Leveraging Wastewater Surveillance for One Health in Low- and Middle-Income Countries: A Pathway to Integrated Public Health

Presented by:

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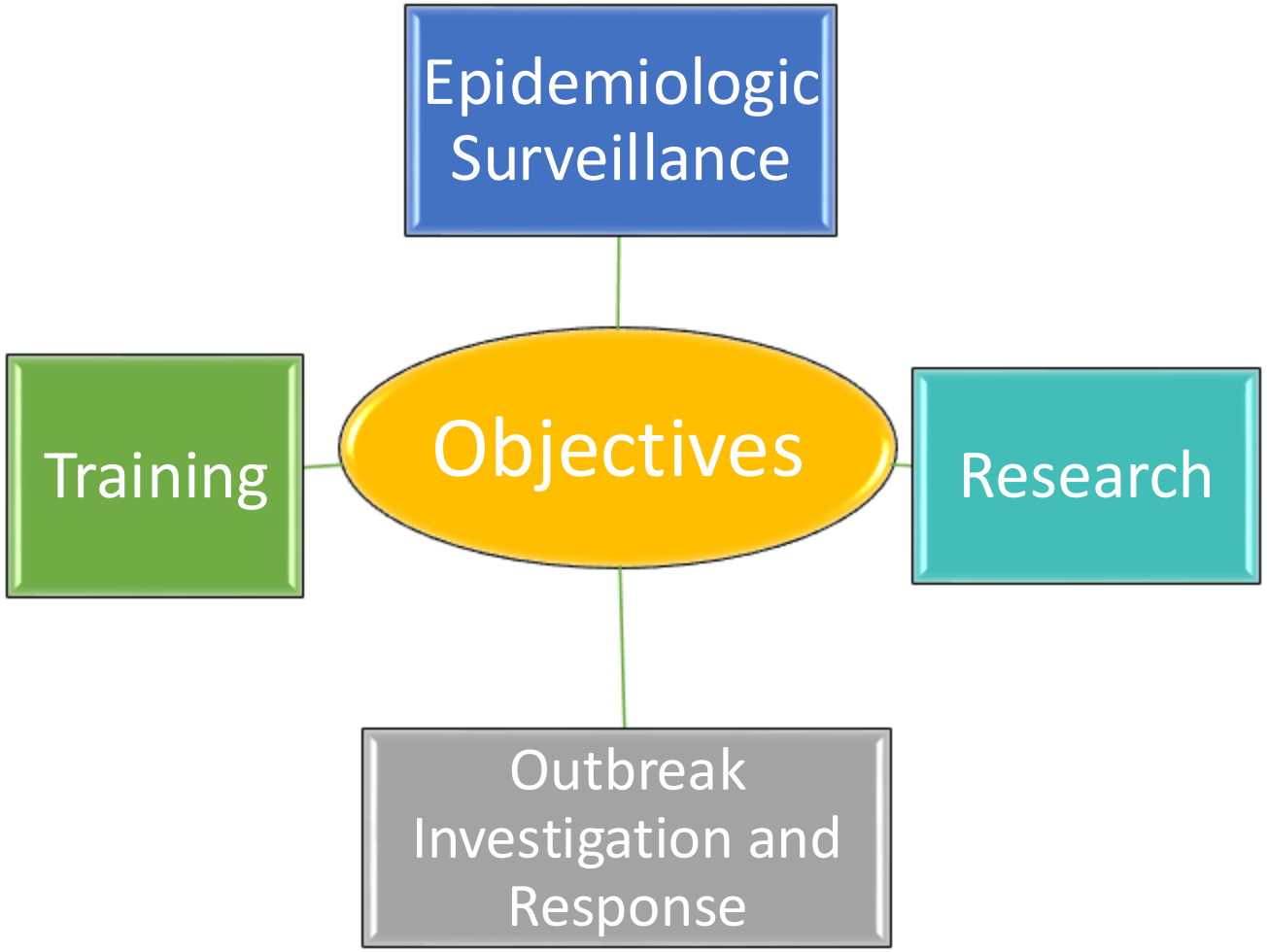


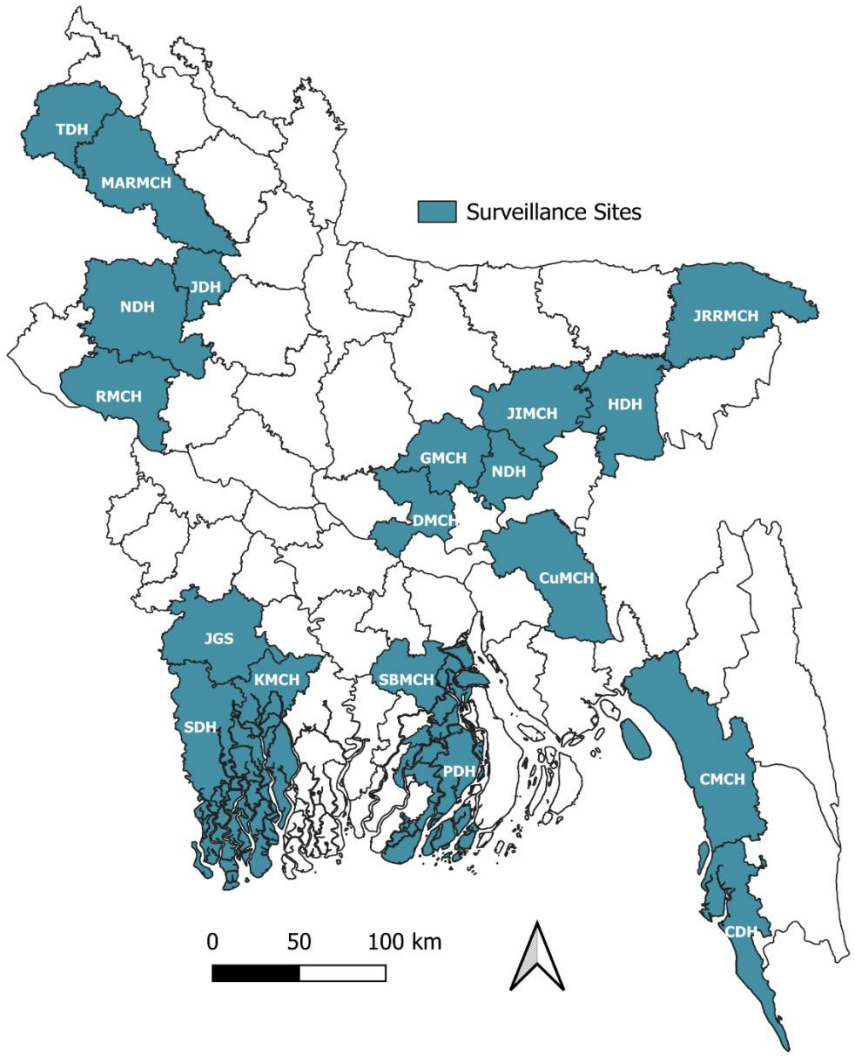
Focal Institute

- National Influenza Center (NIC)
- Global Health Security (GHS)
- One Heath Secretariat
- International Health Regulation (IHR)
- Member of IANPHI
- Global Disease Detection Centre for US CDC

