# Reflections from RADx-rad Wastewater-based Epidemiologic Studies and Potential Future Directions

Presented by
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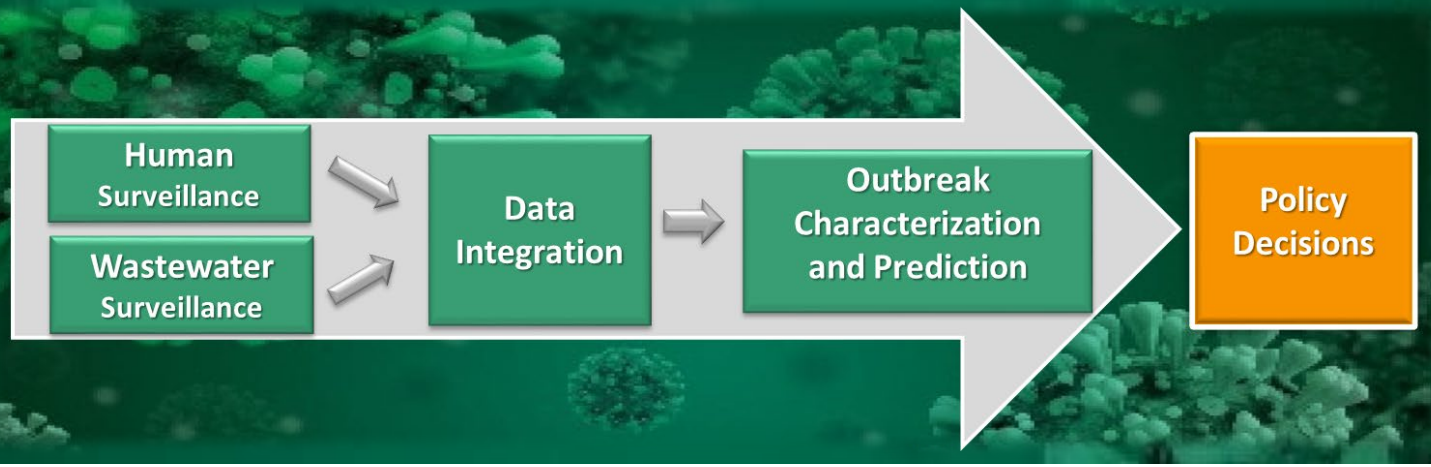



UNIVERSITY OF MIAMI

Weill Cornell Medicine

Funded by NIH RADx-rad Grant 1U01DA053941-01

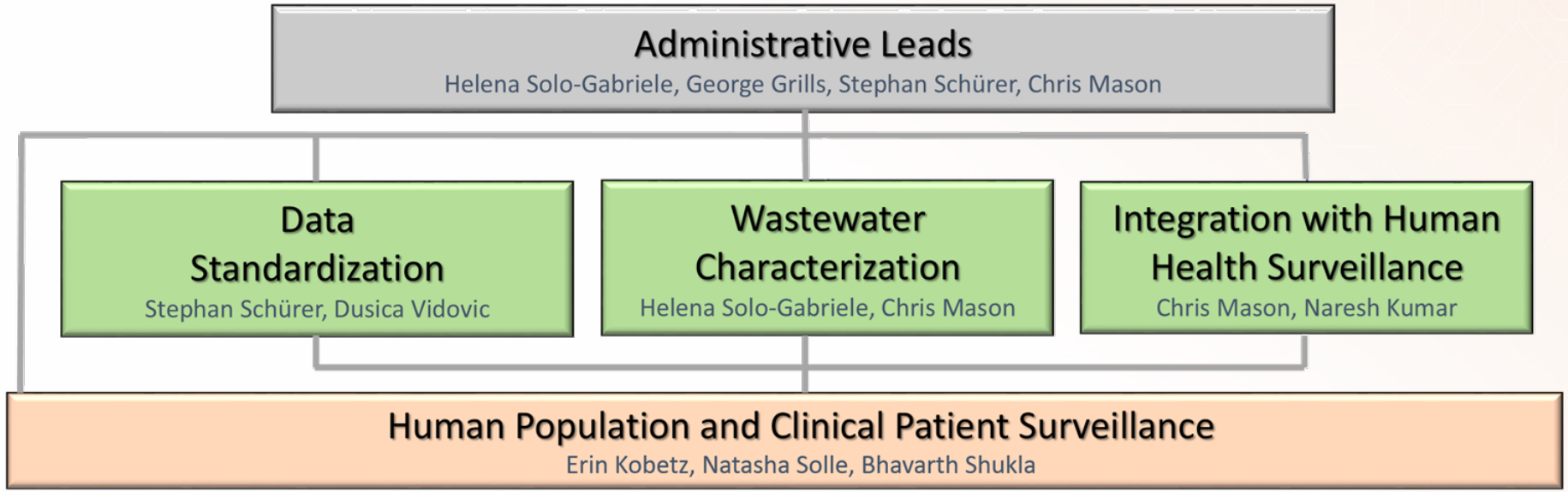
# SF-RAD: SARS-CoV-2 Wastewater-Based Surveillance

Aims

1. Data standardization and informatics infrastructure
2. Wastewater characterization
3. Integration with human health surveillance

- Relate wastewater to human surveillance data
- Evaluate influence of watershed scale
- Evaluate sample collection method
- Evaluate sample concentration methods

## Administrative Organization



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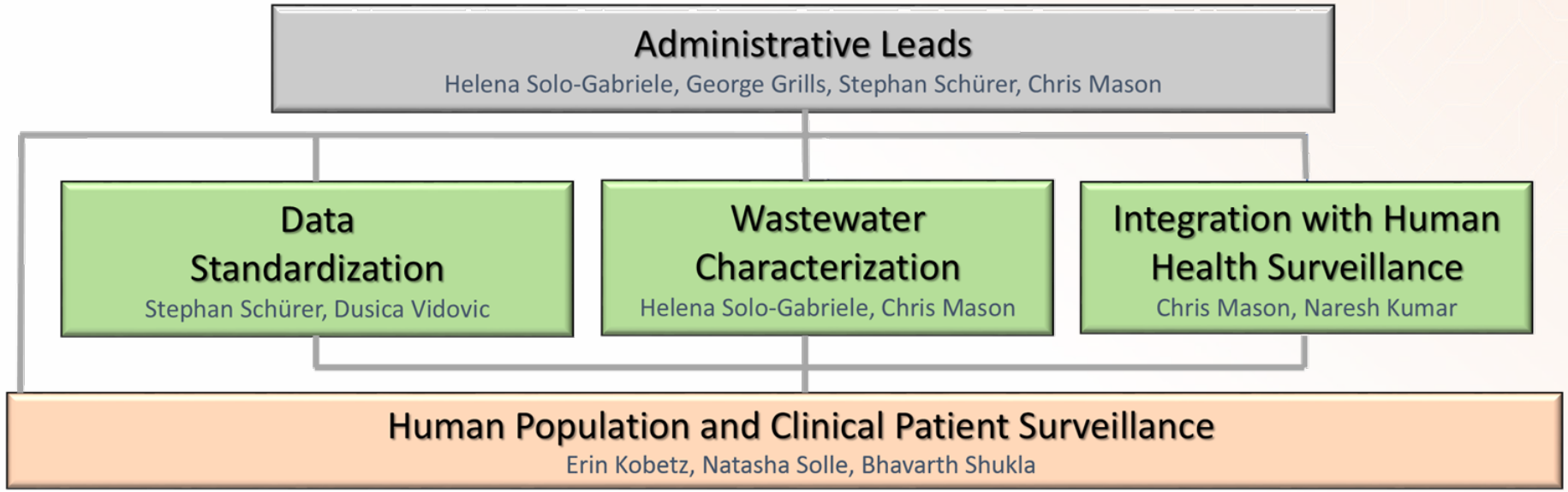


# Human Surveillance

**Campus Students and Faculty/Staff**, UMiami (Sep. 2020)

*Fall'20/Spring'21*

- Students tested weekly (nasal swab, qPCR) Supplemented by breath test
- COVID results and total tests by building/dorm room

*Summer/Fall'21*

- Unvaccinated students tested weekly
- All students tested when wastewater exceeds

