THE EMERGING THREAT OF MULTIDRUG-RESISTANT BACTERIA IN HOSPITAL WATER:

New Approaches to Promote Patient Safety AND Reduce Healthcare-Associated Infections

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Disclosures

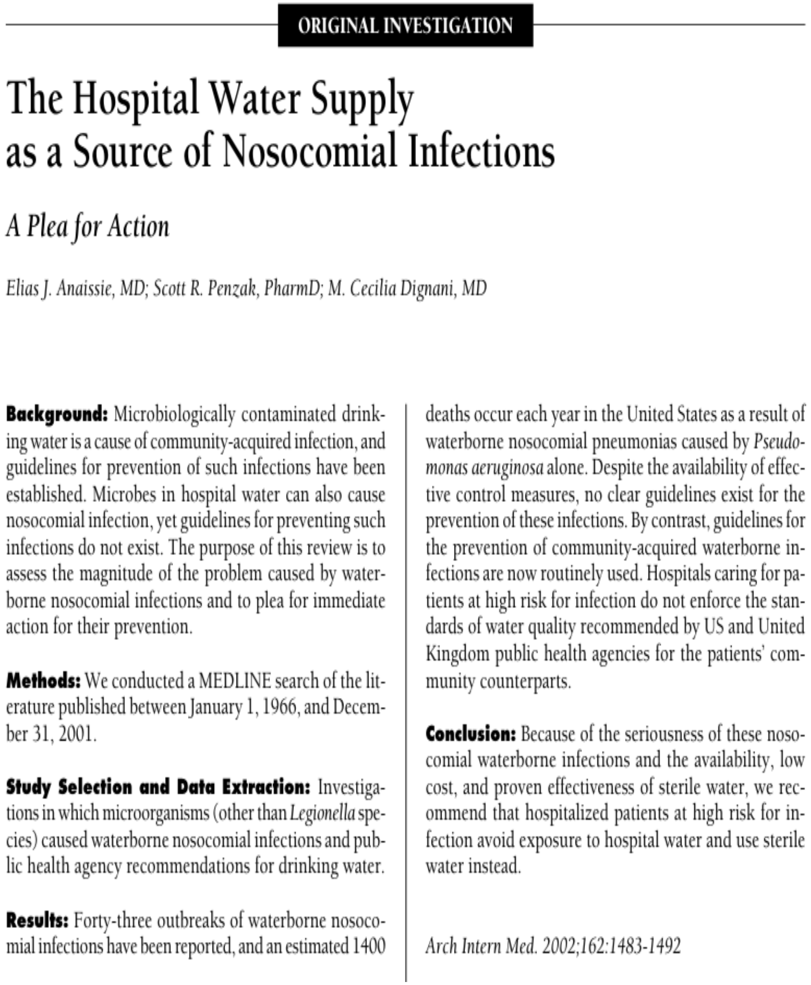
- Joan Hebden is an infection prevention consultant to i3Membrane and received an honorarium for this presentation.

Learning Objectives

- Describe the phases of biofilm proliferation in hospital water systems.
- State how biofilm formation promotes the growth and survival of pathogenic organisms.
- Review the relationship between hospital water systems and the occurrence of healthcare-associated infections (HAIs).
- Identify innovative strategies for addressing the challenges posed by water systems to enhance patient safety.

Waterborne Pathogens and HAIs

A Plea for Action



ORIGINAL INVESTIGATION

The Hospital Water Supply as a Source of Nosocomial Infections

A Plea for Action

Elias J. Anaissie, MD; Scott R. Penzak, PharmD; M. Cecilia Dignani, MD

Background: Microbiologically contaminated drinking water is a cause of community-acquired infection, and guidelines for prevention of such infections have been established. Microbes in hospital water can also cause nosocomial infection, yet guidelines for preventing such infections do not exist. The purpose of this review is to assess the magnitude of the problem caused by waterborne nosocomial infections and to plea for immediate action for their prevention.

Methods: We conducted a MEDLINE search of the literature published between January 1, 1966, and December 31, 2001.

Study Selection and Data Extraction: Investigations in which microorganisms (other than *Legionella* species) caused waterborne nosocomial infections and public health agency recommendations for drinking water.

Results: Forty-three outbreaks of waterborne nosocomial infections have been reported, and an estimated 1400 deaths occur each year in the United States as a result of waterborne nosocomial pneumonias caused by *Pseudomonas aeruginosa* alone. Despite the availability of effective control measures, no clear guidelines exist for the prevention of these infections. By contrast, guidelines for the prevention of community-acquired waterborne infections are now routinely used. Hospitals caring for patients at high risk for infection do not enforce the standards of water quality recommended by US and United Kingdom public health agencies for the patients' community counterparts.

Conclusion: Because of the seriousness of these nosocomial waterborne infections and the availability, low cost, and proven effectiveness of sterile water, we recommend that hospitalized patients at high risk for infection avoid exposure to hospital water and use sterile water instead.

Arch Intern Med. 2002;162:1483-1492

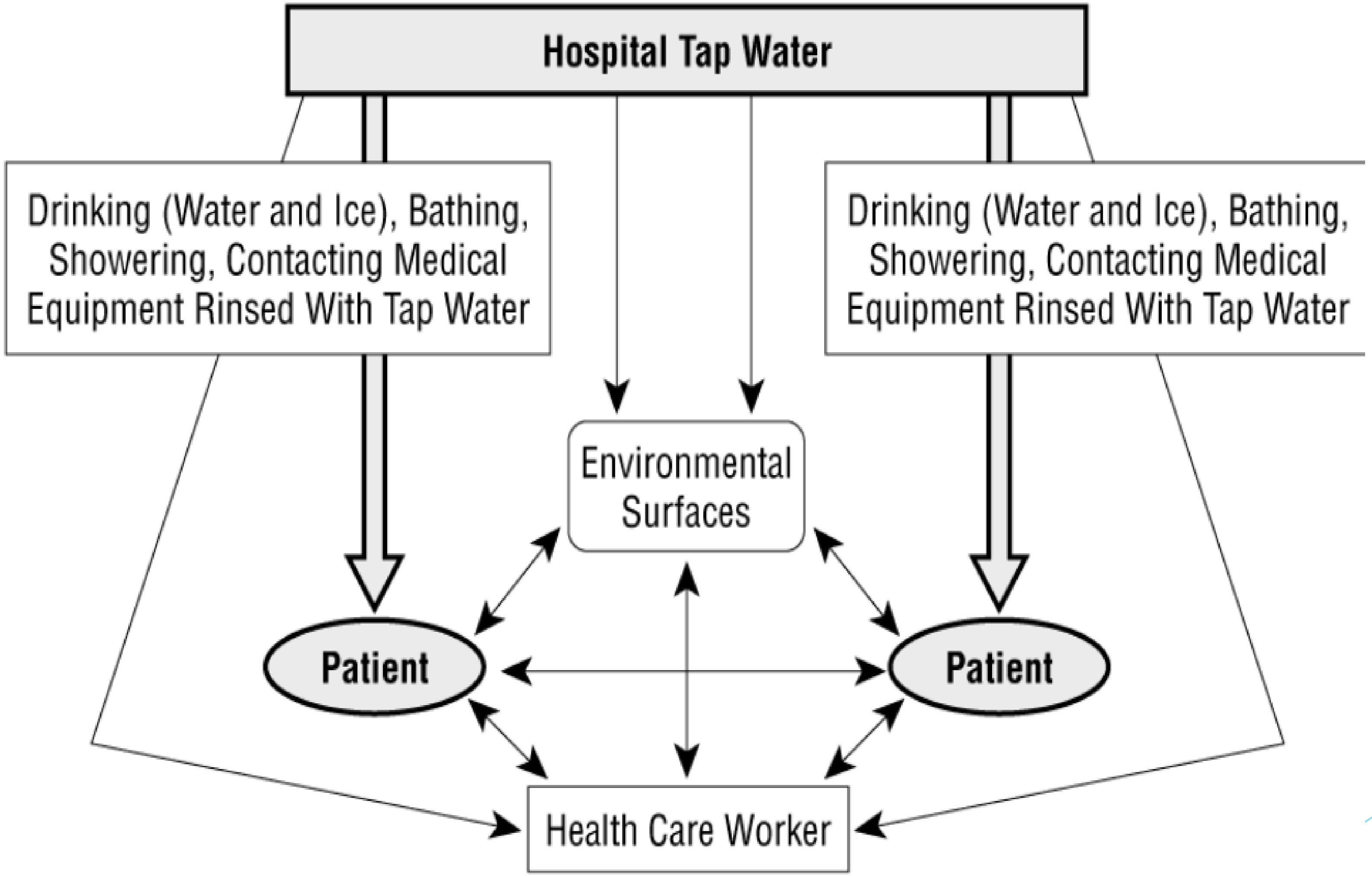
Highlights

- MEDLINE search January 1, 1966-December 31, 2001
- 43 outbreaks of waterborne HAIs
- 1400 deaths annually in the US due to *P. aeruginosa* pneumonias
- Caused by bacteria resistant to at least 2 classes of antimicrobial agents in 76% (13 of 17) of outbreaks with susceptibility testing
- Conclusion:
  - High-risk hospitalized patients should use sterile water

