

Epidemiology of *Legionella* in environments for recreational, tourism or physical activities

Vincenzo Romano Spica, Andrea Paparini

Dipartimento di Scienze del Movimento Umano e dello Sport - Igiene generale e applicata, Istituto Universitario di Scienze Motorie (IUSM), Roma, Italy

Correspondence to: Vincenzo Romano Spica, Dipartimento di Scienze del Movimento Umano e dello Sport - Igiene generale e applicata, Istituto Universitario di Scienze Motorie (IUSM), P.zza L. De Bosis 6, 00194 Roma, Italy. E-mail: vrs@iusm.it

Report presented at *Legionellosi: un rischio crescente*, 18-19 June 2004, Roma, Italy

Abstract

Legionella is a waterborne microorganism responsible of severe pneumonia. Legionnaire's disease and Pontiac fever are clinical syndromes related to contaminated environments. Outbreak sources have been identified in sport facilities, thermal springs, spas, hotels, campsites, cruise ships and other structures for recreational or tourism purposes. Infection spreads by inhalation of contaminated aerosols from showers or whirlpool baths. Exposure to properly maintained swimming pools does not represent a major risk factor. Several prevention strategies and decontamination procedures are available.

Introduction

Legionella pneumophila is naturally found in fresh water. It can survive within protozoa such as amoeba, planctonically or in biofilms.^[1] The most common transmission route seems to involve contaminated airborne droplets somehow released in the environment by mechanical devices such as cooling towers, evaporative condensers, Heating Ventilation Air Conditioning systems (HVAC), decorative fountains, humidifiers, whirlpool baths, and showers.^[2-13] Inhalation of contaminated aerosols, may thus be responsible for the onset of illness, however, there is no evidence of infection transmission by person-to-person or by water ingestion.^[14,15]

Susceptibility to Legionnaire's disease is still an unclear issue, involving several risk factors: genetic, environmental, life styles and health conditions.^[16] Middle-aged and elderly people, immuno-impaired patients, cigarette smokers and people affected by chronic or severe lung diseases are at higher risk. Conversely, Pontiac fever affects children and healthy adults just as frequently as immuno-compromised individuals.^[17-18] *Legionella* is recently arousing scientific and public attention, in light of its growing importance as an emerging pathogen. Facilities, buildings and structures involving recreational waters may represent a risk factor for exposure to *Legionella*.

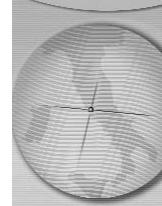
Description of the project

Within the Italian Multicentric Research Group on Legionnaire's disease, several environmental risks have been considered both for nosocomial

and community acquired infections.^[19] The interaction between host and pathogen revealed a complex scenario and the presence of environments at risk. In particular, the social changes in industrialised countries increased the population exposure to recreational waters during sport, fitness and physical activities, tourism or travels. The EWGLI (European Working Group for Legionella Infections) network proposed a surveillance system to detect sporadic cases and outbreaks arisen during travelling and staying in hotels or other types of holiday accommodation. The use of heated water supplies represents a condition for harbouring *Legionella* in hotels or other buildings, ships and trains, where showers represent a widespread mechanical device for aerosol generation. Several reports describe outbreaks from other indoor environments including locker rooms in fitness or sport facilities, spas and thermal springs structures.^[9,20-22] Several species of *Legionella* have been isolated from environmental samples and some of them seem to play a role in pathogenesis (Table 1). Molecular methods and bioinformatics provide a valuable approach for detection and typing of different strains for epidemiological studies and prevention actions.

Conclusions

Swimming pool waters do not represent a major risk for Legionnaire's disease when disinfection is performed following appropriate chlorination procedures. However, locker rooms of pools or other facilities for physical activities may represent



a contamination source mainly through showers.[23] Several decontamination procedures are available for heated water systems and HVAC systems. Monitoring *Legionella* represents an important tool for preventing infection and several laboratory protocols are available to improve

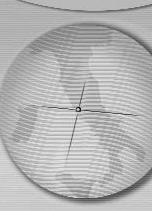
Table 1. *Legionella* species and serogroups. Species are listed in chronological order based on the date of isolation or identification; Serogroup 2 of *L. erythra* has been associated with human disease. (modified from [23]).

