

Implementation of a *Legionella* Ordinance for Multifamily Housing, Garland, Texas

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ABSTRACT

Context: The incidence of legionellosis has sharply increased in the United States as a result of contaminated water systems. Jurisdictions across the country are considering whether to develop and implement regulations to protect individuals against Legionnaires' disease with its associated high morbidity and mortality.

Objective: This article sheds light on the implementation and effectiveness of a 2005 citywide *Legionella* testing mandate of multifamily housing cooling towers in Garland, Texas. This ordinance has been in place for more than 10 years and represents the first of its kind in the United States to mandate routine testing of cooling towers for *Legionella* in multifamily housing.

Design, Setting, and Population: We utilized a mix of both qualitative and quantitative methods to explore the development, adoption, and implementation of the ordinance. Phone interviews were conducted with individuals from the City of Garland Health Department and apartment managers. Quantitative data included public health surveillance data on legionellosis.

Main Outcome Measures: Barriers and facilitators of implementation, number and percentage of cooling towers from multifamily housing units that tested positive for *Legionella* by year, and number of legionellosis cases by year in Garland, Texas.

Results: Study outcomes highlight key themes that facilitated the successful implementation of the *Legionella* testing mandate, including the importance of timing, leadership support, stakeholder engagement, and education and outreach. The number of contaminated cooling towers was reduced over time.

Conclusion: Mandatory monitoring for legionella in a local jurisdiction may result in reduced risk of legionellosis from cooling towers through raising awareness and education of building owners and managers about the need to prevent, detect, and remediate *legionella* contamination in their building water systems. Garland, Texas, broke new ground in the United States in moving toward primary prevention of legionellosis. The ordinance may be useful both in serving to educate and increase awareness about the need for *Legionella* prevention and to monitor effectiveness of maintenance procedures.

KEY WORDS: cooling towers, *Legionella*, Legionnaires' disease, local ordinance, policy, prevention

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Legionellosis, including Legionnaires' disease and Pontiac fever, is a rapidly escalating public health problem that deserves more attention.^{1,2} In the United States, reported legionellosis cases rose from 1127 in 2000 to more than 5000 cases in 2015, with most cases reported being hospitalized individuals with a diagnosis of Legionnaires' disease, the more serious form of legionellosis.^{3,4} The fatality rate is estimated to be 5% to 15%.⁵ Most cases of Legionnaires' disease are not diagnosed; the Occupational Safety and Health Administration

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estimates that there are 10 000 to 50 000 cases of Legionnaires' disease annually.⁶

The source of the infection is most frequently contamination of engineered water systems with *Legionella* (eg, potable water distribution systems, spas, cooling towers). Yet, there is no single set of widely accepted guidelines for the primary prevention of legionellosis in the United States. The Centers for Disease Control and Prevention (CDC) has created several guidelines related to *Legionella* infection control in the health care environment and recommends periodic sampling of water for *Legionella* in protective environments and transplant units to ensure there is no *Legionella* in the water supply.^{7–11} State policies regarding *Legionella* are varied; a few states and local jurisdictions (eg, Maryland, Texas, New York, and Allegheny County, Pennsylvania) have independently addressed *Legionella* prevention in health care settings.¹²

Even fewer guidelines exist for environmental testing for *Legionella* in the non-health care setting. South Dakota Department of Health developed guidelines for ornamental water features in community settings such as hotels, restaurants, offices, and conference centers.¹³ It recommends quarterly testing to ensure *Legionella* levels are below 1 cfu [sic cfu/mL] and annual testing once levels are consistently maintained below this threshold for 1 year. Utah's Bureau of Epidemiology in the Department of Health released *Legionella* guidelines intended for businesses, especially hotels, which provide recommendations on water temperatures and chlorine levels but do not address routine environmental testing for *Legionella*.¹⁴ The state of California has several regulations directed toward recycled water used by industrial or commercial cooling towers to limit *Legionella* transmission and growth, including testing cooling towers of power plants every 6 months.^{15,16} New York City and New York are implementing legislation for maintenance and testing of cooling towers following a large outbreak in the Bronx in 2015; New York State is also addressing potable water systems in health care settings.^{17,18}

