

Legionnaires Disease (*L. Pneumophila*) & Pontiac Fever Outbreak in a City Garage: A Retrospective Cohort Study

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Abstract

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Title: Legionnaires Disease & Pontiac Fever Outbreak in a City Garage: A Retrospective Cohort Study

Objective: Determine if an outbreak of Legionella pneumophila was associated to the city garage.

Background:

In 2004 the Cleveland Department of Public Health received a report from a community member of individuals that worked in a city garage that were ill and hospitalized from Legionnaires Disease. One month following this account the Health Department received an additional report of a Legionnaires Disease case associated with a city garage. It was determined that these two cases were confirmed Legionnaires Disease cases through additional investigation.

Method:

A retrospective cohort study was done to determine whether there was an association between environmental factors and illness. There were forty one participants in the outbreak study.

Results:

There were 18 environmental factors tested epidemiologically and environmentally. One of the hypotheses proposed indicated there is a significant association between sitting in the patio area near the steam jenny and legionnaire's disease or pontiac fever. This hypothesis was weakly associated $p=.08$. Additional sampling done on the water sources also yielded legionella, however isolates were unable to be sub typed and matched to the index case patient.

Discussion:

It is often difficult to determine how individuals were exposed to legionella pneumophila. Although this outbreak is associated to the city facility in question it is often difficult to isolate the source on legionnaires due to the aspect of the pathogen and that it is sporadic in the environment as a whole.

Learning Objectives:

1. Describe the magnitude of legionella pneumophila as a pathogen in water reservoirs.
2. Explain the epidemiology of legionella pneumophila as it pertains to this study.
3. Understand challenges to counter legionella pneumophila in water reservoirs.

Introduction:

Legionella are bacteria present in aquatic environments, the risk of transmission to humans depends on the presence of several factors: conditions favorable for amplification, a mechanism for dissemination, strain virulence factors and susceptibility of the host. This study conducted in 2004 was the result of an outbreak within a facility garage, in which water reservoir exposure was routine. The study was conducted to try to determine the exposure source of legionella in several employees of this facility, while implementing safety measures as appropriate in the environment.

Methodology:

A retrospective cohort study was done to determine whether there was an association between environmental factors and illness. There were forty one participants in the outbreak study. A questionnaire was developed and implemented to determine risk factors and determinates for transmission (see below).

A Risk Ratio (RR) was done to quantify a relationship between the exposure and the illness or outcome. A Chi-square (χ^2) statistic was completed to look at the strength of association between the exposure and illness and exposure and non-illness. P-value (p) and 95% Confidence Intervals (C.I.) were also used for further indication of exposure and likelihood of chance and true cases resulted from the outbreak source. The software utilized to analyze this data was SPSS.

Hypotheses:

The following hypotheses were derived from the preliminary epidemiological data collection:
Hypothesis 1: There is a significant association between the use of the steam jenny and legionnaire's disease or Pontiac fever.
Hypothesis 2: There is a significant association between sitting in the patio area near the steam jenny and legionnaire's disease or Pontiac fever.
Hypothesis 3: There is a significant association between the use of the bulk hose and legionnaire's disease or Pontiac fever.

Results:

The epidemiological curve showed propagation in cases of pontiac fever and legionnaires disease through this outbreak [Figure 1]. This result was indicative of *L. Pneumophila*'s ability to be present intermittently in the environment. The overall age and gender distribution of exposed were mainly males in the 25-65 year age group, legionnaires disease case ages ranged from 56-65. The majority of clinical symptoms suggested pontiac fever [Table 1]. The floor drain was positive for legionella species not pneumophila, however additional testing procedures to determine if this was pathogenic was not conducted [Table 2]. Pontiac Fever was more prominent in most workers, those with legionnaires disease had a history of chronic disease and smoking, those with Pontiac fever also had chronic disease history regardless of risk behaviors. The results indicated a closer association at $p=.08$ in the area where the city trucks were cleaned daily by an apparatus called the steam jenny (SJ), this area also served as a break area for the cases in this study thus causing exposure [Table 3].

