# EPIDEMIOLOGIC SURVEY OF *LEGIONELLA* URINE ANTIGEN TESTS WITHIN A LARGE WISCONSIN INTEGRATED HEALTH CARE SYSTEM

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BACKGROUND

- *Legionella pneumophila* is an aerobic, pathogenic, gram-negative bacterium.

- Human infection presents as potentially life-threatening pneumonia otherwise known as Legionnaires' disease.
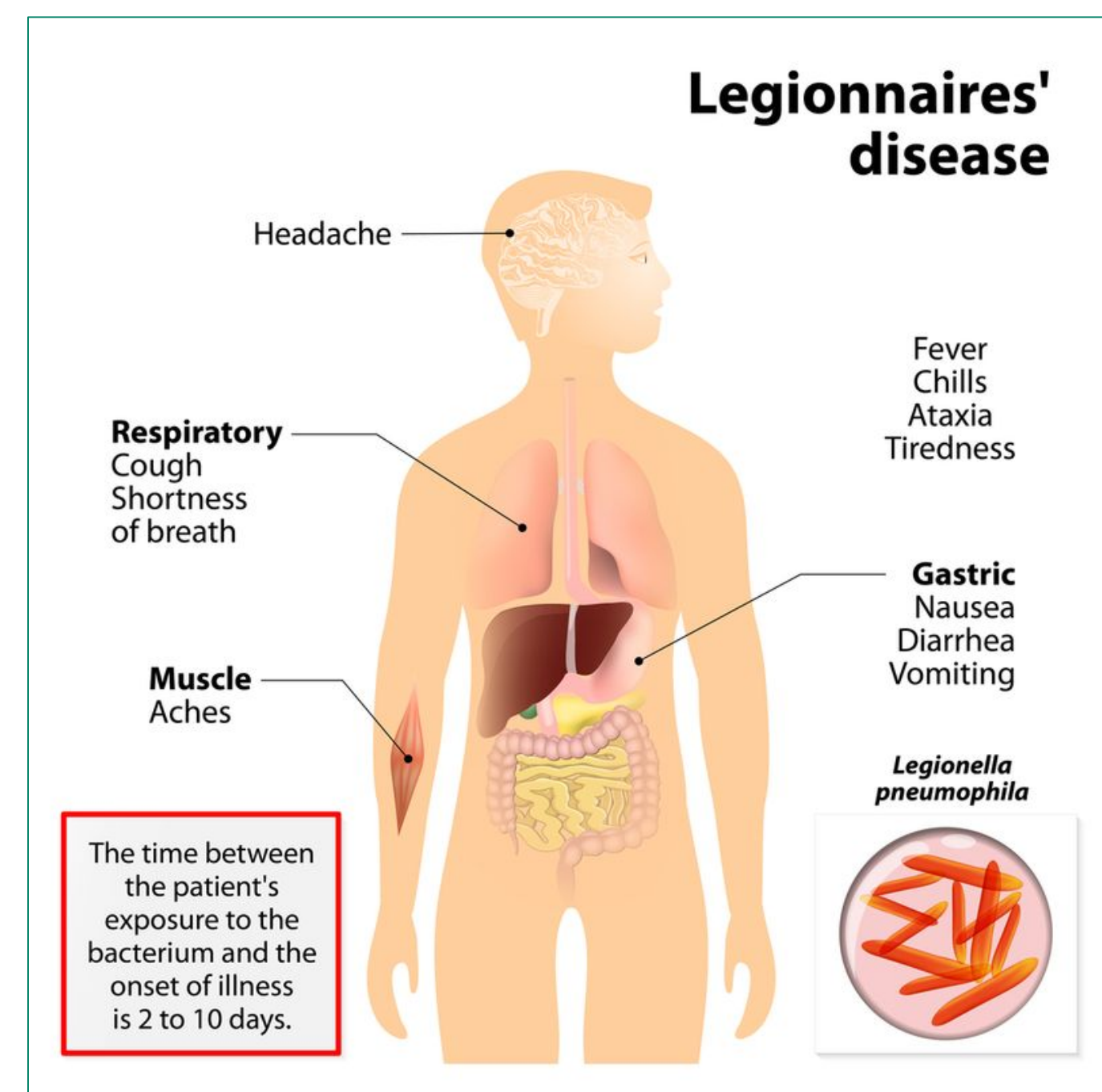
- *Legionella* organisms exist in biofilms and survive and multiply within free-living amoebas.

- Outbreaks have been associated with contaminated cooling towers and other fresh water sources.

