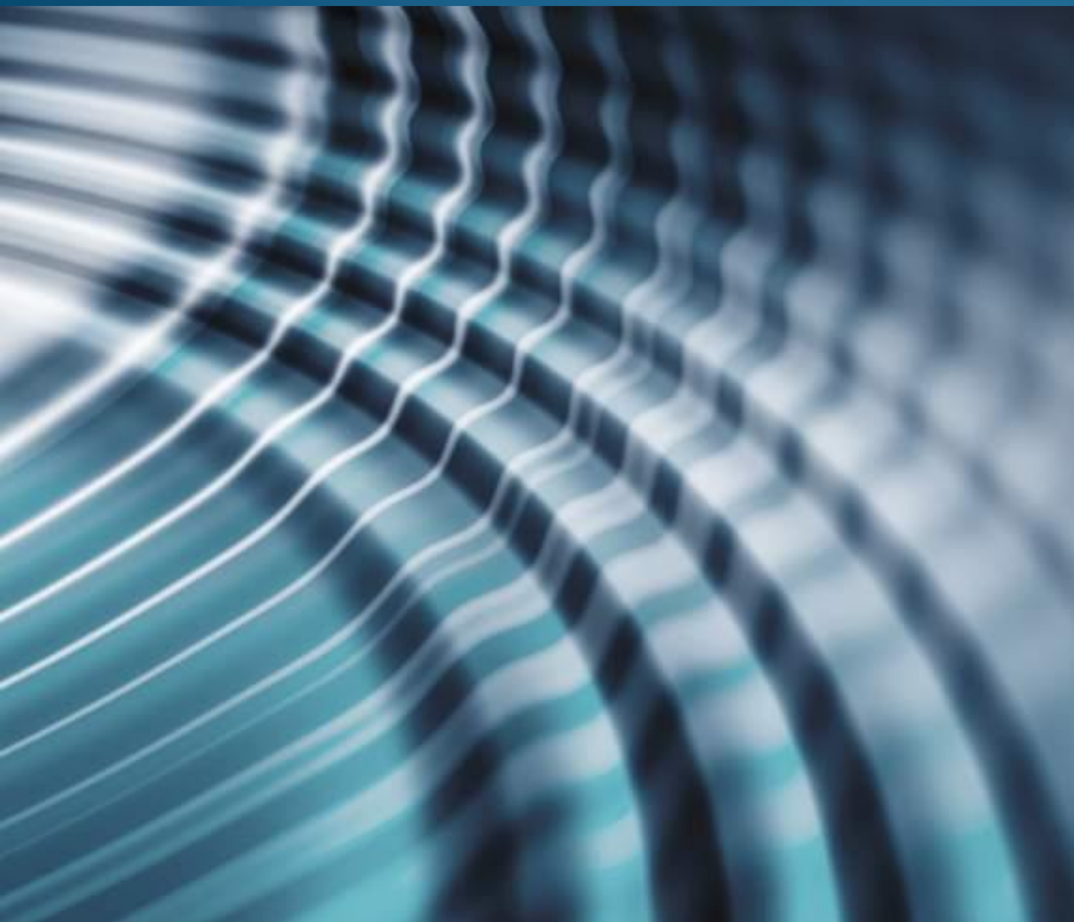


Waterborne Pathogens:

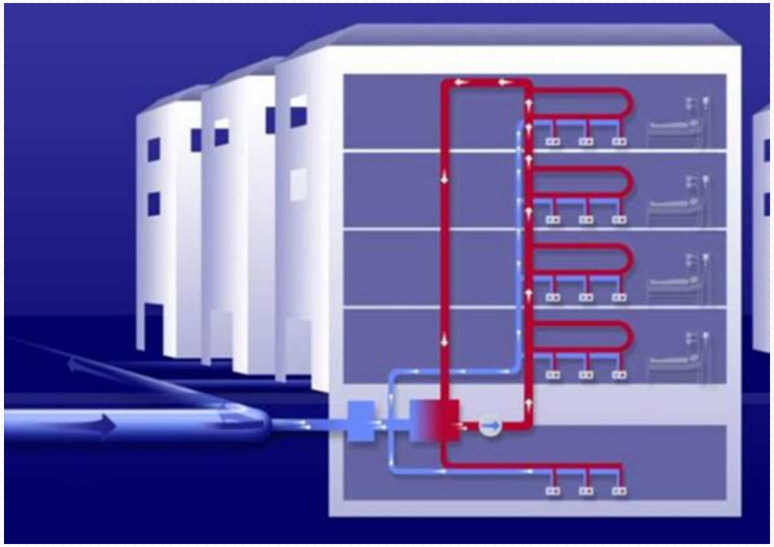
A source for Hospital Acquired Infections

Presented by:
Dustin Crumby, RN BSN MBA

Disclosures

- Employee of PALL Corporation, however this presentation does not express my personal interest or the interest of PALL Corporation.

Objectives



- Recognize that potable water systems are a source of gram negative hospital acquired infections
- Develop an understanding of the IMPACT of waterborne pathogens in the healthcare setting

Professional Background

- 10 years of nursing experience in various roles including ICU, Wound Care, Infection Prevention, and Healthcare Administration.

Water is essential to life…

- Approximately 71% of the earths surface is water
- Approximately 60% of the human body is comprised of water
- Adult humans must consume between 2-3L of water per day

Hospital Acquired Infections and Infection Prevention

- Approximately 1 out of 20 hospitalized patients in the U.S. will contract an HAI.
- Infection prevention and control measures aim to reduce the risk of acquiring an infection while receiving care, with particular focus on those who are most vulnerable.
- Infection prevention promotes quality within the healthcare setting creating an environment that is safe for the patient and the staff in a cost efficient manner.

Costs of HAIs

Type of Infection	Low Cost	High Cost
Surgical Site Infection	$10,443	$25,546
Central Line Associated Blood Stream Infect.	$5,734	$22,939
Catheter Associated Urinary Tract Infection	$589	$758
Ventilator Associated Pneumonia	$11,897	$25,072
Average of All HAIs:		
$13,973 with a standard deviation of $17,998		

Scott, R.D. (2009). *The direct medical costs of Healthcare-Associated Infections in U.S. Hospitals and the benefits of Prevention.* CDC. Retrieved from http://www.cdc.gov/HAI/pdfs/hai/Scott_CostPaper.pdf

Direct costs of multidrug-resistant Acinetobacter baumannii in the burn unit of a public teaching hospital.

Wilson SJ, Knipe CJ, Zieger MJ, Gabehart KM, Goodman JE, Volk HM, Sood R.
AM J Infect Control. 2004 Oct: 32(6):342-2

Am J Infect Control. 2004 Oct;32(6):342-4.

Direct costs of multidrug-resistant Acinetobacter baumannii in the burn unit of a public teaching hospital.

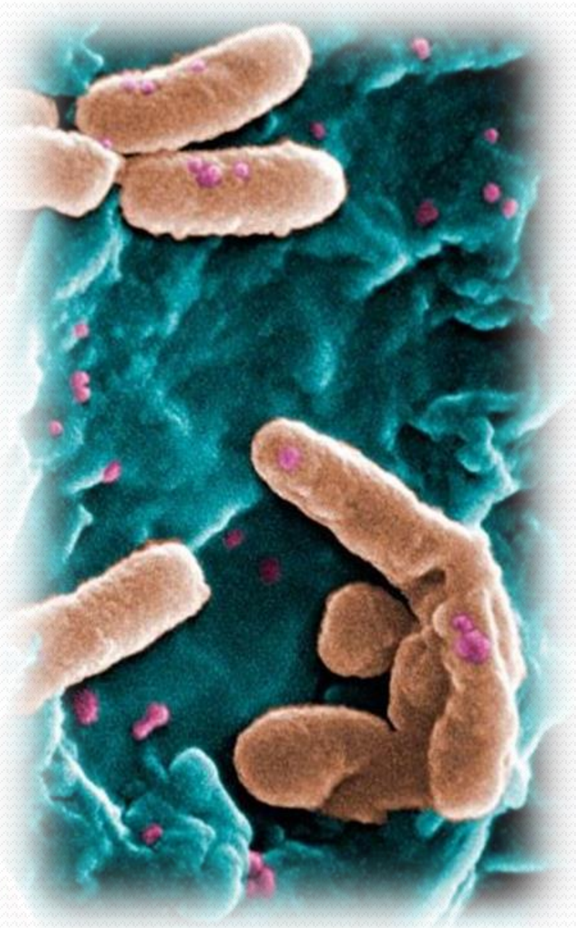
Wilson SJ[1], Knipe CJ, Zieger MJ, Gabehart KM, Goodman JE, Volk HM, Sood R.

⊕ Author information

Abstract

We conducted a case-control study to determine the attributable direct costs of multidrug-resistant Acinetobacter baumannii (MDRAB) in the burn unit of a public teaching hospital. The mean total hospital cost of patients who acquired MDRAB was 98,575 dollars higher than that of control patients who had identical burn severity of illness indices (P <.01). These data should help infection control practitioners and others determine the cost-effectiveness of specific interventions designed to control this emerging nosocomial pathogen.

Waterborne Pathogens

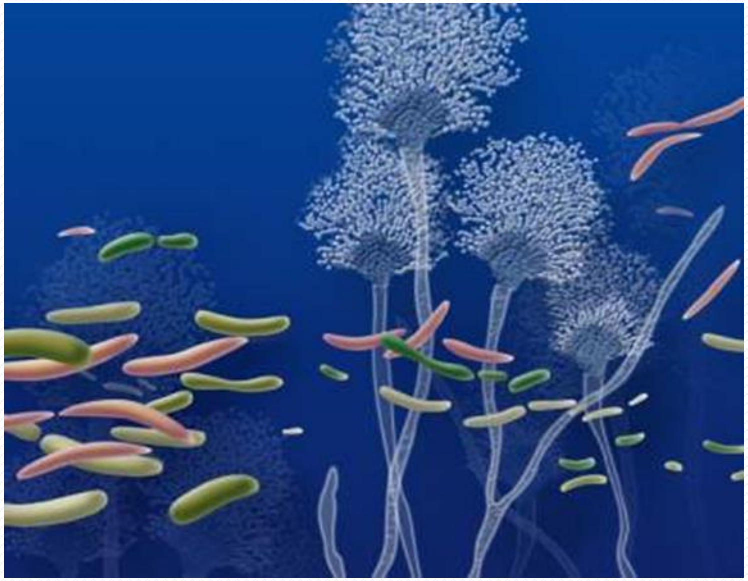


- Microorganisms that are present in water supplies have been linked to infecting susceptible hosts.
- Infections commonly result during bathing/washing, drinking, preparation of food, manufacturing of ice, rinsing medical devices, and aerosolization of water particles from flowing water.

Common infectious agents found in potable water

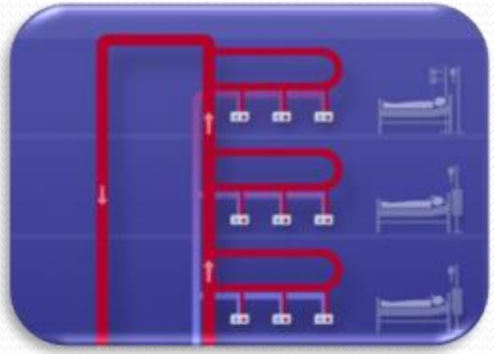
A large variety of microorganisms can be detected within water systems:

- *Pseudomonas* spp.
- *Legionella* spp.
- Nontuberculous Mycobacteria
- *Acinetobacter* spp.
- *Cryptosporidium* spp.
- *Klebsiella* spp.
- *Escherichia* coli
- *Aspergillus* spp.



Pseudomonas aeruginosa and ***Legionella pneumophila*** are among those which are of particular concern for immunocompromised patients

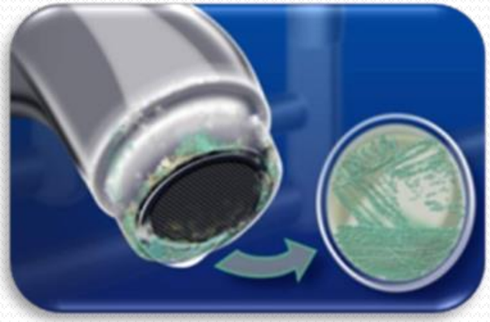
Water systems as a potential source of hospital associated infections



Hot water recirculation loops

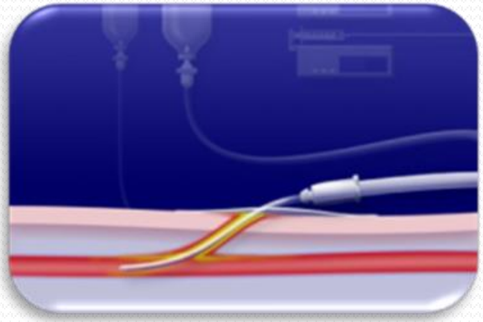
Biofilms found in plumbing systems

Portal of exit



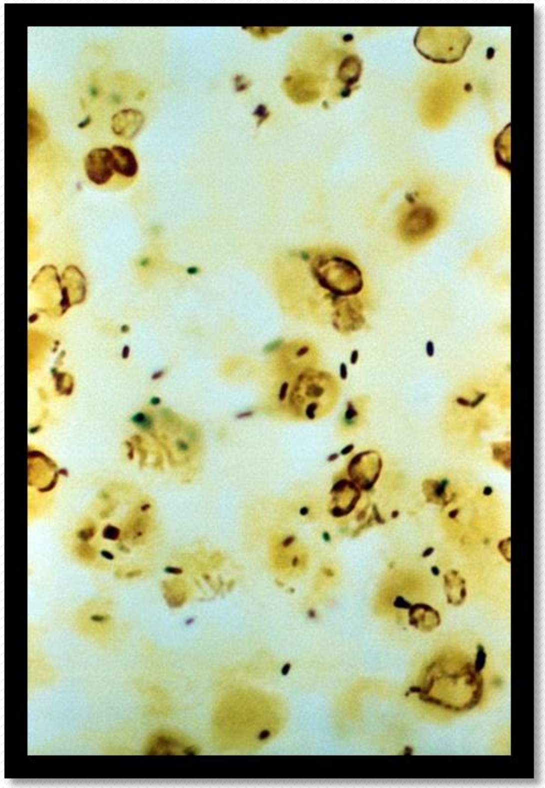
Bacterial colonization

Modes of transmission



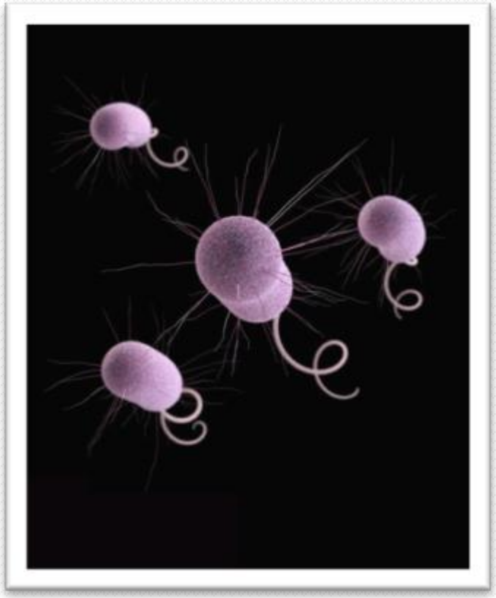
Portal of entry

Legionella species



- Gram negative bacteria naturally found in the environment, usually in warm water.
- Legionella bacteria is not transmitted from person to person
- Can cause Legionnaires' disease or Pontiac fever
- People get the disease when they breathe in the mist that is contaminated with bacteria

