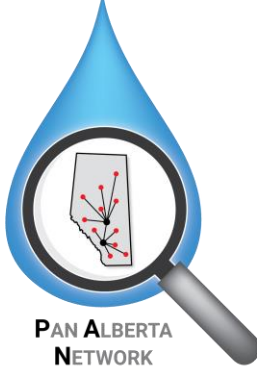


Targeted Wastewater-Based Surveillance for COVID-19 Outbreaks in the Long-term care facilities in Edmonton, Canada



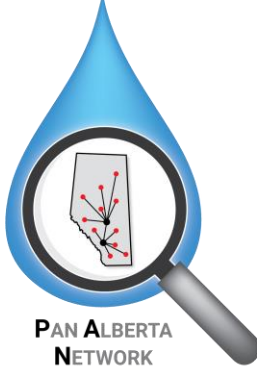
Xiaoli Pang^{1,2}, Bonita E. Lee¹, Tiejun Gao¹, Yuanyuan Qiu¹, Qiaozhi Li¹, Eleanor Risling³, Lorie A. Little³, Douglas Faulder³, Melissa Johnson³, Krista Howden³, Janelle Wallace³, Michael Parkins⁴, Casey Hubert⁴, Kevin Frankowski⁴, Steve E. Hruddy¹, Christopher Sikora³

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CITF Scientific Meeting
7 – 9 March 2023 · Vancouver, BC, Canada

Declaration of Conflict of Interest



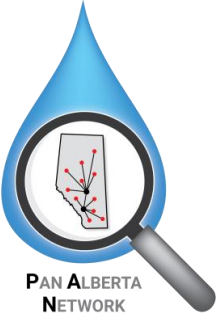
I do not have any conflict of interest
related to this work and presentation

Background and objectives

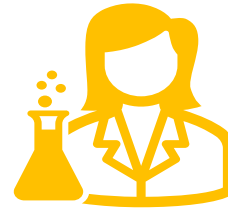
- Recently many studies demonstrated that Wastewater Based Surveillance (WBS) is comprehensive, inclusive, unbiased and possible cost-effective tool.
- Early identification of COVID-19 is a critical step to prevent outbreaks, protect vulnerable seniors and save lives during the pandemic.
- Wastewater (WW) surveillance of SARS-CoV-2 RNA (WBS SARS-CoV-2) has been reported as a leading indicator to clinical cases, which supports site-specific WBS SARS-CoV-2 for long-term care facilities (LTCF) as early warning
- Objectives in this study
 - To study the feasibility of real-time monitoring SARS-CoV-2 in site-specific wastewater samples
 - To study the lead vs. lag time, association, and correlation of SARS-CoV-2 RNA level in sewage samples to COVID-19 outbreaks in these facilities
 - To learn advantage vs. disadvantage of wastewater monitoring

Study work-flow

Site-specific wastewater-based surveillance for SARS-CoV-2



Early warning system by finding viral RNA in sewage & rapidly alerting public health



Pang Research
Lab

COVID-19

Outbreak measures in place

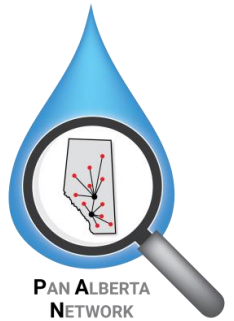


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Study design and methods



SARS-CoV-2 WBS Study period: Jan 6, 2021 and ongoing

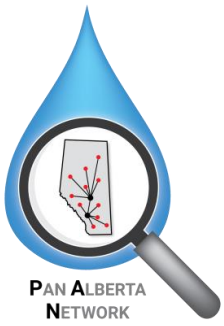
Participants: 12 long term care facilities in the City of Edmonton

Recruitment criteria: 1) has a single point of sewage access (manhole) for the building (requirement of the city bylaw since 1984); 2) has history of confirmed COVID-19 outbreaks vs. unknown COVID-19 activity; and 3) comparable unit size and characteristics of residents and working staff.