Characteristics of Waterborne HAIs

- Presence and amplification in water reservoirs
- Strong association with water biofilms
- Growth requirement with optimal growth at 25ºC - 45ºC (77ºF - 113ºF) with growth inhibition at higher and lower temperatures
- A link between infection with waterborne pathogens and construction activities
- Mode of transmission
  - Aerosolization
  - Ingestion
  - Contact

Anaissie EJ et al. Arch Int Med 2002;162:1483-1492


Hospital Tap Water
Drinking (Water and Ice), Bathing, Showering, Contacting Medical Equipment Rinsed With Tap Water
Drinking (Water and Ice), Bathing, Showering, Contacting Medical Equipment Rinsed With Tap Water
Environmental Surfaces
Patient
Patient
Health Care Worker

Opportunistic waterborne pathogens and HAIs

Pathogens

- **Bacteria:**
  - *Legionella spp.*
  - *Pseudomonas aeruginosa*
  - *Stenotrophomonas maltophilia*
  - *Acinetobacter spp.*
  - *Burkholderia*
  - *Aeromonas*
  - *Serratia*
  - *Mycobacteria (NTM)*
- **Fungi:** *Aspergillus, Fusarium*

Infections

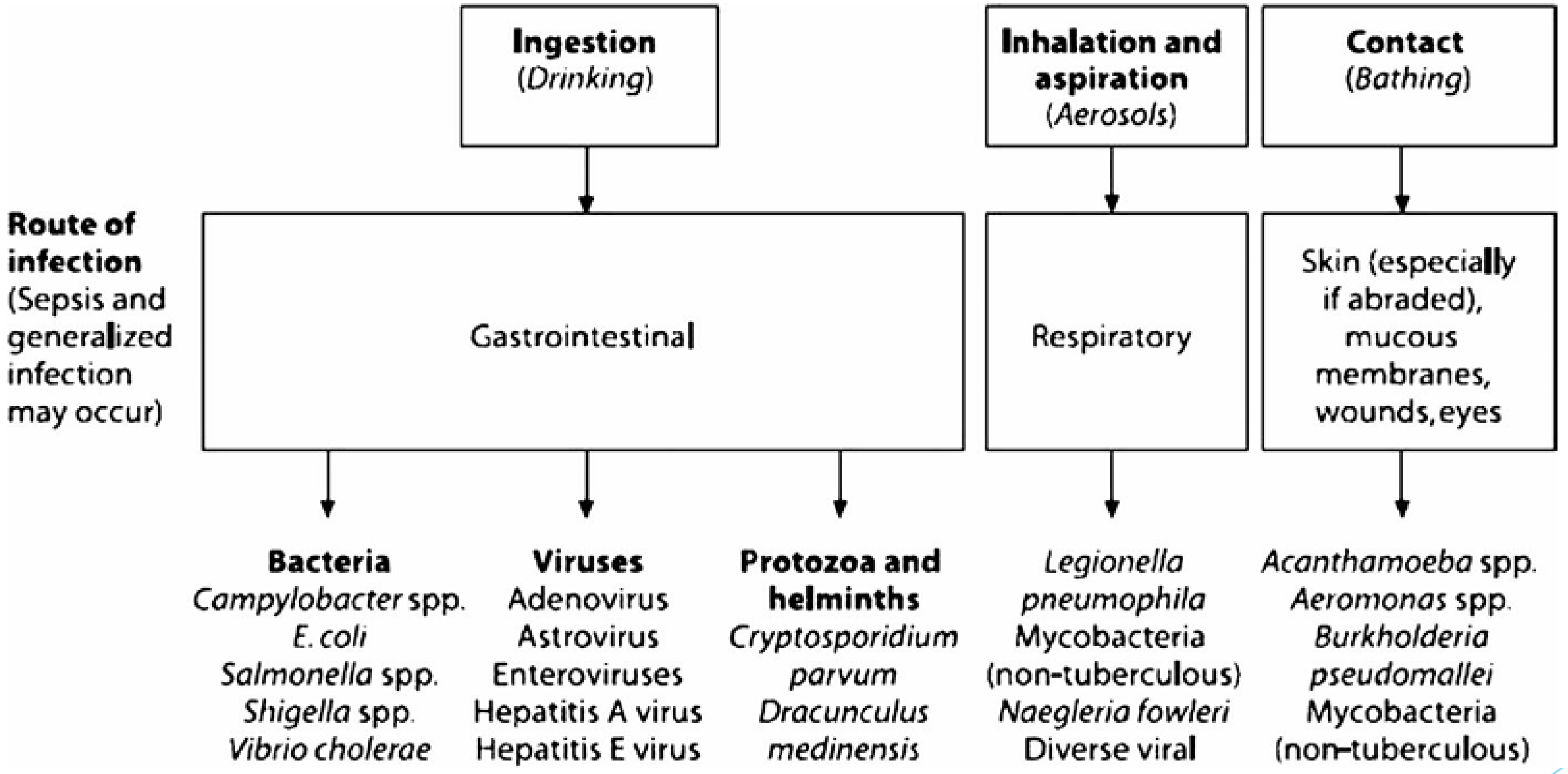
- Bacteremia
- Tracheobronchitis
- Pneumonia
- Sinusitis
- Meningitis
- Ocular
- Peritonitis
- Urinary tract

