Investigating an Outbreak of Legionnaires' Disease from Cooling Towers in Surrey, BC

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BC Centre for Disease Control

Environment and Climate Change Canada

BACKGROUND

What is Legionellosis?

- Caused by *Legionella* bacteria
  - 90% of human infections are caused by *Legionella pneumophila* (Lp)
  - Serogroup 1 (SG1) most common variant
  - Further differentiated by sequence typing

- Three forms of disease:
  1. Asymptomatic infection
  2. Pontiac fever (mild illness)
     - Recovery in 2-5 days without treatment
  3. Legionnaires' Disease (pneumonia)
     - Presents as atypical pneumonia
     - Treated with antibiotics
     - 11-25% mortality rate

RISK FACTORS
Older adults (> 50)
Males
Smokers
Underlying conditions

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Where do you find Legionella?

Transmission and Sources:

- Common in freshwater and soil

- Examples of potential sources:
  - Nebulizers, CPAP machines
  - Hot tubs, shower heads
  - Cooling towers, water fountains

- Health risk when conditions promote proliferation + aerosolization
  - 25-45 ^{o}C, biofilm formation, stagnant water, nutrient sources

- Transmission by inhalation of aerosolized particles

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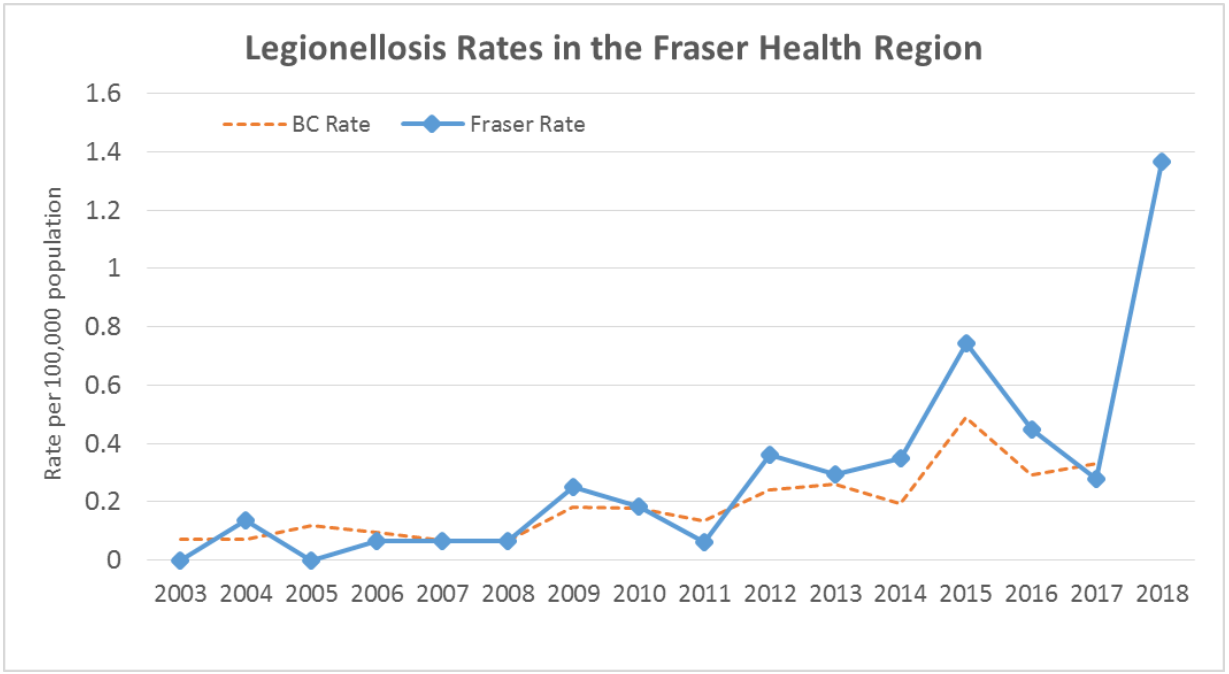
How common is it in Fraser region?



- **5-6 'sporadic' infections on average since 2012**

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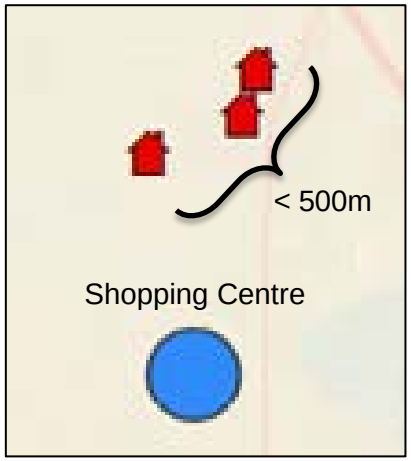
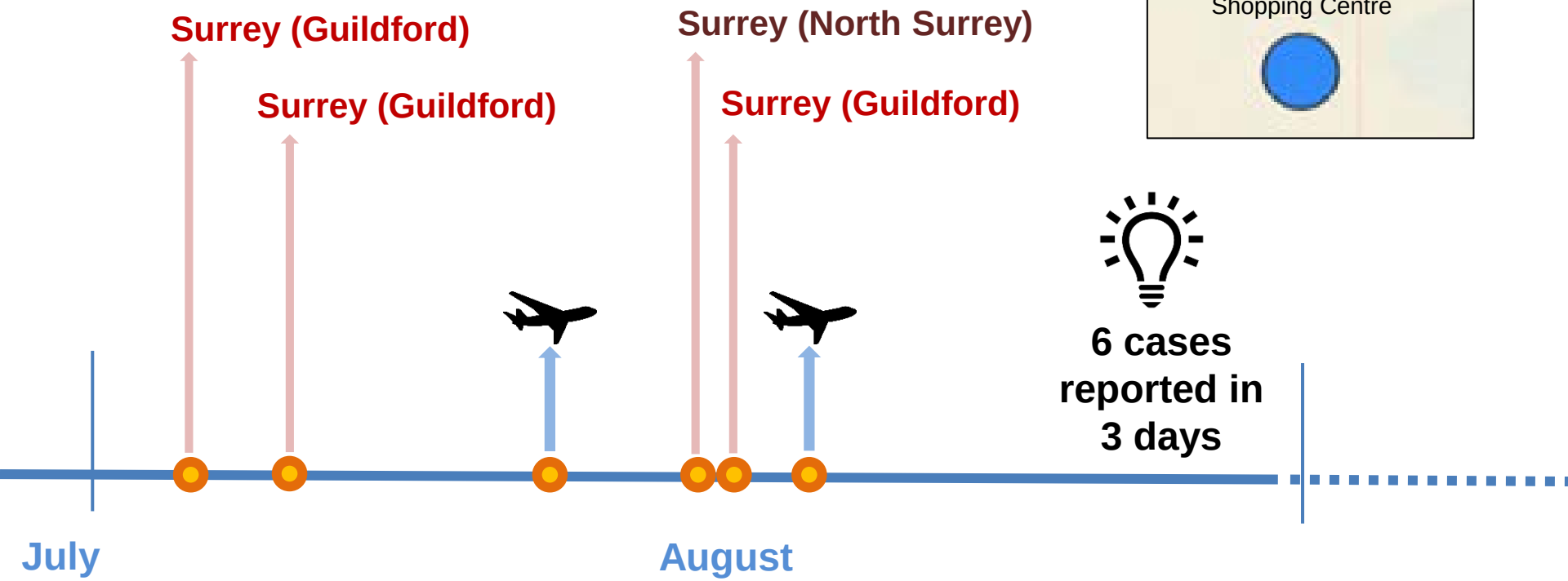
THE 2018 OUTBREAK

The signal: First Cases

- Onset Date





Public Health Actions

- Environmental assessment of two city blocks
- Shopping Centre area revealed several aerosolized water source
  - No registry, so followed up with centre managers and operators
- Conclusions
  - Identified ten cooling towers at the shopping centre
  - Sampled all ten, in addition to other sources of aerosols

