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Our Current Understanding of *Legionella* in Drinking Water



Gary A. Burlingame

ESPRI – The Environmental Science, Policy and Research Institute

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***Legionella pneumophila* is currently being reported, nationally, as the greatest cause of drinking water-associated, waterborne disease outbreaks in the US**

- **Outbreak-associated cases occur**
- **Sporadic cases can be more common**

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It is Regulated under the SDWA

- Surface Water Treatment Rule (SWTR)
- “Treatment Technique”
- Maximum Contaminant Level Goal = 0
- Assumes Ct for *Giardia* and viruses are adequate to control *Legionella*



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Treatment Technique for *Legionella*

- To maintain “a detectable residual” in at least 95% of distribution system samples analyzed each month.
- The definition of detectable is at the discretion of primacy agencies.
- The US EPA is reviewing the regulations and how other agencies should address *Legionella*.

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The MCLG of 0 was applied to *all* species of *Legionella*

Yet it is *Legionella pneumophila* that has been causing almost all of the cases and outbreaks of Legionellosis



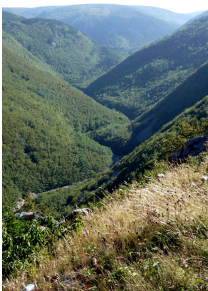
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The MCLG of 0 does not recognize its natural occurrence



Legionella species and *Legionella pneumophila* are naturally found in water systems, and, like coliform bacteria, will occur in treated water distribution systems as a part of the microbiome.

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The SWTR addresses *Legionella* spp. in public water systems..... but.....



To date, *Legionella pneumophila* causes problems in building water systems, typically the hot water systems and cooling towers, which are to be separated from the potable water system by backflow preventers.

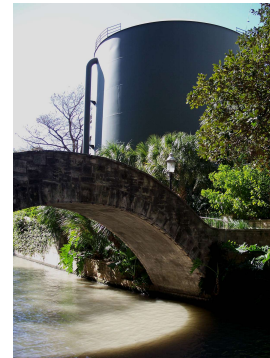
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The Fate and Transport of *Legionella* in Drinking Water Systems



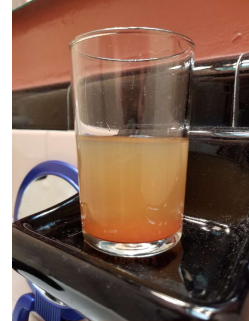
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***Legionella pneumophila* lives in the natural environment, and like many different microorganisms, they find their way into distribution systems and live in the “microbiome” of sediment and biofilm.**



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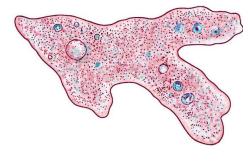
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***Legionella pneumophila* can be engulfed by amoeba and then amplify inside of the amoeba. When the amoeba form cysts or die, they release the *Legionella*. Amoeba are part of the microbiome.**

Keeping amoeba in the cyst form can keep *Legionella* levels under control.



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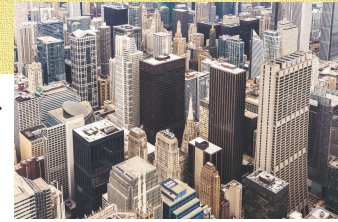
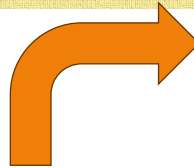
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What is “seeding”?



Legionella pneumophila is present in the treated drinking water at a concentration usually below detection.

Occasionally it enters building water systems from the water supply and finds a favorable niche there.

- Groundwater or surface water – it does not matter!
- Both community & non-community water systems.