World Health Organization declared IEDCR as the National Influenza Centre (NIC) in 2007

Influenza Surveillance, Bangladesh

- **National Influenza Surveillance, Bangladesh** (May 2010 – ongoing)
  - ➢Sentinel sites are 10 in number
  - ➢Samples - ILI (Out patient) and
    -SARI (Hospitalized patient)
- **Hospital based Influenza Surveillance, Bangladesh** (May 2007 – ongoing)
  - ➢Sentinel sites are 09 in number
  - ➢Samples - ILI (Out patient) and
    -SARI (Hospitalized patient)



Objectives

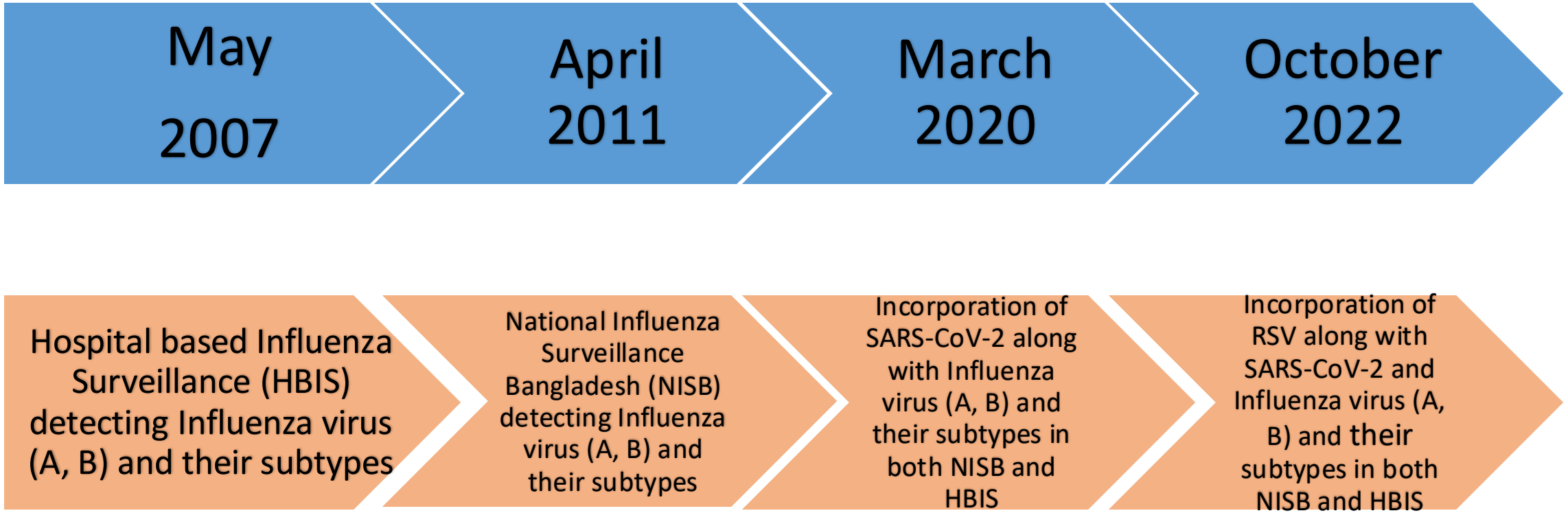
1. To characterize the diversity of circulating influenza strains in Bangladesh

2. To identify novel influenza strains causing life threatening infections in Bangladesh.

3. To identify the proportion of influenza patient from Influenza Like Illness (ILI) patients

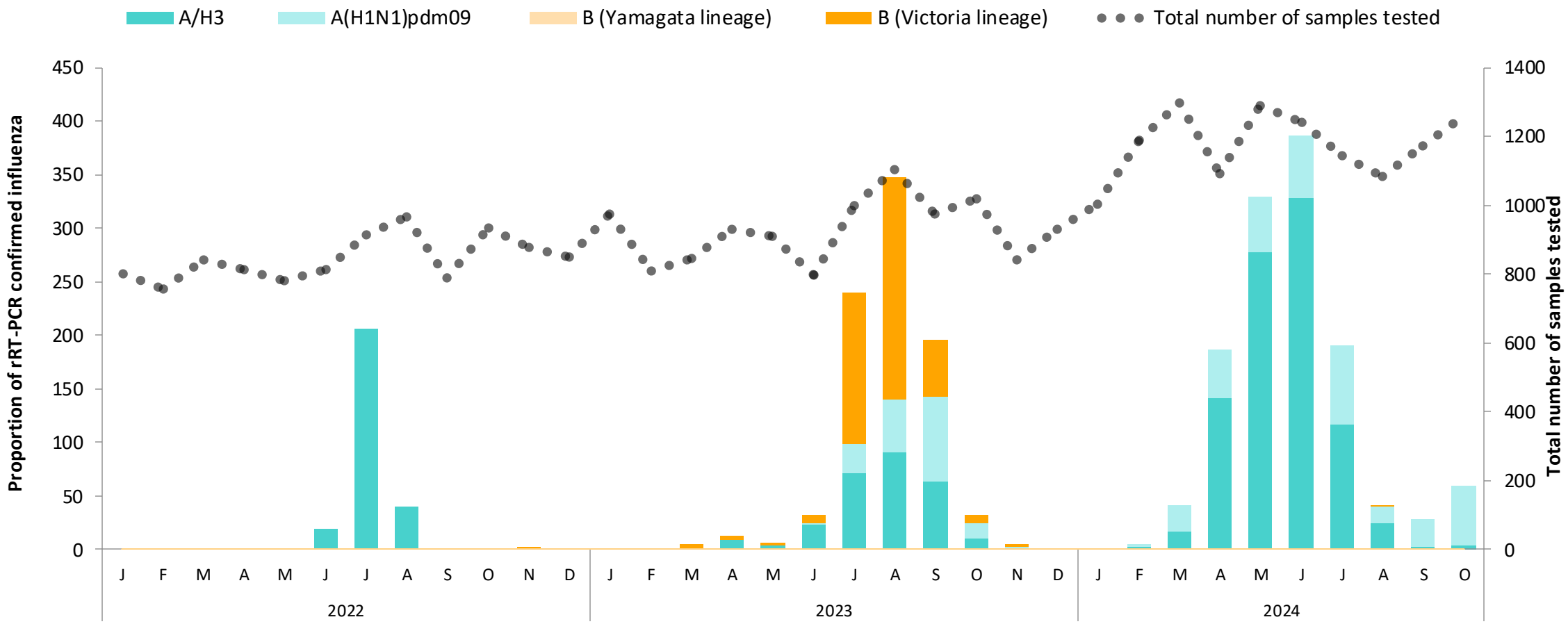
4. To identify the proportion of influenza patient from Severe Acute Respiratory Illness (SARI) patients