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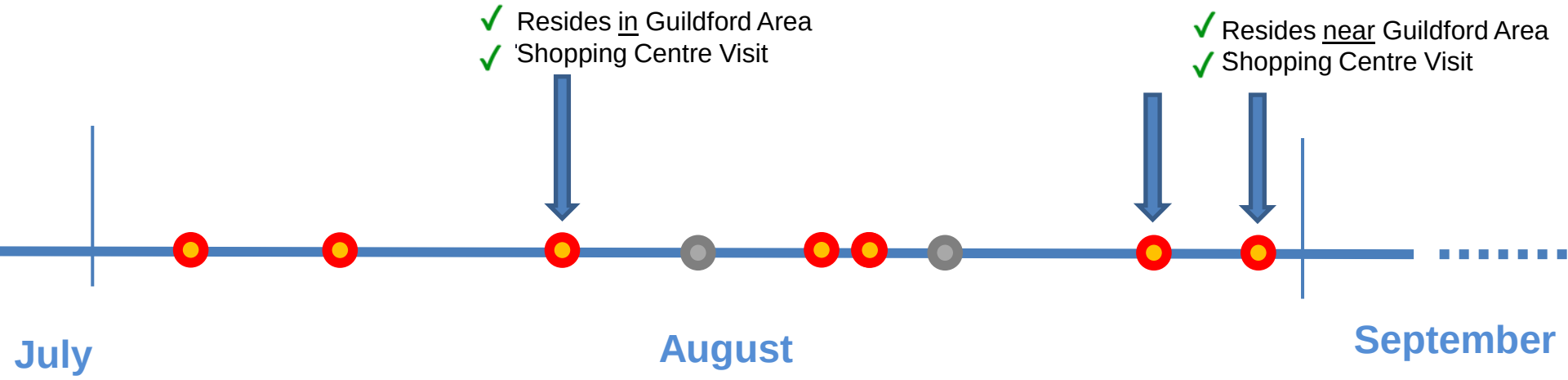
AND MORE CASES…

Further Support for Suspected Source Area

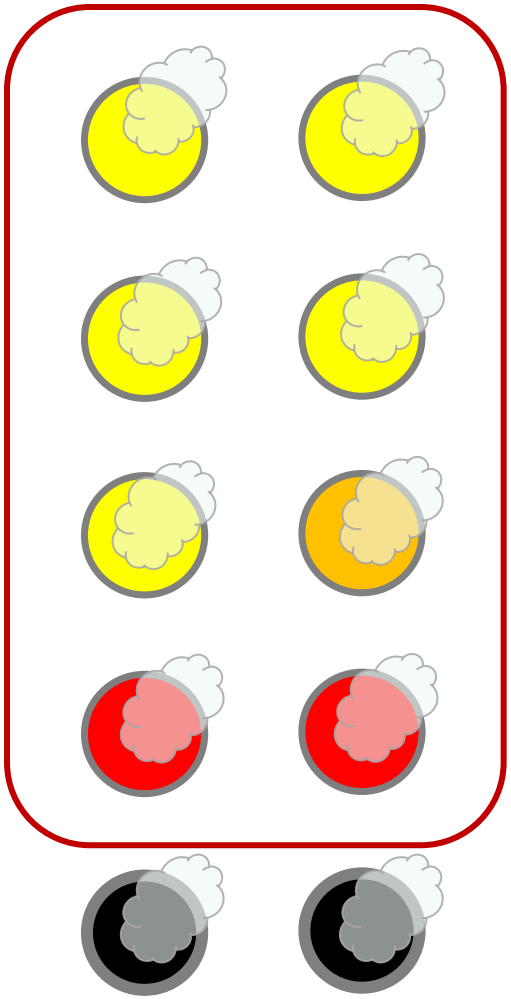
Date Symptoms Began

- Outbreak case
- Non-Outbreak case



LAB RESULTS ARE IN…

Out of *10* towers tested:



Legionella spp.

5

Legionella pneumophila

1

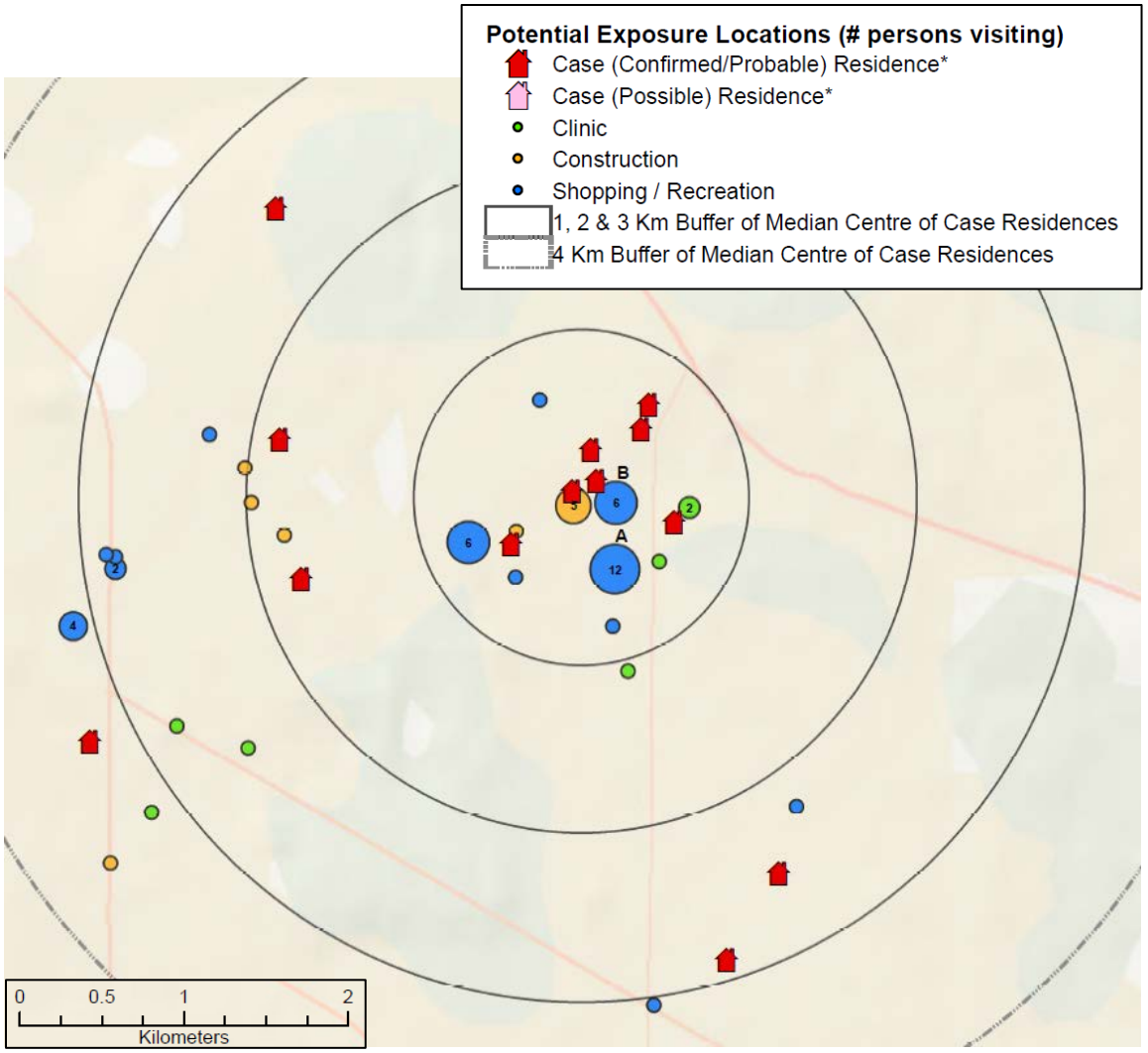
Legionella pneumophila SG1

2

COVERING ALL THE BASES

Enhanced Questionnaire Findings

- Descriptive analysis and GIS mapping based on enhanced interviews
- Identified most visits were within the vicinity
- Other commonly visited locations:
  - A nearby public facility
  - A large supermarket approximately 500m west



