Connecticut Epidemiologist

CONNECTICUT PUBLIC HEALTH

When it Rains it Pours: Rainfall and Legionnaires' Disease Risk in Connecticut, 2013–2022

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Background

Legionnaires' Disease (LD) is a type of severe pneumonia caused by *Legionella* bacteria. *Legionella* bacteria are ubiquitous in natural and man-made aquatic environments and multiply inside free-living amoebae in the presence of fresh warm water (25–42˚C) (1). *Legionella* is typically transmitted by inhaling contaminated aerosolized water containing *Legionella* (2). Individuals at highest risk of LD include people over the age of 65 and those with weakened immune systems or chronic medical conditions (3). LD is associated with high morbidity and mortality (4). The overall case fatality rate is ten percent but can be as high as twenty-five percent for healthcare-associated LD (1).

In the United States, the number of LD cases increased 6.5-fold between 2000–2019, with the highest monthly case counts occurring during July–August (2). Prevention of LD remains challenging due to a range of environmental factors associated with outbreaks including travel, health care facility residence, proximity to cooling towers, whirlpool spas, recreational water activities, decorative fountains, and grocery store misters (5). Climate change may also pose an increasing risk of exposure that affects the incidence of waterborne infections like LD (6). Heavy rainfall is associated with an increase in LD risk (7). Global warming is likely to contribute to large increases in rainfall and a greater frequency of extreme precipitation events in the Northeastern states (8).

Against the backdrop of changing climate, LD represents an emerging public health concern. This article describes the epidemiology of LD in Connecticut from 2013–2022 and examines incidence of LD in relation to precipitation during the same time period.

Methods

LD is both laboratory and provider reportable in Connecticut (CT). Data on confirmed LD cases from 2013–2022 were analyzed. Demographic and clinical characteristics of LD cases were described and disease incidence by year was calculated. Annual precipitation totals for the state were calculated by summing monthly total precipitation measurements obtained from the National Oceanic and Atmospheric Administration (NOAA) (9). The association between annual precipitation totals and annual incidence of LD in CT was examined using Pearson's correlation coefficient (r).

Results

During 2013–2022, a total of 1,018 confirmed cases of LD were reported in CT with a median of 101 cases (range 56–202) reported annually. Incidence of LD increased from 1.8 cases per 100,000 population in 2013 to 3.2 in 2022 (Figure 1). The majority of cases were male (61%) and White, non-Hispanic (44.0%). The median age was 62 years (range 3 months – 100 years) (Table 1). Among cases with known hospitalization status, 97% (964/995) were hospitalized. Among cases with known outcome, overall case fatality rate was 8.6% (62/720).

Based upon data from the NOAA, a total of 472 inches of precipitation were recorded in CT during 2013–2022, with a median of 46.8 (range 32.7–62.8) inches annually. There was a significant positive correlation between annual precipitation totals in CT and annual incidence rates of LD (N=10, df=8, r=.70, p=.02) (Figure 2).

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Discussion

LD incidence rates in Connecticut were similar to those reported nationally, with an increase in incidence between 2013–2022 (2). Annual precipitation totals above the yearly median were associated with an increase in LD cases in Connecticut from 2013–2022. The positive correlation of annual precipitation in inches and LD incidence rate is consistent with findings from a recent meta-analysis of 17 articles that identified precipitation rates as a factor of influence on LD occurrence (10), suggesting that increased rainfall might affect exposure to *Legionella* in Connecticut. Temperature and humidity have also been recognized as weather-related factors that might impact risk for LD, with risk increasing when weather is warm and humid (11). We did not have data on temperature and humidity. Additional limitations of this analysis include that data on actual exposure to rainfall by individual case patients is not known. Also, the impact of the COVID-19 pandemic on LD incidence rates in Connecticut from 2020–2022 was not examined. However, the vast majority of cases were hospitalized and urine antigen testing for the diagnosis of LD remained widely available at all Connecticut hospitals during this time period. A better understanding of the role of rainfall as a mechanism for amplifying *Legionella* dispersal and the influence of other weather factors on *Legionella* exposure is needed to help guide messages on preventing LD.

