

# Legionella Pneumophila & Water Distribution Systems

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**Abstract – The presence of the bacteria Legionella in water systems, especially in the hot water distribution system, represents in terms of health protection of inhabitants the crucial problem which can not be overlooked. There are a lot of guidelines and regulations developed in many individual countries for the design, operation, and maintenance of tap water systems to avoid the growth of bacteria Legionella. The core of the article consists in our investigation of Legionella contamination of hot water in a cross-sectional survey in Kosice, the Slovak Republic.**

Key words – Legionella pneumophila, contamination, hot water, distribution system, regulation, thermal disinfection

## I. Introduction

In Legionellosis is a collection of infections that emerged in the second half of the 20th century, and that are caused by Legionella pneumophila and related Legionella bacteria.

Water is the major natural reservoir for legionella, and the bacteria are found worldwide in many different natural and artificial aquatic environments, such as cooling towers; water systems in hotels, homes, ships and factories; respiratory therapy equipment; fountains; misting devices; and spa pools.

About 20% of the cases of legionellosis detected in Europe are considered to be travel-related; these cases present a particular set of problems because of difficulties in identifying the source of infection [1].

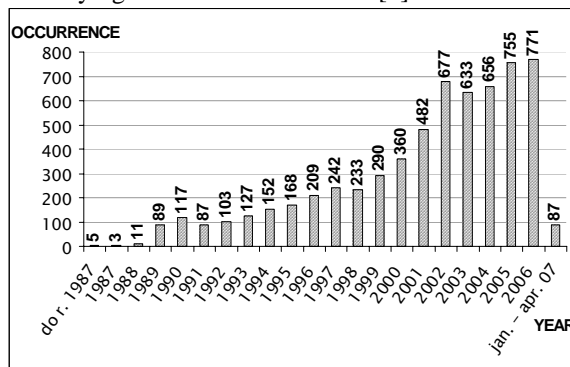


Fig.1 The outcome of illness for all cases with onset in 2007[5]

## II. Legionnaires' disease and Pontiac fever

Legionnaires' disease lacks characteristic symptoms or signs - there is no typical syndrome, and not everyone exposed to the organism will develop symptoms of the disease (Yu et al., 1982; Macfarlane et al., 1984; Granados et al., 1989; Roig et al., 1991; Sopena et al., 1998; Ruiz et al., 1999; Gupta, Imperiale & Sarosi, 2001). However, several clinical signs are classically associated with Legionnaires' disease rather than with other causes of pneumonia.

Legionnaires' disease is often initially characterized by anorexia, malaise and lethargy; also, patients may develop a mild and unproductive cough. About half of patients develop pus-forming sputum, and about one third develop blood-streaked sputum or cough up blood (haemoptysis).

Almost half of patients suffer from disorders related to the nervous system, such as confusion, delirium, depression, disorientation and hallucinations. These disorders may occur in the first week of the disease [1].

Pontiac fever is an acute, self-limiting, influenza-like illness without pneumonia (that is, it is "non-pneumonic"). Unlike Legionnaires' disease, Pontiac fever has a high attack rate, affecting up to 95% of exposed individuals (Glick et al., 1978).

## III. Legislation

In the last years particular parts of the 'STN EN 806 Specifications for installations inside buildings conveying water for human consumption' have been accepted by the Slovak Republic.

Installations have to be operated and maintained without having an adverse effect on conveying water for human consumption and water quality. Safety quality and suitability of procedures accepted for safeguarding of system performance according to EN 806 and EN 1717 should be regularly controlled.

Conditions of installations operation have to be compared with conditions of design and assembly in order to insure their functionality.

- Potable water is safeguarded by basic formula:
- Cold water must remain cold
- Hot water must remain hot

Water must not stagnate in water pipes longer than it is necessary

## IV. Aims and Methods

To assess the potential public health impact of Legionella colonization at domestic level, as well as public level, a descriptive multicentric study was undertaken to identify and qualify the levels of the microorganism in a substantial number of Slovak domestic and public hot water samples.

We addressed three specific aims:

- to estimate the frequency of Legionella colonization and severity of contamination at different levels
- to identify the potential risk factors for contamination relative to distribution systems and water characteristics
- to define relative role of each risk factor and suggest possible remediation.

Lastly, risk for legionellosis will be retrospectively evaluated by collecting information about pneumonia symptoms recorded by residents at buildings [2].

### V. Sample collection

From February to October 2006, a total of 46 water samples were collected from private homes, hospitals and boiler houses of Kosice, representative samples of Eastern Slovakia.