OBJECTIVE

Our study aimed to identify unrecognized outbreaks and geodemographic associations of *Legionella*, given limited literature regarding the epidemiology of infections in Wisconsin and recent outbreak reports.
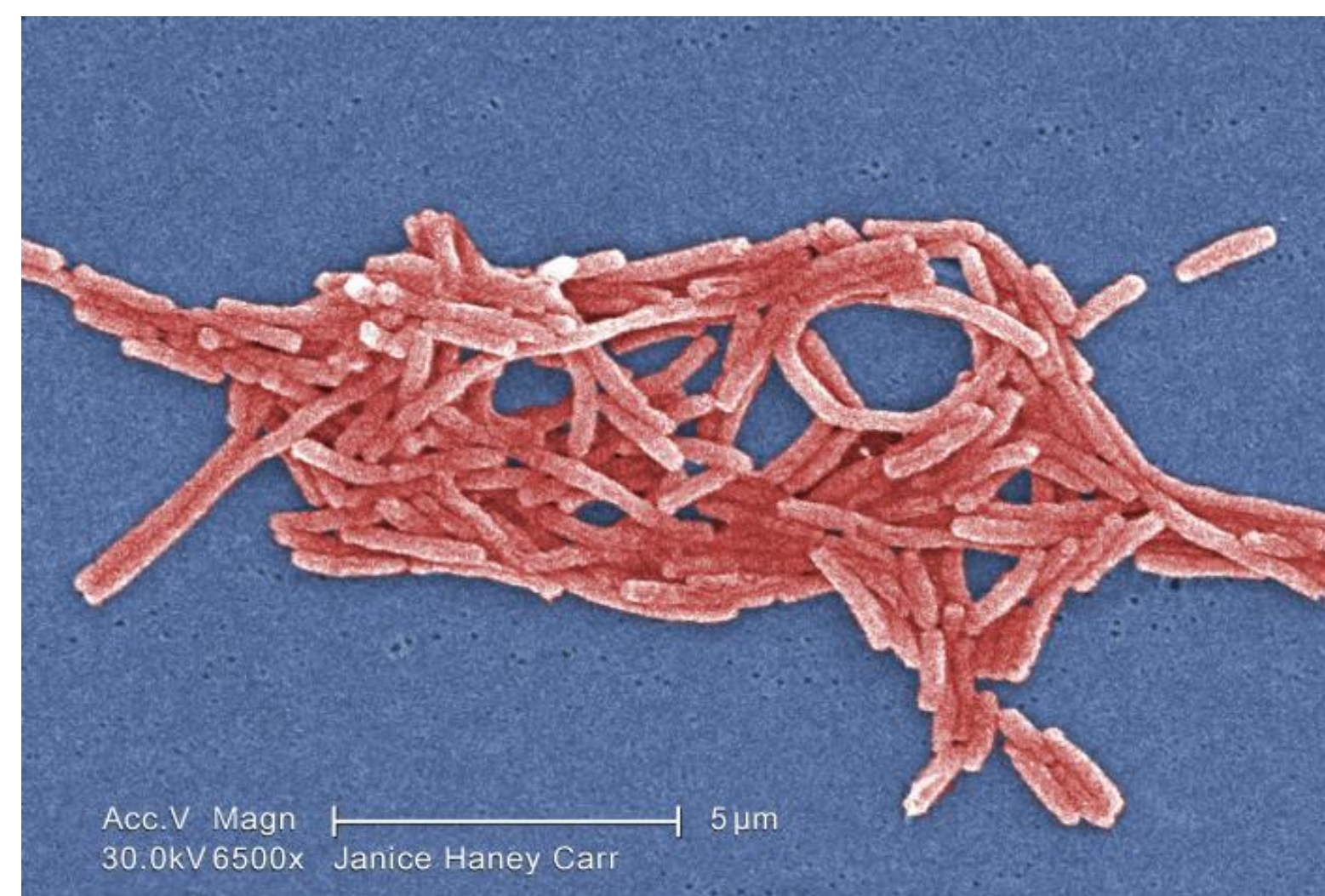
METHODS

- Retrospective chart review on:
  - All in-patients and out-patients who underwent LgAg urine antigen testing
  - Within a single Eastern Wisconsin health system
  - Between January 2013 and December 2017

- Random sample inclusive of all positive tests was reviewed.
  - If a patient was ever identified as positive, only the encounter in which they had their first positive test was included in the analyses.
  - For all other patients, only their first negative test was included.
  - Ultimately, the above rules let us get down to the individual patient level.