Integrated Respiratory Disease Surveillance



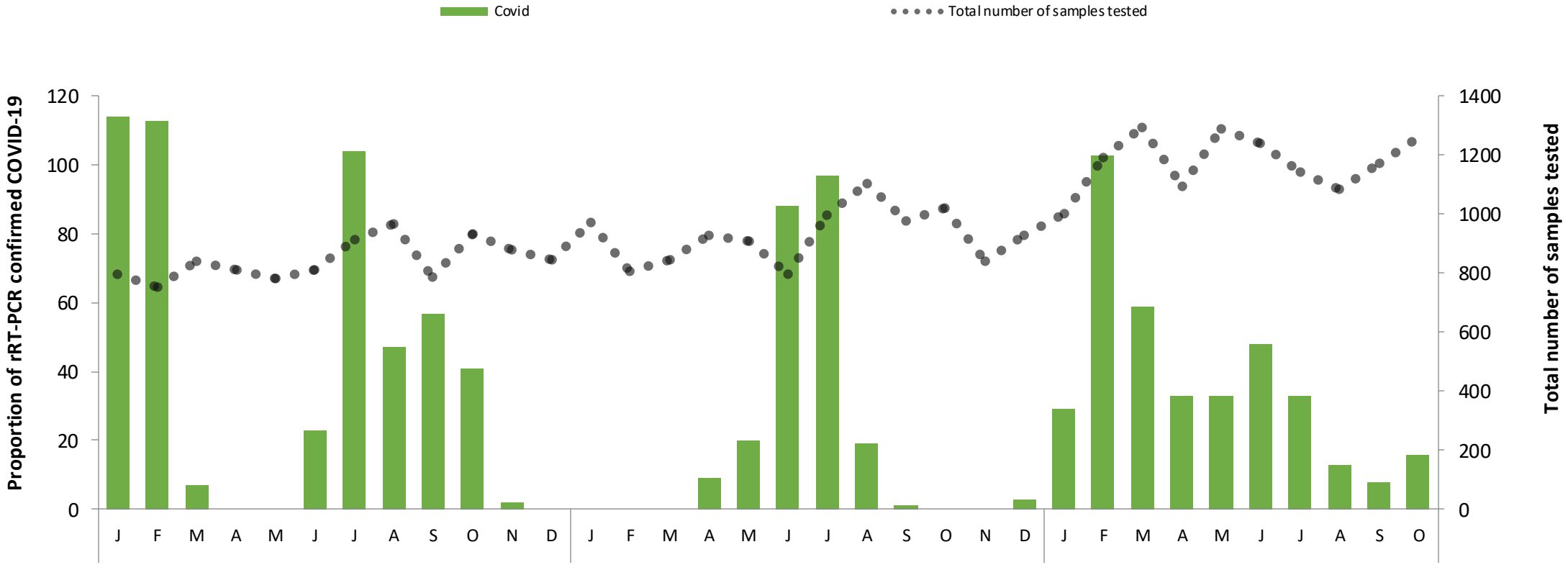
January 2022 to October 2024 Influenza cases

Total tested (N=33040) vs Positivity (n=2712)

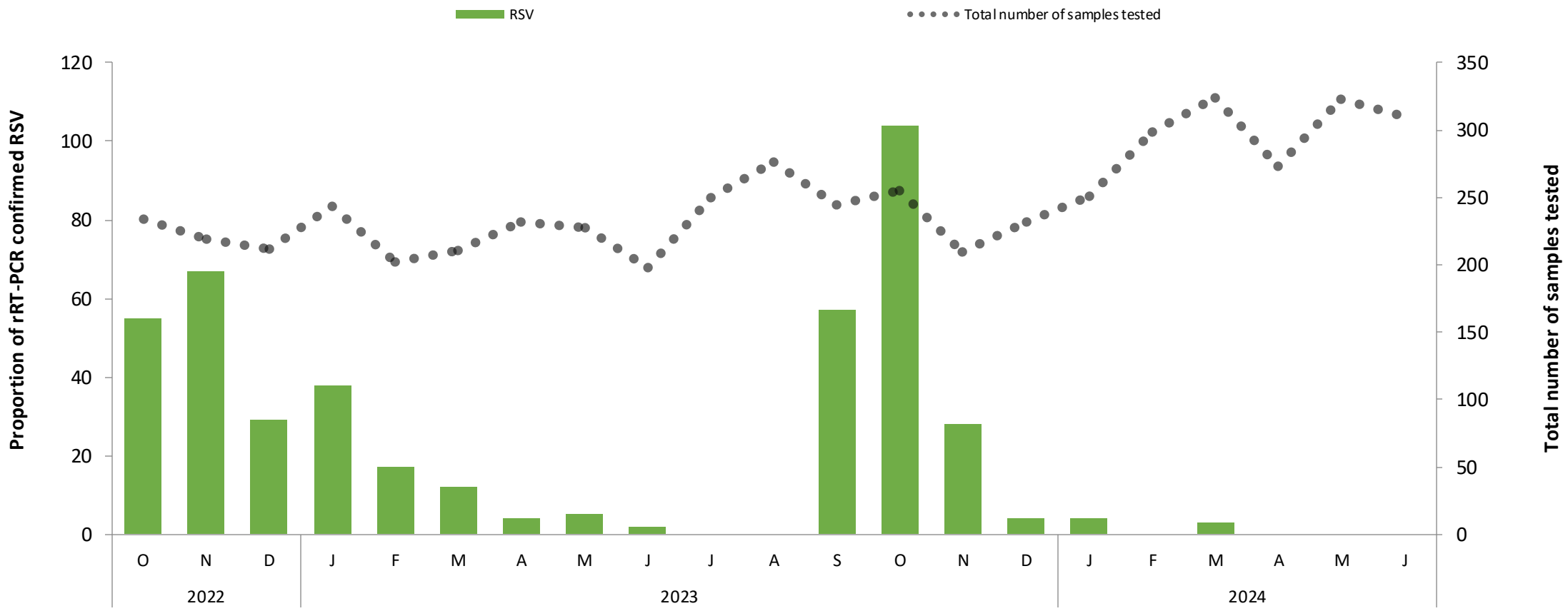


A total of 54 Influenza virus partial genome (M, NA, NP, HA, NS) sequencing was done during January 2023 to July 2024.

