



# **Legionellosis Outbreak Luxor Hotel, 2010-2011 Las Vegas, Nevada**

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## **Public Health Investigation Final Report**

Southern Nevada Health District  
Office of Epidemiology  
Las Vegas, Nevada

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## **BACKGROUND:**

On January 06, 2012, the Centers for Disease Control and Prevention (CDC) Respiratory Diseases Branch, as part of the national surveillance system to detect cases of Legionnaires' disease among travelers, informed the Southern Nevada Health District (SNHD) Office of Epidemiology (OOE) of a case report of laboratory-confirmed Legionnaires' disease in a person who had stayed at the Luxor Hotel in Clark County during their incubation period. The case had illness onset in December 2011. At the time of the report, the case was deceased.

On January 06, 2012 the SNHD OOE notified Environmental Health (EH) about the new case report. There was no room number provided on the original notification and no case name or age. OOE requested that CDC consult with the reporting state and request a room number. The room number was provided by CDC to the OOE on January 10, 2012.

The Luxor was previously associated with Legionnaires' disease cases in the spring of 2011. The first case had illness onset in March of 2011 and had stayed at the hotel from March 16 through 21. This case was reported to SNHD by CDC on May 6, 2011. A second case was reported on June 15, 2011. This case had illness onset in April 2011 and had stayed at both the Luxor and the Aria within the incubation period. The SNHD was investigating an outbreak of Legionnaire's disease associated with the Aria at the time. In June 2011, SNHD Environmental Health staff took bulk water samples, environmental swabs and conducted the CDC Environmental Assessment at the Luxor in response to these two cases being reported from the CDC. Results showed that *Legionella* was not detected in the water samples. The environmental swabs leaked in transport and could not be tested. The CDC Environmental Assessment conducted in 2011 did not indicate that the facility was at an increased risk of having a person who stayed at the facility contract legionellosis.

Based on the facility's previous history and the report from CDC on January 06, 2012 of a new case associated with the facility, an epidemiologic and environmental investigation was initiated on January 11, 2012.

## **METHODS:**

### **Environmental Investigation**

SNHD staff visited the hotel on January 11, 2012 and collected samples 23 samples from two rooms on the same hot water riser as the case's room, since the case's room was occupied on that date. An additional sample was taken on the return from the hot water loop. These samples included 18 (50ml) bulk water samples and 5 environmental swabs. For each fixture in the room a pre- and post- one minute flush sample was taken from both cold water and hot water supplies to the fixture. When the hot and cold water could not be isolated, then two samples consisting of a pre- and post- one minute flush were taken with the fixture valve placed in the position that provided the hottest water possible. All of the sampling was done using CDC recommended procedures, and samples were delivered to the Las Vegas NALCO office to be sent to NALCO Laboratories (Naperville, IL) for testing. After the sampling of each fixture, a water temperature and free chlorine residual was measured. Additional sampling on the same date was completed by a third party, Phigenics, Naperville, IL, a laboratory selected by the Luxor facility management. The samples collected by Phigenics mirrored the bulk water samples taken by SNHD and were taken immediately following any SNHD bulk water sample collection. Phigenics did not take any environmental swabs. The SNHD requested that facility

managers provide a copy of their current water management plan and any sampling results that occurred during the past six months. After the sampling was completed EH staff reviewed the CDC Environmental Assessment and documented any changes from the one completed in June 2011.

A second visit was made on January 12, 2012 to review the testing and water management plan and receive maintenance and disinfectant records for the indoor spa. During this visit, SNHD also conducted water chemistry screens of the water contained in the permitted public bathing places located within the spa.

On January 13, 2012, EH staff observed Phigenics staff sample the room where the case stayed. SNHD requested that no preventative or preemptive maintenance occur until EH returned on January 17, 2012 to conduct its own environmental sampling room of the fixtures in the case's room using the CDC recommended procedures. Fourteen samples were taken in this room that consisted of four environmental swabs and ten (50ml) bulk water samples. All fourteen samples were taken using CDC recommended procedures and delivered to the Las Vegas NALCO office to be sent to NALCO Laboratories (Naperville, IL) for testing. For each fixture in the room a pre- and post- one minute flush sample was taken from both cold water and hot water supplies to the fixture. When the hot and cold water could not be isolated, then two samples consisting of a pre and post one minute flush were taken with the fixture valve placed in the position that provided the hottest water possible. After the sampling of each fixture, a water temperature and free chlorine residual was measured. Additional sampling on the same date was completed by a third party, Phigenics, Naperville, IL, a laboratory selected by the Luxor facility management. The samples collected by Phigenics mirrored the bulk water samples taken by SNHD and were taken immediately following any SNHD bulk water sample collection. Phigenics did not take any environmental swabs.

