

IPCNC NEW ZEALAND ANNUAL CONFERENCE

Review of Biofilms in Clinical Environments and Disinfection Practices

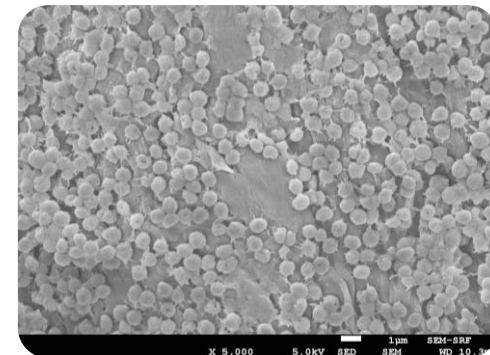
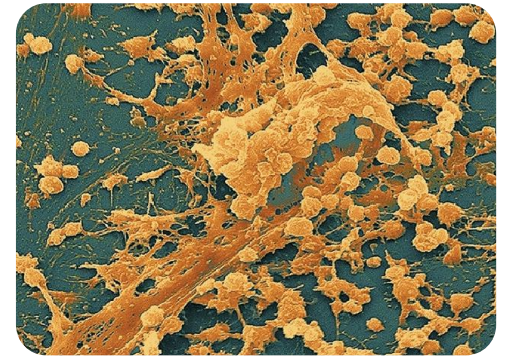
Jincy Jerry

Infection Prevention & Control · NHS Ayrshire & Arran, Scotland
Formerly Mater Misericordiae University Hospital, Dublin

What is a Biofilm

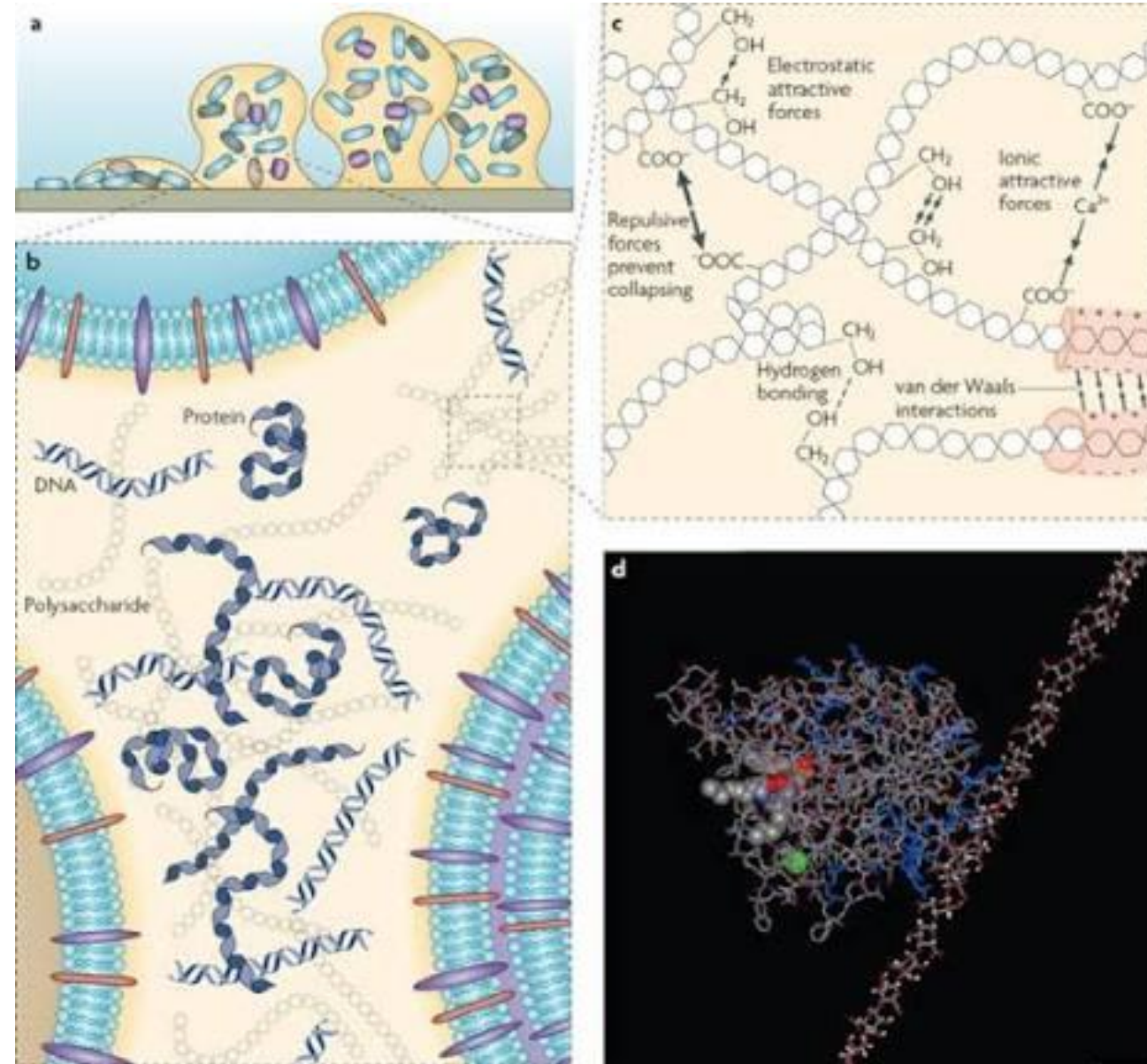
Community of microorganisms that has **fixated onto a surface**, encased in **extracellular polymeric substances (EPS)**

A **multicellular** community of all types of organisms (bacteria, yeasts, viruses, etc.)



EPS component

Polysaccharides	Long chains of sugars; the main slime or gel
Proteins	Structural proteins and enzymes
Extracellular DNA (eDNA)	DNA released outside cells, often from bacterial cell breakdown
Lipids and membrane vesicles	Fat-like molecules and tiny membrane packets
Water, nutrients and ions	Trapped within the matrix





What Are Bacterial Biofilms? A Six Minute Montage

biofilm



4:14 / 6:00



More videos

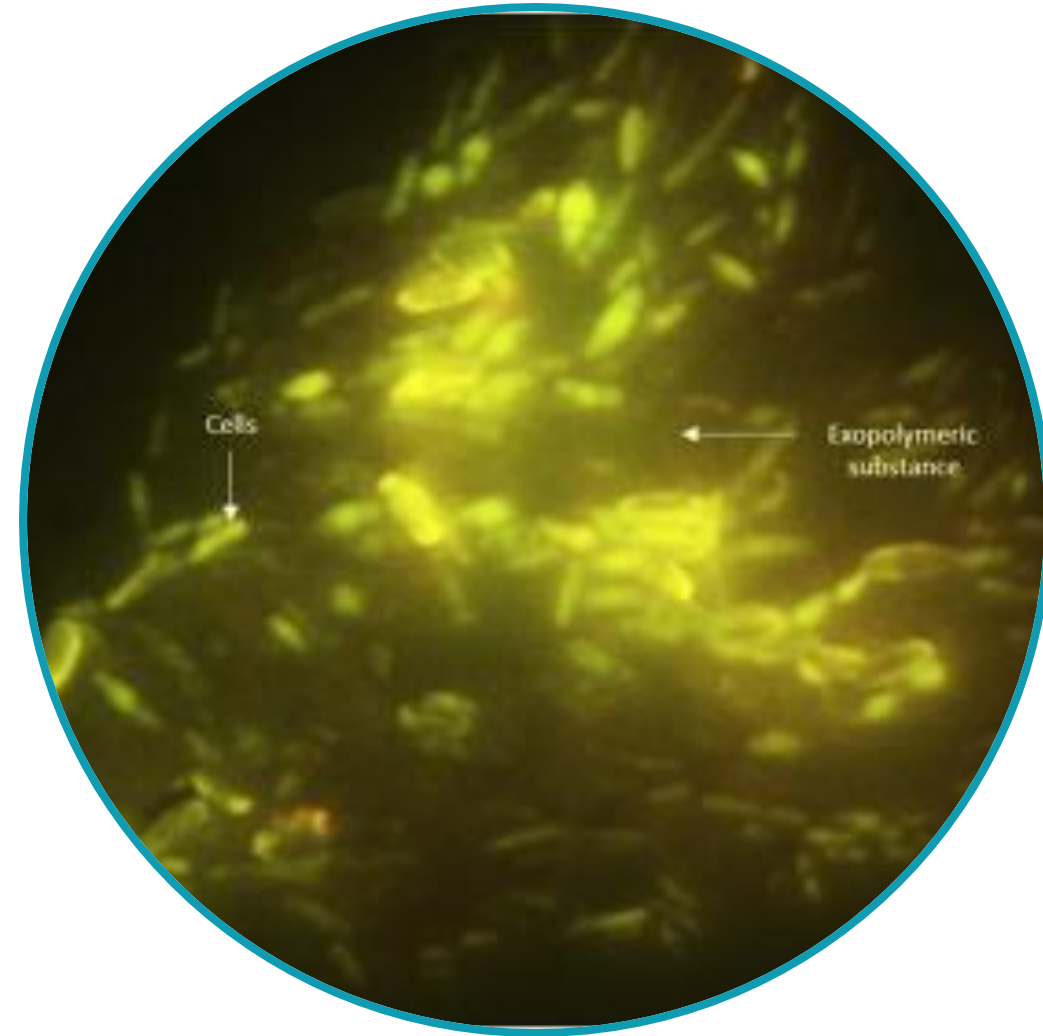
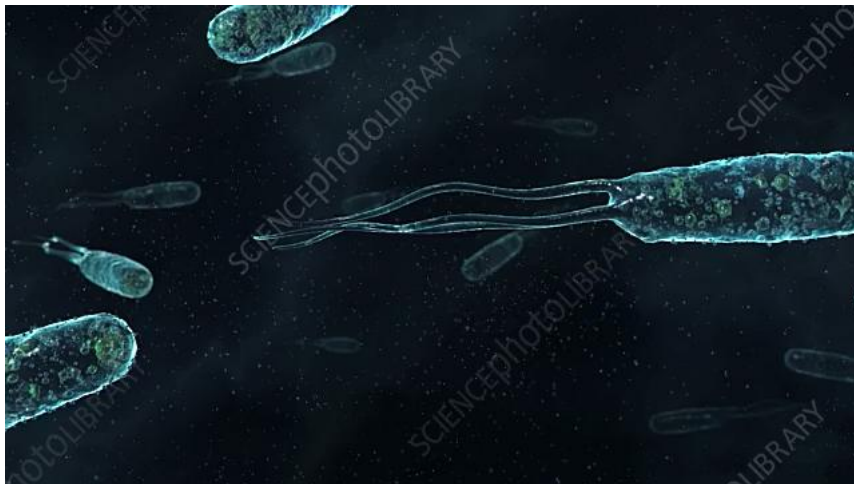