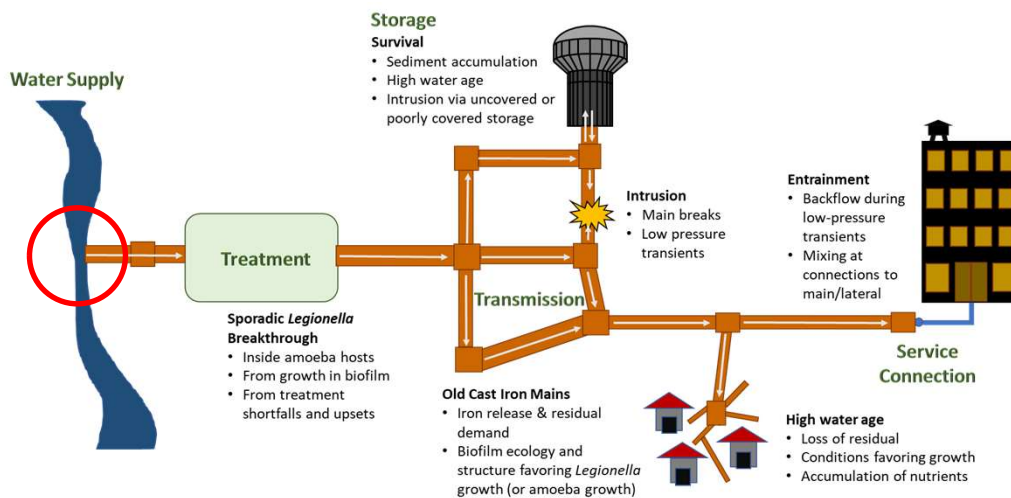
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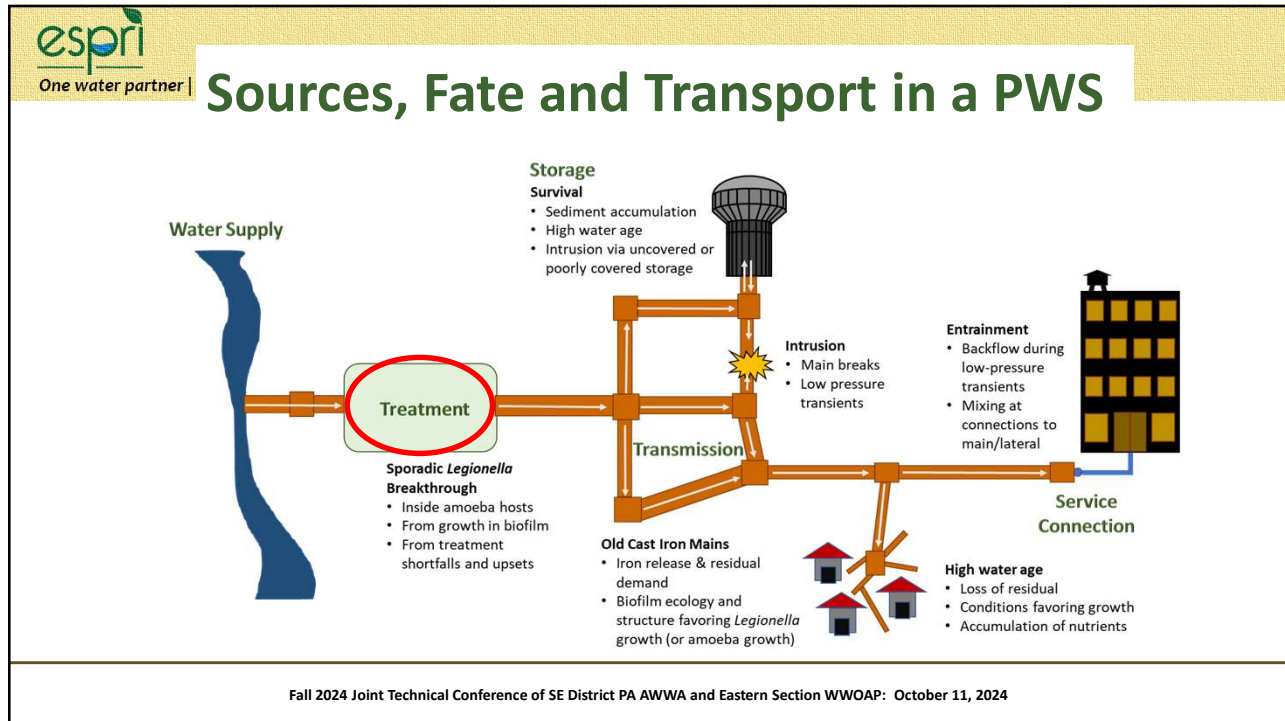
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Sources, Fate and Transport in a PWS