**University Hospital**, UMiami Medical (Sep. 2020)

- Treat known COVID patients
- Electronic medical records pulled regularly

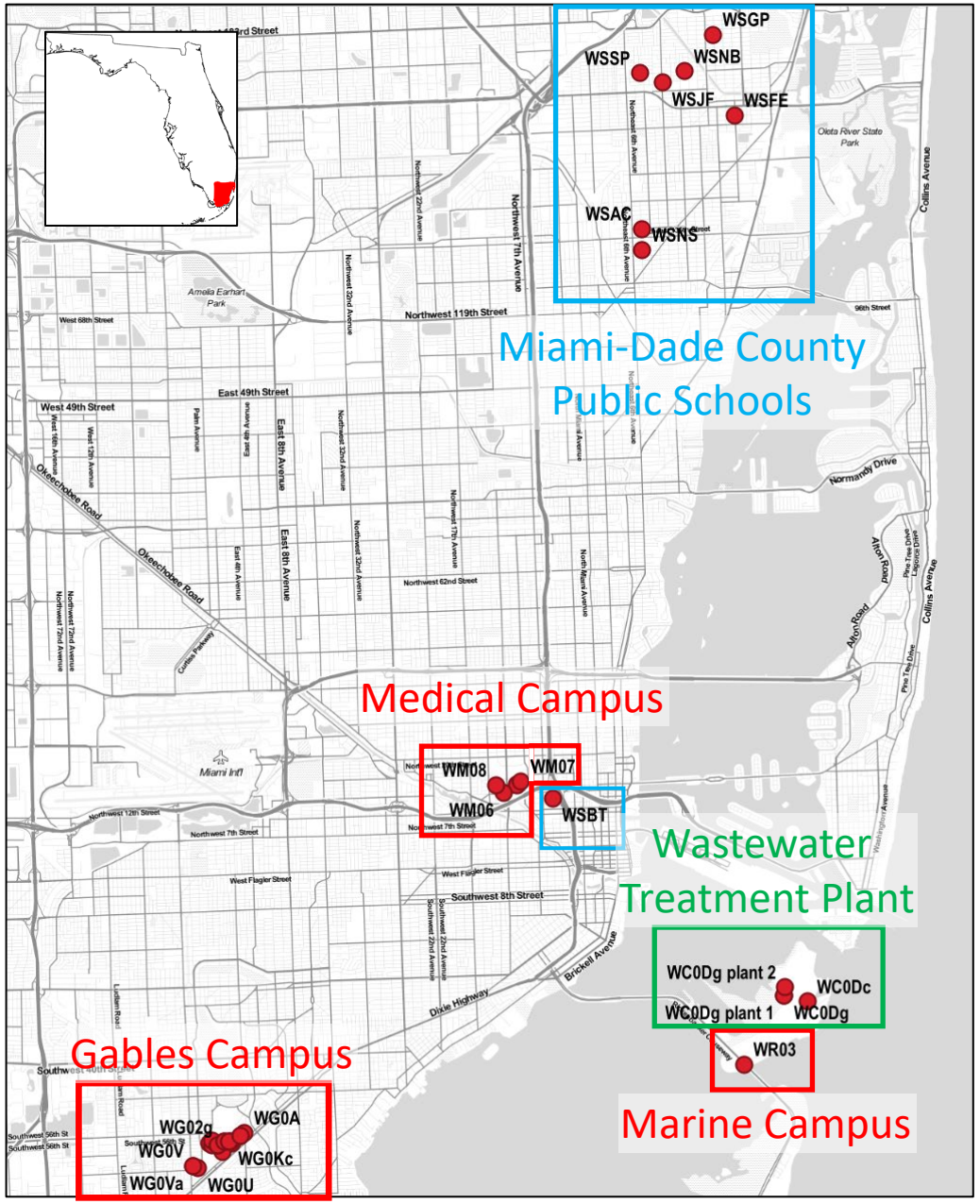
**Miami-Dade County Residents**, FDOH WWTP (Jan. 2021)

- Positives by zip code
- Number of tests by zip code
- Augment with Biobot wastewater data (Apr. 2020)

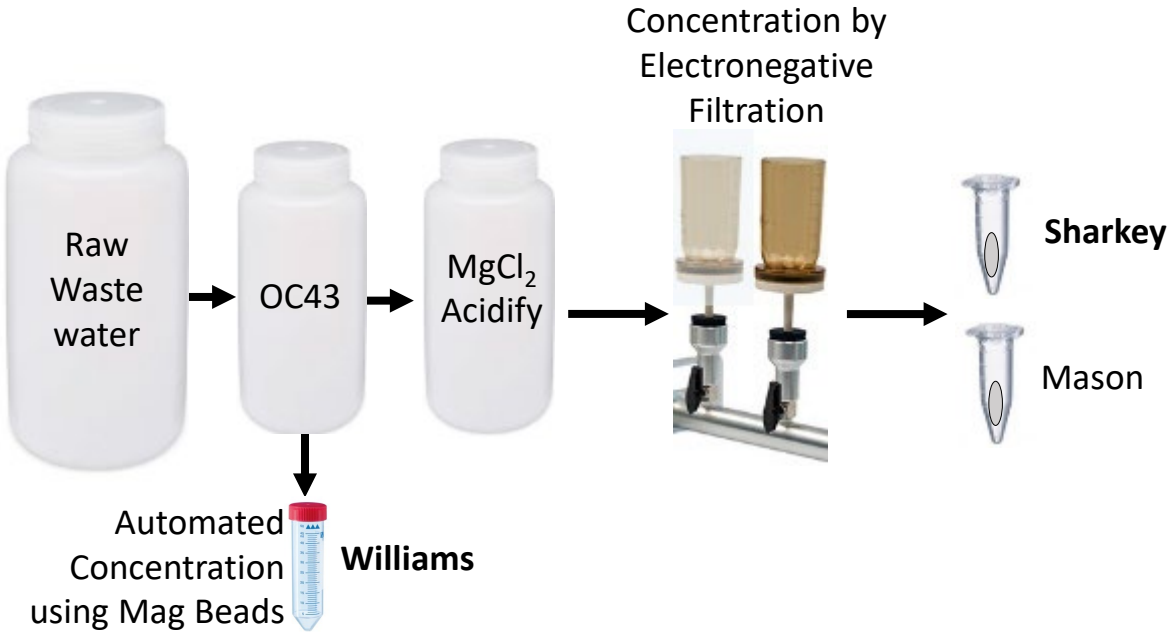
**Miami-Dade County Public Schools**, MDCPS (Jan. 2022)

- In collaboration with RADx-UP project (Gwynn, PI)
- 9 Schools (4 Elementary, 2 Middle, 3 High Schools)