The selection was made on the basis of the water distribution systems inside the town and buildings and heater types in each area. After we identified each building, we asked a random family, or a work collective to participate in the study, i.e. to complete our questionnaire and give informed consensus for water collection.

Laboratory examinations and Legionella analysis were made by the Regional Health Office – referential centre for potable water in Kosice. The hot water samples were drawn from the bathroom outlets in the case of residential houses (shower heads or bathroom taps) in the sterile 1-L glass bottles after a short flow time (to eliminate cold water inside the tap or flexible shower pipe). To neutralize residual free chlorine, sodium thiuosulphate was added into sterile bottles for bacteriological analysis, whereas acid-preserved glass bottles were used for chemical determinations [3].

The collection bottles were returned to the laboratory immediately after sampling for bacteriological examination by a Membrane filtration. Filters Millipore were used for 10 ml sample volumes. Adjusted samples were inoculated on the medium GVPC surface[1].

### VI. Positive samples

Legionellas presence was detected in 8 samples out of analysed drinking water samples.

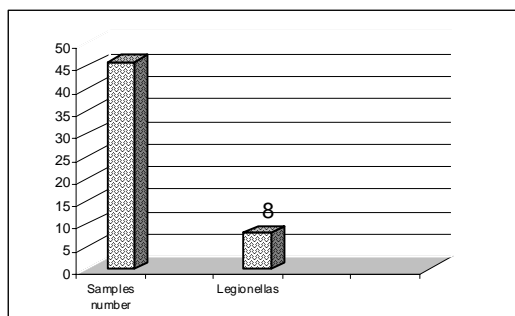


Fig. 2 Legionella results determination for potable water hot in Kosice.

Positive findings were recorded in 8 samples of PWH (potable water hot) Fig.2. In waters for human consumption (potable water cold - PWC) volume of legionellas were detected, from sporadic colonies of 20 CFU/100ml up to massive colonizations in the quantity 6700 CFU/100ml per a sample.

In water for human consumption (PWH) volume of legionellas were detected, from sporadic colonies of 200CFU/100ml up to massive colonizations in the quantity 14600 CFU/100ml per a sample. Legionellas

presence was detected in 8 samples of analysed PWH samples, i.e. in 17,4 %.

### VII. Discussion and Results

There was a necessity to react promptly due to positive findings in residential areas. The most reliable and available solution was thermal disinfection.

Thermal disinfection is periodic rising of temperature for specific time in the whole hot water distribution system including outlet points with a certain time of flushing these points at increased temperature. The temperature level and time of flushing are very important. (75 °C-with 10 minutes of outlet flushing). However, there are still areas not reached by disinfection which remain the contamination source. Non-adjustment of systems leads to fast spreading of Legionella in distribution systems (WHO 2007).

That is why our sampling in contaminated places was repeated immediately after thermal disinfection which was almost negative. After 12 days the level of Legionella colonies was almost the same as before this measure Fig.3.

Much worse results were obtained in similar survey in Italy or Germany [1]. In this case 36 - 68 % of samples were positive. In case the thermal disinfection in contaminated places was not done the concentration of bacterias will have an exponential character.

The measures have proved that the thermal disinfection is not a suitable system treatment. New strategies are tend to permanent disinfection due to the fact that spasmodic disinfection is not enough reliable to ensure the required standard.

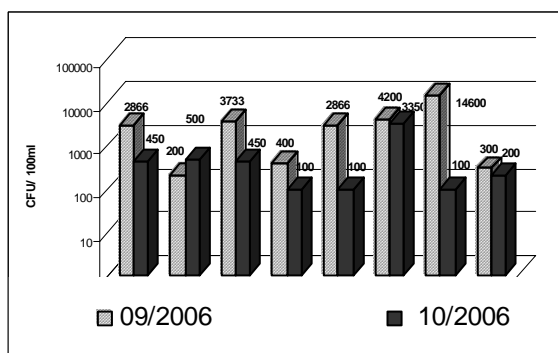


Fig.3 Legionella results – positive samples

### Conclusion

Thermal disinfection was verified not to be the systematic solution and therefore it is inevitable to search for a new complex solution. Expenses on the elimination of Legionella from the water distribution systems are very high and the results are often not sufficient.

Our control preventive measures have been in progress in order to search for an effective way to suppress the spread of the Legionella bacteria in water systems. Nevertheless, it should be the common goal of designers and operators to reduce the risk of Legionella bacteria in the installation inside buildings.

To prevent tragic events it is necessary to monitor the issue in the world and pay attention to precautionary regulations.

### Acknowledgements

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