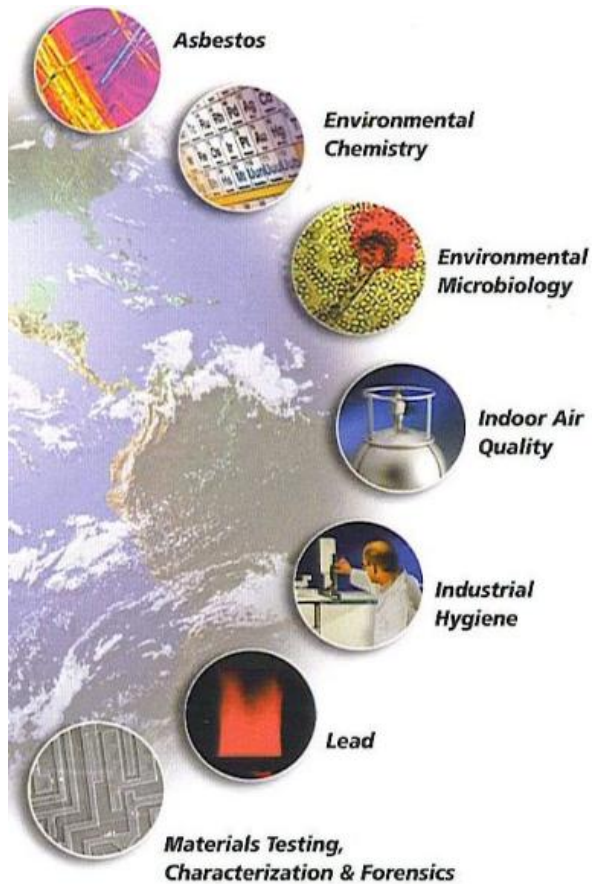




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Legionella and ASHRAE 188

March 21, 2013

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History of Legionella

1. Major outbreak of pneumonia at the 1976 American Legion Convention in Philadelphia
2. 240 cases of pneumonia with 34 fatalities
3. Causative agent was unknown at the time- earlier outbreaks went undiagnosed
4. Source is still unknown. Cooling tower samples were negative. No one tested the potable water.