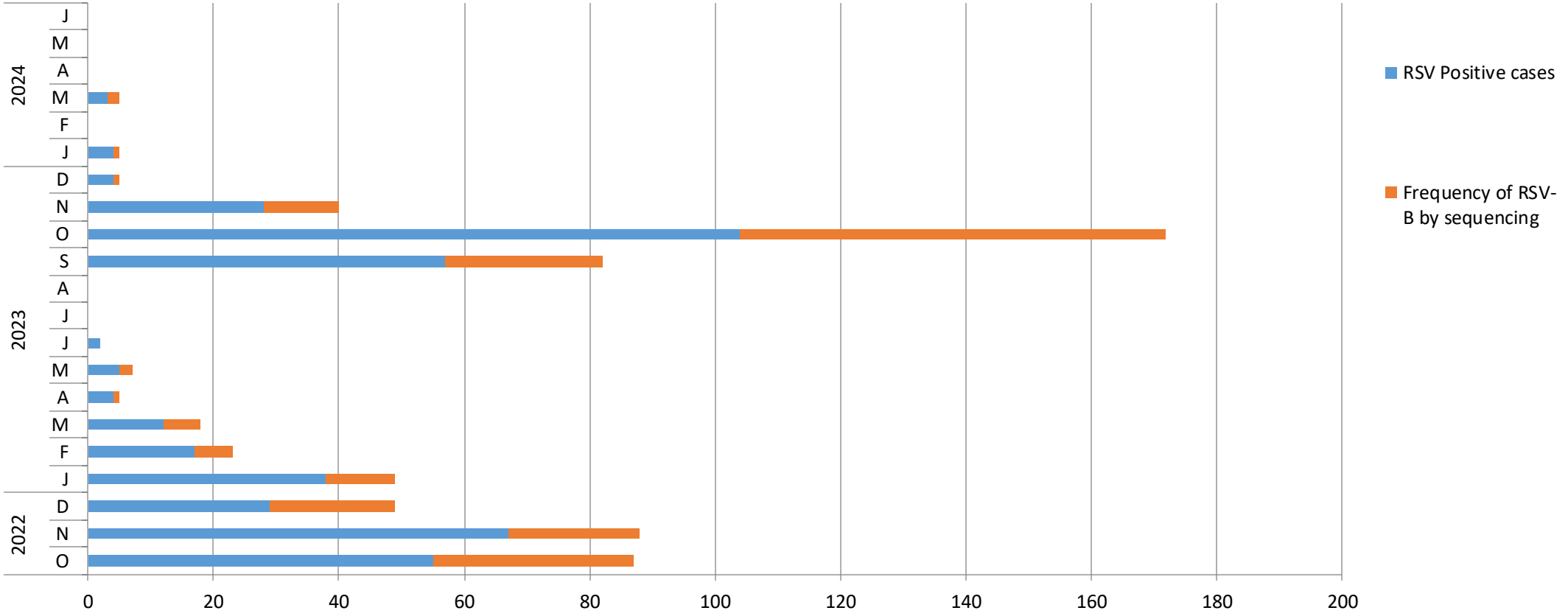
January 2022 to October 2024 COVID-19 cases Total tested (33040) vs Positivity (n=1120)



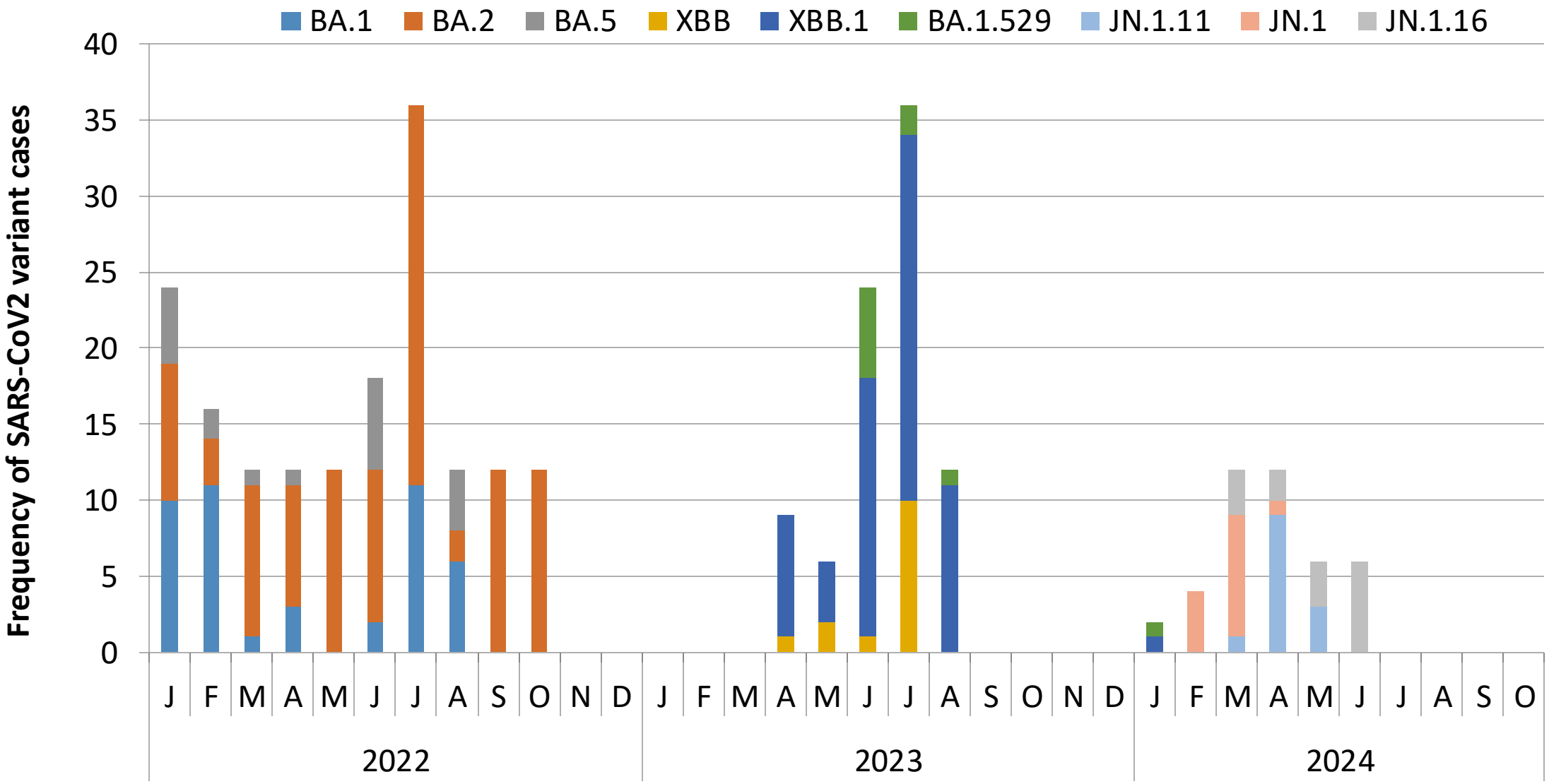
October 2022 to June 2024 RSV cases
Total tested (N=5224) vs Positivity (n=429)



