

# Risk assessment of legionellosis in cardiology units

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## Keywords

Infective endocarditis • Legionella • Cardiac valve prosthesis • Environment

## Summary

*Infective Endocarditis (IE) is a disease with high morbidity and mortality. Nowadays, in addition to classic pathogens were isolated exigent Gram negative bacteria as A. baumannii, A. lwoffii, C. burnetii, Bartonella, Chlamydia and Legionella. We present our experience of Legionella isolations in environmental sample (water and air) collected from the Cardiology units belonging to*

*two hospitals in Messina (Italy). A total of 80 samples were carried out, 30 and 50, respectively in the first and in the second structure: 55 of water and 25 of aerosol.*

*The positivity of 30% of the water samples analyzed and 15% of those aerosol strengthens the conviction of the need for greater environmental monitoring, especially in the wards at high risk.*

## Introduction

The continuous alert of legionellosis disease occurred in hospitals around the world and the clusters observed in major public places mean that the “*Legionella*” phenomenon became of primary importance for Public Health [1, 2]. The risk of illness increases dramatically if the germ is found in certain wards such as intensive care, cardiology, pulmonology for critical conditions of their hospitalized patients [3-8]. As reported in many articles in the scientific literature, we would like to emphasize as *Legionella* may be potentially related to endocarditis when it is found in the hospital environment.

The Infective Endocarditis (IE) is an infection of the endocardial surface of the heart, which may involve one or more heart valves, the mural endocardium, or a septal defect. If left untreated, IE is generally fatal. IE is in continuous evolution: in the face of an increasing role of degenerative valvular disease and iatrogenic factors such as the presence of prosthetic and intracardiac devices, factors like rheumatic disease have become secondary. The average age of patients has increased dramatically and with it the comorbidity. The frequency at which a particular organism causes endocarditis depends on how frequently can gain access to the circulatory system and its ability to survive in the bloodstream and stick to the components of NBTE (non-bacterial thrombotic endocarditis), to subendothelial structures exposed or to the endothelial surface. Over the past few years, despite the improvement recorded in both clinical-diagnostic and therapeutic circle, the incidence and mortality of infective endocarditis have not been substantially reduced [9, 10].

From an etiological point of view there are significant changes: in addition to classic pathogens (*S. aureus*,

*Streptococcus* sp, *Enterococcus* sp) Gram negative bacteria are isolated, for example those belonging to the group HACEK (*Haemophilus* sp, *Actinobacillus actinomycetemcomitans*, *Cardiobacterium hominis*, *Eikenella corrodens*, *Kingella kingae*). Moreover, there are studies reporting cases of endocarditis caused by *A. baumannii*, *A. lwoffii*, *C. burnetii*, *Bartonella*, *Chlamydia* and *Legionella* spp as the responsible of associated forms with negative blood culture [11-16]. Concerning *Legionella*, in the literature are describes cases which *L. micdadei*, *L. bozemanii*, *L. anisa*, *L. dumoffi* and *L. cardiac*, in addition to *L. pneumophila*, are implicated in the genesis of cardiovascular disease, with involvement of valvular structures, both prosthetic that native [17-28].

In hospital and other health care facilities, waterborne diseases may originate from the bacterial colonization of water pipes, taps, cooling towers, showers and water supplies [29-35]. For hospitalized subjects, risk assessment on the basis of levels of exposure to contaminated water pipes should be calculated following constant environmental monitoring, and critically with strict clinical surveillance. As is known, *Legionella* is able to survive for long periods in water and even to replicate in the presence of chlorine, if it manages to create suitable conditions (biofilm, parasitism of amoebas and protozoic cysts, etc.) [36, 37].

The Italian National Institute of Health (in Italian, Istituto Superiore di Sanità) reported that during 2015 in Italy nosocomial cases of legionellosis were 82 (5.3%) of total cases reported, of which 33 (40%) were of certain nosocomial origin, and 49 (60%) possibly of nosocomial origin [38].

It follows, therefore, that environmental surveillance of *Legionella* spp. is needed for risk assessment and prevention of hospital-acquired legionellosis.

The objectives of the present investigation were to carry out the risk assessment of Legionellosis in Cardiology Units, verifying the presence and distribution of *Legionella* in water and air samples, in order to optimize the prevention program in higher risk areas.

## Materials and methods

Ethical Approval was not required as this research did not involve human beings and/or animals.

From October 2015 to September 2016, 55 samples drawn from the water distribution system of Cardiology wards belonging to two hospitals sited in Messina (Italy) were examined for *Legionella* spp.