 YouTube

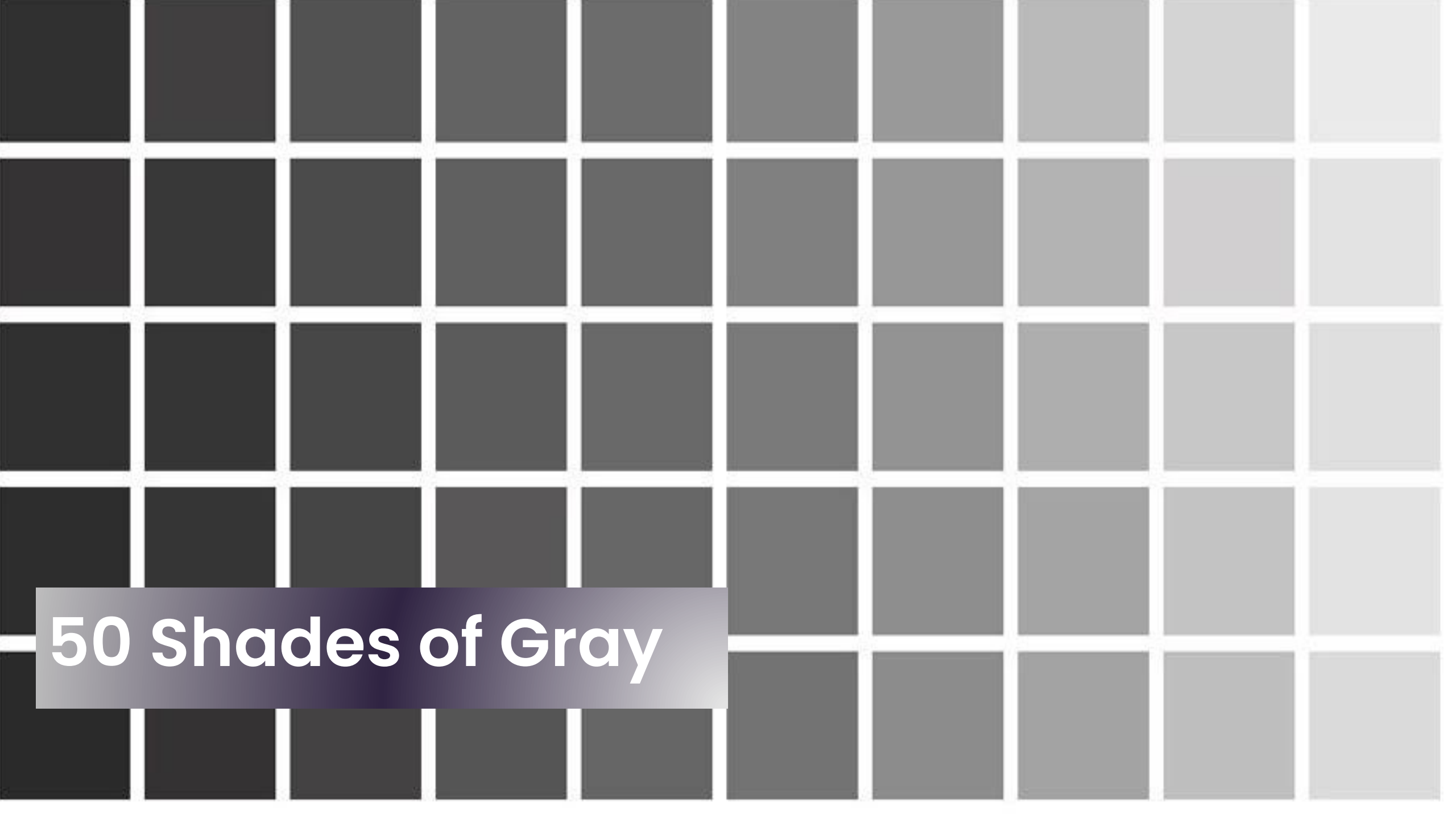
Biofilm: A Healthcare Burden?

Bacteria living in a biofilm can exhibit much **higher resistance** to disinfectants and antibiotics compared to their planktonic state

Estimated to be **10–10,000 times more resistant!**



Source: Science Photo Library



50 Shades of Gray

Types of Biofilms



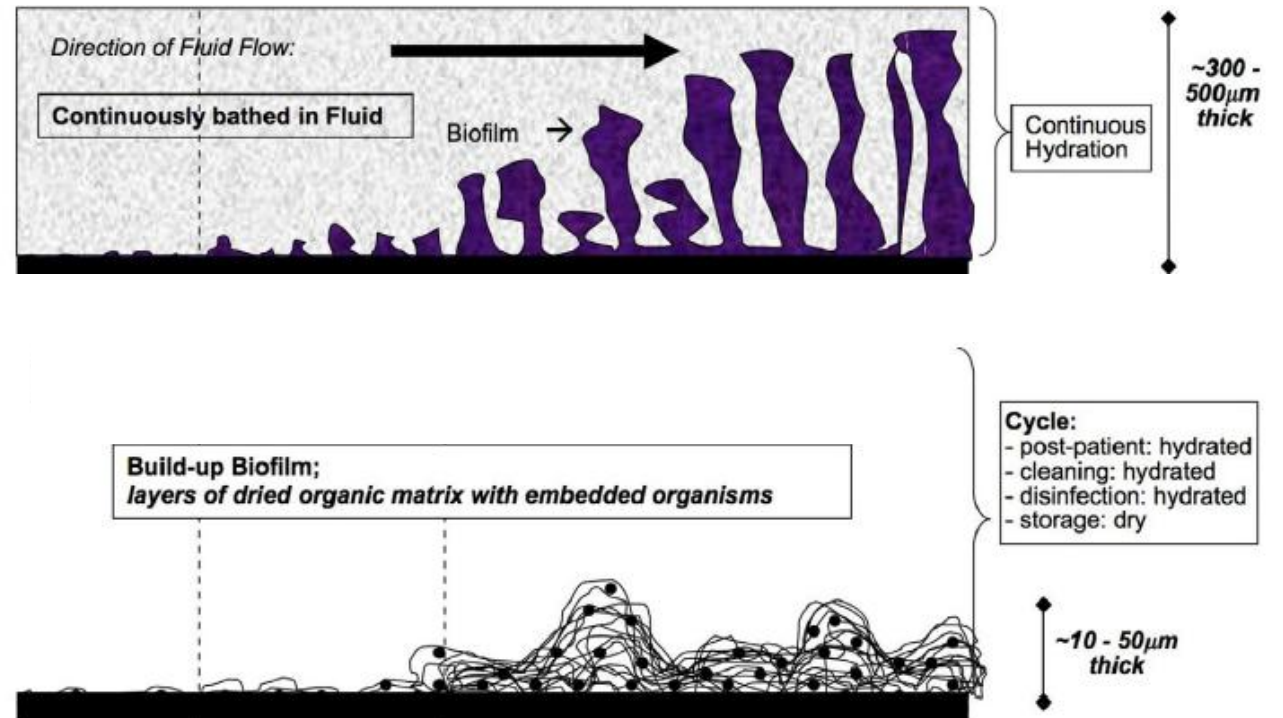
Wet biofilms

Exists in environments where moisture is consistently present.