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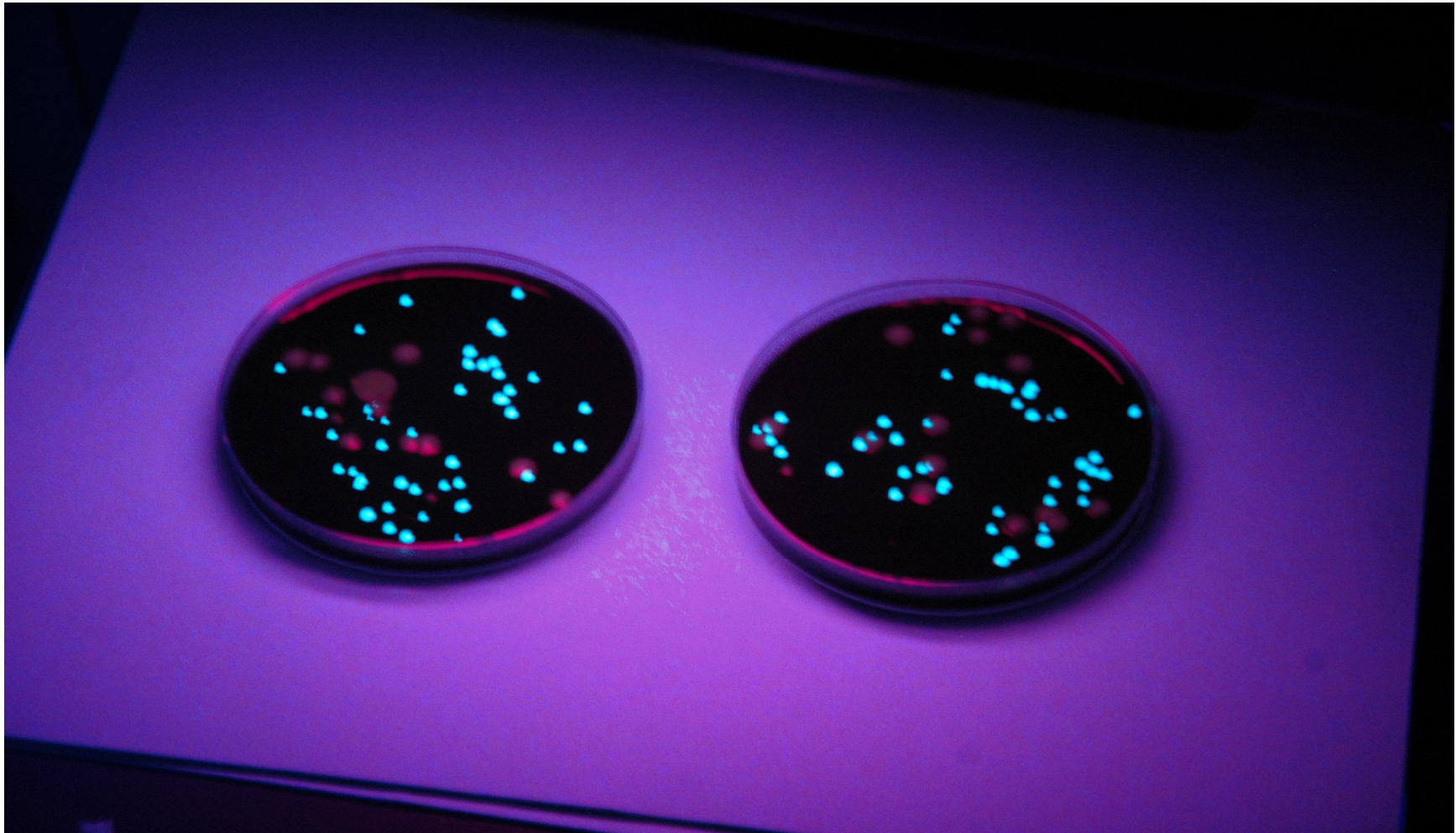
The Discovery-Legionellosis

1. Eventually the bacterium was isolated, identified, and named *Legionella pneumophila*
2. Bacterium must be inhaled deep into the lung via contaminated aerosolized water
3. Water droplets must be between 1 and 5 microns in diameter to enter deepest part of the lung
4. *L. pneumophila* serotype 1 causes 85% of illness in the US



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L. pneumophila





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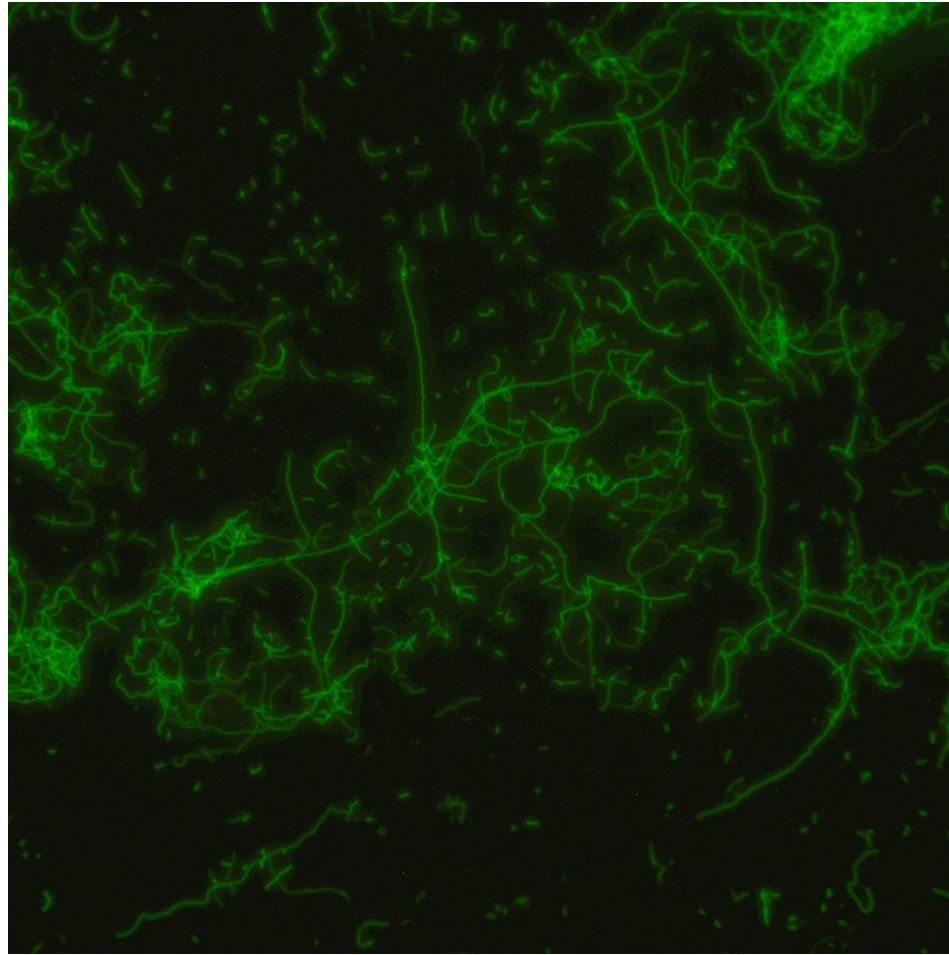
Legionella Bacterium