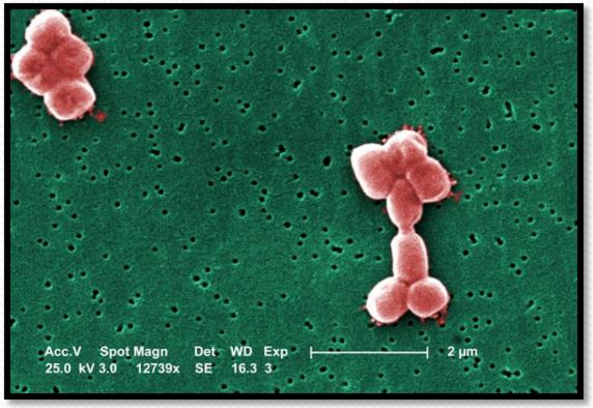
Pseudomonas species



- Gram negative bacteria found naturally in the environment.
- Generally targets people with weakened immune systems.
- Most commonly spread by healthcare workers, hospital water systems and improperly cleaned equipment.
- Approximately 51,000 HAIs occur in the US annually

Acinetobacter species

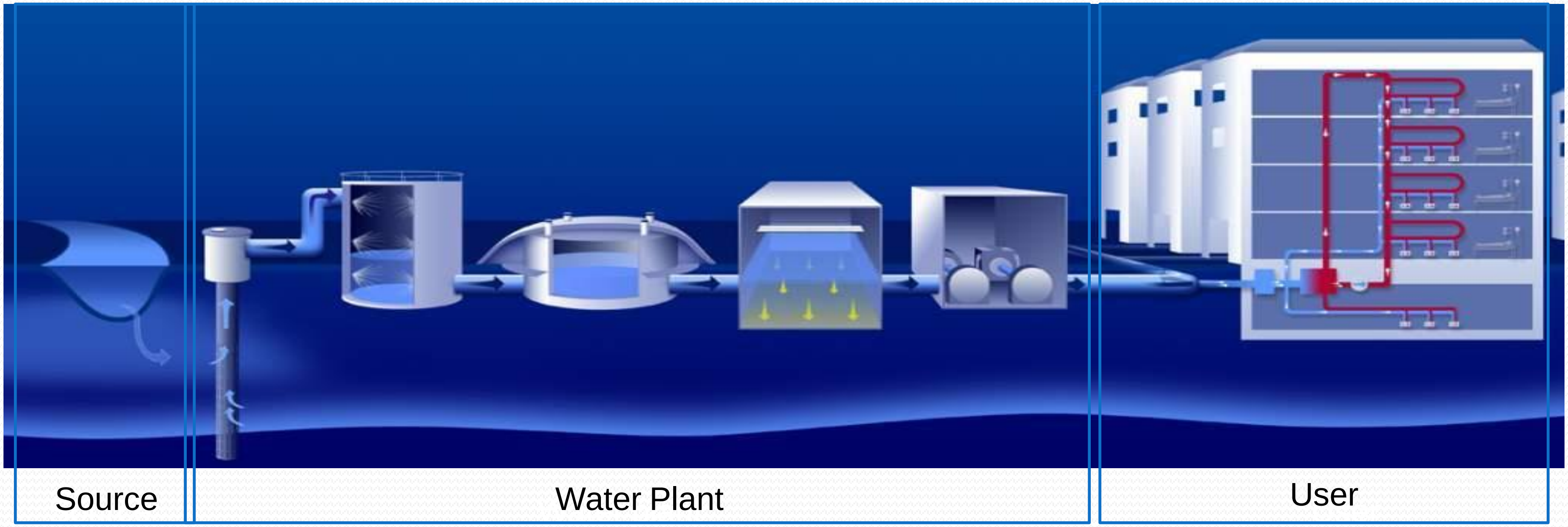
- Gram negative bacteria that generally targets immune compromised patients.
- Generally isolated from water and soil.
- High rate of antibiotic resistance.
- Known for it's ability to form biofilms and survive on artificial surfaces.



How does bacteria enter the water system?

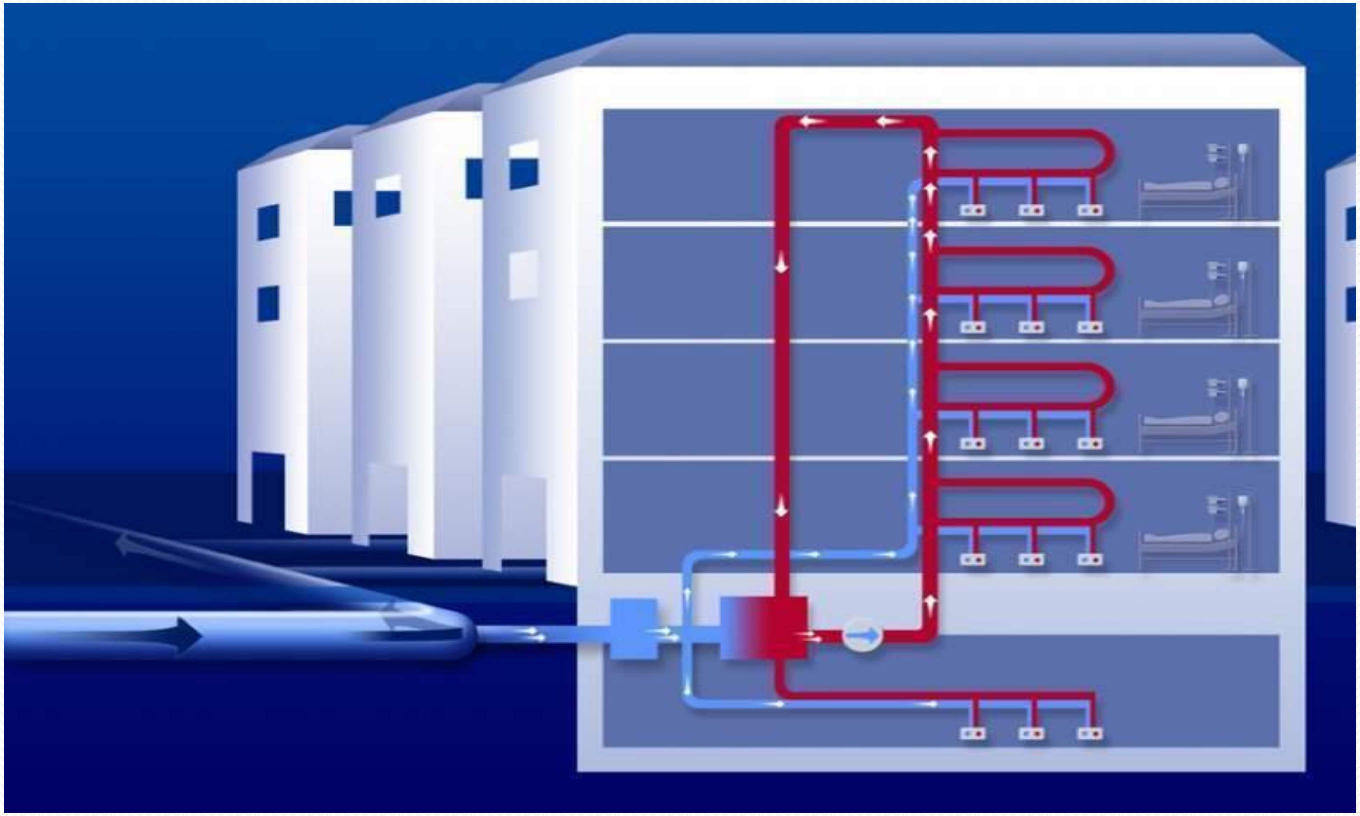
- During initial construction, remodels, maintenance and water line breaks
- From patient or staff to water supply
- Incoming water supply

Drinking water supply chain



Water transport from source to communities

Drinking Water Supply Chain



Plumbing of hospital premises is a reservoir for opportunistically pathogenic microorganisms: a review

Williams, M.M., Armbruster, C.R., and Arduino, M.J.
Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, GA, USA: Department of Microbiology, University of Washington, Seattle, WA, USA

Conclusion:

- Several bacterial species are natural inhabitants of portable water distribution systems that are opportunistic pathogens to sensitive patients in healthcare facilities.
- Infection prevention is challenging since there is lack of understanding of the ecology, virulence and infectious does of these opportunistic infections
- Water distribution systems and equipment or services can serve as reservoirs for waterborne pathogens.

Plumbing of hospital premises is a reservoir for opportunistically pathogenic microorganisms: a review

Margaret M. Williams[a]*, Catherine R. Armbruster[b] and Matthew J. Arduino[a]

[a]*Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, GA, USA;* [b]*Department of Microbiology, University of Washington, Seattle, WA, USA*

(*Received 7 September 2012; final version received 6 December 2012*)

Several bacterial species that are natural inhabitants of potable water distribution system biofilms are opportunistic pathogens important to sensitive patients in healthcare facilities. Waterborne healthcare-associated infections (HAI) may occur during the many uses of potable water in the healthcare environment. Prevention of infection is made more challenging by lack of data on infection rate and gaps in understanding of the ecology, virulence, and infectious dose of these opportunistic pathogens. Some healthcare facilities have been successful in reducing infections by following current water safety guidelines. This review describes several infections, and remediation steps that have been implemented to reduce waterborne HAIs.

Keywords: healthcare-associated infection; biofilm; potable water; premise plumbing; opportunistic pathogen

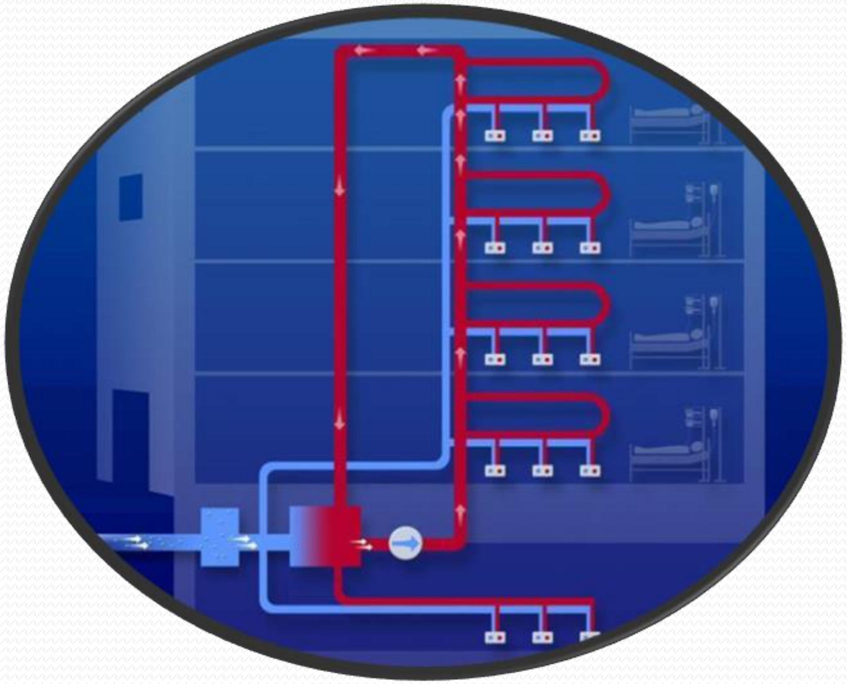
Introduction

Water distribution systems (WDS) and equipment or services using water can serve as reservoirs for waterborne

deficiencies, solid organ and hematopoietic transplants). The special circumstances that lead to waterborne HAI occur at the three-way intersection of non-sterile potable

Reservoirs in Healthcare Water System

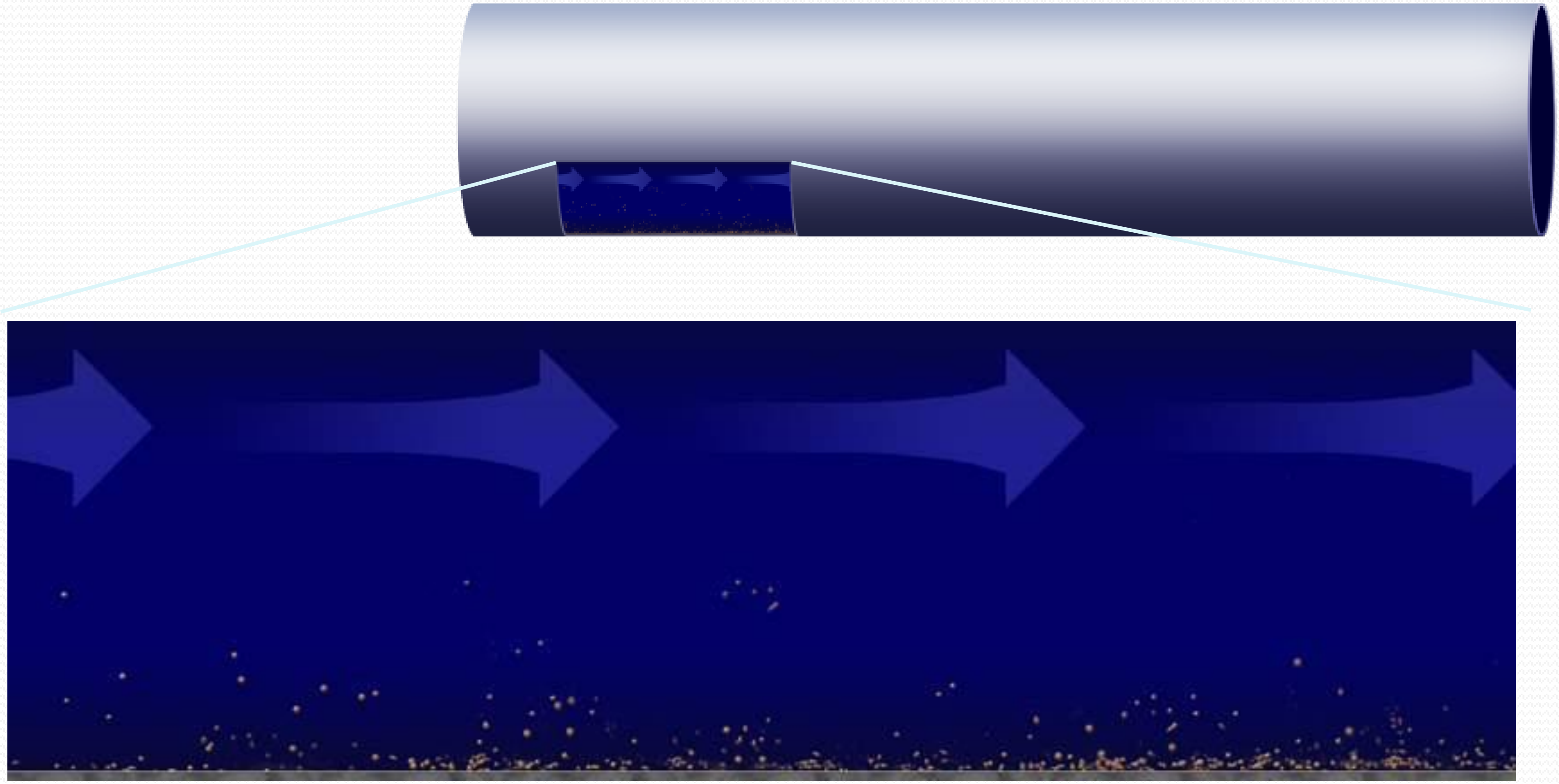
- Corrosion of pipes and valves
- Dead ends
- Hydrotherapy tubs
- Mixing valves
- Ice Machines
- OR Hose Reals



