

# Outbreak of Legionellosis Associated with Exposure to a Hotel Outdoor Hot Tub, Orange County, Florida, March 2008

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## Introduction

On March 11, 2008, the Pinellas County Health Department (PCHD) Epidemiology Program was notified by a local hospital of a laboratory-confirmed case of Legionnaires' disease with onset on March 7. On March 12, an infection control practitioner at the same hospital reported an additional laboratory-confirmed case of Legionnaires' disease with onset of March 9. Both people had attended a recent wedding in Orlando, Florida. The PCHD Epidemiology nurse spoke to the father of the bride. He reported a third person with Legionnaires' disease hospitalized in Canada with an onset date of March 6 or 7 and a fourth symptomatic wedding guest (not hospitalized) from Canada who reportedly was being followed by a physician. Test results for *Legionella* were not available on this guest at the time of the initial notification.

All four people were Canadian residents from different cities who had traveled separately to Orlando for the wedding. All four attended the wedding on March 1, which was held at a private park with approximately 100 guests. According to the father of the bride, there were no natural or man-made water bodies in the vicinity. The four ill people stayed at Hotel A in Orlando, where 40 to 50 other wedding guests also stayed, arriving between February 27 and February 29 and departing between March 2 and March 4 (length

of stays ranged from two to six days). The father of the bride reported that each of the three people with laboratory-confirmed Legionnaires' disease had spent time in and around the hot tub at Hotel A with no other common relevant exposure reported. The PCHD epidemiology nurse contacted the Florida Department of Health (DOH), the Florida Department of Business & Professional Regulation (DBPR), and the Orange County Health Department (OCHD) and an investigation was initiated.

## Methods

### Case Definition and Case Finding

A confirmed case was defined as any person with radiologically confirmed pneumonia who was urine-antigen positive for *Legionella* and who had stayed at Hotel A in Orlando, Florida within the two weeks prior to illness onset. A probable case was defined as any person with radiologically confirmed pneumonia who had stayed at Hotel A in Orlando, Florida within the two weeks prior to illness onset.

To facilitate case finding, contact information for all guests who checked out of Hotel A in Orlando, Florida between February 27 and March 15, 2008 was obtained. An informational letter was mailed to all guests who provided the hotel with a valid address, alerting them to the ongoing investigation of

Legionnaires' disease cases, providing information on the transmission and signs and symptoms of Legionnaires' disease, and requesting contact if a similar illness was experienced. In addition, a notice was posted nationwide on Epi-X and multiple notices and updates were posted statewide on EpiCom requesting that any Legionnaires' disease cases with history of travel to Orlando be reported to the OCHD. A press conference was held in Orlando on March 14 to notify the local public of the investigation and to request that any person with respiratory illness who had recently stayed at Hotel A seek medical care.

DOH contacted the Legionnaires' Disease Program Surveillance & Outbreak Response Coordinator of the Respiratory Diseases Branch at the Centers for Disease Control and Prevention (CDC), who facilitated communication with Health Canada and the European Working Group for *Legionella* Infections to gather information on cases and potential cases in Canada and Europe.

### Epidemiological Investigation

Names and telephone numbers of wedding guests were obtained from the bride and the family of the bride. A detailed questionnaire was administered via telephone to all wedding guests who could be reached.

Health Canada interviewed two guests who were seen in Canadian hospitals; the remaining guests were interviewed by Florida DOH epidemiology staff.

Due to a low response rate from the wedding cohort and the identification of a case outside of the wedding cohort, a case-control study was performed to determine possible risk factors. All confirmed and probable cases were included in the study. Four controls per case were matched on age using standard five-year intervals. Controls were randomly selected from hotel guests who checked out of Hotel A between February 27 and March 4 and did include wedding guests. Valid telephone numbers in English-speaking countries were called in random order. The person who answered the phone was asked how many people were in each group that stayed in the hotel and the ages of those persons. Any person in the group who was the appropriate age was asked to participate in the study. The first four persons of the appropriate age to be interviewed for each case were included in the analysis. Persons experiencing respiratory illness during the two weeks after their hotel stay were excluded from analysis to avoid possible misclassification as a control. Control interviews were conducted via telephone by epidemiology personnel. Data entry and analysis were done with Epi Info Version 3.4.3 (November 26, 2007).