- Naturally occurring with over 80 species 60 serogroups; hundreds of strains (genus, species, serotypes, strains)
- Gram negative, rod shaped bacteria with a flagella (tail)
- Protozoonotic with amoeba, protozoans, blue green algae
- May survive 135 + days in room temp. distilled water; over a year in tap water



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L. pneumophila





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Legionella Bacterium

Fastidious Bacteria

- *68⁰ F to 120⁰ F for viability*
- *77⁰ F to 113⁰ F for amplification*
- *Needs iron*
- *Needs L-Cysteine*
- *Lower Dissolved Oxygen*
- *pH of 4.5 to 10.5*
- *Resistant to low levels of free chlorine*
- *Rubber, some plastics facilitate growth*
- *Copper inhibits growth*

Our plumbing systems!



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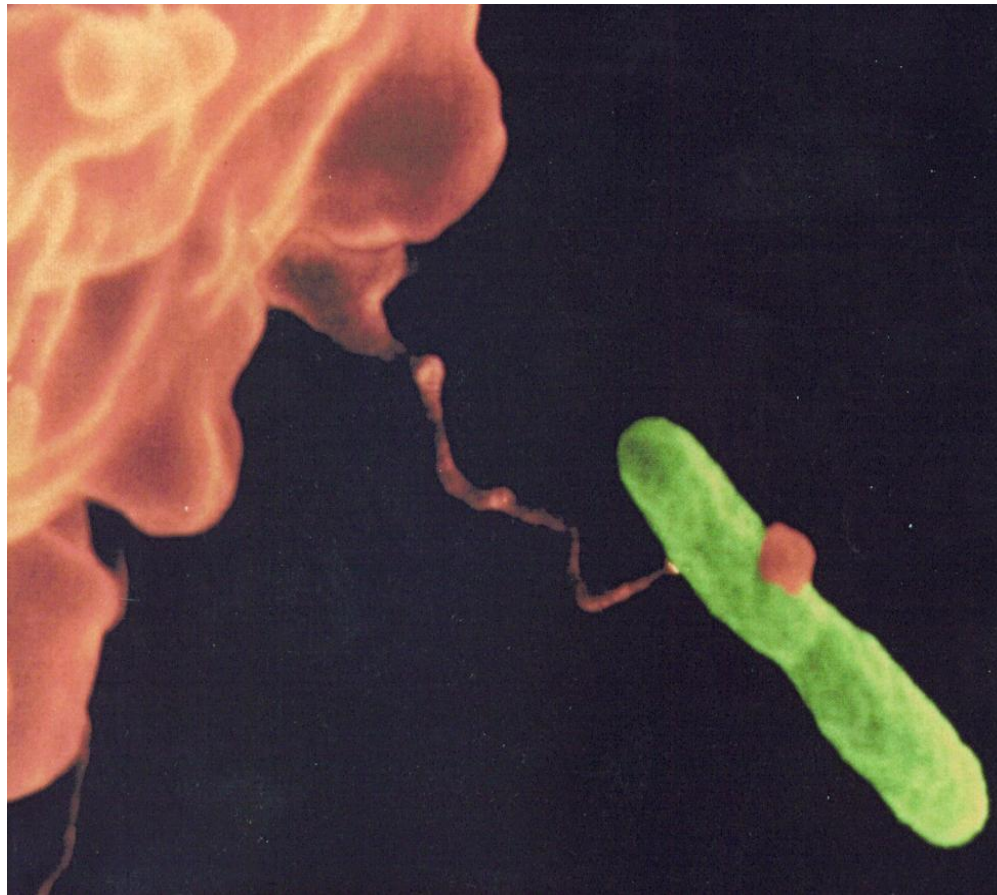
Ecology of Legionella

