

### IS YOUR HEALTH IN YOUR HANDS?

Genetics

Microbiome

Environment

Behavior

Medical Care

Social Factors

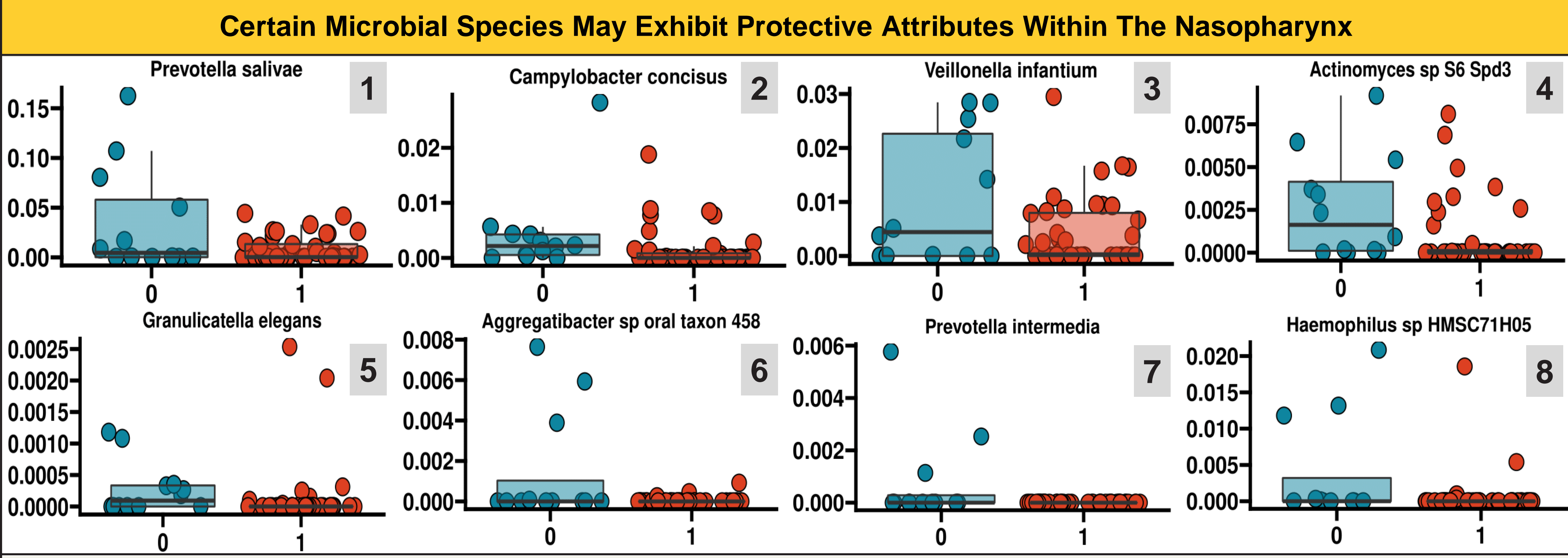
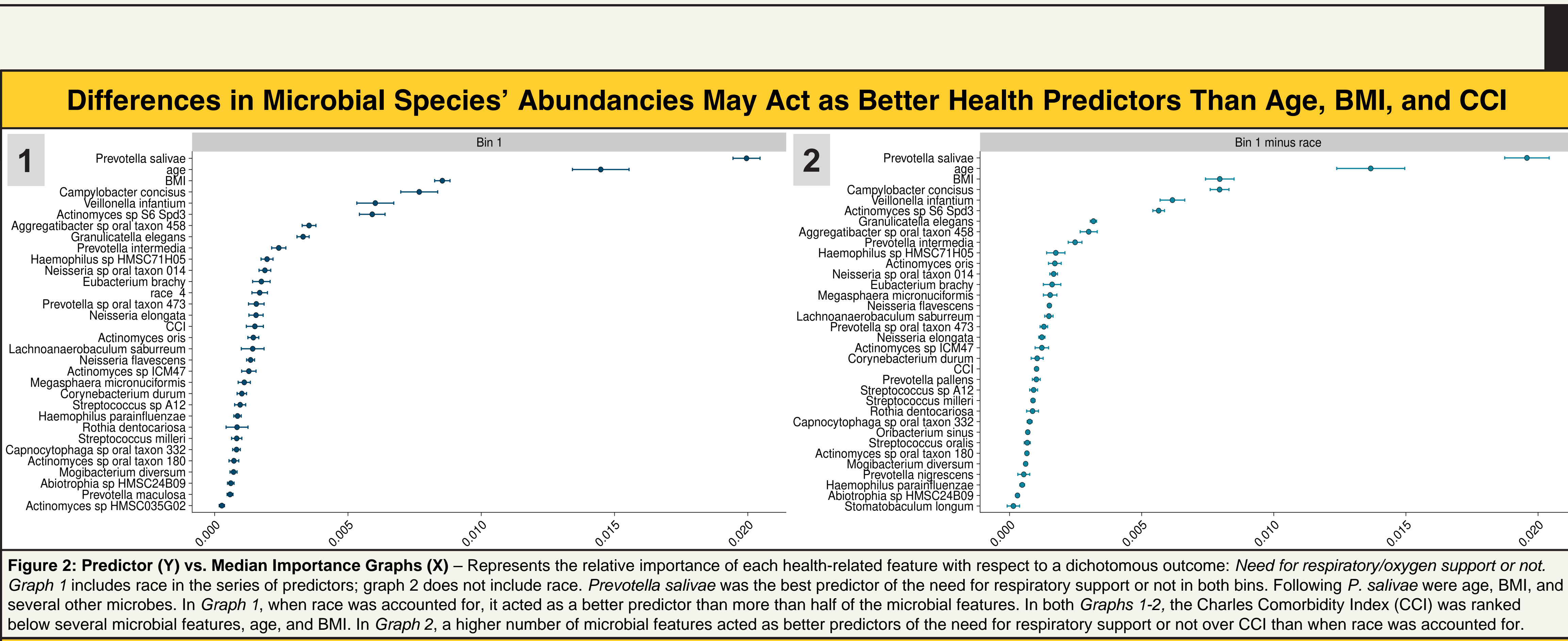
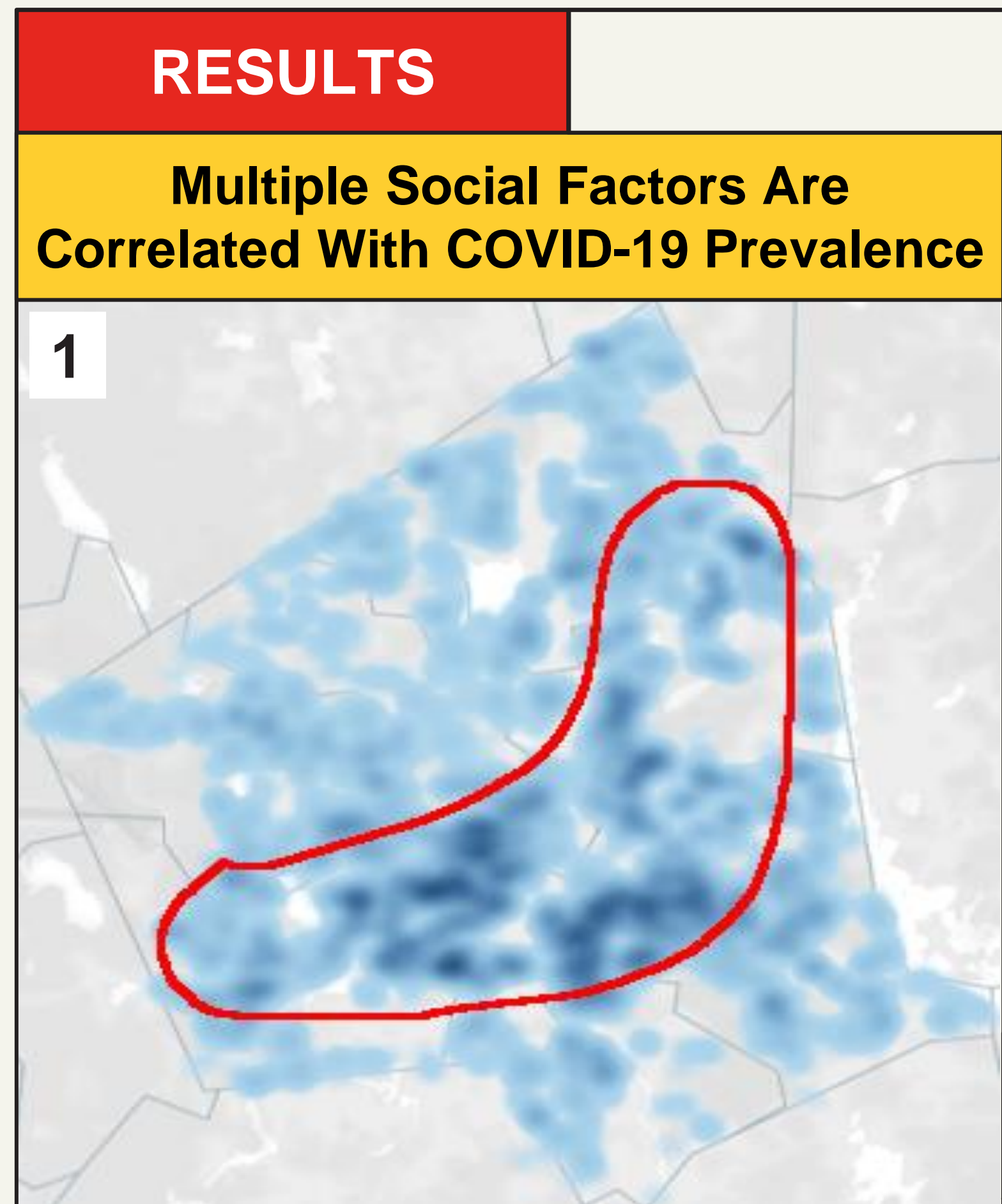
### HYPOTHESES

