

# Sampling Respiratory Viruses in Exhaled Breath Using the Gesundheit-II (G-II)

Maya B. Hoffman, Tyler J. Spielman, Nathan F. Monteparte, Madison L. Sawyer, Ali Hasani, Anna Pulley, Philippe P. Lubet, Yi Esparza, Saratu Kehinde, Olga Volchansky, William C. Smith, Alycia A. Smith, Kristen K. Coleman, and Donald K. Milton

Public Health AeroBiology Laboratory, University of Maryland, College Park

## Background

### Respiratory Pathogens

From COVID-19 to the emerging H5N1 “bird flu,” many diseases are airborne (i.e., acquired through inhalation).<sup>1,2</sup>

### Aerosol Generation

Bioaerosols are suspended particulate matter of a biological origin.<sup>3</sup> Infectious bioaerosols are airborne particles that can transmit pathogens via talking, sneezing, and coughing. Bioaerosols range from 0.1 to 100µm in diameter, with fine bioaerosols classified as ≤ 5µm.<sup>4</sup>

## Objectives

- Measure viral shedding in exhaled breath (EB) of acutely ill College Park student participants
- Compare respiratory pathogens found in mid-turbinate swabs vs. exhaled aerosols to gain insight into the airborne transmissibility of various respiratory pathogens

## Methods

We sampled from a cohort of 70-75 University of Maryland dormitory roommate pairs to provide a mid-turbinate (MT) swab and 30-minute EB samples using the Gesundheit-II bioaerosol sampler. Study participants were selected based on self-reported onset of symptoms. MT swabs and EB samples were screened for common respiratory viruses using Cepheid and TaqMan Array Cards (TAC). Samples were cultured for influenza A virus using TCID<sub>50</sub> assay.<sup>5</sup>