Professional organizations also have provided guidance for primary prevention of *Legionella*. The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has recently released a standard for industry related to *Legionella* prevention.¹⁹ This standard recommends a water management program that includes many components to assure safe and effective maintenance of large building water systems; each building owner and water safety team should decide whether to conduct environmental testing. The American Industrial Hygiene Association (AIHA) has also released guidelines in 2015 that recommend routine

quantitative testing of water in cooling towers and potable water systems.²⁰ The CDC attributes 22% of outbreak-related cases of Legionnaires' disease to contaminated cooling towers.²¹

In 2005, Garland, Texas, became the first city in the United States to mandate routine testing of cooling towers for *Legionella*.²² The City of Garland Health Department (GHD), which serves a population of more than 230 000 residents in the larger Dallas Fort Worth area of Texas, is the agency responsible for overseeing the implementation of the multifamily housing *Legionella* testing ordinance. The ordinance states:

Sec. 32.04(D)(6) of Chapter 32, "Neighborhood Sanitation and Housing Services" of the Code of Ordinances of the City of Garland, Texas, is hereby amended to read as follows: "(6) Each owner of a multifamily dwelling or lodging establishment which utilizes a cooling tower as a functional portion of an HVAC system shall, at the owner's expense, perform annual testing of the cooling tower for the presence of *Legionella pneumophila*. The testing shall be performed by a third-party entity using analytical and collection procedures approved by the City. In the event that the property owner cannot provide a proper sampling technique, the property owner, on a form provided for such use by the City, may request that the sample be obtained and tested by the City Health Department and reimburse same for incurred expenses. The owner shall provide the laboratory test report to the City within 10 days of receipt for negative results and within 48 hours of receipt for positive test results."²²

The multifamily permitting application packet specifically requests information from property owners/managers about utilization of cooling towers on the property and references the ordinance.²³

This report describes the policy development, implementation, and adoption of the City of Garland multifamily housing *Legionella* ordinance as well as defines the potential impact of the ordinance on the incidence of *Legionella* in multifamily housing cooling towers in Garland, Texas.

Methods

We used a mix of both qualitative and quantitative methods.²⁴ This approach was selected to capture the implementation experience of the City of Garland *Legionella* ordinance from multiple perspectives. Qualitative methods were selected to explore the "how" and "why" of the implementation experiences, most directly from interviews with key stakeholders. Quantitative methods were selected to provide a broader sample and perspective of the

implementation experience and included public health surveillance data.

Semistructured interviews were conducted with 4 key informants from Garland, Texas; 2 were city government officials responsible for the cooling tower ordinance development and/or implementation and 2 were property managers who are required to comply with the ordinance. A list of apartment managers was provided by the City of Garland. Two of 8 apartment managers agreed to be interviewed; the remaining 6 were unable to be reached despite repeated attempts. Recruitment occurred via e-mail and by phone, and the interviews were conducted by telephone. Interviews lasted an average of 60 minutes and were recorded with permission of the informants. This study received approval from the Emory University institutional review board.

Informants working for the City of Garland were asked to describe the development, implementation, and adoption of the ordinance. Specific areas of inquiry included history of *Legionella* surveillance and monitoring; ordinance policy development and decision making; stakeholder involvement; and facilitators and barriers to implementation and adoption of the ordinance. Property managers were asked to describe their role, the size and type of property managed, and their knowledge and assessment of the ordinance, including issues related to compliance.

Quantitative data were obtained on the number of multifamily housing cooling towers that tested positive for *Legionella* since implementation of the ordinance. Public health surveillance data on legionellosis were also obtained from GHD. Data were void of personal identifiers.

Analysis

Qualitative data analysis began with the transcription of the digital audio files. Each transcript was cleaned and reviewed by the interviewers (E.A.W., S.B., and R.L.B.). Summary notes prepared from each interview were also used to facilitate analysis. Content from the interviews was analyzed according to the interview questions and organized into key themes determined by the responses. Interviewers met to discuss the key themes and to find consensus on final analysis. Quantitative data analyses including linear trend in percent positive cooling towers over time were calculated using SAS version 9.4 (SAS Institute, Cary, North Carolina).