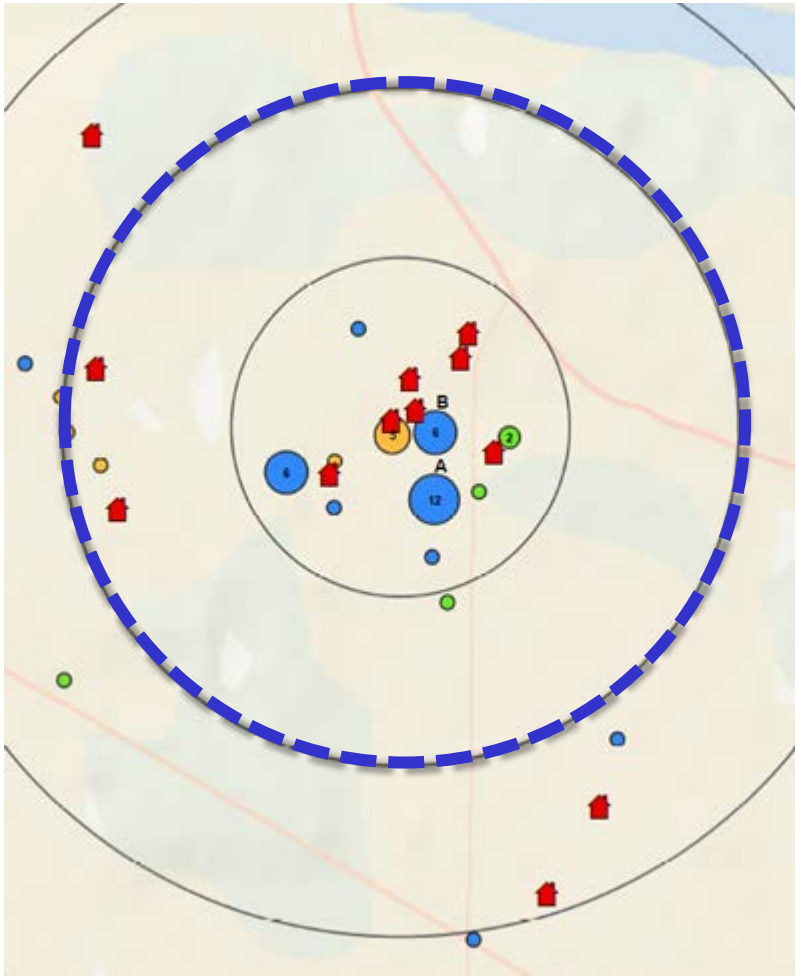
*case residence locations have been offset to maintain privacy

Checking for Other Potential Sources

- Health Protection team in partnership with City of Surrey worked to locate buildings within a 2km radius that could potentially have a cooling tower
- Exposure analysis based on where cases visited before they developed symptoms
- Based on this information and the distribution of cases, a nearby public facility and supermarket were investigated

→ **Cooling tower confirmed at public facility**

- **Sampled immediately**



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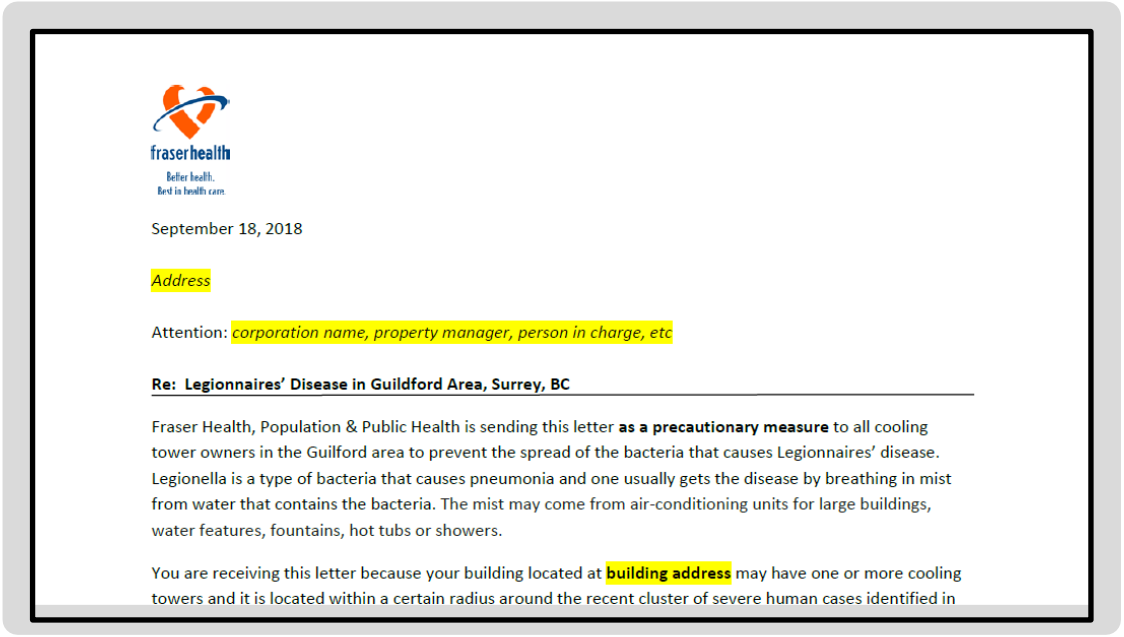
Precautionary Measures

- Letters recommending all building operators in the 4km zone to:
  - Confirm presence/absence and operational status of cooling tower
  - Recommend preventative maintenance



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Better health.
Best in health care

September 18, 2018

Address

Attention: *corporation name, property manager, person in charge, etc*

Re: Legionnaires' Disease in Guildford Area, Surrey, BC

Fraser Health, Population & Public Health is sending this letter **as a precautionary measure** to all cooling tower owners in the Guilford area to prevent the spread of the bacteria that causes Legionnaires' disease. Legionella is a type of bacteria that causes pneumonia and one usually gets the disease by breathing in mist from water that contains the bacteria. The mist may come from air-conditioning units for large buildings, water features, fountains, hot tubs or showers.

You are receiving this letter because your building located at **building address** may have one or more cooling towers and it is located within a certain radius around the recent cluster of severe human cases identified in

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LAB UPDATE

More Lab Results

- Cooling tower results for nearby public facility:
  - Positive for Lp SG1!

Isolates obtained for sequence typing:

- Environmental isolates (2):
  - One of the two SG1-contaminated cooling towers at the shopping centre
  - the public facility cooling tower

- Only 2 clinical isolates

→ **Both ST109**

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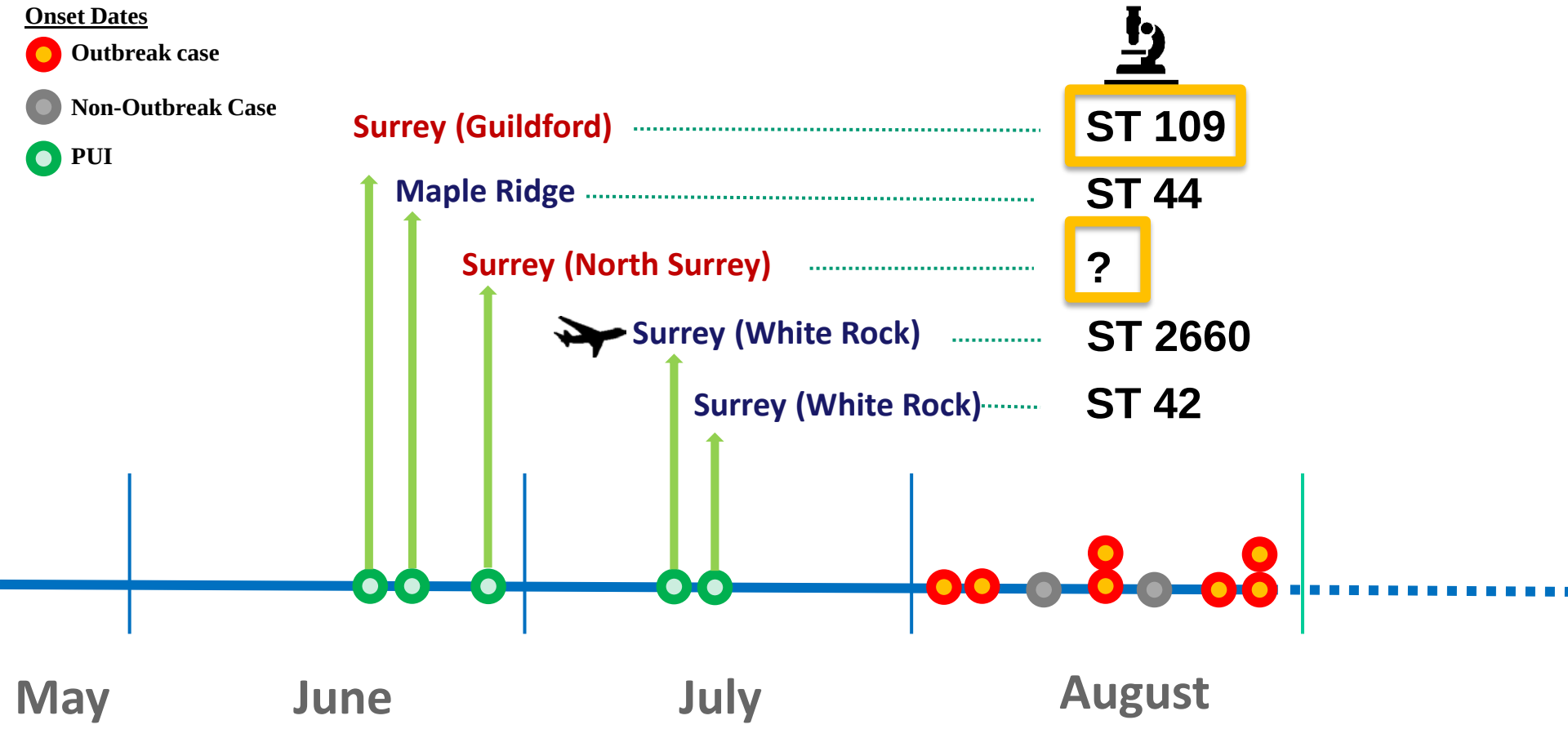
Previous Cases Linked



