

Legionellosis 2020

Examining trends in Legionellosis, sources of exposure,
and health outcomes in Macomb County from 2009 to 2019.

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Introduction

Legionellosis is a disease caused by *Legionella* bacteria. Legionellosis includes Legionnaires' Disease, which can be a serious type of pneumonia, and Pontiac Fever, which is a less severe disease without pneumonia. Legionellosis can be a mild respiratory illness or it can become severe enough to cause death. Cases usually occur as singular events and outbreaks are relatively rare. *Legionella* naturally exist in bodies of water and moist soil. This bacteria can be found in rivers and ponds, hot and cold water taps, hot water tanks, water in cooling towers, hot tubs, and decorative fountains. Conditions that are favorable to *Legionella* growth include warm water temperatures, stagnation, scale and sediment, and low biocide levels. Legionellosis may occur when people breathe in mist or accidentally swallow water into the lungs containing *Legionella*.

Most healthy people will not get sick if they are exposed to *Legionella*. Certain individuals are at increased risk for developing disease. Risk factors for developing Legionellosis include: current or former smokers, chronic lung disease, weakened immune system from diseases like cancer, diabetes, or kidney failure, and taking medications that weaken the immune system. People at any age can get Legionellosis, but elderly adults are more at risk for getting sick and developing more severe disease.

Legionellosis is a nationally reportable disease. This means that when a person tests positive for the bacteria *Legionella*, the positive lab results are automatically reported to the person's local health department for follow-up. Cases are reported electronically through the Michigan Disease Surveillance System (MDSS). MDSS is a secure database for all communicable diseases reported in the state of Michigan. The data collected in MDSS are confidential. Protected information can only be accessed by certain health care workers for reasons related to surveillance.

Macomb County Health Department investigates cases of Legionellosis to confirm the diagnosis, provide education on preventing transmission, mitigate outbreaks, and try to identify and remedy the source of *Legionella* exposure.

For more information regarding Legionellosis, please use the following sources:

[Macomb County Health Department Communicable Disease Surveillance](#)

[CDC: What is Legionnaires' Disease?](#)

[National Notifiable Diseases Surveillance System \(NNDSS\): Legionellosis Case Definition](#)

[Legionnaires' Disease Surveillance Summary Report \(CDC, 2014-2015\)](#)



Executive Summary

- Rate of Legionellosis
 - The rate of Legionellosis cases is higher in Macomb County (9.15 cases per 100,000 people in 2019) than it is in Michigan overall (4.84 cases per 100,000 in 2019).
 - Both the Macomb County and Michigan rate have been dramatically increasing since 2015, however, both rates decreased from 2018 to 2019.
 - The largest increase in the number of cases was seen in the 70+ age group.

- Changes in Legionellosis cases from 2009-2011 to 2018-2019
 - The proportion of cases that Black residents account for increased from 6.4% in 2009-2011 to 17.8% in 2018-2019.
 - The average number of days a case was hospitalized increased from 6.91 days in 2009-2011 to 8.63 days in 2018-2019.
 - An increase in the average number of days a case was hospitalized may indicate an increase in the severity of the disease.
 - The number of cases with any healthcare exposure increased from 6.4% of cases in 2009-2011 to 26.1% of cases in 2018-2019.

- Legionellosis Mortality Rates
 - The overall mortality rate for all confirmed Legionellosis cases in Macomb County from 2009-2019 was 6.33 deaths per 100 cases.
 - Cases with definite healthcare exposure had a significantly higher mortality rate (50.00 deaths per 100 cases) than the overall mortality rate, however this rate is based on a very small sample size.
 - Cases with travel-associated exposure had a significantly lower mortality rate (3.85 deaths per 100 cases) than the overall mortality rate.

- Limitations to this report
 - Legionellosis cases are underdiagnosed and the numbers and rates presented likely underestimate the true incidence of the disease.
 - Some of the categories presented were limited to small sample sizes. Caution should be exercised in the interpretation of rates based on small numbers.

- Recommendations
 - Buildings such as hospitals, senior/assisted-living facilities, hotels, and others that may be susceptible to *Legionella* exposure should take the CDC recommended precautions and create procedures for water management programs.
 - Healthcare professionals should be aware of who is at an increased risk for developing Legionellosis and what warrants Legionellosis testing.