Legionnaires Disease Questionnaire

Hello, I am from the Cleveland Department of Public Health. We are investigating a Legionnaires Disease cluster and are asking a number of questions to employees of the Ridge Road facility to find out how you spend your time both at work and at home, here is a calendar to help you recall some dates I may ask you about. Everything you tell me is kept confidential. If you agree to the interview lets begin.....

- Last Name: _____
- First Name: _____
- Age: _____
- Gender: Male Female
- Race: White Black Asian/Pacific Islander Native American Other _____
- Ethnicity: Non-Hispanic Hispanic
- Home Address: _____
- City: _____
- Zip code: _____
- Home phone number: area code () number _____

Now I am going to ask questions about whether you were ill or not.

- Were you sick with a respiratory illness at anytime from June 1 to now? Yes No (*If No, skip to 15*)
- If Yes, do you remember the date you first felt ill? Yes No If yes, date: _____
- Did you go to the doctor? Yes No
- Were antibiotics prescribed? Yes No
- If yes, what was the name: _____
- Were any of the following tests done?

Chest x-ray	Yes	No
Urine antigen	Yes	No
Bloodwork	Yes	No
Sputum culture	Yes	No
- Name of doctor: _____
- Location: _____

- Why do you think you became ill?

A. Cough	Yes	No	If Yes, Onset Date: _____	Duration: _____
B. Fever	Yes	No	If Yes, Onset Date: _____	Duration: _____
C. Headache	Yes	No	If Yes, Onset Date: _____	Duration: _____
D. Muscle Ache	Yes	No	If Yes, Onset Date: _____	Duration: _____
E. Chills	Yes	No	If Yes, Onset Date: _____	Duration: _____
F. Sweats	Yes	No	If Yes, Onset Date: _____	Duration: _____
G. Shortness of breath (SOB)	Yes	No	If Yes, Onset Date: _____	Duration: _____
H. Other: _____	Yes	No	If Yes, Onset Date: _____	Duration: _____
- Did you miss any days of work during the time from June 1 to now? Yes No
- Were in an area of the facility that you normally do not go? Yes No
- If yes, date? _____ Duration: _____

- Did you drink water from any of the following sources at the Ridge Road facility from June 1 to August 5?

Water fountain in break room (implugged)	Yes	No
Water hose at bulk wash area	Yes	No
Water hose near "Steam Jenny"	Yes	No
Water from bathroom (by locker room)	Yes	No
Water from bathroom in main office	Yes	No
- Did you use the water hose (bulk wash area) to wash your or someone else's vehicle? Yes No
- If yes, how often? _____ (Times per week)
- If yes, how often? _____ (Minutes)
- Did you use the "Steam Jenny" to clean your or someone else's vehicle? Yes No
- If yes, how often? _____ (Times per week)
- How long? _____ (Minutes)
- Did you have contact with the heater for the "Steam Jenny"? Yes No Dates? _____
- Do you use a mask when cleaning your vehicle? Yes No
- Do you use the shower? Yes No If yes, how often? _____ (per week)
- Do you eat in the lunch/break room? Yes No If yes, how often? _____ (per week)
- Do you use the Locker Room? Yes No If yes, how often? _____ (per week)
- Do you use the bathroom near the break room? Yes No If yes, how often? _____ (per week)
- Do you use the bathroom in the main office? Yes No If yes, how often? _____ (per week)
- Do you use the water in the break room (sink)? Yes No If yes, how often? _____ (per week)
- Do you sit in the chairs located outside across from the "Steam Jenny"? Yes No
- If yes: A. More than once a day B. Daily C. 2-3 times a week D. Once a week E. Less than once a week
- During the time you are sitting there is the "Steam Jenny" in use?

A. Never	Yes	No
B. Sometimes	Yes	No
C. Always	Yes	No

Now I am going to ask you questions about your home and your activities outside of work.