The isolates obtained from the environmental sampling were sent to the CDC for monoclonal antibody testing and DNA sequencing.

### **Epidemiological Investigation**

Clinical laboratory results and case histories of the three known cases were reviewed. Through CDC, SNHD staff was able to contact the state epidemiologist in the state where the most recent case resided. The epidemiologist shared detailed case history, advised that a pre-mortem sputum specimen from the case had been obtained and that the state public health laboratory would culture for *Legionella* bacteria. Additionally, if cultures were positive, the isolate would be submitted to CDC for genetic comparison with any positive environmental isolates.

#### **Case-finding**

To enhance case-finding, on January 18, 2012 the SNHD posted on CDC's EPI-X a request to other state and local health departments to report to the SNHD cases of legionellosis with a travel history to Las Vegas in 2011.

A public notice (Attachment I) regarding the outbreak was published on the SNHD website on January 30, 2012.

The health district's help line (702) 759-INFO, is routinely forwarded to Rocky Mountain Poison and Drug Center (RMPDC). Because high call volume was anticipated, RMPDC was ready to take calls relating to this event on January 30, 2012. Any calls from physicians regarding potential legionellosis cases as well as calls from persons with respiratory symptoms and a history of staying at the Luxor were forwarded to the SNHD OOE. The call center was deactivated on March 15, 2012.

The following case definition was used during this outbreak:

*Confirmed Case:*

A person who stayed overnight at the Luxor and became ill between two days after arriving and fourteen days after leaving, had positive laboratory testing for *Legionella pneumophila* serogroup 1, including isolation (by culture) of any *Legionella* organism (from respiratory secretions, lung tissue, pleural fluid, or other normally sterile fluid), by detection of *L. pneumophila* serogroup 1 antigen in urine using validated reagents, or by seroconversion (fourfold or greater rise in specific serum antibody), and met one of the following clinical criteria:

- Received care (as an inpatient or outpatient) for one or more symptoms consistent with pneumonia (fever equal or greater than 101° F, chills, cough, fatigue or weakness) OR
- Received antimicrobial treatment that is effective against *Legionella* and another pneumonia causing organism was not isolated such as *S. pneumoniae* OR
- Had radiographically-confirmed pneumonia.

*If any criteria for the definition are unknown (e.g., receipt of antibiotics) and the case otherwise meets the definition, assume that the missing criteria exists for investigation purposes.*

## **RESULTS:**

### **Environmental Survey Results:**

The screening of the spa found that the pH levels of the water were above the regulatory standard and the bromine and total alkalinity were within regulatory standards. A Luxor representative submitted their water management program on January 19, 2012. After review and additional discussion, Luxor submitted a revised plan on January 23, 2012.

### **Laboratory Results:**

The results from the sampling conducted on January 11, 2012 of two rooms served by the same hot water system as the room where the case stayed, and results from the sampling conducted by the SNHD on January 17 of the room where the case stayed detected *Legionella pneumophila* in each of the three rooms. Additionally, the results provided by the Luxor from their 2011 third and fourth quarter testing indicated *Legionella pneumophila* was present in both high rise hot water systems that served the entire floor where the case stayed. The third quarter results indicated *Legionella pneumophila* was present in the hot water system that served the opposite side of the building where the case stayed and the fourth quarter results indicated that *Legionella pneumophila* was present in the hot water system serving the room where the case stayed. Even though these two systems serving floors 17 to 30 are not directly connected, the SNHD results and the Luxor results indicated that the potential risk of contracting legionellosis was the same for both of these systems.