Methodology

Data

For this report, cases were defined as laboratory-confirmed Legionellosis cases in the Macomb County, Michigan jurisdiction entered into MDSS from January 1, 2009 through December 31, 2019. All data presented in this report were extracted from MDSS on January 14, 2020.

Statistics

The following statistical tests and procedures were applied where statistically significant differences are noted:

- T-test used to assess difference in means between two groups.
- Z-test used for comparing proportions or rates between two groups.
- Univariate and multivariate logistic regression used to determine demographic variables and exposures associated with a case's health outcomes (death versus survival).

Variable Definitions per MDHHS guidelines

Outbreak: two or more cases who have been exposed to the same possible source (e.g. hospital, senior/assisted-living facility, hotel, job site) during a 12-month period.

Exposure categories:

- Definite healthcare-associated: confirmed case who was hospitalized for the entire 10 days prior to illness onset.
- Possible healthcare-associated: confirmed case who had exposure to a healthcare facility for a portion of the 10 days prior to illness onset.
- Travel-associated: confirmed case with a history of spending at least one night away from home, either in the same country of residence or abroad, in the 10 days before onset of illness
- Senior/Assisted-living facility-associated: confirmed case who had exposure to a senior or assisted-living facility for a portion of the 10 days prior to illness onset.

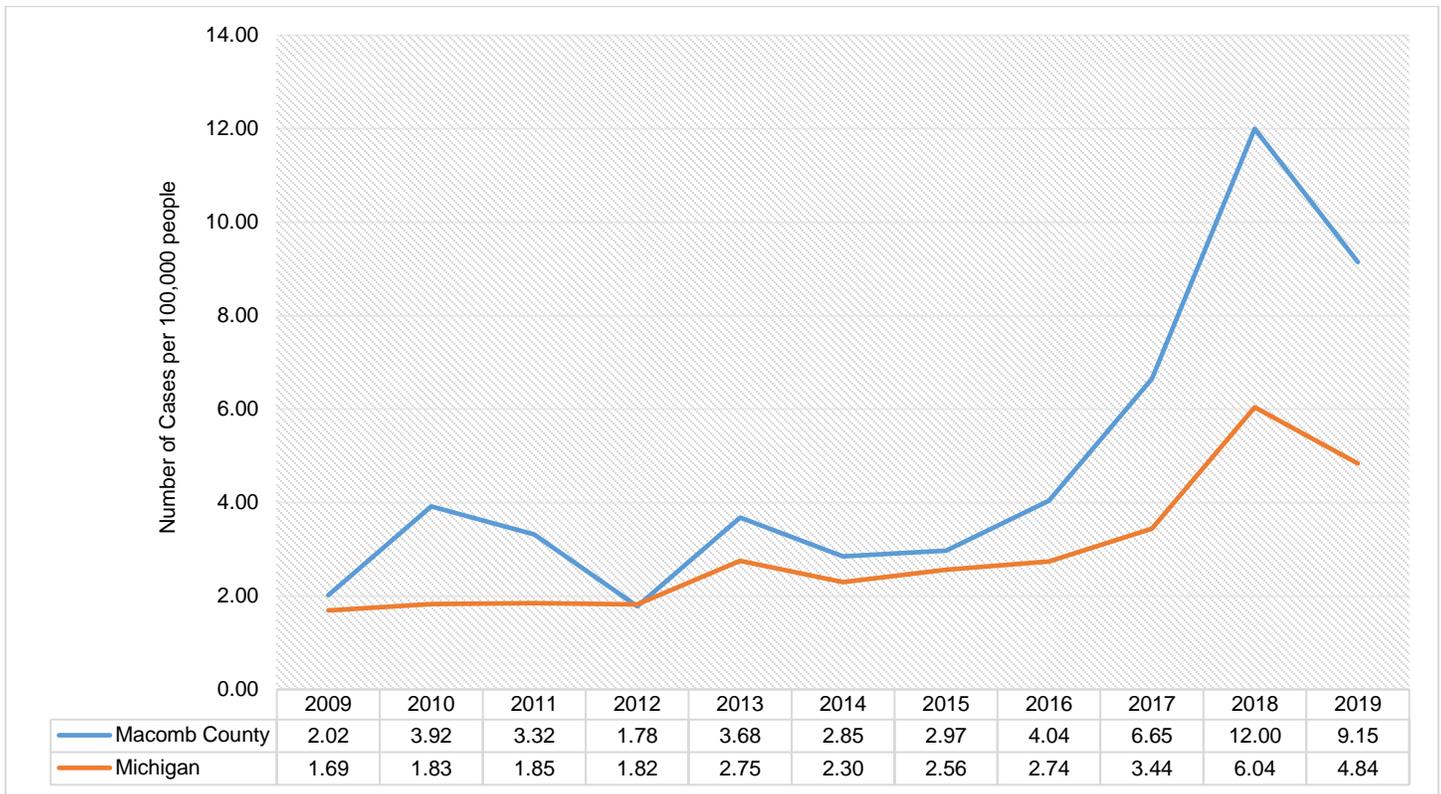


Results

Table 1. Number of Confirmed Legionellosis Cases in Macomb County and Michigan (2009 – 2019)

Year	Macomb County Cases	Michigan Cases
2009	17	168
2010	33	181
2011	28	183
2012	15	180
2013	31	272
2014	24	228
2015	25	254
2016	34	271
2017	56	340
2018	102	597
2019	77	479

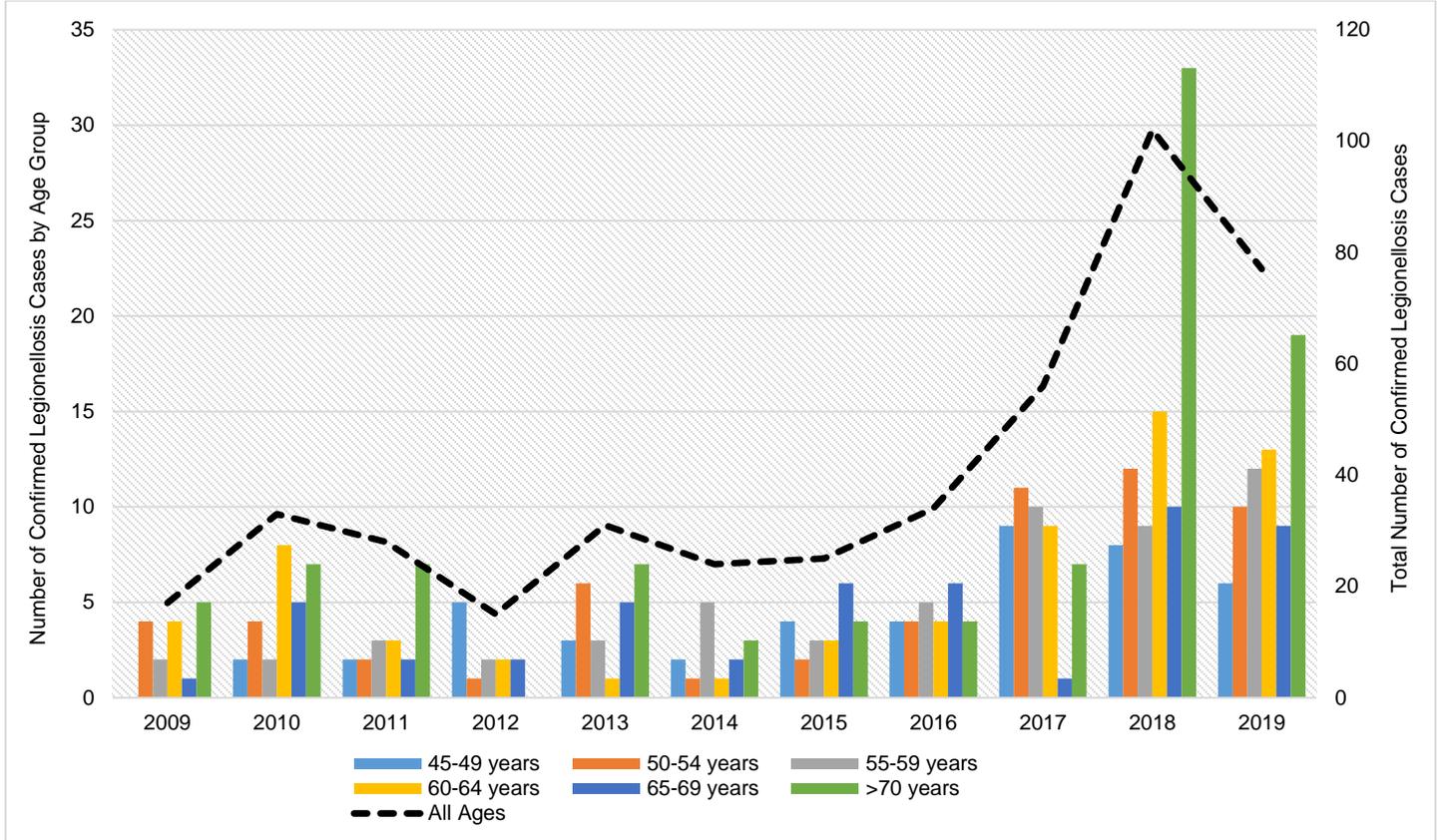
Figure 1. Rate of Confirmed Legionellosis Cases in Macomb County and Michigan (2009 – 2019)