Species	No. of serogroups	No. associated with disease
<i>L. pneumophila</i>	15	15
<i>L. bozemani</i>	2	2
<i>L. dumoffii</i>	1	1
<i>L. micdadei</i>	1	1
<i>L. longbeachae</i>	2	2
<i>L. jordanis</i>	1	1
<i>L. wadsworthii</i>	1	1
<i>L. hackeliae</i>	2	2
<i>L. feeleii</i>	2	2
<i>L. maceachernii</i>	1	1
<i>L. birminghamensis</i>	1	1
<i>L. cincinnatensis</i>	1	1
<i>L. gormanii</i>	1	1
<i>L. sainthelensi</i>	2	2
<i>L. tucsonensis</i>	1	1
<i>L. anisa</i>	1	1
<i>L. lansingensis</i>	1	1
<i>L. erythra</i>	2	1
<i>L. parisiensis</i>	1	1
<i>L. oakridgensis</i>	1	1
<i>L. spiritensis</i>	1	0
<i>L. jamestownensis</i>	1	0
<i>L. santicrucis</i>	1	0
<i>L. cherrii</i>	1	0
<i>L. steigerwaltii</i>	1	0
<i>L. rubrilucens</i>	1	0
<i>L. israelensis</i>	1	0
<i>L. quinlivanii</i>	2	0
<i>L. brunensis</i>	1	0
<i>L. moravica</i>	1	0
<i>L. gratiana</i>	1	0
<i>L. adelaideensis</i>	1	0
<i>L. fairfieldensis</i>	1	0
<i>L. shakespearei</i>	1	0
<i>L. waltersii</i>	1	0
<i>L. genomospecies</i>	1	0
<i>L. quateirensis</i>	1	0
<i>L. worsleiensis</i>	1	0
<i>L. geestiana</i>	1	0
<i>L. natarum</i>	1	0
<i>L. londoniensis</i>	1	0
<i>L. taurinensis</i>	1	0
<i>L. lytica</i>	1	0
<i>L. drozanskii</i>	1	0
<i>L. rowbothamii</i>	1	0
<i>L. fallonii</i>	1	0
<i>L. gresilensis</i>	1	0
<i>L. beliardensis</i>	1	0

sensitivity and specificity.[24,25] Bioinformatics provides an advanced approach to verify or exclude a suspected transmission route and control the outbreak spreading by supporting focused decontamination plans.