The SNHD notified the Luxor hotel management that the emergency disinfection procedures, found in section VI of the Luxor Water Management Program dated January 23, 2012, were to be implemented beginning January 27, 2012 and completed as rapidly as possible. Additional water sampling for *Legionella* was required (attached letter from Glenn Savage to Anthony Williams dated January 26, 2012). The Luxor management, working closely with the SNHD, determined that they would exceed the SNHD recommendations by initiating emergency remediation procedures as described in their water management plan for all of the hot water systems serving guest rooms rather than conduct environmental sampling of these systems. After remediation of each hot water system and prior to the rooms being occupied by guests, samples were taken from 1% of the rooms along with the most distal room on each riser by Luxor's staff and their consultant, Phigenics. The samples were tested by Phigenics and were analyzed for *Legionella pneumophila*. The remediation of the various hot water systems commenced on January 27, 2012 and continued until February 11, 2012. The environmental sampling conducted after the remediation activities by the hotel staff and their consultant found that no viable *Legionella* organisms were present in the water tested.

The CDC laboratory received and tested fixed lung tissue and a clinical isolate from the December 2011 case. Both were positive for *Legionella pneumophila* serogroup 1. Monoclonal antibody testing results from the clinical and environmental specimens were compared. All of the isolates had the same monoclonal pattern, and sequence based typing revealed the clinical isolate from the December 2011 case matched three of five environmental isolates, including one from the Jacuzzi tub located in the case's room. The case had used the tub while staying at the Hotel A prior to becoming ill.

### **Case Finding Results:**

No additional cases were identified as a result of the posting to EPI-X.

A total of 97 calls were received by the HelpLine. Four ill callers were referred to the Office of Epidemiology for further follow up. Three callers did not have sufficient laboratory testing to be classified as cases. One person had been an employee at the Luxor for 17 years and was actively employed at the time he became ill and was diagnosed with Legionnaires' disease in December 2010. This person's illness was not reported to the SNHD when he became ill in 2010. Hospital records were reviewed and revealed that the individual had pneumonia in December of 2010 and had a positive urine antigen test for *Legionella pneumophila* serogroup 1. Staff interviewing the person could not establish a specific exposure to contaminated water at the Luxor within the 2 weeks prior to onset of illness. However, since there were multiple possible exposures and three subsequent cases, the employee's illness was considered to likely be associated with the Luxor. The epidemic curve is shown in Figure 1 below:

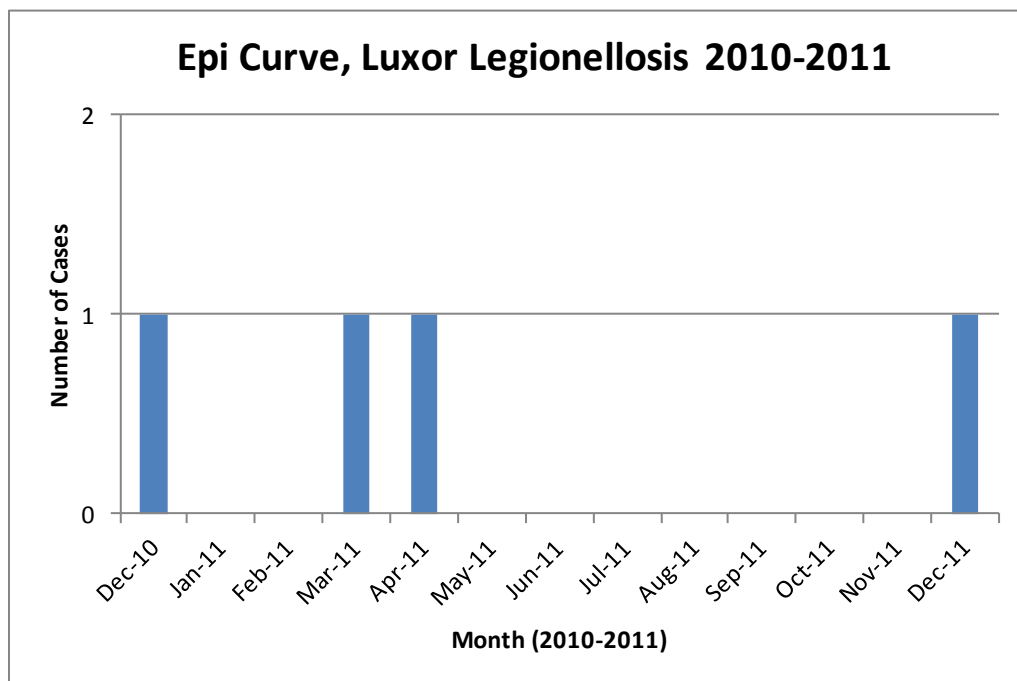


Figure 1. Epidemic Curve for Luxor Legionellosis Outbreak

**DISCUSSION:**

The initial plan submitted by Luxor was not adequate for the emergency control of the *Legionella* in their water system. First, the original plan reacted to positive test results by focusing on remediation of the single room where the positive test occurred, rather than further identifying if there is *Legionella* present in other similar areas of the water system. The proposed remediation required that the fixture where the positive test result was found be replaced and the system flushed only at that point. Additionally, while the occasional super chlorination of the system in the plan was done at the recommended level per the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) guidelines<sup>2</sup>, it was only held for one hour and all the fixtures on the riser were not flushed. The guidelines require a two hour minimum not to exceed 24 hours, to be followed by a through flushing of the system.