Legionella pneumophila

Aspergillus fumigatus

Pseudomonas aeruginosa

Mode of Transmission of Waterborne Pathogens

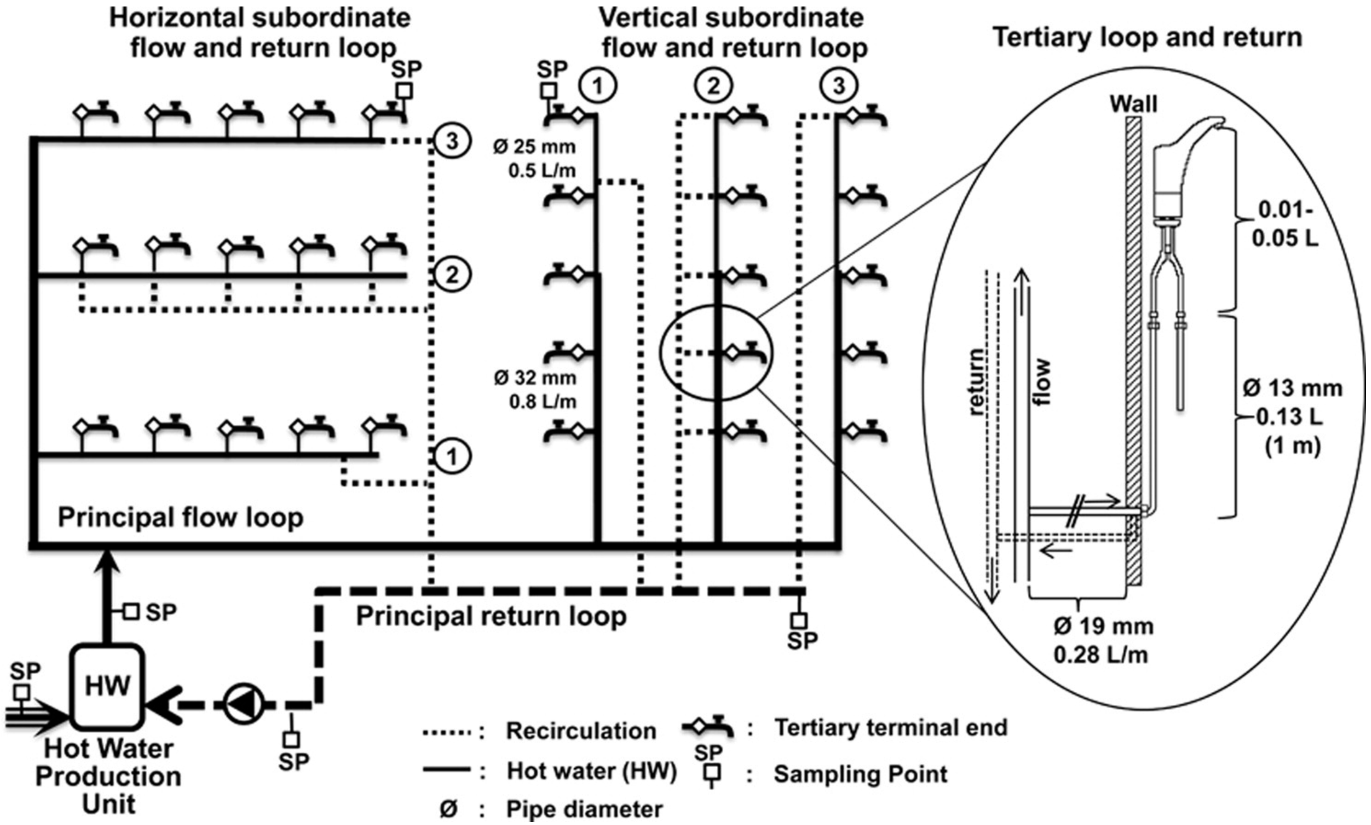


Exner M et al. AJIC 2005; 33(5) S1

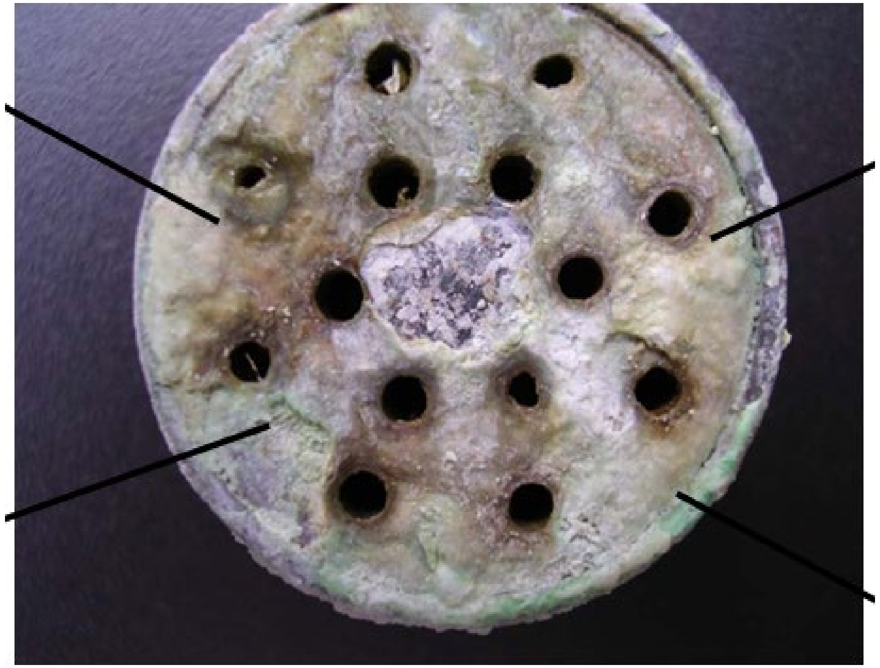
Biofilms

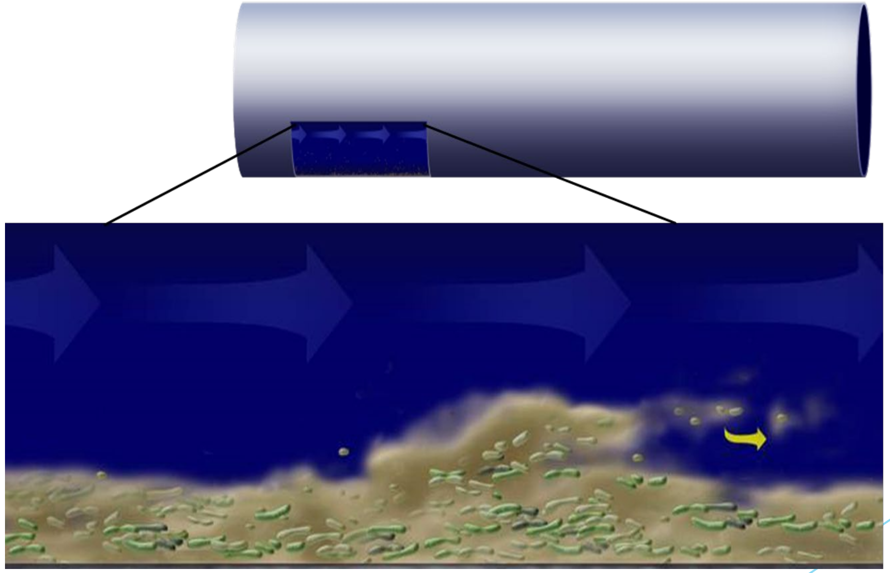
Development and Promotion of Antimicrobial Resistance

The Complexity of Hospital Water Systems



The Challenge: Biofilm Development



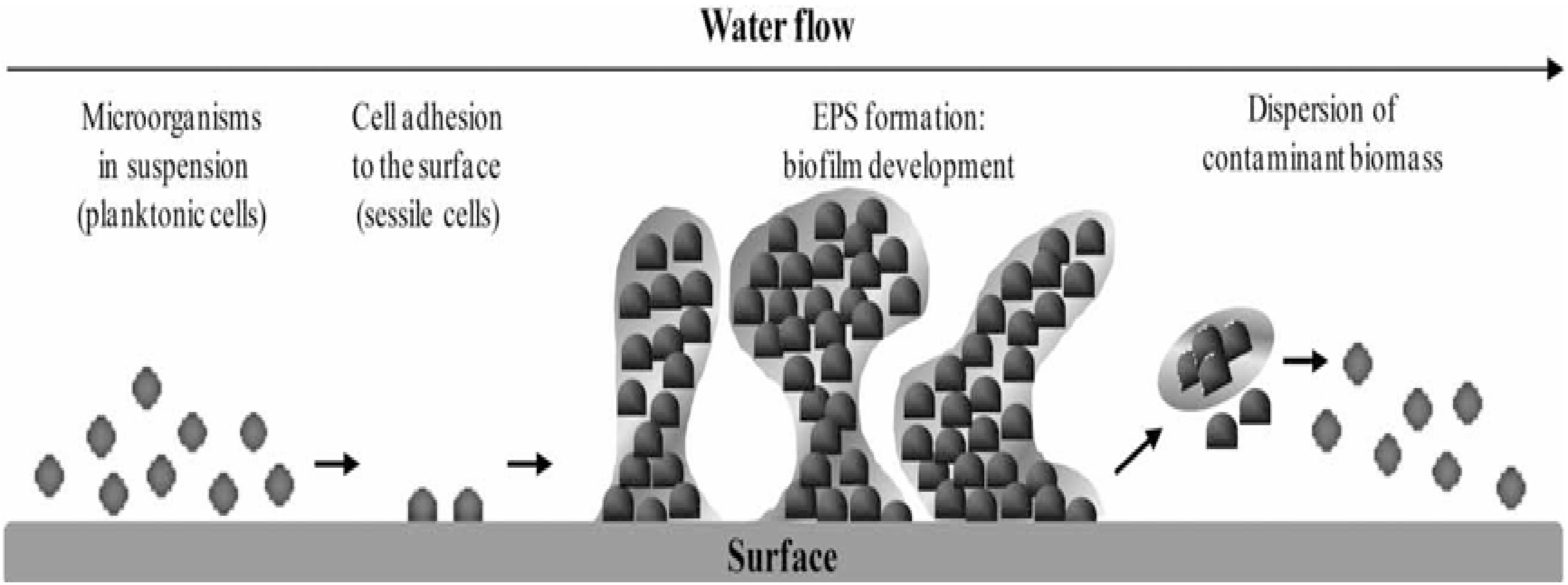


Microbial biofilms may be responsible for more than 65% of bacterial infections in the US.