FINDING A LINK

Sequence Typing Results

Case isolates: 3 of 14

→ **All ST109**

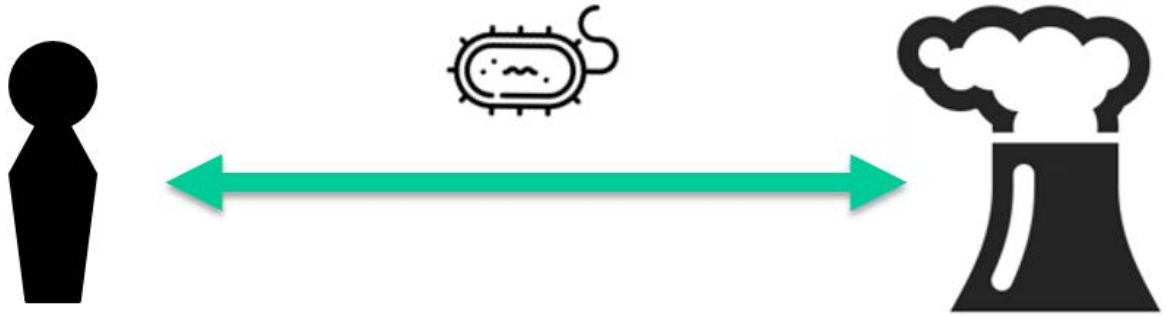
Cooling tower isolates:

- SG1-contaminated cooling tower at the shopping centre

  → **ST1777**

- the public facility cooling tower

  → **Identical to cases! (ST109)**



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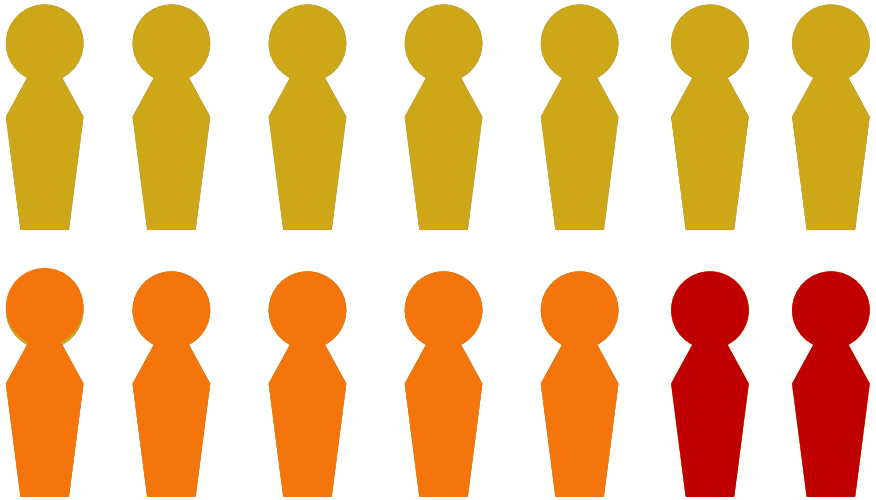
IN THE END

Epi Summary: Cases



- 14 outbreak cases [Aged 36 to 90 (median: 68), 50% male, risks/comorbidities]
- All 14 hospitalized
  - 7 required ICU
  - 2 deceased (14% case fatality)