- Naturally occurring in all surface waters, groundwater, soil, compost, sludge
- Geographical prevalence – in US found more frequently in Northeast, Mid-Atlantic, Mid West, South East –very high NY, MD, Illinois
- Geographic species and strain differences
- Fresh, brackish, and salt water
- Seasonal trend – outbreaks increase from June until November altho outbreaks occur year round in hospitals and nursing homes
- Outbreaks have occurred in every state
- Cooling towers versus potable water, water features, hot tubs



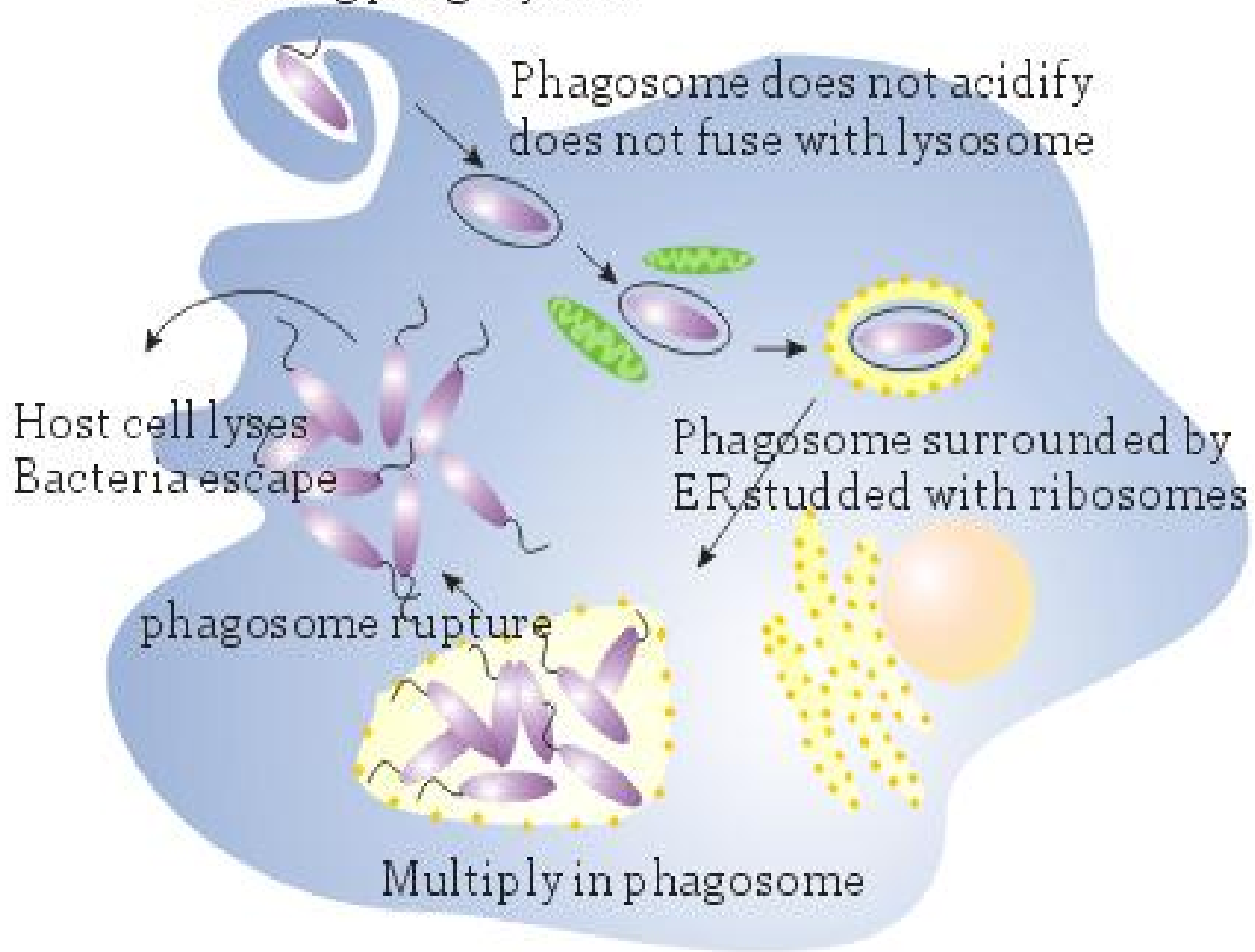
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The Bacterium