- **Demographics – Statistical Methods:**
  - Chi-squared, 2-sample t-tests, and stepwise regression for univariable analysis as appropriate
  - Binary logistic regression for multivariable analysis

- **Geographic Patterns -- Mapping Methods:**
  - SAS, Tableau, and other GIS mapping software
  - Positive test results with ZIP codes within Wisconsin were mapped to locate hotspots
    - Specifically looked at ZIP codes within Milwaukee County
  - Negative cases were used to investigate significant geodemographic differences in patients testing positive versus negative
  - Additionally, geographic information for positive tests were mapped to locate hotspots.

RESULTS

- Of all LgAg results in the original data set (N=21,599) of the affiliated laboratory, 146 (0.68%) were positive.

- After chart review of the random sample inclusive of all positives, 138 positive cases remained in the final data set, 135 with ZIPs in WI. Differences in demographics are described in (**Table 1**).

Predictor	All Patients Tested (N=11,652)	Negative LgAg (N=11,514)	Positive LgAg (N=138)	Positive vs. Negatives on Univariable P Value	Positive vs. Negatives on Multivariable P Value
Race/Ethnicity				N/A	N/A
White	81.4% (n= 9,384)	81.5% (n=9,289)	69.9% (n= 95)		
Black	12.3% (n= 1,415)	12.1% (n= 1,381)	25.0% (n= 34)		
Alask Nat/Amer In	0.4% (n= 47)	0.4% (n= 47)	--		
Asian	0.9% (n= 103)	0.9% (n= 103)	--		
Hispanic	4.9% (n= 562)	4.9% (n= 555)	5.2% (n= 7)		
2 or more	0.1% (n= 13)	0.1% (n= 13)	--		
Pacific Islander/HI	0.03% (n= 4)	0.04% (n=4)	--		
Unknown	(n= 124)	(n= 122)	(n= 2)		
White vs. Non-White				<0.0001	0.123
White	81.4% (n= 9,384)	81.5% (n=9,289)	69.9% (n= 95)		
Non-White	18.6% (n= 2,144)	18.5% (n=2,103)	30.2% (n= 41)		
Unknown	(n= 124)	(n=122)	(n= 2)		
Gender				<0.0001	<0.0001
Male	48.9% (n= 5,700)	48.7% (n= 5,603)	70.3% (n= 97)		
Female	51.1% (n= 5,952)	51.34% (n= 5,911)	29.7% (n= 41)		
Mean Age When Tested	67.6 years	67.7 years	59.4 years	<0.0001	<0.0001
Year				0.00067	Reference
2013	20.9% (n= 2,438)	20.8% (n= 2,392)	33.3% (n= 46)		0.001
2014	20.0% (n= 2,335)	20.1% (n= 2,319)	11.6% (n= 16)		0.035
2015	20.0% (n= 2,332)	20.1% (n= 2,310)	15.9% (n= 22)		0.049
2016	18.9% (n= 2,201)	18.9% (n= 2,179)	15.9% (n= 22)		0.286
2017	20.1% (n= 2,346)	20.1% (n=2,314)	23.2% (n= 32)		
Time of Year				<0.0001	Reference
January	10.5% (n= 1,228)	10.6% (n=1,225)	2.2% (n= 3)		0.996
February	8.1% (n= 944)	8.2% (n= 944)	--		0.677
March	10.2% (n= 1,184)	10.3% (n= 1,182)	1.5% (n= 2)		0.430
April	8.7% (n= 1,015)	8.8% (n= 1,014)	0.7% (n= 1)		0.287
May	7.9% (n= 922)	8.0% (n= 917)	3.6% (n= 5)		
June	7.0% (n= 819)	7.0% (n= 808)	8.0% (n= 11)		0.020
July	7.2% (n= 837)	7.0% (n= 806)	22.5% (n= 31)		0.000
August	7.3% (n= 853)	7.2% (n= 827)	18.8% (n= 26)		0.000
September	7.7% (n= 900)	7.6% (n= 877)	16.7% (n= 23)		0.000
October	7.9% (n= 919)	7.9% (n= 905)	10.1% (n= 14)		0.006
November	7.9% (n= 919)	7.9% (n=905)	10.1% (n= 14)		0.001
December	9.5% (n= 1,112)	9.6% (n= 1,104)	5.8% (n= 8)		0.126

Table 1. Predictors of positive LgAg tests.

Note: When accounting for ZIP code groups (e.g., 532XX) in the whole random sample which was inclusive of Wisconsin ZIP codes only and those with 100 or more tests, the above associations in the multivariable analysis were unchanged.