Frequency of RSV positive cases by sequencing
All(n=429) are RSV-B (Clade-6)



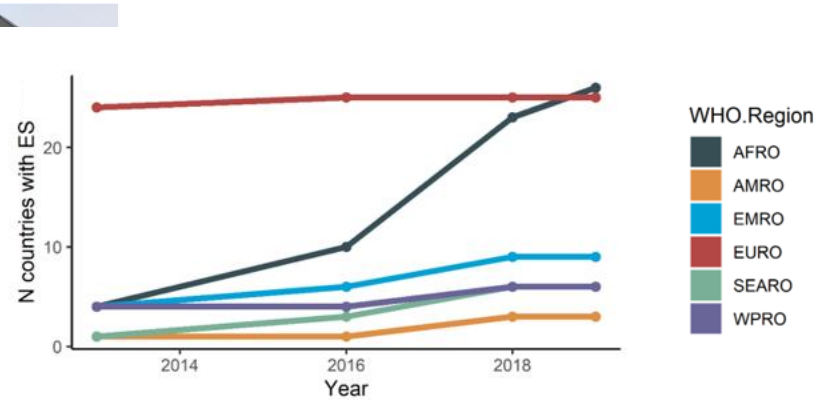
Frequency of SARS-CoV2 positive cases by sequencing (January 2022 to October 2024)

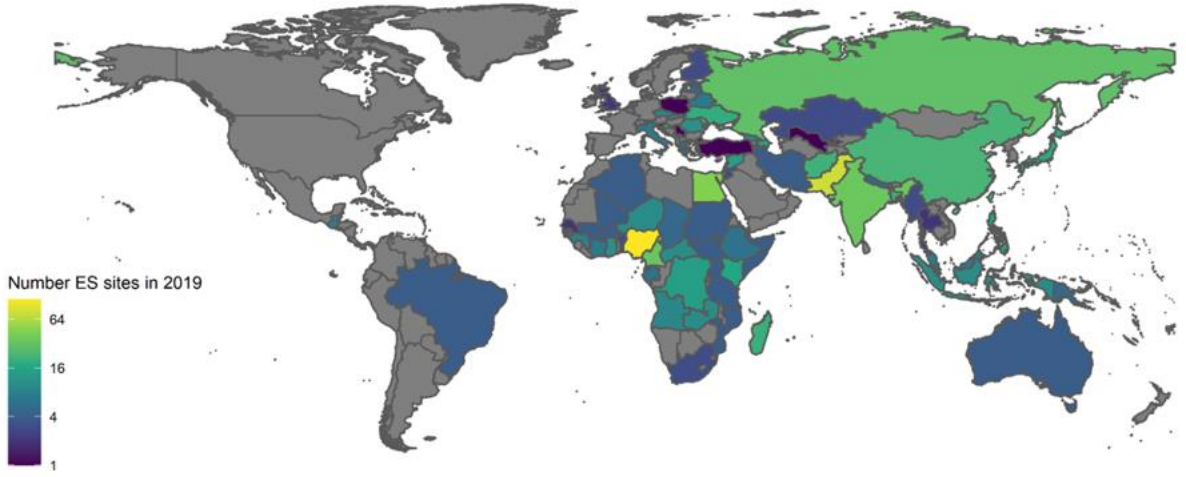


Sewage surveillance

- Systematic testing of sewage / wastewater for infectious disease(s)
- Samples collected from convergent sewage systems (informal or formal)
- Efficient unbiased method to sample from populations
- Used as a supplementary surveillance system by the Global Polio Eradication Initiative
  - *Detections can identify outbreaks and trigger vaccination campaigns*