# Sample Collection Plans



# General Workflow

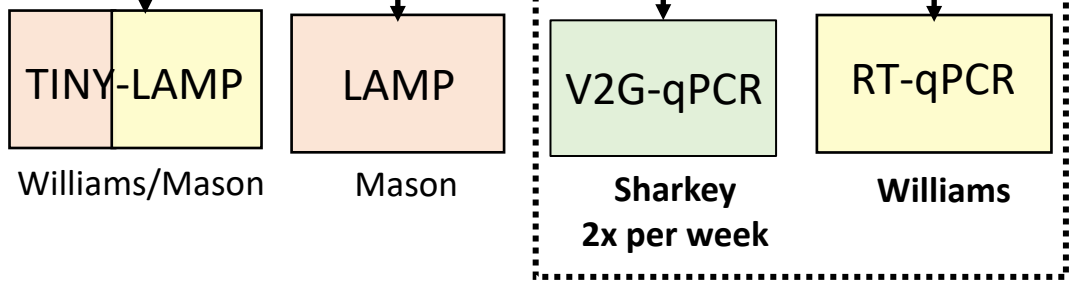



M. Sharkey,
Center for AIDS Research, UM

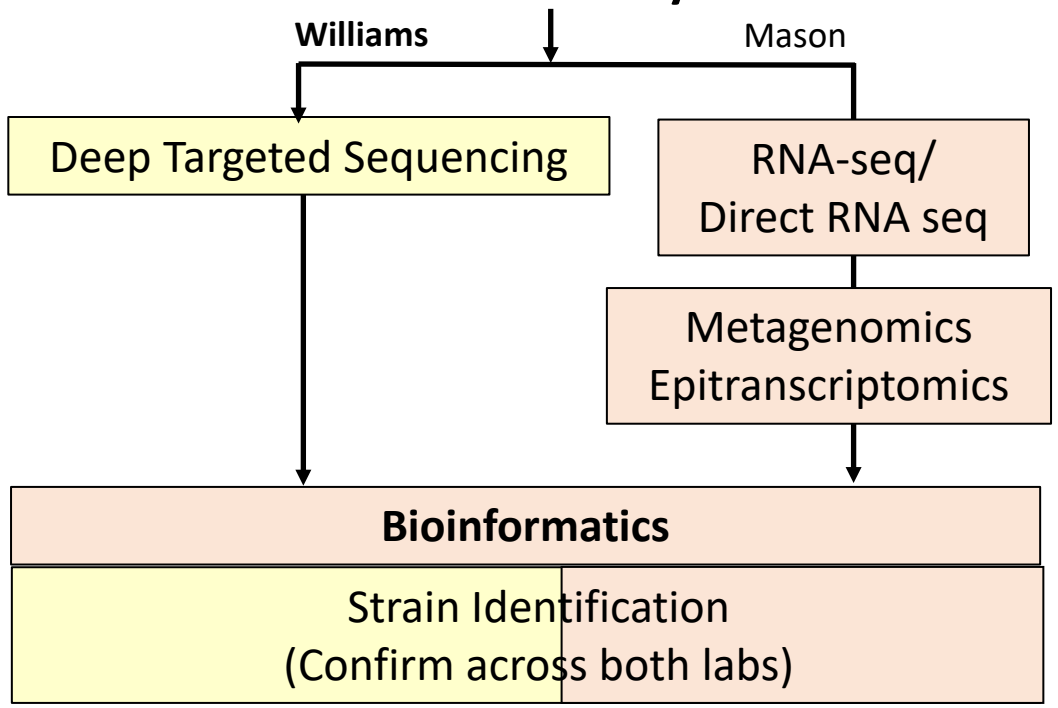
S. Williams
Onco-Genomics Shared Resource, UM

C. Mason,
Integrated Genomics Lab, WCM/MetaSub

## Rapid Detection




## Genomic Analysis




Sharkey et al. 2021
https://doi.org/10.1016/j.scitotenv.2021.149177

Babler et al. 2022
https://doi.org/10.1021/acsestwater.2c00047

# Human Surveillance

**Student Campus Residents**, UMiami Gables/Marine (Sep. 2020)

*Fall'20/Spring'21*

- Students tested weekly (nasal swab, qPCR) Supplemented by breath test
- COVID results and total tests by building/dorm room

*Summer/Fall'21*

- Unvaccinated students tested weekly
- All students tested when wastewater exceeds

**University Hospital**, UMiami Medical (Sep. 2020)

- Treat known COVID patients
- Electronic medical records pulled regularly

**Miami-Dade County Residents**, FDOH WWTP (Jan. 2021)

- Positives by zip code
- Number of tests by zip code
- Augment with Biobot wastewater data (Apr. 2020)

*Pilot*, **Miami-Dade County Public Schools**, MDCPS (Jan. 2022)

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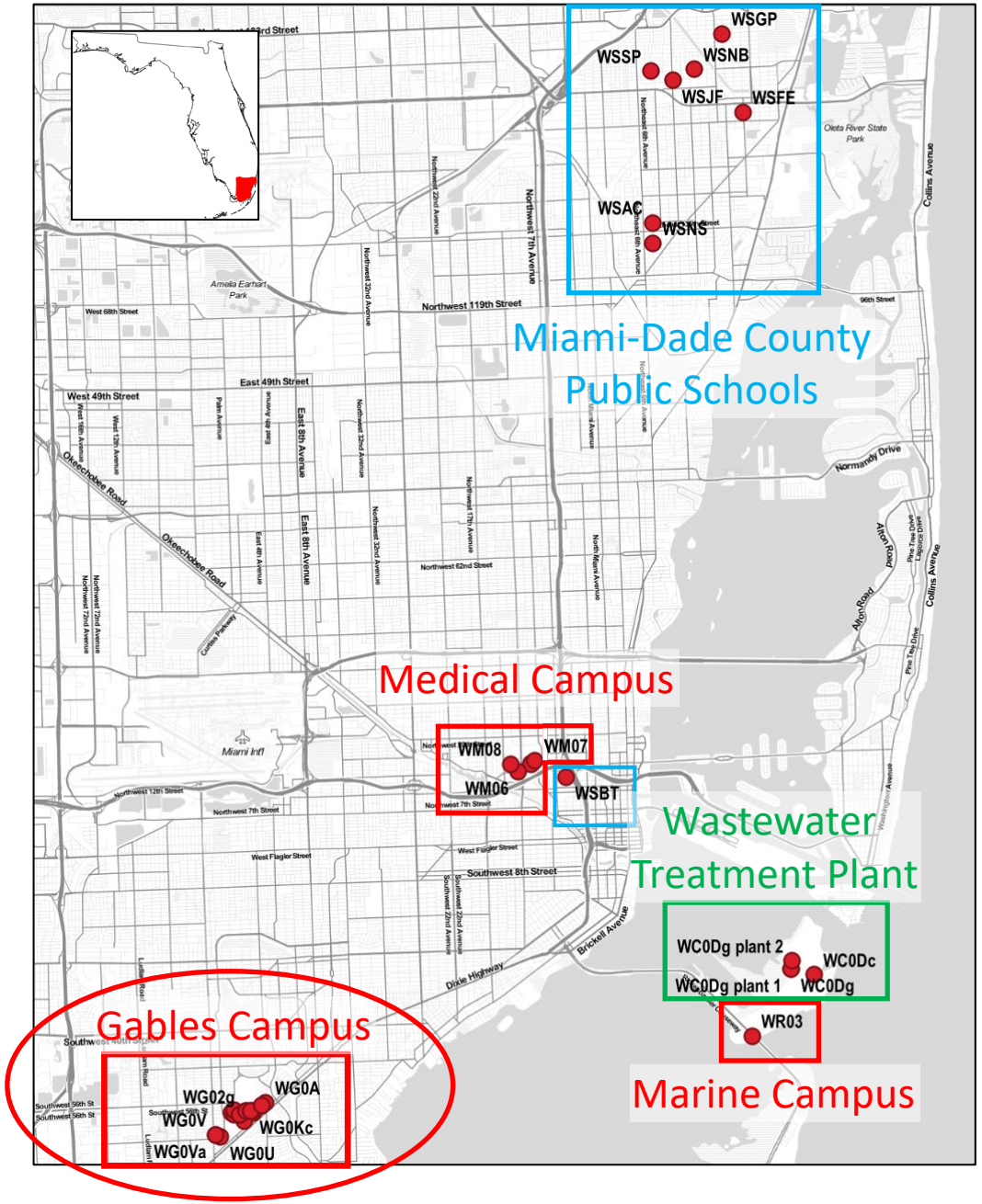