EPCOR Water Services (EPCOR): professional teams provide full support for assessment, access and collection of sewage samples from manholes of LTCFs

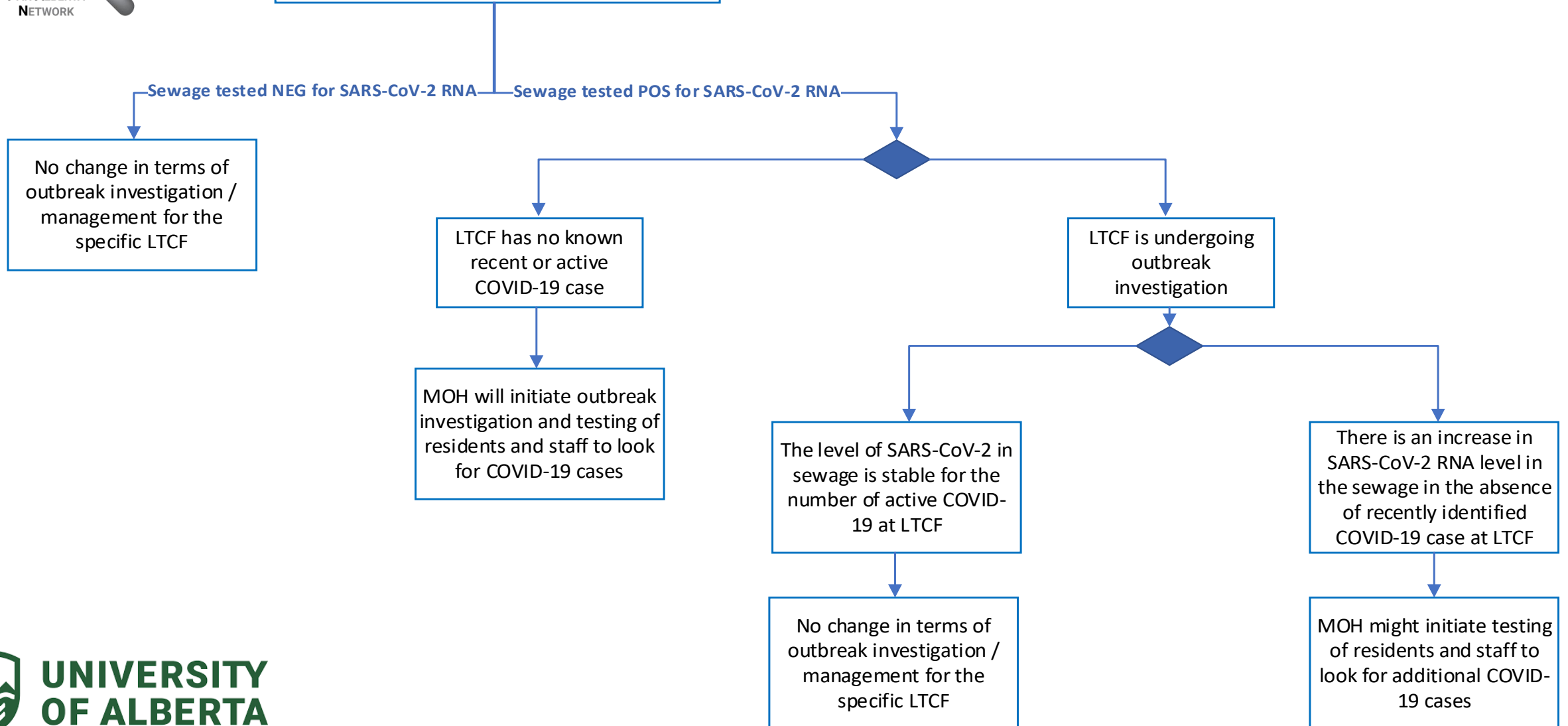
Laboratory testing (Qiu et al. 2021): 100 ml WW was concentrated from supernatant using the Centricon filter (30-kDa); the total nucleic acid extracted from concentrated samples and RT-qPCR assay was performed in duplicates to detect and quantify N1 and N2 genes of SARS-CoV-2 using an external standard curve on an ABI 7500 PCR instrument





Two-three times per week sampling and testing of site-specific sewage samples from 12 long-term-care facilities (LTCF) with 24- hour turn-around-time of results reported to Public Health Physician, i.e., Medical Officer of Health (MOH)

Flow diagram of SARS-CoV-2 sewage testing, result reporting and possible public health response led by the MOH, Medical Officer of Health, Edmonton Zone



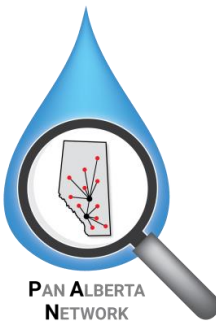
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LTCF WBS study in the city of Edmonton data