References

- Steinert M, Hentschel U, Hacker. *Legionella pneumophila*: an aquatic microbe goes astray. *FEMS Microbiol Rev* 2002;26(2):149-62.
- Breiman RF, Cozen W, Fields BS, et al. Role of air sampling in investigation of an outbreak of Legionnaires' disease associated with exposure to aerosols from an evaporative condenser. *J Infect Dis* 1990;161:1257-61.
- Breiman RF, Fields BS, Sanden GN, Volmer L, Meier A, Spika JS. Association of shower use with Legionnaires' disease. Possible role of amoebae. *JAMA* 1990; 263:2924-6.
- Cordes LG, Fraser DW, Skalny P, et al. Legionnaires' disease outbreak at an Atlanta, Georgia, country club: evidence for spread from an evaporative condenser. *Am J Epidemiol* 1980; 111:425-31.
- Dondero TJ Jr, Rendtorff RC, Mallison GE, et al. An outbreak of Legionnaires' disease associated with a contaminated air-conditioning cooling tower. *N Engl J Med* 1980;302:365-70.
- Fenstersheib MD, Miller M, Diggins C, et al. Outbreak of Pontiac fever due to *Legionella anisa*. *Lancet* 1990;336:35-37.
- Garbe PL, Davis BJ, Weisfeld JS, et al. Nosocomial Legionnaires' disease: epidemiologic demonstration of cooling towers as a source. *JAMA* 1985;254:521-4.
- Hanrahan JP, Morse DL, Scharf VB, et al. A community hospital outbreak of legionellosis. Transmission by potable hot water. *Am J Epidemiol* 1987;125:639-49.
- Jernigan DB, Hofmann J, Cetron MS, et al. Outbreak of Legionnaires' disease among cruise ship passengers exposed to a contaminated whirlpool spa. *Lancet* 1996;347:494-9.
- Keller DW, Hajeh R, DeMaria A Jr, et al. Community outbreak of Legionnaires' disease: an investigation confirming the potential for cooling towers to transmit *Legionella* species. *Clin Infect Dis* 1996;22:257-61.
- Mahoney FJ, Hoge CW, Farley TA, Barbaree JM, Breiman RF. Communitywide outbreak of Legionnaires' disease associated with a grocery store mist machine. *J Infect Dis* 1992;165:736-9.
- Mangione EJ, Remis RS, Tait KA, et al. An outbreak of Pontiac fever related to whirlpool use, Michigan 1982. *JAMA* 1985;253:535-39.
- Spitalny KC, Vogt RL, Orciari LA, Witherell LE, Etkind P, Novick LF. Pontiac fever associated with a whirlpool spa. *Am J Epidemiol* 1984;120:809-17.
- Fraser DW, Tsai TR, Orenstein W, et al. Legionnaires' disease: description of an epidemic of pneumonia. *N Engl J Med* 1977;297:1189-97.
- Yu VL, Zuravleff JJ, Gavlik L, Magnussen MH. Lack of evidence for person-to-person transmission of Legionnaires' disease. *J Infect Dis* 1983;147:362-3.
- Romano-Spica V, Montagna MT, Stancanelli G, et al. Genetic polymorphisms as susceptibility factors to *Legionella* pneumonia. 19th Annual Meeting of the EWGLI Group 15-18 May 2004; Chamonix Mont Blanc, France.
- Doebbeling BN, Wenzel RP. The epidemiology of *Legionella pneumophila* infections. *Semin Respir Infect* 1987;2:206-21.
- Lutichau HR, Vinther CC, Uldum SA, Moller JS, Faber M, Jensen JS. An outbreak of Pontiac fever among children and adults following a whirlpool bath. *Ugeskr Laeger* 1999;161:3458-62.
- Borella P, Montagna MT, Romano-Spica V, et al. *Legionella* infection risk from domestic hot water. *Emerg Infect Dis*.



2004;10:457-64. Erratum in: *Emerg Infect Dis* 2004; 10:1353

20) Pelaz C, Cano R, Baladrón B. *Legionella* and spas in Spain. 19th Annual Meeting of the EWGLI Group 15-18 May 2004; Chamonix Mont Blanc, France (abs).

21) Benin AL, Benson RF, Arnold KE, Fiore et al. An outbreak of travel-associated Legionnaires disease and Pontiac: the need for enhanced surveillance of travel associated legionellosis in United States. *J Infect Dis* 2002;185:237-43.

22) Castellani Pastoris M, Benedetti P, Greco D, et al. Six cases of travel-associated Legionnaires' disease in Ischia involving four countries. *Infection*. 1992;20:73-7.

23) Leoni E, Legnani PP, Bucci Sabattini MA, Righi F. Prevalence of *Legionella* spp. in swimming pool environment. *Water Res*. 2001;35:3749-53.

24) Borella P, Montagna MT, Romano-Spica V, et al. Environmental diffusion of *Legionella* spp and legionellosis frequency among patients with pneumonia: preliminary results of a multicentric Italian survey. 2003 *Ann Ig*: 15:493-503.

25) Borella P, Montagna MT, Romano-Spica V, et al. Relationship between mineral content of domestic hot water and microbial contamination. *J Trace Elem Med Biol*. 2003;17(Suppl 1):37-43.