Results

History of Legionella surveillance and monitoring

In 2004, *Legionella* surveillance and monitoring policy changed in Garland when the responsibility

for enforcing the minimum housing standards was transferred from the law enforcement department to GHD. Officials from GHD created the Multifamily Inspection Program to manage the inspection of all multifamily housing units and enforcement of the ordinances and codes as set forth by the mayor and the city council.²⁵

Policy development

A policy window opened in early 2005 with the transition of the minimum housing standards enforcement to the health department. The entire chapter of the ordinance was under review, and revisions were being made to multiple sections. During a legionellosis case investigation, Richard Briley, the Managing Director of Health and Code Compliance and a city health specialist, discovered that an individual with Legionnaires' disease was living next to an apartment's cooling tower. Although a direct link between the patient's infection and the cooling tower could not be made, the potential association seeded the idea that there existed an opportunity for prevention; cooling towers could be proactively tested for *Legionella*. A memo outlining the minimum standards for the multifamily housing was drafted and reviewed by the city's attorney. At the time, Bob Day, the Mayor of Garland as well as an optometrist by training, expressed interest and awareness of Legionnaires' disease and as such was able to garner support for the ordinance with the city council. The ordinance was passed unanimously on April 19, 2005. Later that year, the mayor listed the ordinance as one of his top 5 achievements for the year.

The short-term goals of the ordinance were to determine the number of multifamily housing cooling towers that were contaminated with *Legionella*, to reduce the number of contaminated cooling towers over time through a program of monitoring and proper maintenance, and to raise awareness among building owners/managers of the problem. The overall goal was to reduce the risk of legionellosis.

Implementation

To ensure quick implementation of the ordinance, GHD officials sent letters to the managers of all multifamily housing units, informing them of the cooling tower testing and reporting requirements. Managers were also informed of the ordinance at the annual multifamily managers meeting in May 2005. They were given until September 1, 2005, to comply. An environmental health specialist and a maintenance person went to each multifamily housing unit to perform the initial inspection and collection. If a manager of the multifamily housing unit wanted a third-party testing laboratory to perform the sampling and

testing, the ordinance allowed for it; the company must have been approved by GHD. The department closely monitored the third-party testing laboratories that performed the collection and testing; the department wanted to ensure that the companies that cleaned the cooling towers were not also the ones testing the units in order to ensure legitimacy of the test results. Units that tested positive were remediated and retested until they tested negative for *Legionella*.

Adoption

Annually, letters are sent out to multifamily housing unit managers reminding them to test their cooling towers by July 1 and to report within 10 days of receipt for negative results and within 48 hours of receipt for positive results. If the multifamily housing manager elects to have the health department perform the collection and testing, the cost is \$250.²³ Managers may also use a preapproved third-party testing laboratory to perform the collection and testing. Educational efforts to encourage managers to maintain their systems and eliminate the presence of harmful bacteria in cooling towers are ongoing to compensate for management turnover.

Progress toward goals/results

Initially, in 2005, 7 of 18 (39%) multifamily housing unit cooling towers tested positive for *Legionella* (Figure 1). Three of these units had repeat positive tests. Over time, the number of multifamily

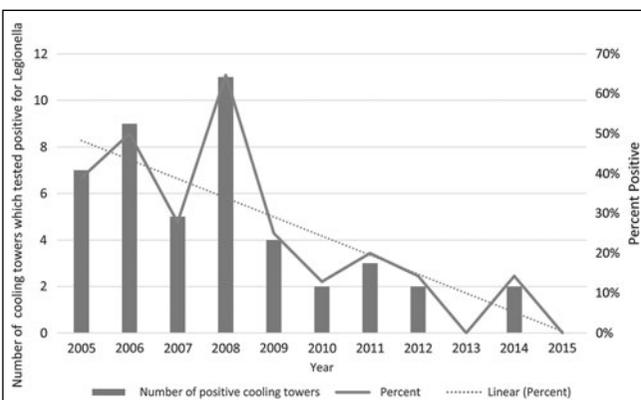


FIGURE 1 Number and Percentage of Cooling Towers From Multifamily Housing Units That Tested Positive for *Legionella* Over Time in Garland, Texas^a

Abbreviation: HVAC, heating, ventilating, and air-conditioning.