To recover *Legionella* spp. from water samples the standard procedures reported in the Italian Guidelines for the prevention and control of legionellosis, approved State-Regions Conference, in its meeting of May 7, 2015, were used [39].

In addition to water samples, *Legionella* has also been searched in 25 samples collected from the aerosol formed around the faucet when the water flows. In this case two Petri dish with a diameter of 9 cm were placed on the sites of the tap. Simulating handwashing, the health-care worker responsible for sampling has caused the formation of aerosol. The plates were inoculated only for the passive fall of the aerosol and this imply an even greater risk for patients who use the washbasins [40-43]. The result was an average of values measured on 2 plates/1 h and expressed as CFU/dm<sup>2</sup>/h.

The isolates were further identified as *L. pneumophila* serogroups using the microagglutination kit '*Legionella pneumophila antisera set 1 and 2*' and *Legionella antisera* for several *Legionella* species as *L. dumoffii*, *bozemanii*, *micdadei*, etc (Biogenetics, Denka Seiken co., Ltd, Tokio, Japan).

## Results

A total of 80 samples were carried out, 30 and 50, respectively in the first and in the second structure: 55 of water and 25 of aerosol. Of 55 water samples analyzed

(20 in the Hospital 1 and 35 in the Hospital 2), 18 (33%) were positive for the presence of *L. pneumophila*, 7 (35%) in the first and 11 (31%) in the second.

With regard to samples of air, of 25 samples taken, in 8 (32%) *L. pneumophila* was detected. Besides *L. pneumophila* 1, the identified serogroups were 3 and 6, the latter only in the second hospital. The mean concentration of *Legionella* did not show significant differences between the two structures ( $p>0.05$ ). As expected, the same serogroups isolated from water were found, in much smaller quantities, in respective aerosol samples. The results are summarized in Table 1.

## Discussion and conclusions

The positivity of more than 30% of the water and air samples analyzed, strengthens the conviction of the need for greater and continuous environmental monitoring, especially in the wards at high risk.

The relevance of this alert is focused on the fact that IE sustained by *Legionella* genus is not a frequent but always a possible cause of sudden death in patients undergoing cardiac surgery, especially for prosthesis implantation [44]. Despite the analytical results discovered, strongly indicative of a risk situation, in cardiology wards considered, no cases of Legionnaires' disease had been reported among patients.

Despite the amount of *Legionella* found in the aerosol is considerably low, an efficient air sampling combined with water surveillance is beneficial for preventing legionellosis. Monitoring the air around aerosol producing devices may assist in tracking the greatest potential for *Legionella* spp. aerosolization, identifying plausible infection sources, and assessing the distance that *Legionella* has spread.

Attention should be given in increasing environmental surveillance in higher risk areas, otherwise you could apply to new methods of estimation of the spread of germs, such as Geostatistics [45]. Environmental monitoring, carried out for nearly a year, has certainly been useful to underline the problem, optimizing corrective measures, some of which are already active at the time of sampling, but clearly not sufficient to contain the risk

Tab. I. Distribution of water and air samples taken on Cardiology wards, positivity (%) and serogroups identified.

	total number of samples	samples of water	samples of water (% POS)	Serogroups (CFU/1 min-max)	samples of air	samples of air (% POS)	Serogroups (CFU/dm <sup>2</sup> /h min-max)
Hospital 1	30	20	7 (35)	<i>L. pneumophila</i> 1 (100-4000e+1) <i>L. pneumophila</i> 3 (100-2000e+1)	10	3 (30)	<i>L. pneumophila</i> 1 (0,78-5,5) <i>L. pneumophila</i> 3 (0,78-3,14)
Hospital 2	50	35	11 (31)	<i>L. pneumophila</i> 1 (200-1000e+2) <i>L. pneumophila</i> 3 (100-1000e+1) <i>L. pneumophila</i> 6 (100-2000e+1)	15	5 (33)	<i>L. pneumophila</i> 1 (0,78-6,28) <i>L. pneumophila</i> 3 (0,78-3,93) <i>L. pneumophila</i> 6 (0,78-2,36)
Total	80	55	18 (33)		25	8 (32)	

(as de-calcification, sanitization with chlorine agents, etc.), implementing a more accurate assessment of the state of the water system, considering the replace of some of its components (valves, end portion of the water pipe system, sanitation in recirculation water pipes in the interested departments concerned, etc.), as well as an increase of the level of active epidemiological surveillance on patients and staff of the departments concerned.

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## Authors' contributions

PL and SD carried out: study design, laboratory analysis, data interpretation. EA and MC provided the bibliography and wrote the manuscript. GD performed manuscript revision and handled cardiological aspects.

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