- Has any of your family or household been sick with a respiratory illness in the last 3 months? Yes No
- Do you routinely have anyone in your house under the age of 5? (children/grandchildren) Yes No
- Any travel or stay away from home in the last 3 months? Yes No
- If you stay away from home or travel, list locations and dates: _____
- Have you used or been near a hot tub, Jacuzzi, spa or hot tub since June 1? Yes No
- Did you spend time away from work with any Ridge Road co workers in the last 3 months? Yes No
- If yes, where? _____
- Do you have any hobbies outside of work that utilizes water? Yes No
- Date? _____ Type: _____

- If yes, did you miss work for:

a. Sickness or Medical Leave	Yes	No
b. Vacation or holiday	Yes	No
c. Family Reasons	Yes	No
d. Reserve or guard duty	Yes	No
e. Other _____	Yes	No
- Were you admitted to the hospital in June, July or August? Yes No
- If yes, Date admitted? _____
- How long? _____ (days)
- Where? _____
- Diagnosis? _____
- Diagnostic tests done:

Chest x-ray	Yes	No
Urine antigen	Yes	No
Bloodwork	Yes	No
Sputum culture	Yes	No

Now I am going to ask questions about job related activities since June 1, 2004.

- What team are you apart of?

a. Street maintenance (cleaning)	Yes	No
b. Asphalt (repair)	Yes	No
- On the street maintenance team, which of the following do you drive:

a. street sweeper	Yes	No	If yes, how often (days): _____
b. dump truck	Yes	No	If yes, how often (days): _____
c. water tank/street flusher	Yes	No	If yes, how often (days): _____
d. Other work: _____	Yes	No	If yes, how often (days): _____
- Did you work at the Ridge Road facility between June 1 and August 5th? Yes No
- Which shift have you worked since June 1? _____
- Between June 1 and August 5, did you work at another facility? Yes No
- If yes, where? _____
- Do you remember any of the following changes that happened at work between June 1 and August 5?

Construction around work area	Yes	No	If yes, date? _____	Duration: _____
New machines	Yes	No	If yes, date? _____	Duration: _____
Building hotter than usual	Yes	No	If yes, date? _____	Duration: _____
Building colder than usual	Yes	No	If yes, date? _____	Duration: _____
Changed, swapped shift	Yes	No	If yes, date? _____	Duration: _____
Changed job duties	Yes	No	If yes, date? _____	Duration: _____
Water shut off	Yes	No	If yes, date? _____	Duration: _____
Water too hot	Yes	No	If yes, date? _____	Duration: _____
Water too cold	Yes	No	If yes, date? _____	Duration: _____
Malfunctioning cleaning equipment	Yes	No	If yes, date? _____	Duration: _____
If yes, what equipment	Yes	No	If yes, date? _____	Duration: _____
Equipment taken out of service and then put back on	Yes	No	If yes, date? _____	Duration: _____

Medical History Questions

Now I am going to ask you questions about your health and personal habits.

- Has a doctor or nurse or other health professional ever told you have:

Diabetes	Yes	No
Heart problems	Yes	No
Lung problems	Yes	No
Asthma	Yes	No
Bronchitis	Yes	No
Pneumonia	Yes	No
Liver problems	Yes	No
Immunocompromising conditions (Cancer, HIV/AIDS, Leukemia)	Yes	No
Other: _____	Yes	No
- Are you currently taking any medications that are known to weaken your immune system (prednisone, medications for Rheumatoid arthritis, chemotherapy or any steroids)? Yes No
- Have you smoked at least 100 cigarettes in your entire life (5 packs=100 cigarettes)? Yes No
- If yes, do you now smoke cigarettes every day, some days or not at all?

A. Every day	Yes	No
B. Some days	Yes	No
C. Not at all	Yes	No
- Do you smoke other tobacco products? Yes No

A. Every day	Yes	No
B. Some days	Yes	No
C. Not at all	Yes	No
- Considering all types of alcoholic beverages, approximately how many drinks do you have per week?

A. 1-2 drinks	Yes	No
B. 3-5 drinks	Yes	No
C. >5 drinks	Yes	No
D. None	Yes	No
- Is there anything that I have not asked that I should know? _____

Thank You for your cooperation!!