#### Environmental Investigation

An initial environmental investigation and site visit of Hotel A was conducted on March 13, 2008. Team members included environmental health and epidemiology personnel in addition to a DBPR Inspector. The hotel's outdoor swimming pool and hot

tub were assessed and indoor air quality was evaluated in three of the six rooms in which the five cases stayed (one case stayed in two rooms) during their exposure period and in an additional room on the first floor. The OCHD Swimming Pool Inspector and a DOH Regional Engineering staff member conducted a site visit on March 18 to assess the configuration, design, and maintenance of the hotel's hot water system.

#### Laboratory Investigation

Based on the environmental assessment of the hot tub, environmental samples were collected from various points in the hot tub plumbing system. These samples were collected during the environmental inspection on March 13, 2008 at Hotel A. Each sample consisted of five 100 ml collection bottles with sodium thiosulfate tablets. Sample locations included the skimmer basket on the circulation pump drawing water from the skimmers, the skimmer basket on the circulation pump that provided the air to the therapeutic jets, and the discharge from the first cartridge filter with scrapings from the filter. An additional 100 ml sample was taken from the second cartridge filter with water from the bottom of the filter container and scrapings from the filter. A 500 ml sample was collected from a bucket that was collecting water from the overflow pan from an air conditioning unit in a room a case had occupied. On March 18, two samples were obtained from the hotel boiler drain pipe and the booster boiler drain pipe. The thermometer on the boiler on the seventh floor read 128° F.

## Results

### Case Finding

Four confirmed cases were identified. Three were in Canadian residents who had attended the wedding on March 1, 2008. An additional Canadian wedding guest was investigated by Health Canada but did not meet the probable or confirmed case definition for this investigation. The European Working Group for *Legionella* Infections reported a fourth confirmed case in a United Kingdom resident to the Legionnaires' Disease Program Surveillance & Outbreak Response Coordinator of the Respiratory Diseases Branch at the CDC, who notified the Florida Department of Health, who contacted the OCHD with the information.

The OCHD Epidemiology Program received five telephone calls from guests of Hotel A regarding the informational letter that was distributed. Of these five callers, one met the case definition for a probable case. This person stayed at Hotel A from February 27 to March 1 and had an onset of chills, fever, weakness, fatigue, and shortness of breath on March 8. The patient was diagnosed with pneumonia, which was confirmed by X-rays. A urine specimen subsequently collected on April 7, approximately one month after onset, tested negative for *Legionella* antigen.

The ages of the five people meeting the probable or confirmed case definitions ranged from 43 to 60 years, with a mean of 53.4 and a median of 55. Four of the five people were male. Three of the five people were known to be smokers with underlying health conditions. See Table 1 for a line list of case characteristics. Signs and symptoms reported by cases are presented in Table 2.

## TABLE 1

**Table 1: Characteristics of Cases, Legionnaires' Disease Cluster, Orange County, March 2008**

Patient-Case Status	Gender	Age	Hotel Stay Dates	Onset Date	Medical Risk Factors	Smoker
Patient A-Confirmed	Female	55	2/28/08-3/3/08	3/3/08	Hypothyroid condition	Yes
Patient B-Confirmed	Male	43	2/23/08-3/8/08	3/4/08	Unknown	Unknown
Patient C-Confirmed	Male	60	2/29/08-3/2/08	3/5/08	Bone cancer	Yes
Patient D-Confirmed	Male	58	2/27/08-3/4/08	3/7/08	Heart attack 6 months prior	Yes
Patient E-Probable	Male	51	2/27/08-3/1/08	3/8/08	None	No

**TABLE 2****Frequency of Symptoms,  
Legionnaires' Disease Cluster, Orange County, March, 2008**

Symptom	Number	Percent of Total Ill (N=5)
Fever	5	100%
Chills	5	100%
Weakness/fatigue	5	100%
Diarrhea	4	80%
Congestion	3	60%
Muscle pain	3	60%
Headache	2	40%
Cough	2	40%
Shortness of breath	2	40%
Muscle aches	2	40%
Vomiting	2	40%
Abdominal pain	1	20%

ratio of 22.11 (95% confidence interval: 1.22-1569.46). Note that the two case subjects who did not spend time in the outdoor hot tub both spent time around the hot tub.