Dry biofilms

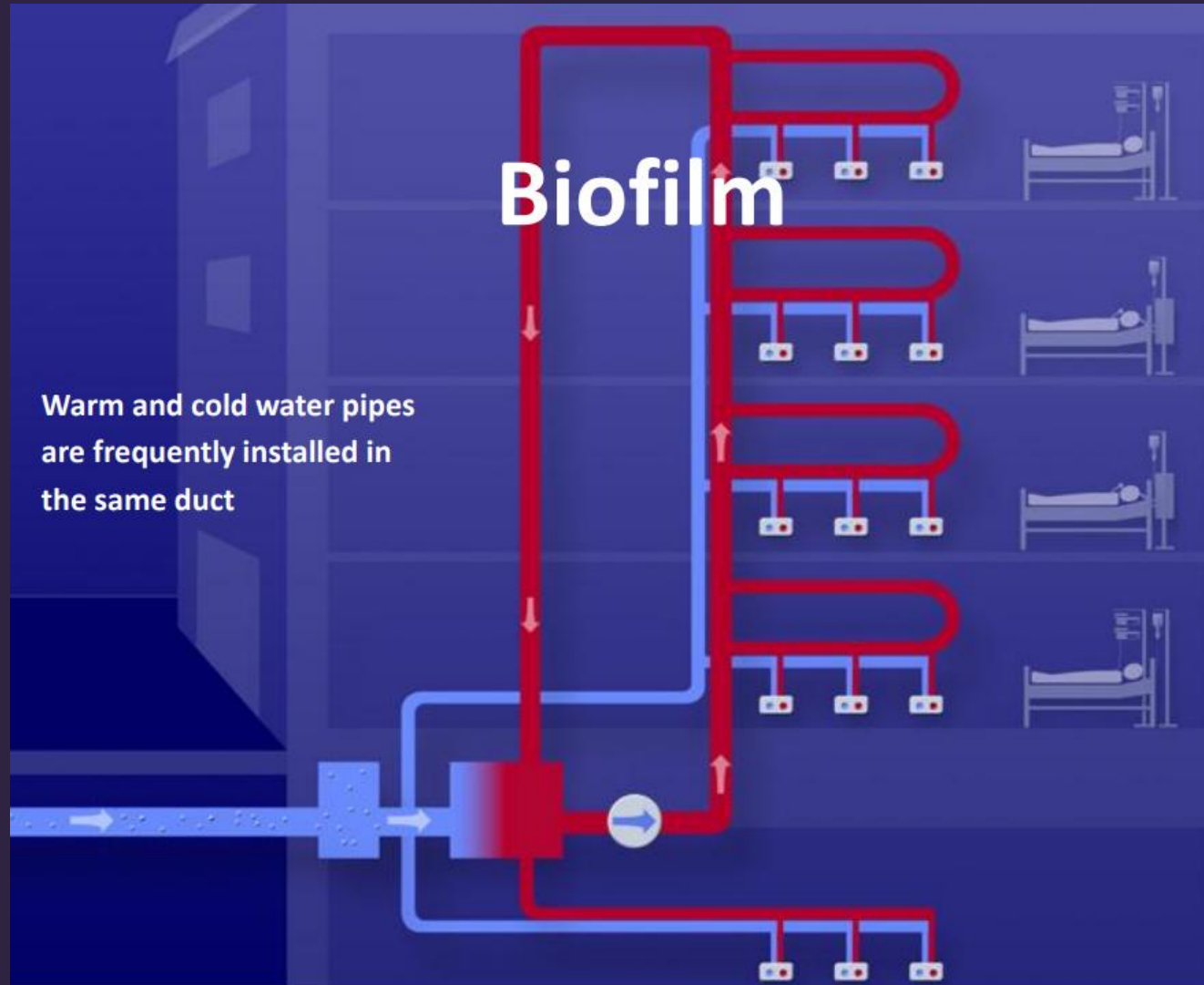
Forms or persists in environments where moisture is limited or has been removed.



Common Biofilms



Healthcare Water Supply System





Hospital pays out after bacteria-linked deaths

Royal Papworth Hospital, Cambridge.

Royal Papworth Hospital: *M. abscessus* Water Outbreak, 2019

- **When:** Shortly after new hospital opening, 2019
- **Where:** Specialist cardiothoracic hospital, all single room, fully mechanically ventilated hospital
- **Organism:** *Mycobacterium abscessus*
- **Affected:** 21 cystic fibrosis and transplant patients/ 2 death
- **Source:** **Hospital water system – building sat completed but unoccupied, the water remained stagnant inside the pipework for an extended period.**
- **Lesson:** New build ≠ safe water system

2026

Harmful bacteria found in new \$162m Mason Clinic unit



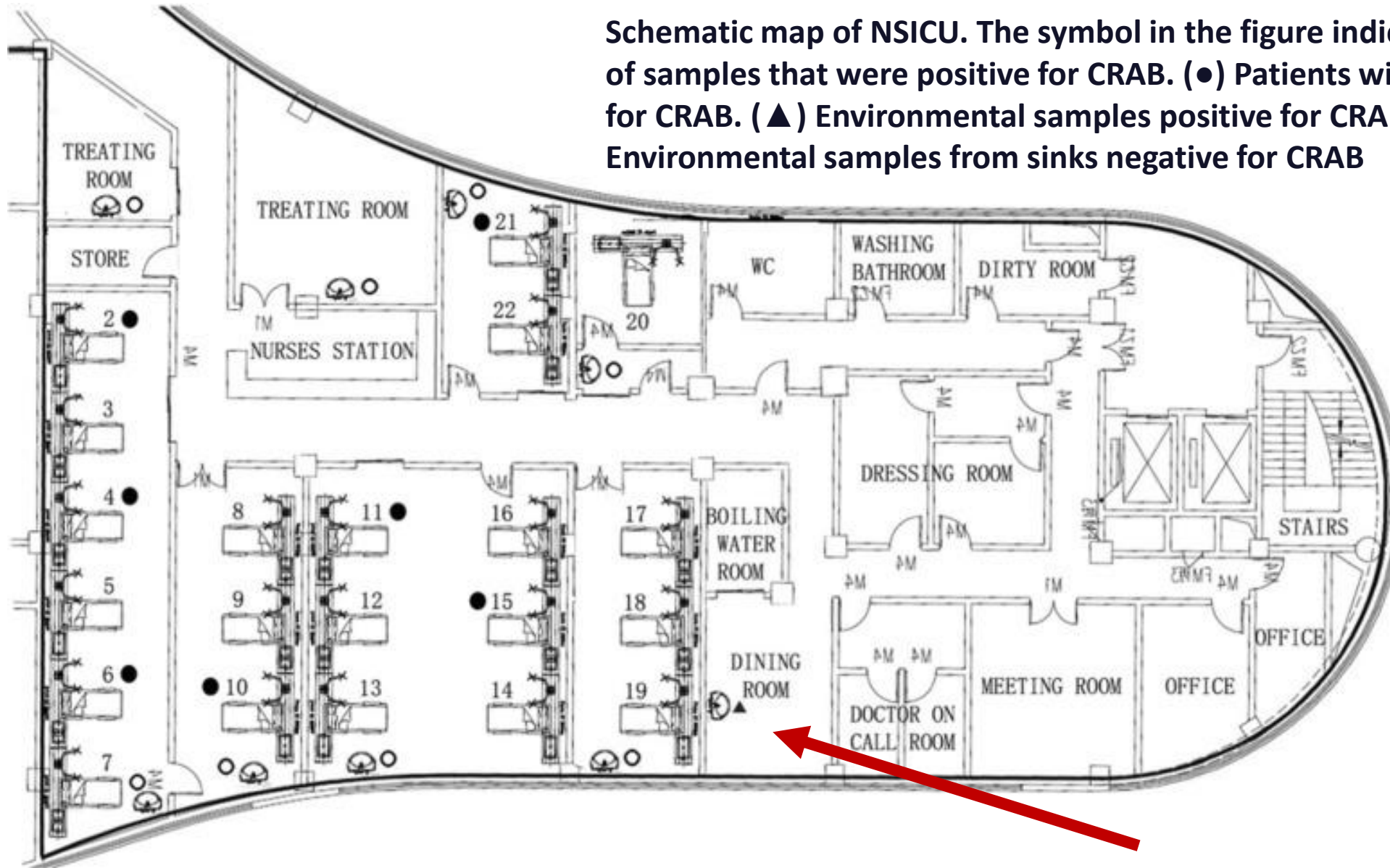
Source: Hospital water system - building sat completed but unoccupied, the water remained stagnant inside the pipework for an extended period.

Faucet Aerators



Faucet aerators as a reservoir for Carbapenem-resistant *Acinetobacter baumannii* (CRAB)

- **Organism:** Carbapenem-resistant *Acinetobacter baumannii* (CRAB).
- **Location:** Neurosurgical intensive care unit (NSICU) in a large tertiary hospital, China
- **Outbreak period :** December 2018 to January 2019.
- **Patients affected:** Seven
- **Device/reservoir:** Faucet aerator on a high-use dining-room handwashing faucet
- **Key findings:**
 - Splash contamination of the aerator, followed by healthcare-worker hand contamination and onward transmission



Of 200 environmental samples collected after cleaning, only the dining-room faucet aerator grew CRAB.

ICE Machines



Burkholderia multivorans infections associated with use of ice and water from ice machines for patient-care activities

- **Organism:** *Burkholderia multivorans* sequence type 659 (ST659)
- **Patients affected:** 46 patients across 4 hospitals
- **Location:** Three hospitals in California and one hospital in Colorado, USA
- **Outbreak period :** 2020–2024
- **Device/reservoir:** Ice and water from the same brand of ice machines
- **Key findings:**
 - Clinical and environmental isolates were **highly genetically similar in WGS**, supporting a shared source
 - Patients were exposed to ice-machine water or ice during care activities, including swallow assessments, bathing, topical analgesia, and external cooling.

Thermostatic Mixing Valve (TMV)/ Thermostatic Mixing Tap (TMT)



NZ Compliance: Hot Storage & Loop Controls

Hot Water Storage Requirements (Clause G12/AS1)

- **The 60°C Minimum:** Water heaters and storage vessels **must store water at no less than 60°C.**

Hot Water Reticulation Return (AS/NZS 3500.4 & G12/AS3)

- **The 55°C Threshold:** For continuous flow and return circulating loops, water re-entering the heating vessel **must not fall below 55°C.**

Cold Water Temperature Controls (Clause G12 Framework)

- **Performance Objective:** Clause G12 legally mandates a "**safe supply**" configured to avoid illness

? Temperature



What temperature should cold water be maintained at in a healthcare building?

Please enter a temperature and, if you can, the guidance or standard you would rely on.

HTM 04-01: Hot & Cold Water Compliance, UK

Core Temperature Controls

- **Hot Water Storage:** Must be stored at a minimum of **60°C** to kill *Legionella* bacteria.
- **Hot Water Distribution:** Must circulate at a minimum of **55°C** and reach outlets at **≥ 55°C within 1 minute** of turning on the tap.
- **Cold Water Systems:** Must be stored and distributed below **20°C** and reach outlets at **≤ 20°C within 2 minutes** of operation.