Coiling phagocytosis





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Legionellosis

1. Infection caused by Legionella
2. Estimated 25,000 to 75,000 cases per year in US-most go unreported*
3. Reportable disease in US, Europe, Australia, Singapore, Japan
4. No person to person transmission
5. Four illnesses of concern



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Legionellosis

- Legionnaires' disease: 2-10 days; serious pneumonia, can last weeks; long term health effects including cognitive impairment
- Pontiac fever: 24-48 hrs; flu-like symptoms; lasts 2-5 days; non-fatal.
- Asymptomatic Legionellosis
- Valve and joint replacement infections – heart, hip, knee



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Legionnaires' Disease

- Low Attack Rate 5%
- High Mortality 15%
- Incubation 2-14 days
- High Fever 102^o -105^o
- Difficulty Breathing
- Cognitive Impairment
- Confusion, disorientation
- Chest/Back Pain
- Dry cough at first, later producing phlegm
- Serious long term sequellae – confusion, cognitive decline, debilitating fatigue, PTSD, arthritis



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Legionnaires' Disease – Risk Factors

Community and Hospital Acquired

- Age
 - . Highest risk in men >65
 - . 3 fold increase in incidence since 2005 in all people <45*
 - . Neonatal cases, preemies – no diagnosis required*
- Smoking
- Pre-existing COPD, diabetes
- Renal disease
- Compromised immune system
- Modern medicine is increasing the number of immune-compromised people –diabetics, RA, psoriasis, AIDS, cancer, asthmatics, Crone's Disease, other autoimmune diseases



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Pontiac Fever

- High Attack Rate 95%
- Low Mortality 15%
- Incubation 1-3 days
- Muscle Aches
- Flu-like symptoms



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Non-pneumonia Legionellosis

- Infects artificial heart valves, hip and knee replacements
- Acute Respiratory Distress Syndrome
 - Severe difficulty in breathing
 - Anxiety
 - Agitation
 - Fever
- We all have antibodies against Legionella



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Changing Epidemiological Trends

- Incidence has tripled since 2000
- Since 2002, cases most commonly reported in 45-64 year old males
- Before 1999 most cases were in males older than 64
- Age adjusted incidence rate for males is twice that of females
- Geographic distribution – increase in states east of Mississippi



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Epidemiological Trends

- Reported in every state
- Highest number of cases in Mid-Atlantic, North Central and South Atlantic –particularly PA, NY and OH
- Seasonal component-most cases occur in summer and fall particularly after rainfall and high humidity events –July thru November but we are seeing case increases in winter
- 20-25% of cases are travel associated –hotel stays, cruises
- Global Warming