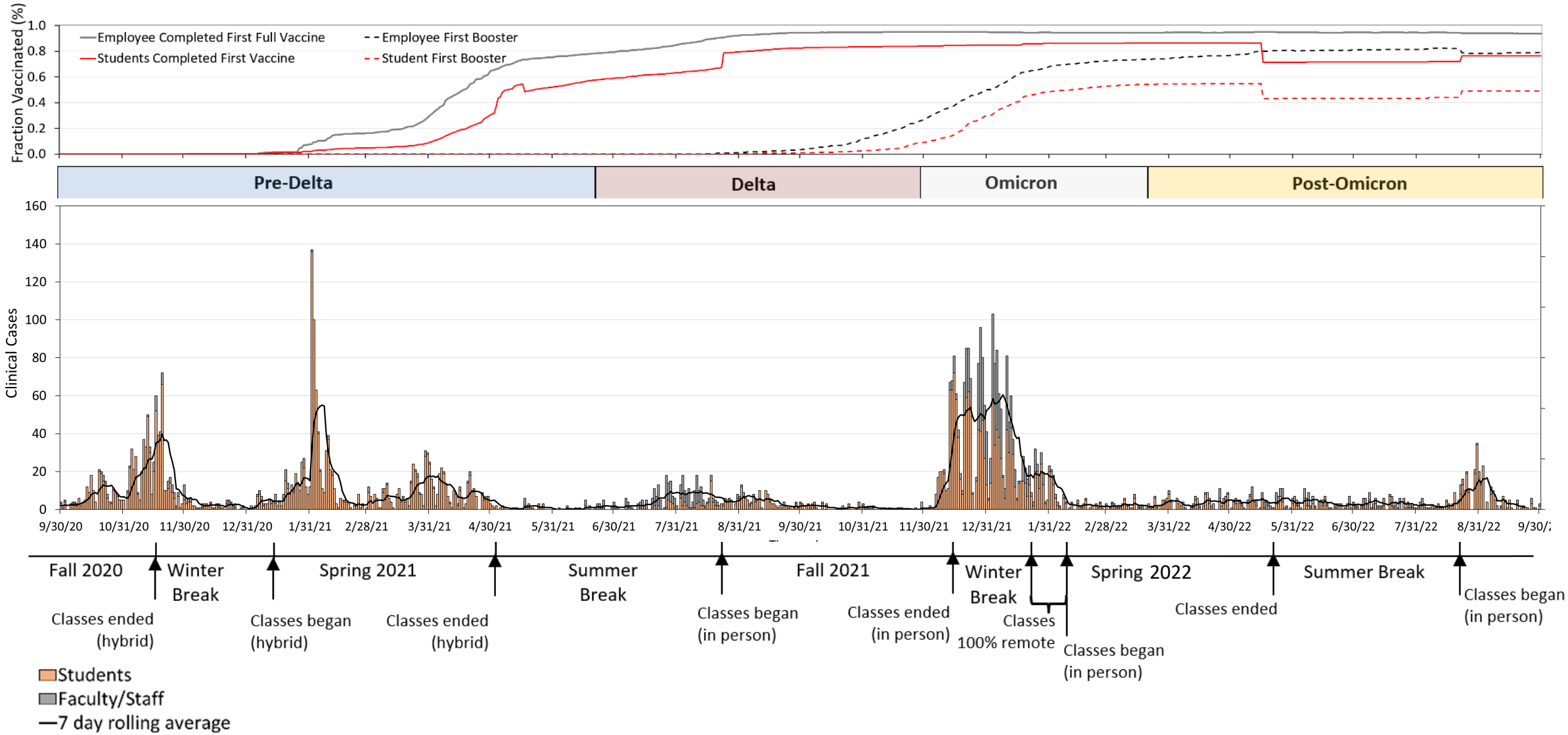


# Campus

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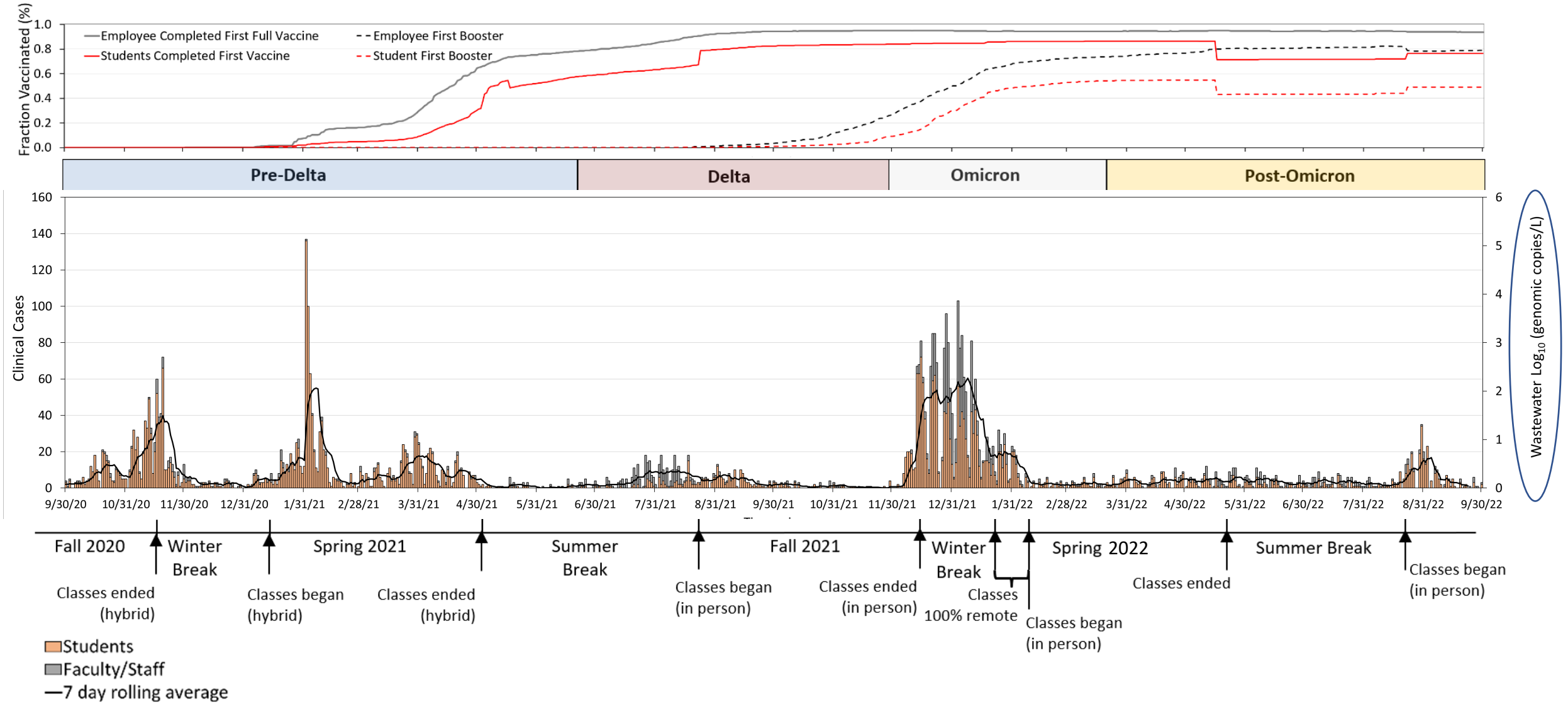


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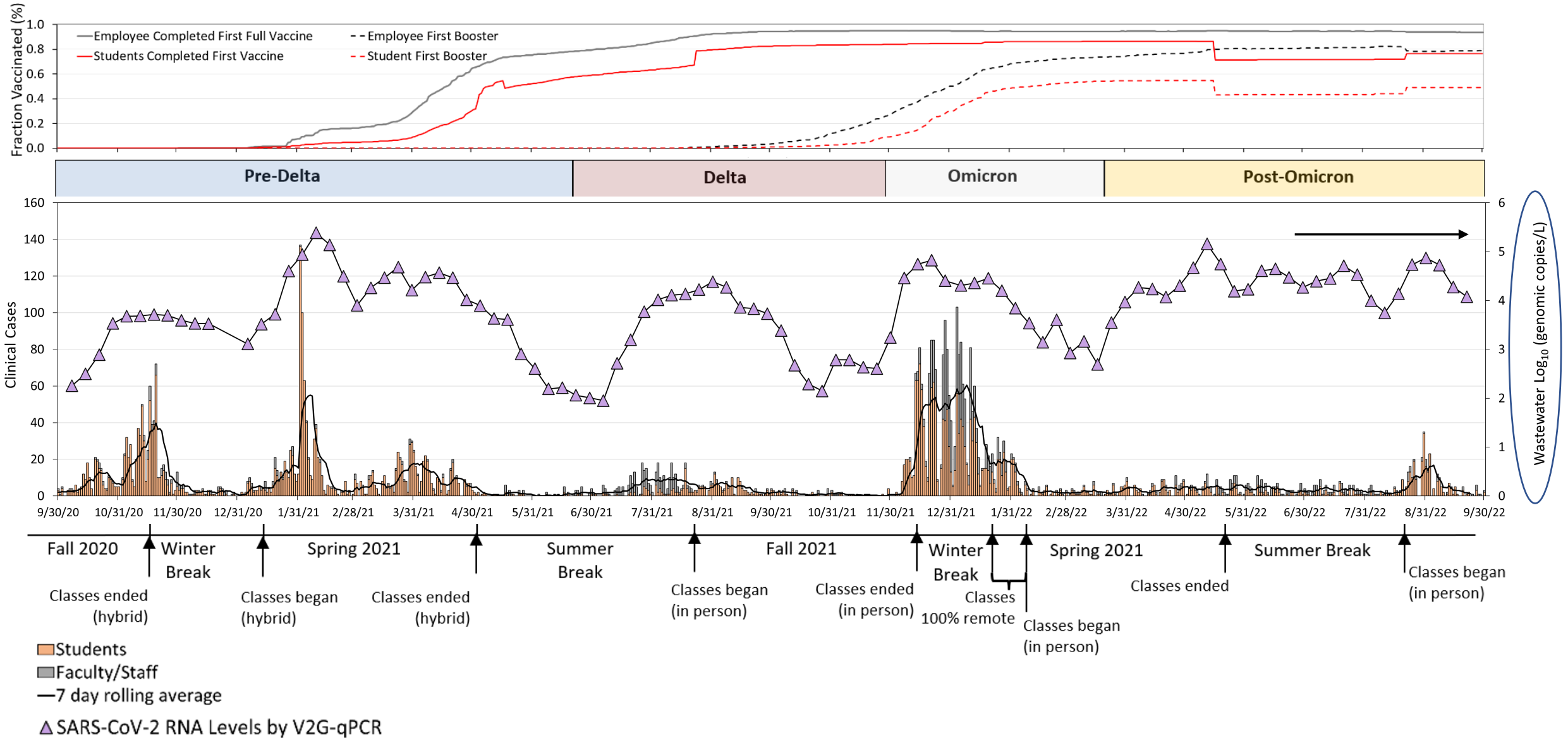


