

Biofilms, Drains, and the Hidden Risks in Healthcare Environments: Disinfection strategies.



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**Drains, biofilms, susceptibility and transmission
(Phil)**

**Disinfection approaches and considerations
(Jon)**

**Chemical approaches
(Jon & Phil)**

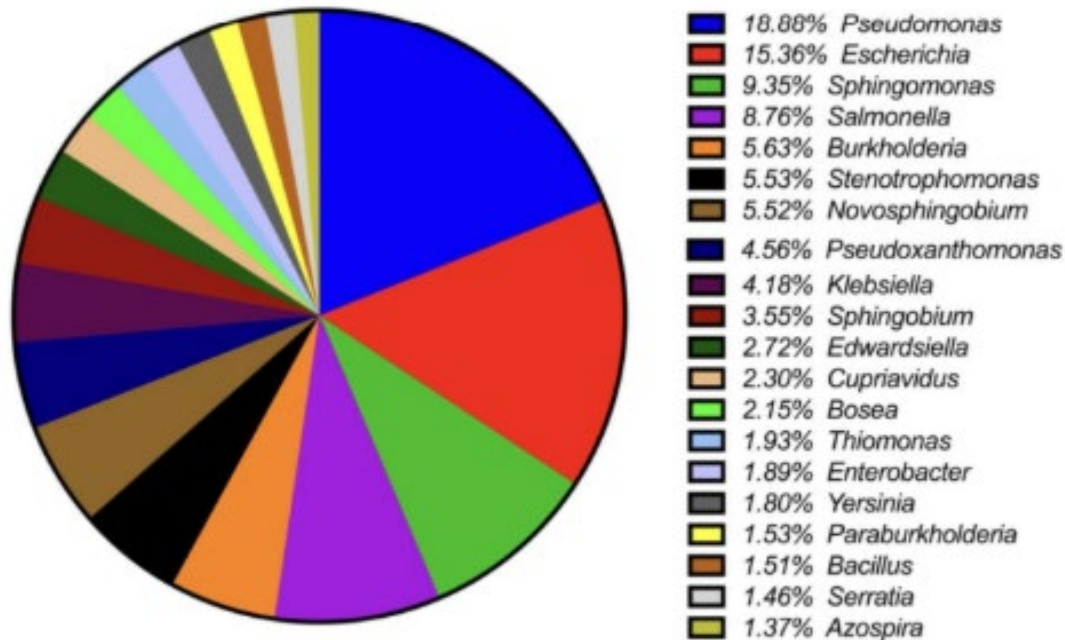
Audience poll

Rank the following risks for the transmission of microbes than can cause healthcare associated infections (HCAs):

- *Hands*
- *Drains*
- *Shared medical equipment*
- *Endoscopes*



Do drains matter in healthcare?