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Legionellosis Outbreaks

- First Recognized Outbreak – Legionnaires' Disease
July, 1976 Bellevue Stratford Hotel, Philadelphia, PA
 - 221 cases; 34 deaths
 - Cooling towers were suspected
- Largest Outbreak-Legionnaires' Disease
July, 2001, Muraca, Spain
 - >800 cases; 3 deaths
 - Source unknown
- Most Decadent Outbreak-Pontiac Fever
April, 2011, Playboy Mansion, Los Angeles, CA
 - >200 cases, no deaths
 - Hot tub was suspected but samples were ND
- Most recent – Pittsburgh VA Hospital
 - 30 cases, 6 deaths
 - Potable Water System



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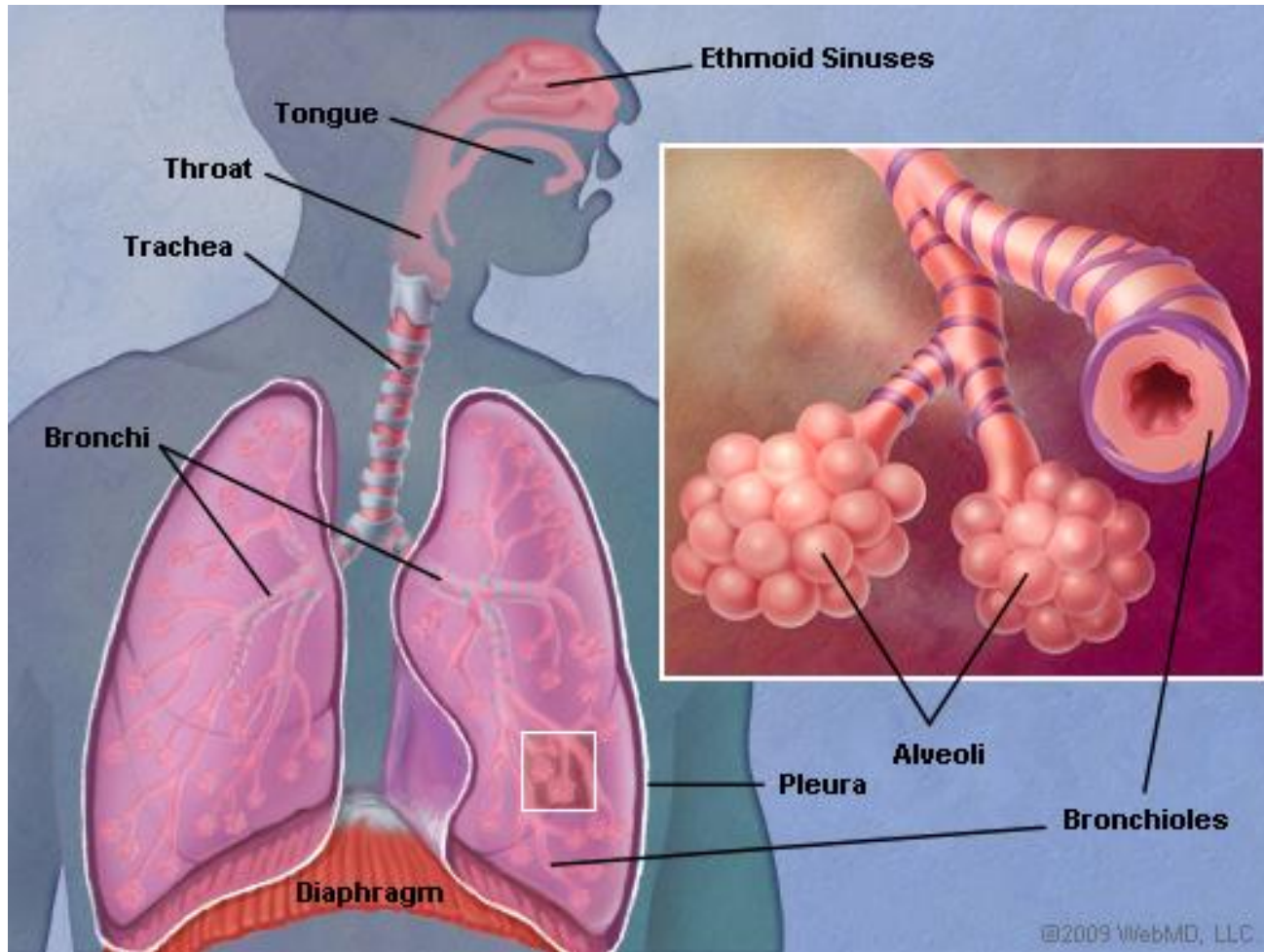
Legionellosis Causation