Biofilms

- Group of microorganisms that stick together in a matrix allowing the organisms to adhere to a surface
- The matrix of extracellular polymeric substance provides protection to the group of microorganisms
- Microorganisms can multiply and/or remain viable in biofilms for long periods of time

Biofilm Development



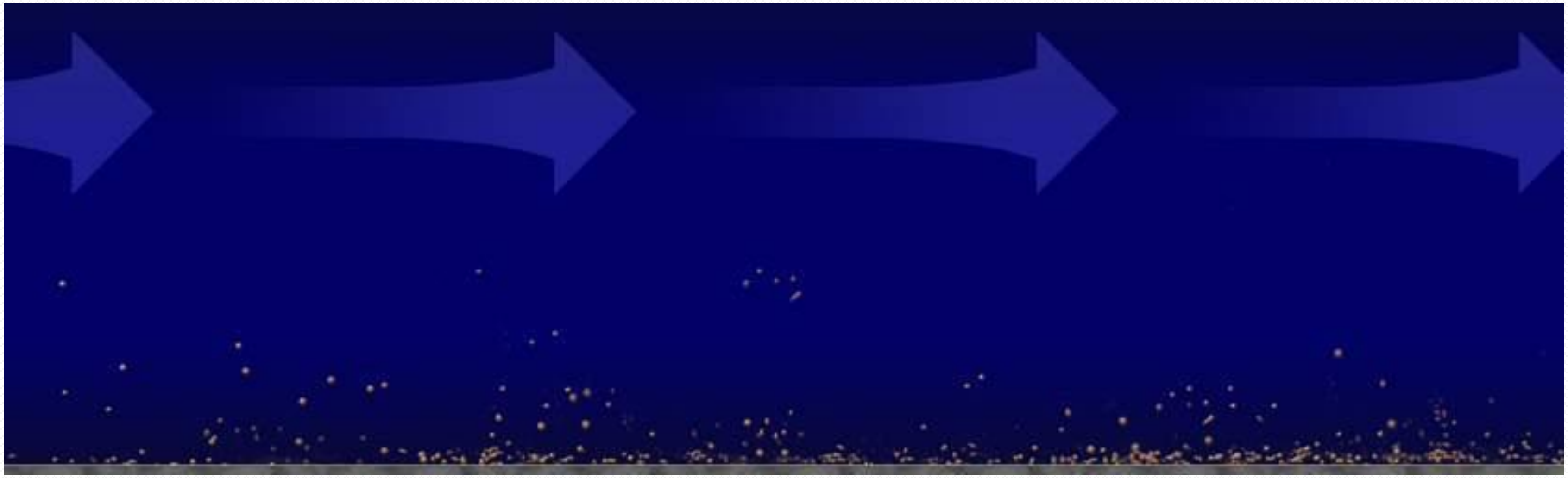
Biofilm develops in several stages

Biofilm Development


Culturable cells


Cells in VBNC stage


Lysed, dead cells



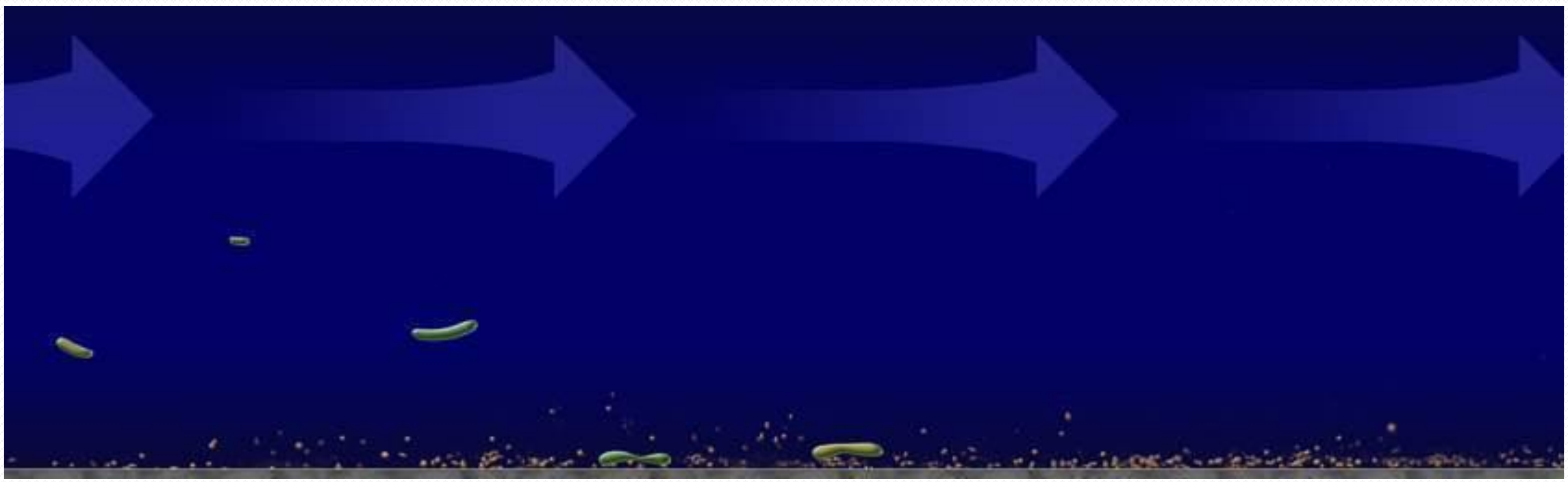
Phase 1: **Particles are adsorbed** to the inner surface of water pipes (conditioning)

Biofilm Development

Culturable cells

Cells in VBNC stage

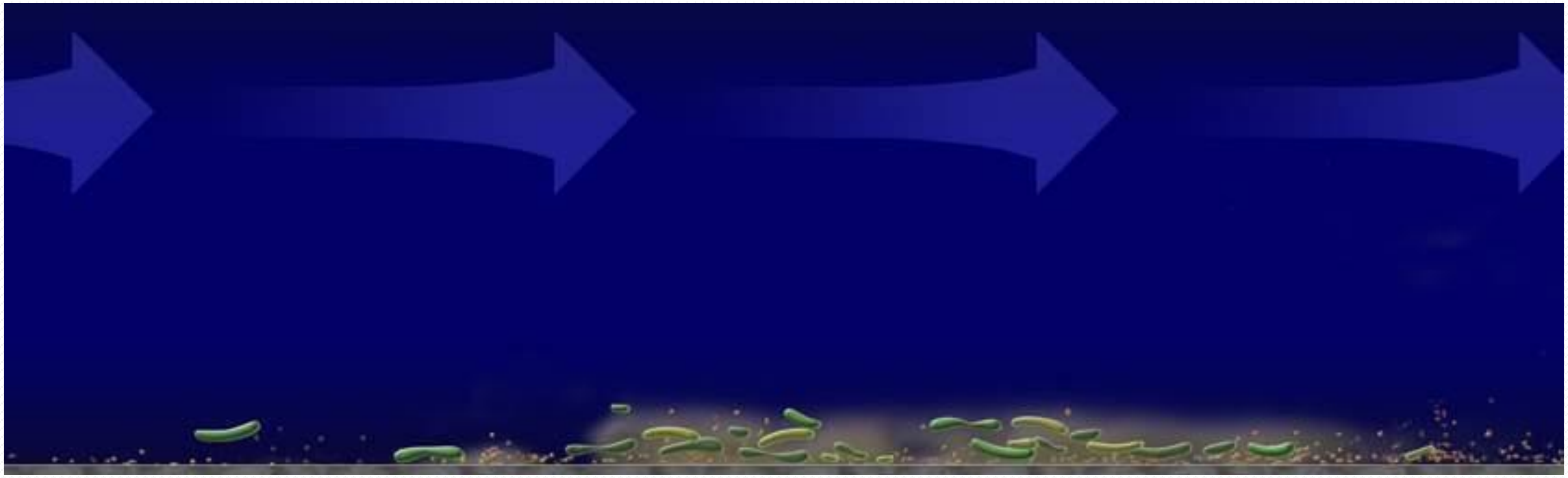
Lysed, dead cells



Phase 2: **Bacteria attach** to the conditioned surface

Biofilm Development

Culturable cells   Cells in VBNC stage   Lysed, dead cells



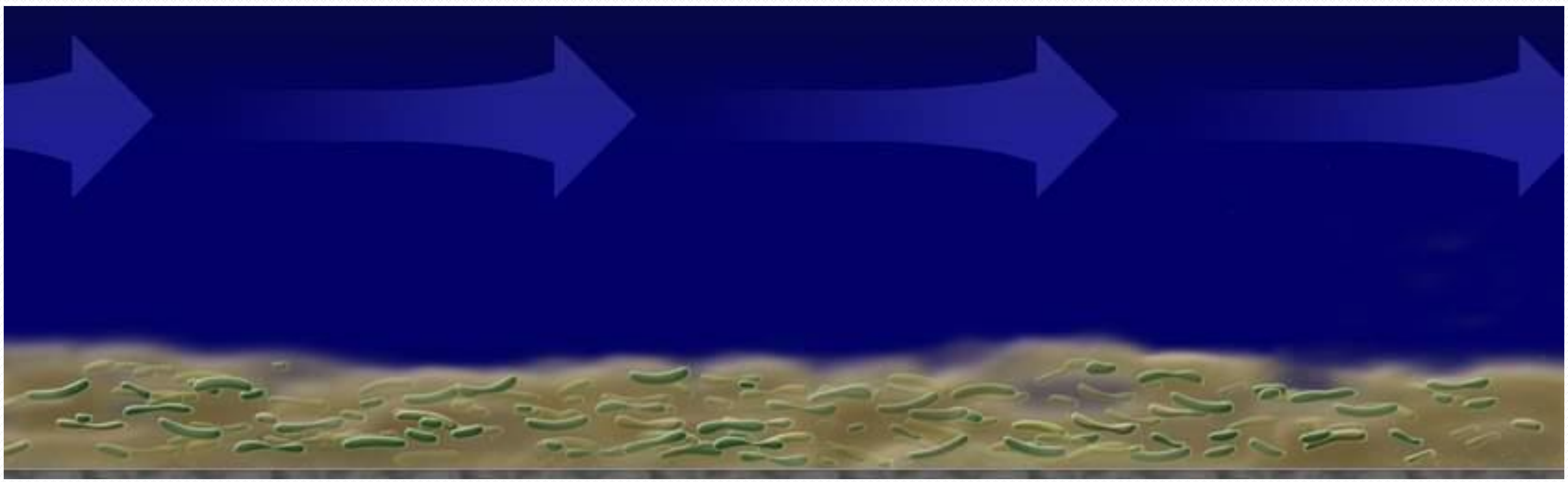
Phase 3: Bacteria produce a **sticky extracellular matrix** & reproduce quickly

Biofilm Development


Culturable cells


Cells in VBNC stage


Lysed, dead cells



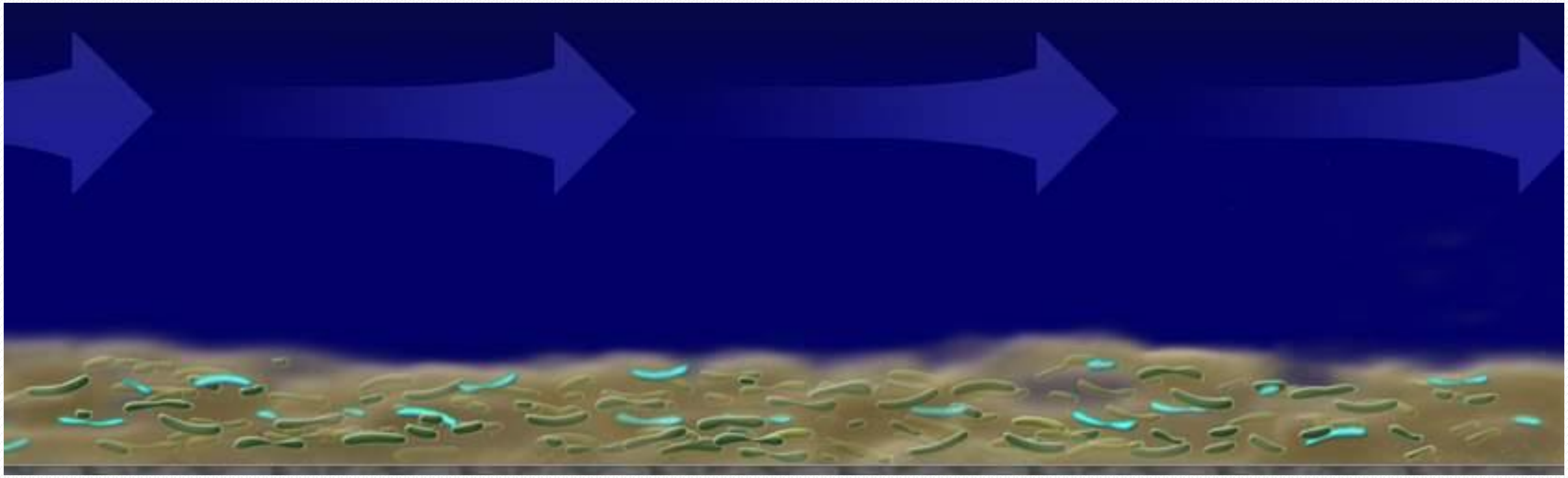
Phase 4: **Biofilm** increases in size and **protects microorganisms** within