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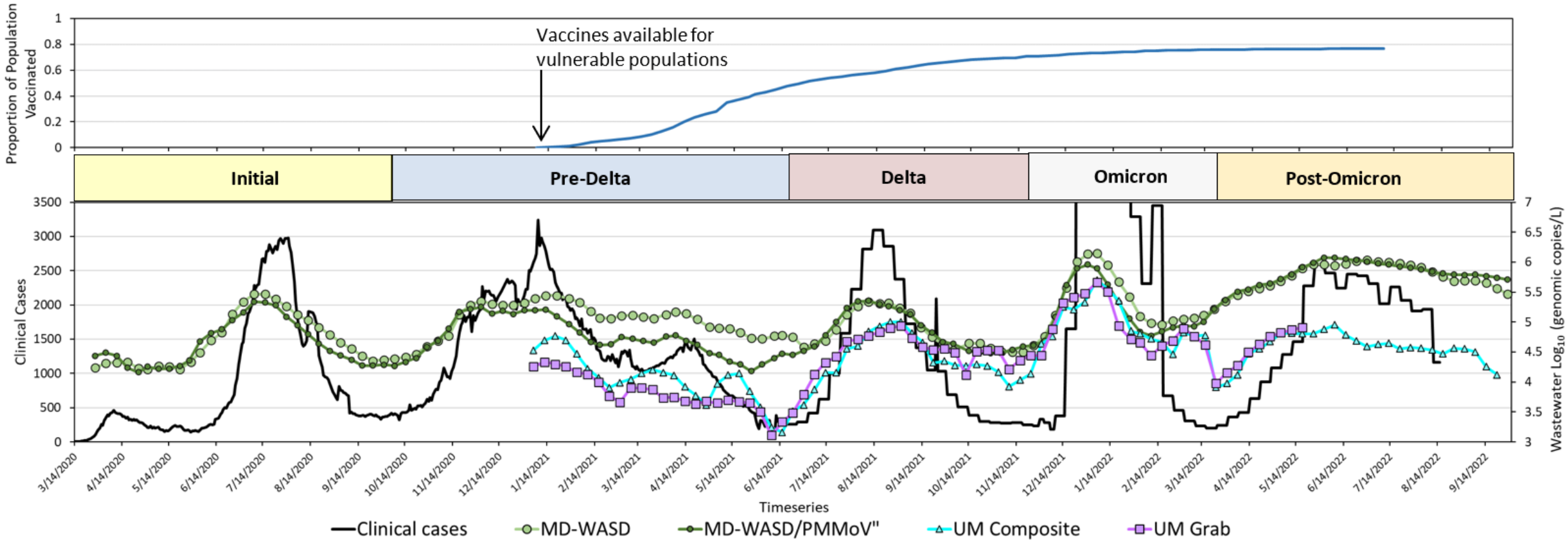
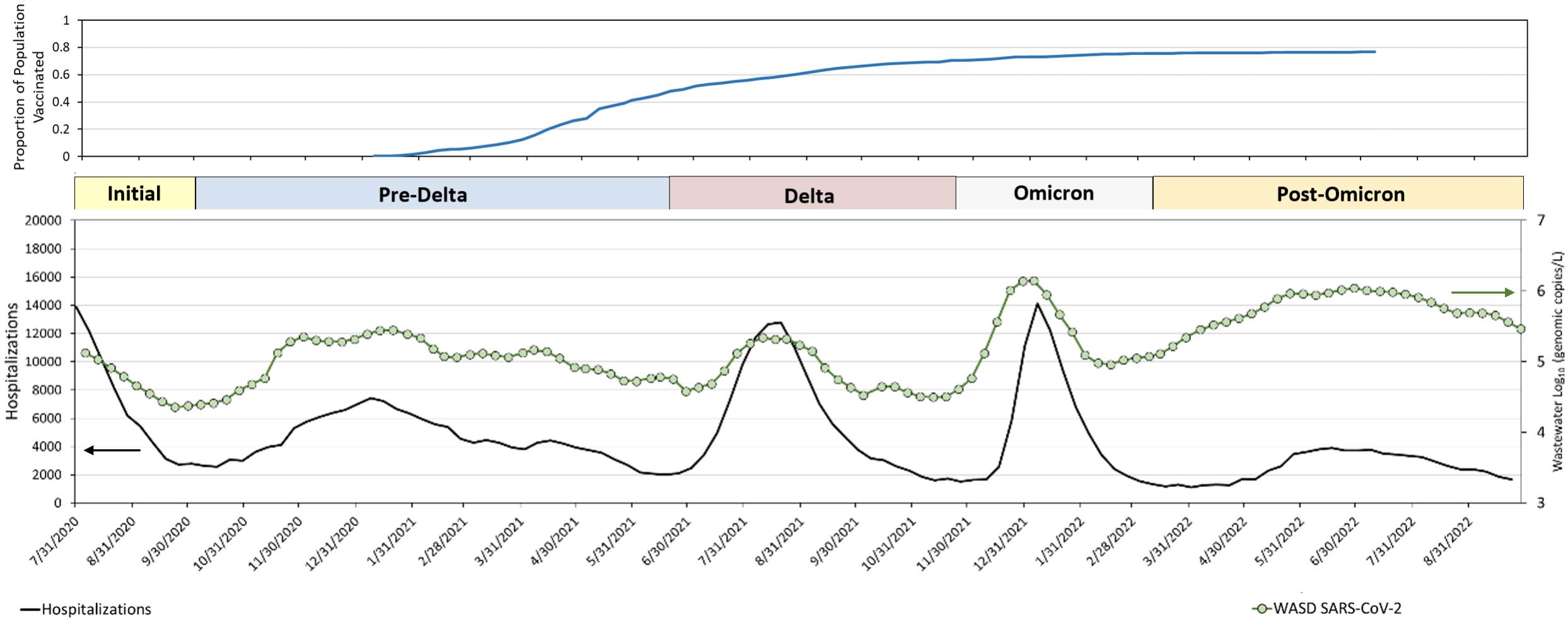