The rate of Legionellosis cases is higher in Macomb County than it is in Michigan overall. Both the Macomb County and Michigan rate have been dramatically increasing since 2015, however, both rates decreased from 2018 to 2019.



Figure 2. Number of Confirmed Legionellosis Cases in Macomb County, MI by Age Group* and Year of Diagnosis (2009 – 2019)



*Limited to age groups with greater than 5 confirmed Legionellosis cases per year. Ages under 45 years old were excluded due to small sample sizes.

As previously mentioned, the number of Legionellosis cases has been increasing in Macomb County since 2015. The largest increase in the number of cases was seen in the 70 years and older age group. In 2018, there were 33 confirmed cases in this age group compared to 5 cases in 2009 in this age group. Older adults are at a greater risk for developing Legionellosis after being exposed to *Legionella*, which is reflected in the Macomb County cases.



Table 2. Legionellosis Case Demographics in Macomb County, MI by Cohort

	Cases 2018-2019	Cases 2009-2011
Total cases	180	78
Sex, N (%)		
Female	56 (31.1)	23 (29.5)
Male	124 (68.9)	55 (70.5)
Age		
Range	22-93	26-87
Mean	60.54	59.03
Median	61	60
Race, N (%)		
White	134 (74.4)	53 (67.9)
Black	32 (17.8)*	5 (6.4)
Other**	7 (3.9)	3 (3.8)
Unknown	7 (3.9)	17 (21.8)
Ethnicity, N (%)		
Hispanic	7 (3.9)	0 (0.0)
Not Hispanic	145 (80.6)	21 (26.9)
Unknown	28 (15.5)	57 (73.1)
*Statistically significant difference at alpha level 0.05		
**Other includes "Other Race" as well as American Indian or Alaska Native, Asian & Pacific Islander, and multiracial individuals		

Due to the large increase in the number of Legionellosis cases in Macomb County, the most recent cohort of cases from 2018-2019 was compared to a cohort of cases from 10 years ago (2009-2011). The purpose of this analysis was to determine if there have been any significant changes in who is developing the disease and how cases are being exposed to *Legionella*.

When comparing the 2018-2019 cases to the 2009-2011 cases, there was no significant change in the proportion of male to female cases (more men than women in both cohorts) or in the average age of cases (about 60 years old for both cohorts). The only significant change found in the demographics of these cohorts was the proportion of cases who were Black. From 2009-2011, 6.4% of cases were Black. This increased to 17.8% in 2018-2019, which was found to be statistically significant.



