

**Surrounded by Nontuberculous Mycobacteria**  
**Prof. Joseph A Falkinham III, Virginia Tech**  
**A Webber Training Teleclass**



**Surrounded by Nontuberculous  
Mycobacteria (NTM)**  
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[www.webbertraining.com](http://www.webbertraining.com)

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## **Nontuberculous Mycobacteria (NTM)**

- Waterborne Opportunistic Pathogens
- Natural Inhabitants of Drinking Water
- Colonists, not Contaminants
- Survive Water Treatment
- Grow in Distribution System
- Survive, Grow, and Persist in Plumbing

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**Hosted by Paul Webber** [paul@webbertraining.com](mailto:paul@webbertraining.com)  
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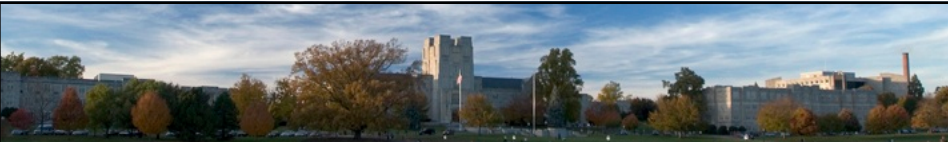



## Representative NTM Species

**Rapidly Growing *Mycobacterium***  
*M. abscessus* complex  
*M. fortuitum*

**Slowly Growing *Mycobacterium***  
*M. avium* complex (MAC)  
*M. avium*, *M. intracellulare*, *M. chimaera*  
*M. kansasii*, *M. xenopi*


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## NTM Identification

- Why Identify to species and subspecies?
  - *M. avium* subsp. *hominissuis*
  - *M. chimaera* vs. *M. intracellulare*
  - *M. abscessus* subsp. *abscessus*
- Different disease severity
- Different antibiotic susceptibility
- Different sources

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## NTM Sources in Hospitals

- Drinking Water and Ice
- Shower, Sink, Drain, Toilet Aerosols
- Humidifiers and Nebulizers
- Fountains, Therapy Baths
- Bronchoscopes & Heater-Coolers
- Disinfectant Solutions

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## NTM Sources at Home

- Aerosols from:  
Shower, Tap Aerator, Toilet, Drain  
Humidifiers, Hot Tubs and Spas
- Refrigerator Water and Ice
- Swimming Pools
- Drinking Water
- Potting Soils

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## Transmission of NTM

- Aerosolization from Showers
- Aerosolization from Taps and Drains
- Water via Aspiration (GERD)
- Water via Contact (cuts, abrasions)
- Water or Ice via Drinking or Contact
- Dust from soil, pots, crops, construction

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## Risk Factors for NTM Infection

- Occupational Lung Damage (Dusts)
- Prior Lung Infection/Treatment
- COPD, Bronchiectasis
- Immune Deficiency (HIV, Cancer)
- Gastric Reflux
- Tall, Slender, Older (180,000 in USA)
- Cardiac Surgery (Heater-Cooler)

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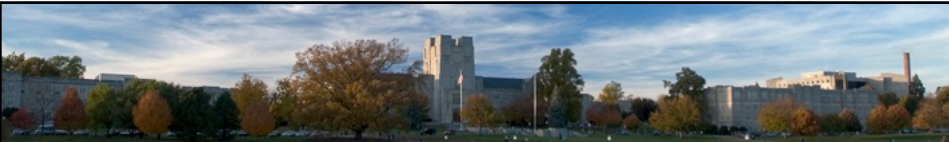





## Risk Factors Hospital Infection

- **Patients:** Immunosuppression, cancer, cystic fibrosis, neonates
- **Hospital Environment:** Surgery, intensive care, cardiac surgery, shower exposure, ice exposure, prolonged residence in hospitals


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## NTM Characteristics - I

- **Thick, Lipid-Rich Outer Membrane**
- Cells are Hydrophobic
- Cells are Impermeable
- **Slow-Growing, but Rapid Metabolism**
- Grow at Low Organic Carbon
- Grow at Low Oxygen Levels
- Grow in Amoebae

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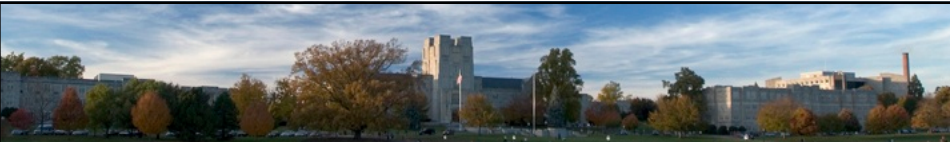