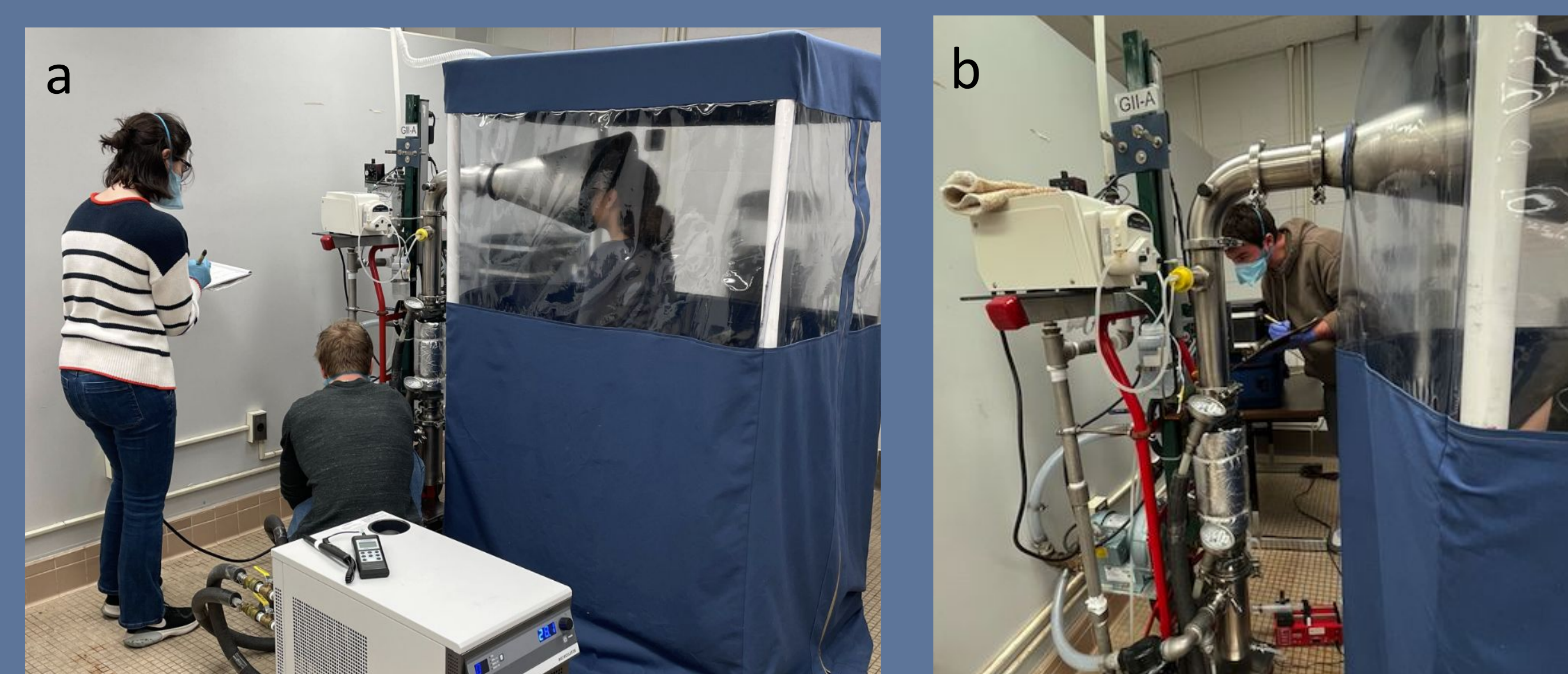


Fig. 1 A) M. Hoffman and N. Monteparte B) T. Spielman recording G-II operating values at minutes 5, 15, and 25.