Biofilm Development

Culturable

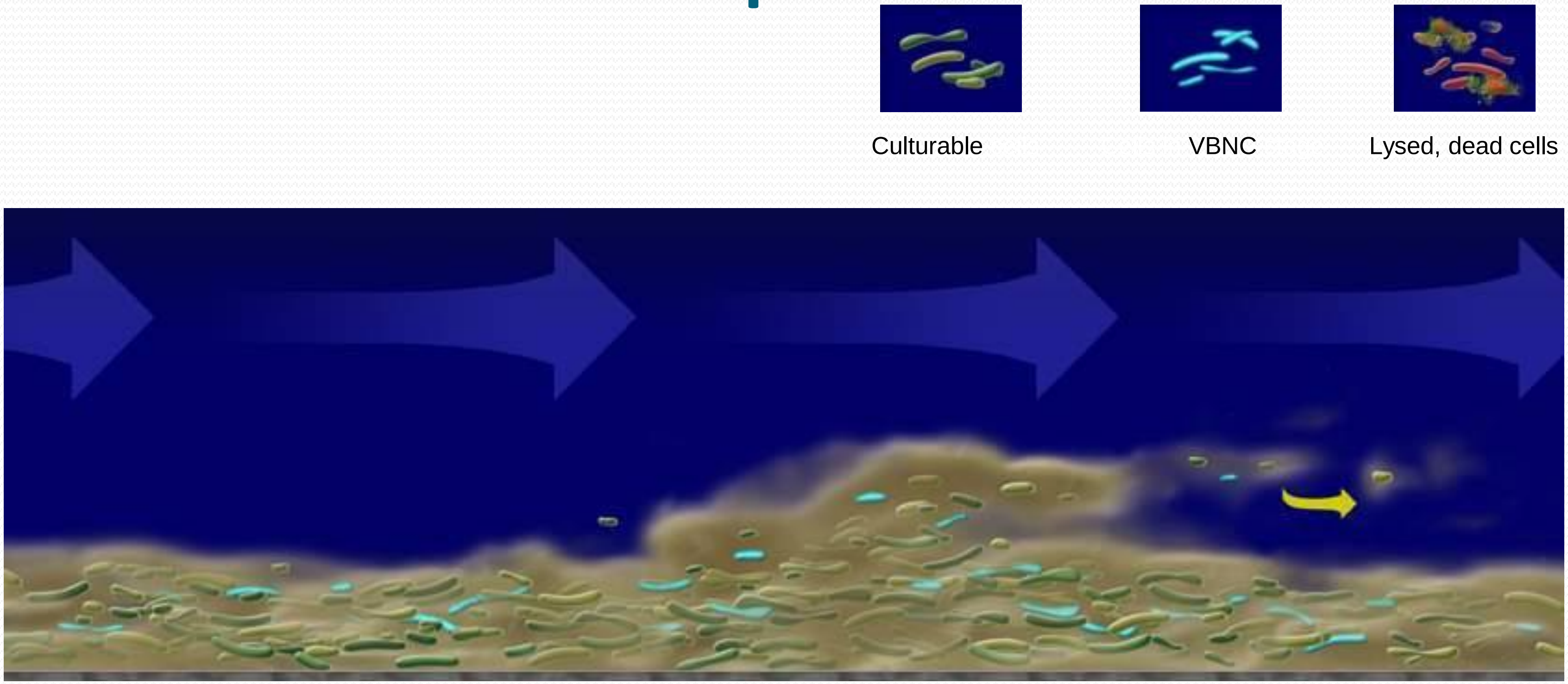
VBNC

Lysed, dead cells



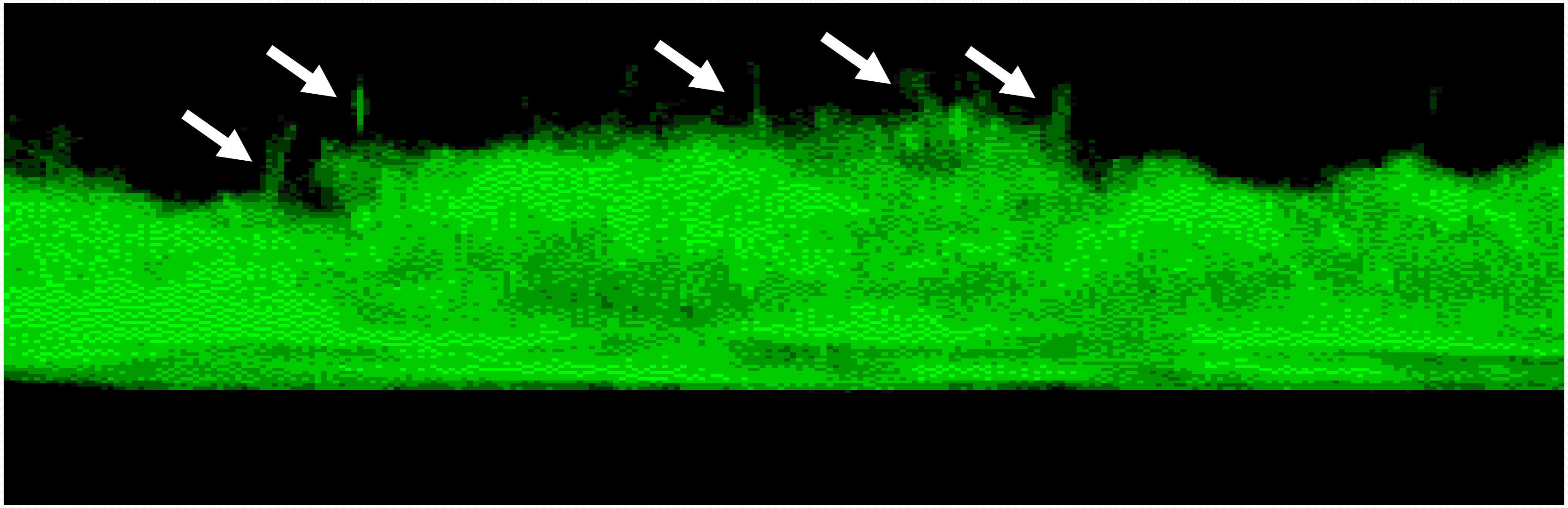
Phase 4: Some cells are **V**iable **B**ut **N**on **C**ulturable **(VBNC)**

Biofilm Development



Phase 5: **Biofilm particles shear off** under the force of water flow

Biofilm Development

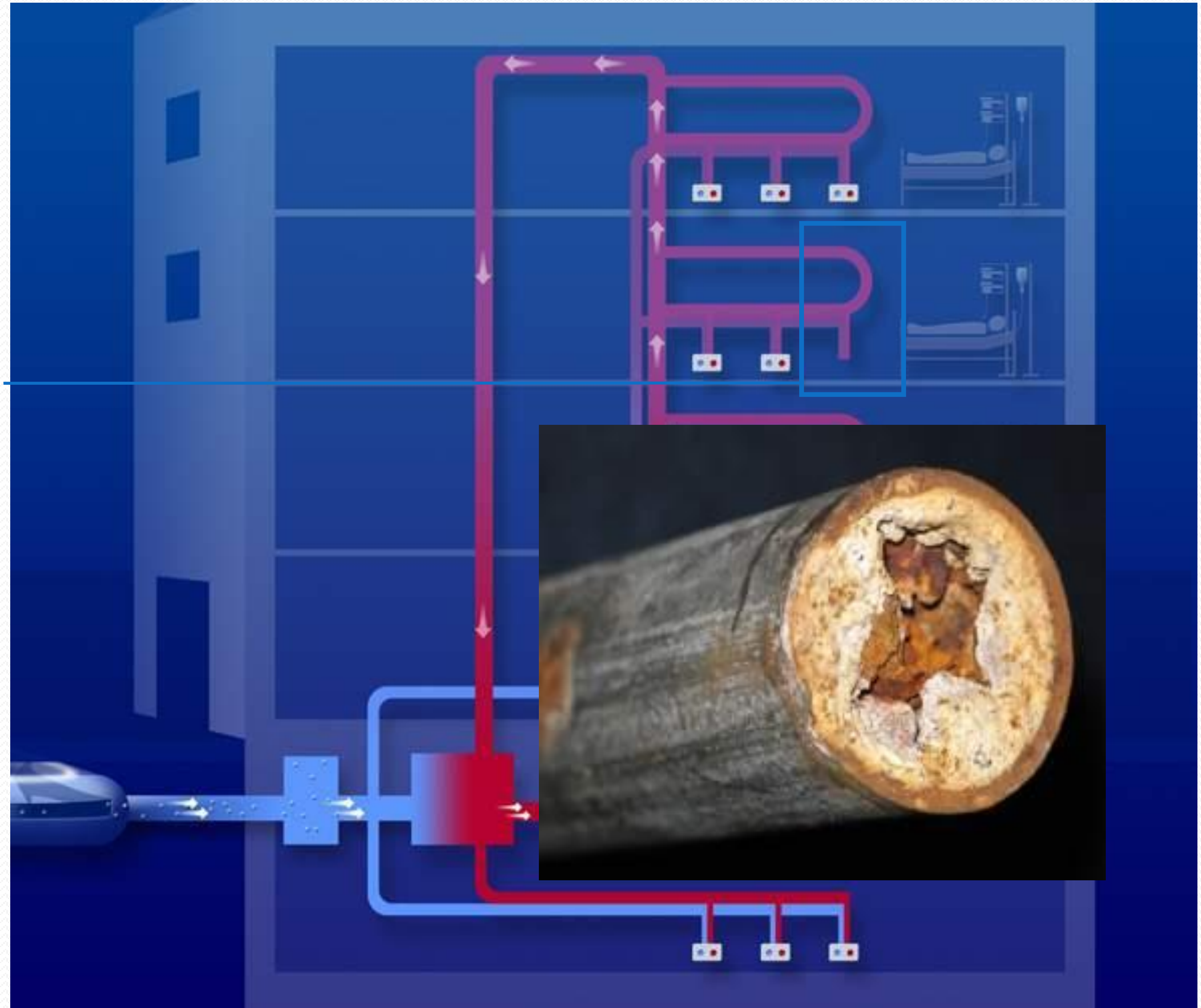


Phase 5: **Biofilm particles shear off** under the force of water flow

Risk Factors for Biofilm Growth

- Stagnant water
- Rubber gaskets
- Flexible hosing
- Areas of low flow
- Pooling of water

Reconstruction measures may result in dead ends



Eliminating Waterborne Pathogens in a Burn Unit

Crumby, D.R. and Lee, J.O.

Eliminating Waterborne Pathogens in a Burn Unit

Dustin R. Crumby RN, BSN, MBA, Jong O. Lee MD ,FACS, FCCM
Department of Patient Care Services
Shriners Hospitals for Children, Galveston, Texas

Introduction

- Drinking water standards allow for the presence of bacteria at certain levels as long as they are not commonly pathogenic to healthy individuals. [1]
- Pediatric patients who suffer a burn injury greater than a 20% Total Body Surface Area Burn are immune compromised making them more at risk for infection from environmental pathogens.[2]
- Between January 2010 through May 2011 53% of hospital acquired infections were related to waterborne pathogens.
- To prevent a hospital acquired infections the chain of infection must be broken at some point.

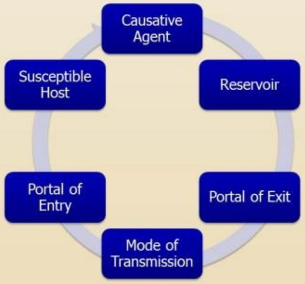
Methods

- An outbreak investigation began February 2010 after 27% of the ICU patients became infected with *Pseudomonas* (n=6) and *Acinetobacter* (n=2) species.
- Patient cultures were obtained on admission and weekly for surveillance purposes during the outbreak investigation.
- Staffing and patient transportation logs were reviewed to help identify potential cross contamination risks.
- Environmental cultures were obtained throughout the hospital.
- Water samples (n=24) were obtained from patient care areas.

Results

- The outbreak investigation data was reviewed by the Infection Control Committee.
- The water culture results tested positive for Pseudomonas (n=7) and *Acinetobacter* (n=2) species.
- Both the *Psuedomonas* and *Acinetobacter* species were multidrug resistant and linked to the positive patient culture results.
- Sterile water was utilized for all dressing changes, hydrotherapy, and operating room procedures.
- Water filters that provide sterilized grade filtered water were trialed and selected based on performance and staff reviews.
- During the trial 99.3% of the point of use filters that previously tested positive, tested negative for all gram negative bacteria.
- After implementing the 0.2 µm water filters on June 1, 2011, *Acinetobacter* (n=1) and *Pseudomonas* (n=3) accounted for 25% of the hospital acquired infections. These infections were linked to cross contamination.

Chain of Infection



Point of Use Water Filter

Conclusion

- The use of 0.2 µm water filters proved to be a cost effective method in eliminating the number of hospital acquired gram negative infections.
- The overall hospital acquired infection rate reduced from 8.9 per 1000 patient days to 5.1 per 1000 patient days after implementing 0.2 µm water filters .
- Sterilized grade filtered water is a cheaper alternative than sterile water.
- No patient deaths were related to sepsis from a hospital acquired infection in 2012 and 2013.