GPEI ©

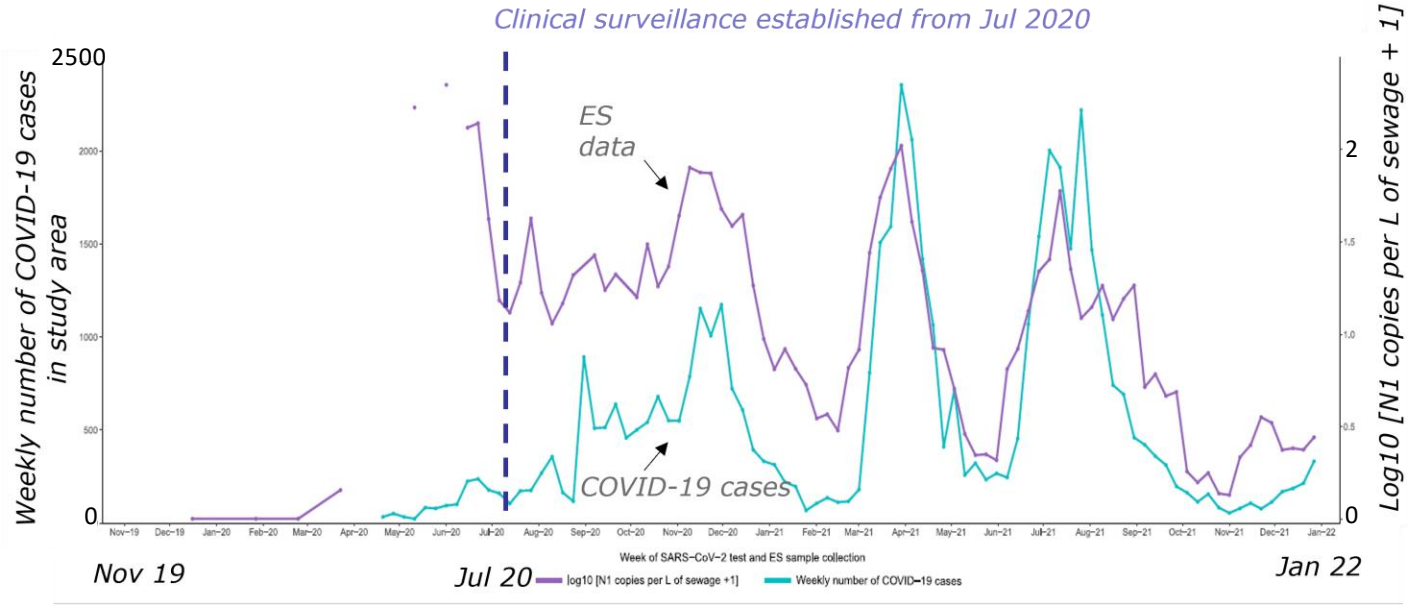


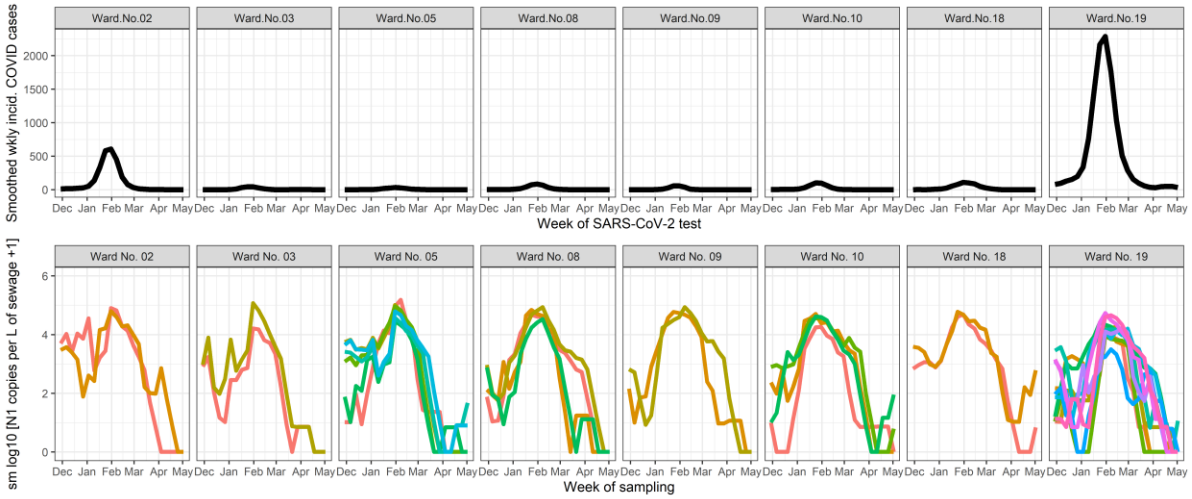


- Not considered for monitoring respiratory pathogens prior to the COVID-19 pandemic

Expansion of ES system provides early warning of SARS-CoV-2 in Dhaka and provides insight on spatial distribution of infection above clinical surveillance

- Highest level of cross-correlation when sewage data precedes case data by 5 days
- During major waves rise in ES preceded cases by 1-2 weeks
- Correlation between the mean sewage viral load and clinical cases increased with time (r = 0·90 in Jul–Dec, 2021 and r=0·59 in Jul–Dec, 2020)





Ward 19 (high income) had 70 – 120 times number of tests per population than other wards

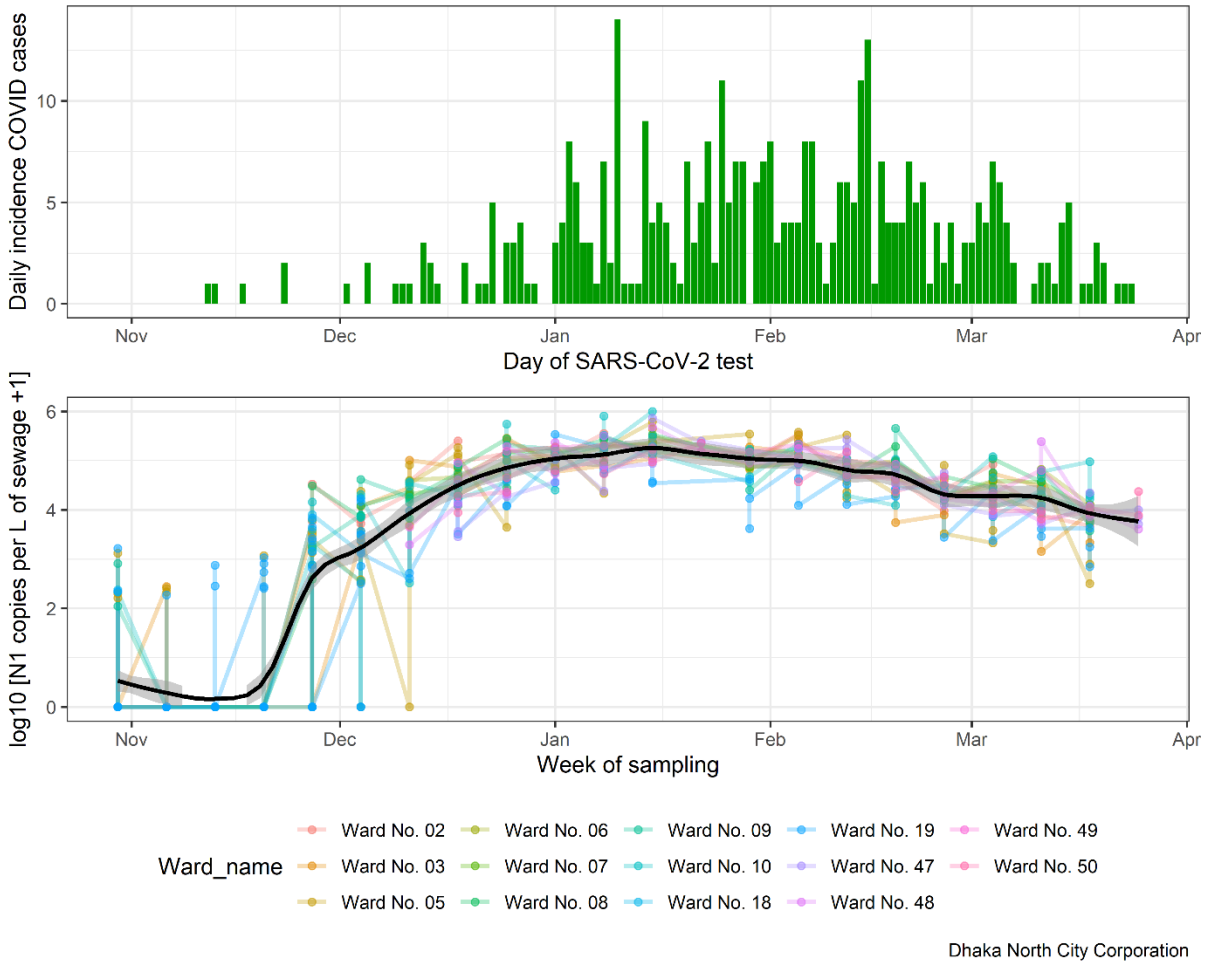
ES provided information that the virus was circulating across different parts of the city