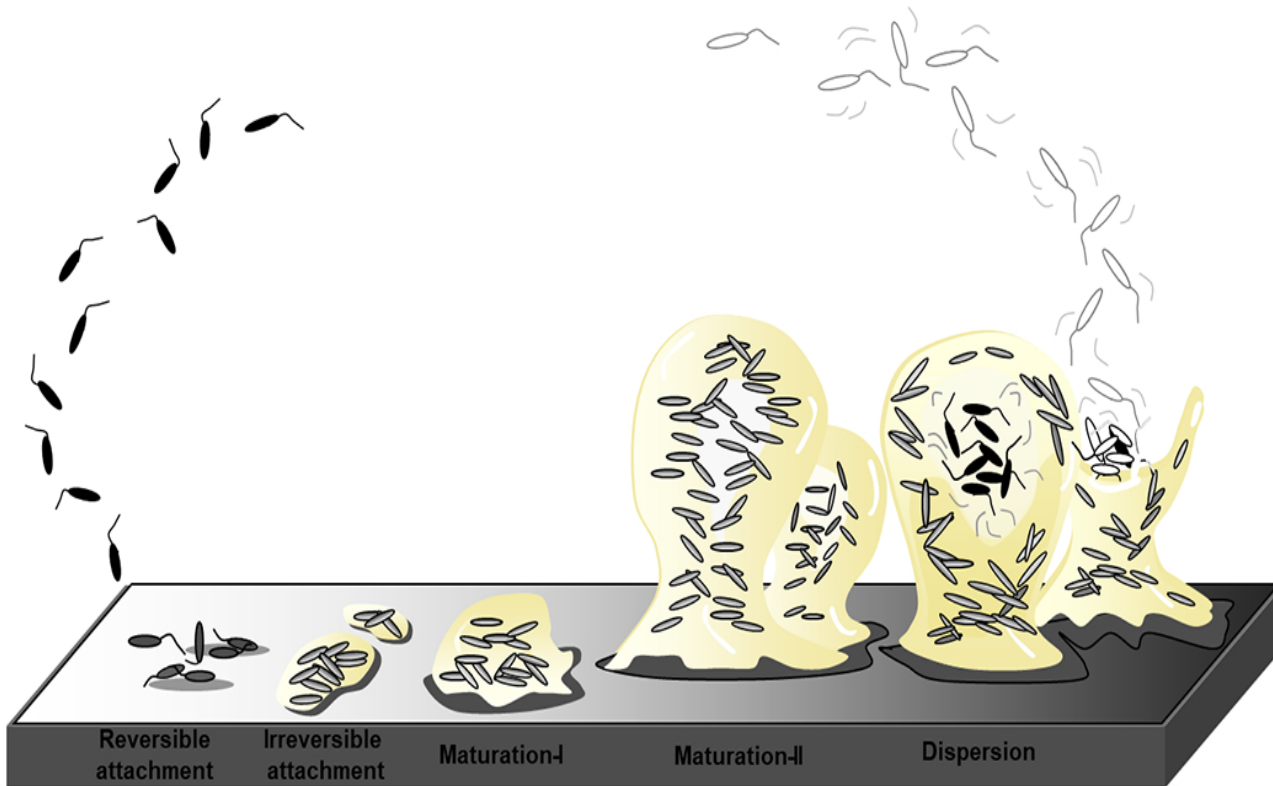
- Evidence (still emerging) suggests yes
- Reservoir of multispecies biofilms and MDROs
- Outbreaks linked to contamination in drains
- ‘Out of sight out of mind’ – decontamination challenges

Role for transmission – the splash zone



- Intravenous equipment - 65%
- Respiratory equipment - 27%
- Personal care items - 68%

What are biofilms?



- Multispecies
- Production of extracellular polymeric substances (EPS)
- Thrive in wet, nutrient rich conditions – drains!