**Environmental Results**

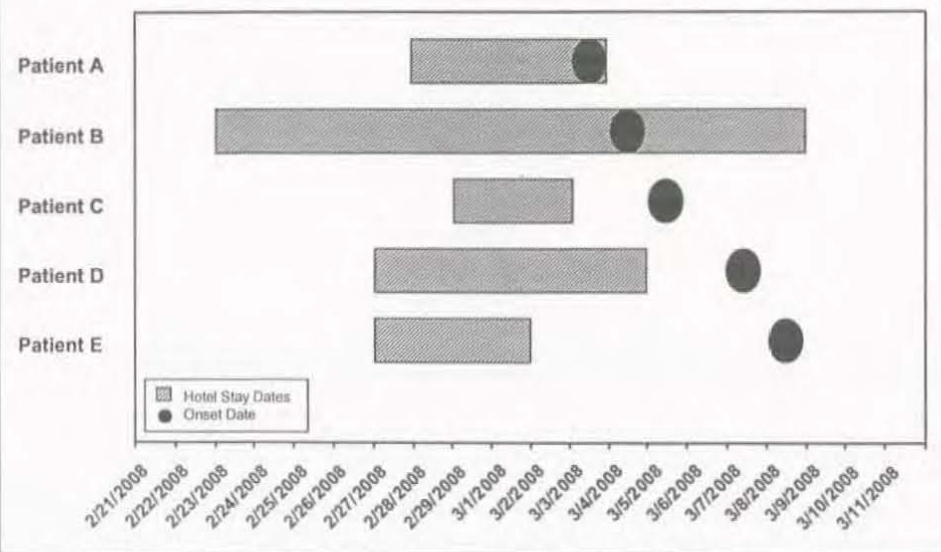
Hotel A is a seven-floor facility with 154 rooms, each with an individual air conditioning unit. There are no cooling towers associated with the air conditioning functions of this facility including the air conditioner units for the common areas. The hotel has a 27,800 gallon outdoor pool with a diatomaceous earth (DE) filter and a 1,850 gallon outdoor hot tub with two cartridge filters heated by natural gas, both of which use automatic chlorine feeders. No other water features or fountains are located on the property. The hotel's management stated that there had been no major construction, plumbing additions or breaks, or other such activities that might compromise water systems, climate control systems, or swimming pools.

The environmental inspection of the pool and hot tub conducted on March 13 revealed initial residual chlorine levels of 0.0 ppm in the pool and 0.5 ppm in the hot tub, which is well below the proper level of 1.0-10.0 ppm for pools and 2.0-10.0 ppm for hot tubs. The OCHD swimming pool inspector closed both the pool and hot tub based on these findings per standard DOH protocols.

The water temperature in the hot tub was 101° F, which is within the optimal temperature range (77-108 ° F) for the growth of *Legionella* bacteria (American Society of Heating, Refrigeration and Air-Conditioning Engineers, 2000). The flow rate in the pool was 120 gpm (designed flow rate=150 gpm) and the flow rate in the hot tub was 70 gpm (designed flow rate=55 gpm). Additionally, the hot tub's cartridge filters did not appear to be adequately maintained. Management stated that filters were cleaned and reused with clean recycled filters replacing dirty filters each morning. The two filters in use during the inspection were visibly dirty and estimated to be at least six months old (see Photograph 1). Management stated that the hot tub was emptied and scrubbed two or three weeks prior to this inspection, but there was no scheduled routine super chlorination. No maintenance logs were available onsite nor were they provided

**FIGURE 1**

Figure 1: Frequency of Illness Onsets by Date and Dates of Hotel Stay, Legionnaires' Disease Cluster, Orange County, March 2008



Onsets ranged from March 4 to March 8. See Figure 1 for dates of onset.

**Epidemiological Results**

All four people meeting the confirmed case definition and the single person meeting the probable case definition were interviewed for the case-control study. Twenty control subjects matched on age were interviewed. The ages of the case subjects ranged from 43 to 60 years (mean=53.4, median=55) and the ages of the control subjects ranged from 40 to 62 years (mean=54.0,

median=56).