^aBetween 2005 and 2007, there were 18 cooling towers. The number of cooling towers decreased over time as multifamily housing units replaced aging HVAC systems; 17 cooling towers in 2008, 16 cooling towers in 2009, 15 cooling towers in 2011, and 14 cooling towers in 2012–2015. Since the number of cooling towers in 2010 is unknown, a value of 15.5 was assigned.

housing units with cooling towers has decreased as aging HVAC (heating, ventilating, and air-conditioning) systems were replaced. Managers of the multifamily housing units were initially surprised at the number of contaminated cooling towers. This raised awareness of the need for routine maintenance for HVAC systems, especially older systems. Since the implementation of the ordinance in 2005, the number of multifamily housing unit cooling towers that test positive for *Legionella* has decreased by approximately 4.8% per year ($P = 0.0038$) (Figure 1), and in 2014 and 2015, 2 of 14 and 0 of 14 cooling towers, respectively, tested positive.

The number of cases of reported legionellosis has remained stable over time in Garland, Texas (mean = 1.4; median = 2; range = 0–3 cases per year). Between 2007 and 2015, there were 13 legionellosis cases reported to GHD (Figure 2). One case in 2010 was linked to exposure to an industrial cooling tower. In a separate case in 2011, an individual with legionellosis had potential exposure to a multifamily housing unit cooling tower, although an investigation did not definitively link the case to the housing unit cooling tower. Of note, the cooling tower serving the multifamily housing unit where the case lived tested positive for *Legionella*.

Lessons Learned and Facilitators to Successful Implementation

Informants identified a number of key facilitators to the successful adoption and implementation of GHD *Legionella* ordinance. Key facilitators included timing, leadership support, stakeholder engagement, and education and outreach. No barriers were identified. One GHD informant stated:

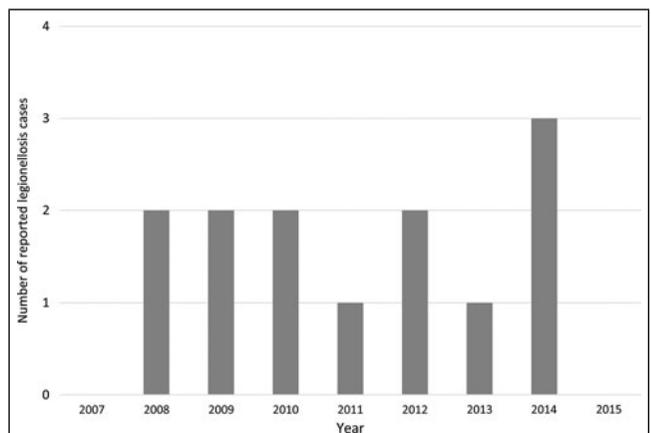


FIGURE 2 Number of Reported Legionellosis Cases Over Time in Garland, Texas^a

^aNo cases of legionellosis were reported in 2007 or in 2015. Data are not available prior to 2007.

This kind of limited public health goal is achievable, and it's doable, and it does take coordination and support and relationships, just from an understanding of how it got passed and understanding the science—buy in from a regulated industry, from a regulated community. And public health goals are achievable, and it's not a huge financial burden on people. You can achieve meaningful reduction of risk to vulnerable populations at not a great expense. If the conditions are right, if you have good support—or the backing of people— and if you explain it well and you do it right from the get-go.

Timing is critical

Capitalizing on the transition of the minimum housing standards enforcement to the health department, the ordinance was conceptualized, developed, and implemented within a short amount of time to take advantage of revising the entire chapter on multifamily housing code. A GHD informant noted:

We were opening the whole book, the whole chapter in our ordinance, to revision, so the timing was right.

Leadership buy-in is key

An important factor to the successful development of the ordinance was the support of leadership. The recognition of the problem and preventive action that was needed by public health, along with the mayor's support and that of the city council, were key to passing the ordinance. Since the mayor was a health care provider and understood exposure, disease, and prevention, he helped the city council understand the science of prevention. Another GHD informant shared:

It's a health department trying to be proactive...it's an elective body that understands.

You have to have the health department or somebody in the public health department that wants to do it, and, two, you have to have an elected body that will listen.