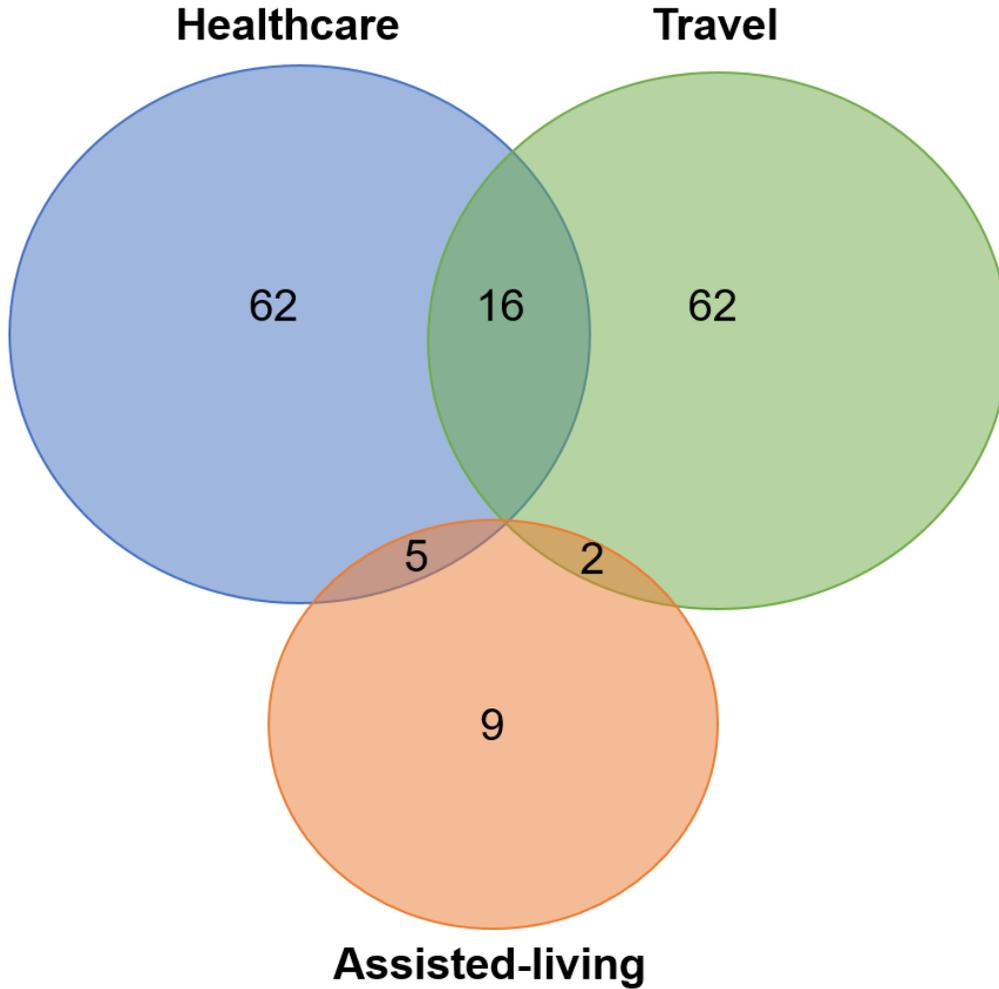
Table 3. Legionellosis Case Outcomes and Exposures in Macomb County, MI by Cohort

	Cases 2018-2019	Cases 2009-2011
Total Cases	180	78
Hospitalized		
Yes	179 (99.4)	75 (96.1)
No	1 (0.6)	3 (3.8)
Days Hospitalized		
Range	1-50	2-27
Mean	8.63*	6.91
Median	6.5	5
Survival, N (%)		
Died	14 (7.8)	3 (3.8)
Survived	164 (91.1)	70 (89.7)
Unknown	2 (1.1)	5 (6.4)
Associated with an outbreak, N (%)		
Yes	10 (5.5)	2 (2.6)
No	12 (6.7)	2 (2.6)
Unknown	158 (87.8)	74 (84.8)
Any healthcare-associated exposure**, N (%)		
Yes	47 (26.1)*	5 (6.4)
No	103 (57.2)	59 (75.6)
Unknown	30 (16.7)	14 (18.0)
Senior/assisted-living-associated exposure***, N (%)		
Yes	12 (6.6)	0 (0.0)
No	144 (80.)	0 (0.0)
Unknown	24 (13.4)	78 (100.0)
Travel-associated exposure, N (%)		
Yes	25 (13.9)	18 (23.1)
No	133 (78.9)	47 (60.3)
Unknown	22 (12.2)	13 (16.6)
*Statistically significant difference at alpha level 0.05		
**Any healthcare exposure includes definite and possible healthcare exposures		
***Recent stays in senior or assisted-living facilities were not recorded during the 2009-2011 timeframe, therefore no statistical testing was conducted on the differences for this exposure in these cohorts.		

In addition to case demographics, the cases' health outcomes and their *Legionella* exposure by cohort were also compared. The proportion of cases who were hospitalized and the proportion of cases who survived did not change significantly from the 2009-2011 cohort to the 2018-2019 cohort. However, the average number of days a case was hospitalized increased significantly. In 2009-2011, the average number of days hospitalized was 6.91, which increased to 8.63 days in 2018-2019. The number of cases with any healthcare exposure also increased significantly from 6.4% of cases in 2009-2011 to 26.1% of cases in 2018-2019. This may indicate an increase in severity of disease.



