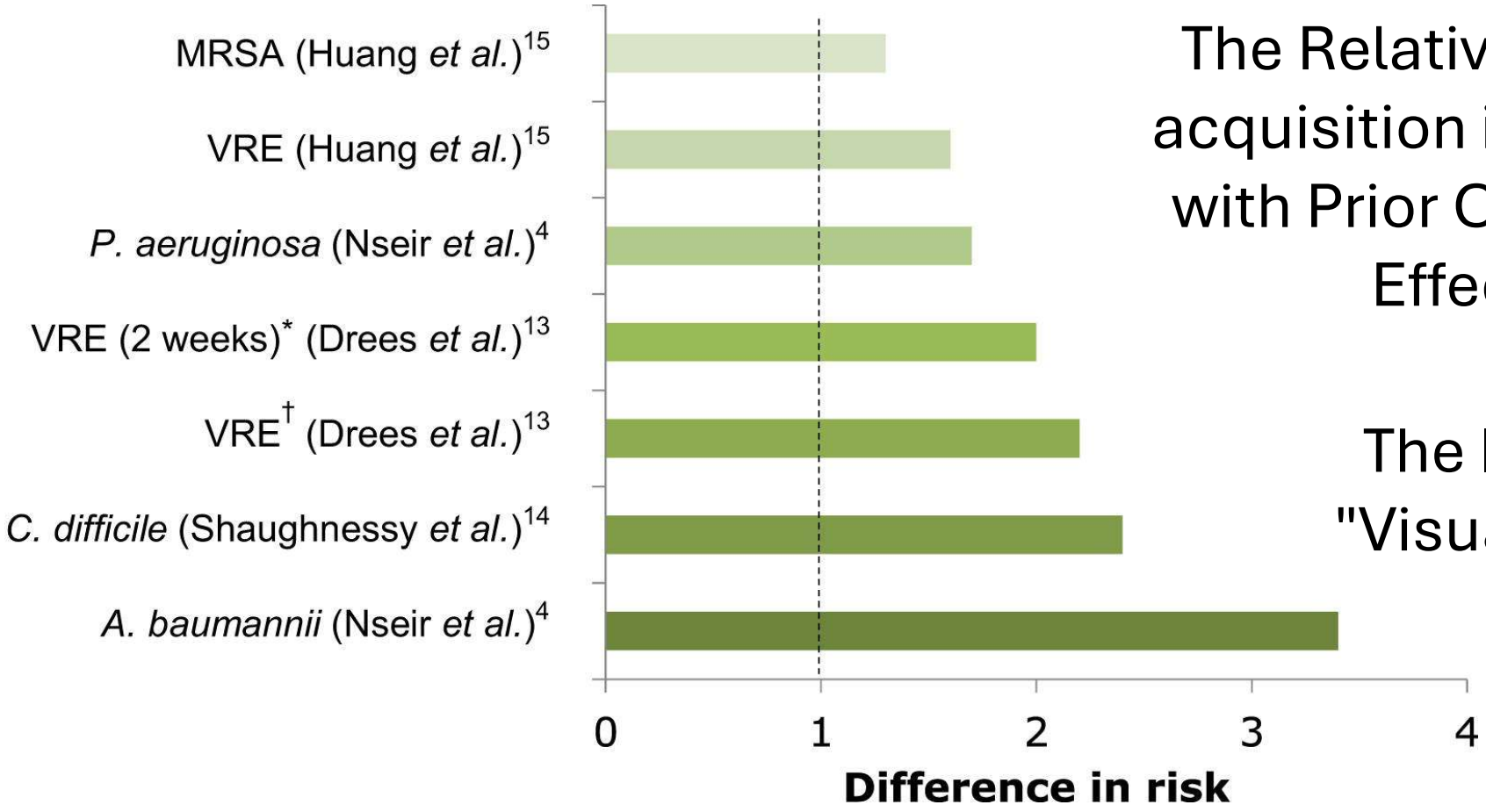
There were 28 ESBL (68%), 25 VRE (61%), 21 MRSA (51%), and 17 CRE (41%) co-colonized participants identified.

Sansom SE, Gussin GM, Schoeny M, Singh RD, Adil H, Bell P, Benson EC, Bittencourt CE, Black S, Del Mar Villanueva Guzman M, Froilan MC, Fukuda C, Barsegyan K, Gough E, Lyman M, Makhija J, Marron S, Mikhail L, Noble-Wang J, Pacilli M, Pedroza R, Saavedra R, Sexton DJ, Shimabukuro J, Thotapalli L, Zahn M, Huang SS, Hayden MK. Rapid Environmental Contamination With Candida auris and Multidrug-Resistant Bacterial Pathogens Near Colonized Patients. Clin Infect Dis. 2024 May 15;78(5):1276-1284. doi: 10.1093/cid/ciad752. PMID: 38059527; PMCID: PMC11093678.


Scene 2


HEBRIDES
Aberdeen
Glasgow
Edinburgh
North Sea
UNITED KINGDOM
Belfast
Isle of Man (U.K.)
Irish Sea
Leeds
Manche
IRELAND
Dublin
Liverpool
Birmingham
Cardiff
London
Amsterdam
NETHERLANDS
Brussels
BELGIUM
Lille
Channel
English
Celtic
DENMA

Increased risk associated with the prior room occupant.



The Relative Risk of acquisition increases with Prior Occupant Effect

The Illusion of "Visually Clean"

Otter J, Yezli S, Salkeld J ...Evidence that contaminated surfaces contribute to the transmission of hospital pathogens and an overview of strategies to address contaminated surfaces in hospital settings, American Journal of Infection Control, 41, S6-S11


Scene 2
Take 2

Surface Survival Time (Inanimate Objects)

Spore-forming bacteria, MRSA, and persistent Gram-negative species exhibit extreme tenacity on dry inanimate surfaces, demanding strict surface disinfection protocols beyond basic daily cleaning.

Otter J, Yezli S, Salkeld J ...Evidence that contaminated surfaces contribute to the transmission of hospital pathogens and an overview of strategies to address contaminated surfaces in hospital settings, American Journal of Infection Control, 41, S6-S11


Scene 2
Take 3

Transfer of pathogens from surfaces to the hands of health care personnel

Direct patient contact
45% of 50 HCP acquired MRSA on their gloved hands
50% of 30 HCP acquired Clostridium difficile on their gloved hands
Compliance with hand hygiene: 80%

Otter J, Yezli S, Salkeld J ...Evidence that contaminated surfaces contribute to the transmission of hospital pathogens and an overview of strategies to address contaminated surfaces in hospital settings, American Journal of Infection Control, 41, S6-S11


Scene 3


Michigan
Lake Erie
N.Y.
Cleveland
Pa.
Indiana
Ohio
West

Participants:

- Newly admitted patients with no known carriage

Method:

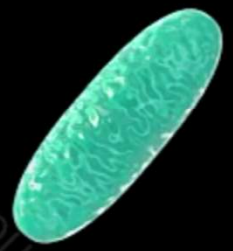
- Interactions between the participants, personnel, portable equipment
- Cultures of high-touch surfaces, floors, bedding, and patients' socks and skin

Redmond et al., 2020 Timing and Route of Contamination of Patient Rooms With Healthcare-Associated Pathogens, Cambridge University Press

