

A comprehensive, and spatially resolved wastewater monitoring enables localization of COVID-19 cases within a university campus, and confirms considerably lower SARS-CoV-2 RNA burden relative to the surrounding community



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INTRODUCTION

- Wastewater-based surveillance (WBS) enables monitoring the occurrence of SARS-CoV-2 RNA in sewer catchments of interests.
- A spatially resolved sampling strategy enables locating hotspot(s) where COVID-19 cases might occur frequently in the university campus.
- A tiered wastewater monitoring program including the target (campus) and the surrounding community enables distinction in disease occurrence within target populations.

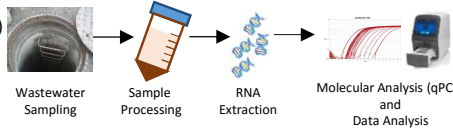
OBJECTIVES

- To pinpoint the location(s) where the high number of COVID-19 cases might exist in the UofC main campus.
- To measure of SARS-CoV-2 RNA within the UofC campus relative to the surrounding community.

METHODS

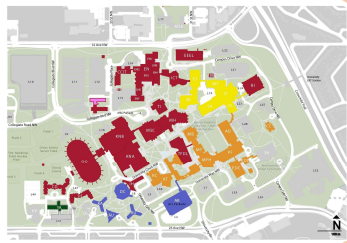
Experimental Work-flow

- Wastewater Sampling (City Calgary)
- Sampling Processing (ACWA)
- RNA Extraction (ACWA)
- Molecular Analysis (UofC)
- Data Analysis (UofC)



Sampling Locations (see map for detail) :

- The South (SO) of Campus (BLUE)
- The North West (NW) of Campus (RED)
- The North East (NE) of Campus (ORANGE)
- The Residence Hall 1 (RH1) (PINK)
- The Residence Hall 2 (RH2) (GREEN)
- Wastewater Treatment Plant (WWTP) that receives wastewaters from UofC campus



Sampling Period:

- Period-A (31.08.21 – 19.12.21; Delta wave)
- Period-B (20.12.21 – 24.04.21; Omicron waves)

Analysis of COVID-19 Case Data for UofC

- Confirmed cases (Cases) were normalized by gross area (A) to account for different population size

$$\text{Confirmed Cases per Area}_{\text{Building}} = \frac{\text{Cases}_{\text{Building}}}{\text{A}_{\text{Building}}} \quad (\text{Eq. 1})$$

(Assumption: Gross area correlates with population)

- Estimation of Cases per Capita (CPC) for UofC (C indicates concentration of SARS-CoV-2 RNA for each area)

$$\text{CPC}_{\text{UofC}} = \frac{A_{\text{UCS}} \cdot C_{\text{UCS}} + A_{\text{UCW}} \cdot C_{\text{UCW}} + A_{\text{UCE}} \cdot C_{\text{UCE}}}{A_{\text{UCS}} + A_{\text{UCW}} + A_{\text{UCE}}} \cdot \text{CPC}_{\text{WWTP}} \cdot \frac{1}{\text{C}_{\text{WWTP}}} \quad (\text{Eq. 2})$$

RESULTS

- The Southern (SO) district of campus showed the highest levels of SARS-CoV-2, especially during Period-B ($p < 0.05$, Wilcoxon rank-sum and signed-rank tests). (Fig. 1)
- Contact tracing reporting revealed that the Dining Center (located in SO) might be the building where COVID-19 cases occur most frequently given its high normalized confirmed cases (Eq.1). (Fig. 2)
- (Estimated) total burdens of SARS-CoV-2 for the UofC main campus (see Eq.2) was significantly lower than the surrounding community (i.e., WWTP). $p < 0.05$ using both Wilcoxon signed-rank and rank-sum tests. (Fig. 3)

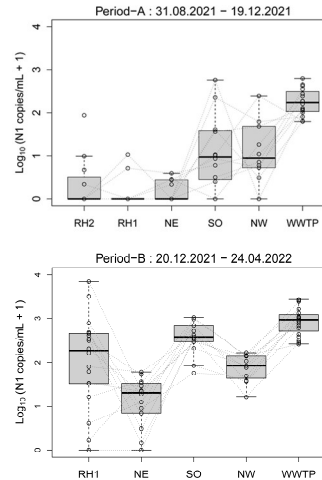


Fig. 1. Comparison of wastewater SARS-CoV-2 concentrations between different sampling locations.

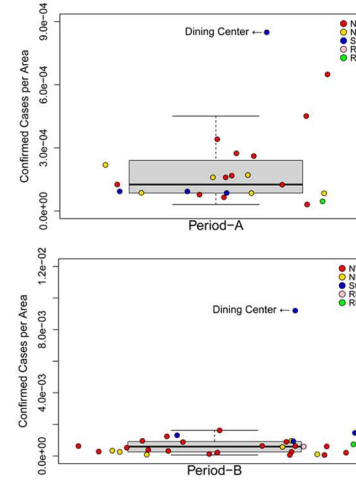


Fig. 2. Normalized cases (confirmed cases per area) for each building in campus during Period-A (upper) and -B (lower).

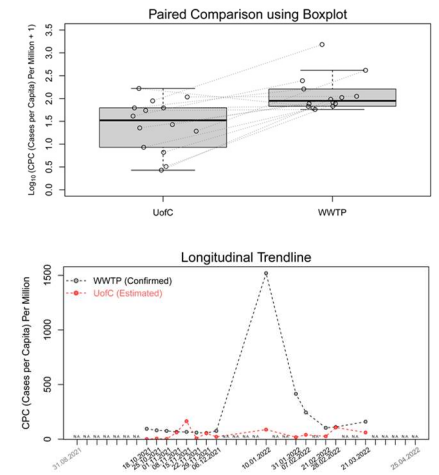


Fig. 3. Comparison between the wastewater SARS-CoV-2 levels for UofC (modelled) and for WWTP (measured) during the monitoring period.

CONCLUSIONS

- A node-based sampling approach reveals ‘hotspots’ for COVID-19 cases within the campus.
- Analysis of contact tracing reports complement WBS analyses.
- SARS-CoV-2 levels across University campus were lower than the surrounding community.

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