Figure 3. Number of Confirmed Legionellosis Cases in Macomb County, MI by Exposure Category (2009 – 2019)



Out of the cases with a known exposure association, an equal number were associated with travel only compared to healthcare only (62 cases). Additionally, 16 cases were associated with both travel and healthcare. 9 cases were associated with a senior/assisted-living facility only. 5 cases were associated with both healthcare and a senior/assisted-living facility. 2 cases were associated with both travel and a senior/assisted-living facility. There were no cases with a recorded association with all three exposures.

It is often difficult to determine the point of *Legionella* exposure because Legionellosis cases usually occur as singular events, symptoms may take a longer time to develop after exposure, and *Legionella* has a relatively low attack rate.

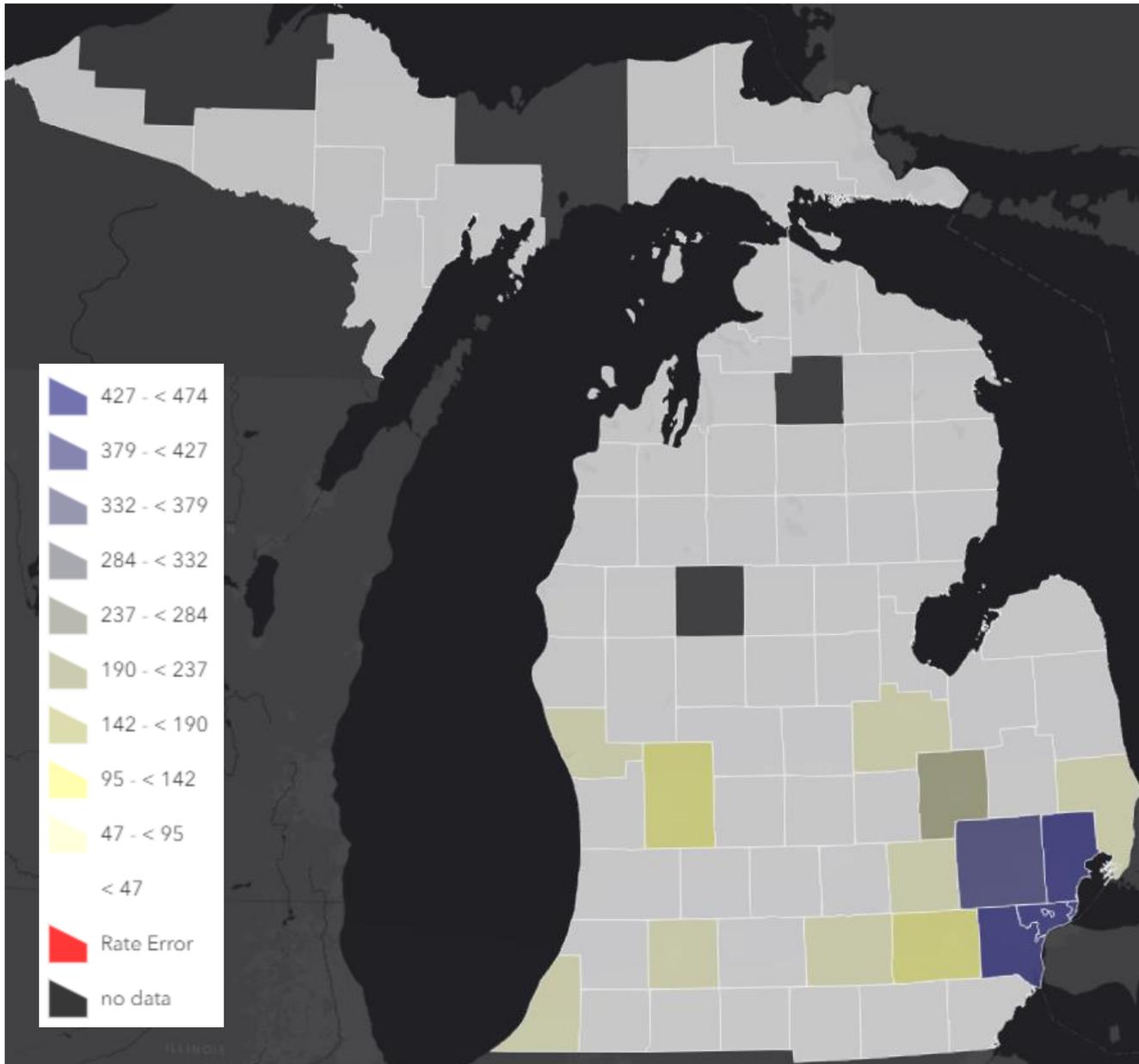
Table 4. Mortality Rate of Confirmed Legionellosis Cases in Macomb County, MI by Exposure Category (2009 – 2019)