Surface contamination

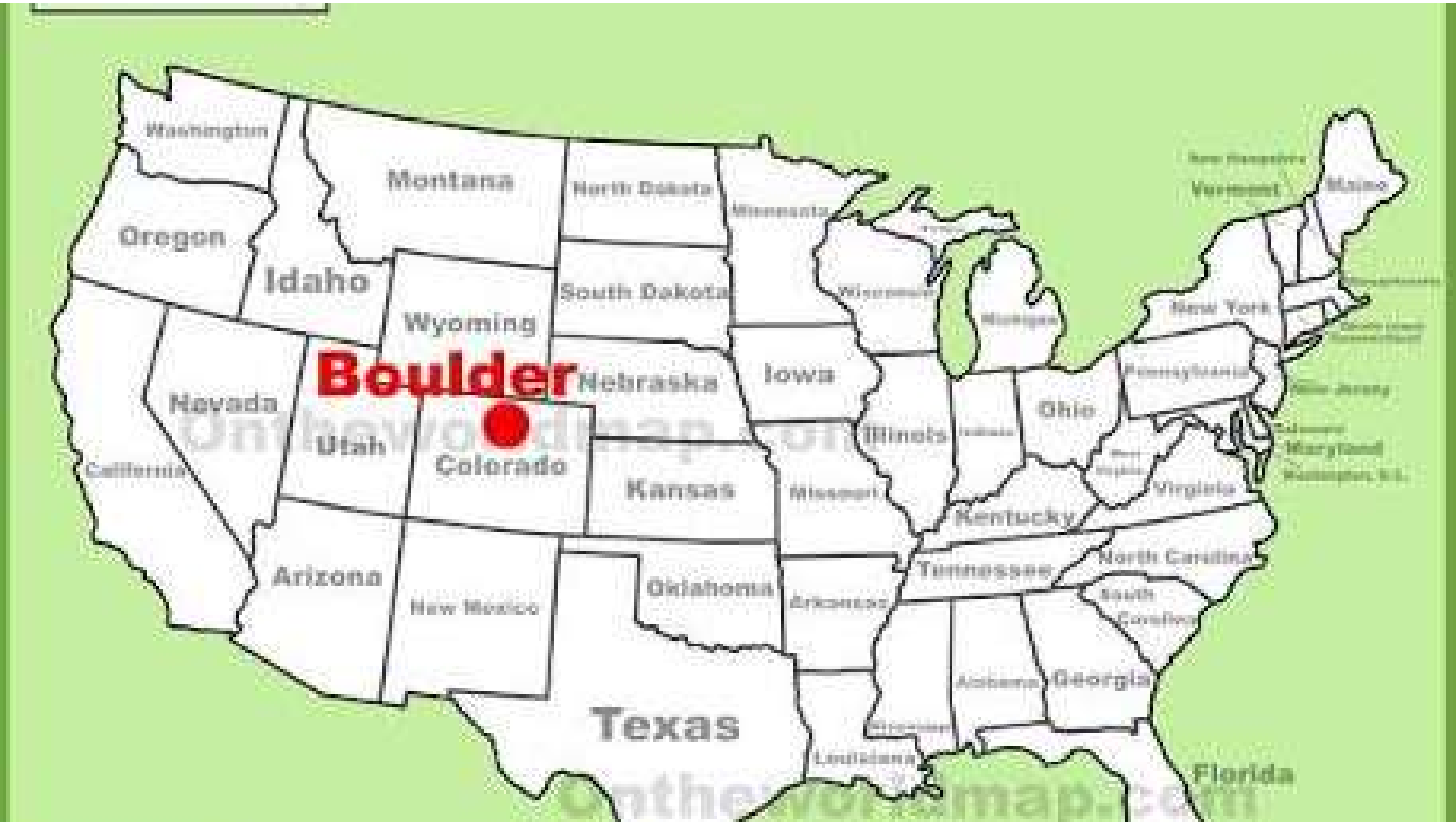
- Nearly half of rooms tested positive for **MRSA within the first 24 hours**.
- 1 or more environmental cultures became positive:

  MRSA - 59%, *C. difficile* -12% and for VRE -12%.
- MRSA contamination of the floor occurred rapidly as personnel entered the room.
- Contamination often started on the floors but ultimately moved to patients' socks, bedding and nearby surfaces.



Redmond et al., 2020 Timing and Route of Contamination of Patient Rooms With Healthcare-Associated Pathogens, Cambridge University Press


