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Characterization of Airborne Legionella Exposure

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Introduction

First described in 1977, Legionella are still of topical interest, and constitute a significant problem of public health. The human contamination occurred exclusively by inhalation of an aerosol contaminated by this hydro-telluric bacteria. In France, the management of the risk associated with Legionella consists of preventing its proliferation in water and keeping its concentrations < 10^3 CFU/L in hot-water networks. This approach is unreliable due to the underestimation of the culture-based method because of the presence of viable/active but non culturable bacteria, and Legionella within biofilms or intra-amoebas that are not accessible with the standardized cultural technique. In addition, no direct relation between Legionella concentrations in water and in aerosols has been established to date. It is therefore difficult to assess the Legionella health risk based only on water measurements. To have a more representative exposure assessment, it would be helpful to determine airborne Legionella bacteria generated from suspicious aquatic environments. Therefore, new approaches in the field of the metrological aspects of Legionella bioaerosols are required.

Objective

Our objective was to perform an environmental study on the feasibility of the detection of airborne Legionella while showering. This monitoring needed efficient sampling and adequate methods for analysis. The aerosolization chamber housed into a biological safety zone class III and field trials were carried out in 34 health institutions (nursing homes) to appreciate:

- the abundance of airborne Legionella generated by hot-water showers,
- the relevance of the collection principles and the methods for airborne Legionella detection.

Methods

- Airflow: 28.3 L.min⁻¹
- Air Volume sampled: 9.8 L
- Legionella detection by culture using a specific agar media for Legionella
- Legionella detection by culture and FISH methods

Laboratory trials

- Hot water faucet open to its maximum pressure and temperature during 7 minutes. Aerosol samplings began only after the faucet of hot water was closed. Registration of the relative humidity and temperature of air.
- Water temperature: 37.4 ± 3.4 °C
- RH: 89.3 ± 12.3 %
- Air temperature: 25 ± 2°C

Laboratory trials

- The aerosolization chamber housed into a biological safety zone class III
- The bioaerosol collection principles influence the culturability of Legionella

Field trials

- In hot water
- In bioaerosol
- Liquid impingement is suitable for airborne Legionella detection

Conclusion

Our objective was to perform an environmental study on the feasibility of the Legionella detection while showering, using the three main principles of bioaerosol collection. The liquid impingement technique has been identified as the most appropriate method for collecting airborne Legionella in well controlled conditions (aerosolization chamber) and during field trials (hot water shower aerosols). Moreover, this study showed an improved assessment of airborne Legionella using the impingement technique combined with the FISH detection method. It may provide a more accurate characterization of aerobiocaitumination by this pathogenic bacteria.

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