Relationships with community members are important

The relationship between GHD and the multifamily housing owners and managers was also a critical aspect for adoption of the ordinance. The multifamily housing managers attend annual meetings with the city government officials (eg, police, fire, health) and are accustomed to inspection visits. Once they realized the cooling towers were contaminated, they had no problem. A GHD official shared:

And my experience has been that if you can get a buy-in from your stakeholders, they will understand why this is important. Then there is no resistance later on. And that's proven true. We get very little resistance. Even had to spend a little bit of money and they didn't mind at all really because they understood the importance of it.

Education and outreach

Education and outreach to stakeholders are important aspects of ordinance adoption. Managers of multifamily housing units may have been skeptical at first, but after seeing the initial test results and extent of contamination, they had no problem with remediation and additional testing. It also enabled managers to hold the companies that service the cooling towers accountable. Repeated educational and outreach efforts are needed when management changes occur.

Once they found a positive [cooling tower], no one's going to ever fuss about killing a pathogen, you know.

It was a very good learning tool for the companies that had to clean them because they were being held accountable for a standard that they had not been held accountable to before.

Interviews with 2 property managers were revealing for their ready acceptance of the ordinance. Both relied on the City of Garland for testing their water annually for a reported fee of \$150 to \$250. Both considered the ordinance reasonable. One of the property managers operated a private multifamily housing unit and the other operated "affordable" housing that was also overseen by the federal housing agency. Both had more than 150 housing units. Neither of these property managers had cooling towers that tested positive. One property owner stated that he would not test the cooling towers if it were not for the ordinance and upon learning that industrial cooling towers were not tested stated, "All cooling towers should be covered by the ordinance."

The second property manager interviewed also expressed support for the ordinance.

The people living here ... have to depend on us and our responsibility, and the city's responsibility to this property is to make a good choice. This is good leadership from the City of Garland. We hold a meeting every year with managers of multi family dwellings and the maintenance and property managers attend. We have to let the special and educated people be our leaders, to oversee the things that ordinary residents like myself don't know any better.

Because of the *Legionella* testing, we are more alert and we are keeping our eye on it a little bit harder than if there were no ordinance. Regardless of testing or not, we should always do a good job, the best we can, but because the ordinance is out there for us to comply with, I think we are a little more alert.

Discussion

The City of Garland, Texas, has been (until 2015) the only jurisdiction in the United States to mandate routine testing of cooling towers serving multifamily housing units. The ordinance was implemented because of a coalescence of factors, including interest and expertise in legionellosis of the local health officer, support by the mayor who supported health protection, and the merger of responsibilities for code compliance for housing with the health department. Also, because there was an annual meeting of managers of multifamily dwellings with the health department and code compliance, trust had been established and implementation was relatively simple.

Several other interesting points were raised by the property managers who were interviewed. First, there was concern that all cooling towers were not covered by the ordinance; the health department does not have code compliance authority for industrial cooling towers. Second, the cost was not considered burdensome by the managers who were interviewed and they saw it as a way to ensure quality control of their contractors who serviced the cooling towers. Although the property managers who were interviewed are not representative of all property managers in Garland, they provided a useful perspective. As is the case with many endeavors, the property managers recognized that they may be more likely to perform their duties with diligence if the results are being monitored.

The finding that the number of cooling towers testing positive decreased over time is notable. It may indicate that more attention to maintenance occurred after the ordinance was implemented and testing initiated and/or may reflect replacement of old systems.

The small number of cooling towers and the low number of cases of legionellosis in Garland are a limitation in terms of generalization of their experience. In addition, some barriers to implementation may not have been identified since only 2 property managers were interviewed. Also, the ordinance had a narrow focus pertaining only to cooling towers associated with multiresidential buildings.

Since the outbreak in the Bronx in 2015, New York City and New York State have passed legislation

that requires registration, inspection, and *Legionella* testing of cooling towers.^{17,18} A number of European countries require registration of cooling towers with local authorities (eg, Andorra, Belgium, France, Malta, the Netherlands, Norway, Singapore, Spain, the United Kingdom, and the Russian Federation).²⁶ In 2011, Germany also began requiring registration and regular testing of water systems that supply water to the public, including apartment buildings, and instituted minimum thresholds for levels of *Legionella*.^{27–29} The European Working Group for *Legionella* infections has stated that “there is enough evidence to suggest that developing water safety plans for wet cooling systems, including system assessment, monitoring and management, is the preferred approach for managing the health risk associated with exposure to *Legionella* spp”²⁶; “monitoring” refers to microbiological monitoring for *Legionella*. More US jurisdictions may want to consider regulating and monitoring of cooling towers.