## Results

### Cepheid Results

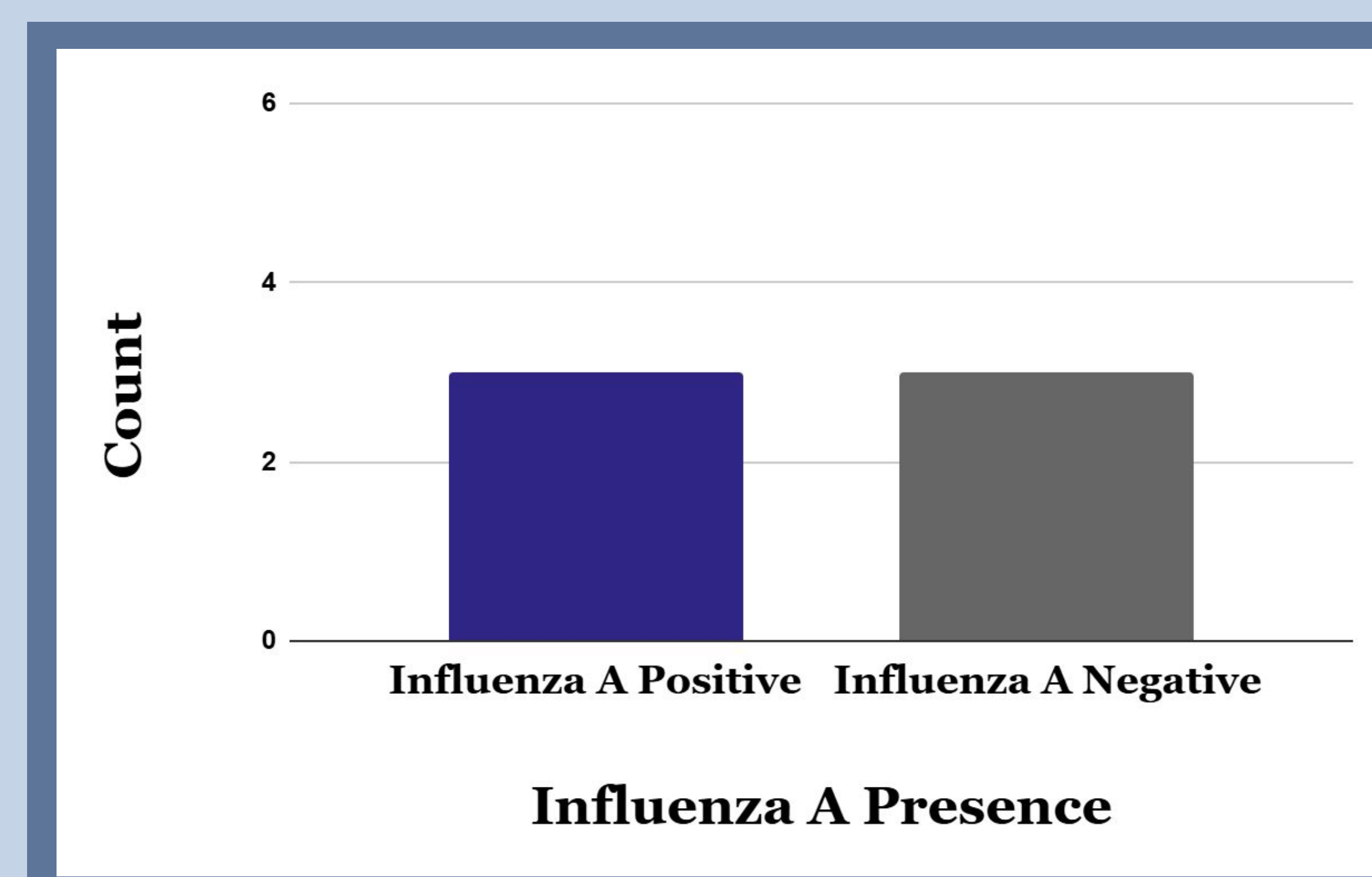


Fig 2. Influenza A detection via Cepheid. Three of the six Cepheid tests were positive for influenza A (one trace-positive sample was omitted), and 3 were negative.