Thermostatic Mixing Valve (TMV)/ Thermostatic Mixing Tap (TMT)



Thermostatic Mixing Valve (TMV)/ Thermostatic Mixing Tap (TMT)



Healthcare-associated *Legionella pneumophila* infection potentially associated with thermostatic mixing valves

- **Organism:** *Legionella pneumophila* serogroup 1
- **Patients affected:** One immunocompromised 2-year-old child
- **Location:** Paediatric clinic, Netherlands
- **Reservoir:** Shower thermostatic mixing valves; contaminated cold-water distribution system
- **Key findings:**
 - The clinical strain was identical to the cold-water isolate.
 - Mixing of contaminated cold water at shower TMVs was the suspected exposure route, even though hot-water temperatures were maintained above 53°C and central hot-water samples were negative

Outbreak of Legionnaires' disease at University Hospital, Nottingham

- **Organism:** *Legionella pneumophila* serogroup 1
- **Patients affected:** 12 developed Legionnaires' disease over 11 months
- **Location:** University Hospital, Nottingham, England
- **Reservoir:** hot-water system serving one hospital block, operated at 43°C
- **Key findings:**
 - Environmental isolates showed several *L. pneumophila* subtypes, but one subtype was linked to patient disease.
 - Increasing the hot-water temperature to 60°C controlled the main outbreak; subsequent cases and persistent low-level colonisation led to installation of copper-silver ionisation.



70°C At 70°C killed virtually instantaneously

60°C At 60°C killed in 5 minutes

50°C At 50°C can survive for a matter of hours

Above 46°C Growth ceases

37°C 37°C Optimum growth rate

Below 37°C Multiplication decreases

20°C Below 20°C Growth is insignificant

Effect of Temperature





Recessed
Dialysis Wall
Boxes

Multicenter Outbreak of Gram-Negative Bloodstream Infections in Hemodialysis Patients

- **Organism:** 21 *Serratia marcescens*, 12 *Pseudomonas aeruginosa*, 11 *Enterobacter cloacae*, and other Gram-negative organisms
- **Patients affected:** 58 bloodstream-infection episodes in 51 patients; 48 episodes (83%) required hospitalisation
- **Location:** Three outpatient haemodialysis facilities, USA
- **Reservoir:** Recessed dialysis wall boxes and effluent-drain connections
- **Key findings:**
 - Pooling and regurgitation of dialysis waste fluid contaminated recessed wall boxes with water-associated Gram-negative organisms and biofilm.
 - Patient and wall-box *S. marcescens* isolates were closely related by PFGE and whole-genome sequencing. The investigation identified opportunities for contaminated hands to transfer organisms from wall boxes to central venous catheter sites..

**Part of the Solution?
Part of Problem?**



The sink splash zone



Outbreaks in Publication

First author and year of publication	Country	Organism	Clinical setting	Drain type and other sources	Patient no.
Gideskog, 2020	Australia	<i>Stenotrophomonas maltophilia</i>	Intensive care	Calorimeter Plastic buckets Sink drains	4 over 2 months
Jung, 2020	Korea	CPE – mixed organisms	Cardiology	Water dispenser	87 over 6 months
Muyldermans, 2020	Belgium	<i>Serratia marcescens</i>	Neonatal ICU	Sink drains Bath drains Baby scale	36 over 9 months
Brehony, 2021	Ireland	OXA 48 CPE – mixed organisms	Medical	Sink Shower	56 over 1 year
Catho, 2021	Switzerland	MDR <i>Pseudomonas</i> spp.	Intensive care	Sink	21 in 2.5 years

Outbreaks in Publication

First author and year of publication	Country	Organism	Clinical setting	Drain type and other sources	Patient no.
Inkster, 2021	UK	Mixed Gram-negative organisms, non-CPE	Haematology	Shower drains Sink drains	16 over 4 months
Nurjadi, 2021	Germany	OXA 48 <i>Enterobacter cloacae</i>	Haematology	Shower drains Sink drains	41 over 6 years
Roberts, 2021	Australia	Carbapenem-resistant <i>Acinetobacter baumannii</i> Other MDR Gram- negative bacteria	Intensive care Burns unit	Bath drain	22 over 4 months
Van der Swet, 2022	Netherlands	ESBL <i>Enterobacter cloacae</i> MDR <i>Pseudomonas</i> spp.	Haematology	Sink drains Shower drains	24 over 2 years
Raun- Peterson, 2022	Denmark	<i>Enterobacter hormachaei</i> OXA 436	Cardiology	Shower drains	7 over 18 months



Endoscopes



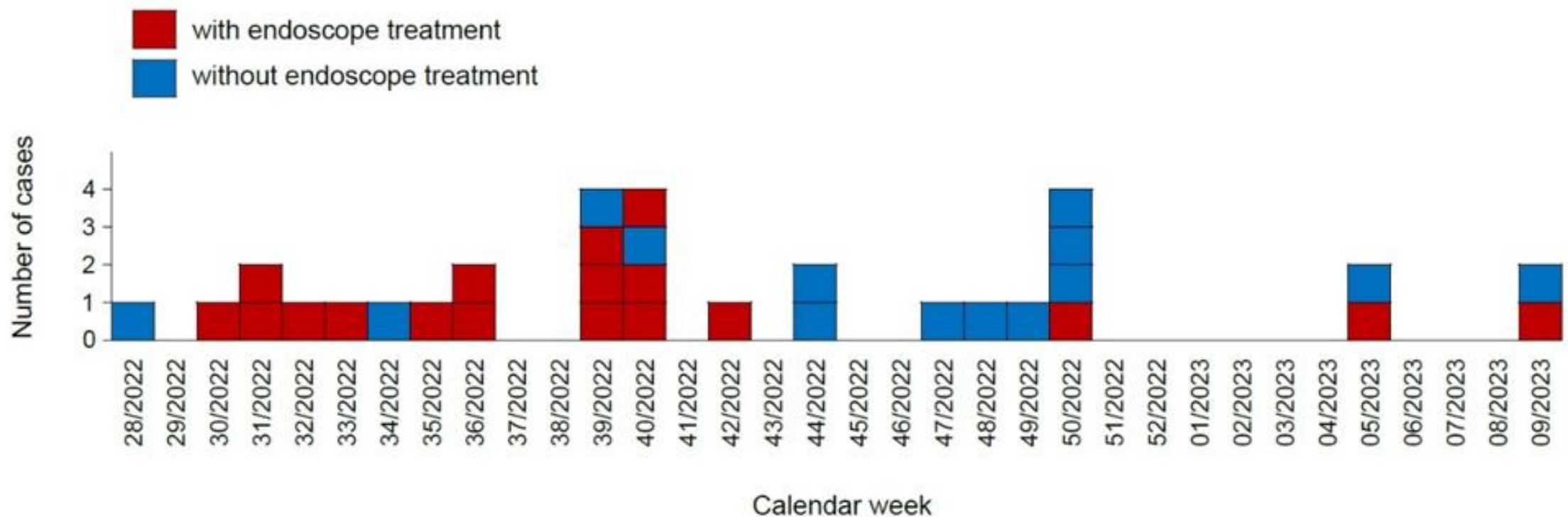


Endoscope-associated outbreak of OXA-181-carbapenemase-producing *Klebsiella pneumoniae* and its implications for hygiene management

J. Haak^{a,†}, I. Klempien^{b,†}, J.B. Hans^c, S. Schaefer^d, K. Meyer-Bothling^b,
S. Gatermann^c, E.E. Dirks^e, K. Konrat^e, M. Arvand^{e,f,*}

Scopes implicated:

6/36 (16.7%) old scopes and 4/67 (6%) new endoscopes grew the outbreak strain
Older endoscopes were replaced and contamination was subsequently also detected
in newly reprocessed scopes



Patients affected: 32

16 of the first 19 affected patients (84%) had undergone gastrointestinal endoscopy), 13 suffered an infection (sepsis, urinary tract infection, pneumonia, wound infection) and 19 were colonized. **Six** patients died **WGS** clonal relatedness of isolates - transmission between patients and due to contaminated endoscopes.

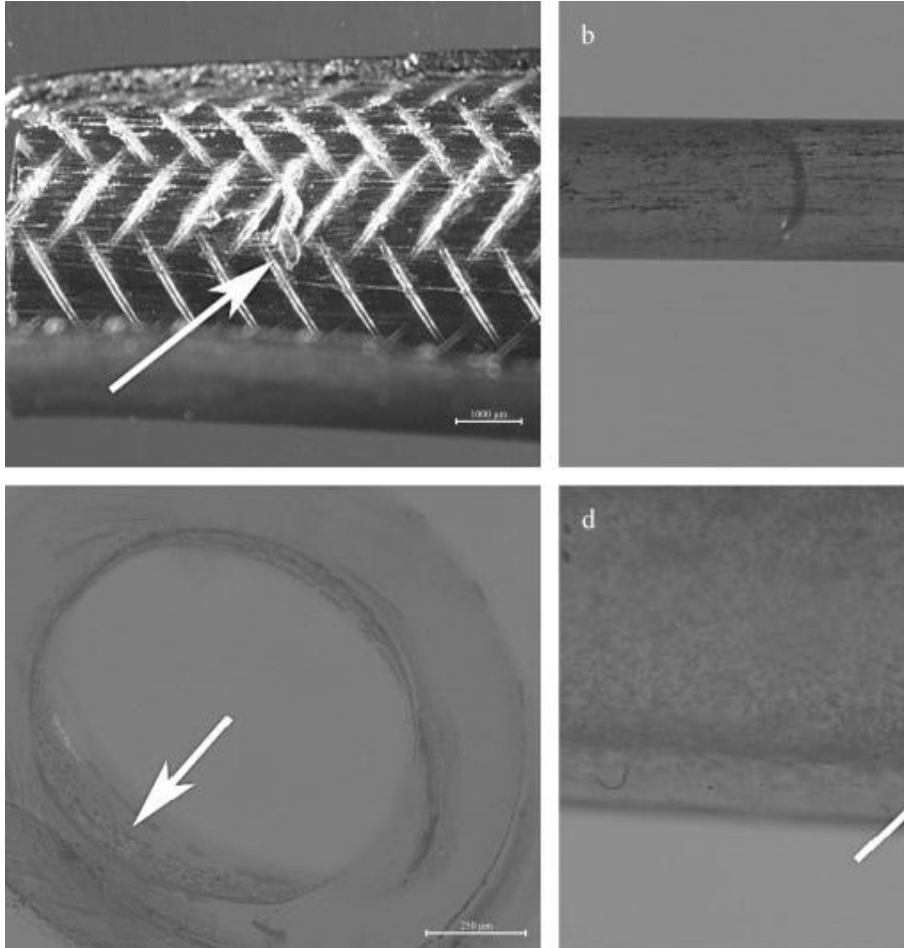
Table I

Results of hygienic-microbiological examinations of reprocessed ready-to-use endoscopes performed by LAGuS