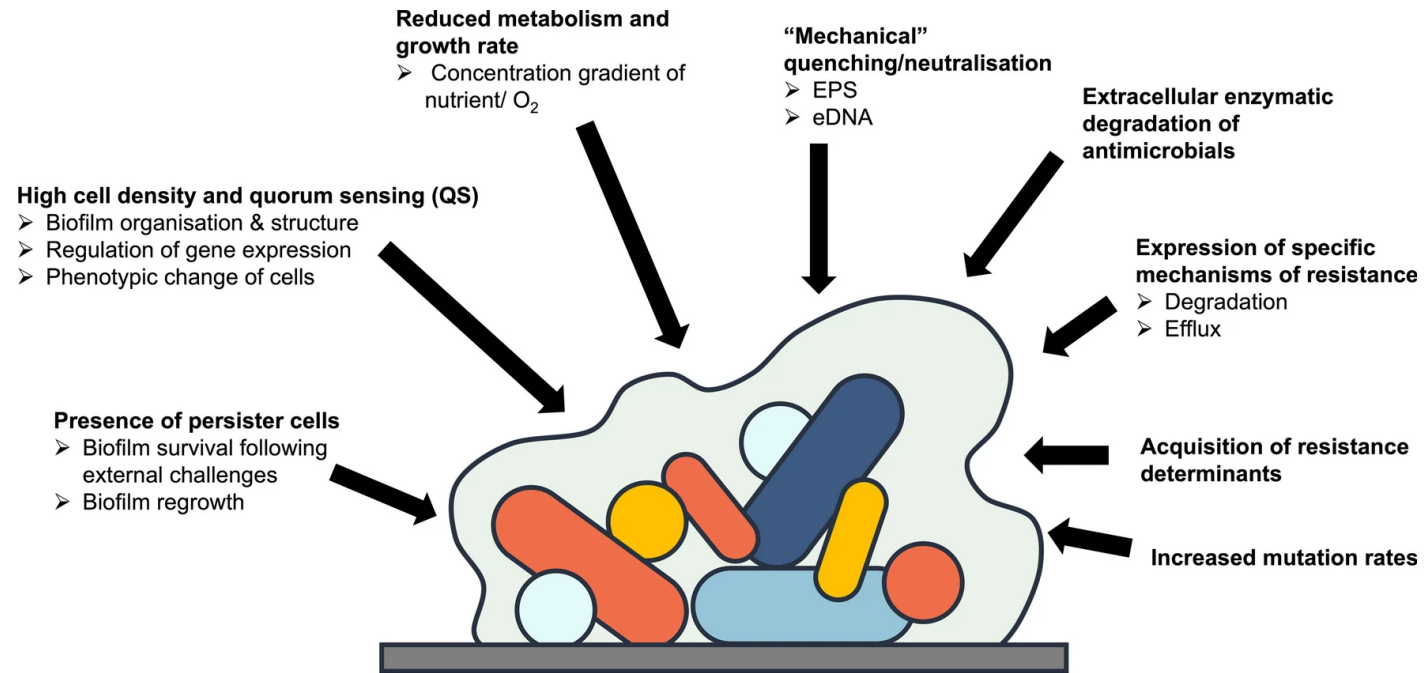
Audience poll

Do you think drains are an important reservoir for transmission in healthcare?