Research to Practice

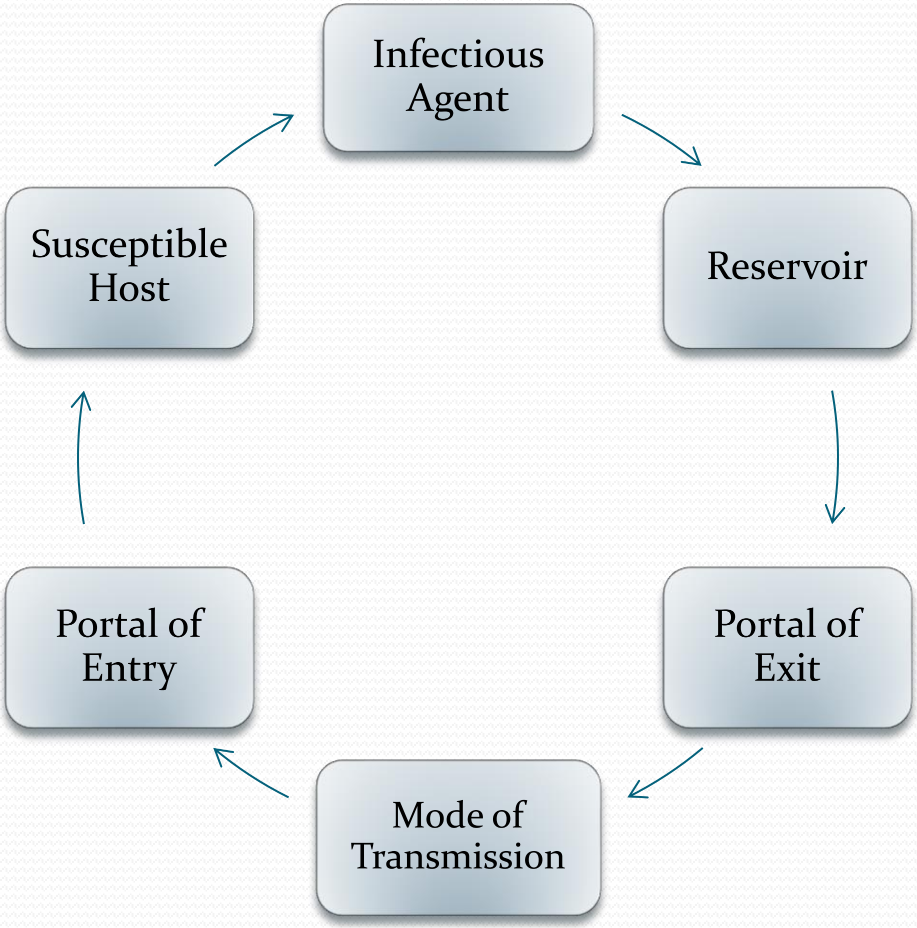
- Burn centers should take a systematic approach to reduce and eliminate the risk of healthcare associated infections.

References

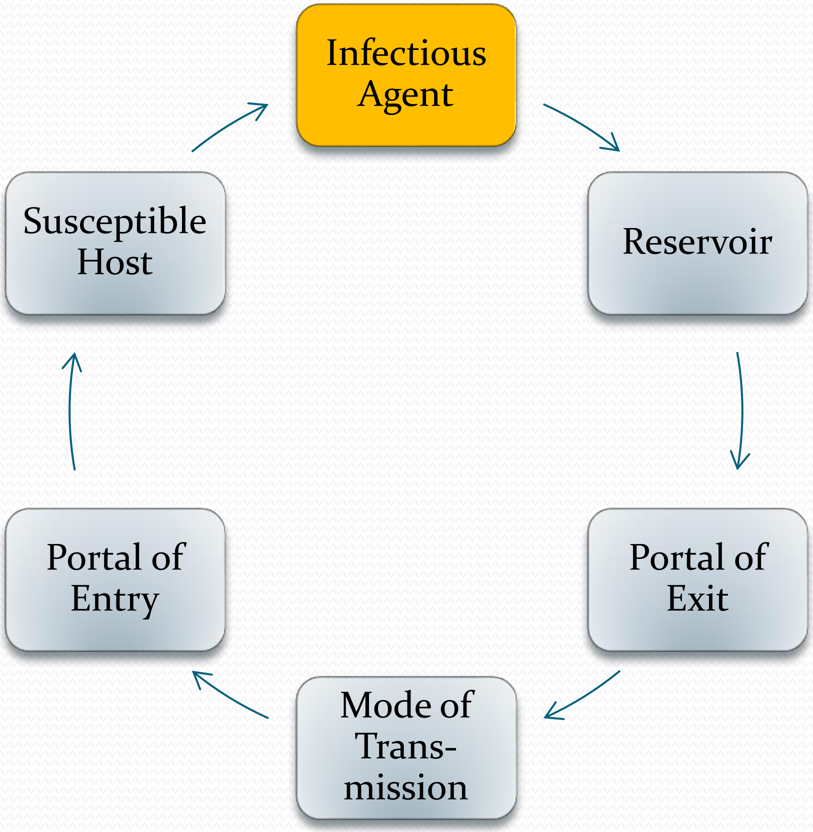
[1] EPA (2013) Drinking water standards-drinking water contaminates. Retrieved from: [illegible]

[2] Herndon, D. (2012) *Total Burn Care.* (4th ed.) US: Sauders.

Chain of Infection

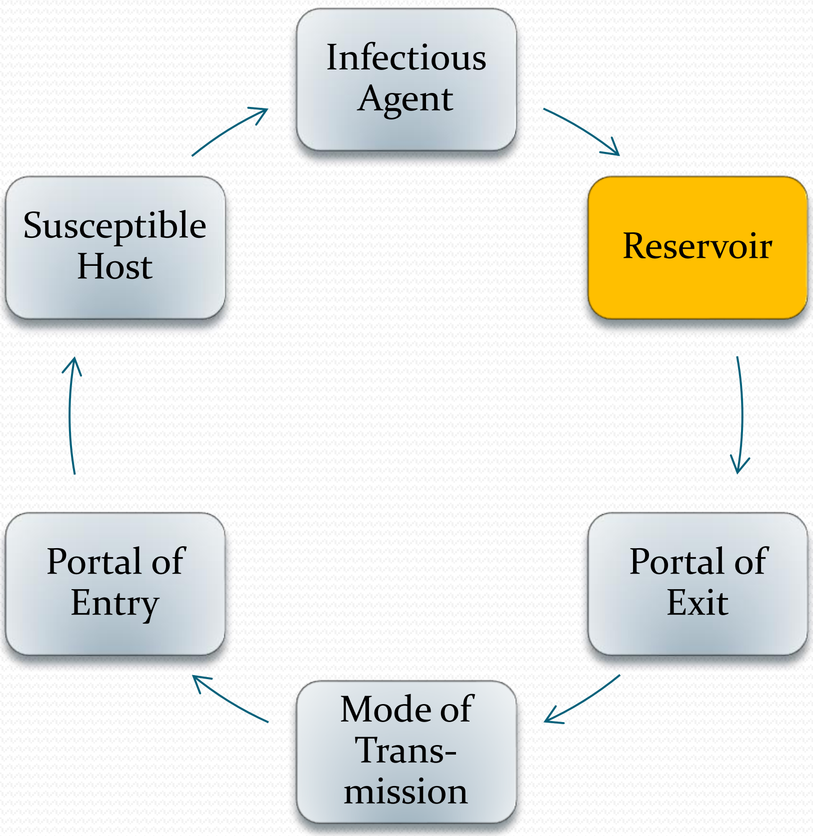


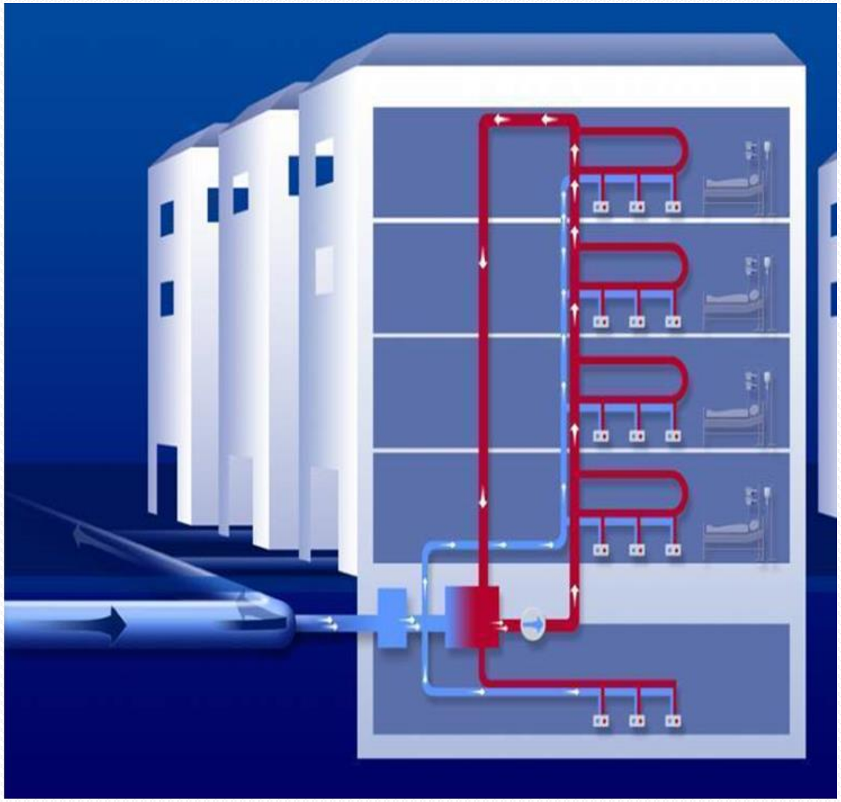
Chain of Infection-Infectious Agent



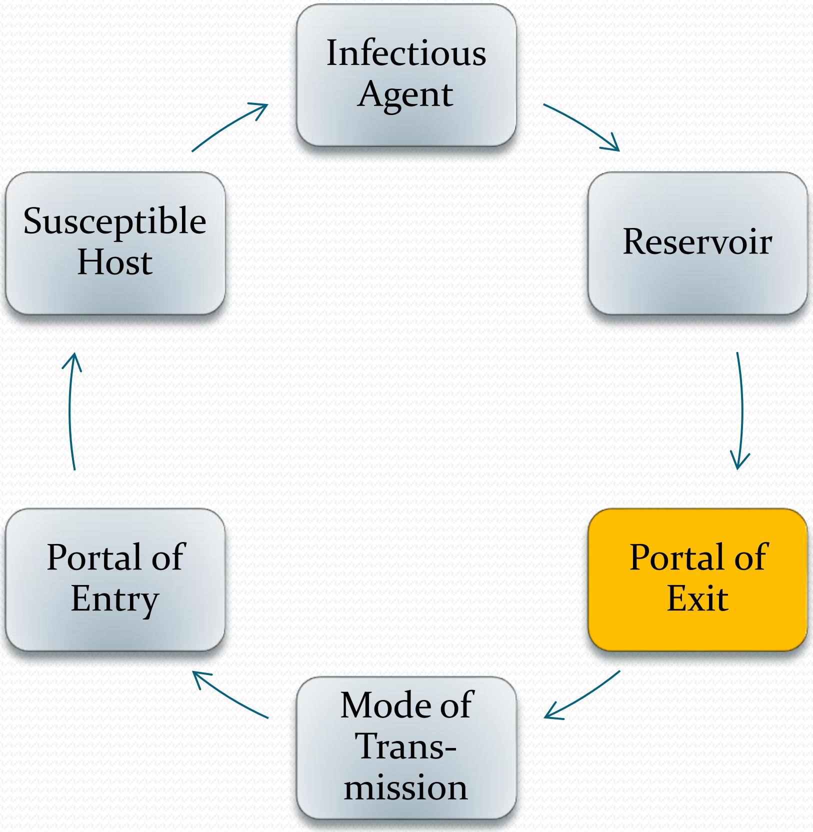
- *Pseudomonas* spp.
- *Legionella* spp.
- Nontuberculous Mycobacteria
- *Acinetobacter* spp.
- *Cryptosporidium* spp.
- *Klebsiella* spp.
- *Escherichia* coli
- *Aspergillus* spp.