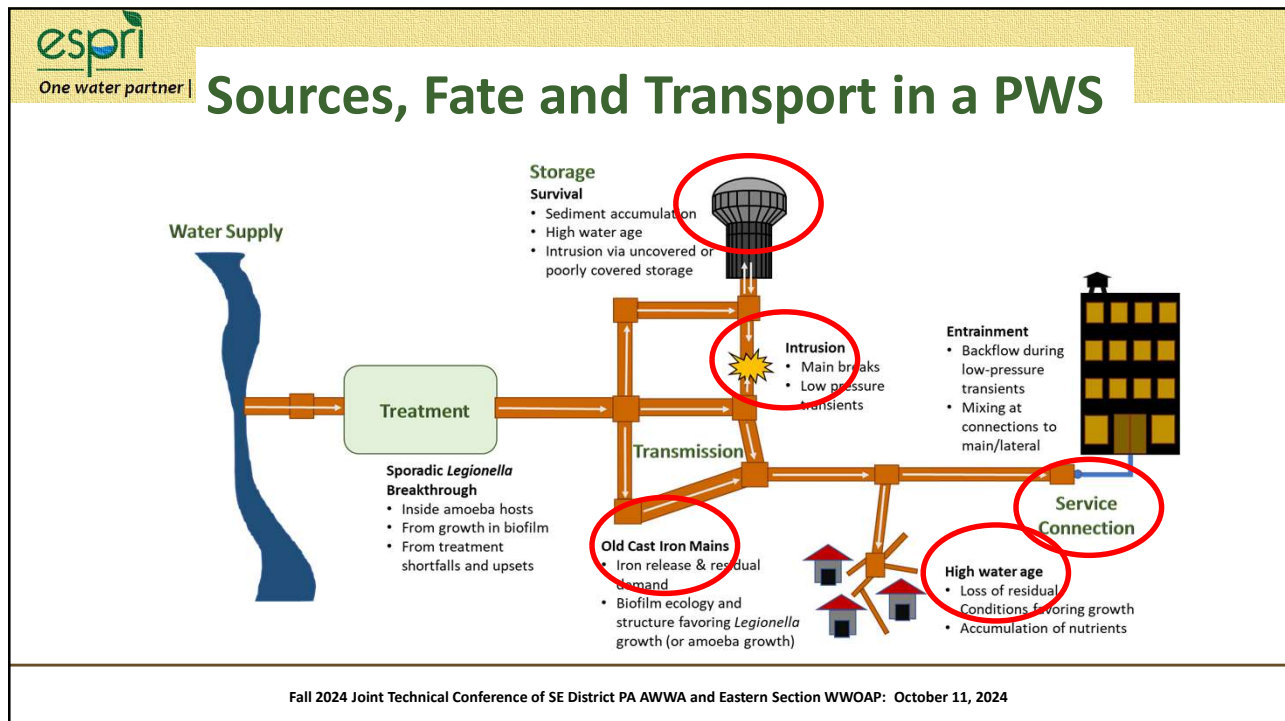


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Thus, we rely on Multiple Barriers to manage *Legionella*.

- While we do not have the information or data, we need to specifically identify risky events.....
- We use common sense and best practices to minimize the possibility of intrusion and breakthrough.

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How do we know if *Legionella* is present?



- PCR can detect the genetic material of *Legionella* spp. in potable water from public water systems and building water systems.
- However, PCR detects genetic material from both viable and non-viable, living and dead bacterial cells.

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A Practical Test Method Exists

- The Legiolert protocol by IDEXX, scores any test with a brown color or turbidity within the Quanti-Tray as positive for *L. pneumophila*.
- Utilities have a high success rate with using the Legiolert test.

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Occurrence of *Legionella pneumophila* In Drinking Water Distribution Systems (Final Report 2024)

- **RESEARCHERS**
- Tim Bartrand, PhD
- Mark LeChevallier, PhD
Jennifer Clancy, PhD
- Randi McCuin



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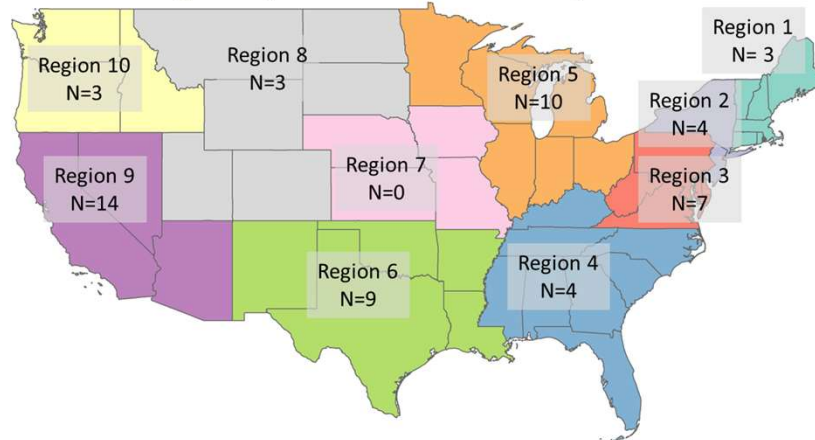
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**A total of 57 PWSs provided data that were used in a recent WRF study;
samples collected during two years when water temperature was warmest**



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Additional data from Mark LeChevallier (2019) were added to the study:

- **1147 samples (649 from free chlorine systems, 498 from chloramine)**
- **15 samples were positive (1.31%) (14 were from free chlorine systems)**
- **6 water utilities had at least 1 positive sample**

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Study Results

- Culturable *L. pneumophila* are rare in distribution system samples - observed in a small proportion (1.2%) of samples.
- 9181 results were qualified
- 109 samples were positive; 87 for free chlorine systems
- > 70% of systems did not detect *Legionella*
- % positive samples ranged from >5% to <3%



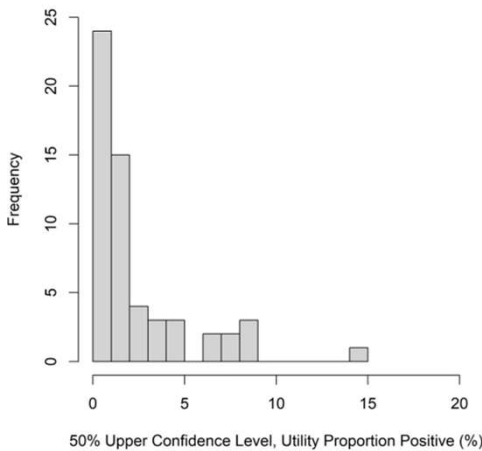
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Is There a Baseline?