Factors favoring the development of biofilms in the water system

- **Water system**
  - Number and position of stagnant points in the water supply system
  - Corrosion
  - Aging of the distribution system itself (pipelines, connections, and storage tanks)
  - Formation of solid deposits on the surfaces
- **Pathogen transport**
  - Running water
  - Aerosols formed in taps and showers
  - Contaminated surfaces

Biofilm development



Capelletti RV and Moraes AM. Preventing hospital infections related to waterborne microorganisms and biofilms. J Water and Health 2016 http://iwaponline.com/jwh/article-pdf/14/1/52/394515/jwh0140052.pdf

Biofilm Formation

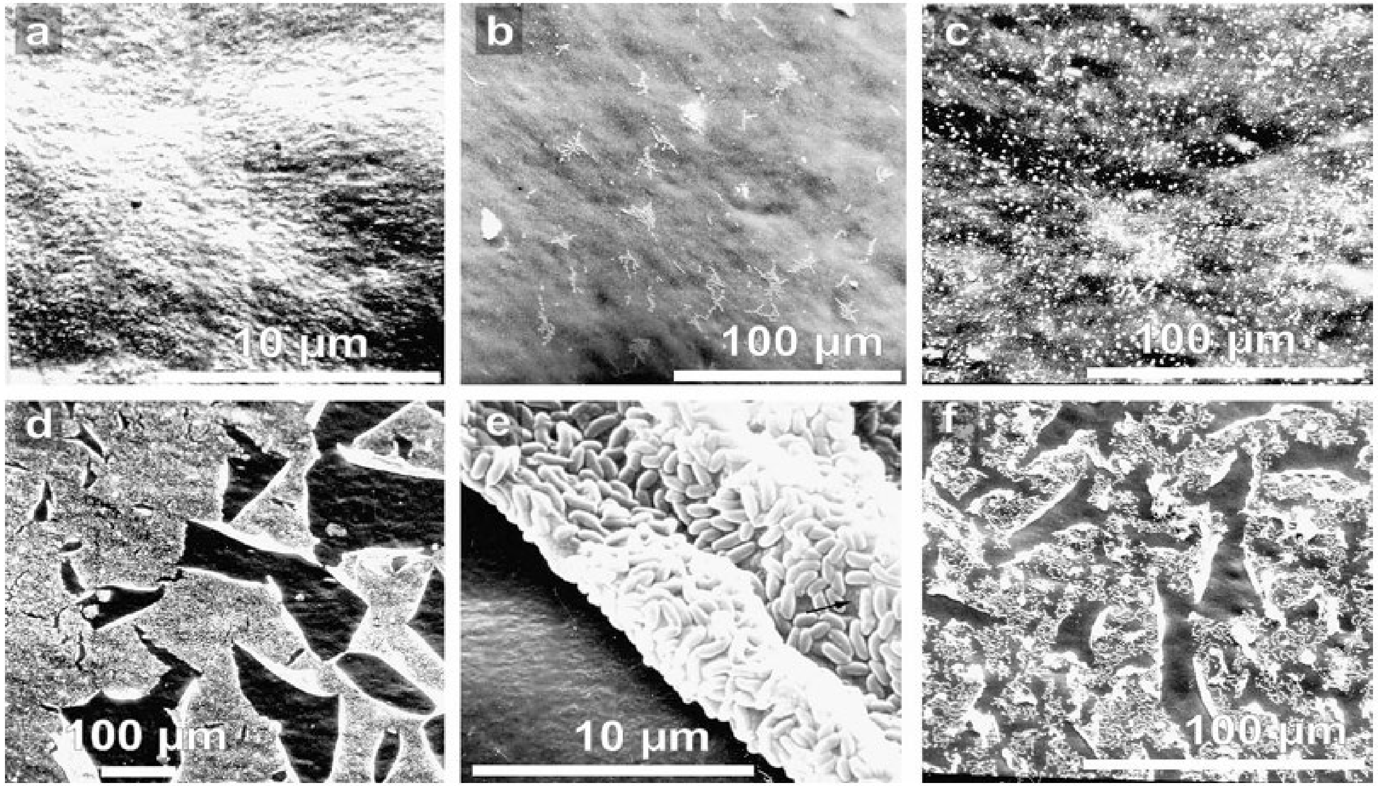
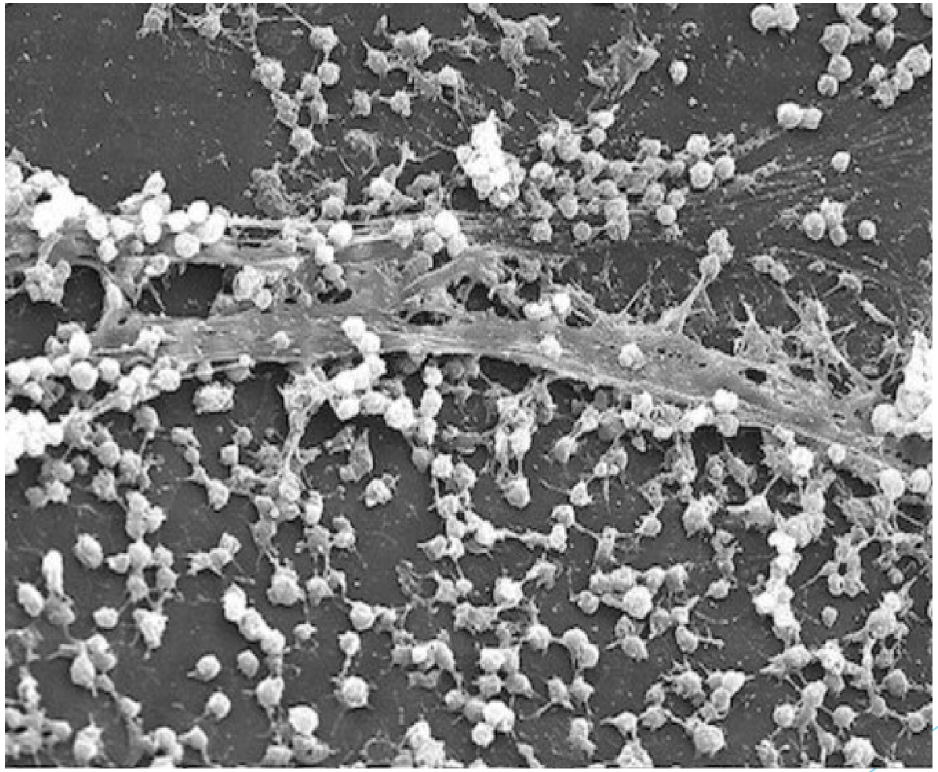


Fig 1. Induction of a biofilm by running drinking water through a silicone tube (inner tube diameter 4 mm). **a**, Inner surface of the control tube without biofilm. **b**, Microcolonies appear after running drinking water for 2 days. **c**, Numerous microcolonies appear after running drinking water for 4 days. **d**, Surface covered with biofilm (disrupted by preparation) after running drinking water for 7 days. **e**, Magnification of **d**. Numerous microorganisms embedded in an extracellular matrix *(arrow)*. **f**, Surface covered with biofilm after running drinking water for 15 days.[12]

Exner M et al.
AJIC 2005; 33(5) S1

Bacterial biofilms and antimicrobial resistance

- Bacteria living in a biofilm can exhibit a 10 to 1,000-fold increase in antibiotic resistance compared to similar bacteria living in a planktonic state
- A study examining antibiotic resistance of *S. epidermidis* in biofilms, 100% of isolates were susceptible to the antibiotic vancomycin when tested in a planktonic state
  - Nearly 75% of them were completely resistant to the same antibiotic when tested within a biofilm.
  - Similar pattern seen with other organisms e.g., *K. pneumoniae*



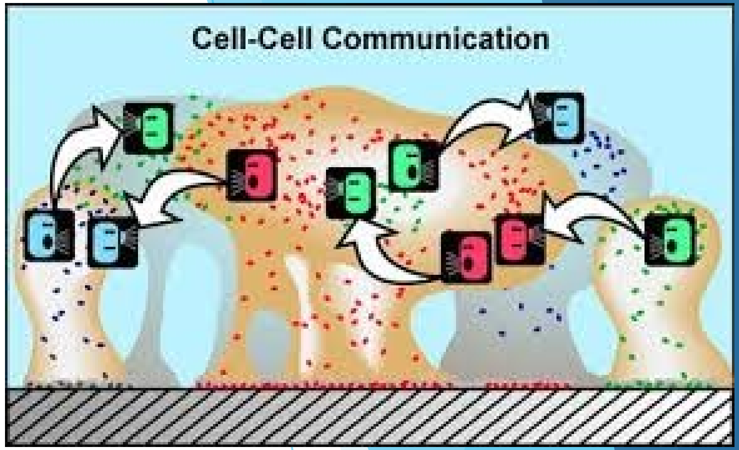
Prinzi A and Rohde R. American Society of Microbiology, Bugs and Drugs article. March 6, 2023.