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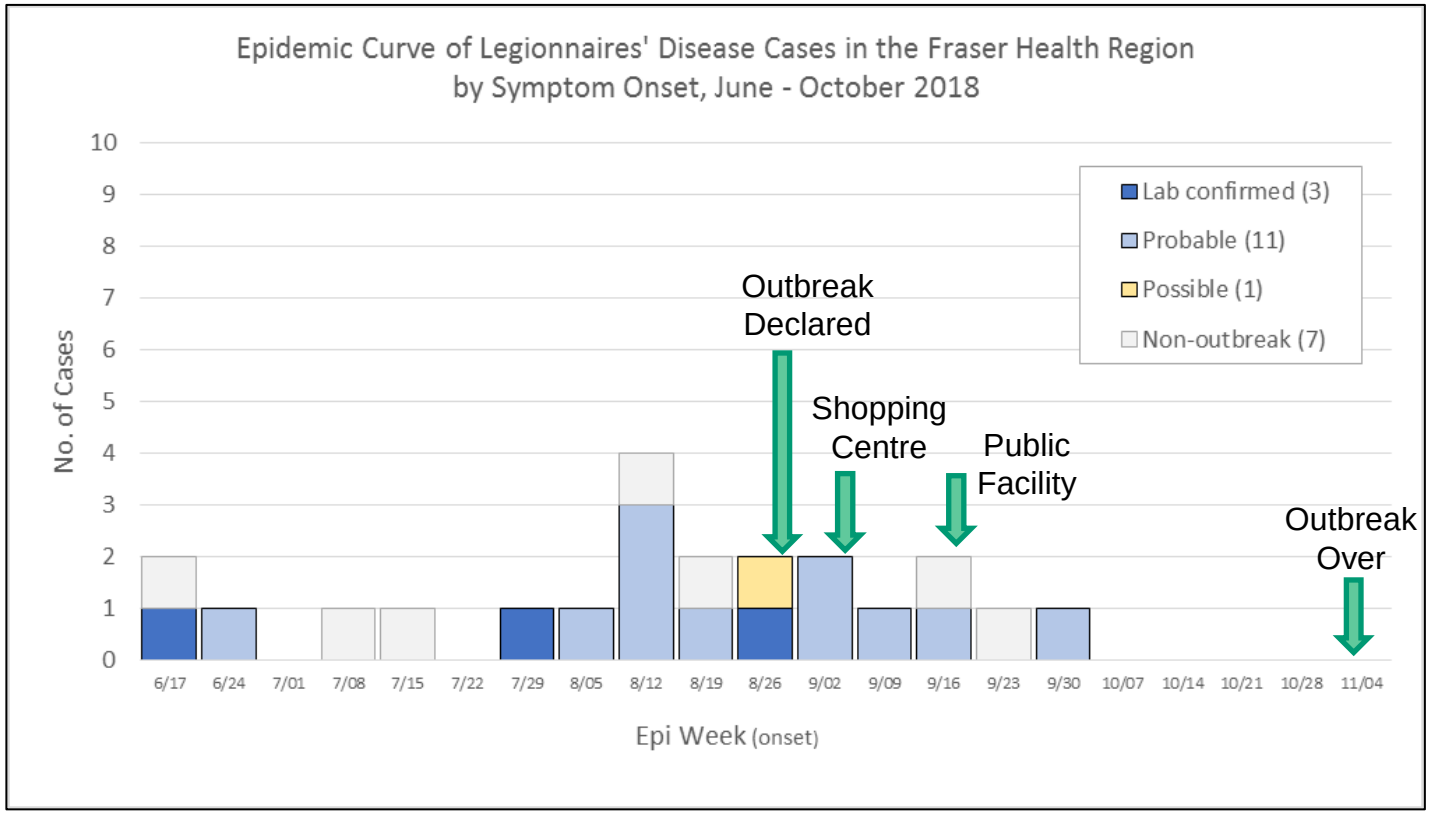
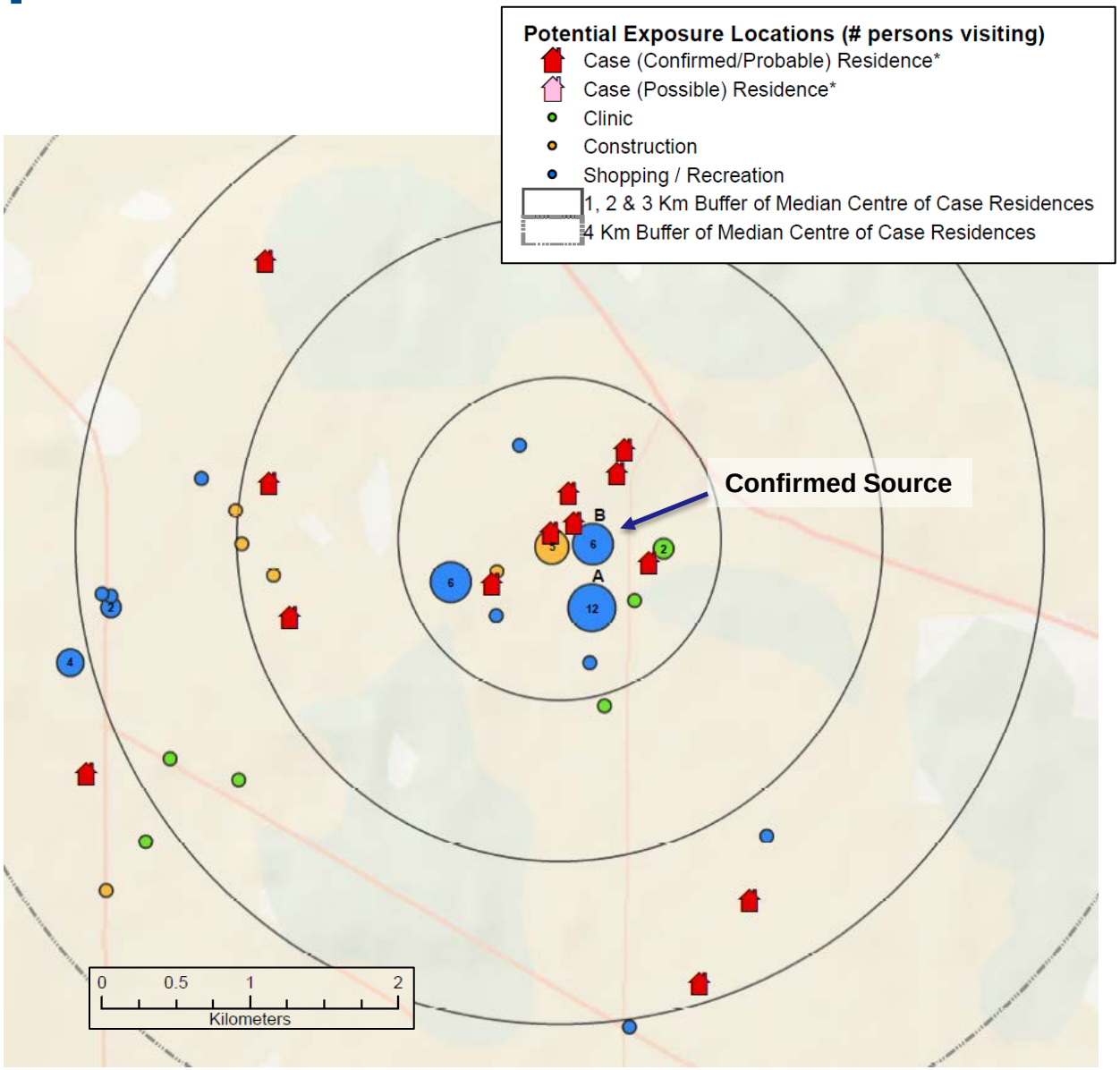
Epidemic Curve



Geographic Case Distribution

Of 14 outbreak cases:

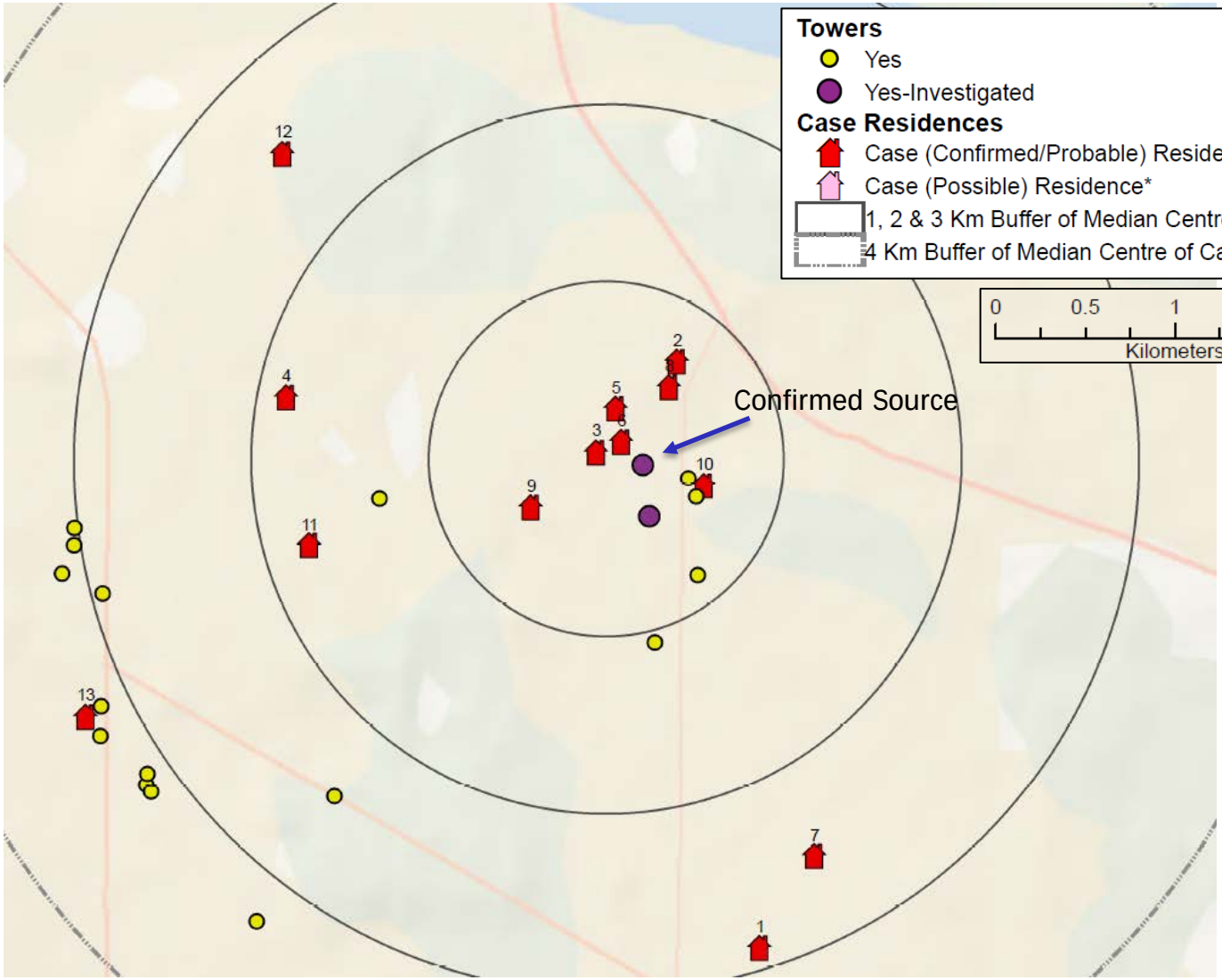
- 12 live within 3km of source
  - 7 cases within 1km
- All but one were residents of Surrey
- Nearly half reported visiting the source facility directly, and 86% of cases visited the shopping centre