Scene 4


Boulder
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Oregon
Montana
Idaho
Wyoming
North Dakota
South Dakota
Minnesota
Nebraska
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Nevada
Utah
Colorado
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Illinois
Ohio
Michigan
New York
Pennsylvania
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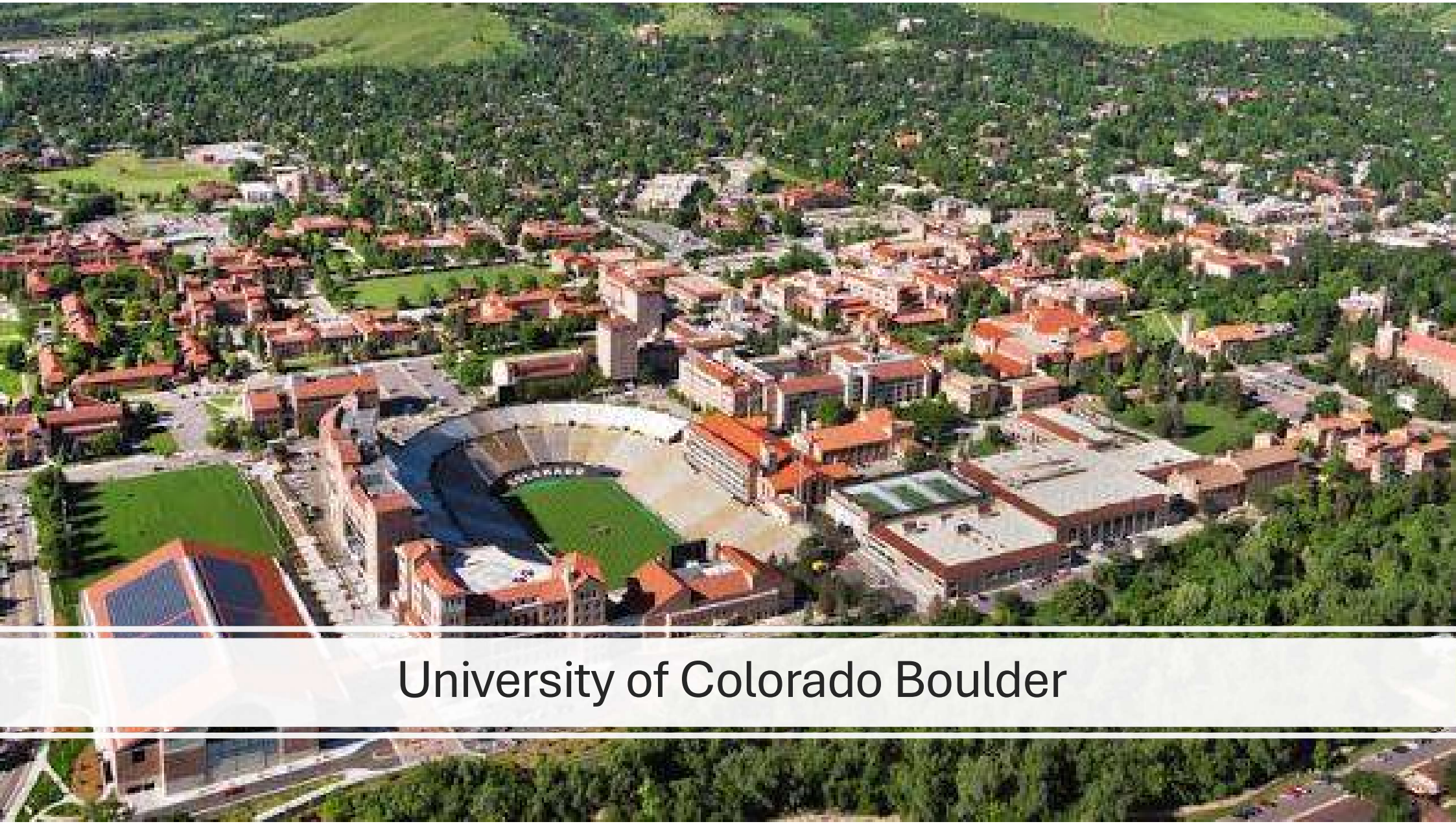
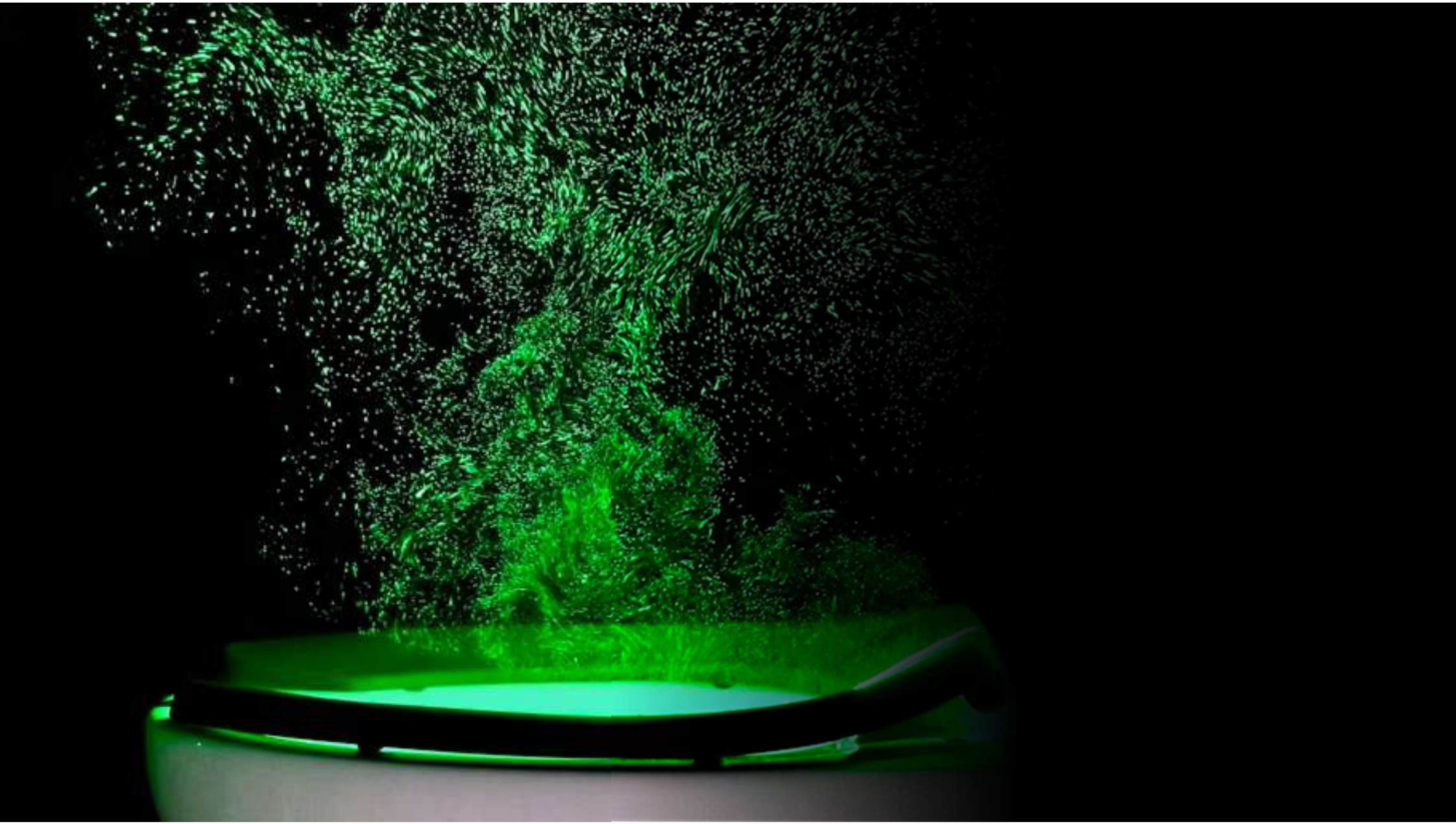
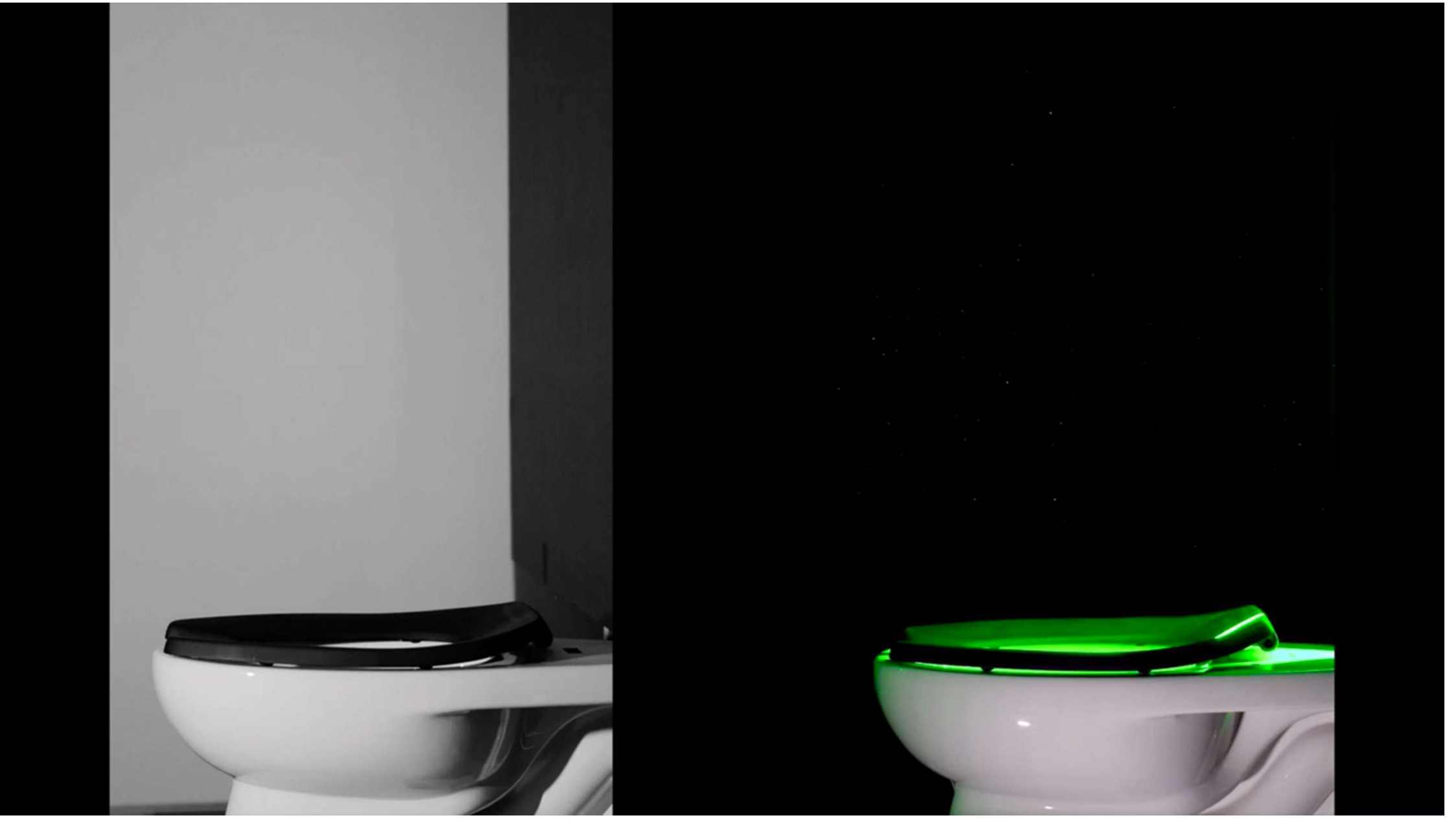
New Mexico
Oklahoma
Arkansas
Texas
Louisiana
Florida
Maine
Vermont



University of Colorado Boulder





Flushing generated a strong, turbulent upward jet with air speeds greater than 2 m/s.

The visible aerosol plume rose to roughly 1.5 m above the toilet within about 8 seconds

Larger droplets generally deposited on nearby surfaces quickly, whereas smaller aerosols—especially those below 5 micrometres—could remain suspended for minutes or longer.


Scene 5


SCOTLAND
NORTH SEA
UNITED KINGDOM
NORTHERN IRELAND
ISLE OF MAN
IRELAND
ENGLAND
Birmingham
WALES
London
CELTIC SEA
ENGLISH CHANNEL

2022

University Hospitals Birmingham in the UK

The sink splash zone

M.I. Garvey et al. / Journal of Hospital Infection 135 (2023) 154–156

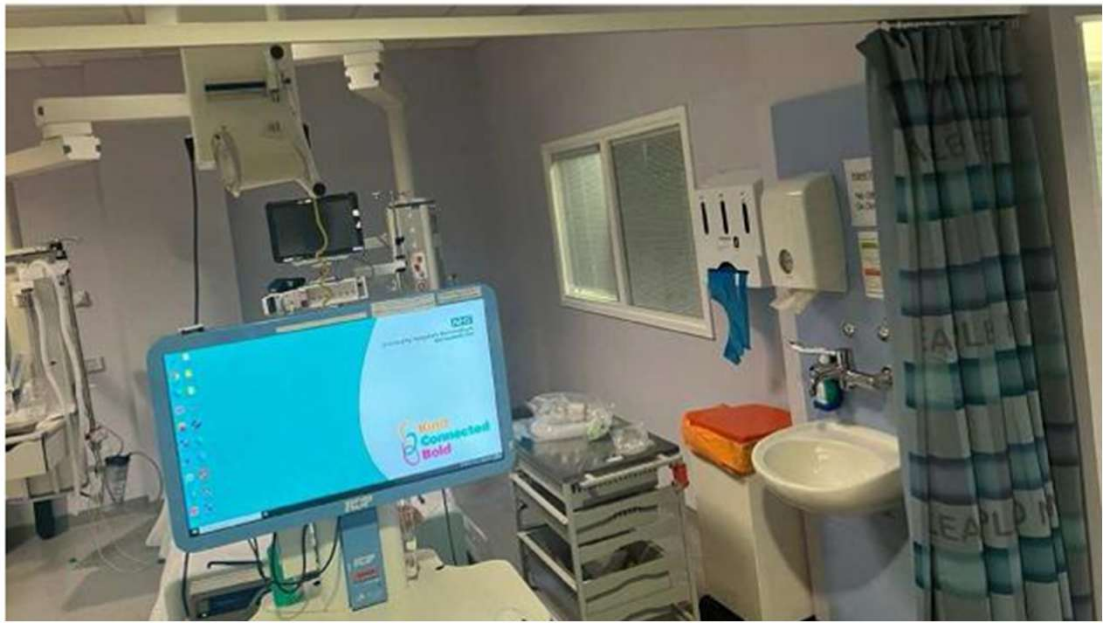
Water droplets travelled as far as 2 metres from the tap/sink - “sink splash zone.”