### MTS TaqMan Array Card (TAC) Results

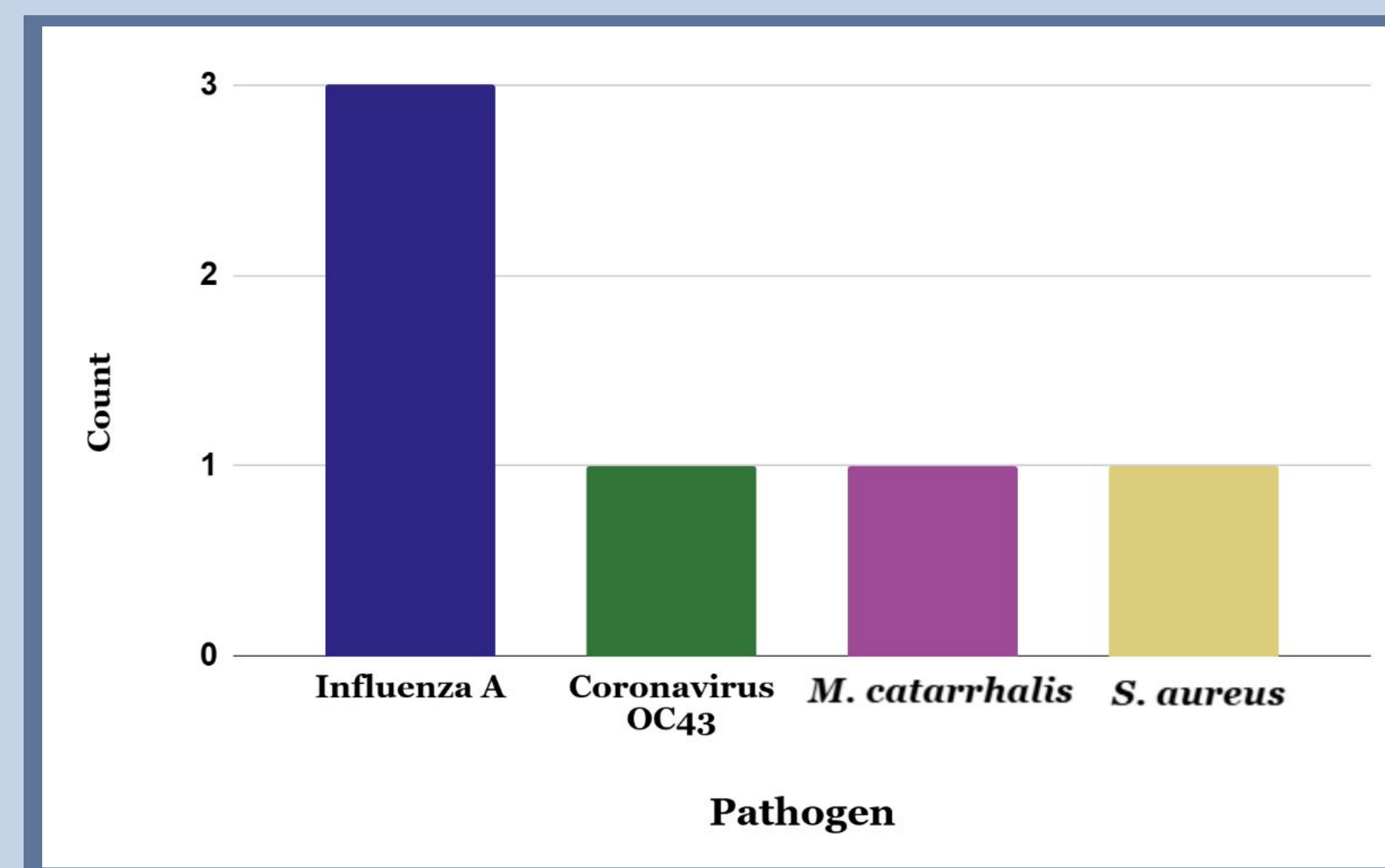


Fig 3. Respiratory pathogen detection via TAC. TAC testing revealed various pathogens in 5, including influenza A, coronavirus OC43, *Staphylococcus aureus*, and *Moraxella catarrhalis*.

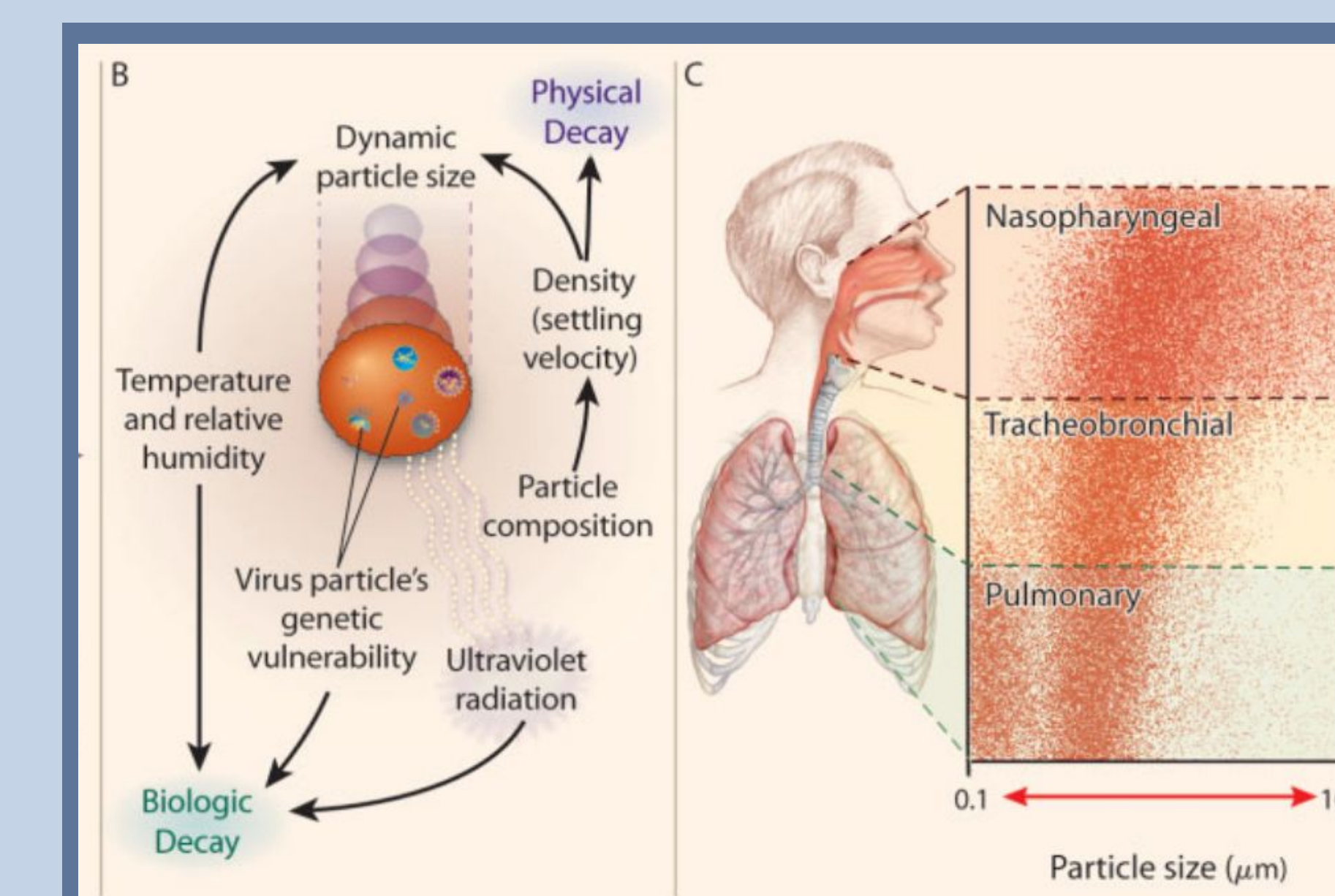
The 7 fine aerosol samples were **culture negative** for influenza A virus. Due to small sample size, results are preliminary. TAC results for G-II samples are pending.