Subsequent discussions with Luxor representatives resulted in the submission of a more aggressive plan for the control of *Legionella*, which was executed prior to receiving the final laboratory results. Additionally, the Luxor decided to conduct secondary disinfection by adding chlorine to the domestic water and has submitted plans and received a permit to operate a Public Water System.

**CONCLUSIONS:**

Enhanced national travel-associated legionellosis surveillance conducted by CDC, in combination with improved availability of clinical testing, has resulted in more frequent detection of facility-related legionellosis outbreaks nationwide. The availability of clinical isolates is critical to the investigation, allowing for specialized testing to match clinical and environmental isolates. In this outbreak, the matching of the monoclonal antibody patterns and the DNA sequences of the *Legionella pneumophila* isolates from the environmental sampling with the isolates from a case provided very strong evidence that the case was exposed to *Legionella pneumophila* during the stay at the Luxor.

There have been several facility-related outbreaks detected on the Las Vegas Strip since 2001. In most instances, there was a single LD case reported weeks or months before a second or third case was reported. Waiting until there are multiple associated cases results in missed opportunities for preventing LD or Pontiac fever cases in visitors to Las Vegas. In retrospect, had there been immediate and appropriate remediation and monitoring of the facility water systems after a single case, it is likely that subsequent cases could have been prevented. To this end, SNHD has identified a need for a standard operating procedure (SOP) to respond more aggressively to LD reports. This SOP is currently under development and will be shared with local resort hotels upon completion.

Effectively designed hotel water management plans can serve to control *Legionella* growth and prevent hotel-associated legionellosis cases. Two critical components of water management plans are the effective control of *Legionella* in the water systems through the use of monitoring of various engineering practices and development of a proper response when these engineering practices have been identified as operating outside of the critical limits set by the water management plan. Sampling, when used, is only one part of this multi-disciplinary approach to monitor and control *Legionella*. When *Legionella* contamination is detected through sampling, the facility should consider not only what additional sampling needs to occur to determine the extent of contamination, but also examine the engineering practices that may cause *Legionella* to grow and take action to change the practices so that *Legionella* is controlled within the system. In the end, the results of any additional sampling can serve as an important guide to target the level and extent of disinfection that needs to take place to remove the contamination from the system.

## **REFERENCES**

1. World Health Organization (2010). *Water Safety in Buildings*.
2. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), Inc. (2000). *Minimizing the Risk of Legionellosis Associated with Building Water Systems*. ASHRAE Guideline 12-2000. ISSN 1041-2336





January 30, 2012

### Public Health Notice

The Southern Nevada Health District has received reports that three guests who stayed at the Luxor Resort were diagnosed with Legionnaires' disease. The health district was informed of these cases through the Centers for Disease Control and Prevention's (CDC) national surveillance system.

The first two cases were reported in the spring of 2011. At that time the health district conducted an environmental assessment and collected bulk water samples from the Luxor. Results of the water samples did not detect *Legionella* bacteria and the environmental assessment indicated guests were not at increased risk of contracting Legionnaire's disease at that time. Both patients have recovered from their illness.

The third case was reported to the health district in January 2012. At the time of the report, the patient was deceased. Based on this latest report the health district initiated a new epidemiological and environmental investigation. At this time environmental sampling was positive for *Legionella* bacteria. The Luxor has been working cooperatively with the health district and began an immediate remediation process in accordance with its ongoing water management system. To date, no additional cases of disease have been reported.

*Legionella* bacteria exist in fresh water and are commonly found throughout the environment. Legionnaires' disease is a form of pneumonia caused by the *Legionella* bacteria. Symptoms include high fever, chills, cough, and some people may also suffer from muscle aches and headaches. Because these symptoms occur in many other forms of pneumonia, appropriate testing must be conducted in order to make an accurate diagnosis. Symptoms usually begin within 2 to 14 days after being exposed to the bacteria. Guests who stayed at the Luxor recently and believe they are having symptoms are encouraged to consult their doctor.