LTCF	Units (No.)	Study duration	Wastewater testing results	
			No. of samples tested	Positive no. (%)
S2	60	6-Jan-2021 to 31- Aug-2022	197	28 (14.21)
S3	188	6-Jan-2021 to 31- Aug-2022	197	81 (41.12)
S4	132	6-Jan-2021 to 31- Aug-2022	197	68 (34.52)
S5	198	6-Jan-2021 to 31- Aug-2022	197	53 (26.90)
S6	82	6-Jan-2021 to 31- Aug-2022	197	52 (26.40)
S7	204	21-Jan-2021 to 31-Aug-2022	193	27 (14.00)
S8*	120	21-Jan-2021 to 29-Apr-2022	168	48 (28.57)
S9	156	21-Jan-2021 to 14-Aug-2022	193	66 (34.20)
S10*	102	21-Jan-2021 to 29-Apr-2022	144	49 (34.03)
S11*	53	24-Jan-2021 to 29-Apr-2022	135	46 (34.07)
S13	80	10-Dec-2021 to 31-Aug2022	105	33 (31.43))
S14	92	10-Dec-2021 to 31-Aug2022	104	36 (34.62)
Total	1467		2027	587 (28.96)

*Three sites have more than one facilities draining into the same manhole

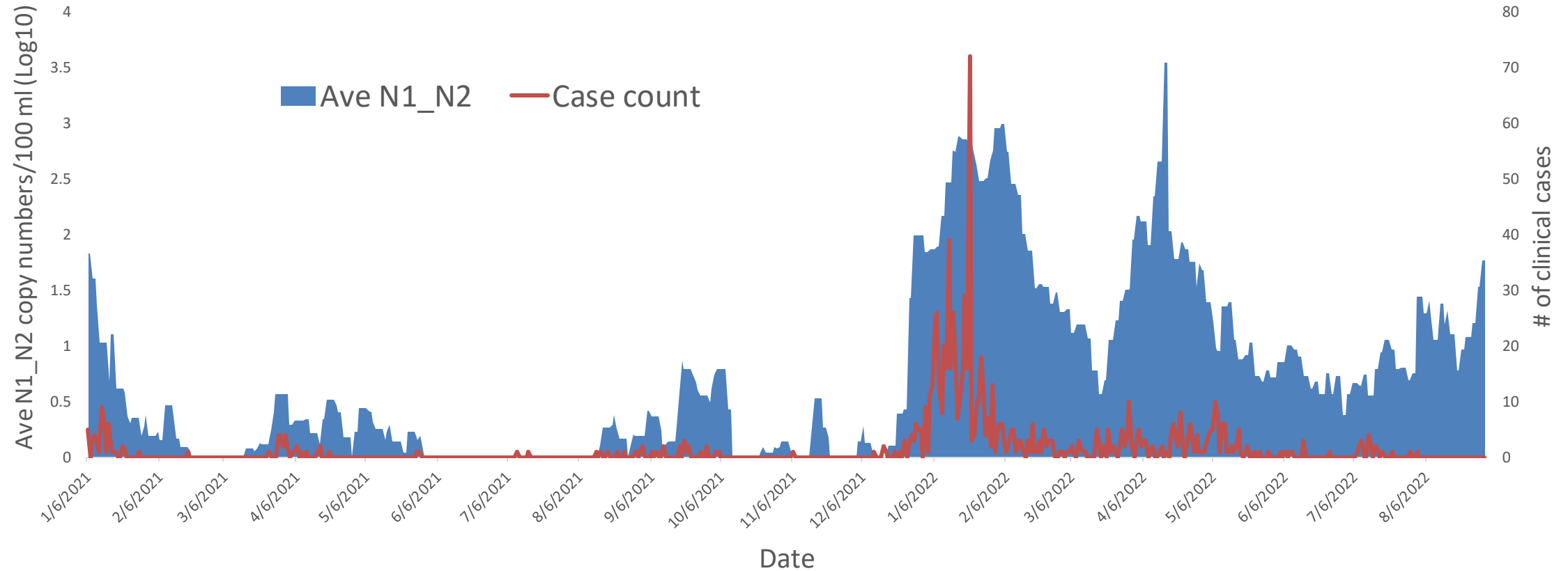
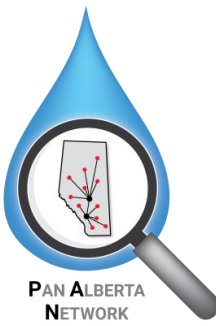
Correlation between WW results (Ave N1_N2 copies $\log_{10}/100$ mL) and no. of COVID-19 clinical cases