	Old endoscopes	New endoscopes
Investigation period	August 2022 to September 2022	October 2022 to May 2023
Number of endoscopes examined	36	67
Number and rate of contaminated endoscopes	6 (16.7%)	4 (6.0%)
Microbiologic results	1. IC: >100 cfu/10 mL, <i>Klebsiella pneumoniae</i> 2. IC: >100 cfu/10 mL <i>Pseudomonas aeruginosa</i> , <i>Klebsiella oxytoca</i> , <i>Escherichia coli</i> , <i>Stenotrophomonas maltophilia</i> AWC: >100 cfu/10 mL, <i>K. oxytoca</i> 3. IC: 6 cfu/10 mL, <i>S. maltophilia</i> 4. IC: 21 cfu/10 mL, <i>Enterobacter cloacae</i> , <i>S. maltophilia</i> 5. IC: 11 cfu/10 mL, <i>Enterococcus faecium</i> 6. WJC: 26 cfu/10 mL, <i>P. aeruginosa</i>	1. AWC: 80 cfu/10 mL, <i>K. pneumoniae</i> (outbreak strain) 2. WJC: 13 cfu/10 mL, CoNS 3. AWC: 15 cfu/10 mL, CoNS 4. IC: >100 cfu/10 mL, <i>Klebsiella aerogenes</i> AWC: >100 cfu/10 mL, <i>K. aerogenes</i> WJC: >100 cfu/10 mL, <i>K. aerogenes</i>
Affected channels	IC, 5/6 (83.3%) WJC, 1/6 (16.7%) AWC, 1/6 (16.7%)	AWC, 3/4 (75%) WJC, 2/4 (50%) IC, 1/4 (25%)
Hygiene-relevant pathogens detected	6/6 (100%)	2/4 (50%)

'Old endoscopes' and 'New endoscopes' correspond to those used prior to and after the replacement of the entire endoscope part, respectively. AWC, air–water channel; cfu, colony forming units; CoNS, coagulase-negative staphylococci; IC, instrument channel; WJC, water-jet channel.

Several Factors Favouring Biofilm Formation



- Advanced age of endoscopes
- Dismantled endoscopes showed wear and tear, making the inner surface rough
- Light microscopy revealed organic matter and residues in the air channel, indicating biofilm formation.
- Residual moisture was detectable even after six months of storage of the device.
- Biofilm tolerated routine 0.075% PAA (reprocessed as per IFU).
- 0.15% PAA was required for ≥ 5 -log reduction.

Final rinse water can recontaminate

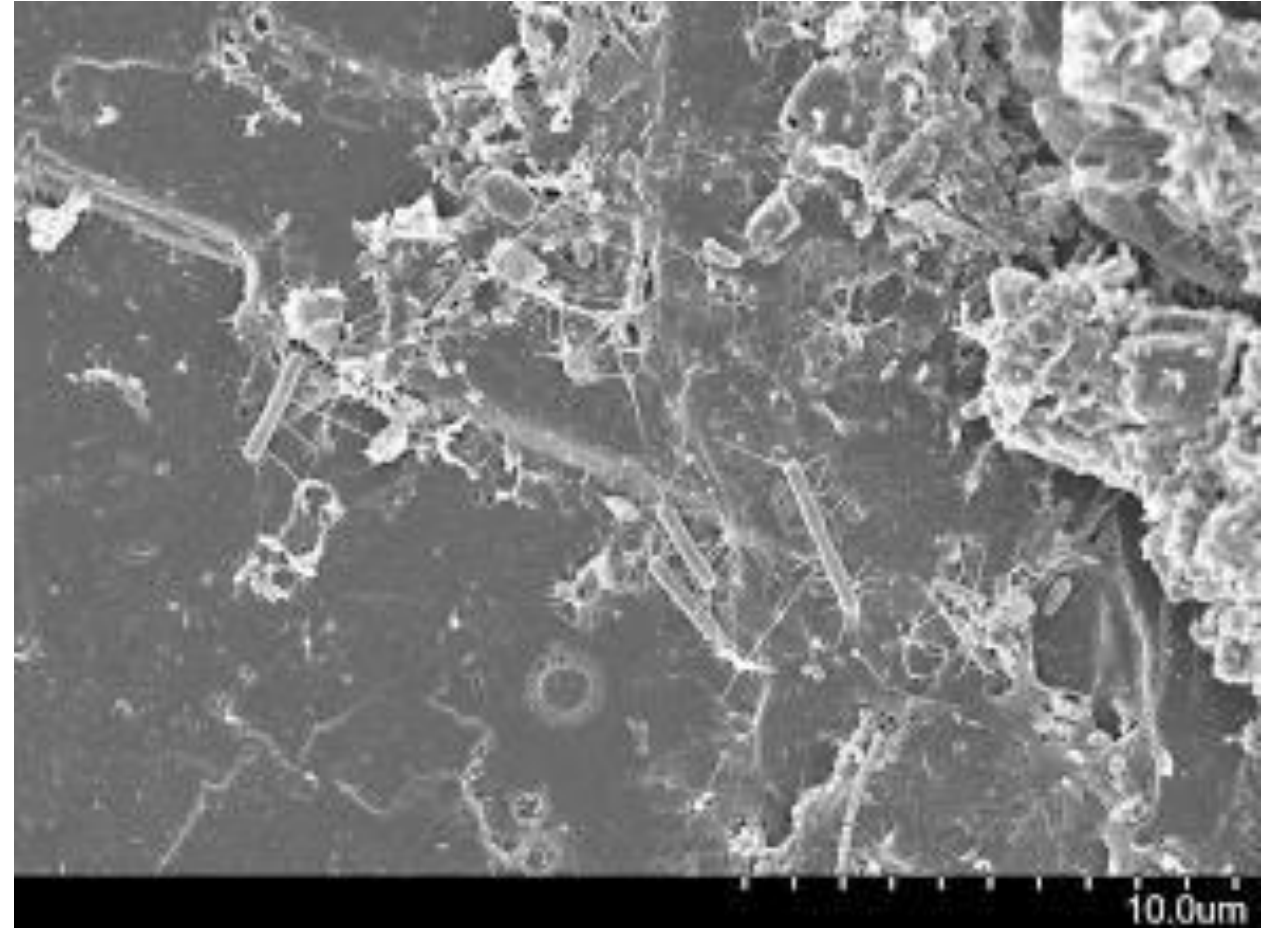
Incomplete channel drying can sustain risk

**Biofilm can make a “passed” reprocessing cycle
falsely reassuring.**

Dry-Surface Biofilm (DSB)

DSB is an invisible, thin layer of germs and protective slime on low-moisture surfaces.

Scattered clusters of microbial cells tightly packed and trapped inside an extracellular polymeric matrix

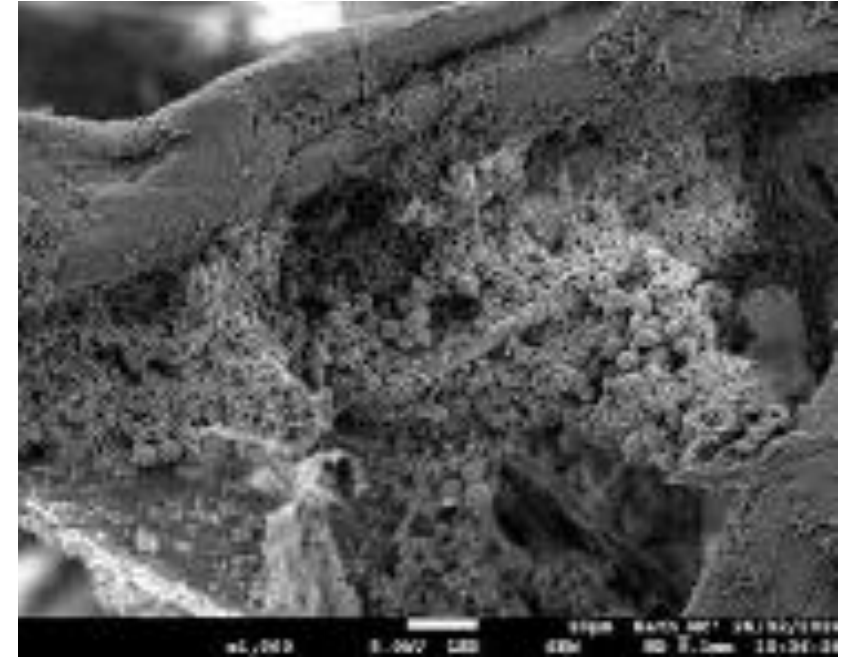


Scanning electron microscopy (SEM)

Dry-surface biofilm

Microscopic Appearance

- **Scattered Aggregates:** Unlike thick, wet biofilms, DSB appear as sporadic patches, rings, or thin clusters – water evaporation shrinks the structure.
- **Sandwich Layers:** Cross-sectional views show a layered defense where damaged cells stay on the dry outer layer while **healthy bacteria hide** safely inside.
- **Not Visible to the Eye:** Most DSBs measure only 10 to 50 micrometers thick, meaning surfaces look clean even when heavily contaminated