*case residence locations have been offset to maintain privacy

KEY CHALLENGES AND CONSIDERATIONS

Cooling Tower Inventory



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Benefits of a Cooling Tower Registry

- Targeted interventions
  - Risk assessment
  - Expedite review of maintenance records and events (e.g. downtimes)
- Global interventions/precautionary measures
- The best intervention: Prevention
  - Monitoring and reporting pathways
  - Standardization of maintenance, testing and remediation

[1] https://www.health.ny.gov/environmental/water/drinking/legionella/cooling_towers.htm

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Source Attribution

✓ Public Facility Cooling Tower confirmed

-ST 109 also in 3 clinical isolates

? One Shopping Centre Cooling Tower not typed

??? Other Shopping Centre Cooling Tower = ST 1777

-not seen before in clinical isolates

→ Rare (EWGLI: 5 non-BC isolates)

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A NOVEL TOOL

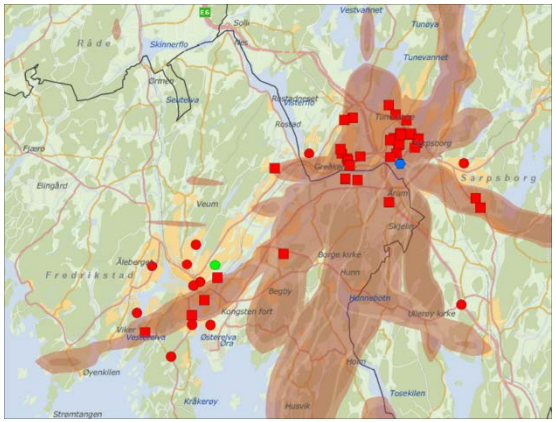
A Starting Point for Plume Modelling

- Range Roses

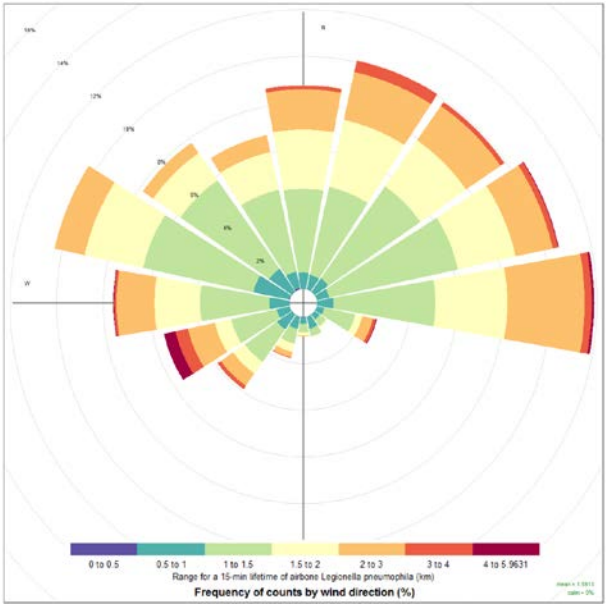
- Displays the **maximum distance** and **proportion of time** that the organism may have been dispersed from a source

- Maximum distance of travel is estimated from:
  - meteorological wind data (‘wind roses’)
  - Estimated survival of organism in aerosols
    - parameters known to impact survival of the organism (temperature, relative humidity, solar exposure)

Plume Modelling[1]

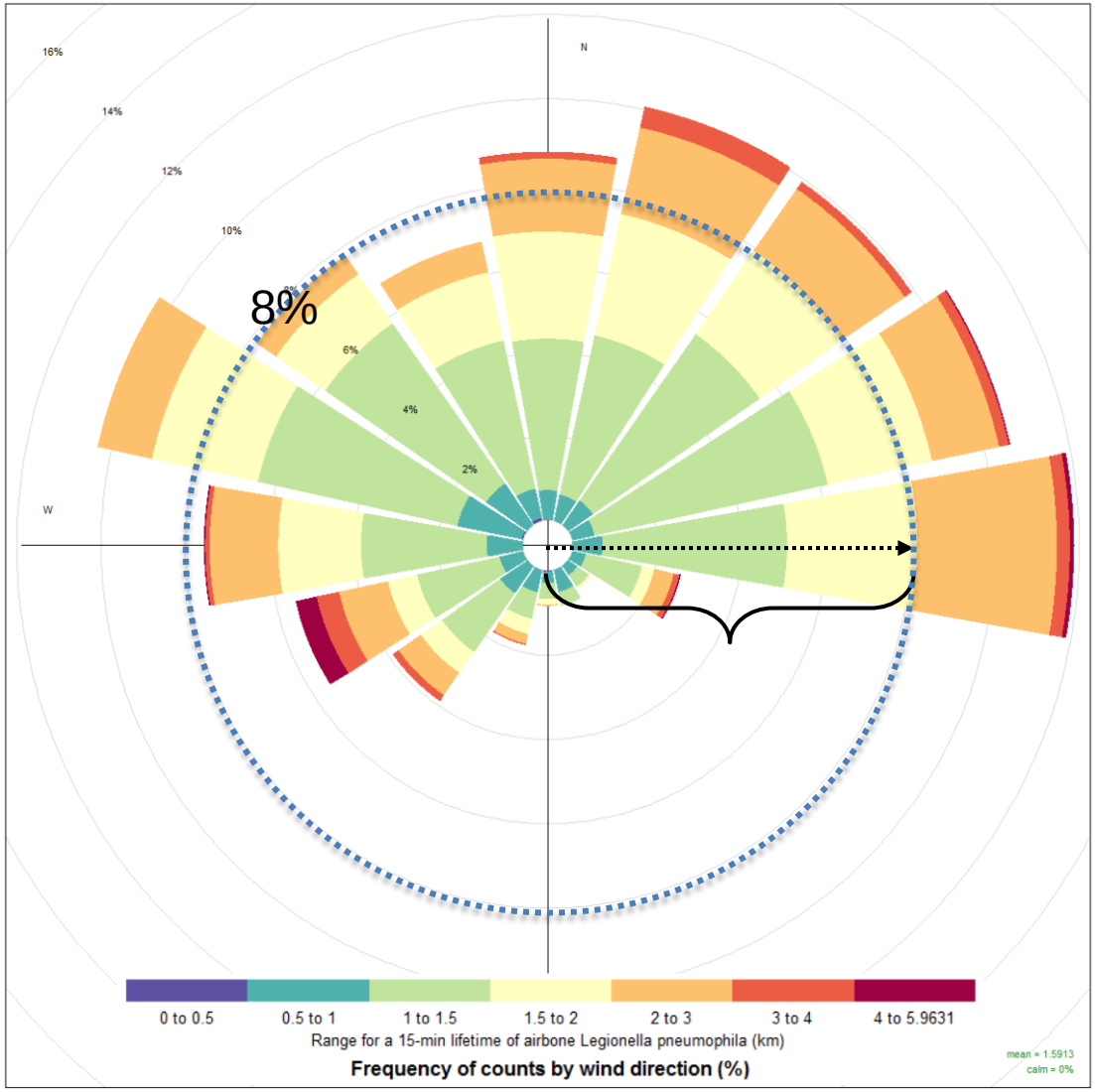


Range Rose



[1]Nygard et al. 2008

Range Rose Interpretation



Range Rose from Implicated Source
FHA Legionnaires' Disease Outbreak
June 1 to September 28, 2019

For ~8% of the time, Lp travelled a maximum of 1.5 to 2 km east from source

[1]Nygard et al. 2008

Range Rose Usage

When the source is **unknown**:

- Assessing likelihood of potential sources
- Identify areas for targeted source investigation