The ASHRAE standard is likely to raise awareness and education among public health and environmental health professionals regarding the need to maintain cooling towers and other complex water systems. The standard requires a water management program for buildings with complex water systems and establishes minimum risk management requirements for these systems. The standard is more comprehensive and complex than the GHD ordinance; the standard does not require monitoring for *Legionella* counts to assess effectiveness. The AIHA released new guidelines on the “Recognition, Evaluation and Control of *Legionella* in Building Water Systems”; AIHA guidelines recommend environmental sampling of cooling towers and the potable water system to “assist facility personnel in evaluating the efficacy of maintenance and water treatment procedures.”²⁰ Testing of cooling towers is recommended more frequently than annually (eg, monthly) by the AIHA since levels of contamination may fluctuate.

Garland only requests testing on an annual basis, and the monitoring is not especially onerous for the health department or the facilities being monitored. The ordinance serves a critical need to educate and increase awareness about *Legionella* prevention and the need for good maintenance among these managers. Because Garland has had so few cases of legionellosis, the impact of the code for cooling towers associated with multifamily dwellings on case rates cannot be documented. However, the increasing percentage of cooling towers registering zero level of contamination with *Legionella* suggests that the risk of legionellosis related to cooling towers may be decreasing.

Implications for Policy & Practice

- Our findings support effective and routine communication between local health departments and multiresidential building owners to promote health and safety of occupants.
- Monitoring for *legionella* may reduce risk of legionellosis from cooling towers through raising awareness of building owners and managers about the need to prevent, detect, and remediate *legionella* contamination in their building water systems.
- The experience of GHD may be useful for jurisdictions considering adoption of regulations to prevent legionellosis in their communities.

Conclusions

The rapid rise in rates of legionellosis in the past decade should propel public health authorities to examine current policies and to strengthen evaluation of prevention practices. Many factors, including an increased elderly and immunocompromised population and an aging water system infrastructure, are likely to continue to contribute to the rapid rise in the rate of legionellosis in the absence of more effective prevention measures. The lessons learned by the City of Garland may help inform and guide these efforts. The effectiveness of simpler and less costly approaches to prevention should be compared with the cost-effectiveness of other strategies.