Splashing was more substantial after handwashing than with the tap running alone.

An unannounced audit identified many items within this zone, including IV equipment, medications, electronic devices, medical equipment and patient-care activity.

Some exposed items and patients were high risk, including immunosuppressed patients with multiple vascular lines.

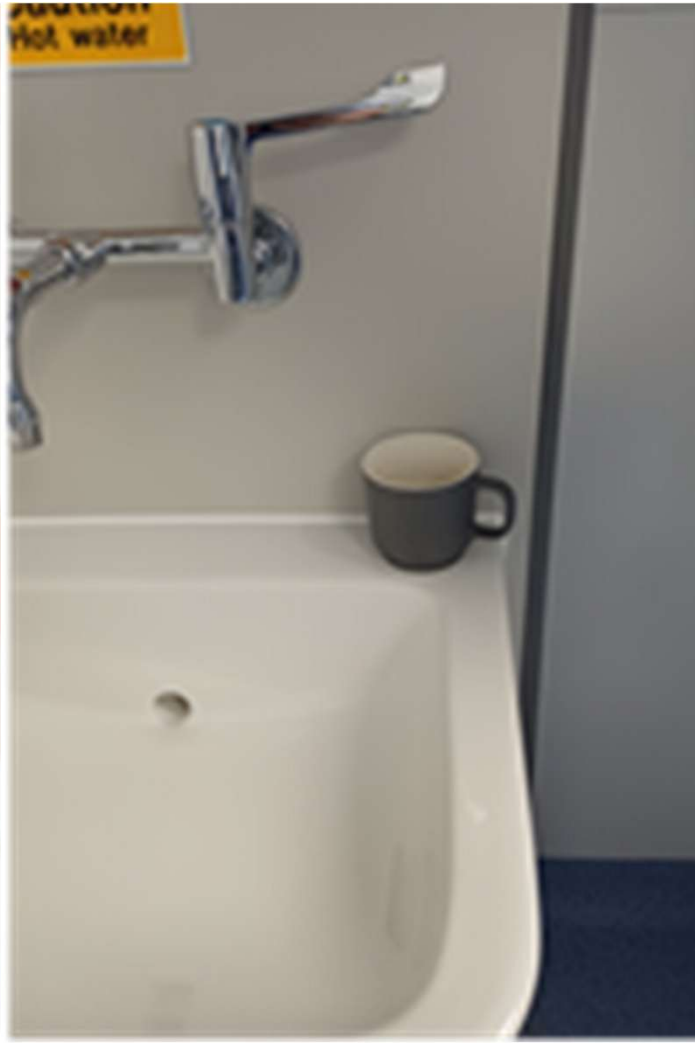
Garvey *et al*. The sink splash zone. *Journal of Hospital Infection*. 2023;135:154–156. doi:10.1016/j.jhin.2023.01.020.


Connected
Bold


CLINICAL WASTE ONLY

Patient juice and cutlery

Medicine crusher



Staff cup : CHWB -OT 11


Scene 5
Take 2

Left: air sampler setup and use with the tap running.

Right: examples of the tryptic soy agar plates and micro-organisms obtained.

Garvey M, Moran R, Wilkinson M … What grows in the sink splash zone Journal of Hospital Infection, 2026; 173, 220-224

Meet The Villains

Environmental sampling when the tap was running:

Gram-negative isolates:

Citrobacter freundii, (one carbapenemase-producing isolate - QE-SINK-CF1).
Enterobacter kobei,
Enterobacter cloacae,
Enterobacter asburiae,
P. aeruginosa
Sphingobacterium multivorum.

Other environmental organisms:

Aerobic spore-forming bacteria, skin flora and fungi (none of which were formally identified) with counts ranging from 14–38 colony forming units (cfu).

Control sampling without the tap running yielded no Gram-negative organisms.

Garvey M, Moran R, Wilkinson M ... What grows in the sink splash zone Journal of Hospital Infection, 2026; 173, 220-224


Scene 5
Take 3

Does these Villians come to New Zealand?

- **Total HAI:** 301 isolated from reported healthcare-associated infections.
- **Met MDRO definition:** 42 isolates (14%).
- **MRSA:** 8 of 63 *S. aureus* isolates (13%).
- **ESBL-positive Enterobacterales:** 28 of 120 (23%).
- **Carbapenem-resistant Enterobacterales:** 5 of 120 (~4%).
- **Combined Enterobacterales MDRO prevalence:** 33 of 120 (28%).
- **Carbapenem-resistant *Pseudomonas aeruginosa*:** 1 of 15 isolates.
- **VRE:** 0 of 36 enterococcal isolates.

N. Grae, A. Singh, D. Jowitt, A. Flynn, E. Mountier, G. Clendon, R. Barratt, B. Gibson, C. Williams, S.A. Roberts, A.J. Morris, Prevalence of healthcare-associated infections in public hospitals in New Zealand, 2021, Journal of Hospital Infection, Volume 131, 2023, Pages 164-172, ISSN 0195-6701, https://doi.org/10.1016/j.jhin.2022.10.002

2023

News / Health 23 June 2023, 5:14pm

Cases of contagious bacterial infection reported at Waikato Hospital

2025

News / Health 18 November 2025, 7:02pm

Infectious diseases researcher says superbug VRE makes one in 10 sick

Does these Villians come to New Zealand?

- 8% of the 5,468 patients surveyed had a recorded MDRO or *Clostridioides difficile* alert.
- ESBL-positive organisms at 4.4% (243 patients)
- MRSA at 3.4% (188 patients)
- The study authors describe the MDRO proportion as a **minimum estimate**, because susceptibility results were unavailable for some isolates and the survey was not designed as a national colonisation-screening study.

N. Grae, A. Singh, D. Jowitt, A. Flynn, E. Mountier, G. Clendon, R. Barratt, B. Gibson, C. Williams, S.A. Roberts, A.J. Morris, Prevalence of healthcare-associated infections in public hospitals in New Zealand, 2021, Journal of Hospital Infection, Volume 131, 2023, Pages 164-172, ISSN 0195-6701, https://doi.org/10.1016/j.jhin.2022.10.002

Does anyone is helping these Villians?

Slido.com
#IPC

After discharge or transfer of a patient with an MDRO, does your organisation have a specific terminal-cleaning policy or SOP?

Following discharge of a patient with Clostridioides difficile infection, what product is used for terminal cleaning in your facility?

Who prepares chlorine disinfectant solutions in your organisation?

For terminal cleaning following discharge of a patient with Clostridioides difficile infection, which combination of chlorine concentration and contact time is used in your organisation?

Microbiological properties

Claim/Conditions	Concentration	Contact time
Dirty Conditions		
Bactericidal according to EN 13727/EN 16615	1000 ppm (1 tab/l)	5 min
Yeasticidal according to EN 13624/EN 16615	1000 ppm (1 tab/l)	5 min
Fungicidal according to EN 13624	10000 ppm (10 tab/l) 5000 ppm (5 tab/l)	5 min 15 min
Tuberculocidal/mycobactericidal according to EN 14348	5000 ppm (5 tab/l)	15 min
Virucidal according to EN 14476	1000 ppm (1 tab/l)	5 min
Sporicidal against C. difficile according to EN 17126	10000 ppm (10 tab/l) 5000 ppm (5 tab/l)	5 min 15 min
Sporicidal according to EN 17126	10000 ppm (10 tab/l)	15 min

Do you routinely verify chlorine concentration after preparation?

How confident are you that the chlorine concentration prepared on your ward matches the intended concentration?


Scene 5
Take 3

WHY CONCENTRATION MATTERS MORE THAN WE THINK

Getting it right protects patients, staff and equipment.