- Random sample (inclusive of Wisconsin ZIP codes only) was mapped for *Legionella* tests within the Aurora Health care system (**Figure 1**).
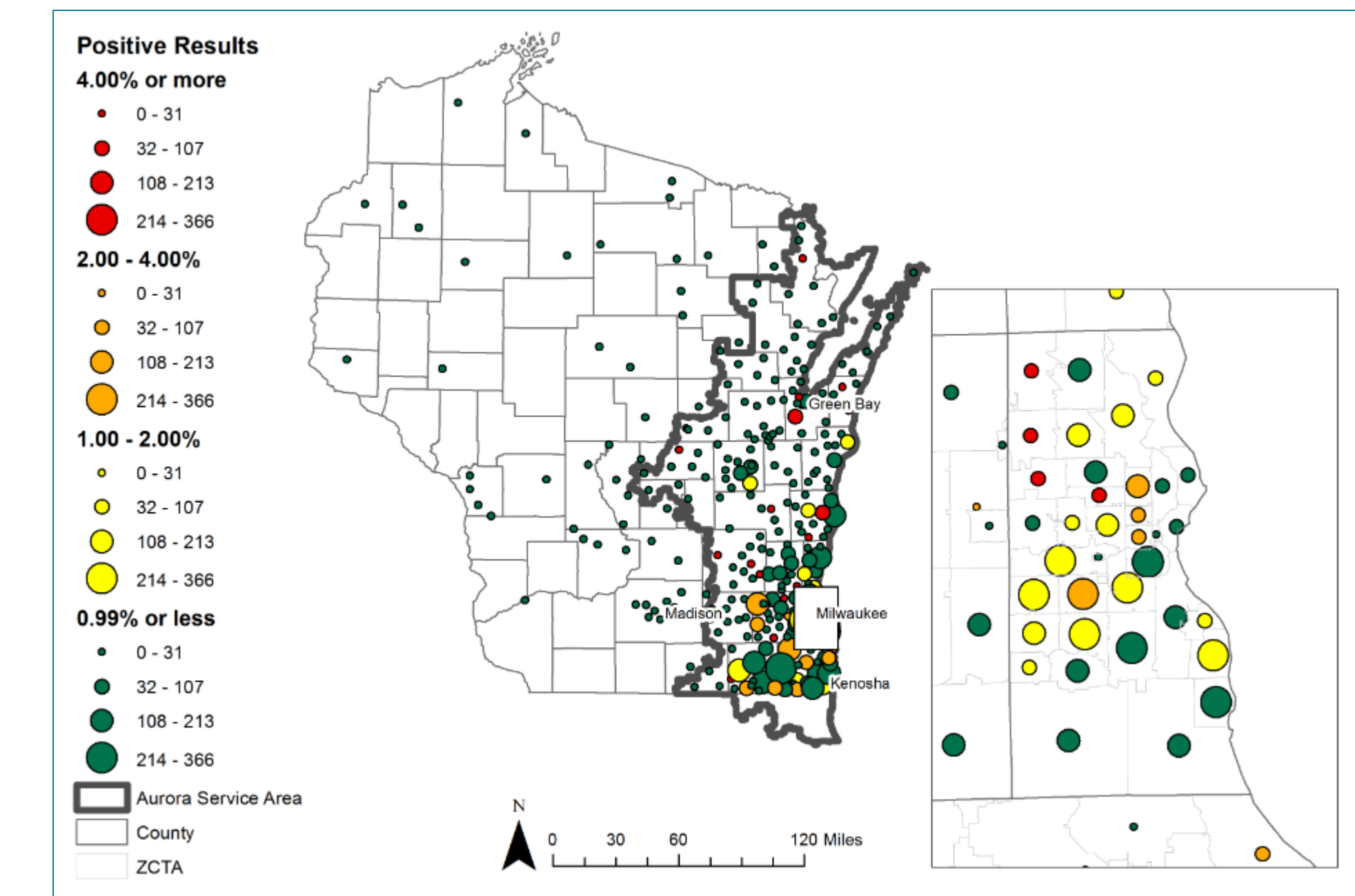

Figure 1. Map of random sample of Wisconsin subjects tested with *Legionella* antigen by ZIP code.

Note: **Size** of dot reflects relative number of subjects tested in that ZIP code. **Color** of dot indicates relative proportion of tests that were positive. Inset shows Milwaukee County only.