▮ Surface Survival Time (Inanimate Objects)



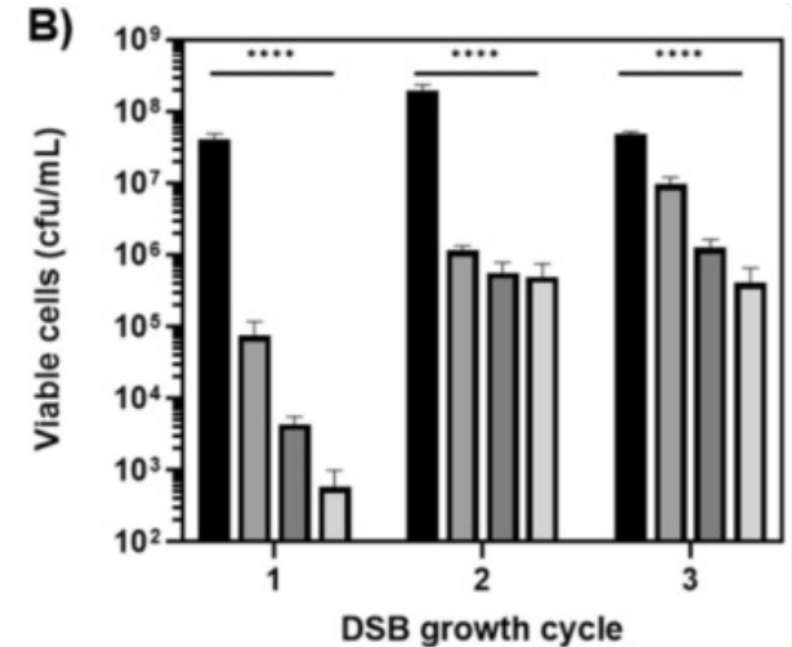
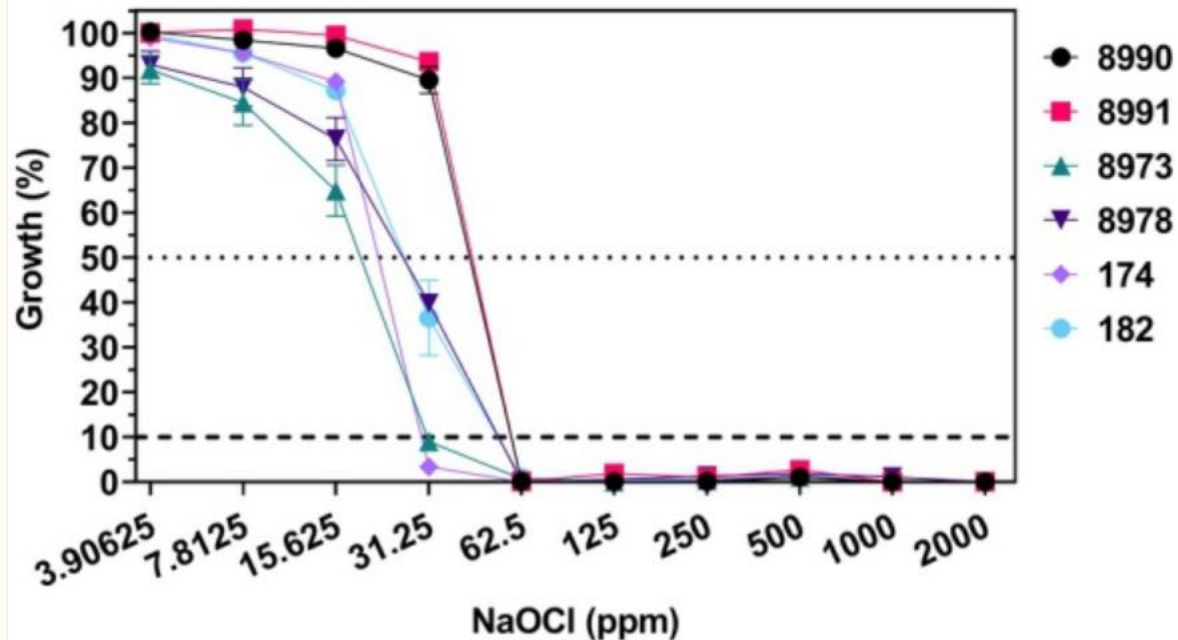
Spore-forming bacteria, MRSA, and persistent Gram-negative species exhibit extreme tenacity on dry inanimate surfaces, demanding strict surface disinfection protocols beyond basic daily cleaning.

Dry Surface Biofilm Formation by *Candida auris* Facilitates Persistence and Tolerance to Sodium Hypochlorite

Key findings:

- **Model:** 12-day dry-surface biofilm of *Candida auris*.
- **Finding:** Biofilm was more tolerant to hypochlorite than free-floating cells.
- **Result:** 500–1,000 ppm with **1–5 minutes' contact time**, achieved only a 2–4 log reduction in viable cells
- **Key lesson:** Planktonic testing may overestimate disinfectant effectiveness.

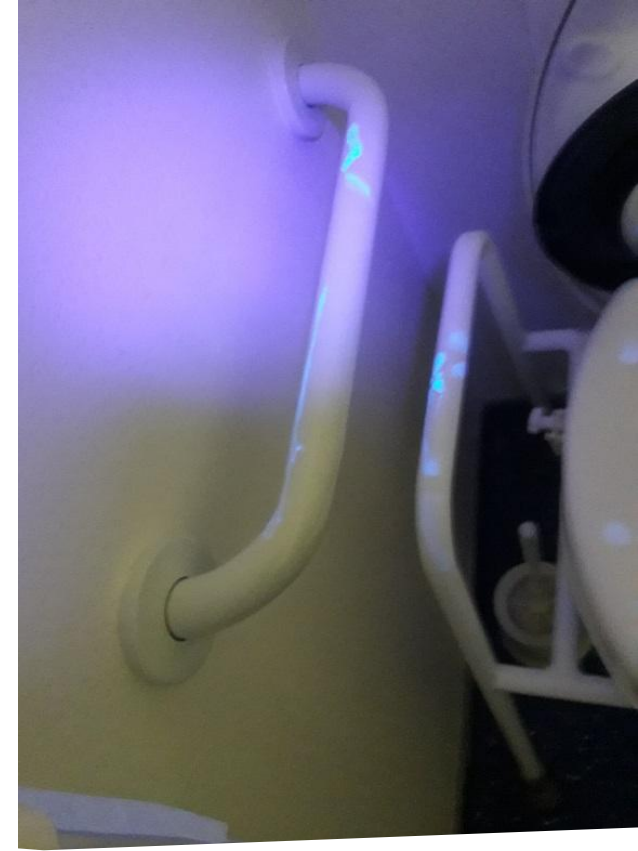
Dry Surface Biofilm by *Candida auris* Facilitates Persistence and Tolerance to Sodium Hypochlorite



- **IPC implication:** A disinfectant that is active against free-floating *C. auris* may be less effective against mature dry-surface biofilm. Cleaning protocols should **prioritise physical removal, correct product concentration and contact time, and validation against relevant biofilm models**—not planktonic testing alone.

Biofilm Contamination Of High-touched Surfaces In ICU

- **Setting:** 57 high-touch surfaces across adult, paediatric and neonatal ICUs in two Brazilian hospitals
- **Bioburden:** Mean 1.32×10^4 bacteria/cm² = **13,200 bacteria per cm²**
- **Highest contamination:** Feeding-bottle containers, stretcher mattresses, humidicrib mattresses and keyboards
- **Culture results:** Only 26/57 (45.6%) surfaces were culture-positive
- **MRDOs:** Detected on 4/26 culture-positive surfaces
- **ESKAPE pathogens:** Detected in 51.8% of sequenced samples (**E** — *Enterococcus faecium*, **S** — *Staphylococcus aureus*, **K** — *Klebsiella pneumoniae*, **A** — *Acinetobacter baumannii*, **P** — *Pseudomonas aeruginosa* and **E** — *Enterobacter* species)
- **Hidden viability:** Live bacteria found on 76.7% of culture-negative samples
- **Biofilm: Present on all 56 surfaces examined by microscopy**
- **Key message: Culture negativity does not equal a clean surface**
- **IPC implication:** Dry-surface biofilms can retain pathogens and MROs, limiting cleaning and disinfection effectiveness



Is cleaning sufficient?

Persistence of Biofilm-Forming and Multidrug-Resistant *Staphylococcus aureus* on High-Touch Hospital Surfaces Despite Routine Cleaning and Disinfection

MARIA LUISA CRISTINA^{1,2}, GIANLUCA OTTRIA¹, ELISA SCHINCA^{1,2}, CAROLINA PICCININI¹, ANNA MARIA SCHITO³, SILVIA BONI⁴, SARA CIMA¹, ALESSIO CARBONE¹, CHIARA DUPONT¹, EMANUELE PONTALI⁴, MARINA SARTINI^{1,2}

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⁴ Department of Infectious Diseases Galliera Hospital, Genoa, Italy

Persistence of Biofilm-Forming and Multidrug-Resistant *Staphylococcus aureus* on High-Touch Hospital Surfaces Despite Routine Cleaning and Disinfection

Results

Biofilm presence despite routine cleaning and disinfection with chlorine

Aerobic colony counts reduced by approximately 70%, but surfaces remained positive.

Viable MROs: MDR strains of *S. aureus* were detected in 12/238 (5.04%) samples, including post-cleaning samples from the near-patient area, **including biofilm formers.**

Persistence of Biofilm-Forming and Multidrug-Resistant *Staphylococcus aureus* on High-Touch Hospital Surfaces Despite Routine Cleaning and Disinfection

Implications for Healthcare & IPC

Cleaning protocols that rely on detergent plus chlorine alone may not disrupt biofilm, allowing MDROs to survive.