- Viable bacteria in natural reservoir
- **Amplification** in water source-growth requirements
- **Dissemination**-respirable droplets formed by aerosolization
- **Transmission**-contaminated, respirable bioaerosols must travel thru
air
- Inhalation/aspiration by susceptible human host → alveoli → pulmonary macrophage



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Susceptible Host



Picture from Web MD



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Amplification - Role of Temperature

< 68 ⁰ F	Bacteria dormant but viable
68 ⁰ to 120 ⁰ F	Multiplication
122 ⁰ F	90% Kill in 2 Hours
140 ⁰ F	90% Kill in 2 Minutes
158 ⁰ F	100% Rapid Kill
>140 ⁰ F	Stored hot water
125 ⁰ F	Hot water return

Lab studies-species, plumbing system, degree of biofilm, sediment, scale, etc.



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Transmission - Infected Aerosols Need to Survive in the Environment

- Bacteria won't survive in airborne droplets in the environment (therefore, no air sampling)
 - . Low humidity
 - . Temperature
 - . UV light
 - Smog
 - . Distance to susceptible host
- If optimal conditions exists, infected aerosols can survive >1 mile*



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Business Opportunities Increasing

- Incidence is increasing
- More public recognition of the disease
- No Federal Standard but there are standards in many other countries that are being recognized here
- Many state, professional, and some city guidelines –Las Vegas!



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Where We are Now

- Currently little uniformity between OSHA, and other industry standard guidelines. Of little use in Legionellosis claims.
- NY, NJ, Allegheny County PA, Maryland, Los Angeles County CA, TX, Garland, TX, Canada, CDC, JCOHA, VA, AWT, CTI. These are suggestions only. Only hospitals in MD, NY, and Allegheny County, PA are regulated.
- EU, Japan, UK, Paris, France, Poland, Australia – Regulations in place



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The Game Changer-ASHRAE 188

- American Society of Heating, Refrigeration, and Air Conditioning
- Standard Program 188 – Prevention of Legionellosis Associated with Building Water Systems
- <http://spc188.ashraepcs.org/index.html>



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ASHRAE 188

- 1 Purpose: The purpose of this standard is to present practices for the prevention of legionellosis associated with building water systems
- 2 Scope:
 - 2.1 This Standard provides methods of risk management for the prevention of legionellosis associated with centralized industrial and commercial building water systems.
 - 2.2 This standard applies to human occupied buildings, excluding single family residential buildings. While not specifically intended for non-centralized or single-family residential building systems, some of the information presented in the non-mandatory appendix may be useful for these systems.
 - 2.3 This Standard is intended for use by those involved in the ownership, design, construction, installation, (including commissioning), management, operation, maintenance and servicing of centralized industrial and commercial building water systems.



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ASHRAE 188

- ASHRAE 188 is expected to shape how litigants and courts view legal liability in Legionellosis litigation
- Opens the door for more lawsuits against all building owners, buildings with hot tubs and water features for Legionellosis outbreaks. **NO EXCEPTIONS OR GRANDFATHERING.**
- Also intended for architects, consultants, engineers, contractors, water treatment companies



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ASHRAE 188

- Public Comment period ended February 2013
- Adoption is planned for late spring 2013
- It is expected to be incorporated in city, county, state building codes. Therefore it will have the force of law.
- If not part of code, then plaintiffs can use to as evidence of best practices for the industry.