- A preliminary and conservative (high) estimate of background *L. pneumophila* occurrence in public water distribution systems is 5% or less of samples.

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Legionella levels (MPN/100 mL)

- ≤ 100 – Background levels.
- > 100 to ≤ 1000 and no more than 5% of samples positive – Results are within a normal baseline. Monitor closely.
- > 1000 or $>5\%$ of samples positive - Additional action should be taken. Conduct assessments.
- ≥ 5000 MPN/100 mL requires immediate attention and notification.

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Legionella and Chlorine Residuals



- For both free chlorine and chloramine systems, the highest proportion positive corresponds to disinfectant concentration of 0.2 mg/L or less.
- The presence of a total chlorine residual does not guarantee that *Legionella* will NOT be detected.

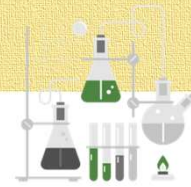
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Minimum Total Chlorine Residual



- The greatest benefit may be realized when raising disinfectant concentration to 0.2 mg/L; further increases in disinfectant concentration appear to provide marginal improvements in *L. pneumophila* control.
- The consistency of maintaining a minimum disinfectant residual may be more important than the disinfectant residual concentration level

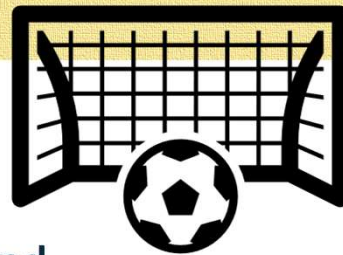
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Final Point



Although the greater responsibility and opportunity for risk management lies with building owners and operators, there are steps we can take to assist these operators in better managing *L. pneumophila* health risk.

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What do we know today?

- Several dozen species of *Legionella* bacteria are known to exist.
- These bacteria include ones that naturally occur in soil and groundwater and surface water.
- *Legionella pneumophila* is one of the many species that are found.
- *L. pneumophila* is the major cause of water-related Legionnaires disease.
- Exposure to *L. pneumophila* occurs mainly by inhalation of water droplets or mist containing *L. pneumophila*.

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Each water utility will have a “baseline” level of *Legionella pneumophila* that is not a direct public health risk, however, much more data are needed to define this:

- Occurrence – how often a monitoring program detects a positive sample
- Abundance – the quantity of *L. pneumophila* that is found in positive samples

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A baseline consists of:

- Occurrence frequency (which should be < 5%)
- Concentration (which should be ≤ 1000 MPN/100 mL)
- No sample location should produce consecutive positive samples, especially samples with concentrations > 1000 MPN/100 mL.

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Research is needed to determine under which circumstances *Legionella pneumophila* is introduced to the distribution system, under which circumstances does it increase in occurrence and abundance in distribution, and how mitigation efforts counter these conditions.

Currently we rely on expert judgement and best practices.

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A well-run water utility can minimize the occurrence and survival of *Legionella pneumophila* as the seed to building water systems.



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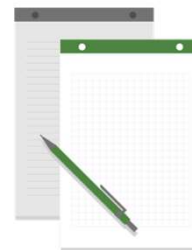
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A well-run water utility will also provide conditions that help building water systems apply best management practices:

- Supply water with a detectable disinfectant residual
- Maintain water pressure and supply
- Provide water quality information
- Minimize iron corrosion and sediment
- Minimize corrosion-promoting conditions

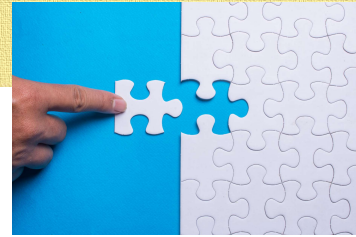


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A well-run water utility will:

- Minimize water age and prevent areas of stagnation
- Maintain water quality in storage facilities
- Manage biofilm and nitrification
- Manage water pressure and leakage
- Follow best practices for water main installation and repair

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An MCLG=0 for *Legionella* spp. which includes *Legionella pneumophila*, can hinder the essential collection of data to understand occurrence, causes for occurrence, and the success of mitigation efforts.

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QUESTIONS ?

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