Bacterial biofilms and antimicrobial resistance

- Biofilm-associated antimicrobial resistance begins at the attachment phase and increases as the biofilm ages
- The extracellular matrix that might physically restrict the diffusion of antimicrobial agents does not appear to be the predominant mechanism
- Mechanism of biofilm-associated antimicrobial resistance seems to be multifactorial
  - Resistance at the biofilm surface: biofilm structure complexity makes it challenging for antibiotics to work their way through the matrix; slow diffusion of the antibiotic may lead to deactivation
  - Resistance within the biofilm microenvironment: antibiotic encounters metabolic byproducts, waste, nutrients, and reduced oxygen; impact on bactericidal activity.
  - Resistance of bacterial "persister" cells

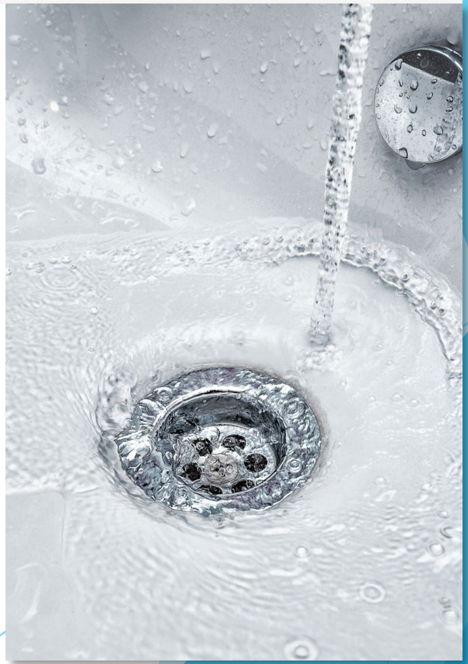
Patel R. *Clinical Orthopaedics and Related Research* 437():p 41-47, August 2005. | *DOI:* 10.1097/01.blo.0000175714.68624.74
Prinzi A and Rohde R. ASM, Bugs and Drugs article. March 6, 2023

Bacterial biofilms and antimicrobial resistance

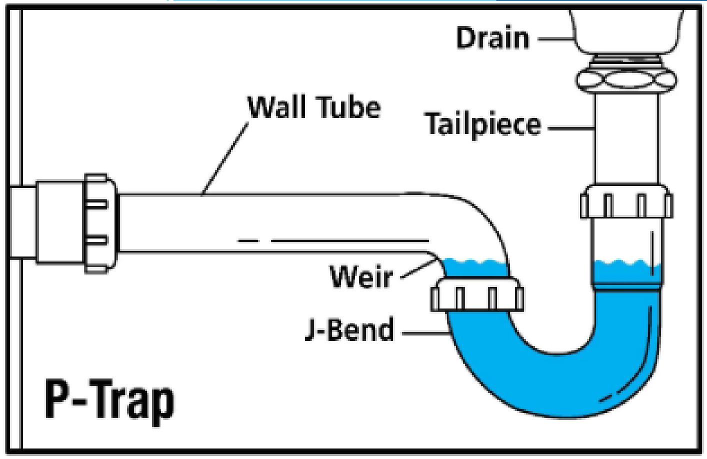


- "Persister" cells: bacterial subpopulations deep in the biofilm layer
  - Enter a dormant state in which they are resistant to extreme conditions, like chemical treatment or antibiotic activity
  - Cell survival and resistance to antibiotic treatment is not related to genetic changes
  - When the organisms are released from the biofilm or begin dividing again, they return to their pre-persister susceptibility profile
- Advantages to the biofilm environment for bacteria
  - Proximity to multiple organisms
  - Supports bacterial communication and allows for the transfer of mobile genetic elements
  - The biofilm environment supports plasmid stability and allows organisms to transmit resistance information more readily.

The Role of the Sink, Drains and Faucets



Sink Drains and Dispersion



- Sink drains have been identified as important reservoirs for multidrug-resistant Gram-negative bacteria
  - Drain contamination caused fluorescent droplets in wash basins in 80% of experiments, with splashing observed up to 30 cm from the drain.
  - P-trap/tailpiece contamination did not result in droplets outside the drain, suggesting drains—not deeper plumbing—are the primary risk.
  - Drain plugs reduced droplet dispersal (13/25 experiments without plugs vs. 5/25 with plugs; P = 0.04).
  - Tap positioning influenced spread: sinks with taps directly above drains had droplets on basin walls, **while offset taps limited dispersal.**
- Regular drain maintenance is critical, as colonized drains—not p-traps—contribute to environmental/surface contamination.

Pirzadian J et al. J Hosp Infection 2022; 127: 39-43
https://www.journalofhospitalinfection.com/article/S0195-6701(22)00134-7/fulltext

Sink Trap – Antibiotic and Chemical Residue

- Survey of Sink Infrastructure and Sink Trap Antibiotic and Chemical Residue in 29 UK Hospitals
  - Antibiotics were detected in 95/287 (33%) sink traps and were associated with medicines/drug preparation rooms ($P < 0.001$)
  - Antibiotic residues in sink traps can contribute to the development of antimicrobial resistance by promoting the exchange of mobile resistance genes
  - **Intervention:** pragmatic approach to optimize sink usage, placement and design features to minimize the risk of bacteria and biofilm emerging into the basin and being disseminated by contaminated water splatter e.g., faucet angle designed to prevent splashing

Rodger G et al. J Hosp Infection 2025;159:140-147

Systematic Reviews and Outbreaks

Systematic Review

- Systematic review of hospital water as a reservoir of carbapenem-resistant organisms (CROs)
  - Over last 20 years, 32 reports of CROs in the hospital water environment, with half occurring since 2010
  - Majority involved clinical outbreaks in ICUs: critically ill and immunocompromised patients
  - Drains, sinks, and faucets were most frequently colonized
  - Predominant organism - *Pseudomonas aeruginosa* (41% of studies)
  - Evidence of CRO transmission between the environment and patients based on phenotypic [8] or genotypic methods when assessed
  - Transmission may result from direct or indirect water contact or from droplets created during water activities
  - The incorrect design and use of hand-wash basins and other water areas may propagate outbreaks

Kinzy Gordon AL, et al. CID 2017:64 (15 May)