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ASHRAE 188 Increases Liability for Building Owners

- Flaherty v. Legum & Norman Realty Inc. 2007, \$20 million settlement denied where husband alleged that his wife's Legionnaire's disease was caused by a manager's negligence in maintaining common water system at condominium complex.
- Husband could not prove negligence because he did not offer expert testimony, industry standards, or applicable ordinance or statute to **establish a standard of care that building manager had to exercise.**



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Who is Impacted?

- Determine a building's risk
 - 1) Multiple housing units with > 1 centralized water heater
 - 2) > 10 stories high (including below grade levels)
 - 3) If there is cooling tower/evap condenser that provides cooling or refrigeration for heating, ventilation, AC, or refrigeration
 - 4) Inpatient health care facility where occupants are > 65 or those receiving chemotherapy or bonemarrow/stem cell transplants.



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Risk/Who is Impacted?

5. Has 1 or more whirlpools, hot tubs, spas, water features or devices that release water aerosols.*
6. Receives incoming potable water that has less than 0.5 ppm of residual halogen concentration (chlorine or bromine).
- (7.) Single family residences not included but what about vacation rental properties?



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Backbone is Risk Management Plan

- To identify the Amplification, Dissemination and Transmission pathways of Legionella
- Events Impacted by Operation, Design & Maintenance Practices
- Hazard Analysis Critical Control Point (HACCP)
System Risk Management Process each risk factor
- HACCP is a scientifically based risk management method that prevents hazards from harming people.



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7 HACCP Principles

1. Conduct a hazard analysis to ID points in the potable or utility water system where there significant potential for Legionella growth
2. Identify each critical control point (CCP). A CCP is that point identified above that is controlled to minimize risk
3. Establish critical limits for each CCP. These limits refer to the methods that control amplification, dissemination, and/or transmission of Legionella
4. Monitor control of each CCP
5. Take corrective action when monitoring indicates control is not reached
6. Verify and Validate your HACCP
7. Document your design, operation, emergency and maintenance procedures



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Review - What Does HACCP Include?

- **An identified HACCP team** consisting of facilities, safety, infection control personnel, as well as consultants with Legionella expertise to develop the plan
- **Reviewing or creating flow diagrams** of all potable and utility water systems to identify how all water received, processed, delivered to end point users
- Doing **building inspections** to confirm the diagrams are accurate
- **Identify processing steps** used to condition or treat water before use or consumption



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Review - What Does HACCP Include?

- **Hazard Analysis Summary** for each processing step. Indicate severity of hazard
- List **control measures** to prevent, eliminate or reduce the hazard
- **Identify CCPs** for the process. Typically there will be one or two CCPs for each process
- **Establish critical control limits**
- **Validate control limits**
- **Verify Implementation** – Do what you say you are going to do and identify the schedule
- **Documentation (Recordkeeping)** - Being able to prove all the above



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Field Test Kits

- Not CDC Elite Proficient. CDC will not accept into the Legionella proficiency program
- No validation of test method or procedure
- No validation of media used in the kits
- Is manufacturing of the media standardized?
- Problem with “reproduceability” of the test samples
- Limit of Quantitation is not sensitive enough



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Aerosolized Water Sources Known to be Associated with LD

- Cooling Tower Mist-down draft
- Evaporative Condensers, Air Coolers
- Shower Heads and Faucets
- Hot tubs and Whirlpool Baths
- Architectural Fountains and Waterfalls
- Body Misters
- **Cool Mist Humidifiers**
- Metalworking Fluids
- Nebulizers, Respiratory Therapy Equipment
- Commercial car washes (recycled water only)
- Windshield Wiper Fluid – only use commercial preparations
- Recycled water
- Vegetable misters
- Ice machines in hotels and hospitals
- Potting Soil
- **CPAP** - Using tap water vs distilled water



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Questions?

www.legionellatesting.com