TOO LOW
Disinfection is ineffective – pathogens can persist

JUST RIGHT
Effective disinfection for safer care

TOO HIGH
Risks to staff, damage to equipment and surfaces

GET IT RIGHT
Correct dilution, training and monitoring make the difference

A UK audit of NaDCC solutions prepared on wards (target 1000 ppm) found:

RANGED FROM **40 ppm** to **3720 ppm**

AROUND **2/3** WERE BELOW TARGET

AVERAGE **575 ppm** ONLY A SMALL MINORITY WERE IN RANGE

KEY TAKEAWAY: We can't take disinfectant concentration for granted. Measure it. Monitor it. Get it right. Every time.

Garvey M, Offorbuzor F, Wilkinson M … Chlorine in cleaning – are we concentrating enough? Journal of Hospital Infection, 2024; 155, 37-39/


Scene 6


antic
cean
Belfas
IRELAND
Dublin
Irish
Sea
Isle
of
Man
(U.K.)
Liverpool
UNI
KIN

The Mater Misericordiae University Hospital

Average Activity

- **24,437 inpatients**
- **68,347 day patients**
- **239,815 outpatients**
- **87,410 emergency department visits**

825 beds	**206 day beds**
16 Operating Theatres	**HLIU**
26 negative pressure **33 PPVL rooms**	**36 ICU + 41 HDU beds** **(12 negative pressure + 10 PPVL)**

Reflecting on 2019.....

- Carbapenemase-Producing Enterobacteriaceae (CPE) outbreak – ongoing since 2017
- VRE outbreak – oncology unit
- Norovirus Outbreak
- C Diff outbreak – multiple wards

Cleaning Policy at the Mater 2019

- Sodium hypochlorite
- Vaporized Hydrogen Peroxide (VHP) for all Carbapenemase-Producing Organism

Challenges

- Cost : €60,000 per annum
- Bed delays – blocked beds awaiting VHP cleaning
- Inconvenience and increased delay at weekend

EU Point Prevalence Survey 2017

	Mater 2017	All hospitals 2017
Number of patients surveyed	570	10,333
Number with HAI	75 13.2%	633 6.1%
HAI attributed to current hospital	64 11.2%	

Key Human Factors Affecting Hospital Cleaning

1. Staff Turnover and Training Gaps

High turnover among environmental services (EVS) staff.

Lack of formal training programs

Poor adherence to cleaning protocols

2. Time Pressure and Workload

EVS staff often face **tight schedules**, limiting the time available for thorough cleaning.

Cleaning is deprioritized when staff are overburdened or when patient turnover is high

3. Inconsistent Use of Disinfectants

Improper selection, dilution, or application of cleaning agents reduces effectiveness.

4. Communication and Organizational Culture

Poor communication between EVS staff and clinical teams.

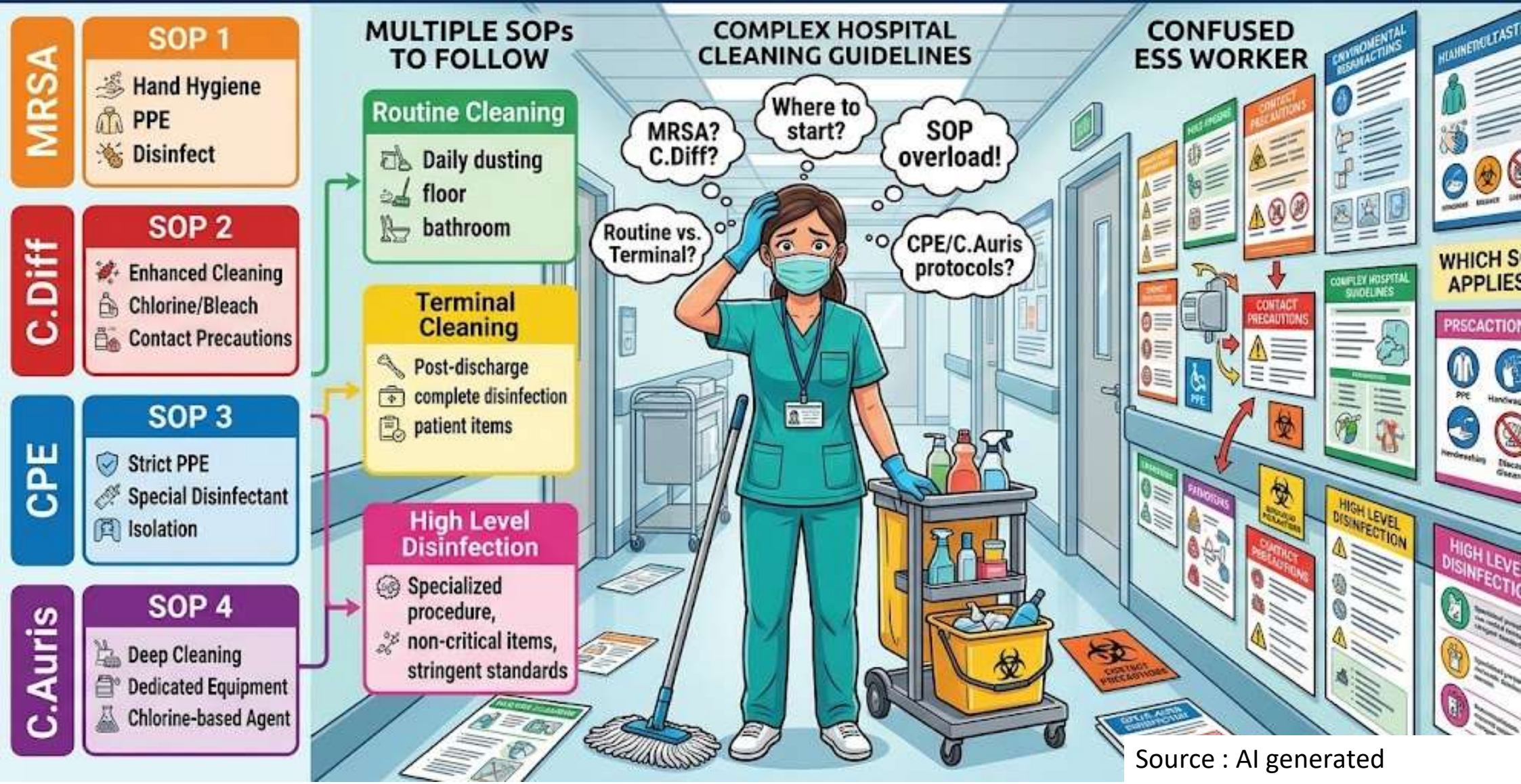
Lack of recognition and integration of cleaning staff

5. Environmental and Physical Constraints

Multibed rooms and occupied patient areas are harder to clean effectively.

Physical layout and patient movement patterns influence cleaning feasibility

CONFUSION AMIDST CRITICAL HOSPITAL CLEANING SOPs

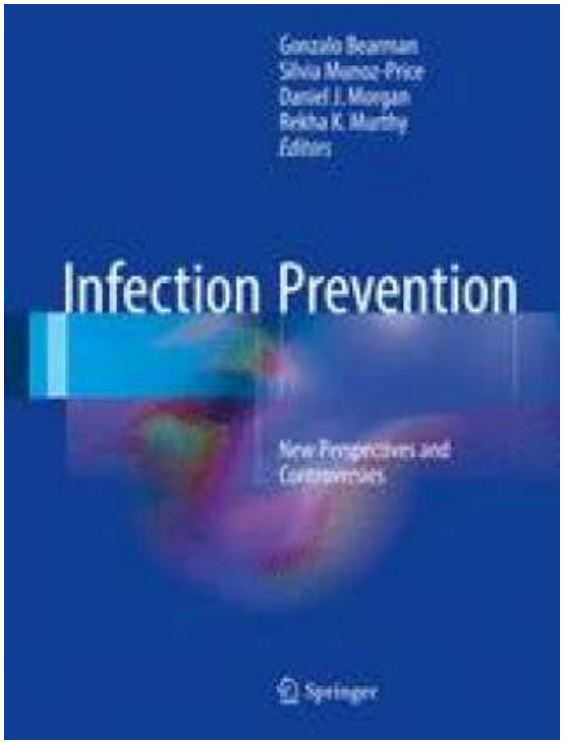


Source : AI generated

"What did you do today?"