Chain of Infection - Reservoir





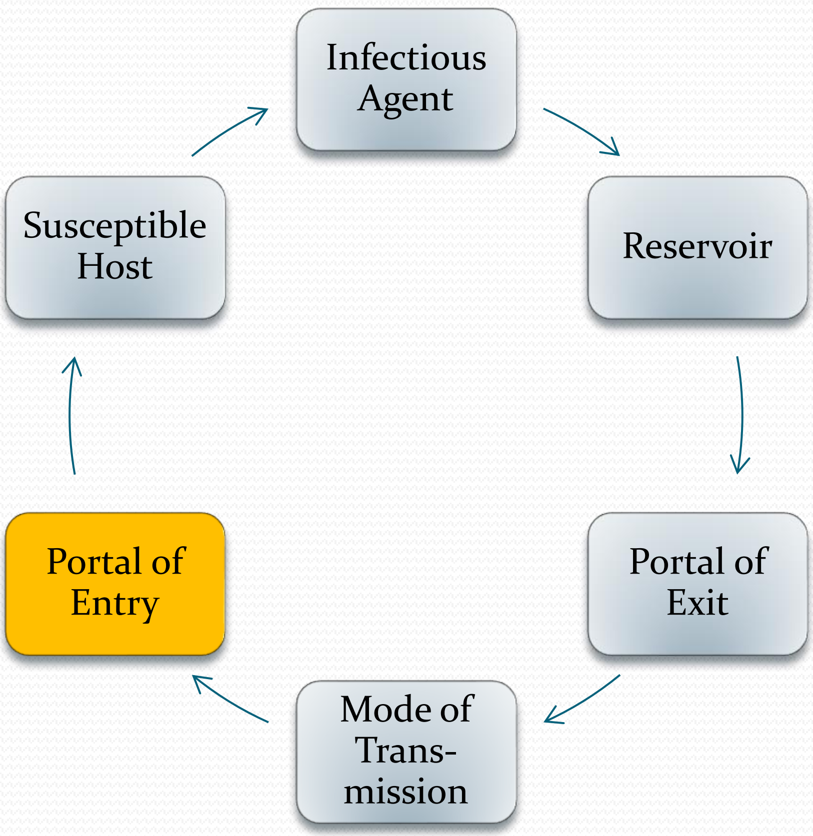
Chain of Infection-Portal of Exit

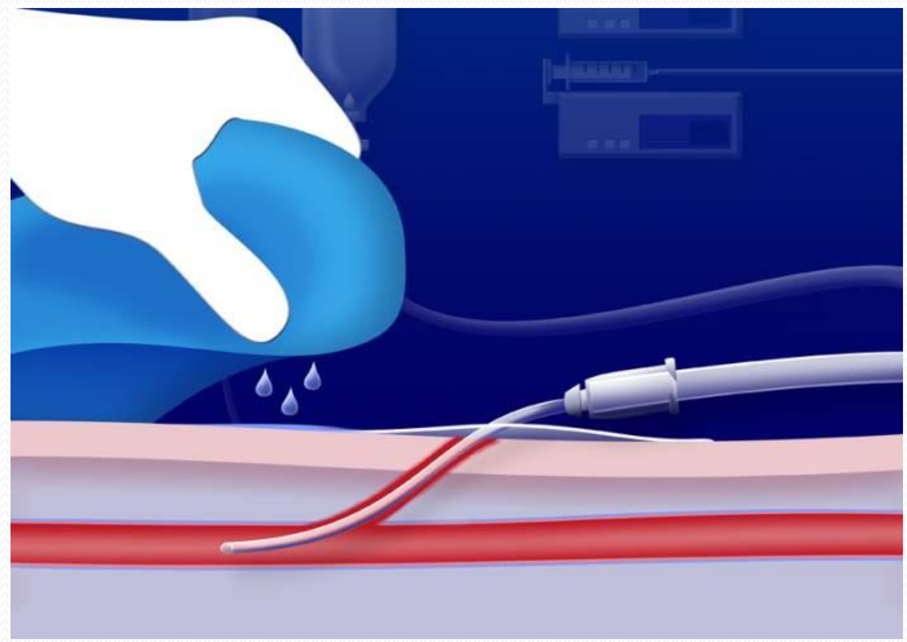


Chain of Infection-Mode of Transmission

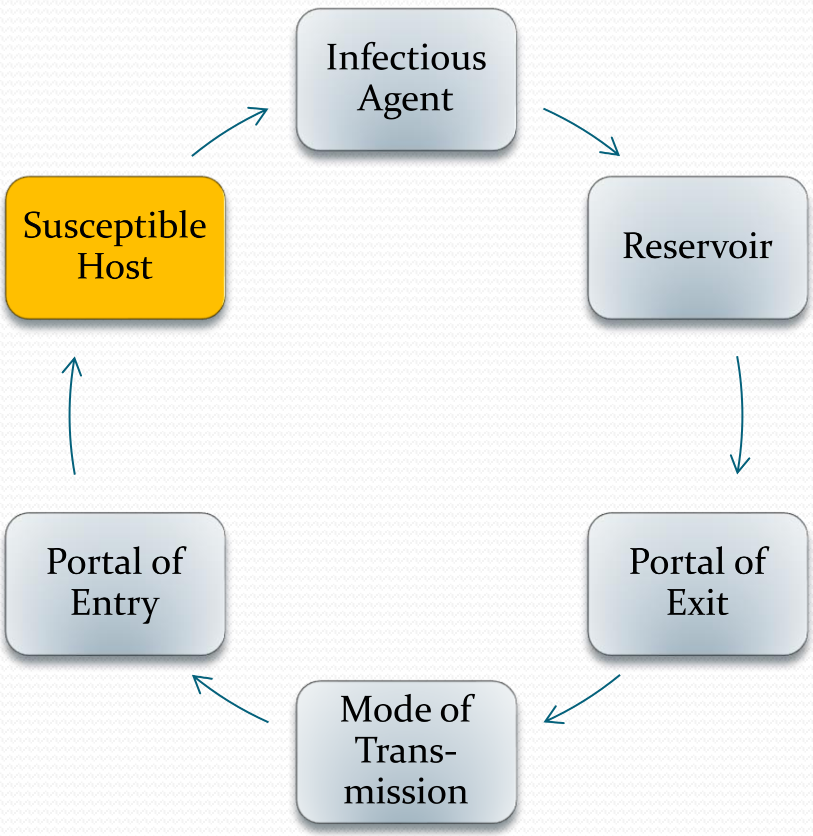
- Infectious Agent
- Reservoir
- Portal of Exit
- Mode of Trans-mission
- Portal of Entry
- Susceptible Host

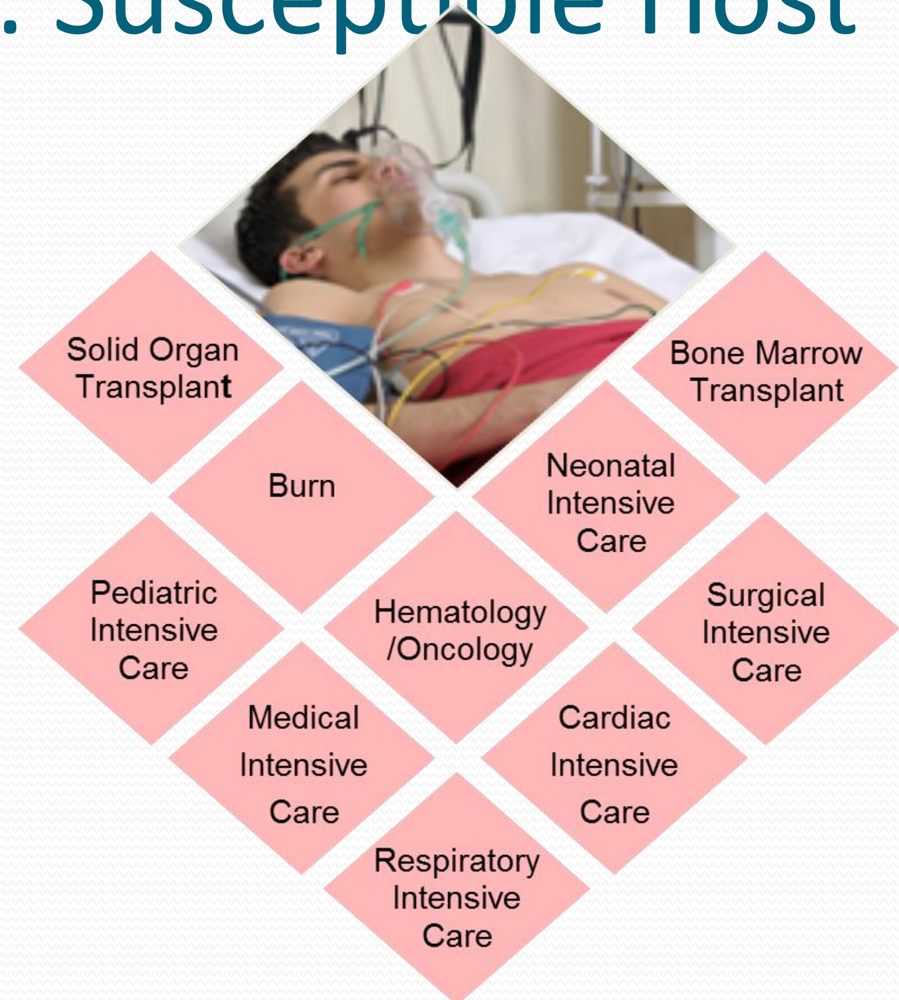
Chain of Infection-Portal of Entry





Chain of Infection: Susceptible Host

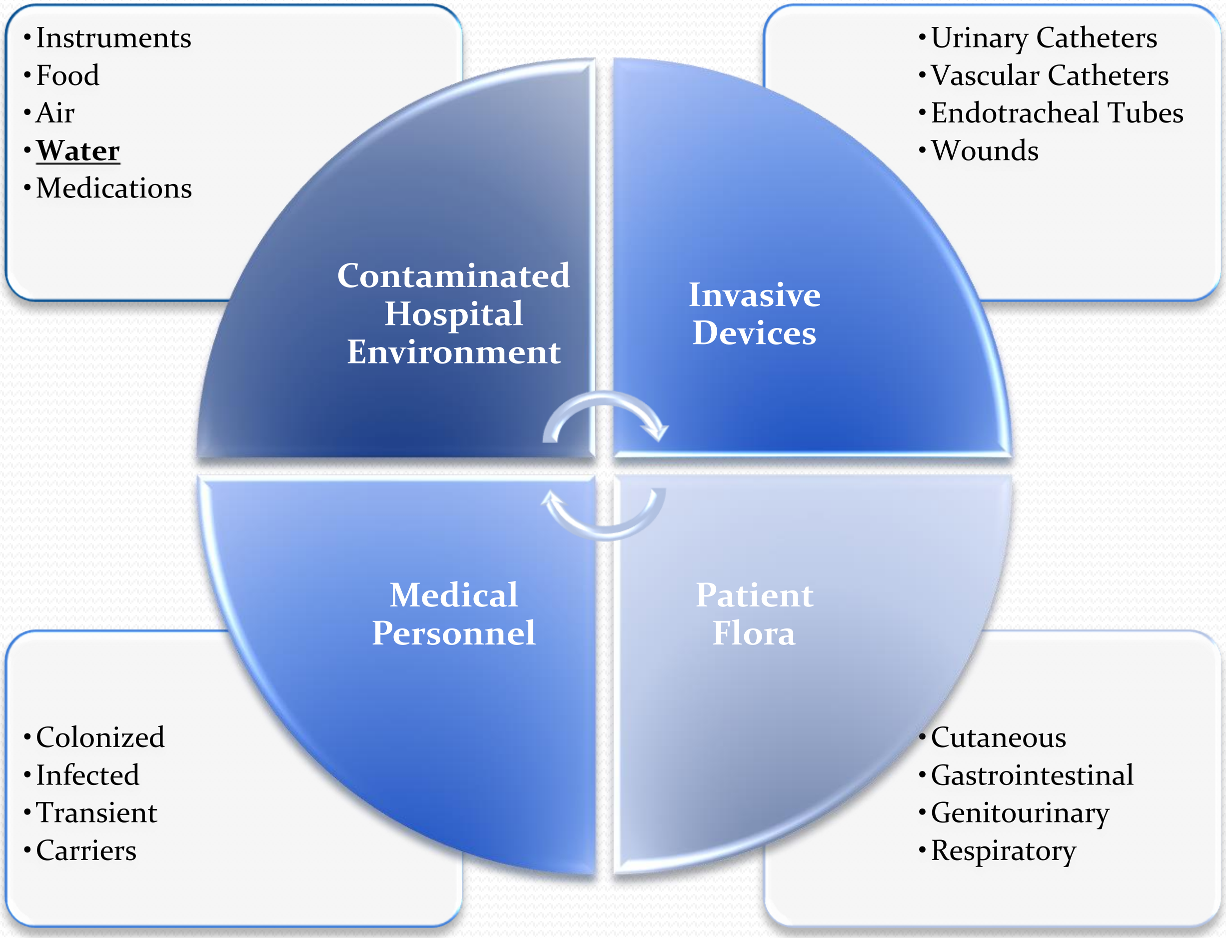




At-Risk Patient Populations

- Solid Organ Transplant
- Bone Marrow Transplant
- Burn
- Neonatal Intensive Care
- Pediatric Intensive Care
- Hematology /Oncology
- Surgical Intensive Care
- Medical Intensive Care
- Cardiac Intensive Care
- Respiratory Intensive Care

Sources of Hospital Acquired Infections



Tap from hospital colonized with *P. aeruginosa*

With kind permission of Prof. Martin Exner, University Bonn, 2013

Drinking Water

Transmission pathways for waterborne pathogens

Consumption via drinking	Inhalation of aerosols	Application via contact
↓	↓	↓
gastrointestinal > liver, blood	lung (also aspiration)	Wounds, mucosa, catheters

Legionella pneumophila, Pseudomonas aerginosa, Acinetobacter in hospital water

Key Points:

- *Legionella pneumophilia* isolated from 9.6% of samples
- *Pseudomonas aeroginosa* from 11.4% of samples
- *Acinetobater* isolated from 1.8% of samples

Conclusion:

Water proved to contain gram negative bacteria, the main cause of nosocomial pneumonia at this institution.

Indian J Pathol Microbiol. 2012 Jul-Sep;55(3):352-6. doi: 10.4103/0377-4929.101743.

Colonization of hospital water systems by Legionella pneumophila, Pseudomonas aeroginosa, and Acinetobacter in ICU wards of Tehran hospitals.

Yaslianifard S[1], Mobarez AM, Fatolahzadeh B, Feizabadi MM.

Author information

Abstract

BACKGROUND: Nosocomial infection caused by non-Enterobacteriaceae gram negative bacteria (GNB-NE) is increasing in intensive care units (ICU).

AIM: The objective of this study was to determine whether potable water in ICU wards at Tehran hospitals is contaminated with L. pneomophila, P. aeroginosa and Acinetobacter spp.

MATERIALS AND METHODS: A total of 52 water samples from shower bath and taps water in seven hospitals of Tehran were collected. The water sample concentrated by filtering through millipore cellulose filters and cultured on BCYE agar and tryptic soya agar media. The presence of Legionella pneumophila was confirmed by real time PCR assay using primers-probe designed for the mip gene.

RESULTS: Legionella pneumophila, Pseudomonas aeroginosa and Acinetobacter were isolated from 5 (9.6%), 6 (11.4%) and 1 (1.8%) of the hospital water systems, respectively. This study demonstrated the presence of Legionella, Pseudomonas and Acinetobacter in water system in ICU wards of different hospitals in Tehran.