Figure 1. Number of Confirmed LD Cases and Incidence of LD by Year, Connecticut, 2013–2022

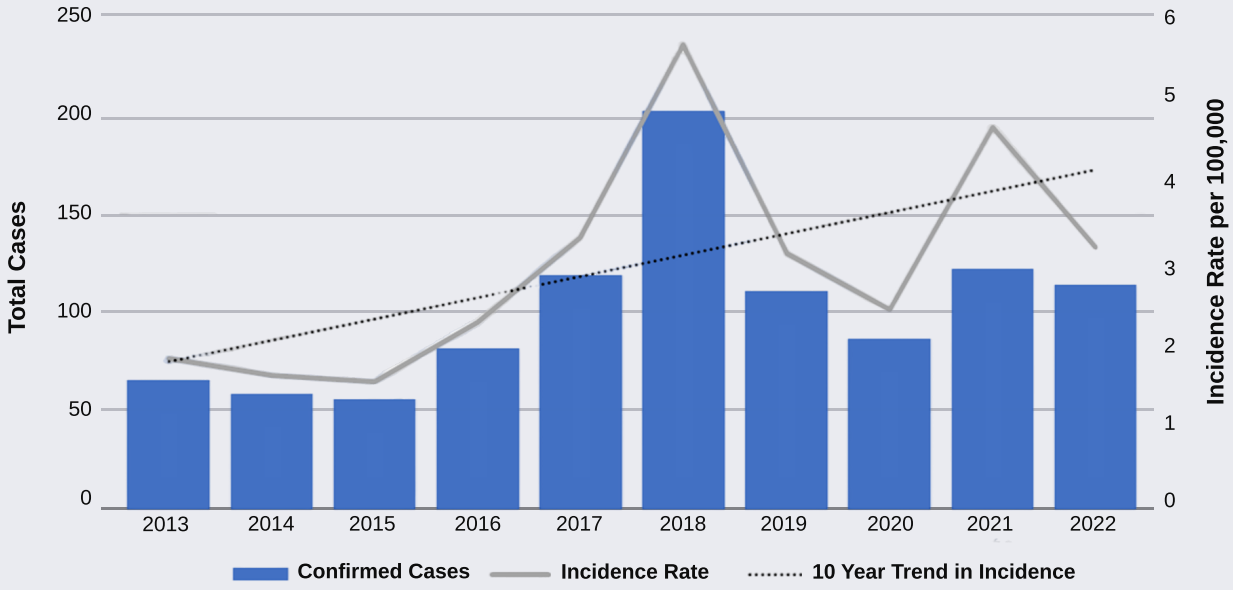


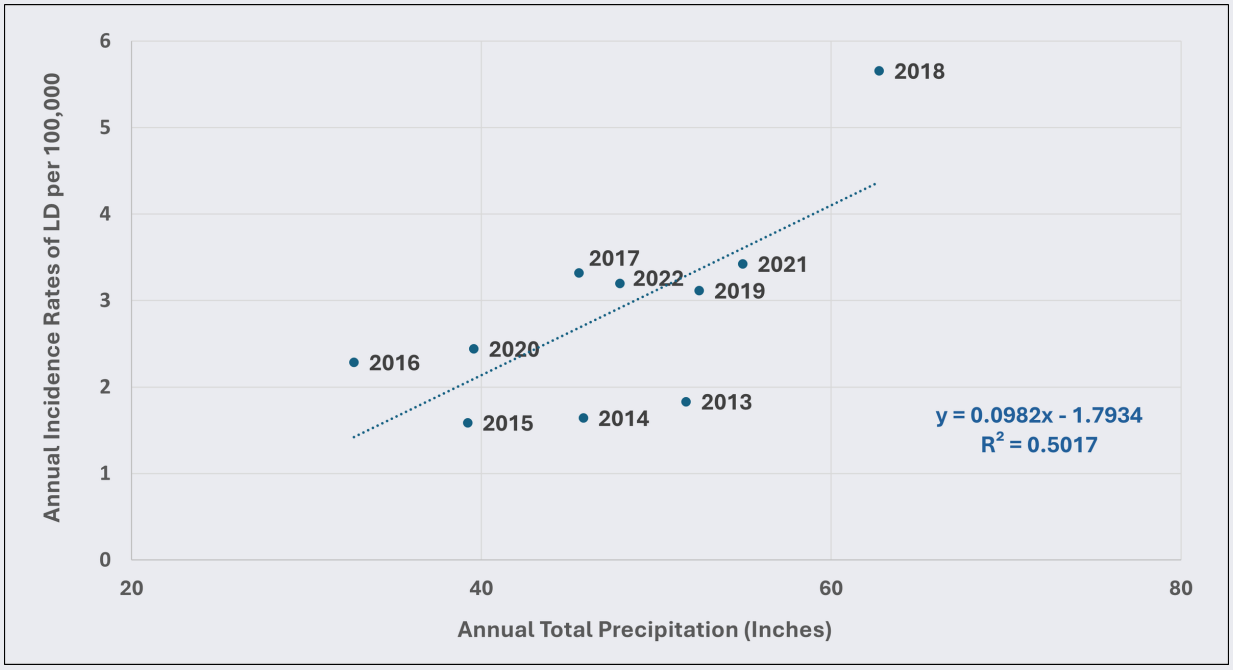
Table 1. Number and Percentage of LD Cases, by Selected Patient Demographic Characteristics, Connecticut, 2013–2022 (n=1,018)