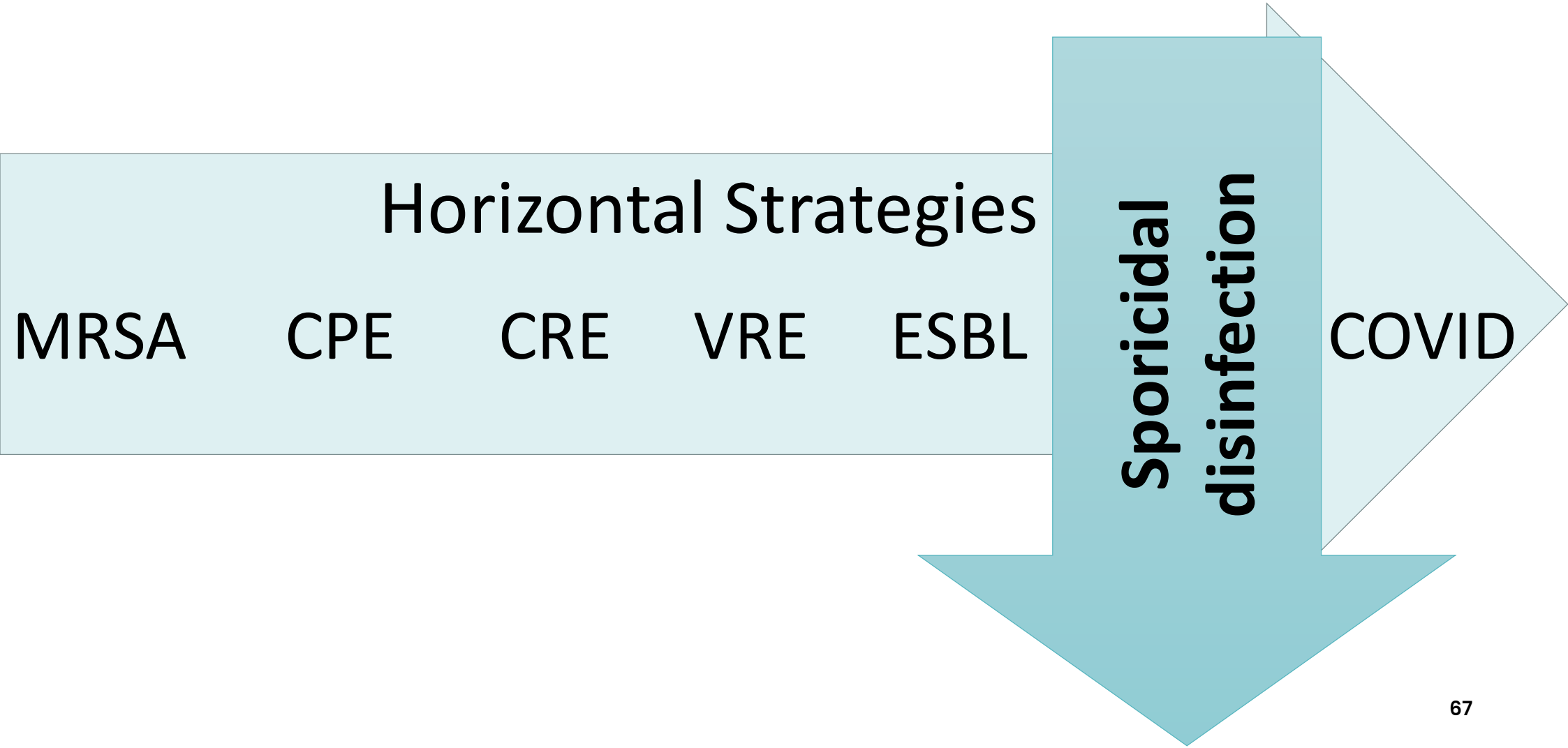
Me: Survived, I survived.

Vertical Versus Horizontal Infection Control Interventions



Abbas, S.M., Doll, M., Stevens, M.P. (2018). Vertical Versus Horizontal Infection Control Interventions. In: Bearman, G., Munoz-Price, S., Morgan, D., Murthy, R. (eds) Infection Prevention. Springer, Cham. https://doi.org/10.1007/978-3-319-60980-5_18

Vertical Versus Horizontal Infection Control Interventions



MICROBIOLOGY

RESEARCH ARTICLE

Ahmed and Joshi, *Microbiology* 2023;169:001418

DOI 10.1099/mic.0.001418

MICROBIOLOGY SOCIETY

OPEN ACCESS

Clostridioides difficile spores tolerate disinfection with sodium hypochlorite disinfectant and remain viable within surgical scrubs and gown fabrics

Humaira Ahmed[1] and Lovleen Tina Joshi[2,*]

Abstract

Clostridioides difficile is the most common cause of antibiotic-associated diarrhoea globally. Its spores have been implicated in the prevalence of *C. difficile* infection due to their resistance and transmission ability between surfaces. Currently, disinfectants such as chlorine-releasing agents (CRAs) and hydrogen peroxide are used to decontaminate and reduce the incidence of infections in clinical environments. Our previous research demonstrated the ability of *C. difficile* spores to survive exposure to recommended concentrations of sodium dichloroisocyanurate in liquid form and within personal protective fabrics such as surgical gowns; however, the present study examined the spore response to clinical in-use concentrations of sodium hypochlorite. Spores were exposed to a 10 min contact time of 1000, 5000 and 10 000 p.p.m. sodium hypochlorite, and spore recovery was determined. To understand whether biocide-exposed spores transmitted across clinical surfaces *in vitro*, biocide-exposed spores were spiked onto surgical scrubs and patient gowns and recovery was determined by a plate transfer assay. Scanning electron microscopy was used to establish if there were any morphological changes to the outer spore coat. The results revealed that viable biocide-exposed *C. difficile* spores can be recovered from surgical scrubs and patient gowns, with no observable changes to spore morphology, highlighting the potential of these fabrics as vectors of spore transmission. This study demonstrates that alternative strategies should be urgently sought to disinfect *C. difficile* spores to break the chain of transmission in clinical environments.

INTRODUCTION

Clostridioides difficile is a Gram-positive, anaerobic, spore-forming bacterium and the primary aetiological agent of antibiotic-associated diarrhoea globally [1]. Exposure to antibiotics has been shown to disrupt the colonic microbiota of the gut which permits *C. difficile* colonization in 4% of adults and 15–70% of infants [2]. Therefore, the spectrum of *C. difficile* infection (CDI) varies from asymptomatic carriage, mild or severe diarrhoea to life-threatening pseudomembraneous colitis, toxic megacolon and death [3, 4]. CDI causes ~29 000 deaths per year in the USA and 8382 deaths per year in Europe, with current data showing that the incidence of CDI was increasing prior to the start of the COVID-19 pandemic in the UK [5, 6]. While the cause of increased CDI during this period is currently a source of debate, these data confirm that *C. difficile* is still very much present within healthcare environments.

Patients with CDI are usually treated with antibiotics such as metronidazole, vancomycin and fidaxomicin [7]. Recent studies, however, have established antibiotic resistance within *C. difficile*; concerningly, plasmid-mediated metronidazole resistance (pMETRO plasmid) has been found and fluoroquinolone-resistant *C. difficile* has been found to be directly associated with metronidazole resistance [8, 9]. Currently research into vancomycin resistance is being explored, and recently *in vivo* resistance to fidaxomicin has been described [10, 11]. The implications of antibiotic resistance in *C. difficile* are significant and include increased infection incidence, mortality and transmission of *C. difficile*. Another factor affecting *C. difficile* spore transmission

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PUBLIC AND ENVIRONMENTAL HEALTH MICROBIOLOGY

Biocide Resistance and Transmission of *Clostridium difficile* Spores Spiked onto Clinical Surfaces from an American Health Care Facility

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ABSTRACT *Clostridium difficile* is the primary cause of antibiotic-associated diarrhea globally. In unfavorable environments, the organism produces highly resistant spores which can survive microbicidal insult. Our previous research determined the ability of *C. difficile* spores to adhere to clinical surfaces, finding that spores had markedly different hydrophobic properties and adherence abilities. Investigation into the effect of the microbicide sodium dichloroisocyanurate on *C. difficile* spore transmission revealed that sublethal concentrations increased spore adherence without reducing viability. The present study examined the ability of spores to transmit across clinical surfaces and their response to an in-use disinfection concentration of 1,000 ppm of chlorine-releasing agent sodium dichloroisocyanurate. In an effort to understand if these surfaces contribute to nosocomial spore transmission, surgical isolation gowns, hospital-grade stainless steel, and floor vinyl were spiked with 1×10^6 spores/ml of two types of *C. difficile* spore preparations: crude spores and purified spores. The hydrophobicity of each spore type versus clinical surface was examined via plate transfer assay and scanning electron microscopy. The experiment was repeated, and spiked clinical surfaces were exposed to 1,000 ppm sodium dichloroisocyanurate at the recommended 10-min contact time. Results revealed that the hydrophobicity and structure of clinical surfaces can influence spore transmission and that outer spore surface structures may play a part in spore adhesion. Spores remained viable on clinical surfaces after microbicide exposure at the recommended disinfection concentration, demonstrating ineffectual sporicidal action. This study showed that *C. difficile* spores can transmit and survive between various clinical surfaces despite appropriate use of microbicides.