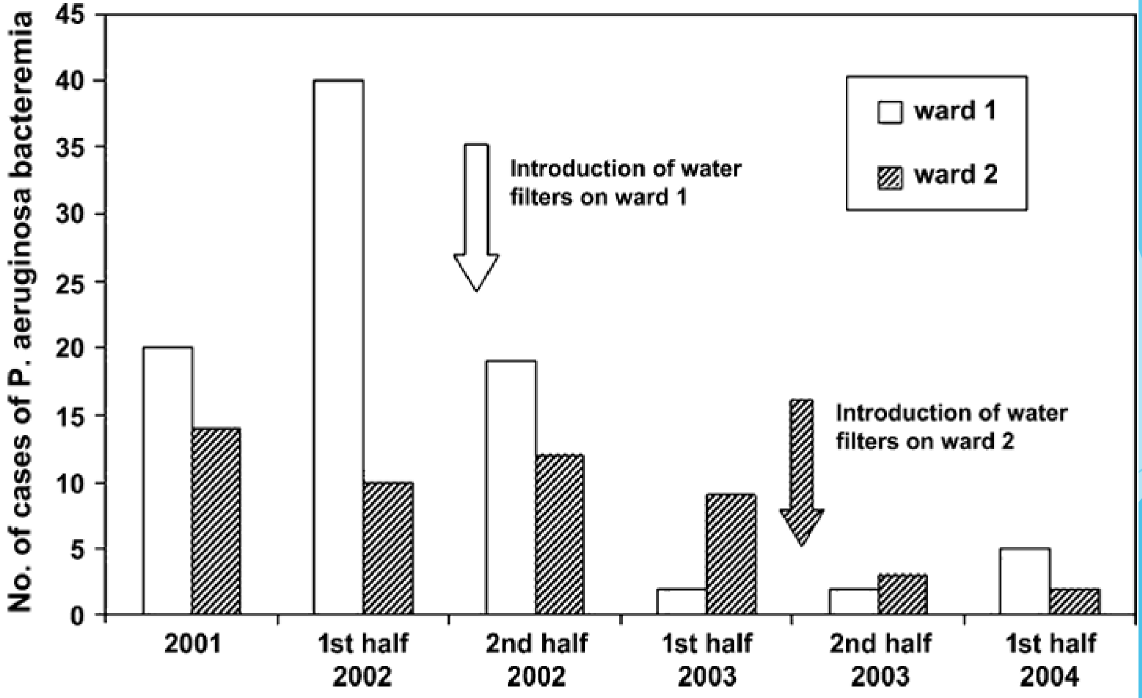
Outbreak Investigation

- Extended-spectrum beta-lactamase-producing Enterobacteriaceae (ESBLE) outbreaks in ICUs
  - Multi-centre study in 13 ICUs, including microbiological testing for ESBLE contamination at 185 sinks[1] ; 57 sinks were contaminated (31%) with ESBLE, mostly Klebsiella and Enterobacter
  - 81 sinks (44%) were used for handwashing as well as the disposal of body fluids; splash risk was identified for 67 sinks (36%) among which 23 were contaminated by ESBLE
  - Lower sink contamination rate was significantly associated with use of the sink being restricted to handwashing and to daily sink disinfection using bleach
  - An ICU with a cluster of infections was associated with the spread of the same strain into numerous sinks; water from all the taps was directed straight into the drain with visible spray back onto surfaces
- Transmission from contaminated sinks to healthcare providers hands can occur[2]

1Roux D et al. J Hosp Infection 2013; 85: 106-111
2Kanamori H, Weber DJ, Rutala WA. CID 2016;62(11):1423–35

Water Outlets as a Reservoir for Opportunistic Pathogens

- ICU tap water: significant source of exogenous *P aeruginosa* (PA) isolates
- 9.7% and 68.1% random tap water samples on different types of ICUs were positive for PA and between 14.2% and 50% of colonization episodes in patients were due to genotypes found in ICU water
- Installation of single-use filters on ICU water outlets appears to be an effective concept to reduce water-to-patient transmissions



Trautman M et al. AJIC 2005;33(5) S1

Ricci P, Graldi P, Galli S, Vinelli N. Pseudomonas infections and water treatment in a haematology ward. 30th Congresso Nationale L'Azienda Sanitaria, Sorrento, Italy, 2004, abstract no. 164.

Water Outlets as a Reservoir for Opportunistic Pathogens

- Tap water as a source of *Pseudomonas aeruginosa* in a medical ICU setting
  - *P. aeruginosa* was found in 11.4% of 484 tap water samples taken from patients' rooms and in 5.3% of 189 other tap water samples (*P*<0.01)
  - *P. aeruginosa* was isolated from 38 patients; molecular typing of *PA* isolates revealed that more than half of patient colonization was acquired through tap water or cross-transmission
  - 11/21 (52.4%) faucets tested were contaminated with strains of *PA* that matched patient isolates often from the same or neighboring rooms: **contaminated tap water can directly contribute to patient colonization**
  - In several cases, the genotypes of *PA* from hands of HCWers matched those from the last patient they had contact with or the last tap water sample used: **HCWers can act as vectors for *P. aeruginosa* transmission**

Rogues AM et al. J Hosp Infection 2007;67(1):72-78
https://www.journalofhospitalinfection.com/article/S0195-6701(07)00209-5/abstract

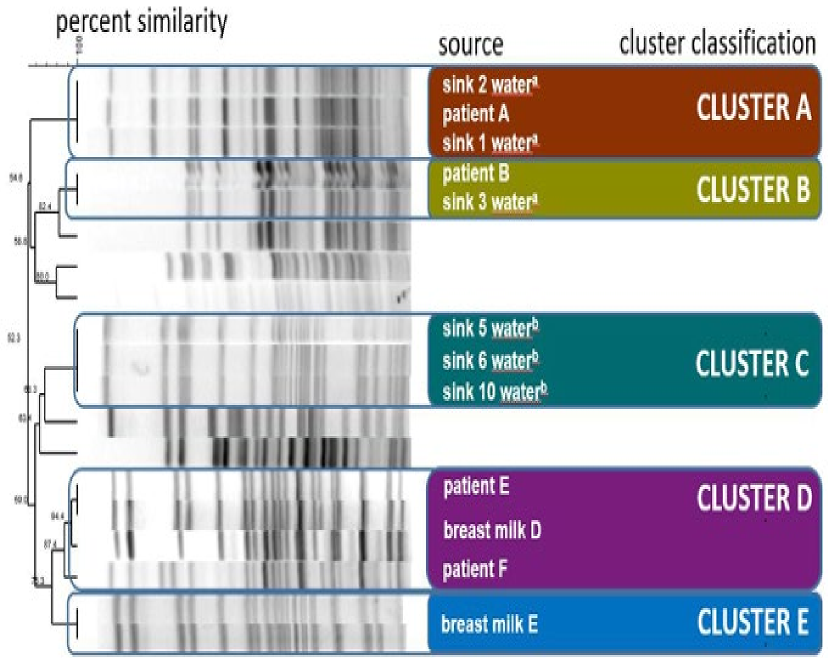
Outbreak Investigation – Neonatal ICU

- High-risk population for infection: underdeveloped neonatal immune systems and use of invasive devices, e.g., umbilical catheters, endotracheal tubes
- Outbreak with *P. aeruginosa* : 8 cases with 2 deaths; previous outbreak mitigated with improved hand hygiene and enhanced environmental cleaning
- PA was isolated from swabs or bulk water from 4 of 7 NICU sinks sampled. Swabs or bulk water from 3 of 10 sinks sampled also showed HPCs of >1000 CFU/mL; water splashing observed onto adjacent countertops, including those designated for preparation of breast milk and infant formula
- Practice issues: Humidifier reservoirs of incubators were filled with tap water, despite manufacturer IFU recommending distilled water; tap water used for bathing; parents cleaned reusable breast pump equipment using handwashing sinks that were also used for other medical purposes

Weng MK et al. Am J Infect Control 2019;47:1148-1150

Outbreak Investigation – Neonatal ICU

- After hyperchlorination and filter placement, post-filter water samples had HPCs of <3 CFU/ml; *P aeruginosa* was still cultured from first-catch faucet water samples from 3 of 5 NICU faucets sampled
- Plumbing proximal to NICU sinks was replaced to mitigate infection risks
- Practice interventions: preparing formula and breast milk away from splash zones near sinks, bathing with sterile water, manufacturer IFUs for using breast pump equipment and refilling and maintaining humidifier reservoirs of incubators



Several environmental and patient isolates were indistinguishable by PFGE

Weng MK et al. Am J Infect Control 2019;47:1148-1150

Infection Prevention in the NICU

Published in final edited form as:
Clin Perinatol. 2021 June ; 48(2): 413–429. doi:10.1016/j.clp.2021.03.011.