There is a need for:

Biofilm-effective detergents and disinfectants

Potential redesign of surfaces/materials

More robust monitoring (e.g. SEM samples / advanced QC studies in research settings).

Maillard and Centeleghe
Antimicrobial Resistance & Infection Control (2023) 12:95
<https://doi.org/10.1186/s13756-023-01290-4>

Antimicrobial Resistance
and Infection Control

REVIEW

Open Access

How biofilm changes our understanding of cleaning and disinfection

Jean-Yves Maillard^{1*} and Isabella Centeleghe¹



How biofilm changes our understanding of cleaning and disinfection

Findings

- **Biofilms significantly reduce disinfectant efficacy** across all settings (surfaces, drains, devices).
- **Mechanical action is crucial** – chemical disinfectants alone are insufficient for DSB.
- **Biofilms act as reservoirs for MDROs** and facilitate persistence on surfaces for long periods.
- Failure to manage biofilms leads directly to increased HAI risk.
- Both biofilm type and location dictate the cleaning/disinfection strategy.





How serious do you perceive the risk of biofilm formation to be within your hospital?



In your organisation, are there particular clinical areas where biofilms are more of a concern?



How confident are you that your hospital's current measures are effective in detecting and preventing biofilm formation?

How biofilm changes our understanding of cleaning and disinfection



Environmental Cleaning

Mechanical action (e.g., wiping pressure, number of strokes) is often essential.

- **Consider biofilm regrowth rates when designing periodic cleaning schedules.**

Medical Device Reprocessing

- **Enhanced cleaning steps (enzymatic detergents, friction, borescopes) may be required.**
- **Strict drying is necessary to prevent regrowth.**
- **Consider single-use components.**



Drains

Routine application of disinfectants is insufficient – biofilms regrow rapidly.

- **Physical redesign and measures to minimise splash dispersion should be considered.**

Standards & Testing

- **Current standards are inadequate because they do not use realistic, clinically relevant biofilm models.**
- **Education of IPC professionals is essential to address biofilm-related contamination**

Current Standard Test Methods

ORGANISMS ARE IN A **PLANKTONIC STATE**
DO NOT CONSIDER **BIOFILM DEVELOPMENT**



Chemical disinfectants and antiseptics.
Application of European Standards for chemical
disinfectants and antiseptics



Surfaces & Medical devices: MDRO's and Biofilms

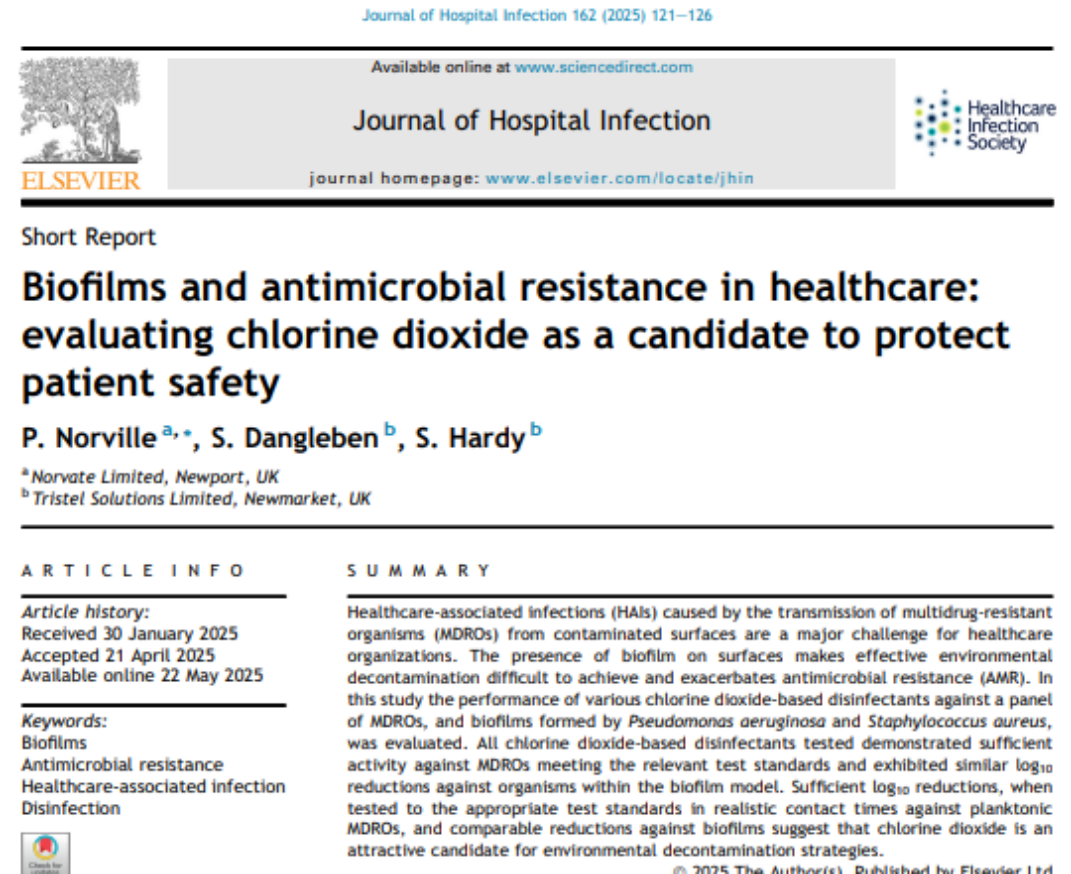
Published in collaboration with
Dr. Phillip Norville

Journal of Hospital Infection

May 2025

Short Report

Open access

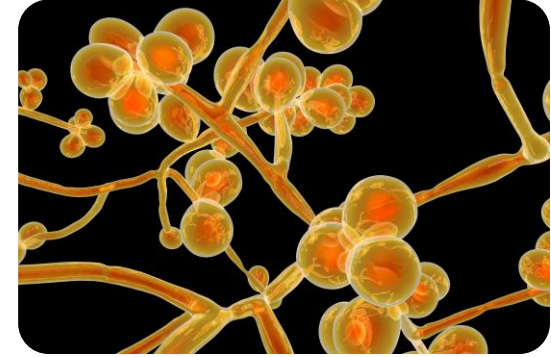


Surfaces & Medical Devices: MDRO's

Multi Drug Resistant Organisms (MDROs)

Tested against a panel of clinically relevant microorganisms using various test methodologies, depending on the product application

- ***Candidozyma auris*** (formerly *Candida auris*)
- **MRSA** Methicillin-resistant *Staphylococcus aureus*
- **VRE** Vancomycin-resistant *Enterococcus faecium*
- **CRE** Carbapenem-resistant *Klebsiella pneumoniae*
- **ESBL** Extended-Spectrum Beta-Lactamase producing *Klebsiella pneumoniae*
- **MDRAB** Multidrug-Resistant *Acinetobacter baumannii*



Surfaces: Biofilms

Bacterial biofilm efficacy evaluated using MBEC assay (ASTM E2799)
and grown over 72 hours

