Clinical and Environmental Distributions of *Legionella* Strains in France Are Different

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Received 1 August 2003/Returned for modification 9 September 2003/ Accepted 9 October 2003

In France, the clinical distribution of *Legionella* species and serogroups does not correspond to their environmental distribution. *Legionella pneumophila* serogroup 1 is more prevalent among clinical isolates (95.4%) than in the environment (28.2%), whereas *L. anisa* is more frequent in the environment (13.8%) than in the clinical setting (0.8%).

*Legionella* infection occurs mainly by inhalation of aerosols generated from water sources such as distribution systems and cooling towers (13). The species *Legionella pneumophila* accounts for about 90% of the cases of legionellosis, and about 85% are due to serogroup 1 (5, 16). Other *Legionella* species are rarely pathogenic in humans, the most common being *L. longbeachae* (3.9%) and *L. bozemanii* (2.4%), except for in Australia and New Zealand, where *L. longbeachae* is responsible for 30% of the cases of Legionnaires' disease (16). In contrast, the distribution of *Legionella* species and serogroups in the environment is poorly known; most environmental studies have involved limited numbers of samples (4, 11, 14, 17) and/or only identified the species *L. pneumophila* (7, 9, 11, 14, 15).

To determine whether the clinical distribution of *Legionella* species and serogroups reflects their environmental prevalence, we studied three collections of clinical and environmental isolates obtained from the French national *Legionella* surveillance network.

All of the *Legionella* strains (*n = 259*) isolated from patients with Legionnaires' disease in France between July 2001 and December 2002 in 57 French departments were sent to the national *Legionella* reference center (NRCL) as part of the epidemiological surveillance system. Fifty-eight percent were community acquired, 16% were hospital acquired, and 26% were of undetermined origin. The species and serogroup distribution was comparable to that reported elsewhere: *L. pneumophila* was responsible for more than 90% of the cases, and *L. pneumophila* serogroup 1 accounted for the majority of these (Table 1) (5, 16). In contrast to the collection of clinical strains, the NRCL panel of environmental strains is not exhaustive and is not systematically isolated from the environment for clinical cases. To minimize the sampling bias, we studied two different collections of environmental isolates: (i) 2,747 strains isolated by standard methods in 66 French departments between July 2001 and December 2002 and sent to the NRCL for identification and (ii) 381 strains isolated by the NRCL from 554 water samples originating from four French departments between January 2001 and July 2002. The water samples were collected from taps, showers, water valves, boilers, cooling towers, fountains, thermal waters, swimming pools, medical sprays, and air conditioners. Most (87.3%) came from hospital water systems, and the remainder came from private buildings, hotels, airports, spas, and swimming pools (12.7%). *Legionellae* were isolated in accordance with the ISO 11731 standard procedure (6) and identified to the species and serogroup levels (10 colonies per sample) by direct immunofluorescence with polyclonal rabbit sera raised by the NRCL. *Legionella* isolates showing cross-reactions with rabbit sera were identified to the species level by random amplified polymorphic DNA PCR (8) or by sequencing of the *mip* gene (12).

The proportion of each species and serogroup was compared between the two environmental panels using a two-tailed *χ*² test with a significance level of 5%. The distribution was similar in the two panels (Table 1), and we thus considered the two populations to be representative of environmental *Legionella* colonization in France. The nationwide and Lyon panels comprised mainly *L. pneumophila* (75.5 and 75.6%, respectively). *L. pneumophila* serogroup 1 represented 28.2 and 29.1% of the isolates, respectively, and non-*pneumophila* species accounted for 24.5 and 24.4% of the isolates, respectively (Table 1).

To determine whether the environmental situation reflected the clinical distribution, the species and serogroup distributions were compared between the 2,747 environmental isolates and the 259 clinical isolates. The distributions of most species and serogroups differed significantly. In particular, *L. pneumophila* serogroup 1 accounted for 95.4% of the clinical isolates but only 28.2% of the environmental isolates (Table 1), while *L. pneumophila* serogroup 3 accounted for only 1.2% of the human isolates compared to 10.8% of the environmental isolates. Non-*pneumophila* *legionellae* accounted for only 1.2% of the clinical cases but 24.5% of the environmental isolates. *L. anisa*, the most frequent non-*pneumophila* species in the environment (13.8%), accounted for only 0.8% of the clinical isolates.
Only 15.8% of the clinical isolates were from confirmed nosocomial cases, whereas 87.3% of the samples collected in the Lyon area were from hospitals; the origin of the 2,747 isolates was not known. However, the distribution of species and serogroups did not change when only nosocomial isolates were considered; for example, *L. pneumophila* serogroup 1 accounted for 97.6% of the clinical isolates and 27.4% of the environmental isolates. We then examined the level of *Legionella* colonization of hospital water systems by studying the 554 water samples predominantly collected from hospitals (87.3%). The 286 positive water samples (51.6%) contained between 10^2 and 10^7 *Legionella* CFU/liter, and 138 samples (48.3% of the positive samples) contained ≥10^4 CFU/liter. Despite this frequent contamination of hospital water systems in France, hospital-acquired legionellosis remains relatively infrequent, with about 100 cases annually (15% of all of the cases in France) (3).

The high frequency of *L. pneumophila* serogroup 1 isolation from clinical samples, as previously observed (5, 16), is not therefore linked to environmental predominance but may be due to higher infectivity or more efficient intracellular growth (1, 2). The low prevalence of non-*pneumophila* species among clinical isolates relative to their environmental abundance suggests that these species are less pathogenic than *L. pneumophila*, in keeping with the observation that most confirmed infections involving non-*pneumophila* species occur in immunosuppressed patients (10).

In conclusion, the clinical prevalence of *Legionella* species and serogroups appears to be explained by differences in pathogenicity rather than environmental predominance.

We thank David Young for editing the manuscript and Philippe Vanhems for useful suggestions.

**REFERENCES**


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<tr>
<th>TABLE 1. Comparative <em>Legionella</em> species and serogroup distribution in clinical and environmental isolates</th>
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<tr>
<td><strong>Legionella</strong> species or serogroup</td>
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<td>-------------------------------------</td>
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<tr>
<td><em>L. pneumophila</em> serogroups</td>
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<tr>
<td>8</td>
</tr>
<tr>
<td>Other</td>
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<tr>
<td>Total non-pneumophila legionellae</td>
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<td>Total</td>
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*χ² test comparing the distributions of species and serogroups between clinical and environmental isolates identified by the NRCL. Significantly different when *P* < 0.05, NS, not significant; NC, not calculated.