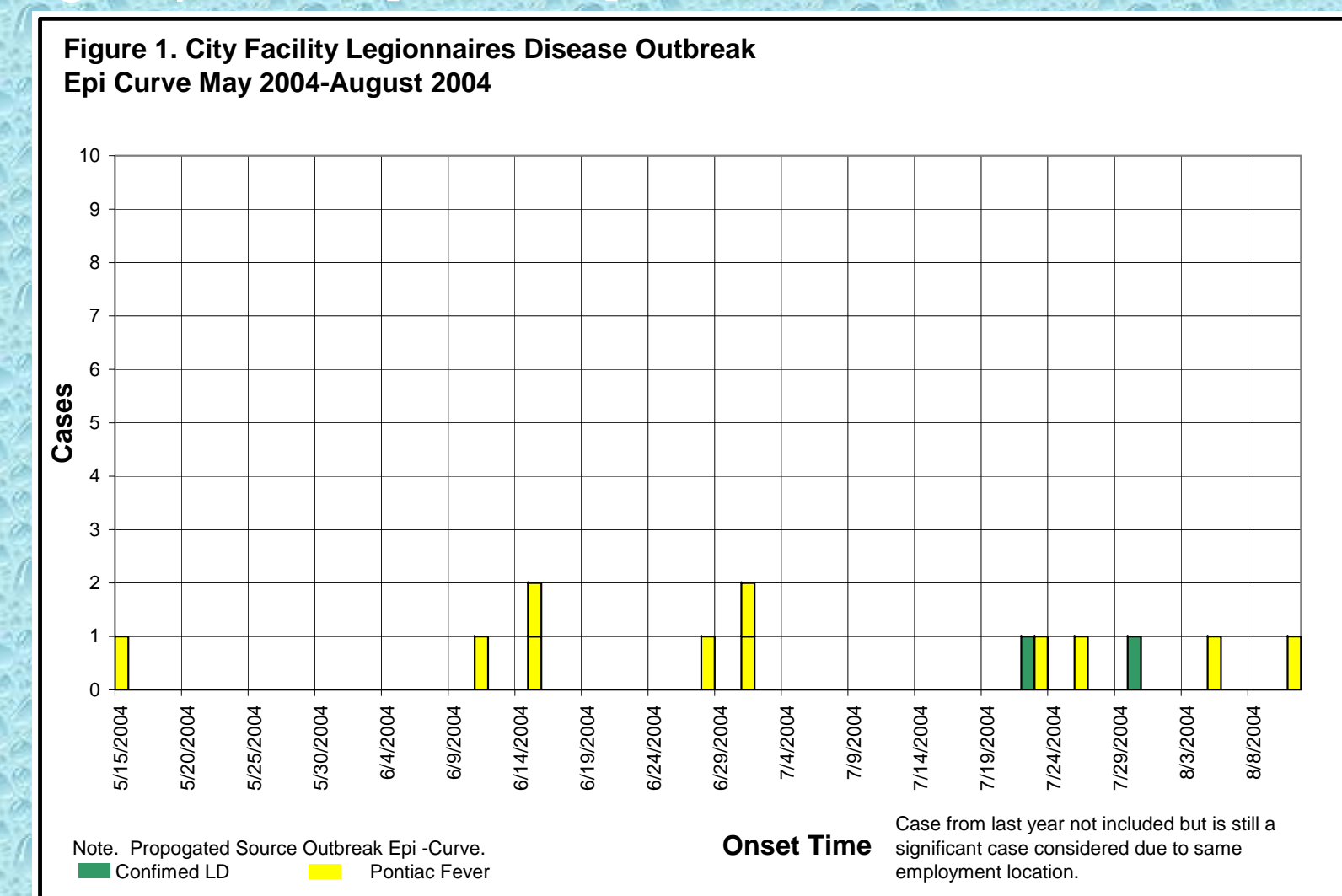


Table 2. University of Pittsburgh Results

Environmental Sample Results	10-Aug-04	19-Aug-04
Main Wash Area	Negative	Negative
Air Compressor	Negative	Negative
Floor Drain	Negative	Legionella pneumophila
Steam Jenny	Negative	Species, not pneumophila
Hot Water Tank	Negative	Negative
Office Sink	Negative	Negative
Employee Lounge Fountain	Negative	Negative
Shower Head	Negative	Negative

Clinical Sample Results

Case #	Result
Case #1	Negative
Case #2	Negative

Note: Tests from hospitals indicated Ugg positive and positive cup indicating they were positive. The isolates sent to U.P. were post treatment.