- *Pseudomonas aeruginosa*
- *Staphylococcus aureus*

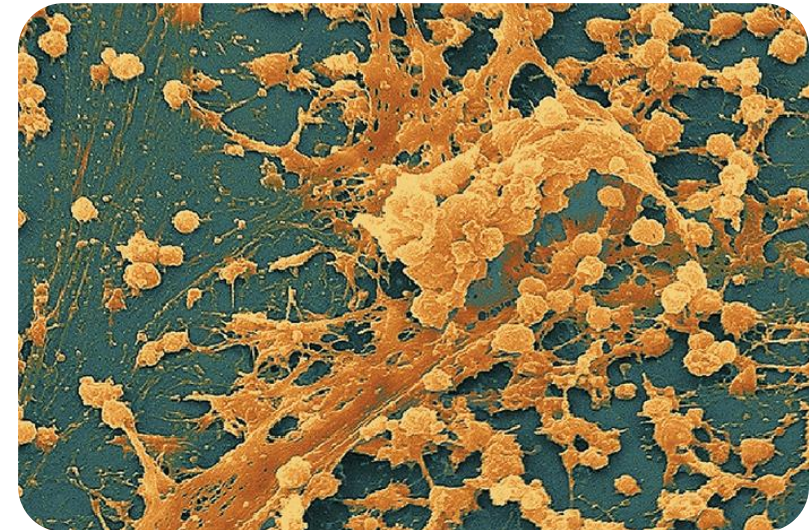
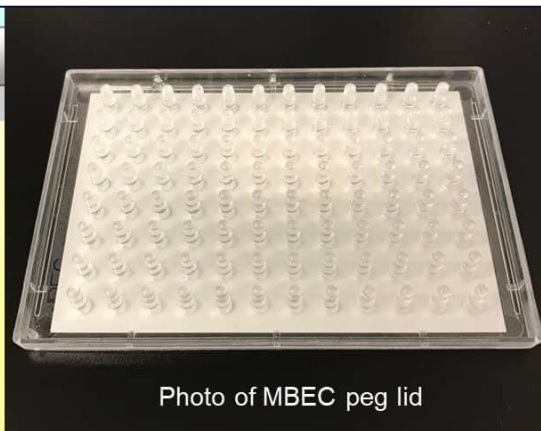
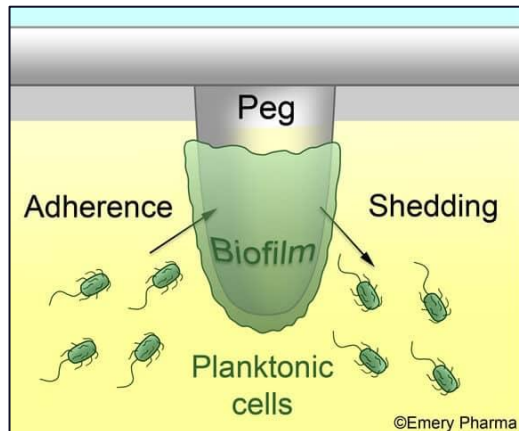
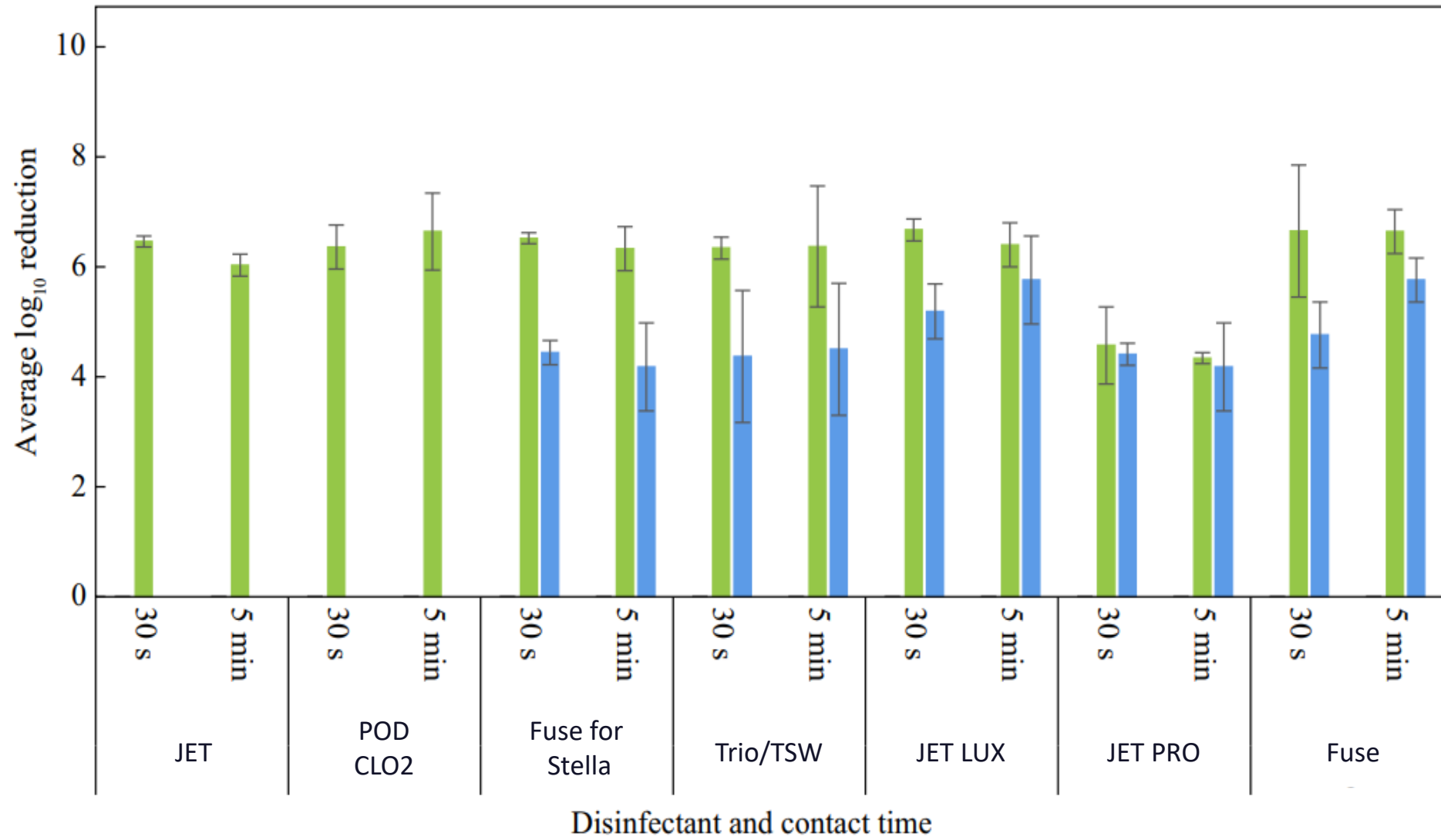


Table 1

Test solutions and results of EN efficacy testing of multidrug-resistant organisms

Product	Active substance	Disinfectant type	Test standard	Microorganism	Contact time	Log ₁₀ reduction
A	ClO ₂ : 200 ppm	Disinfectant foam	EN 14561	VRE <i>Enterococcus faecium</i> NCTC 12204	30 s	>6
				CRE <i>Klebsiella pneumoniae</i> NCTC 13443		>6
				ESBL <i>Klebsiella pneumoniae</i> ATCC 700603		>5
				MDRAB ATCC BAA-1799		>5
				MRSA NCTC 12493		>5
			EN 16615	MRSA NCTC 12493		>5
						Spread: <50 cfu
						>6
						>5
						>5
B	ClO ₂ : 150 ppm	Liquid solution for wiping	EN 13727	MRSA NCTC 12493	5 min	>5
				<i>Candidozyma auris</i> (formerly <i>Candida auris</i>) DM 21092		>5
				ESBL <i>Klebsiella pneumoniae</i> ATCC 700603		>5
				MDRAB ATCC BAA-1799		>5
				VRE <i>Enterococcus faecium</i> NCTC 12204		>5
			EN 14562	CRE <i>Klebsiella pneumoniae</i> NCTC 13443		>5
				<i>Candidozyma auris</i> (formerly <i>Candida auris</i>) DSM 21092		>4
				<i>Candidozyma auris</i> (formerly <i>Candida auris</i>) NCPF 8984		>4
						Spread: <50 cfu
				<i>Candidozyma auris</i> (formerly <i>Candida auris</i>) NCPF 8985		>5
C	ClO ₂ : 120 ppm	Liquid solution for immersing	EN 14561	VRE <i>Enterococcus faecium</i> NCTC 12204	5 min	>6
D	ClO ₂ : 200 ppm	Activated wipe	EN 14561	VRE <i>Enterococcus faecium</i> NCTC 12204	30 s	>6
			EN 13727	MRSA NCTC 12493		>5
E	ClO ₂ : 200 ppm	Disinfectant foam	EN 14562	<i>Candidozyma auris</i> (formerly <i>Candida auris</i>) DM 21092	60 s	>5
				MRSA NCTC 12493		>5
						Spread: <50 cfu
				ESBL <i>Klebsiella pneumoniae</i> ATCC 700603		>5
						Spread: <50 cfu
			EN 16615	MDRAB NCTC 13420		>5
				VRE <i>Enterococcus faecium</i> ATCC 6057		>5
				CRE <i>Klebsiella pneumoniae</i> NCTC 13809		Spread: <50 cfu
				<i>Candidozyma auris</i> (formerly <i>Candida auris</i>) NCPF 8984		>5
						Spread: <50 cfu
F	ClO ₂ : 200 ppm and QAC	Disinfectant foam	EN 16615	MRSA NCTC 12493	60 s	>5
				ESBL <i>Klebsiella pneumoniae</i> NCTC 13465		Spread: <50 cfu
						>5
				MDRAB NCTC 13420		Spread: <50 cfu
						>5
				VRE <i>Enterococcus faecium</i> ATCC 6057		Spread: <50 cfu
				CRE <i>Klebsiella pneumoniae</i> NCTC 13809		>5
				<i>Candidozyma auris</i> (formerly <i>Candida auris</i>) NCPF 8984		Spread: <50 cfu
						>4
						Spread: <50 cfu
G	ClO ₂ : 120 ppm	Liquid solution for mopping/wiping	EN 14561	MDRAB NCTC 13420	5 min	>5
				VRE <i>Enterococcus faecium</i> NCTC 12204		>5
				CRE <i>Klebsiella pneumoniae</i> NCTC 13443		>5
				MRSA NCTC 12493		>6
				MDRAB NCTC 13420		>5
			EN 14562	<i>Candidozyma auris</i> (formerly <i>Candida auris</i>) DMS 21093		>4



KEY QUESTION

Is the protocol designed to address microorganisms as they exist in the real clinical environment, not just in standard laboratory tests?

CONSIDER THE FOLLOWING:



Published evidence

- Backed by peer-reviewed biofilm efficacy data
- Uses mature biofilm models and clinically relevant organisms



Mechanical & chemical action

- Combines effective cleaning with disinfection
- Disrupts biofilm, not just microbial kill



Realistic contact times

- Contact times achievable in routine clinical practice



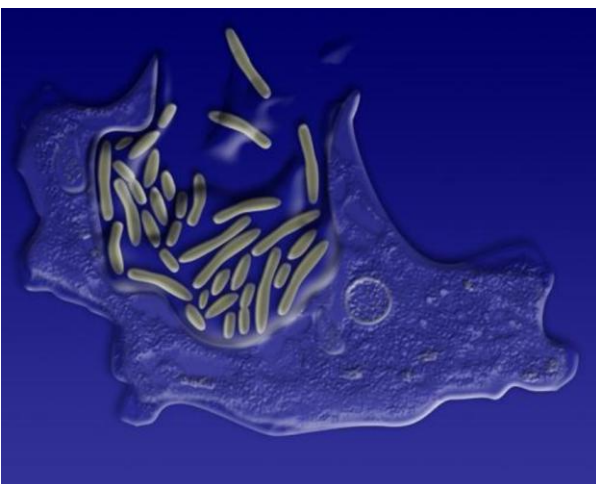
Appropriate for intended application

- Environmental surfaces
- Medical devices
- Drain and wastewater systems
- Wet vs dry biofilm environments



Compatibility & safety

- Compatible with equipment and surfaces
- Safe for staff and patients



A SMART PERSON
LEARNS FROM THEIR MISTAKES.

A WISE PERSON
LEARNS FROM OTHER'S MISTAKES.

UNIVERSITY OF TORONTO

Thank You