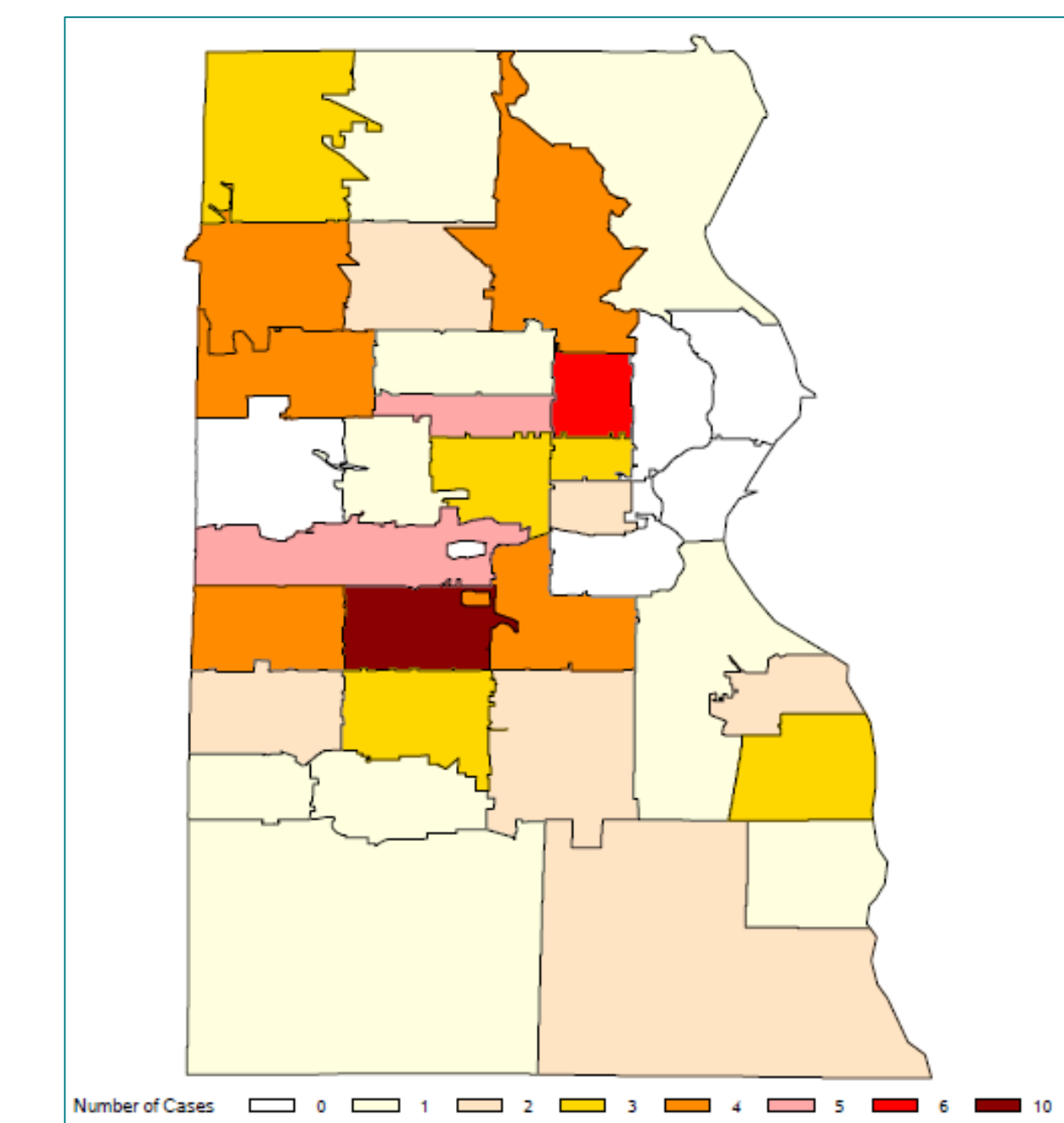- Within Milwaukee county, of the 5,507 tests done, 82 patients tested positive for *Legionella* (**Figure 2**).

Figure 2. Positive Legionella Tests in Milwaukee County.

Note: Based on the recent Milwaukee Health Report's break down of socioeconomic status (SES), 3.7% (n=3) were High, 14.6% (n=12) were Medium-High , 23.2% (n=19) were Medium, 32.9% (n=27) were Medium-Low, and 25.6% (n=21) were Low. When compared to expected positive tests, 8.2%, 20.5%, 29.0%, 21.7%, and 20.6%, respectively, observed positive test distribution was significantly different (p=0.038).

CONCLUSIONS

Of the original data set's LgAg results, the prevalence of positive tests was <1.0%. Patients tested in warmer months, who were relatively younger, male, and non-White were more likely to test positive. This methodology, if done real-time, may complement public health detection of *Legionella* outbreaks. Further study on built environments near clustered cases may reveal additional sources of infection.

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