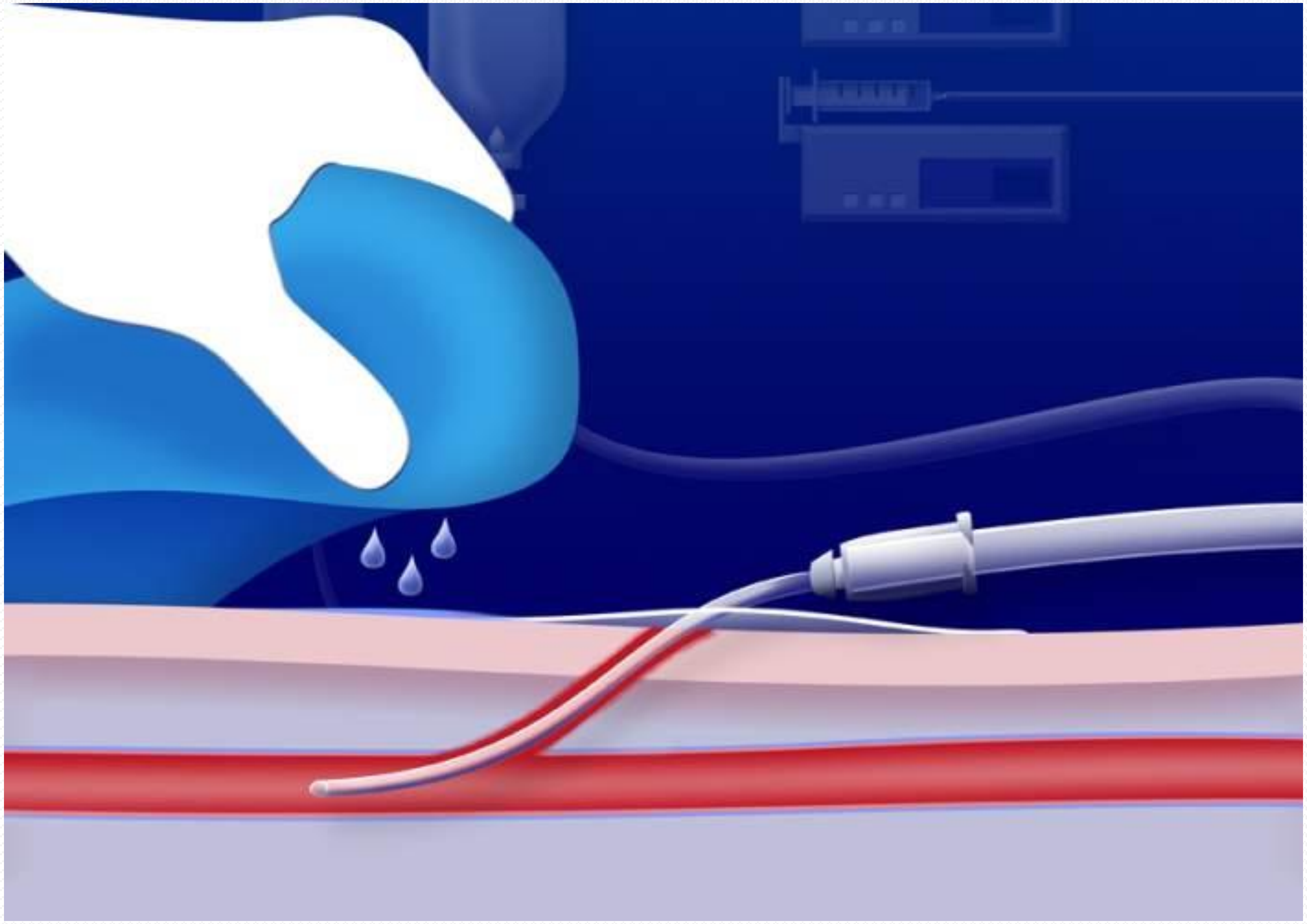
CONCLUSIONS: Hot water from shower heads could be a potential source of infection for Legionella pneumophila. Water was also proved to contain Pseudomonas aeruginonsa, the main GNB-NE causing nosocomila pneumonia at Tehran hospitals. Care should be taken concerning cleanliness and decontamination of water supplies at ICUs for pathogenic organisms.

40% of healthcare associated pseudomonas infections/colonizations is potentially due to contaminated tap water.

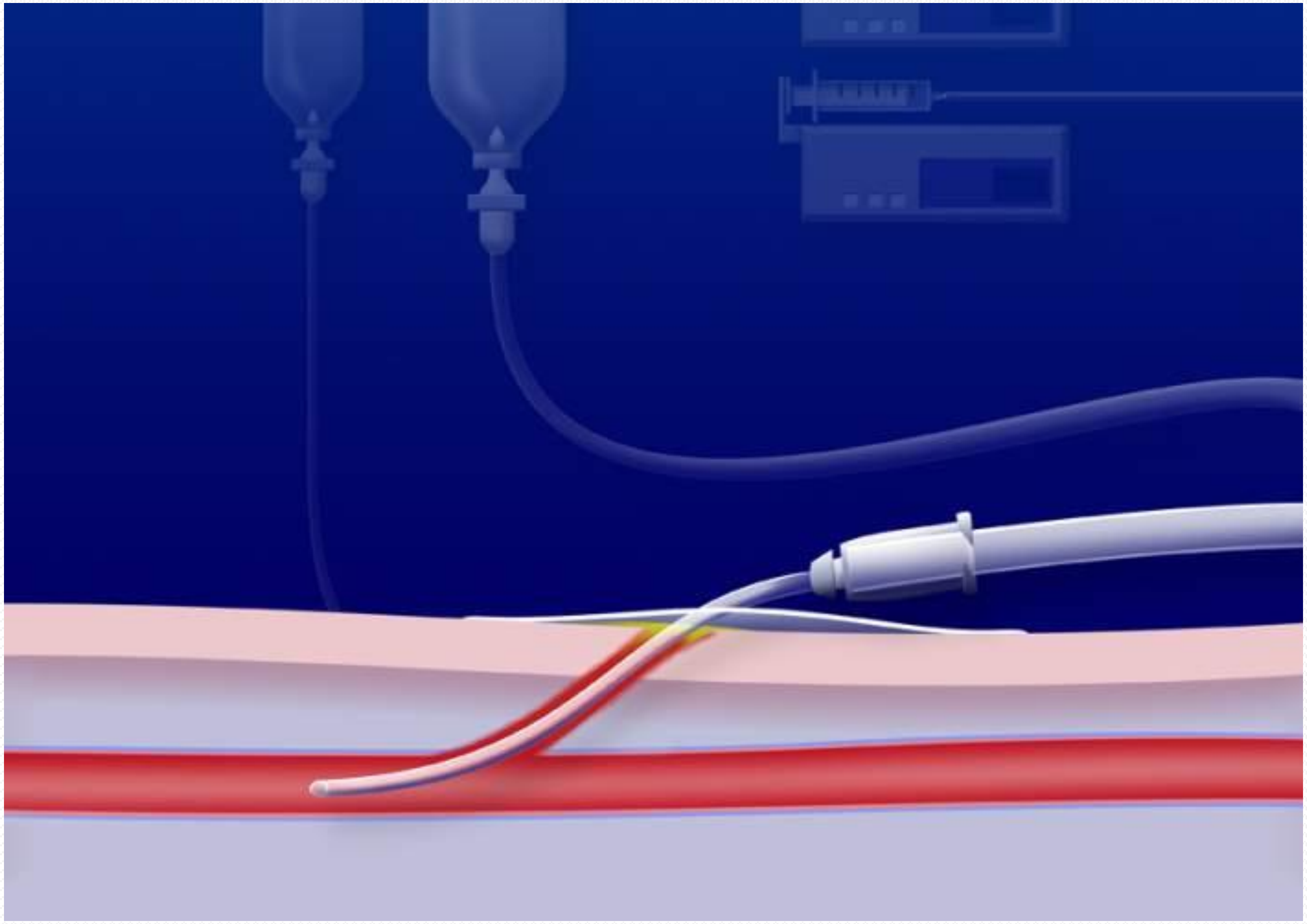
Author	Hospital	Unit	Percentage
Ferroni et al. 1998	Paris/France	Pediatric surgical unit	21.4 %
Berthelot et al. 2001	St. Etienne/France	2 mixed ICUs	14-25%
Trautmann et al. 2001	Ulm/Germany	Surgical unit	29.4%
Reuter et al. 2001	Ulm/Germany	Surgical unit	42%
Vallés et al. 2004	Barcelona/Spain	Mixed ICUs	37-42%
Blanc et al. 2004	Lausanne/Switzerland	5 ICUs	42%
Trautmann et al. 2005	Ulm/Germany	Medical ICU	50%

Trautmann M et al., Krh-Hyg+ Infverh 27:2005

Portal of entry



Portal of Entry



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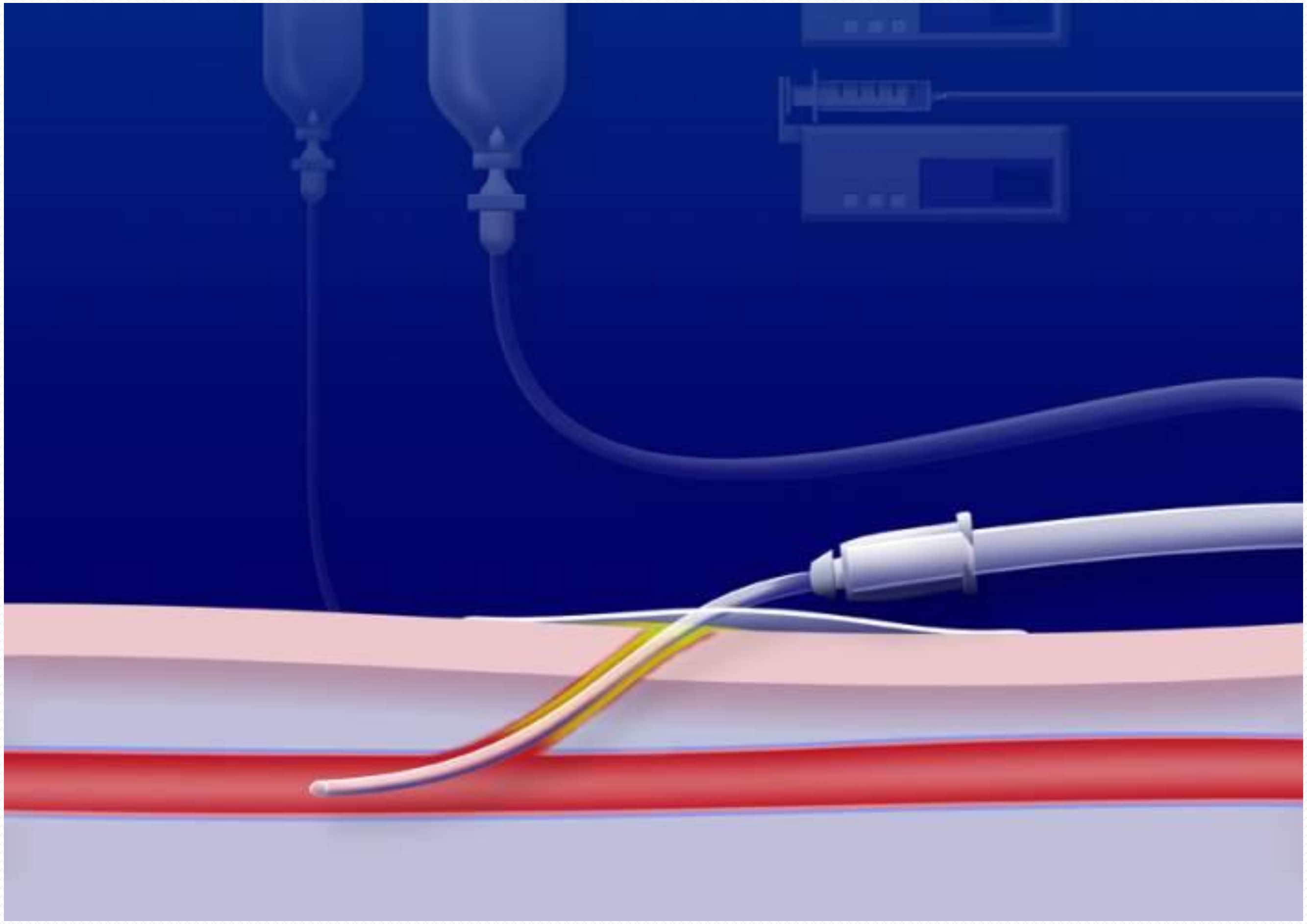

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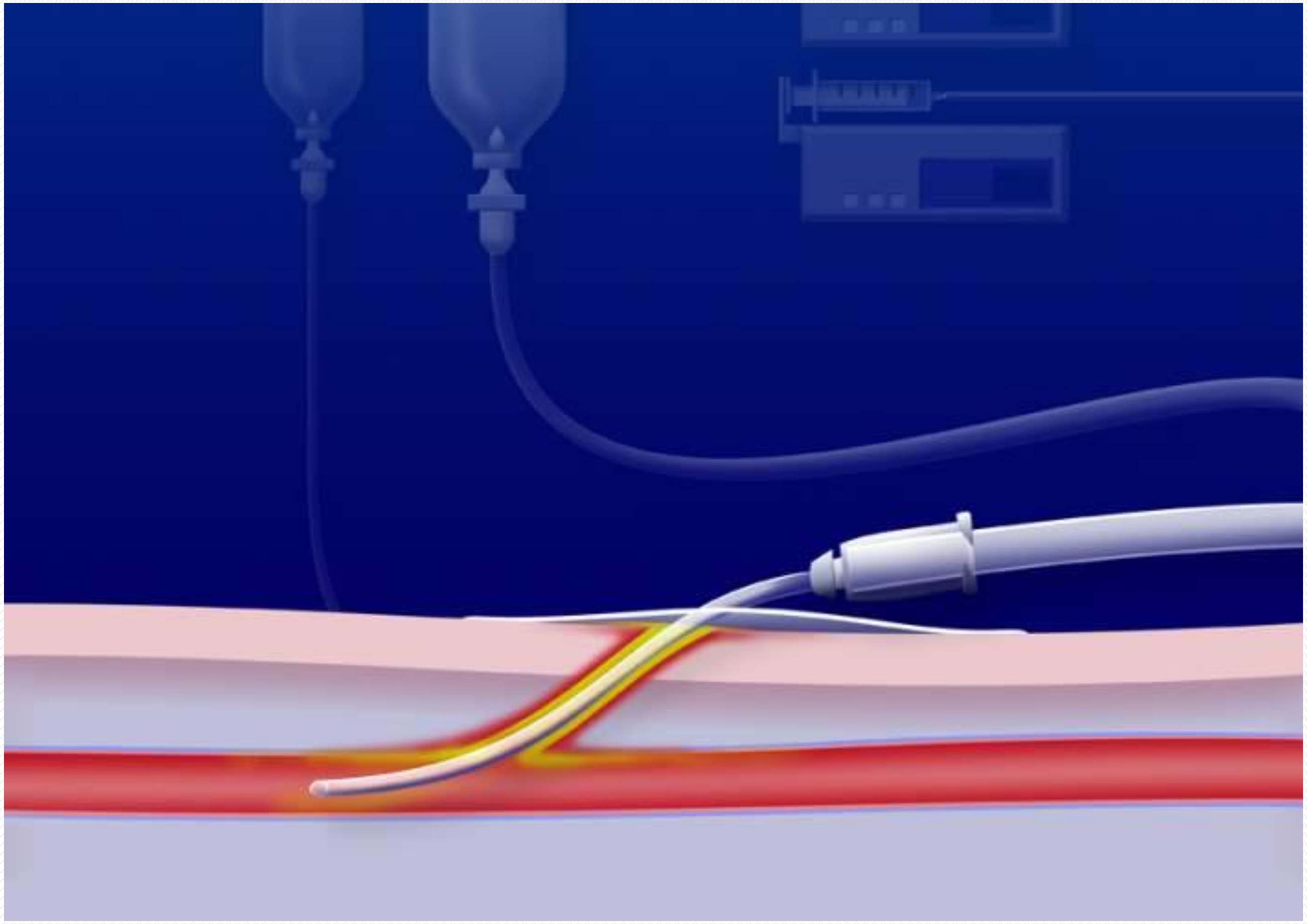

Pseudomonas aeruginosa and Pseudomonas putida outbreak associated with contaminated water outlets in an oncohaematology paediatric unit.