WW results	Clinical cases counts	Pearson's correlation (p value)	Spearman's rank correlation (p-value)
Ave N1_N2	staff	0.52 (<0.001)	0.64 (<0.001)
Ave N1_N2	resident	0.30 (<0.02)	0.49 (<0.001)
Ave N1_N2	staff and residents	0.59 (<0.001)	0.58 (<0.001)



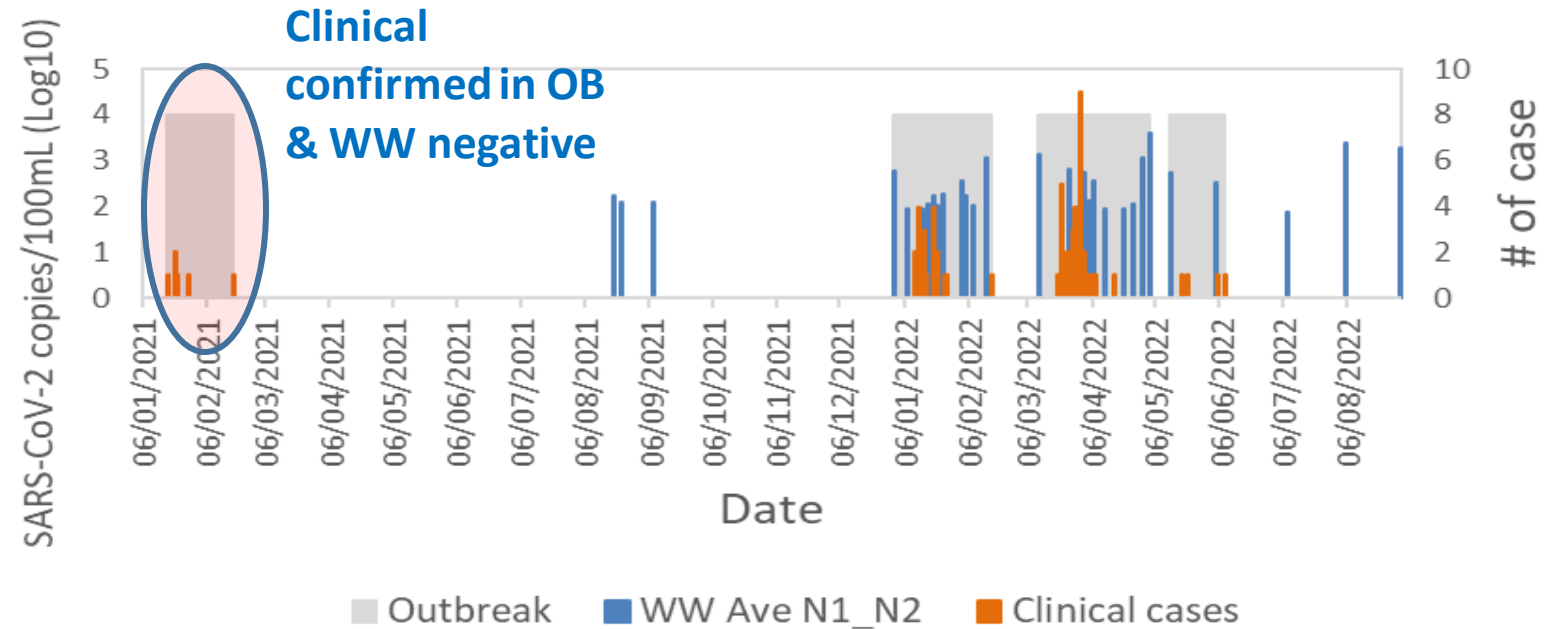
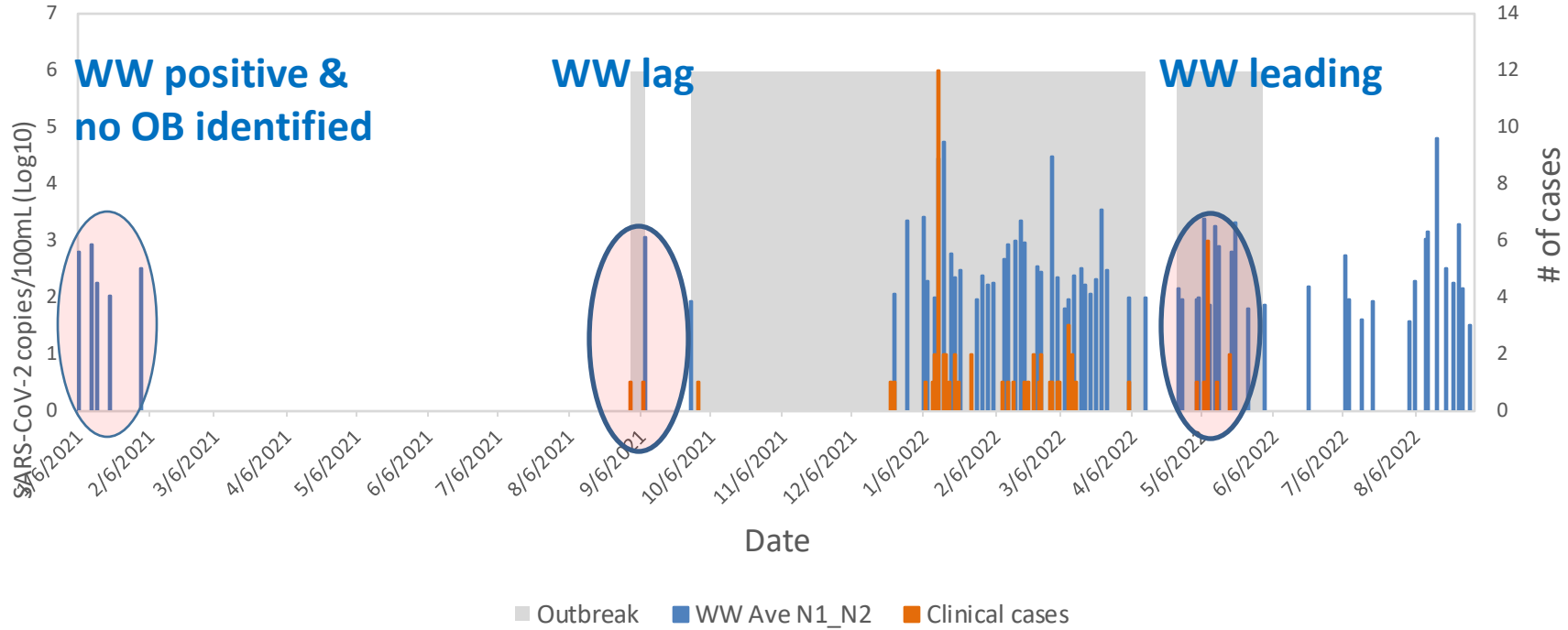
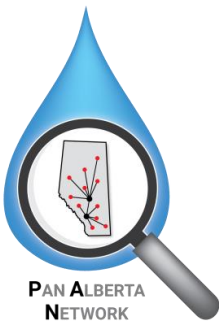
Overall temporal trends of SARS-CoV-2 detected in WW and COVID-19 clinical cases in the 12 LTCF