Data analysed and disseminated weekly in real-time, shared with National COVID-19 taskforce to increase situational awareness through our dashboard

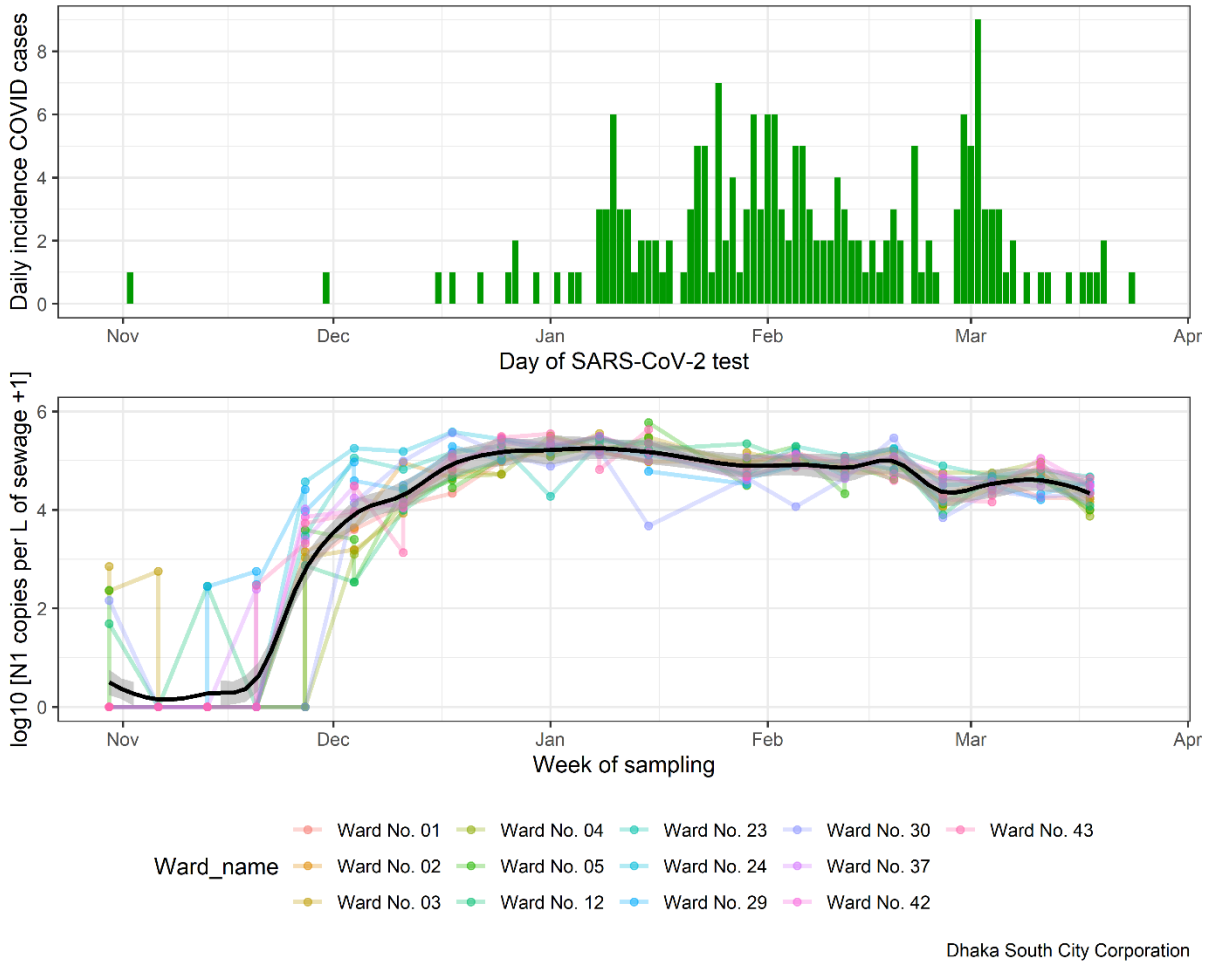
Rogawski McQuade et al Lancet Microbe. 2023 https://doi.org/10.1016/S2666-5247(23)00010-1
Wettstone et al. 2023 https://gh.bmj.com/content/8/8/e012921