## Discussion

### Respiratory Shedding & Deposition

By collecting G-II exhaled breath samples, we can learn how influenza and other respiratory pathogens are shed from the respiratory tract, and how this impacts onward transmission.

- Smaller aerosol particles tend to persist longer in the air and are prone to deposit in the lower respiratory tract.<sup>6</sup>
- Larger aerosol particles are prone to deposit in the upper respiratory tract, potentially causing milder illness.<sup>6</sup>



Roy CJ, Milton DK. Airborne Transmission of Communicable Infection — The Elusive Pathway. NEJM 2004.

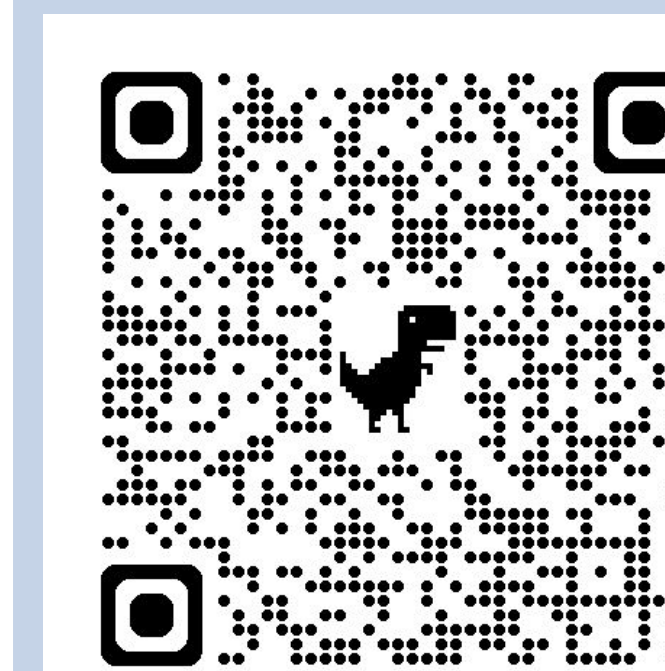
Fig 4. B) The length of time an infectious particle resides and survives in the air depends on its initial size, composition, and environmental factors; C) The portion of the respiratory tract of a susceptible host in which inhaled particles are deposited is a function of the particles' aerodynamic size.<sup>6</sup>

### Public Health Implications

Our findings may refine guidelines for infection control in shared living spaces by:

- Better informing public health interventions to control outbreaks, and
- Setting new standards for infection control.

## References



## Acknowledgements

We express gratitude towards the PHAB Lab bioaerosol team for training and expertise to make this project possible, as well as the PHAB Lab clinical and virology team for support throughout the data collection process. This research is funded by the NIH: NIAID Centers of Excellence for Influenza Research & Response (0258D5044609), Evaluating Modes of Influenza Transmission using Innovative Technologies and Designs in Controlled Environments (U19AI162130A).