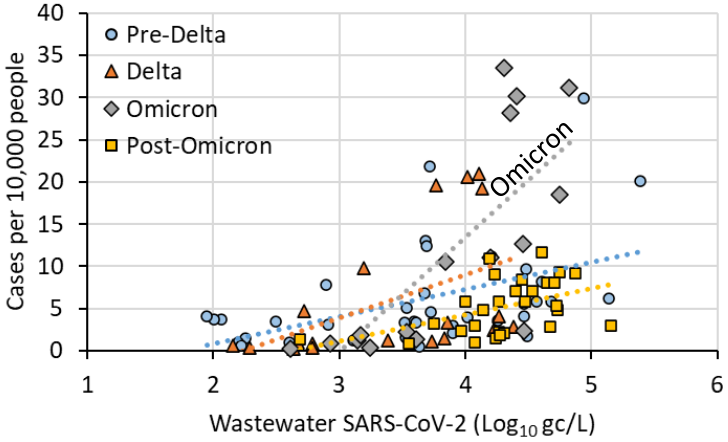

# Cases and Community Wastewater



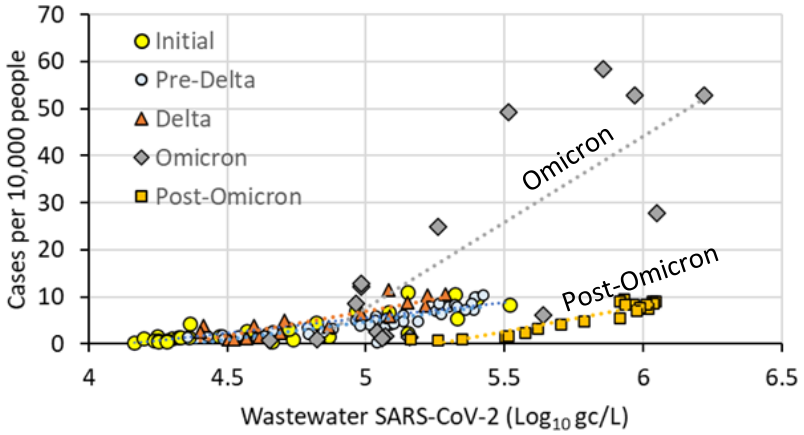

# Hospitalizations and Community Wastewater

# Variations by Variant Waves

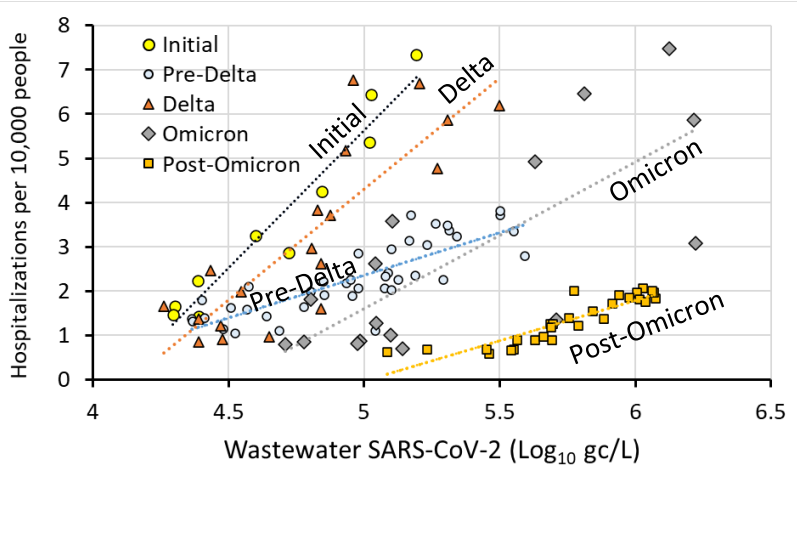
## Campus (Cases)




## Community (Cases)




## Community (Hospitalizations)




Cases: Omicron (◆) wave highest prevalence of cases per level observed in WW

Hospitalizations: Initial wave (●) highest hospitalization rate followed by Delta (▲) per level observed in WW

Zhan et al. (in preparation)

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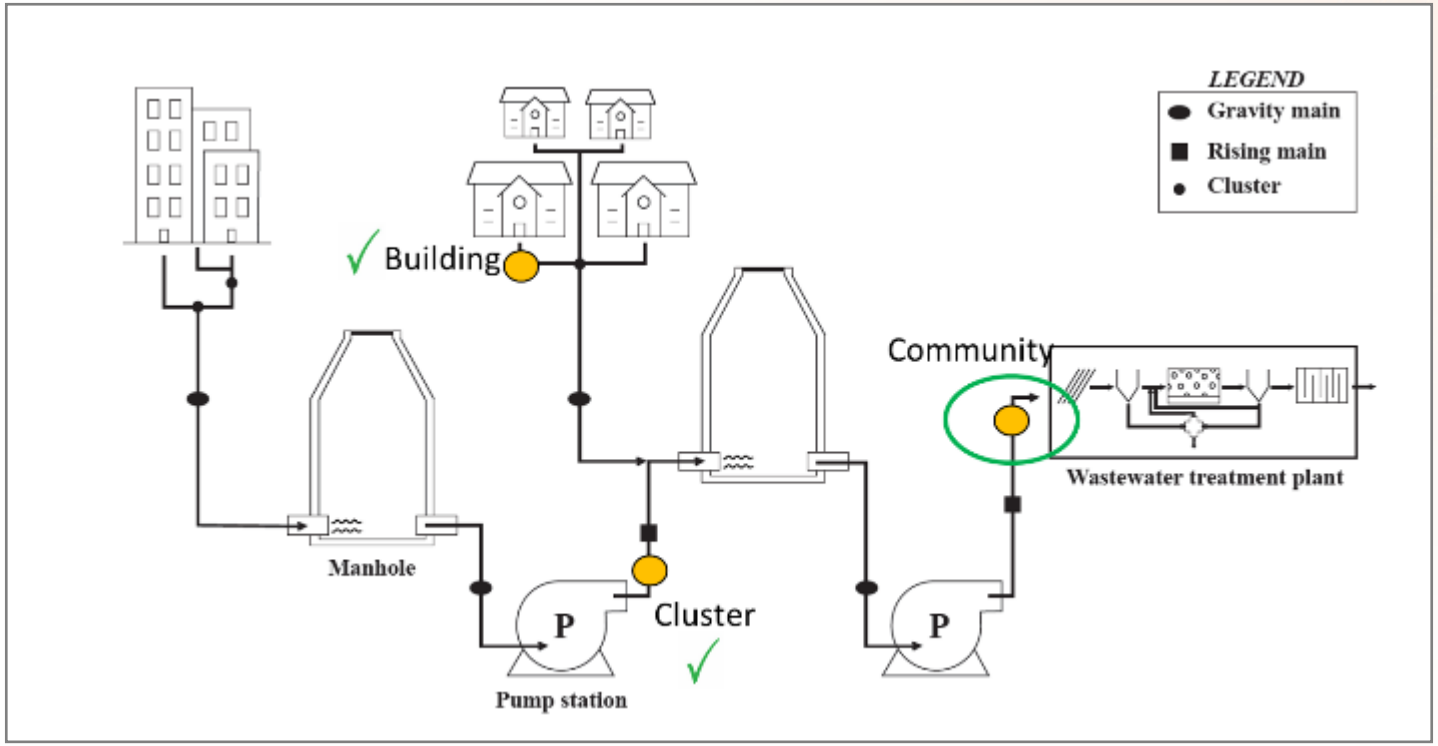
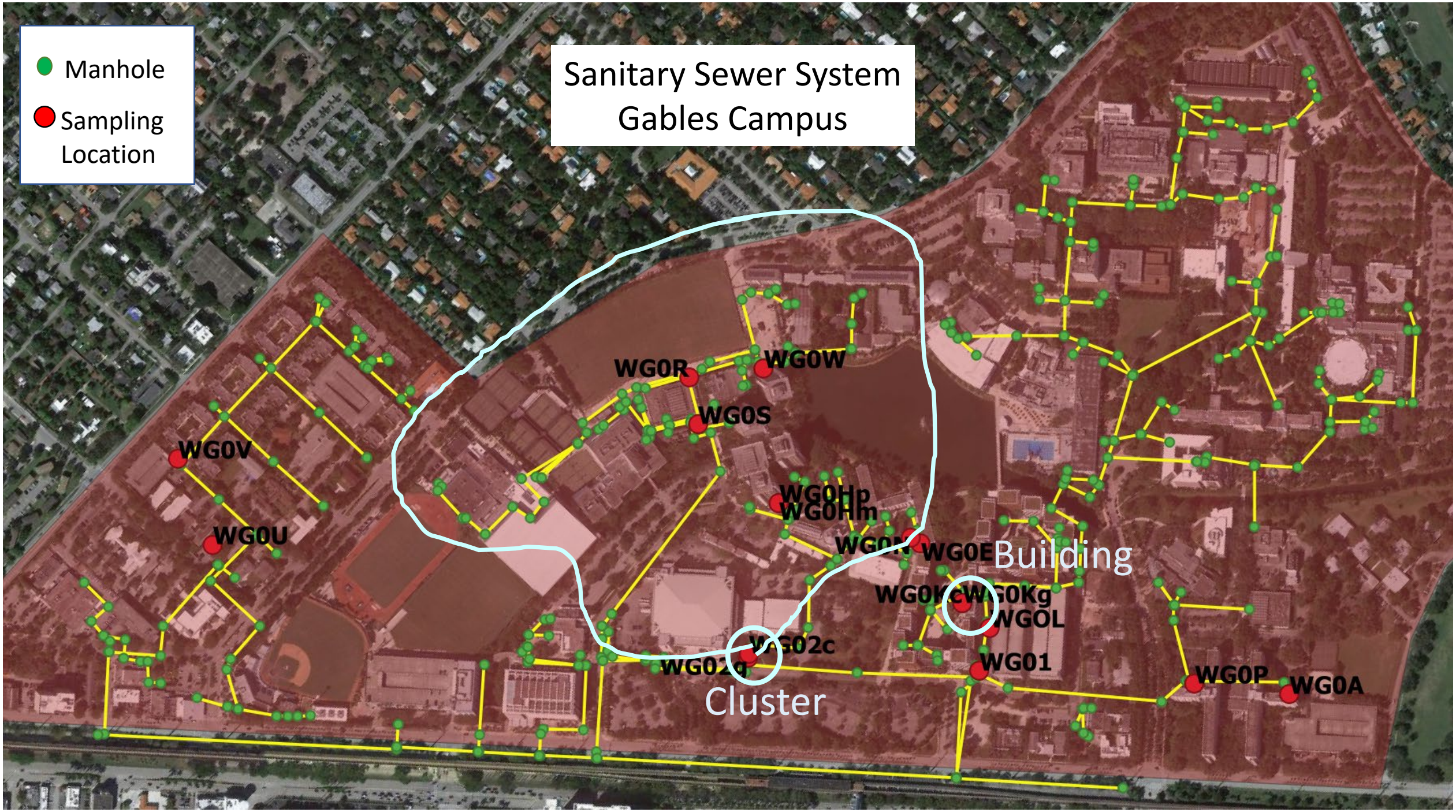
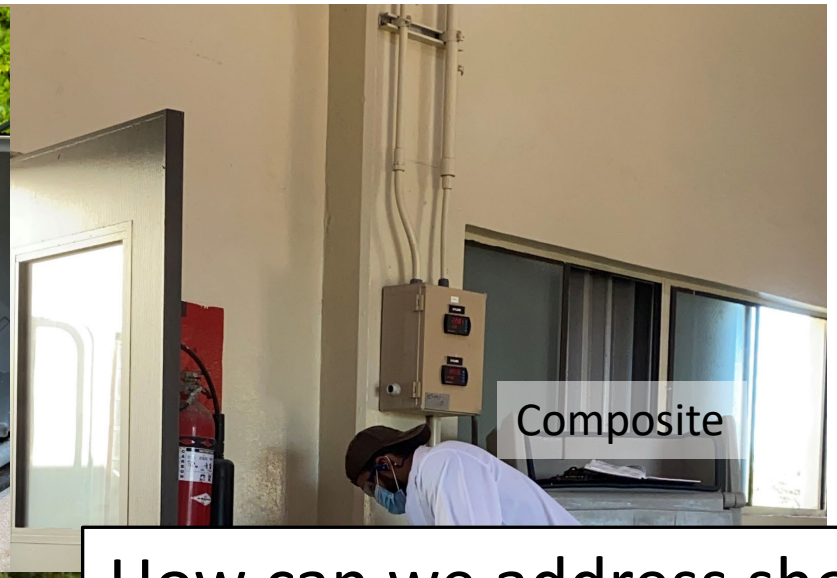