Characteristic	No.	%
Sex		
Male	621	61.0
Female	397	39.0
Race and Ethnicity		
Hispanic	86	8.4
White, non-Hispanic	448	44.0
Black, non-Hispanic	106	10.3
Other, non-Hispanic	12	1.2
Unknown	366	36.0

Characteristic	No.	%
Age		
0-19	3	0.3
20-39	84	8.3
40-59	344	33.8
60-79	456	44.7
80+	129	12.7
Unknown	2	0.2

When it Rains it Pours: Rainfall and Legionnaires' Disease Risk in Connecticut, 2013–2022 *(continued)*

Figure 2. Annual Incidence of LD Cases and Annual Precipitation, Connecticut, 2013–2022



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Infectious Diseases Section

Annual Statistics - Total Reported Cases by Disease—Connecticut, 2023

REPORTED DISEASES	2023
Acute flaccid myelitis	0
Anaplasmosis	65
Anthrax	0
Babesiosis	246
Borrelia miyamotoi disease	4
Botulism	2
Brucellosis	0
California encephalitis virus disease	0
Campylobacteriosis	838
Candida auris - clinical	5
Candida auris - colonization	14
Candidemia	261
Carbapenem-resistant *Acinetobacter baumanii* (CRAB) - clinical	17
Carbapenemase-producing CRAB (CP-CRAB) - clinical	11
Carbapenem-resistant Enterobacterales (CRE) - clinical	378
Carbapenemase-producing CRE (CP-CRE) - clinical	135
Carbapenemase-producing carbapenem resistant *Pseudomonas aeruginosa* (CP-CRPA) - clinical	34
Carbapenemase-producing organism (CPO) -colonization	27
Chancroid	0
Chikungunya virus disease	2
Chlamydia trachomatis infection	13,197
Cholera (toxigenic *Vibrio cholerae* O1 or O139)	0
Coronavirus Disease (COVID-19)	82,757
Cryptosporidiosis	47
Cyclosporiasis	38
Dengue virus infections	13
Diphtheria	0
Eastern equine encephalitis virus disease	0
Ehrlichiosis	6
Enterotoxigenic *E. coli* (ETEC)	146

Infectious Diseases Section

Annual Statistics - Total Reported Cases by Disease—Connecticut, 2023

REPORTED DISEASES	2023
Giardiasis	189
Gonorrhea	4,098
Group A Streptococcal disease, invasive	338
Group B Streptococcal disease, invasive	373
Haemophilus influenzae, invasive	78
Hansen's disease (Leprosy)	2
Hemolytic uremic syndrome postdiarrheal	2
Hepatitis A, acute	2
Hepatitis B, acute	1
Hepatitis B, chronic	428
Hepatitis B, perinatal infection	0
Hepatitis C, acute	4
Hepatitis C, chronic	622
Hepatitis C, perinatal infection	0
HIV	246*
Legionellosis	123
Listeriosis	17
Lyme disease	3,239
Malaria	15
Measles (rubeola)	0
Meningococcal disease (*Neisseria meningitidis*)	5
Mpox	4
Mumps	2
Neonatal sepsis	23
Pertussis	11
Plague	0
Pneumococcal disease, invasive (*Streptococcus pneumoniae*)	260
Poliomyelitis	0
Powassan virus disease	5
Q fever	1

*Data still under review

Infectious Diseases Section

Annual Statistics - Total Reported Cases by Disease—Connecticut, 2023

REPORTED DISEASES	2023
Rabies, human	0
Rocky Mountain spotted fever	9
Rubella	0
Salmonellosis (excluding S. Typhi infection and S. Paratyphi infection)	499
Severe Acute Respiratory Syndrome-associated Coronavirus disease (SARS-CoV)	0
Shiga toxin-producing *Escherichia coli* (STEC)	146
Shigellosis	173
Smallpox	0
St. Louis encephalitis virus disease	0
Staphylococcus aureus, methicillin-resistant (MRSA), invasive	713
Staphylococcus aureus, methicillin-sensitive (MSSA), invasive	1,287
Staphylococcus aureus, vancomycin-intermediate (VISA)	1
Staphylococcus aureus, vancomycin-resistant (VRSA)	0
Syphilis, congenital	2
Syphilis, early non-primary, non-secondary	116
Syphilis, primary	102
Syphilis, secondary	163
Syphilis, unknown duration or late	554
Tetanus	0
Trichinellosis	0
Tuberculosis	66
Tularemia	0
Typhoid (*S. typhi*)/paratyphoid (*S. paratyphi*) fever	10
Varicella (Chickenpox)	61
Venezuelan equine encephalitis virus disease	0
Vibriosis (any species of the family Vibrionaceae, other than toxigenic *Vibrio cholerae* O1 or O139)	46
Viral hemorrhagic fevers	0
West Nile virus disease	7
Yellow fever	0
Yersiniosis	126
Zika virus disease	0

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