



Factors Influencing Opportunistic Premise Plumbing Pathogens in Homes

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Opportunistic Premise Plumbing Pathogens (OPPPs)

- Normal inhabitants of natural waters and soils
- Enter drinking water via treatment plants
- Colonists, not contaminants
- Treatment selects for OPPPs
- Survive, grow, persist in drinking water
- Infect individuals with risk factors



Risk Factors for OPPP Lung Infection

- Occupational Dust Exposure
- Surgical Exposure (OR or ICU)
- Prior Lung Infection
- Genetic (Cystic Fibrosis)
- Older, Slender, Taller Women (risk ?)



OPPPs

- *Legionella pneumophila*
- *Pseudomonas aeruginosa*
- *Mycobacterium avium* complex
- *Acinetobacter baumannii*
- *Sphingomonas paucimobilis*
- *Stenotrophomonas maltophilia*
- *Cupriavidus* spp.
- *Acanthamoeba polyphaga*



OPPP Characteristics

- Disinfectant-Resistance
- Prefer to Adhere to Surfaces
- Form Biofilms on Surfaces
- Grow at Low Organic Carbon
- Grow at Low Oxygen (stagnation)
- Concentrated in Aerosols
- Grow in Amoebae
- Desiccation-Tolerant



Adherence and Biofilm Formation

- Adherence Driven by Hydrophobicity
- Growth of Adherent Cells = Biofilm
- Protective Extracellular Matrix
- Residence and Persistence
- Resistance to Disinfection and Washout
- Re-appearance Following Disinfection



NTM in Household Plumbing

- Enter Plumbing Through Municipal Pipe
- Grow in Water Heater
- Transported Throughout House
- Attach to Surfaces Form Biofilm
- Aerosolized in Showers, Taps, Drains
- Grow in Stagnant Water



Reducing OPPP Exposure -1

- Raise Water Heater Temperature-130 F
- Showerhead with Large Diameter Holes
- Increase Bathroom Ventilation
- No Direct Water Flow into Drains
- Remove Aerators on Taps
- Flush Before Collecting Water



Reducing OPPP Exposure - 2

- Disinfect Showerhead
- Don't Drink Refrigerator Water or Ice
- Only Use Evaporative Humidifier
- Avoid Spas and Hot Tubs
- Flush House if Vacant (Second Homes)



Reducing OPPP Exposure - 3

- Drain Water Heater Monthly
- Substitute Well Water for Piped Water
- Install Showerheads with Filters
- Install Tap Filters
- Use Water Bottles with Filters or UV



Regular Remediation

- Drain Water Heater Monthly
- Raise Water Heater to 130° F (55° C)
- Reduce Stagnant Portions: **Flush**
- Remove All Dead Ends
- Point-of-Use Filters and Shower Heads
- Remove Aerosol-Generators



Monitoring OPPs

- What to sample; water or biofilm?
- What indicator; *Escherichia coli* or heterotrophic plate count (HPC) don't correlate with OPPP numbers?
- What frequency to monitor?
- What OPPP numbers indicate disease risk?



Green Buildings Enrich OPPP Numbers

- Lower Water Heater Temperatures
- Longer Water Residence Time
- Reduced Flow, Misting Shower Heads
- Biofilm Build-Up

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