References

1. Neil K, Berkelman R. Increasing incidence of legionellosis in the United States, 1990-2005: changing epidemiologic trends. *Clin Infect Dis*. 2008;47(5):591-599.
2. Centers for Disease Control and Prevention. Legionellosis—United States, 2000-2009. *MMWR Morb Mortal Wkly Rep*. 2011;60(32):1083-1086.
3. Centers for Disease Control and Prevention. Summary of notifiable diseases—United States, 2000. *MMWR Morb Mortal Wkly Rep*. 2002;49(53):1-102.
4. Centers for Disease Control and Prevention. Provisional cases of selected notifiable diseases, United States, weeks ending December 28, 2013, and December 29, 2012 (52nd week)*. *MMWR Morb Mortal Wkly Rep*. 2015;63(51/52):ND-726.
5. Marston BJ, Plouffe JF, File TM Jr, et al. Incidence of community-acquired pneumonia requiring hospitalization. Results of a population-based active surveillance study in Ohio. The Community-Based Pneumonia Incidence Study Group. *Arch Intern Med*. 1997;157(15):1709-1718.
6. Occupational Safety and Health Administration. Health & Safety Topics: Legionnaires' disease. <https://www.osha.gov/SLTC/legionnairesdisease>. Accessed September 9, 2016.
7. Centers for Disease Control and Prevention. Guidelines for environmental infection control in health-care facilities: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). *MMWR Recomm Rep*. 2003;52(RR10):1-42.
8. Centers for Disease Control and Prevention. Guidelines for preventing health-care-associated pneumonia, 2003. *MMWR Recomm Rep*. 2004;53(RR03):1-36.
9. Centers for Disease Control and Prevention, Infectious Disease Society of America, and American Society of Blood Marrow Transplantation. Guidelines for preventing opportunistic infections among hematopoietic stem cell transplant recipients. *MMWR Recomm Rep*. 2000;49(RR-10):1-125, CE121-CE127.
10. Barbaree JM, Gorman GW, Martin WT, Fields BS, Morrill WE. Protocol for sampling environmental sites for *Legionellae*. *Appl Environ Microbiol*. 1987;53(7):1454-1458.
11. Centers for Disease Control and Prevention. Water sampling strategies and culture techniques for detecting *Legionellae*. *MMWR Recomm Rep*. 2003;52(RR10):43.
12. Parr A, Whitney EA, Berkelman RL. Legionellosis on the rise: a review of guidelines for prevention in the United States. *J Public Health Manag Pract*. 2015;21(5):E17-E26.
13. Keane T. *Guidelines for Control of Legionella in Ornamental Water Features*. Chalfont, PA: Legionella Risk Management Inc; 2005.
14. Utah Department of Health Bureau of Epidemiology. Legionellosis cluster/outbreak investigation: Information for businesses and other facilities. http://health.utah.gov/epi/diseases/legionella/Legionella_Cluster-Outbreak_Guidelines_for_Businesses.pdf. Accessed May 9, 2012.
15. California Code of Regulations, Use of Recycled Water for Cooling, §60306 (2000).
16. State of California Energy Commission Staff. Cooling Water Management Program Guidelines for Wet and Hybrid Cooling Towers at Power Plants, §CEC-700-2005-025 (2004).
17. New York City Administrative Code, Maintenance of Buildings, Cooling Towers, §28.317 (2015).
18. New York State Department of Health. Protection Against *Legionella*, §10.4 (2015).
19. American Society of Heating Refrigerating, and Air-Conditioning Engineers. *Standard 188-2015—Legionellosis: Risk Management for Building Water Systems*. Atlanta, GA: American Society of Heating Refrigerating and Air-Conditioning Engineers; 2015:18.
20. Kerbel W, Krause JD, Shelton BG, Springston JP, eds. *Recognition, Evaluation and Control of Legionella in Building Water Systems*. Falls Church, VA: American Industrial Hygiene Association; 2015.
21. Garrison LE, Kunz JM, Cooley LA, et al. Vital Signs: deficiencies in environmental control identified in outbreaks of Legionnaires' disease—North America, 2000-2014. *MMWR Morb Mortal Wkly Rep*. 2016;65(22):576-584.
22. Code of Ordinances of the City of Garland, Texas, Neighborhood Sanitation and Housing Services Article I. Minimum Housing Code, §32.04 (2007).
23. Application for multi-family dwelling license. City of Garland, Texas. <http://www.garlandtx.gov/civicax/filebank/blobdownload.aspx?blobid=11564>. Published 2014. Accessed September 6, 2016.
24. Yin R. *Case Study Research: Design and Methods*. 4th ed. Thousand Oaks, CA: Sage Publications; 2009.
25. Garland Texas Made Here. *Code Compliance*. Garland, TX: Garland Texas Made Here; 2015. <https://www.garlandtx.gov/gov/cd/code/default.asp>. Accessed July 21, 2015.
26. Ricketts KD, Joseph C, Lee J, Wewalka G; European Working Group for *Legionella* Infections. Survey on legislation regarding wet cooling systems in European countries. *Euro Surveill*. 2008;13(38):18982.
27. Federal Ministry of Health, Federal Ministry of Consumer Protection, Food and Agriculture in agreement with the Federal Ministry of Economics and Technology and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Germany). Zweite verordnung zur anderung der trinkwasserverordnung [Drinking Water Ordinance (TrinkwV)]. Berlin, Germany: Federal Law Gazette; 2011.
28. Exner M, Pleischl S, Grummt HJ, Engelhart S. [Experience with prevention and control of legionellosis in Germany: plea for proactive risk management]. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz*. 2011;54(6):699-708.
29. Germany Federal Environment Agency. *Improved Assurance of Drinking Water Quality in Buildings. Amendments to Drinking Water Ordinance Provide More Protection Against Legionella and Chemicals in Installation Materials*. Berlin, Germany: Germany Federal Environment Agency; 2011. http://www.umweltbundesamt.de/sites/default/files/medien/press/pe11-051_improved_assurance_of_drinking_water_quality_in_buildings.pdf. Accessed January 23, 2014.