- *Strongly agree*
- *Agree*
- *Neutral*
- *Disagree*
- *Strongly disagree*

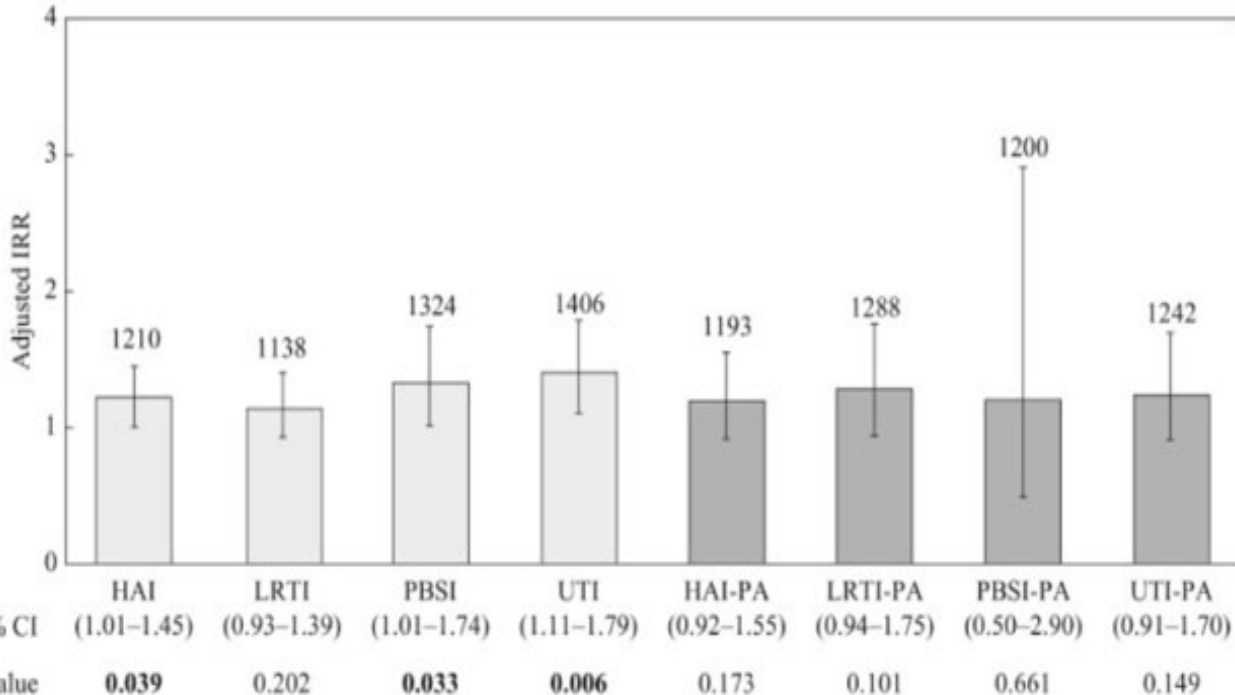


Reduced antibiotic and disinfectant susceptibility



- Biofilms exhibit up to 100–1,000× reduced susceptibility
- Not ‘traditional mechanisms’
- Metabolic heterogeneity and persister cells
- EPS binds, neutralises, or slows diffusion

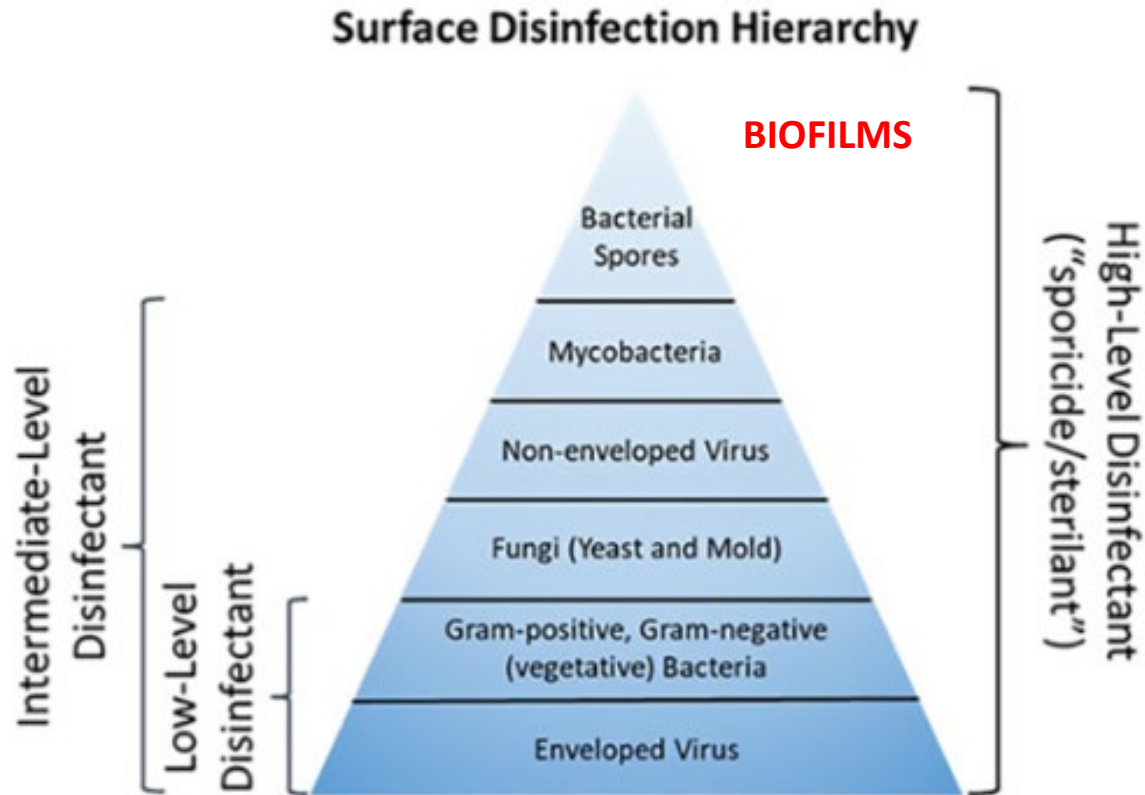
Drains and infection outbreaks



- Side rooms with sinks have higher infection rates
- Outbreaks often difficult to trace
- Outbreaks can last for years

Disinfection approaches and considerations

Disinfecting biofilms and drains



- Drains challenge traditional understanding of disinfectant susceptibility
- Requirement for novel approaches (innovation)

Options for disinfecting drains



- Thermal (hot water/steam)
- Chemical
- Physical (removal)
- Emerging technologies