Cleveland Bio-Industries Laboratory

CRB Results (this lab was not equipt to perform full typing)

Sink in employee lounge	Result
Sink in employee lounge	Negative
Sink in Foreman's Office	Negative
Main wash	Legionella Species isolated
Showerhead	Legionella Species isolated
Steam Jenny Hose	Negative
Rinse hose near steam jenny	Negative
Water Fountain	Negative

Note: PI instructed lab on packaging and storage to send isolates to Univ. Pitts. for screening. CRB failed to package specimen correctly and failed to send to U. of Pitt. Lab. This yielded an unsuccessful attempt at typing.

Table 1: Signs and Symptoms of Cases

Signs or Symptoms	Number of Cases	Percent
Headache	8	62%
Fever	6	46%
SOB	9	69%
Coughing	11	85%
Chills	5	38%
Sweats	5	38%
Muscle Aches	10	77%
Respiratory Illness	10	77%
Other	3	23%

Table 3. Population Sample for a Retrospective Cohort Study of The City Facility

Exposure	that worked and used/drank, equipment/water in facility			that worked and did not use/drink, equipment/water in facility			RR	χ^2	P-VALUE	Lower 95% C.I.	Upper 95% C.I.		
	Ill	Well	Total	Ill	Well	Total							
Bathroom Locker (drink)	0	3	3	0.00	13	24	37	0.35	0.00	0.54	0.296	undefined	undefined
Main Office (MO) Bath (drink)	1	3	4	0.25	12	24	36	0.33	0.75	0.82	0.608	0.1291	4.3575
Bulk Hose (drink)	0	2	2	0.00	13	25	38	0.34	0.00	0.81	0.450	undefined	undefined
Dump Truck	5	5	10	0.50	8	23	31	0.26	1.84	0.29	0.149	0.8195	4.5800
Equipment out of service	4	6	10	0.4	9	21	30	0.30	1.33	0.85	0.41	0.5232	0.8977
Fountain (drink)	1	3	4	0.25	12	24	36	0.33	0.75	0.82	0.608	0.1291	4.3556
Hose Near Steam Jenny (SJ) (drink)	1	1	2	0.5	12	26	38	0.32	1.58	0.816	0.55	0.3667	6.837
Maif. Equip	5	9	14	0.36	8	18	26	0.31	1.161	0.97	0.508	0.4677	2.8808
Bulk Hose (use)	7	15	22	0.32	6	12	18	0.33	0.954	0.812	0.59	0.39	2.3361
Steam Jenny (use)	11	24	35	0.31	2	5	0.40	0.785	0.898	0.53	0.2415	2.5565	
Lunch/break room (use)	5	13	18	0.28	8	14	22	0.36	0.763	0.812	0.408	0.3021	1.9315
Locker Room	8	11	19	0.42	5	16	21	0.24	1.768	0.37	0.185	0.6983	4.4785
Sweeper	0	3	3	0.00	13	25	38	0.34	0	0.56	0.3073	undefined	undefined
Water in Break Room (use)	4	11	15	0.27	8	16	24	0.33	0.8	0.934	0.471	0.2908	2.012
Bathroom in MO (use)	4	8	12	0.33	9	19	28	0.32	1.03	0.768	0.608	0.3954	2.7207
Street flusher (use)	1	2	3	0.33	12	26	38	0.32	1.055	0.56	0.692	0.1992	5.592
Chairs near SJ	9	11	20	0.45	4	16	20	0.2	2.25	0.18	0.08	0.6265	6.1256
Bathroom Near BR (use)	13	22	35	0.37143	0	5	5	0	undefined	0.205	0.122	undefined	undefined

Note: Those lines not equating the 41 individuals interviewed indicates no response given.
 * = significance or weak significance

Conclusion: There were 18 exposures analyzed and several areas tested to determine association. The hypotheses tests suggested no significant association between exposure to work related water sources tested and illness. However, remediation of the environment did ensue through the chlorination of hot water systems, city flusher trucks in addition, follow-up sampling of all water retaining systems. Lessons learned indicated, the inability to isolate Legionella from an environmental source does not definitively rule out its presence.