Other *Legionella* Species

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Since the discovery of *Legionella pneumophila* in 1977, the family Legionellaceae has expanded to include over 40 named species.' Like *L pneumophila,* these other species are found in aquatic environments and soil. The vast majority of human infections are pneumonic, occurring after exposure to an environmental source of *'Legionella}* Nineteen species have been documented to cause human infection based on isolation from clinical material (Table 230-1). Isolates of the other species are limited to water and soil, although several have been implicated in human infection based on seroconversion in the absence of isolation.

In addition to the described species, there are other organisms that are in all probability members of the genus *Legionella,* based on analysis of 16S ribosomal RNA sequences.[3,4] These organisms, known as *"Legionella*-like. amebal pathogens" (LLAPs), infect freshwater amebas, and are found in aquatic environments capable of supporting the growth of *Legionella.* LLAPs grow very poorly or not at all on media supporting the growth of *Legionella.* However, there is serologic evidence implicating LLAPs as occasional causes of community-acquired pneumonia.[5]

In 1977 workers from the University of Pittsburgh and the University of Virginia visualized gram-negative, weakly acid-fast organisms from lung tissue of immunosuppressed patients with acute pneumonitis.[6,7] Almost all of the patients were receiving steroids or cytotoxic chemotherapy; renal transplant recipients were a prominent group. Although organisms could be seen on biopsy and autopsy lung specimens by various stains, they could not be grown on standard bacteriologic culture media. A *Legionella-like* organism was isolated after the clinical specimens were inoculated into guinea pigs and embryonated eggs. Sera from these patients contained high titers of antibodies against this organism, confirming its etiologic role in pneumonia.

This new organism, originally called Pittsburgh Pneumonia Agent, was serologically and genetically distinct from *L. pneumophila,* although it phenotypically resembled *L.pneumophila* in growth requirements and the presence of branched-chain fatty acids in the cell wall. The organism proved to be identical to organisms isolated in 1943 ("TATLOCK") and 1959 ("HEBA") from guinea pigs injected with the blood of two patients with nonpneumonic illnesses.[8,9] The first documented isolation of *L. bozemanii* was in 1959 from the lung tissue of a patient dying of pneumonia after immersion in fresh water.[9,10]

DESCRIPTION OF THE PATHOGENS

Legionella species are gram-negative aerobic bacilli that share a number of common phenotypic features, including growth on buffered charcoal-yeast extract agar, lack of growth on blood agar, catalase activity, and requirement for cysteine. Tests for urease, nitrate reduction, and fermentative activity are uniformly negative." Although individual species differ in several phenotypic characteristics, such as gelatin liquification, hippurate hydrolysis, and oxidase activity, these tests are of limited utility in differentiation. When grown on yeast extract agar, *Legionella* species produce a water-soluble, extracellular compound that fluoresces yellow-green on exposure to long-wave ultraviolet light. Several species exhibit a blue-white or red autofluorescence under ultraviolet light. Most species produce β-lactamase; *L. micdadei, L. maceachernii.* and *L. feeleii* do not. Cell wall fatty acid profiles and ubiquinone content are sufficiently distinctive to permit species identification on the basis of gas-liquid chromatography.[12] Differentiation of the common species is most conveniently made in the laboratory by direct fluorescent antibody staining of the isolates. Slide agglutination can also be used for selected isolates.[2] Determination of DNA homology is the definiti\e method, especially for the less common strains. Other biochemical and immunologic methods for species classification of *Legionella* are described in Chapter 229.

Species	References
L. micdadei	89, 90
L. bozemannii	10, 57
L. dumoffii	10, 91
L. longbeachae	92
L. wadsworthii	93
L. hackeliae	94
L. maceachernii	95
L. feeleii	96
L. birminghamensis	62
L. cincinnatiensis	97
L. jordanis	98
L. gormanii	99
L. anisa	100
L. tusconensis	101
L. sainthelensis	102
L. lansingensis	103
L. parisiensis	104
L. oakridgensis	105

L micdadei is unique in that it retains the modified acid-fast stain.'" *L. micdadei* can appear as weakly or partially acid-fast bacilli in clinical specimens. The acid-fast property is not usually present in organisms grown on solid media, but may be retained in liquid culture. The modified acid-fast stain substitutes 1% sulfuric acid (a less potent decolorizing agent) for the traditional 3% hydrochloric acid. This characteristic has occasionally led to misidentification of *L micdadei* infection as mycobacterial infection, with initiation of antituberculous agents.[7,13,14]

Like *L.pneumophila,* other *Legionella* species are pathogenic for freshwater amebas,[15,16] and a number of species are capable of vigorous intracellular growth within human macrophages.[17] All *Legionella* species tested contain the *dot/icm* loci, composed of 24 genes essential for pathogenesis, mediating uptake *of Legionella* by macrophages, evasion of lysosomal fusion, intracellular replication, and host cell lysis. However, in vitro cytopathogenicity for macrophages varies among species, with *L pneumophila, L. micdadei,* and *L. dumoffii* being the most cytopathogenic.[17]

EPIDEMIOLOGY

Like *L pneumophila,* other *Legionella* species are widely distributed in aquatic habitats and soil.[18,19] Several species associated with human disease have only been isolated from clinical specimens. In addition to *L. pneumophila,* water distribution systems may be colonized with any of a number of *Legionella* species, including *L. micdadei, L bozemanii, L. dumoffii, L. anisa,* and *L. feeleii*.[20-25] Recovery of these species is generally less frequent and technically more demanding than is recovery of *L pneumophila.* Commensal microflora and sediment known to promote proliferation of *L. pneumophila* in water distribution systems do not support the growth of *L. micdadei*.[26] Thus the growth kinetics of *L.micdadei* may explain its infrequent presence in the water supply, such that only patients with prolonged hospitalization or immunosuppression are susceptible. Like *L.pneumophila,* other species multiply within aquatic protozoa.[15,16]

The role of *non-pneumophila Legionella* species in community-acquired pneumonia is gradually emerging. Investigators in Ohio reported seven culture-confirmed cases of community-acquired *L. bozemanii* pneumonia from a single institution over a 5-year period.[27] In a subsequent study, 14% of patients with community-acquired pneumonia showed seroconversion to *Legionella* species, including *L bozemanii*