Lead-lag analyses between WW results and outbreak investigation

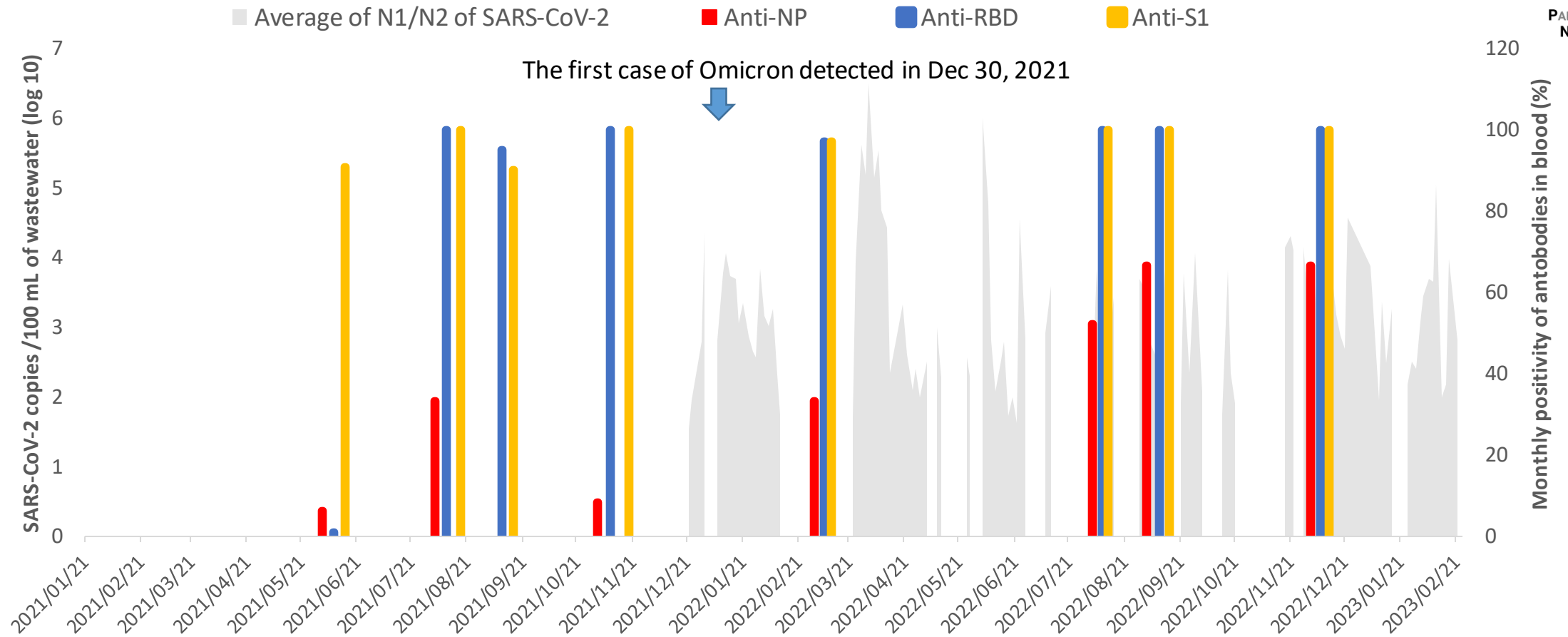
Concordant results				Discordant results		
Confirmed COVID-19 outbreaks					No confirmed COVID-19*	
Outbreak #	WW lead # (%)	WW lag # (%)	WW and clinical overlap # (%)	WW negative # (%)	WW tested #	WW positive # (%)
37	14 (38%)	13 (35%)	4 (11%)	6 (16%)	485	246 (51%)

*Some outbreak investigations did not identify any COVID-19 case and some pos WW result were not associated with any outbreak investigation



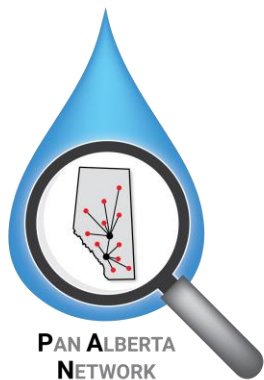
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Relationship between SARS-CoV-2 seroprevalence and the detection of SARS-CoV-2 in wastewater overtime (LTCF # S9)



Conclusions

- ❖ Multidisciplinary collaborative team efforts and effective communication are essential for success
- ❖ WBS SARS-CoV-2 Are:
 - ❖ Sensitive (detecting one case in the whole facility),
 - ❖ Comprehensive (finding asymptomatic / pre-symptomatic / symptomatic case),
 - ❖ Non-invasive and unobtrusive with no interruption to the facility as “silent monitoring”, the positive result is reported
 - ❖ Testing only requires a single sample for the whole facility
 - ❖ Quantitation of SARS-CoV-2 RNA levels in the sewage samples could provide useful information for outbreak monitoring
- ❖ Challenges
 - ❖ Sampling
 - ❖ Getting information from facilities that are extremely busy with COVID-19 outbreaks



The PAN Alberta Network for Wastewater SARS-CoV2 Monitoring

ACKNOWLEDGMENT: The PAN Alberta Network for Wastewater SARS-CoV2 Monitoring consists of key partnership between the University of Calgary, University of Alberta and Alberta Health, and many collaborators from Alberta Precision Laboratories and Alberta Health Services, many municipalities as well as some First Nation communities, FNIHB, and various institutions in Alberta. The investigative teams have many members. We also acknowledge and thank funding support provided by Alberta Health, CIHR, Alberta Innovates, COVID-19 Immunity Task Force, Genome Canada and Mitacs.



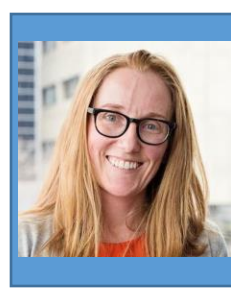
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COVID-19
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