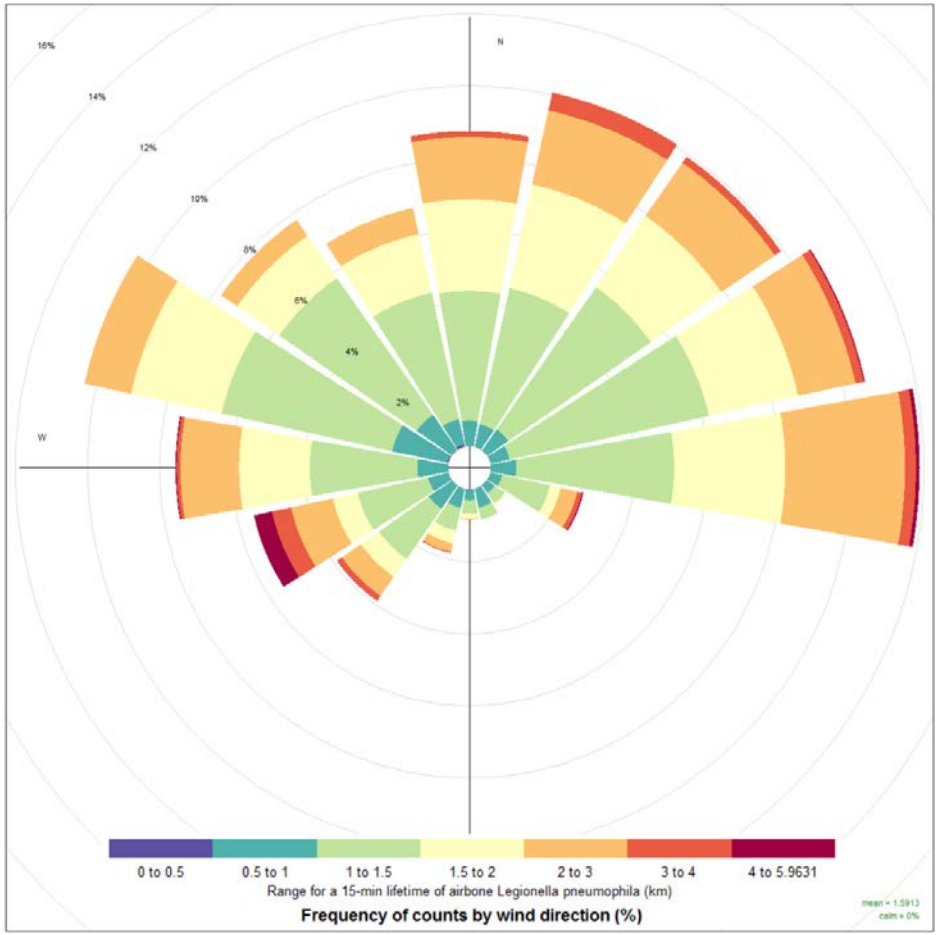
When the source is **suspected/known**:

- Corroborate observed case distribution around implicated source
- Assessing risk and mode of exposure
- Identify populations at potentially greater risk

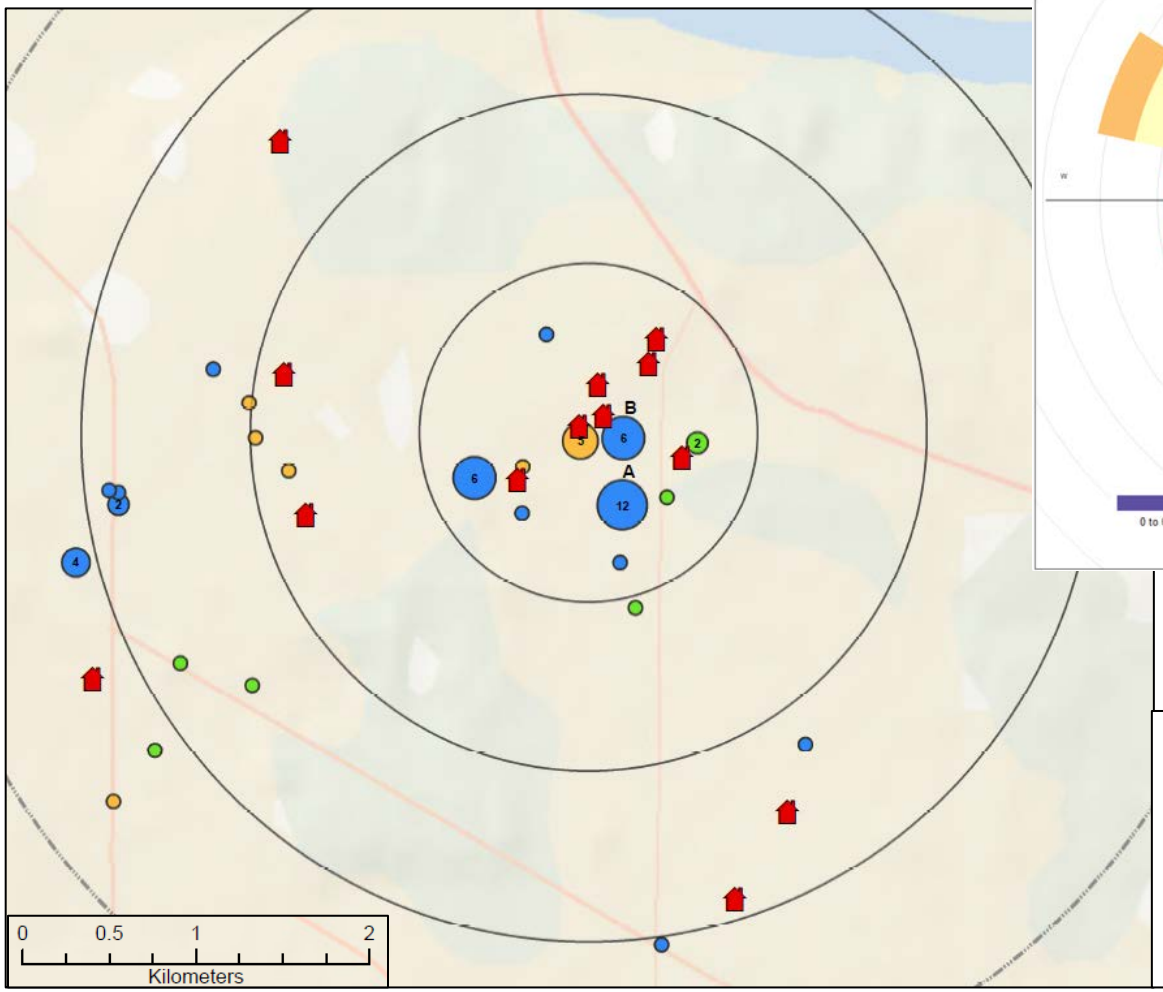
Outbreak Range Rose

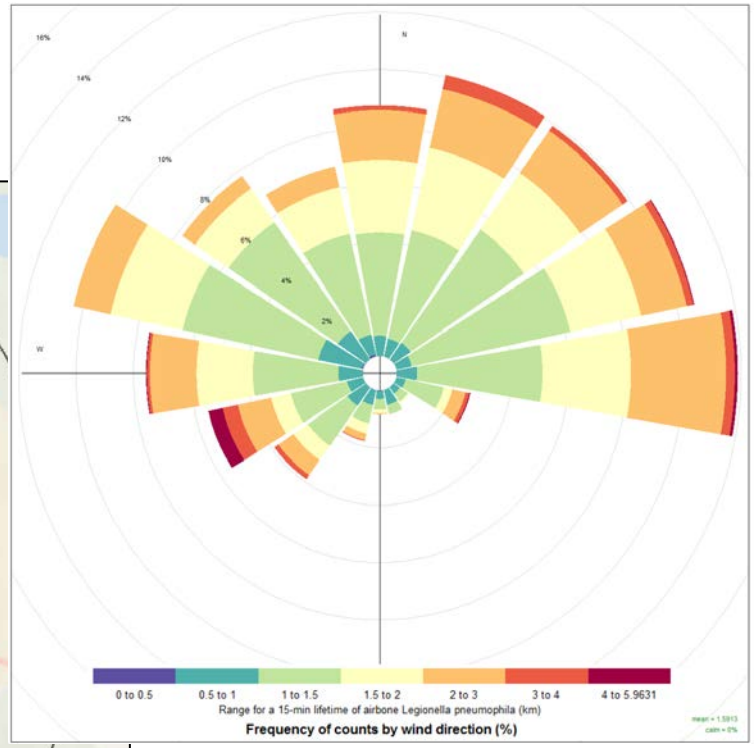
- Minimal dispersion of organism in a southerly direction
  - Particularly South to Southeast
- More than half of the time (60%), dispersion was within 2 km in the NE and NW quadrants
- Maximum travel distance was between 1.5 and 1.7 km on average