	Cases	Deaths	Mortality Rate**
	442	28	6.33
Exposure category, N (%)			
Any healthcare	68 (15.4)	9 (32.1)	13.24
Definite healthcare	4 (0.9)	2 (7.1)	50.00*
Possible healthcare	64 (14.5)	7 (25.0)	10.94
Any travel	78 (17.6)	3 (10.7)	3.85*
Any assisted-living	16 (3.6)	0 (0.0)	0.00
None of these	287 (64.9)	16 (57.2)	5.57
<i>*Statistically significant association with case's health outcome (survival or death) at alpha level 0.05</i>			
<i>**Number of deaths per 100 confirmed Legionellosis cases in that exposure category</i>			

The overall mortality rate for all confirmed Legionellosis cases in Macomb County from 2009-2019 was 6.33 deaths per 100 confirmed cases. Macomb County’s Legionellosis mortality rate is slightly lower than the mortality rate for Legionellosis cases in all of Michigan during this timeframe (6.49 deaths per 100 confirmed cases). Cases with a definite healthcare exposure had a significantly higher mortality rate than the overall mortality rate. Cases with travel-associated exposure had a significantly lower mortality rate than the overall mortality rate. Recent stays in a senior/assisted-living facility were not regularly recorded until 2015, therefore no meaningful comparisons can be made about the mortality rates associated with senior/assisted-living facilities exposure.

Mapping

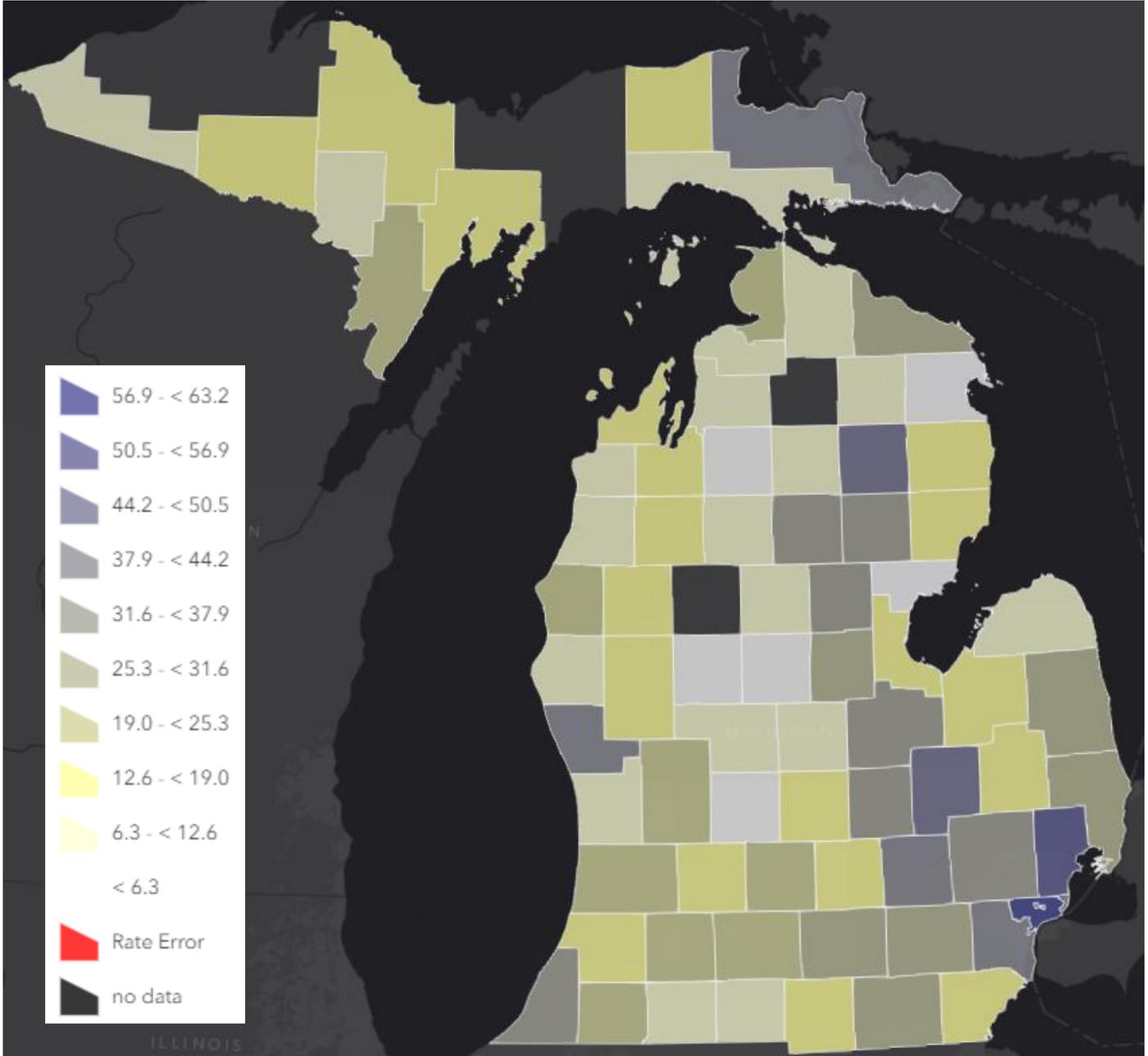
Figure 4. Number of Confirmed Legionellosis Cases in Michigan by County of Residence (2009 – 2019)