Of the five affected people, none had any common travel history or lodging before staying at Hotel A. There were no similar or common community exposures among cases other than the hotel. They stayed on the first (2), sixth (1), and seventh floors (2). Bivariate analysis was used to assess hotel exposures among case and control subjects. Results are presented in Table 3. Spending time in the outdoor hot tub was the only exposure that was statistically significant with an odds

**TABLE 3**

Exposure Specific Frequencies for Cases (n=5) and Controls (n=20), MLE Odds Ratios (OR), Fisher Exact 95% Confidence Intervals (95% CI), and Fisher Exact p-Values, Legionnaires' Disease Cluster, Orange County, March 2008

Exposure	Number of Case Subjects (N=5)	Number of Control Subjects (N=20)	OR	95% CI	P-value
Ate at hotel buffet*	5	18	0.91	0.03-78.35	0.7339
Showered in room*	5	19	0.46	0.00-49.43	0.5957
Used sink in room*	5	20	0.00	0.00-10.46	0.2115
Used a different sink at hotel	0	6	0.00	0.00-3.50	0.2189
Spent time in outdoor pool	1		4.36	0.05-391.89	0.3667
Spent time in outdoor hot tub	3	1	22.11	1.22-1569.46	0.0162
Spent time near outdoor hot tub*	2 <sup>†</sup>	5 <sup>‡</sup>	8.14	0.28-705.10	0.1630
Drank from hotel water fountain	1	2	2.16	0.03-52.37	0.5043
Used AC unit in room*	5	15 <sup>‡</sup>	2.08	0.12-156.80	0.5338
Used heating unit in room	2	3	3.53	0.21-49.68	0.2522

\*OR and 95% CI calculations were not possible with a zero cell; zeros were replaced with 0.5 for these calculations.

<sup>†</sup>Three cases did not answer this question so the total number of case subjects is two instead of five.

<sup>‡</sup>One control did not answer this question so the total number of control subjects is 19 instead of 20.

for the exposure period of February 27 to March 2, 2008. Management reported that the hot tub had not been super chlorinated since the exposure periods of the cases.



Photograph 1: Cartridge Filter, Hotel A, Legionnaires' Disease Cluster, Orange County, March 2008

The OCHD Swimming Pool Inspector and a DOH Regional Engineer staff member conducted an additional site visit on March 18 and discovered a cross connection between the pool

and the hot tub and a broken effluent pressure gauge. They also noted that the hotel was using 140 ft<sup>2</sup> cartridge filters for the hot tub, when the design was for 200 ft<sup>2</sup> cartridge filters. Both the pool and hot tub were reopened on March 25 once these health and safety discrepancies were corrected.

The air quality evaluation of four rooms on March 13 by the OCHD Air Quality Inspector found conditions conducive to the growth of mold. Further investigation by the OCHD disclosed similar conditions throughout all hotel rooms. One of the major contributing factors was the air conditioner unit design, which resulted in a permanent layer of water, mixed with dust and other sources of organic material, providing an environment conducive to microbial growth.

#### Laboratory Results

All environmental samples obtained from Hotel A were culture negative for *Legionella pneumophila*. The chlorine reading of the hot tub taken just prior to sampling, approximately 30 minutes after the pool and hot tub were closed on May 13, was 3.0 ppm with a pH of 7.2. The chlorine levels of the samples collected from the hotel hot water heater locations were 0.2 ppm and 0.5 ppm.

#### Discussion

Four laboratory-confirmed cases of Legionnaires' disease and one probable case were identified during the investigation of this outbreak that occurred during February and March of 2008. Risk factors for Legionnaires' disease include smoking; age (usually 65 years of age or older); chronic lung disease; and a weakened immune system due to cancer, diabetes, kidney failure, or other underlying health conditions (Centers for Disease Control and Prevention [CDC], 2008a). Three of the four people who met the confirmed case definition were smokers and had underlying health conditions, making them more susceptible to Legionnaires' disease. Smoking and other pre-existing health conditions were unknown for the fourth person who met the confirmed case definition. The person who met the probable case definition did not have any known risk factors for Legionnaires' disease.

Epidemiologic data indicate that the source of the outbreak was the outdoor hot tub at Hotel A. The only common exposure among the five affected people was staying at this hotel between February 23 and March 8, 2008. No common exposures outside Hotel A were identified. There was a statistically significant association

between spending time in the hotel's hot tub and acquiring Legionnaires' disease (odds ratio=22.11, 95% confidence interval=1.22-1569.46, p-value=0.0162). Previously documented outbreaks have been linked to aerosol sources, with one of the most likely sources being whirlpool spas (CDC, 2008a). Past outbreaks have further indicated that transmission can occur without a person actually entering the water of a whirlpool spa (Jernigan et al., 1996; Benkela et al., 2000).