- There are oral microbiome signatures associated with the need for respiratory support.
- Social determinants of health correlate with COVID-19 prevalence and density in Worcester Massachusetts.

### METHODOLOGY

**1** Patients with COVID-19 or those exhibiting symptoms had a nasopharyngeal swab ordered upon admission to the UMass Memorial Hospital Emergency Department. Following this, patients were prompted by research staff to enroll in the study. To map the microbiota of each participant, whole DNA/RNA extraction using ZymoBIOMICS DNA/RNA Miniprep Kits was carried out, followed by Illumina sequencing. Illumina reads generated were used by the bioinformatics core at UMass to build a model for determining differences in microbial abundance as a predictor of respiratory support. The model generated used a machine learning algorithm and was trained using half the data collected. The other half of the data was used to generate an F1 score. With a relatively high F1 score of 0.85 the model was used to generate median importance values for a series of clinical factors, and microbial features found in the patients. To discern how specific microbes predicted the need for respiratory support or not, the model was also used to measure differences in abundance levels of each microbe.

**2** In order to determine what social factors may be correlated to COVID-19, an analysis of the most abundantly cited factors related to general health outcomes was performed. Following this, data collected from local and state agencies, and the U.S. Census survey were aggregated and overlaid over maps of Worcester, MA (These maps came from various private data collecting sites). To draw correlations between these social factors and COVID-19 prevalence, these maps were compared to a COVID-19 density map provided by the Worcester Department of Public Health.



**Figure 1: Social Determinants Correlated to COVID-19 Density in Worcester Massachusetts** – Represents different social factors relevant to the spread of disease and poor health. Darker regions represent higher prevalence of the associated determinant. *Graph 1* represents COVID-19 density/prevalence. *Graph 2* represents Hispanics Alone; *Graph 3* represents Whites Alone; *Graph 4* represents Income Below Poverty; *Graph 5* represents Less Than High School Education.

**Figure 3: Microbial Feature Abundance (Y) vs. Dichotomous Outcome (X): Need for respiratory support or not** – Represents the relative abundance of particular microbial features associated with either no need for respiratory support (0, blue), or the need for respiratory support (1, red). Box-and-whisker plots should not be compared within the same graphs, as there is no statistical significance in their differences. Additionally, each graph is associated with its own relative scale. Rather, each relative abundance and outcome should be viewed independently of one another. *Graph 1 (P. salivae)* shows that a higher abundance of microbe in patients is associated with an absence of the need for respiratory support. Similar findings are also seen for the microbial species in *Graphs 2-6, 8*. In *Graph 7* differences in abundances of bacteria were poorly associated with both the need or the absence of the need for respiratory support.

### DISCUSSION

#### COVID-19 Update: March 14, 2020 First Case

Microbiome

Transportation

Education

Crime

Nutrition

Income

In addition to behaviors, genetics, the environment, and medical care, COVID-19 prevalence (as shown from Spring 2020 to present) in Worcester is correlated to multiple social factors as well as patients' microbiomes.

This supports previous studies that highlight the effects of the microbiome on disease progression. Additionally, this supports epidemiological findings that correlate individual life circumstances with health outcomes.

It is important to fund research for new and innovative treatment options, medications, and technologies. It is equally as important to understand how *the world* within and outside of us determine our health.

#### Further Research

Further investigations in microbiology and epidemiology are needed to fully understand the role that both the microbiome and social determinants of health play within people's lives.

How do some microbes protect the individual from worsening COVID-19-associated respiratory distress?

Are there some microbes not found in this population that are highly associated with the need for respiratory support following COVID-19?

Can we detect causal relationships between social factors and the spread of infectious disease? Chronic disease?

What can we do to ensure health-related decisions take into account social factors such as those described in this study?

**COVID-19 Update: April 22, 2021**  
**23,047 Cases**