Infection Prevention in the Neonatal Intensive Care Unit

Julia Johnson, MD, PhD[1], Ibukunoluwa C. Akinboyo, MD[2], Joshua K. Schaffzin, MD, PhD[3,4]

Environmental sampling,
in the absence of an ongoing outbreak,
is of unclear significance

- Colonization of plumbing fixtures has been linked to NICU outbreaks
- Mitigation:
  - avoiding areas of decreased flow
  - ensuring proper disinfection
  - sinks should be designated for waste disposal only or handwashing only
  - sterile water for infant bathing
  - dry warmers for human milk
  - facilities with untreated source water should install filtration or chemical disinfection at the intake point

Point-of-Use Filtration: The Science

Microfiltration of piped water at the tap

A complementary strategy to reduce HAI risk: Ortolano G et al. Am J Infect Control 2005; 33(5)S1

Determining Bacterial Retention of Membrane Filters

- Designed to assess the retentivity of a sterilizing filter under standard challenge conditions
- Challenge of 10^7 bacteria per cm^2 of effective filtration area is selected to provide a high degree of assurance
  - has sufficient sensitivity to detect oversized pores
  - filter will quantitatively retain large numbers of organisms
  - challenge organism, *B. diminuta*

Standard Active | Last Updated: Aug 11, 2023 Track Document

ASTM F838-20

Standard Test Method for Determining Bacterial Retention of Membrane Filters Utilized for Liquid Filtration

F838 Standard Test Method for Determining Bacterial Retention of Membrane Filters Utilized for Liquid Filtration

POU Filtration: The Science

- Tap water examinations revealed high levels of P aeruginosa colonization of all water taps of the surgical ICU (SICU)
- Water outlets of the SICU were equipped with disposable point-of-use water filters, changed weekly and, later, 2-week intervals.
- Microbiologic examinations of tap water revealed growth of *P aeruginosa* in 113/117 (97%) samples collected during the prefilter period, compared with 0/52 samples taken from filter-equipped taps
- **Mean monthly episodes of *P. aeruginosa* colonization/infection dropped from 3.9 ± 2.4 (prefilter) to 0.8 ± 0.8 (postfilter)**
- **Colonizations decreased by 85% ($p < 0.0001$), and invasive infections were reduced by 56% ($p < 0.0003$); belonging to the postfilter cohort was strongly associated with reduced infection risk (relative risk = 0.04, $p = 0.0002$)**
- **POU water filtration significantly reduced endemic *Pseudomonas aeruginosa* colonization/infections in the SICU**

Trautmann M et al. Am J Infect Control 2008;36(6):421-429

POU Filtration: The Science

“Filter units could prevent exposure of high-risk patients to waterborne pathogens”

- **Study**: evaluate the ability of point-of-use filters to eliminate *Legionella* and other pathogens from water
- **Methods**: 120 ml hot water samples were collected from 7 faucets (4 with 0.2 micron filters and 3 without) immediately and after a 1-minute flush
  - Samples were collected q2-3 days for 1 week; cycle was repeated for 12 weeks
  - Samples were cultured for *Legionella*, total HPC bacteria, and *Mycobacterium species*
- **Results:**
  - 594 samples collected over 12 cycles
  - No *Legionella* or *Mycobacterium* were isolated from the faucets with filters between time 0 and 8 days
  - Mean concentration of L. pneumophila and Mycobacterium from the control faucets was 104.5 CFU/mL and 0.44 CFU/mL, respectively

Filters achieved a >99% reduction in HPC bacteria in the immediate and post-flush samples

Sheffer PJ et al. Am J Infect Control 2005; 33(5)S1

POU Filtration: The Science

- **Point-of-use filtration method for the prevention of fungal contamination of hospital water**
- Previous study by these investigators demonstrated recovery of filamentous fungi from 94% of water samples collected within the hospital, with recovery of *Aspergillus fumigatus* from 49% and 5.6% of water samples from taps and showers, respectively
- Isolates from patients with proven invasive aspergillosis were genotypically identical to those recovered from hospital water
- POU filters were applied to several outlets (taps and showers) on the pediatric bone marrow transplantation (BMT) unit; filters eliminated the fungi from the water on day 1
- Laboratory experiments showed that the filters were highly effective in reducing the number of CFUs for a period of at least 15 days.

Warris A et al. J Hosp Infection 2010;76(1):56-59 https://doi.org/10.1016/j.jhin.2010.03.014

Comparison of Water Treatment Methods for the Reduction of Microbial Contamination

Ortolano G et al. Am J Infect Control 2005; 33(5)S1

Method	Ease of installation	Cost	Maintenance	Efficacy Short-term	Efficacy Long-term	Disadvantage
Heat	Easy	Low	Easy	Good	Poor	Failure to maintain consistent temperature Recolonization at low temperature Hard to reach all taps with dead-leg piping and antiscald valves Scalding potential Labor intensive Recontamination occurs in 30-60 days Increase in biofilm sloughing possible May not penetrate biofilm
Chlorine	Difficult must hold 10-50 ppm for 12-24 hr, shock method or 1-2 ppm continuous	High	Fair-difficult	Good	Fair	Amoeba, harbingers of bacteria, are resistant to chlorine Recolonization after system disinfection *Legionella* species more resistant to chlorination System corrosion causes pipe leaks and can promote biofilm formation Carcinogenic byproducts (trihalomethanes) Chlorine levels checked frequently Potential resistance of Mycobacteria Does not penetrate into center of established biofilms
Chlorine dioxide	Fair	Low-Moderate	Fair-Difficult	Good	Poor	Unknown corrosive properties Unknown maintenance of effective concentration in hot water systems Does not penetrate completely into biofilm Costly

Method	Ease of installation	Cost	Maintenance	Efficacy Short-term	Efficacy Long-term	Disadvantage
						Costly
Monochloramines	Fair	Moderate	Fair-difficult	Good	N/A	More difficult to remove from water than chlorine or chlorine dioxide May not penetrate into biofilm Potential resistance of Mycobacteria Must be removed from water used for dialysis
Copper-silver ionization	Fair	Low-Moderate	Moderate			Metallic ions added to drinking water Works well only on water with low dissolved solids content Can corrode steel or galvanized pipe Not equally effective for all pathogens
UV	Fair, local effect	Moderate	Moderate cleaning for effective energy transmission	Good	Fair	Scale problems Electricians required Poor penetrating power of UV light in established biofilms
Ozone	Difficult	High	Moderate	Good	Poor	May cause injured cells Partially degraded organics may enhance biofilm formation Disinfects only at the point of injection Decomposes quickly in hot water Hard to hold effective concentration Specialized equipment required to generate ozone
POU filtration	Easy, immediate barrier	Low	Simple	Good	Good	Correct installation essential for bacterial removal

Potential for Retrograde Colonization of the POU Filter

- Ability of POU filters to sequester *P. aeruginosa* depends on the duration and frequency of use and water quality
- Some studies have reported *P. aeruginosa* contamination occurring within the recommended term of use given by the manufacturer
- Hollow-fibre filters are gaining popularity as they allow greater flow of water and for structural strength allowing for longer use
- Water from 25 showers tested was heavily colonized (>300 cfu/mL) with *P. aeruginosa* at the showerhead
  - *P. aeruginosa* was found in 32% (8/25) of post-filter shower water effluent
  - Filters were sampled at 15 -150 days of use (median 15 days), with 26% (6/23) of filter units becoming colonized before the expiry date.
- Failure potentially due to retrograde contamination (external contamination of the showerhead passed back to the filter cartridge itself) or failure of the hollow-fibre filter matrix

Yetis O et al. J Hosp Infection 2022;130:1-6

ISO 22196: Validation of the Bacteriostatic Activity

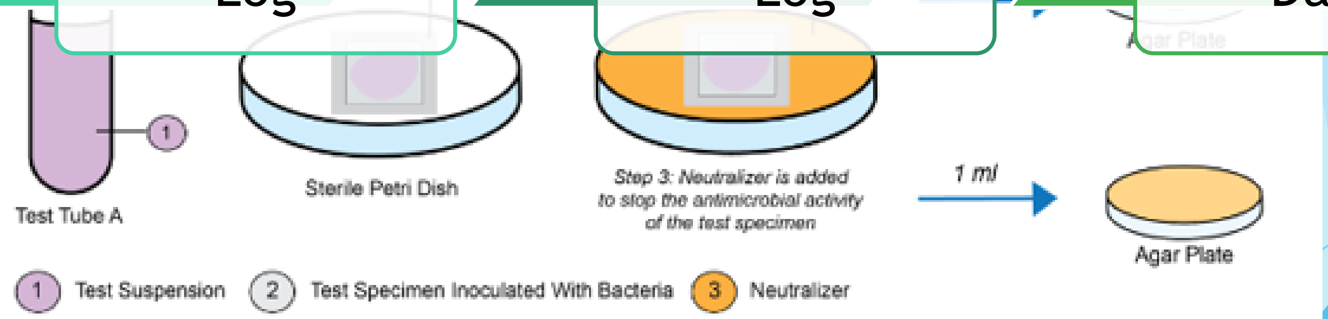
> 4 log *Ps. aeruginosa, E. coli, Staph. aureus* in 24 h.

30 Days: 5 Log

50 Days: 4 Log

60 Days: 3 Log

90 – 120 Days?