SARS-CoV-2 update since Nov 2023

North Dhaka

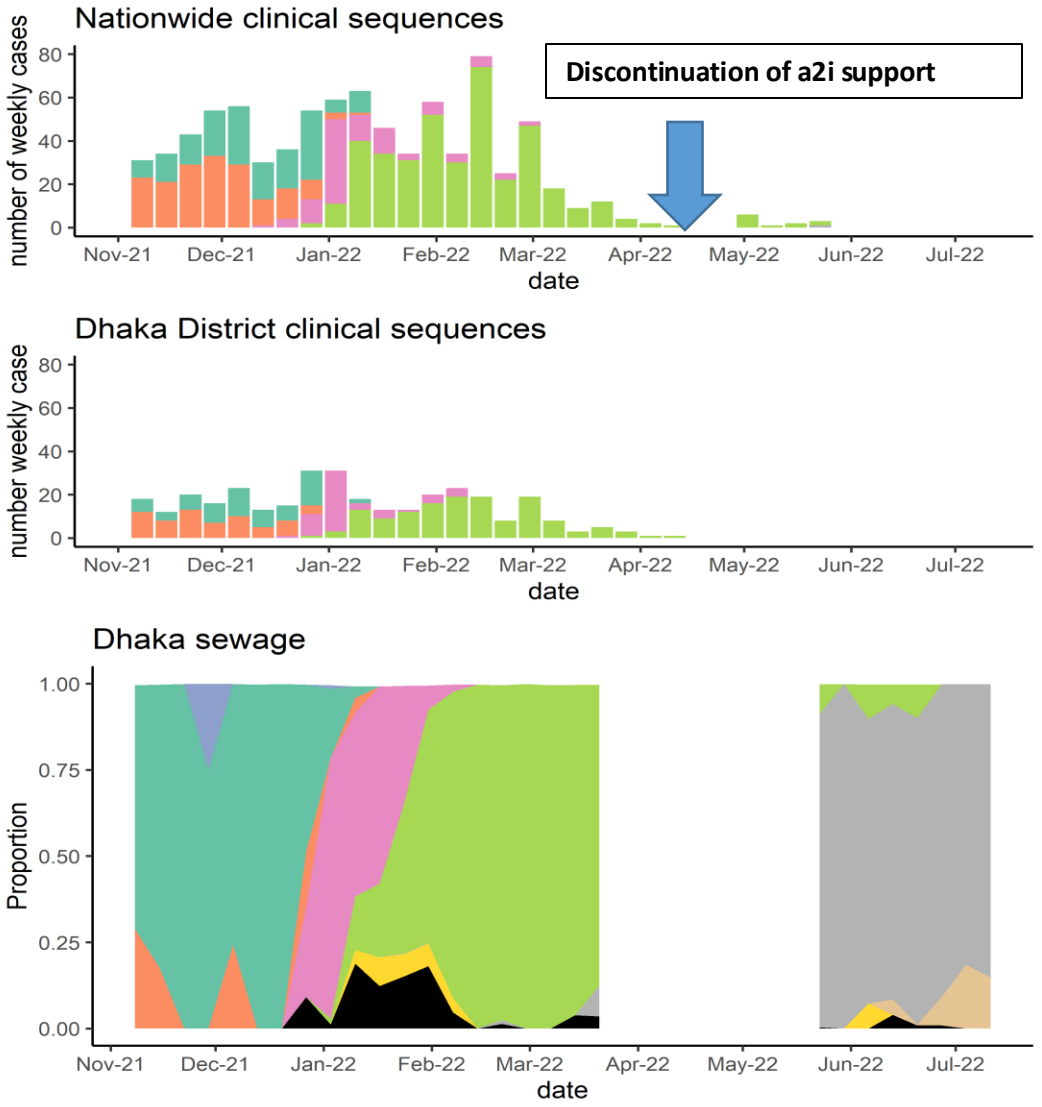


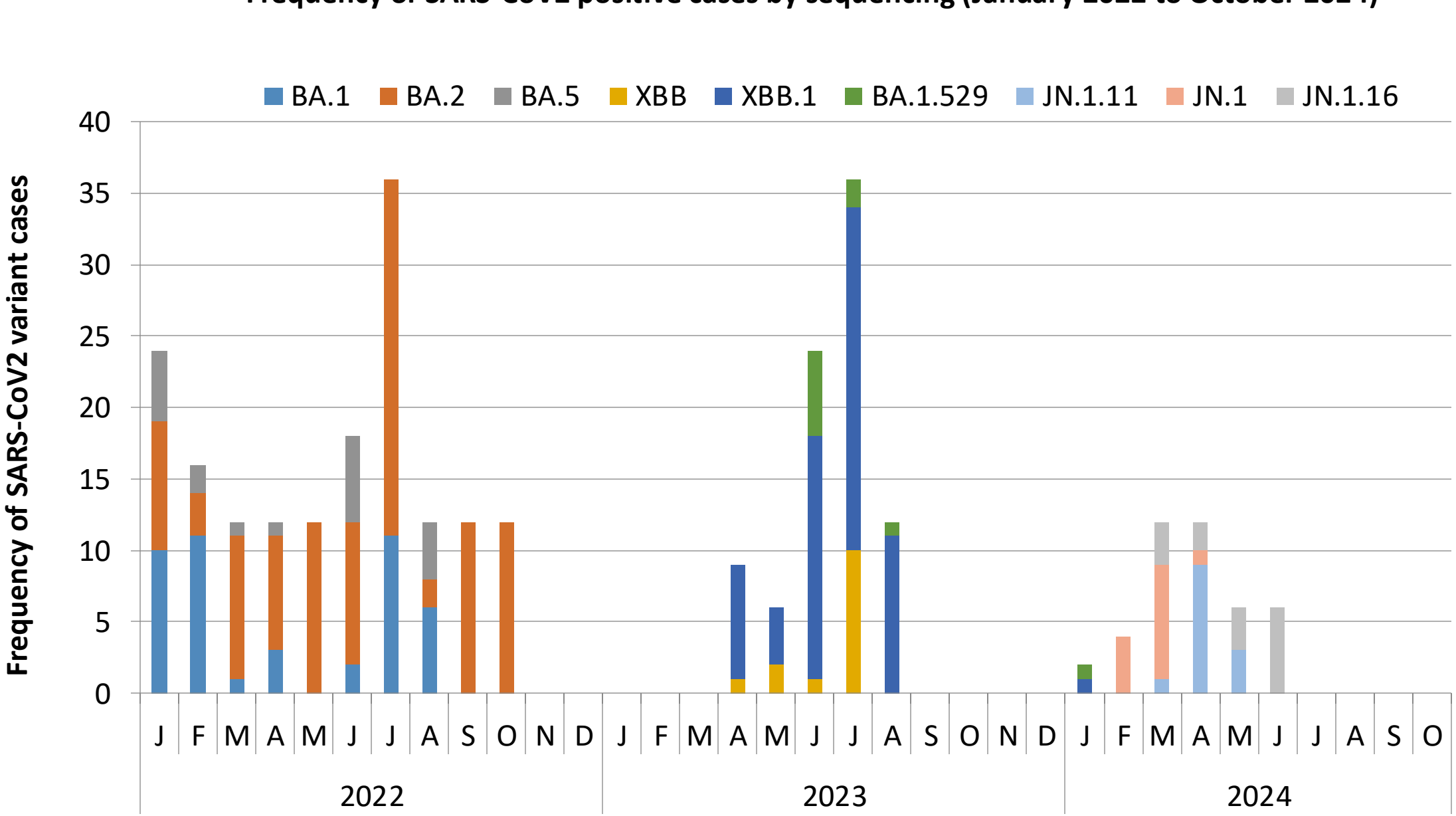
South Dhaka



Case data no longer geolocated, consistent dynamics observed in sewage across the city

- Clinical sequences (N = 843 nationw consortium)
- Sewage Illumina Covidseq (N = 263, Freyja platform to identify subvariants)
- Similar distribution of subvariants across the two surveillance systems
- Consistent evidence of fast BA.2 replacement
- BA.5 detected later in time in sewage




Frequency of SARS-CoV2 positive cases by sequencing (January 2022 to October 2024)
BA.1
BA.2
BA.5
XBB
XBB.1
BA.1.529
JN.1.11
JN.1
JN.1.16
Frequency of SARS-CoV2 variant cases
40
35
30
25
20
15
10
5
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
2022
2023
2024

Conclusions

- Multi-institutional collaboration has informed the utility and design of wastewater ES in Dhaka
- Understanding access to clinical surveillance through partnership enabled effective interpretation of ES
- ES through an informal sewage network provided an early warning
- Sampling from populations with varying socioeconomic status allowed ES to provide information the spatial SARS-CoV-2 distribution
- Further work needed to understand site level variation and catchment population size; and association of physicochemical properties with site performance.
- Further research is underway for ES for other infectious diseases (Measles, RSV, Influenza, Cholera, Enteric pathogens) in Dhaka city
- Finding a way for linkage of geological data with clinical and environmental samples after April 2022.

Thank You