Range Rose from Implicated Source
FHA Legionnaires' Disease Outbreak
June 1 to September 28, 2019



Case Distribution

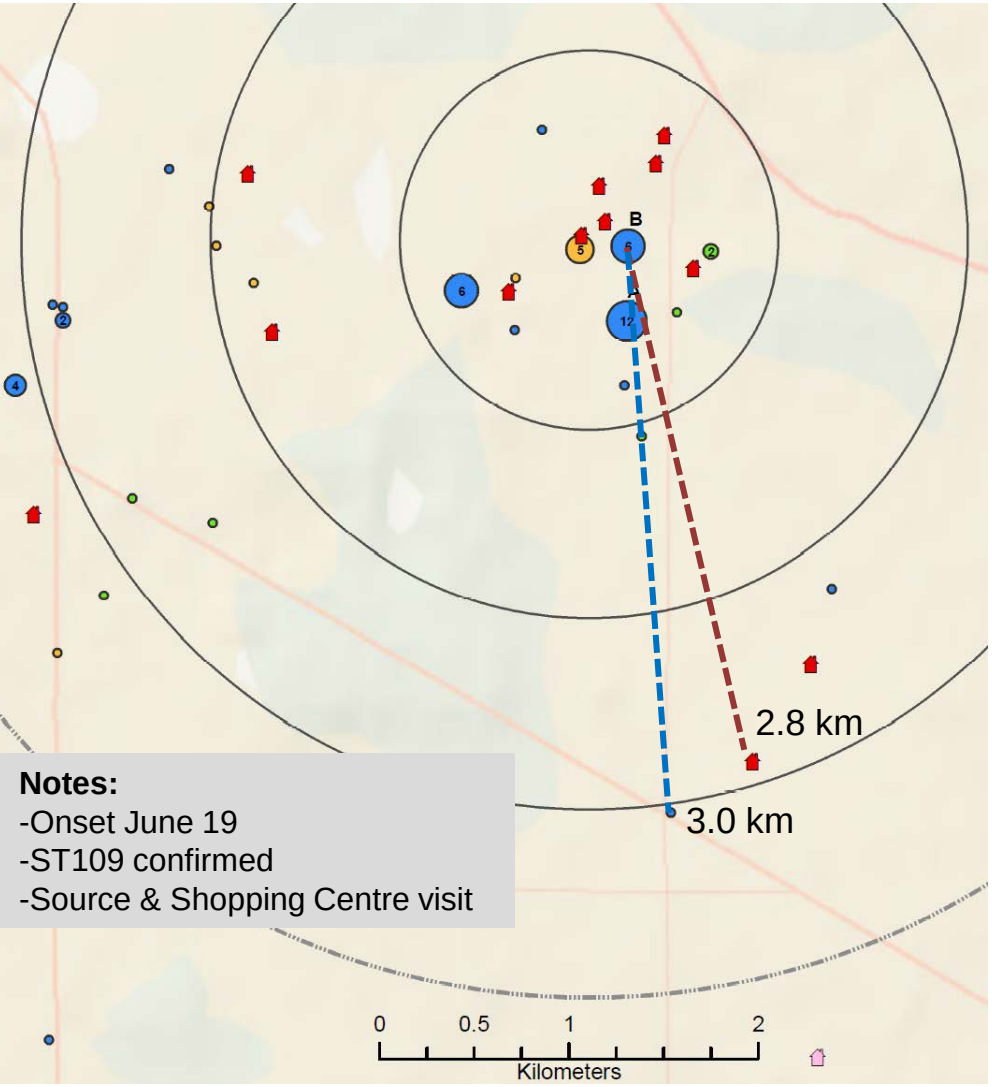




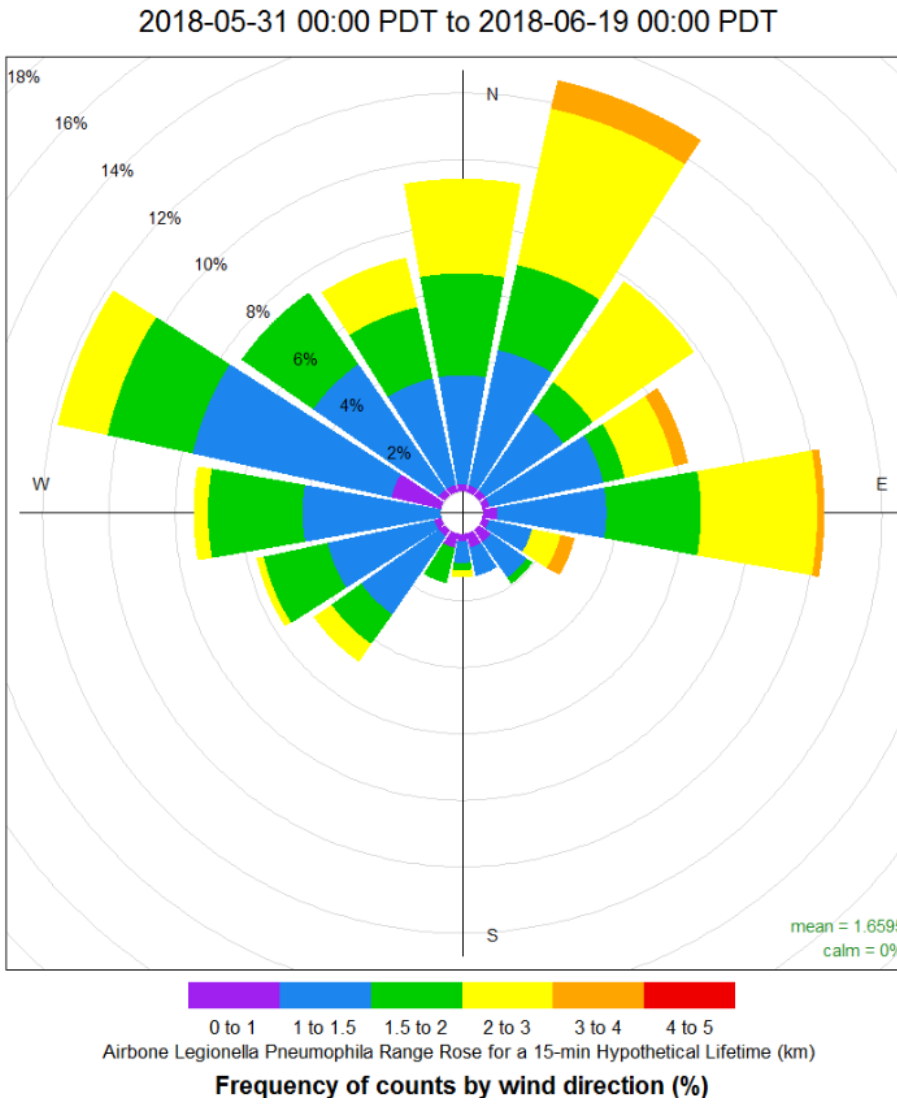
Potential Exposure Locations (# persons visiting)

- Case (Confirmed/Probable) Residence*
- Case (Possible) Residence*
- Clinic
- Construction
- Shopping / Recreation
- 1, 2 & 3 Km Buffer of Median Centre of Case Residences
- 4 Km Buffer of Median Centre of Case Residences

Example: Case Exposure Assessment



Notes:
-Onset June 19
-ST109 confirmed
-Source & Shopping Centre visit



Summary

- Strategies, considerations, and tools available for investigating and managing a Legionnaires' Disease outbreak
  - Utility of global and targeted intervention strategies to overcome challenges
  - Range Roses: practical and useful tool for exploring dispersion modelling
- Knowledge of cooling tower locations via a registry can greatly expedite the investigation process and help to inform intervention strategies as well as prevention

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Acknowledgments

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