Environmental inspection observations at the hotel support the biological plausibility of a causal association with illness. The chlorine levels observed in the hot tub at the time of inspection were not sufficient for disinfection, which could allow *Legionella* bacteria to thrive in the warm water. The existing design of the filters and water flow of the hot tub created a condition where a large volume of water was passing through an insufficiently sized filter. Hot tubs produce aerosolized water droplets, less than 5 µm, which can be inhaled when the therapeutic jets are operating. The stagnant water observed in multiple individual rooms due to air conditioner design may have been conducive to microbial growth; however the epidemiological investigation does not support this as the source of illness and there is little evidence of Legionnaires' disease outbreaks associated with individual air conditioners (CDC, 2008a). The lack of positive laboratory results for *Legionella* from the environmental samples could be due to laboratory or sampling error. Negative results could also mean that the organism was not present in detectable quantities for methods used, or the organism was not present at time of sampling (Barbaree, 1987).

Legionnaires' disease is a common cause of community-acquired pneumonia, with an estimated 8,000 to 18,000 cases in the United States each year. This disease is caused by *Legionella* bacteria, which can be found naturally in the environment, particularly in the type of warm water found in hot tubs, cooling towers, hot water tanks, large plumbing systems, or parts of big air conditioner systems of large buildings. The bacteria do not seem to grow in car or window air conditioners. People who are susceptible become infected with Legionnaires' disease when they breathe

in a mist that contains the bacteria. For instance, water contaminated with *Legionella* bacteria in a hot tub that is not properly cleaned, disinfected, and maintained could be aerosolized in the form of mist. These bacteria are not spread person-to-person (CDC, 2008a).

Symptoms of Legionnaires' disease, including high fever, chills, and a cough, usually develop two to 14 days after exposure to the bacteria. Some people may also experience muscle aches and headaches. Symptoms are similar to many other forms of pneumonia, so diagnosis can be difficult. Most healthy people who contract Legionnaires' disease recover from the infection, and most cases can be treated successfully with antibiotics prescribed by healthcare providers. Pontiac Fever is a less severe clinical manifestation of *Legionella* infection and results in a self-limiting, flu-like illness that usually resolves within two to five days (CDC, 2008a).

As with many studies, difficulty with recall several weeks after exposure was a limitation in the case-control study. Details regarding exposures, such as length of time in the hot tub and hot tub conditions, were not consistently available, so dose-response relationships could not be assessed. Sampling activities were conducted at the time of the initial case reports, but ten days had already passed since exposure. Negative culture results at that time do not rule out the possibility that *Legionella* bacteria were present at the time of exposure.

## Recommendations

Low water volumes combined with high temperatures and heavy bather loads make public spa operation challenging (CDC, 2008b). The result can be low disinfectant levels that allow the growth and spread of a variety of bacteria, including *Legionella*, that can cause skin and respiratory illnesses (CDC, 2008b). This outbreak highlights the risk for transmission of *Legionella* bacteria from an inadequately maintained hot tub. It is critical that all pools, hot tubs, spas, and whirlpools be properly maintained on a regular basis in a prescribed manner to prevent the transmission of disease. Chlorine or bromine and pH levels should be maintained at recommended

levels according to the CDC or the manufacturer's guidelines. Disinfectant and pH levels should be tested frequently to ensure the presence of prescribed disinfection and water quality levels. Complete and accurate records of disinfectant/pH measurements and maintenance operations should be maintained. Filtration and recirculation systems should be designed and maintained according to manufacturer recommendations. Spa surfaces should be scrubbed and hyper chlorinated regularly to remove any biofilms and water should be drained and replaced on a regular basis (CDC, 2008b). Personnel should be appropriately qualified and competent to operate, maintain, and monitor public swimming pools and spas.

Rapid recognition of cases of *Legionella* by the medical community and subsequent prompt reporting to public health authorities are critical in order to quickly identify *Legionella* clusters and potential environmental sources of the causative organism. Once notified of potential cases both epidemiology and environmental health personnel must rapidly respond to determine the existence of a disease outbreak, the extent of the illnesses and collect appropriate environmental samples.

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