Macomb County had the third highest number of confirmed Legionellosis cases in the state of Michigan from 2009-2019 with 442 cases. Michigan cases were largely concentrated in the tri-county area: the City of Detroit had 475 cases, Wayne County had 447 cases, and Oakland County had 391 cases.



Figure 5. Rate of Confirmed Legionellosis Cases in Michigan by County of Residence (2009 – 2019)



Macomb County had the second highest rate of confirmed Legionellosis cases from 2009-2019 with 52.56 cases per 100,000 people. From 2009-2019, the City of Detroit's rate was 66.55 cases per 100,000 people, Genesee County's rate was 50.02 cases, Oscoda County's rate was 46.30 cases, Livingston County's rate was 42.55 cases, and Wayne County's rate was 40.39 cases.



Limitations

Due to the long incubation period (the time it takes from being exposed to a pathogen like *Legionella* to developing noticeable symptoms) and low attack rate (very few people will develop illness after exposure), Legionellosis cases and outbreaks are difficult to recognize in a timely manner that would allow for pinpointing of the *Legionella* exposure source. This makes it difficult to not only identify the exposure source, but also to remedy the source to prevent future cases as well as link cases that may have had the same exposure. Partially due to the long incubation period, Legionellosis cases are underdiagnosed and the numbers and rates presented likely underestimate the true incidence of the disease.

Some of the categories presented were limited to small sample sizes. Caution should be exercised in the interpretation of rates based on small numbers.

Comparisons and trends regarding race were limited to White and Black races as the number of cases for other races were too small to make meaningful comparisons.

Recent stays in a senior/assisted-living facility were not routinely recorded until 2015, therefore no meaningful comparisons can be made about trends in Legionellosis linked to senior/assisted-living facilities prior to 2015.

Recommendations for the public

Most healthy people exposed to *Legionella* do not get sick. People at increased risk (age 50+ years, current/former smokers, chronic lung disease, immunocompromised) should exercise caution and seek healthcare immediately if pneumonia-like symptoms develop, especially if traveled recently or been exposed to healthcare/assisted-living facilities.

Recommendations for facilities

Buildings such as hospitals, senior/assisted-living facilities, hotels, and others that may be susceptible to *Legionella* exposure should follow the [CDC recommended precautions and create procedures for water management programs](#).

Recommendations for healthcare professionals

- Indications that warrant testing for Legionellosis include:
 - Patients who failed outpatient antibiotic therapy for community-acquired pneumonia
 - Patients with severe pneumonia, in particular those requiring intensive care
 - Immunocompromised patients with pneumonia
 - Patients who traveled away from their home within 10 days before onset of illness
 - Patients at risk for Legionellosis with healthcare-associated pneumonia
- The preferred diagnostic tests for Legionellosis are culture of lower respiratory secretions (e.g. sputum, bronchoalveolar lavage) on selective media and the *Legionella* urinary antigen test.
- Healthcare professionals should report Legionellosis cases to the local health department within 24 hours of diagnosis.