IMPORTANCE *Clostridium difficile* is a health care-acquired organism and the causative agent of antibiotic-associated diarrhea. Its spores are implicated in fecal to oral transmission from contaminated surfaces in the health care environment due to their adherent nature. Contaminated surfaces are cleaned using high-strength chemicals to remove and kill the spores; however, despite appropriate infection control measures, there is still high incidence of *C. difficile* infection in patients in the United States. Our research examined the effect of a high-strength biocide on spores of *C. difficile* which had been spiked onto a range of clinically relevant surfaces, including isolation gowns, stainless steel, and floor vinyl. This study found that *C. difficile* spores were able to survive exposure to appropriate concentrations of biocide, highlighting the need to examine the effectiveness of infection control measures to prevent spore transmission and to consider the prevalence of biocide resistance when decontaminating health care surfaces.

KEYWORDS *Clostridium difficile*, biocide, public health, spores, surfaces, survival,

Citation Dyer C, Hutt LP, Burky R, Joshi LT. 2019. Biocide resistance and transmission of *Clostridium difficile* spores spiked onto clinical surfaces from an American health care facility. Appl Environ Microbiol 85:e01090-19. https://doi.org/10.1128/AEM.01090-19.

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The Growing IPC Challenge

1 Emerging pathogens

New and re-emerging organisms with unknown environmental behaviour

2 Healthcare-associated infections

Persistent HCAI burden across acute and community settings

3 AMR pressures

Resistance narrowing the margin for error in prevention

4 Reduced staffing resources

Fewer hands, less time for decontamination tasks

5 Faster patient turnover

Shorter windows between patients for reprocessing

6 Environmental contamination

Surfaces and shared equipment as reservoirs for transmission

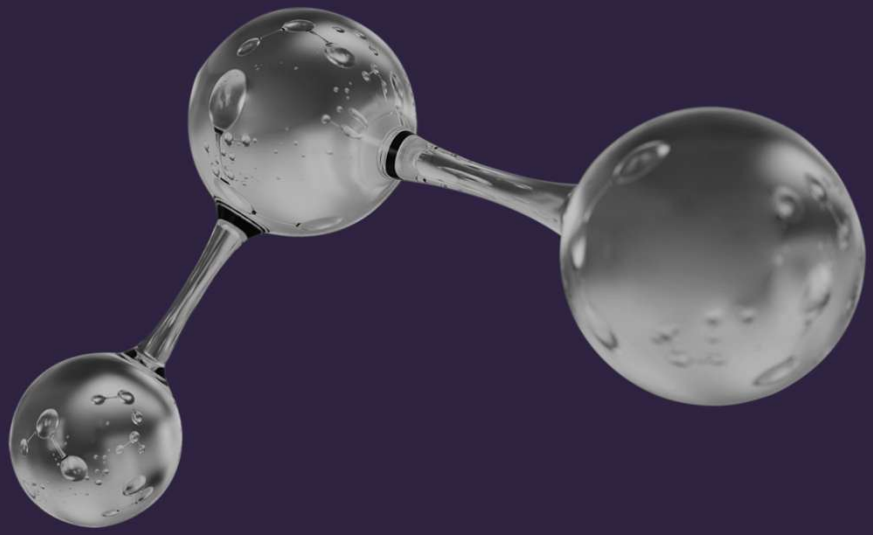
What characteristics should a disinfectant have to meet modern IPC needs?

What IPC Teams Need

- **Broad-spectrum efficacy** Bacteria, viruses, fungi, mycobacteria and spores
- **Fast action** Contact times that fit the clinical window
- **Resistance stewardship** Does not contribute to AMR
- **Simplicity** Few steps, little room for user error
- **Safety** Protective of staff, patients and the environment
- **Material compatibility** Protects the lifespan of costly devices

Chemistry	Total Oxidation Capacity	Oxidation/ corrosion potential (V)	Disinfection level	Contact time	Safety for daily usage as a standard cleaning product
Sodium Hypochlorite (Bleach)	2e-	1.48	Sporicidal - full spectrum*	Variable contact times based on active concentration	Unwanted side-reactions risk making chloroform which is a strong carcinogen ✖
Hydrogen Peroxide	2e-	1.78	Sporicidal - full spectrum*	Variable contact times based on active concentration	Concentrated peroxide solutions are highly corrosive ✖
Peracetic acid	2e-	1.76	Sporicidal - full spectrum*	Variable contact times based on active concentration	By-products of acetic acid, water, and oxygen are formed ✖
Chlorine Dioxide	5e-	0.95	Sporicidal - full spectrum*	Fast-acting (≤5 mins)	By-products of water. sodium citrate and a sr amount of salt are formed ✓

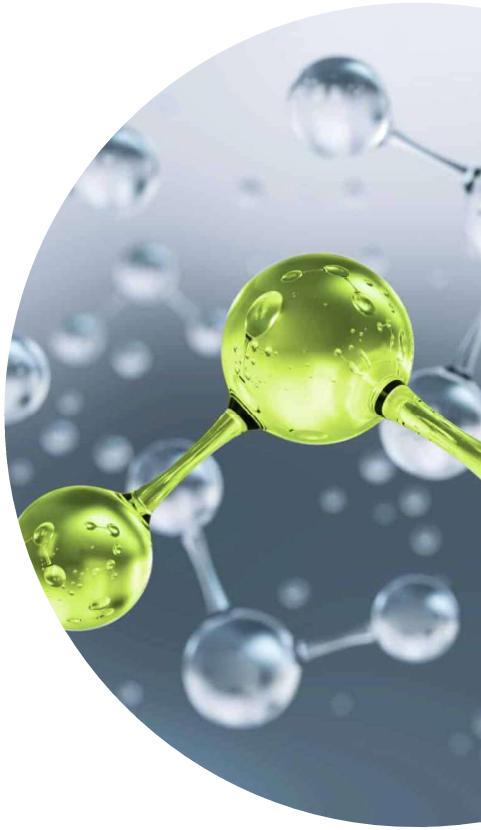
Chemistry	Total Oxidation Capacity	Oxidation/ corrosion potential (V)	Disinfection level	Contact time	Safety for daily usage as a standard cleaning product
Ethanol/ Isopropanol	N/A	N/A	Low-level biocidal (Bacteria, yeast, enveloped viruses and some fungi) **Non-sporicidal**	Variable contact times based on microorganism	Highly volatile and flammable ✖
Quaternary ammonium salts (Benzalkonium chloride)	N/A	N/A	Low-level biocidal (Bacteria, yeast, enveloped viruses and some fungi) **Narrow spectrum** **Non-sporicidal**	Variable contact times based on active concentration	Poses an increased risk of microbial resistance ✖



Chlorine Dioxide

What is Chlorine Dioxide and how does it work?

- **Chlorine dioxide is a molecule comprised of two oxygen atoms bonded to one chlorine atom – ClO_2**
- **Highly effective at low concentrations compared with alternative oxidising agent**
- **Destroys the ability of the cell to function normally -> Cell Death**



Chlorine Dioxide Trial @Mater

Oct 2019

- Three months Trial
- Oncology ward
- VRE and Cdiff outbreak

Nov 2019

- Extended trial
- ICU
- Longstanding CPE outbreak (2017)

- No new HCAI VRE & Cdiff for 3 months in Oncology ward
- No new HCAI CPE for two months in ICU
- Hospital roll out in Feb 2020

29th Feb 2020

- First COVID case in Ireland
- ? Chlorine Dioxide Vs Sodium Hypochlorite
- ? Conduct a research
- If we find COVID in common area??

Journal of Hospital Infection 105 (2020) 589–592

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevier.com/locate/jhin

Short Report

Do established infection prevention and control measures prevent spread of SARS-CoV-2 to the hospital environment beyond the patient room?

J. Jerry*, E. O'Regan, L. O'Sullivan, M. Lynch, D. Brady

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Environmental Decontamination

Mater Misericordiae University Hospital, Dublin — June 2020

AIM

- Assess environmental contamination during the COVID-19 pandemic
- Evaluate the impact of environmental cleaning using Tristel Fuse for Surfaces

KEY FINDINGS

- 42.3% of patient-area surfaces contaminated before cleaning
- 3% contamination outside patient rooms
- Contamination reduced to 4% following cleaning
- The one remaining positive result occurred on a damaged item

SARS-CoV-2 POSITIVE SURFACE SWABS

42.3% → **4%**

Patient-area surfaces BEFORE cleaning

AFTER cleaning with Tristel Fuse for Surfaces

TAKEAWAY

Effective environmental cleaning protocols using chlorine dioxide chemistry significantly reduced environmental contamination from an emerging pathogen of concern.