ISO 22196:

VALIDATION OF THE ANTIMICROBIAL > 4 LOG

Guidelines and Standards

SHEA/IDSA/APIC Practice Recommendations: Hand Hygiene

- Take steps to reduce environmental contamination associated with sinks and drains
  - Ensure that handwashing sinks are constructed according to local administrative codes
  - Include handwashing sinks in water infection control risk assessments for healthcare settings
  - If possible, dedicate sinks to handwashing
  - Educate HCP to refrain from disposing substances that promote growth of biofilms (eg, intravenous solutions, medications, food, or human waste) in handwashing sinks
  - Use an EPA-registered hospital disinfectant to clean sink bowls and faucets daily
  - Do not keep medications or patient care supplies on countertops or mobile surfaces that are within 1m (3 feet) of sinks.
  - Consult with state or local public health official when investigating confirmed or suspected outbreaks of HAIs due to waterborne pathogens of facility plumbing

Glowicz JB et al. Infection Control & Hospital Epidemiology 2023;44(3): 355 - 376

CMS Requirement QSO-17-30 Hospitals/Critical Access Hospitals/LTC

Facilities must have water management plans and documentation that, at a minimum, ensure each facility:

- Conducts a facility risk assessment to identify where *Legionella* and other opportunistic waterborne pathogens (e.g. *Pseudomonas*, *Acinetobacter*, *Burkholderia*, *Stenotrophomonas*, nontuberculous mycobacteria, and fungi) could grow and spread in the facility water system.
- Develops and implements a water management program that considers the ASHRAE industry standard and the CDC toolkit.
- Specifies testing protocols and acceptable ranges for control measures, and document the results of testing and corrective actions taken when control limits are not maintained.
- *Maintains compliance with other applicable Federal, State and local requirements.*

Note: CMS does not require water cultures for Legionella or other opportunistic water borne pathogens. Testing protocols are at the discretion of the provider.

CDC Guidelines – *Legionella* Toolkit

- Sediment and biofilm, temperature, water age, and disinfectant residuals (STAR) are the key factors that affect *Legionella* growth in potable water systems

Use the document:

- 1. Help evaluate hazardous conditions associated with potable water systems 2. Implement Legionella control measures for potable water systems per ASHRAE Guideline 3. Complement existing resources for water management programs (WMP) 4. Support environmental assessments conducted during public health investigations


December 26, 2024

Version 1.2

Toolkit for Controlling *Legionella* in Common Sources of Exposure (*Legionella* Control Toolkit)

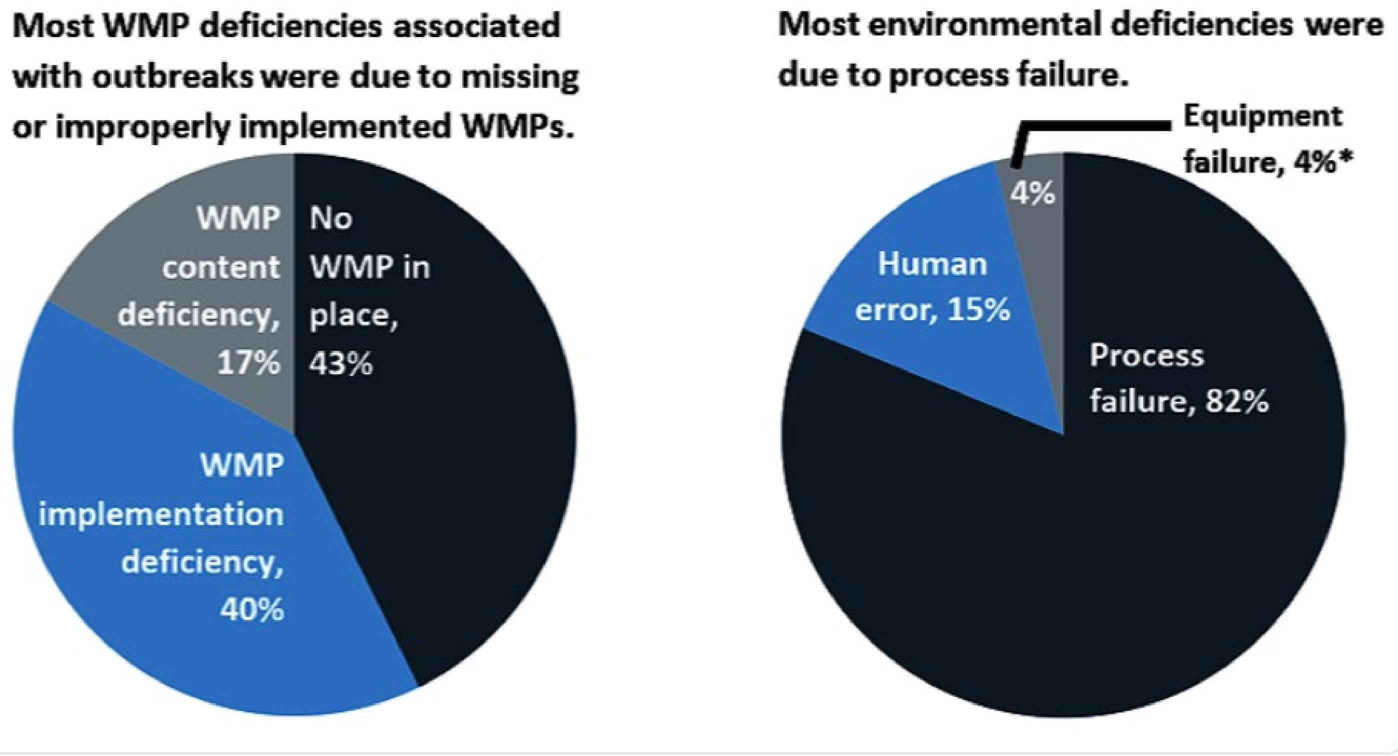
https://www.cdc.gov/control-legionella/php/data-research/outbreaks-water-management-gaps/index.html

CDC Legionella Toolkit

- Recognize that point-of-use (POU) microbial filters with an effective pore size of 0.2-microns or less that comply with the requirements of ASTM F838 can provide immediate control at individual fixtures in a water system if integrated into a water management plan.
- POU filters protect only the connected fixture. Correct location selection is critical to *Legionella* exposure prevention across the water system
- Follow the manufacturer recommendations regarding frequency of replacement and appropriate operating conditions
- POU filters may need to be removed before performing an acute remediation procedure

Water Management Program Team

Water Management Plan Deficiencies



https://www.cdc.gov/control-legionella/php/data-research/outbreaks-water-management-gaps/index.html

WMP Resources

[Water Management Program Template]

[Water Management Program (WMP) Evaluation Tool]

[Water Management Program Evaluation Tool – Excel supplement]

[www.cste.org]

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

- Standards for water management
- ASHRAE 188: Legionellosis: Risk Management for Building Water Systems
  - Conduct a building survey to determine its risk characterization
  - Develop a Water Management Plan for Legionella control in all building water systems
  - Document the Plan with all specified verification and validation steps followed
- ASHRAE 514 – Risk Management for Building Water Systems: Physical, Chemical, and Microbial Hazards
  - New and Updated Standard November 2024
  - Requirements are similar to ASHRAE 188 but are more developed
  - Some additional requirements: e.g., contingency response plan for potable hot and cold water to address water sampling and locations, test methods in response to disease or outbreak as well as the corrective action plan and the persons responsible.

https://www.ashrae.org/technical-resources/standards-and-guidelines/guidance-for-water-system-risk-management

Summary

- Increasing awareness of serious clinical sequelae, particularly among immunocompromised patients at high risk for morbidity and mortality, from exposure to water-borne pathogens in hospitals.
- Biofilm development and proliferation in plumbing infrastructure promotes antimicrobial resistance; <u>supports plasmid stability and allows organisms to transmit resistance information</u>.
- Water splatter from the sink drain allows pathogen dispersal to the environment and/or transmission to patients.
- Bacterial drain reservoirs are often difficult to eradicate, as commonly used hospital disinfectants have limited efficacy on these biofilms, and recolonization may occur after exposure to contaminated materials or retrograde growth from p-traps.
- POU filtration (0.2*um or less)* serves as an efficient and cost-effective adjunct to secondary water treatment for the prevention of transmission of waterborne pathogens.
- The new ASHRAE standard 514 should be thoroughly reviewed to ensure regulatory compliance with your water management plan and team composition.

Thank you

Questions?