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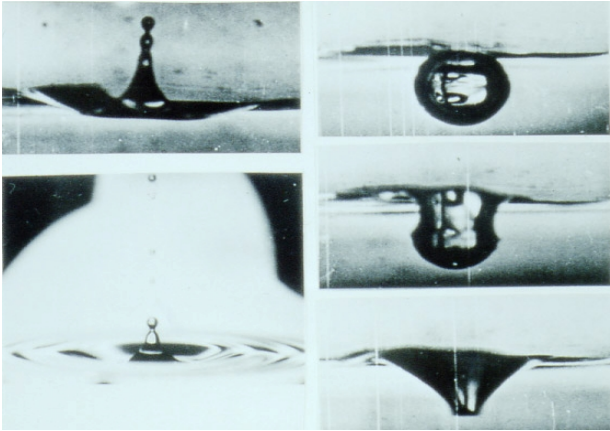
## NTM Characteristics - II

- Resistant to Disinfectants
- Adhere and Form Biofilm
- Biofilm Cells More Resistant
- Desiccation-Resistant
- Concentrated in Aerosols
- Slow Entry of Nutrients


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## NTM Aerosolization



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## NTM Love Plumbing

- Enter Plumbing via Municipal Source
- High Surface to Volume Ratio
- Adherence and Biofilm Formation
- Survive and Grow in Water Heater
- Portion of Water Heated and Circulated
- Stagnation Doesn't Reduce Growth
- Growth at Low Organic Carbon Levels

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## Monitoring Challenges

- Numbers Don't Correlate with *E. coli*, HPC, nor Other Measures
- Enumeration Requires Special Media and Long Incubation
- Enumeration by PCR (Dead + Living)
- No Infectious Dose Identified
- Where and When to Monitor?

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## Emergency Remediation

- **Actions:**
  - Circulate Very Hot Water: 70° C
  - Circulate High Chlorine: 5 ppm
- **Problem:**
  - How to Remove Biofilm?
- **Never Get Rid of OPPPs**

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## NTM Remediation - I

- Dedicated water delivery to:
  - Neonatal Intensive Care
  - Intensive Care
  - Kidney Dialysis
  - Transplant Suites

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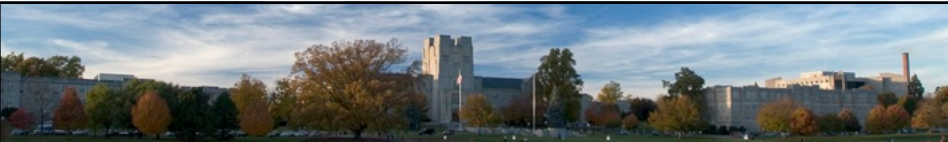





## NTM Remediation - II

- Disinfection a Two-Stage Process:  
**Biofilm-Disruption & Disinfectant-Killing**
- Biofilm NTM Resistant to Disinfectant
- Surviving Biofilm Cells Re-Inoculate
- Rapid Reappearance of NTM
- Need to kill NTM in Biofilms

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## NTM Remediation - III

**Killing Biofilm NTM Requires Biofilm-Disruption:**

- (1) Detergent** to break hydrophobic bonds
- (2) Salts** to break ionic bonds
- (3) Enzymes** to break down DNA, lipids, polysaccharides, and proteins

**Question:** Tolerance of plumbing or instrument

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## Regular Remediation

- Drain Water Heater Monthly
- Raise Water Heater to 130° F
- Flush Stagnant Portions
- Remove All Dead Ends
- Point-of-Use Filters and Shower Heads
- Remove Aerosol-Generators

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## Green Buildings Enrich NTM Numbers

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

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January 26, 2023	<b><a href="#">PERSONAL PROTECTIVE EQUIPMENT IMPLEMENTATION IN HEALTHCARE SETTINGS</a></b> Speaker: <b>Prof. Maria Clara Padoveze</b> , University of São Paulo, Brazil
February 2, 2023	<b><a href="#">SURFACES – A FOUNDATIONAL ISSUE IN INFECTION CONTROL</a></b> Speaker: <b>Linda Lybert</b> , Healthcare Surfaces Institute
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