Jerry, O'Regan, O'Sullivan, Lynch & Brady, Mater Misericordiae University Hospital, June 2020


Scene 6
Take 2

Four successful years with NO Cdiff, CPE, VRE, Norovirus outbreak

EU Point Prevalence Survey 2023 vs 2017

	Mater 2017	All hospitals 2017	Mater 2023	Model 4 hospital 2023	All Hospital 2023
Number of patients surveyed	570	10,333	565	5420	12472
Number with HAI	75 13.2%	633 6.1%	47 8.3%	486 9.0%	932 7.5%
HAI attributed to current hospital	64 11.2%		40 7.1%		

Disinfectant Selection

Why IPC Programs Fail

Failure is rarely a single event. It is usually the accumulation of small, practical compromises made under pressure.

1. **Workflow complexity**
   Multi-step processes invite shortcuts

2. **Inadequate cleaning**
   Soiling shields organisms from the disinfectant

3. **Inappropriate disinfectant selection**
   Chemistry mismatched to the organism or device

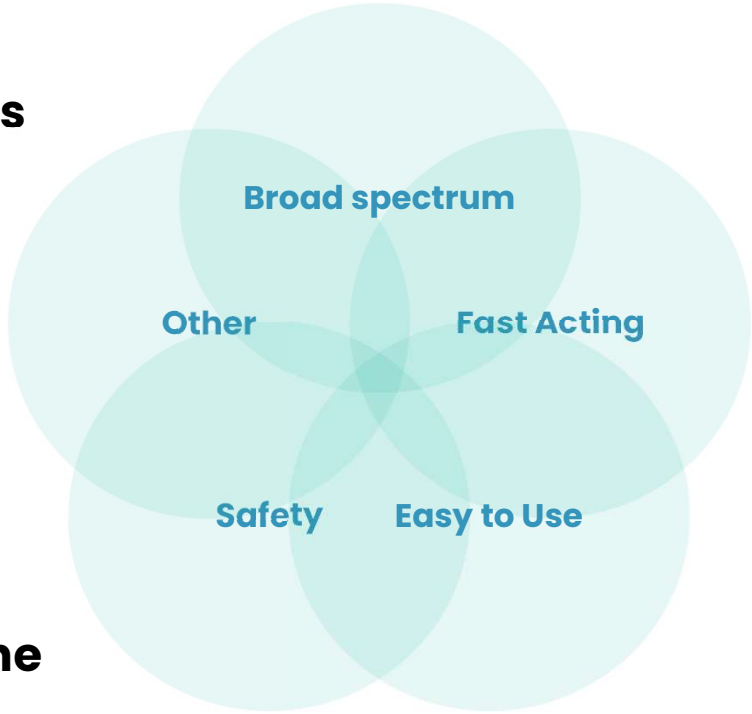
4. **Incorrect dilution**
   Concentration drifts away from validated conditions

5. **Insufficient contact time**
   Wet-time not achieved in real-world practice

6. **Poor compliance**
   Protocols understood but not consistently followed

Choosing the Right Disinfectant

- ❑ **Kill claims for the most prevalent healthcare pathogens**
- ❑ **Fast kill times and acceptable wet contact times**
- ❑ **Ease of use**
- ❑ **Safety**
- ❑ **Other factors such as training and support offered by the manufacturer, costs and standardisation**



Source: https://dph.illinois.gov/content/dam/soi/en/web/idph/files/publications/document-8-rutala-weber-selection-of-the-ideal-disinfectant.pdf *DOI: 10.1086/676877*

DISINFECTION SELECTION

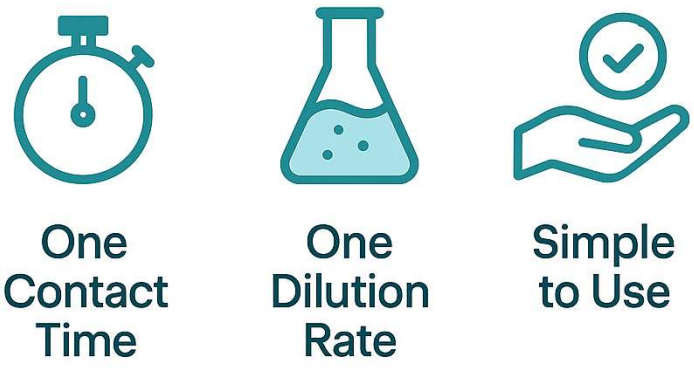
Contact Times

- Time the disinfectant must remain wet on the surface
- Essential for achieving the claimed level of kill
- Shorter contact times improve ease of practice and reduce user error
- Kill time within the drying time

DISINFECTION SELECTION

Usability

- Simple process reduce user error
- One clear contact time improves consistency
- One dilution rate avoids preparation mistakes
- Lower complexity supports reliable disinfection outcomes



DISINFECTION SELECTION

Safety

- Hazard levels vary significantly between disinfectant classes
- Consider the product hazard profile
- Check CLP!

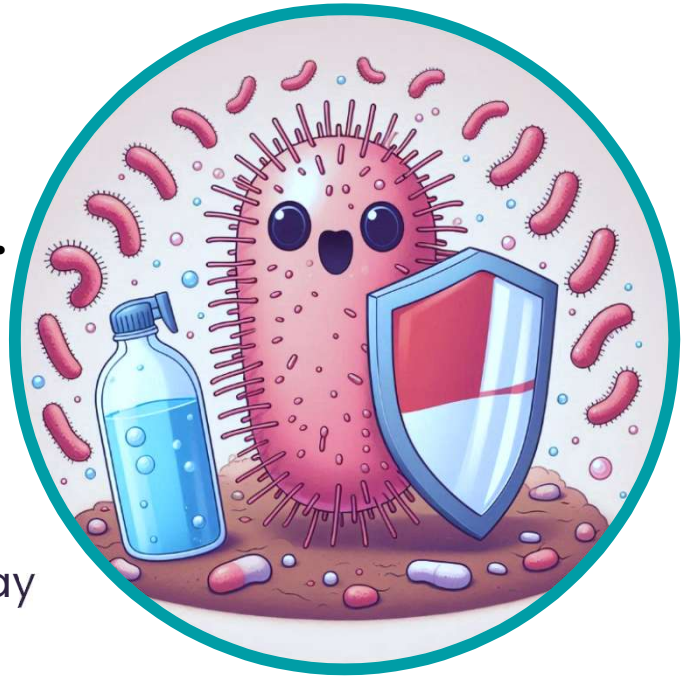
DISINFECTION SELECTION

Material Compatibility

- **Disinfectants interact differently with various materials**
- **Incompatible chemistries can cause degradation to the surfaces and materials**
- **Follow device manufacturer guidance and care cards**

Antimicrobial Resistance AMR

Disinfectants play a key role in the effort to prevent **AMR.**



- Sub-lethal doses of disinfectants, build microbial **tolerance**
- Oxidisers overcome this by attacking all parts of the cell
- Several mechanisms at once → no viable adaptation pathway

Microorganisms cannot build resistance to chlorine dioxide.

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Andrés, CMC, Lastra, JMP de la, Andrés Juan, C, Plou, FJ & Pérez-Lebeña, E 2022, 'Chlorine Dioxide: Friend or Foe for Cell Biomolecules? a Chemical Approach', International Journal of Molecular Sciences, vol. 23, no. 24, p. 15660.

Why Choose Chlorine Dioxide?

- Broad Spectrum
- Low Concentrations
- Uniform Contact TIme
- Good Safety Profile
- Realistic Contact Time
- Eliminate Pre-Wetted Plastic Wiipes

How Chlorine Dioxide Solves IPC Challenges

IPC CHALLENGE	CHLORINE DIOXIDE FEATURE
Emerging pathogens	Broad-spectrum activity
Staff compliance	Fast contact times
Complex protocols	Simple workflows
Outbreak management	Sporicidal efficacy
AMR concerns	Multi-target oxidation
Equipment longevity	Material compatibility

SUPPORTING IPC OUTCOMES

Where Chlorine Dioxide Fits Within IPC Practice

1 Environmental surfaces

Patient rooms, clinical areas and high-touch/ high risk surfaces where contamination accumulates.

2 Shared patient equipment

Devices moving between patients, where turnover leaves little reprocessing time.

3 Semi-critical devices

Instruments contacting mucous membranes and requiring high-level disinfection.

4 High-risk clinical environments

Outbreak settings, isolation areas and immunocompromised patient pathways.

One chemistry, applied consistently across the environments where risk is greatest.


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Tākina Event Cent
WELLIN
ClO2
RUN! THEY HAVE CHLORINE DIOXIDE!