Audience poll

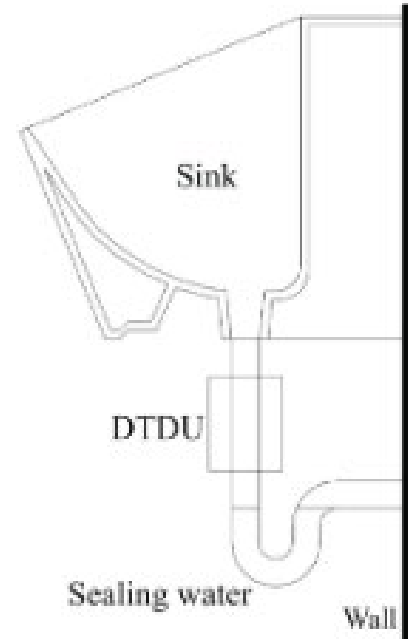
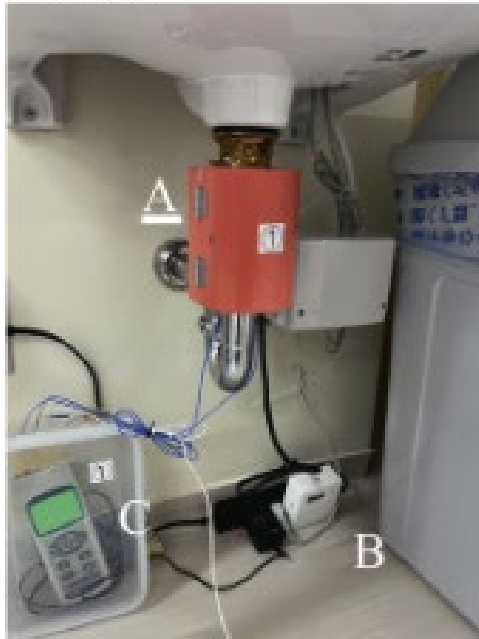
What strategies do you use to address drain contamination in your organisation?

- *Thermal*
- *Chemical*
- *Physical (i.e removal)*
- *A combination*
- *None*



Thermal approaches

Pattern L



- High-temperature flushing ($\geq 60\text{--}100^\circ\text{C}$) disrupts EPS and can kill embedded microorganisms
- Steam penetrates complex drain geometry
- **Limitations:** may not reach all sections pipework and requires safe system design to avoid scalding

Chemical approaches

- Chlorine dioxide, bleach and QACs
- Foaming need to navigate drain geometry
- Activity in presence of organic matter
- **Limitations: Penetration, efficacy varies by chemistry and organic load, poor delivery/contact time**

Removal

- Complete removal and replacement of pipes and drains (also waterless care)
- Physical removal of biofilm
- **Limitations: Expensive, disruptive to clinical areas, biofilm formation starts again?**

Chemical approaches

Key characteristics of a drain disinfectant

- High level efficacy (high log reduction)
- Broad spectrum (including bacterial spores)
- Antibiofilm capability (disrupt EPS)
- Ability to penetrate complex pipe geometries and suitable with different drain types
- Compatibility with materials
- Safe for staff and environment
- Practical delivery method
- Long lasting (determines frequency of application)
- Cost effective



Assessing performance

- Minimum biofilm eradication concentration (MBEC)
- ASTM E2799-22
- Laboratory/experimental models
- Real world vs lab conditions (variation in drain design)
- Biocidal product regulation
- Independent validation



Consideration for efficacy testing

- Log reduction (high)
- Efficacy against multiple species
- Able to penetrate EPS (and eliminate)
- Reduce regrowth/recovery
- Mimic real world conditions (as close as possible)
- Activity in the presence of organic matter



Audience poll

Rank the most important characteristic of a disinfectant used to decontaminate drains/biofilms.