Aumeran C, Pallard C, Robin F, Kanold J, Baud O, Bonnet R., Souweine B, Traore O.

J Hosp Infect. 2007 Jan; 65(1);47-53, Epub 2006 Nov 30

Key Points:

- Eight children suffered blood stream infections with Psuedomonas species
- Repetitive intragenic consensus polymerase chain reaction indicated two discrete patterns for P. aerug. and P. putida in the water system and patients

Pseudomonas aeruginosa and Pseudomonas putida outbreak associated with contaminated water outlets in an oncohaematology paediatric unit.

Aumeran C[1], Paillard C, Robin F, Kanold J, Baud O, Bonnet R, Souweine B, Traore O.

Author information

Abstract

This paper describes an outbreak of Pseudomonas aeruginosa and Pseudomonas putida that occurred in an oncohaematology paediatric unit between January and April 2005. Eight children had nosocomial infections due to P. aeruginosa (N=5) or P. putida (N=3), which were recovered from central venous catheter blood cultures (N=4), the catheter exit site alone (N=2), or the catheter exit site and the catheter tip (N=2). Subsequent investigation showed that contaminated water outlets represented the possible source of spread. Studies of nursing and environmental cleaning practices revealed two modes of catheter contamination. A reduction in the size of the catheter dressing at the exit site gave less protective cover during showers, and a detergent-disinfectant diluted with tap water had contaminated perfusion bottles. Repetitive intergenic consensus polymerase chain reaction indicated two discrete patterns for P. aeruginosa and one for P. putida. The water network was chlorinated, and disposable seven-day filters were fitted on all taps and showers. Due to the deleterious effects of chlorination on the water network and the cost of the weekly filter change, a water loop producing microbiologically controlled water was installed. In addition, the concentration of the detergent-disinfectant was increased and refillable sprayers were replaced with ready-to-use detergent-disinfectant solution for high-risk areas. Following these measures, no Pseudomonas spp. have since been isolated in clinical or environmental samples from the ward.

Removal of waterborne pathogens from liver transplant unit water taps in prevention of healthcare-associated infections: a proposal for a cost-effective, proactive infection control strategy.

Zoy ZY, Hu BJ, Qin L, Lin YE, Watanabe H, Zou Q, Gao XD

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Removal of waterborne pathogens from liver transplant unit water taps in prevention of healthcare-associated infections: a proposal for a cost-effective, proactive infection control strategy.

Zhou ZY[1], Hu BJ, Qin L, Lin YE, Watanabe H, Zhou Q, Gao XD.

⊕ **Author information**

Abstract

Hospital water supplies often contain waterborne pathogens, which can become a reservoir for healthcare-associated infections (HAIs). We surveyed the extent of waterborne pathogen contamination in the water supply of a Liver Transplant Unit. The efficacy of point-of-use (POU) water filters was evaluated by comparative analysis in routine clinical use. Our baseline environmental surveillance showed that Legionella spp. (28%, 38/136), Pseudomonas aeruginosa (8%, 11/136), Mycobacterium spp. (87%, 118/136) and filamentous fungi (50%, 68/136) were isolated from the tap water of the Liver Transplant Unit. 28.9% of Legionella spp.-positive water samples (n = 38) showed high-level Legionella contamination (≥10(3) CFU/L). After installation of the POU water filter, none of these pathogens were found in the POU filtered water samples. Furthermore, colonizations/infections with Gram-negative bacteria determined from patient specimens were reduced by 47% during this period, even if only 27% (3/11) of the distal sites were installed with POU water filters. In conclusion, the presence of waterborne pathogens was common in the water supply of our Liver Transplant Unit. POU water filters effectively eradicated these pathogens from the water supply. Concomitantly, healthcare-associated colonization/infections declined after the POU filters were installed, indicating their potential benefit in reducing waterborne HAIs.

Legionella in transplant units
Patterson WJ et al, J Hosp Infect 37:1997

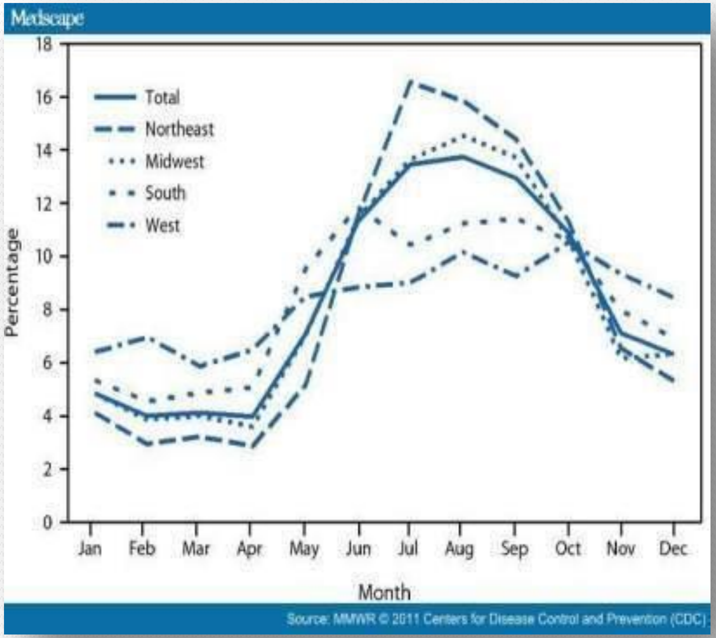
- Prospective, multicentre study in 69/81 (85%) British transplant units
- *Legionella* spp. has been isolated in 38/69 (55%) and *L. pneumophila* in 31/69 (45%) of transplant units. Free floating protozoa have been identified in 68%
- No significant differences between cold and warm water samples

Warm water	Cold water
• 56.2 ˚ C (37 – 74.6 ˚ C)	• 16.6 ˚ C (8.3 – 28.9 ˚ C)
• *Legionella* spp. *55 %*	• *Legionella* spp. *47 %*
• *L. pneumophila 45 %*	• *L. pneumophila 35 %*
• *Protozoa 70 %*	• *Protozoa 42 %*

CDC baffled by Legionnaire's disease cases way up in the US

August 19th 2011

- While older people and those living in the Northeast are most at risk Legionnaire's disease occurs in all age groups and regions
- Men account for 60% of cases
- Number of cases reported to the CDC rose from 1,110 in 2000 to **3,522 in 2009**
- The incidence rate increased from 0.39 to 1.15 per 100,000 people during that time



http://www.medicalnewstoday.com/articles/233072.php

Common Water Treatment/Filtration options

Type
Continuous Chlorination (CL_2)
Chloramine/Monochloramine (Cl_2)
Copper Silver
Ozone
UV Lighting
Chlorine Dioxide (ClO_2)
Filtration/Point of Use Filtration

Continuous Chlorination

Typically applied to achieve 1 mg/L (ppm)

PRO:

- Relatively inexpensive
- Effective disinfectant
- Can provide a constant residual

CON:

- Efficacy depends on system pH
- Possible corrosion issues
- Possible THM issues (Tri-halomethanes)
- Rapid bacteria re-growth is common upon dosing disruption
- Safety issues with Cl_2 gas

Monochloramines

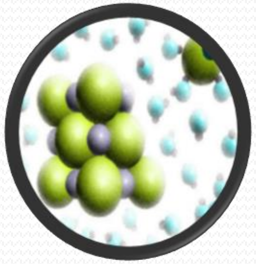
PRO:

- Low reactant disinfectant
- Can provide a constant residual
- On site generation

CON:

- Low reactant disinfectant
- Efficacy depends on system pH
- Possible corrosion issues
- Biofilm
- Nitrates
- Safety issues with ammonia

Copper-Silver Ionization



Target Doses: Copper 0.1 - 0.4 ppm Silver 0.01 - 0.03 ppm
EPA Limits: Copper <1.3 ppm Silver <0.1 ppm

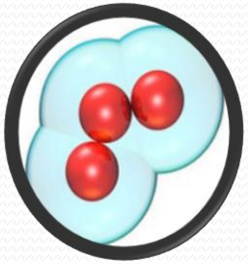
PRO:

- Good residuals
- Good for low flow/stagnant conditions
- Easy to install
- Has been actively promoted
- Effective on bulk water bacteria

CON:

- EPA questions use in potable water
- Used in hot water systems only
- Difficult to control Cu-Ag ion doses
- Conflicting reports on biofilm reduction
- Issues in hard water
- Less effective at pH>7.6
- Galvanic corrosion issues reported
- Evidence of bacterial resistance to Cu-Ag over prolonged application

Ozone



PRO:

- An excellent point disinfectant
- Effective at low concentrations with short contact time

CON:

- Requires on-site generation
- Difficult to control, poor residual, which means poor biofilm control
- Expensive technology
- Works best at low pH
- Health and Safety issues
  - Poor solubility
  - Quickly off gases

Ultraviolet Radiation

PRO:

- Good point disinfectant
- Effective at low concentrations with short contact time
- Easy to install, and no adverse effects on water chemistry or on plumbing integrity
- Good for High Velocity Recirculating loops

CON:

- Provides no residual in the system
- Localized disinfection only
- Flow rate and contact time in the UV exposure cell have a direct impact on efficacy
- UV lamps have a limited life, and are susceptible to scale and mineral deposits

Chlorine Dioxide (ClO_2)

PRO:

- Very effective disinfectant at low concentrations (0.2 - 0.5 ppm)
- Penetrates biofilms
- Does not react with water, nor does its chemical composition or activity change with shifts in water pH
- EPA approved for potable water below 0.8 ppm

CON:

- Must be generated on-site.
- Low conversion efficiencies could lead to chlorite formation, which is regulated by EPA at <0.8 ppm

Point of Use Filtration

PRO:

- Very effective barrier that reduces the risk of patient exposures to waterborne pathogens
- Product validation
- Can be used with hot water flushes and secondary disinfection
- Compatible with all sinks, showers, and ice machines
- Does not modify chemical composition of water
- Meets healthy drinking water standards

CON:

- Cost
- Increases workload

Point-of-use water filtration reduces endemic Pseudomonas aeruginosa infections on a surgical intensive care unit

Trautmann M, Halder S, Hoegel J, Royer H, Haller M

Chronically endemic ***Pseudomonas aeruginosa*** colonizations/ infections on a Surgical Intensive Care Unit reduced from 3.9 to 0.8

Point-of-use water filtration reduces endemic Pseudomonas aeruginosa infections on a surgical intensive care unit.

Trautmann M[1], Halder S, Hoegel J, Royer H, Haller M.

Author information

Abstract

BACKGROUND: Endemic infections because of Pseudomonas aeruginosa were observed on a surgical intensive care unit (ICU) for a period of >24 months. Tap water probing revealed persistent colonization of all ICU water taps with a single P aeruginosa clonotype.

METHODS: Water outlets of the ICU were equipped with disposable point-of-use water filters, changed in weekly and, later, 2-week intervals. To delineate the effect of the filters, 4 study approaches were followed: (1) a descriptive analysis of the incidence of P aeruginosa colonizations and infections, (2) microbiologic examinations of tap water before and after installation of the filters, (3) a comparative cohort analysis of representative patient samples from the prefilter and postfilter time periods, and (4) an analysis of general ward variables for the 2 periods.

RESULTS: (1) The mean monthly rate (+/-SD) of P aeruginosa infection/colonization episodes was 3.9 +/- 2.4 in the prefilter and 0.8 +/- 0.8 in the postfilter period. P aeruginosa colonizations were reduced by 85% (P < .0001) and invasive infections by 56% (P < .0003) in the postfilter period. (2) Microbiologic examinations of tap water revealed growth of P aeruginosa in 113 of 117 (97%) samples collected during the prefilter period, compared with 0 of 52 samples taken from filter-equipped taps. (3) In the comparative cohort analysis, a number of patient-related variables were significantly associated with P aeruginosa colonization/infection. Considering these variables in a multivariate analysis, belonging to the postfilter cohort was the factor most strongly associated with a reduced risk of P aeruginosa positivity (relative risk, 0.04; P = .0002). (4) General ward variables such as bed occupancy, personnel-to-patient ratio, or microbiologic culturing density did not differ significantly between the 2 periods.

CONCLUSION: Taking into account various patient-related and general ward variables, point-of-use water filtration was associated with a significant reduction of chronically endemic P aeruginosa colonizations/infections on a surgical ICU.

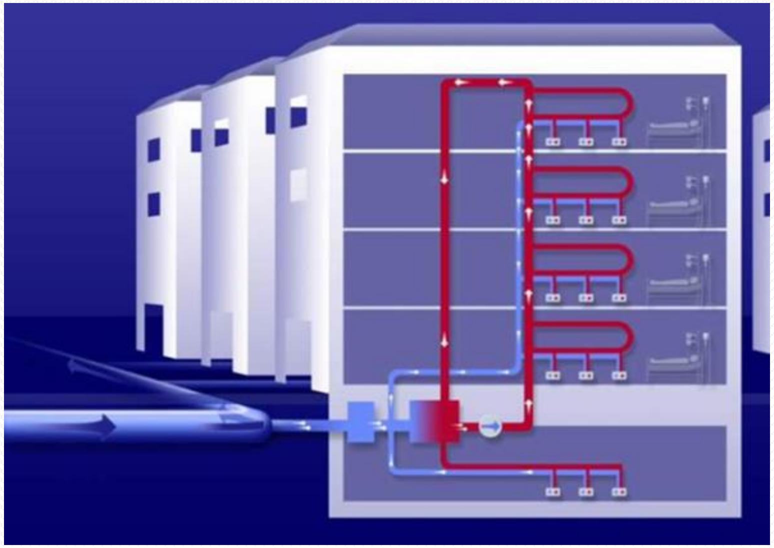
When is surveillance recommended?

- Signs that the water system is not under control
- After periods of stagnation
- After work on the distribution system
- Notice a cluster of cases of a gram negative pathogens

Sampling (culturing) Water

Bacterial counts in water samples can differ significantly within a short time period due to the irregular shedding of biofilm particles into the water distribution system

Sampling Water



- If water samples are obtained when the water is first turned on, this sample represents the water quality between the faucet and the circulating system
- If water samples are obtained after allowing the water flow for a period of time, this sample represents the water quality in the circulating system

Control Measures

- Facility Specific
  - Establish base line data
  - May use antibiograms
  - May perform active surveillance
  - Monitor content of water
  - Use your NHSN/State Reportable Data
  - Establish thresholds

Questions