Association of Fresh Waterways and *Legionella pneumophila* infection in Eastern Wisconsin: A Case-Control Study

Hannah M. William BS[1]; Kayla Heslin, MPH[1,2]; Jessica J. F. Kram, MPH[1]; Caroline P. Toberna BS[1,2]; Dennis J. Baumgardner, MD[1]
[1]Aurora University of Wisconsin Medical Group and Center for Urban Population Health, Advocate Aurora Health, Milwaukee, WI, USA; [2]Advocate Aurora Research Institute, Milwaukee, WI

Background

- *Legionella pneumophila* is an environmentally acquired, intracellular bacterium which causes Legionnaires' disease.
- Known to infect humans through contaminated cooling towers and other built sources, there is recent preliminary evidence of associations with fresh waterways.[1]
- A positive Legionella urine antigen (LUAT) test is diagnostic of *L. pneumophila* infection.

Purpose

Our study aimed to identify associations of *Legionella pneumophila* infection and fresh waterways in Eastern Wisconsin.

Methods

Study Design: A case-control study which was a secondary analysis of data from our previously reported epidemiologic survey of LUAT tested patients from our system.[2]

Setting/Dataset/Population Studied: Home address data from patients who underwent LUAT testing at a single Eastern Wisconsin health system between January 2013 and December 2017.

We investigated ZIP codes in which there were 3 or more positive cases with 50 or more tests completed, as well as adjacent ZIP codes in which there were 2 or more positive cases and 50 or more tests completed. For every positive case within these identified ZIP codes, three random negative LgAg controls were also selected (1:3 ratio).

Addresses were geocoded and mapped using ARC-GIS. Nearest waterway and distance (ft) to the home address at the time of LUAT was identified and verified/corrected by hand using Google Maps point-to-point distance measurement tool. Bodies of water were classified per the Wisconsin Department of Natural Resources to differentiate between types of water bodies (seepage lake, spring lake, drained lake, drainage lake, impoundments and river/streams).

Outcome Measures/Statistics: Minitab statistical software was used for basic descriptive and inferential statistics. Verified distances and categorical data were analyzed using 2-sample t-tests (as the distance distributions approximated normal), and chi-squared goodness-of-fit tests, respectively. P values less than 0.05 were deemed statistically significant.

Results

- No specific bodies of water were found to be over-represented among all positive cases in Wisconsin during this investigation (N=135; Figure 1).
- Differences in distance from nearest waterway among all positive cases in Wisconsin are represented in Figure 2.
- Overall, mean distance to nearest waterway did not differ between cases (2958+/-2049 ft., N=80) and controls (2857+/-2018 ft., N=240; p=0.701).
- However, non-Milwaukee County ZIP code cases were closer to nearest waterway than controls (1165 +/- 905 vs. 2113 +/- 1710 ft.; p=0.019; Total N=48).
- Additionally, cases in the non-Milwaukee County group were disproportionately within 1320 ft. of a waterway (8 observed cases vs. 3.50 expected cases, p=0.004). This was not seen in the Milwaukee County ZIP codes group (17 cases vs. 19.55 cases, p=0.495).
- Types of nearest waterways did not differ between LUAT positive cases and controls (Table 1).

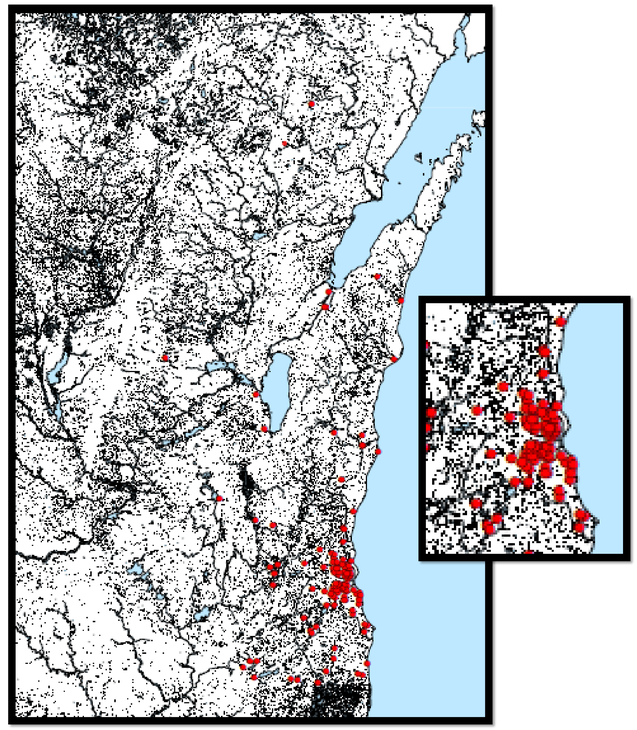

Figure 1. Home locations of individuals with positive *Legionella* tests.
Figure description: Dot map of home addresses for patients with positive *Legionella* urine antigen tests (LUAT).

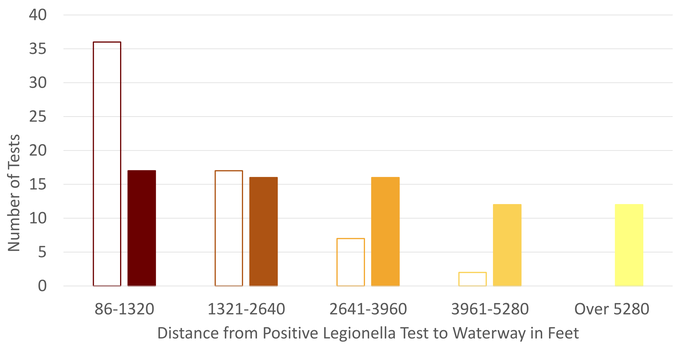

Figure 2. Distance from positive Legionella test to waterway.
Figure description: Bar graph of the number of positive LUAT cases associated with each distance from a body of water. The left (open) bars represent suburban (non 532xx) ZIP codes, and the right (solid) bars represent urban (532xx) Milwaukee county ZIP codes.

Nearest waterway type	Cases (N=80)	Controls (N=240)	p value
Seepage lake, N (%)	18 (22.5)	59 (24.6)	0.602
Spring lake, N (%)	0 (0.0)	3 (1.3)	
Drainage lake, N (%)	16 (20.0)	34 (14.2)	
River/stream, N (%)	46 (57.50)	144 (60.0)	

Table 1. Nearest waterway type.

Conclusions

Additional studies are needed to determine if proximity to fresh waterways is consistently associated with Legionella infections. Moreover, studies on the relative importance of fresh versus built environmental water sources in the acquisition of legionellosis in non-urban areas is warranted.

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References
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Contact
Dennis.Baumgardner@aah.org

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