- *Efficacy*
- *Material compatibility*
- *Safety*
- *Residual activity*



Chlorine dioxide as a suitable candidate

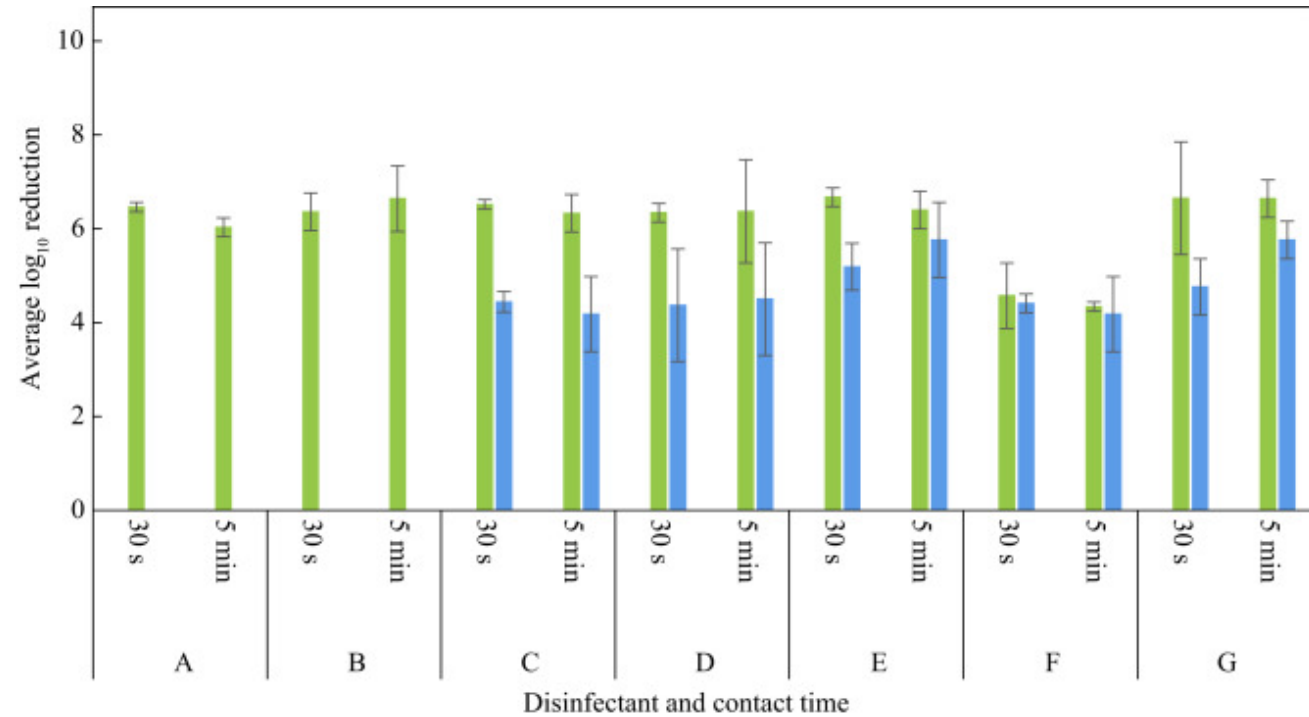
- Strong oxidising agent
- Effective against bacteria, fungi, viruses, spores
- Works in the presence of organic matter
- Low corrosivity compared to hypochlorite
- Minimal harmful by-products
- Supported by growing evidence base

Chlorine dioxide as a suitable candidate

Feature	Chlorine Dioxide	NaDCC	Quats
Anti-biofilm activity	High	High (concentration depend)	Low
Organic load tolerance	High	Low	Low
Corrosivity	Low	High	Low
Fumes / safety	Low	High	Low
Material compatibility	Good	Poor	Good
Evidence in drains	Weak	Weak	Weak

Published evidence

- Various applications of chlorine dioxide tested
- Disinfection efficacy and biofilms
- EN testing and MBEC
- MDROs and PA and SA biofilms
- Efficacy from 30 seconds against biofilms



Summary and recommendations

- Drains and biofilms present a serious IPC challenge
- Reservoir of outbreaks
- Disinfection is complex and multifactorial
- Chlorine dioxide is a potential candidate - strong balance of efficacy, safety and practicality
- **Standardised efficacy tests are required**
- **Innovation and novel methods**
- **Futureproofing and consideration of risk – new hospitals**



programme

Q&A

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