"We want to reassure the public that all the appropriate steps have been taken to remediate the water system and we continue to work proactively and cooperatively with the staff and management of the Luxor. We appreciate MGM Resorts' ongoing commitment to ensuring guest health and safety, especially in establishing improved water management practices at their resorts," said Dr. Lawrence Sands, chief health officer for the Southern Nevada Health District.

Between 8,000 and 18,000 people are hospitalized with Legionnaire's each year in the United States. Many infections are not diagnosed or reported, so this number may be higher. The disease can be successfully treated with antibiotics; however, it can be very serious and cause death in up to 5 percent to 30 percent of cases. Approximately 20-25 percent of reported Legionnaires' cases are travel-associated and travel histories are routinely sought during case investigations.

Additional information on *Legionella* is available on the Southern Nevada Health District website, [www.SNHD.info](http://www.SNHD.info), or by calling the health district's information line, (702) 759-INFO (4636) or toll free (866) 767-5038.



January 26, 2012

Anthony Williams  
Vice President Property Operations  
3850 Las Vegas Blvd. South  
Las Vegas, NV 89109

**Re: Ongoing Legionellosis Investigation**

Dear Mr. Williams:

On January 11, 2012 Southern Nevada Health District (SNHD) staff met with you and other representatives of Luxor Hotel and Casino to discuss an investigation into a case of travel associated Legionellosis. On that date our investigation was initiated into a case that reportedly stayed at the Luxor Hotel and Casino during the case's incubation period in December, 2011. Because of the Luxor's recent history of having two confirmed cases of Legionellosis from guests who stayed at the Luxor in the spring of 2011, environmental samples were taken from the two rooms located on the same hot water system that served the room where the December 2011 case stayed. Twenty-three samples from two rooms were taken on January 11, 2012 by SNHD staff and were tested by our contract laboratory which is ELITE certified. Two of these samples indicated that *Legionella pneumophila* serogroup 1 was present. On January 13, 2012, samples were taken from the room where the case stayed. The preliminary results indicate that two samples from this room have *Legionella pneumophila* present. As soon as the results are final, they will be shared with you. Finally, the quarterly reports of the sampling completed by Phigenics, your contractor, during the third and fourth quarter of 2011 indicate that there were three positive results of sampling at the facility. All three of the results were from the two hot water systems that supply the floors 16 to 30 of the pyramid. The most recent results in December, 2011 indicated that both the hot water system supplying the room where the case stayed, in addition to room 30120, were contaminated with *Legionella pneumophila* serogroup 1.

Based on these results, SNHD finds the documented presence of *Legionella pneumophila* in the water system to be a Substantial Health Hazard as specified by section 2.13 of the SNHD Regulations Governing the Sanitation and Safety of Public Accommodation. As such, this finding must be immediately addressed to ensure that the disease causing organism is appropriately removed from the water supply. You are on notice that your emergency disinfection procedures, found in section VI of your Water Management Program, dated January

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23, 2012 will begin on January 26, 2012. The remediation must be completed before January 30, 2012. Direct oversight from SNHD will be required for all steps in this procedure. Additionally, a random selection of 1% of all remaining guest rooms which are not served by the pyramid high rise systems, must be tested. Also, the most distal room of each remaining individual hot water system must be tested. The distal room will not be considered included as part of the random selection of the 1% of the rooms. All fixtures in the selected and distal rooms must be sampled. This sampling must be completed before February 1, 2012.

All sampling results are to be shared with the SNHD as soon as they are received. Based on the results, additional remediation may be required for these systems. Please coordinate all remediation and sampling activities with Mark Bergtholdt, SNHD Environmental Health Supervisor, so that adequate SNHD staff can be scheduled to observe the various remediation and sampling activities. Mr. Bergtholdt can be reached by phone at (702) 759-0677 or by e-mail at [bergtholdt@snhdmail.org](mailto:bergtholdt@snhdmail.org). All costs in oversight of this will be charged to your facility. Failure to comply to this notice immediately could result in further administrative or legal action up to and including revocation of your SNHD Permit for a Public Accommodation.

I appreciate your cooperation in the matter.

Southern Nevada Health District



Glenn D. Savage, REHS  
Environmental Health Director