Correlation of Occurrence of *Legionella pneumophila* and Blastomycosis Cases Within ZIP Codes: Eastern Wisconsin

Dennis J. Baumgardner, MD; Email: dennis.baumgardner@aurora.org

Department of Family Medicine, Aurora University of Wisconsin Medical Group; Center for Urban Population Health, Milwaukee, WI, USA

### Methods

**Study Design:** Secondary data analyses of two Eastern Wisconsin laboratory registries from overlapping 5-year time periods.

**Setting/Dataset/Population Studied:** Cases, by ZIP code, of positive *Legionella pneumophila* urine antigen tests (fits CDC criteria for diagnosis), 2013-2017, and laboratory-confirmed blastomycosis cases, 2015-2019, from 4 urban/suburban Eastern Wisconsin 53xxx ZIP code groups.

**Outcome Measures/Statistics:** Estimated incidence figures for each disease were calculated from our previously published analysis data (refs 1, 2). Pearson correlation was calculated, and linear regression was performed with LpP case distribution as outcome variable, blastomycosis distribution as predictor variable.

### Results

- Yearly predicted LpP and blastomycosis cases in the Aurora Wisconsin catchment area were 27 and 24, respectively, such that a 1:1 distribution was assumed. This was confirmed by results: 136 cases each in 5-year time spans.

- Pearson correlation of distribution of LpP and blastomycosis cases by ZIP code was moderate at 0.541 (p<0.001).

- Of 136 ZIP codes from 11 counties studied, 61 had no LpP or blastomycosis cases, 35 both types of cases, 24 only LpP cases, 16 only blastomycosis.

- Blastomycosis case distribution was a significant predictor of LpP cases in a linear regression model (p<0.001) with equation: 
  \[
  \text{LpP cases by ZIP} = 0.419 + 0.636(\text{number of blastomycosis cases})
  \]
  R-squared (adj) = 28.7%

### Conclusions

This preliminary, modest correlation of the ZIP code distribution of LpP and blastomycosis is intriguing given known association of LpP, but not blastomycosis, with human built water sources. Correlation was seen despite both diseases presenting with endemic infections as well as outbreaks. Such a correlation may suggest an undescribed common outdoor environmental source.

Further study of LpP and blastomycosis co-associations with waterways, and other potential common sources (or potential common environmental hosts such as the ubiquitous Acanthamoeba which can harbor both) seems warranted.

### Background

- *Legionella pneumophila* (intracellular bacteria) pneumonia (LpP) and blastomycosis (dimorphic fungi, *Blastomyces*) are potentially serious environmentally acquired infections which are both prevalent in Eastern North America, including Wisconsin.

- There is good evidence that blastomycosis is associated with fresh water systems, including urban/suburban rivers such as the one pictured below (Figure 1).

- There is preliminary evidence that some LpP may be associated with fresh waterways as well.

- If the acquisition of both diseases is similarly associated with a geographic feature, one might expect similar geographic distributions of case addresses.

### Objective

To perform a (very) preliminary exploratory analysis of the correlation of the distribution of LpP and blastomycosis cases among ZIP codes in Eastern Wisconsin.

### Figures

- Figure 1. River associated with blastomycosis
- Figure 2. *Legionella pneumophila* bacteria
- Figure 3. Blastomyces dimorphic fungus in the mold (environmental) form.
- Figure 4. *Legionella* (facultative intracellular bacteria) lifecycle involving amoebas such as Acanthamoeba. From: Comas I. Nature Genetics 2016;48:115-6. It has been shown that Blastomyces may also be hosted by Acanthamoeba (ref 3).