Manhole
Sampling Location
Sanitary Sewer System
Gables Campus
WG0R
WG0W
WG0S
WG0V
WG0U
WG0Hp
WG0Hm
WG0E
Building
WG0Kg
WG0L
WG02c
WG02q
WG01
WG0P
WG0A
Cluster

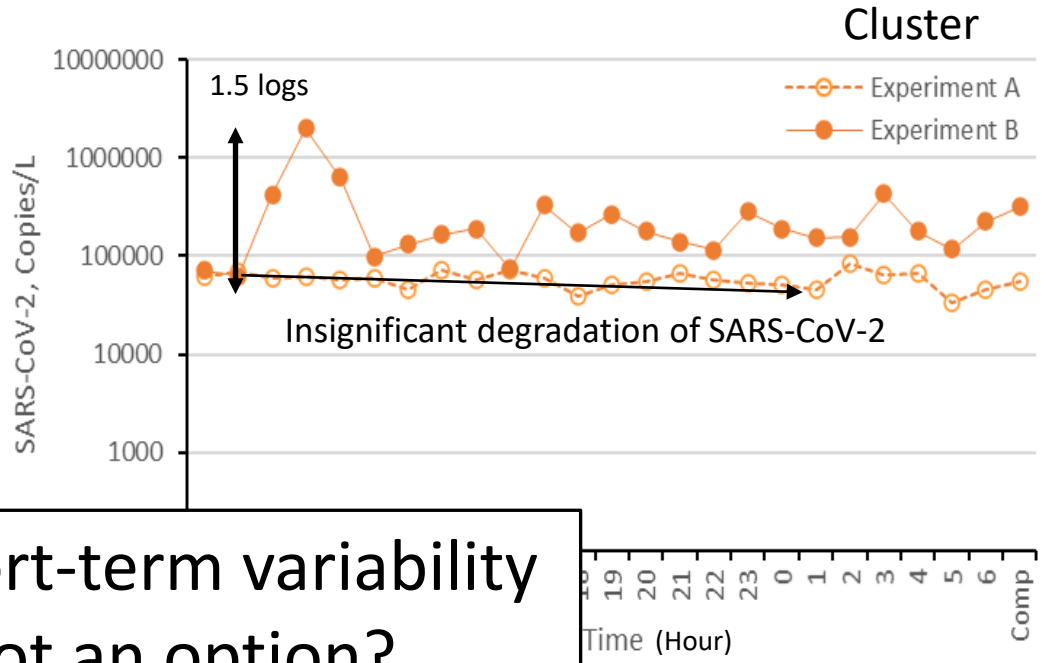
# Sample Collection Strategies

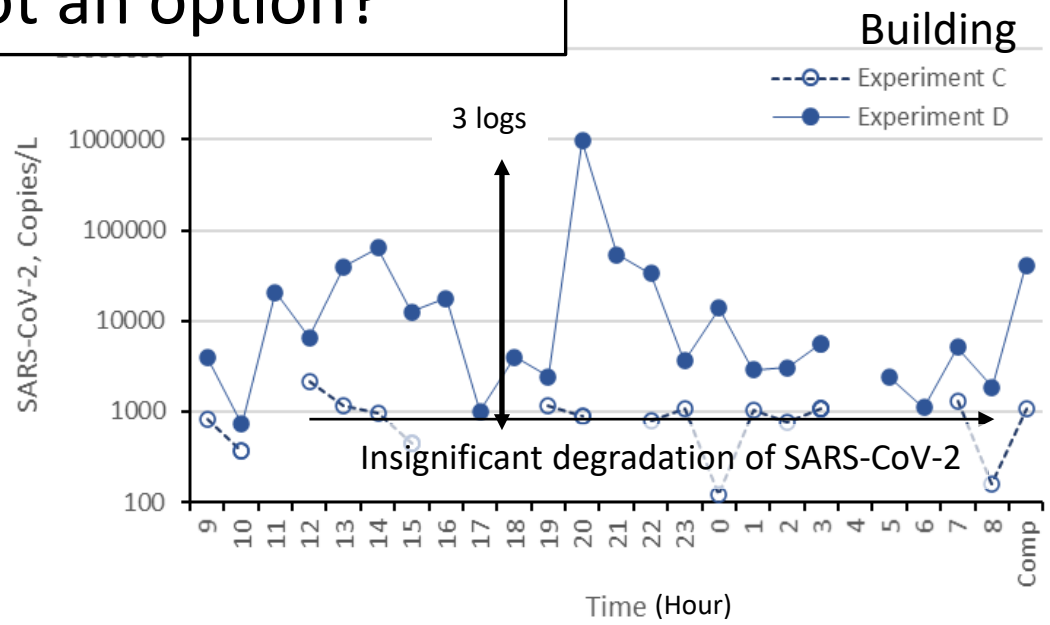
Babler et al. in review

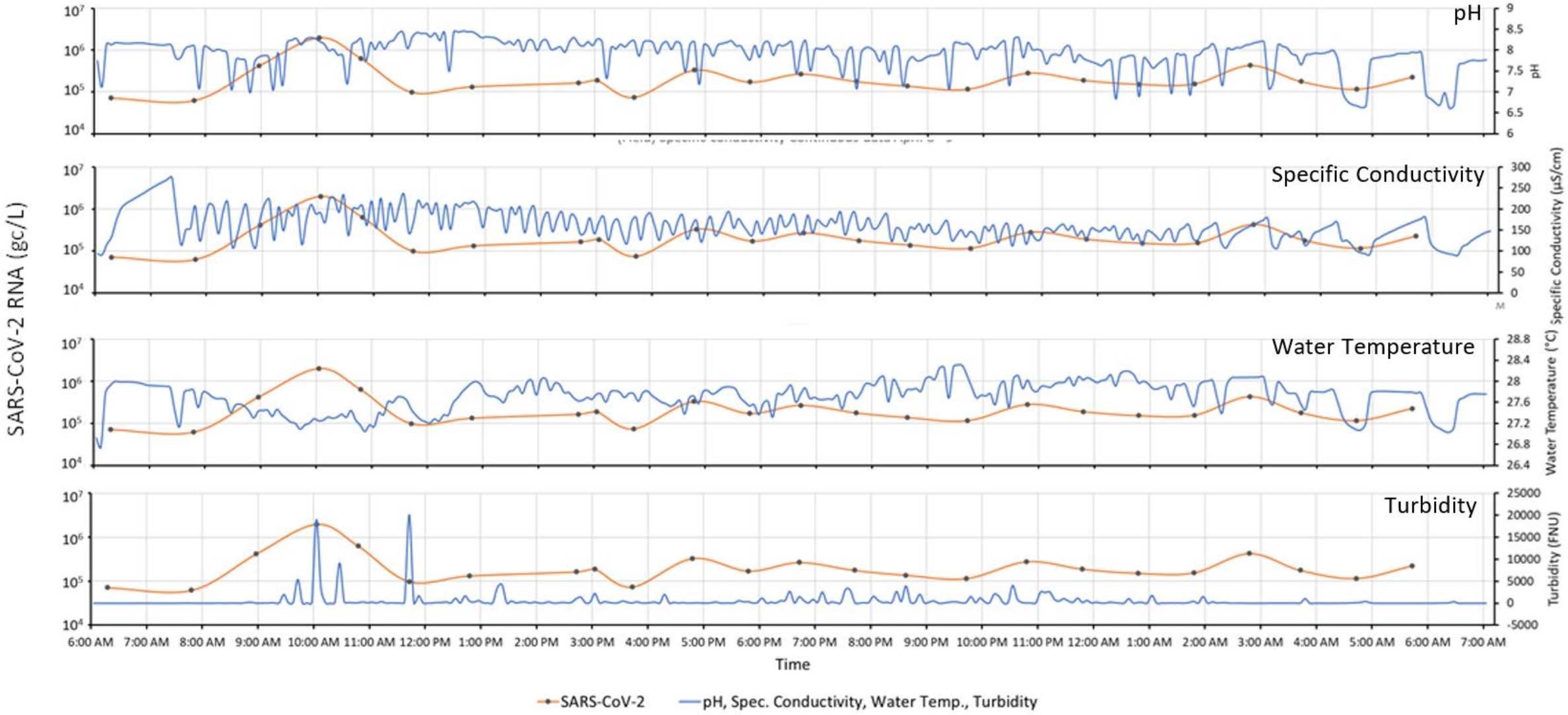






How can we address short-term variability if composites are not an option?






No significant and consistent correlation with water quality

Lamm et al. in review

SARS-CoV-2 RNA

SARS-CoV-2

SARS-CoV-2

Flow

Flow

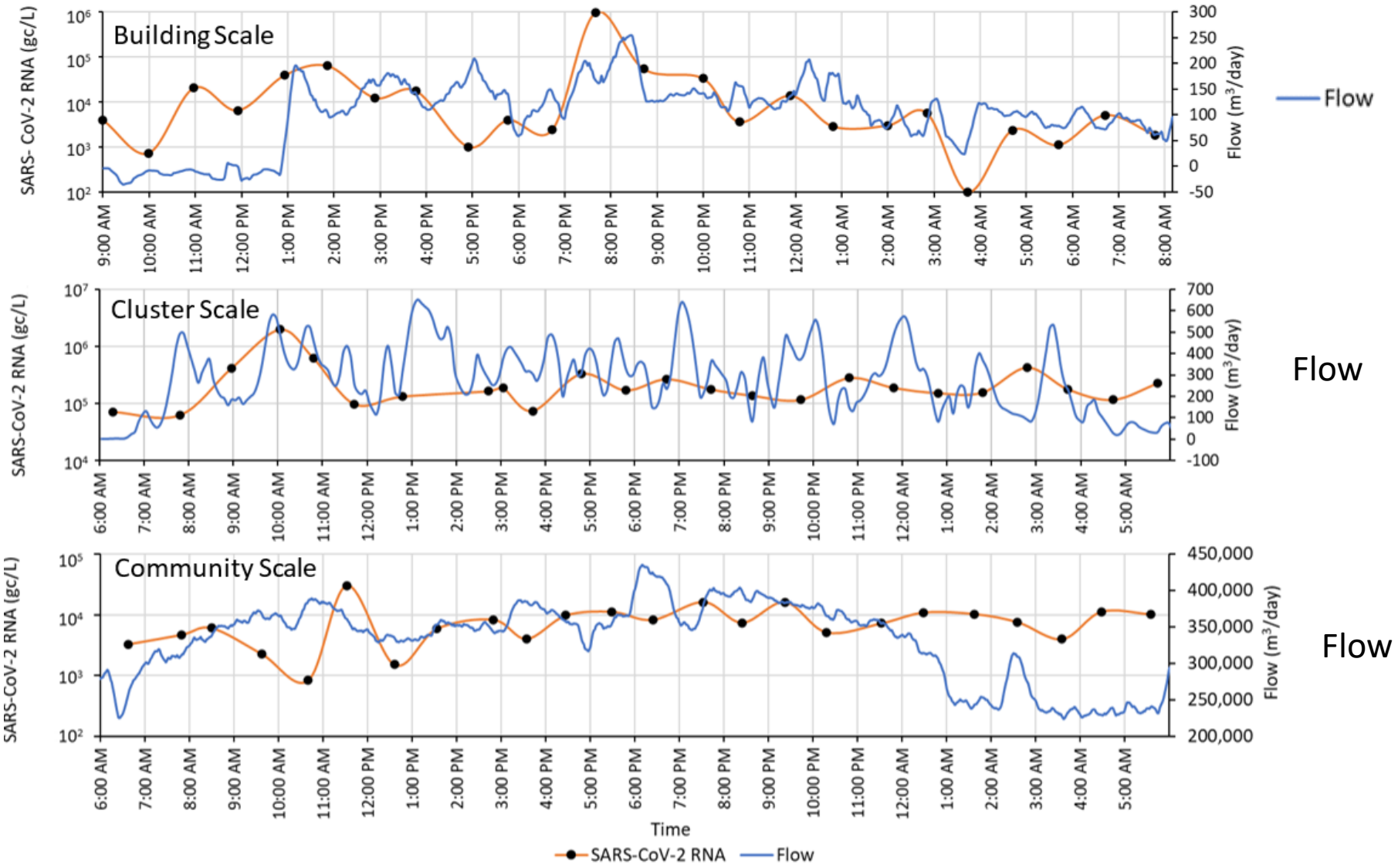



Figure 4: Flow at continuous (few minutes) time scales versus SARS-CoV-2 levels in wastewater collected at building, cluster, and community scales.

No significant and consistent correlation with wastewater flow

Lamm et al. in review

# What about Normalization of SARS-CoV-2 Signal?

Indicators of Human Waste

- PMMoV (Pepper Mild Mottled Virus) – human dietary indicator
- B2M (Human Housekeeping Gene) – human waste indicator
- Fecal Coliform (by culture) – traditional fecal indicator

At campus scale:

- PMMoV ✓
- B2M ✓
- Fecal Coliform ✗

No benefit at community scale (in our hands)

# Reflections (Take-Aways)

- Unique features of SARS-CoV-2 make it a good candidate for WBE (stable in WW and predictive of cases and hospitalizations)
- Signal changes with variants
- Smaller systems would benefit from composite sampling and/or targets for normalization

# Future Directions

- Automated data system that combines WW and health information
- Alternative targets (other RNA viruses, DNA viruses, bacteria, yeast, etc)
- Additional media (aerosols and swabs, see http://dx.doi.org/10.1016/j.scitotenv.2022.159188)
- Integrate WW into health monitoring system
- Public communication of data in real time at individual and community levels
- Ethics and inclusivity

# Acknowledgments

Questions (hmsolo@miami.edu)



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- City Miami Police

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- Cecil Bowen
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- Jonathan Foox
- Braden Tierney

Miami-Dade Water & Sewer Dept

Sylvester Comprehensive Cancer Center

# Thank you

SF-RAD website (covidsfrad.org)