

Israel wastewater surveillance for respiratory viruses

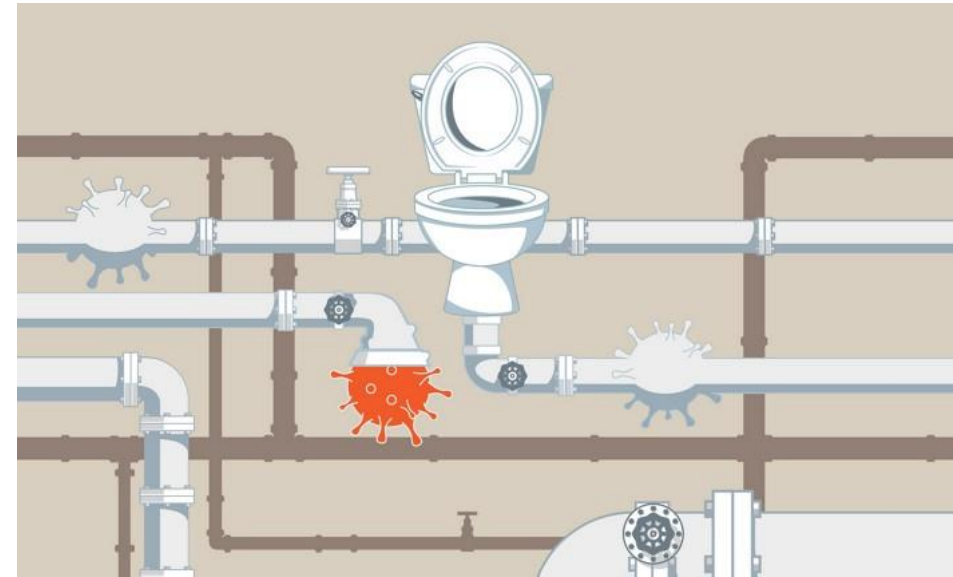
Dr. Itay Bar-Or

Head of the Environmental Virology Laboratory

Israel Ministry of Health

ECDC and WHO Europe Joint Annual Influenza
and COVID-19 Surveillance Meeting

5-7 October 2022



wastewater surveillance for pathogens



Is WWS can be complementary surveillance tool for respiratory viruses with harmonized sampling and analysis?

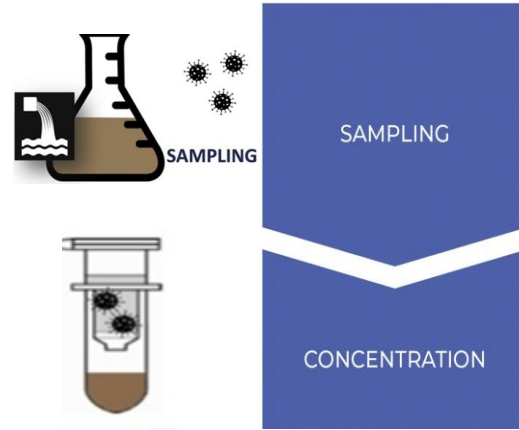
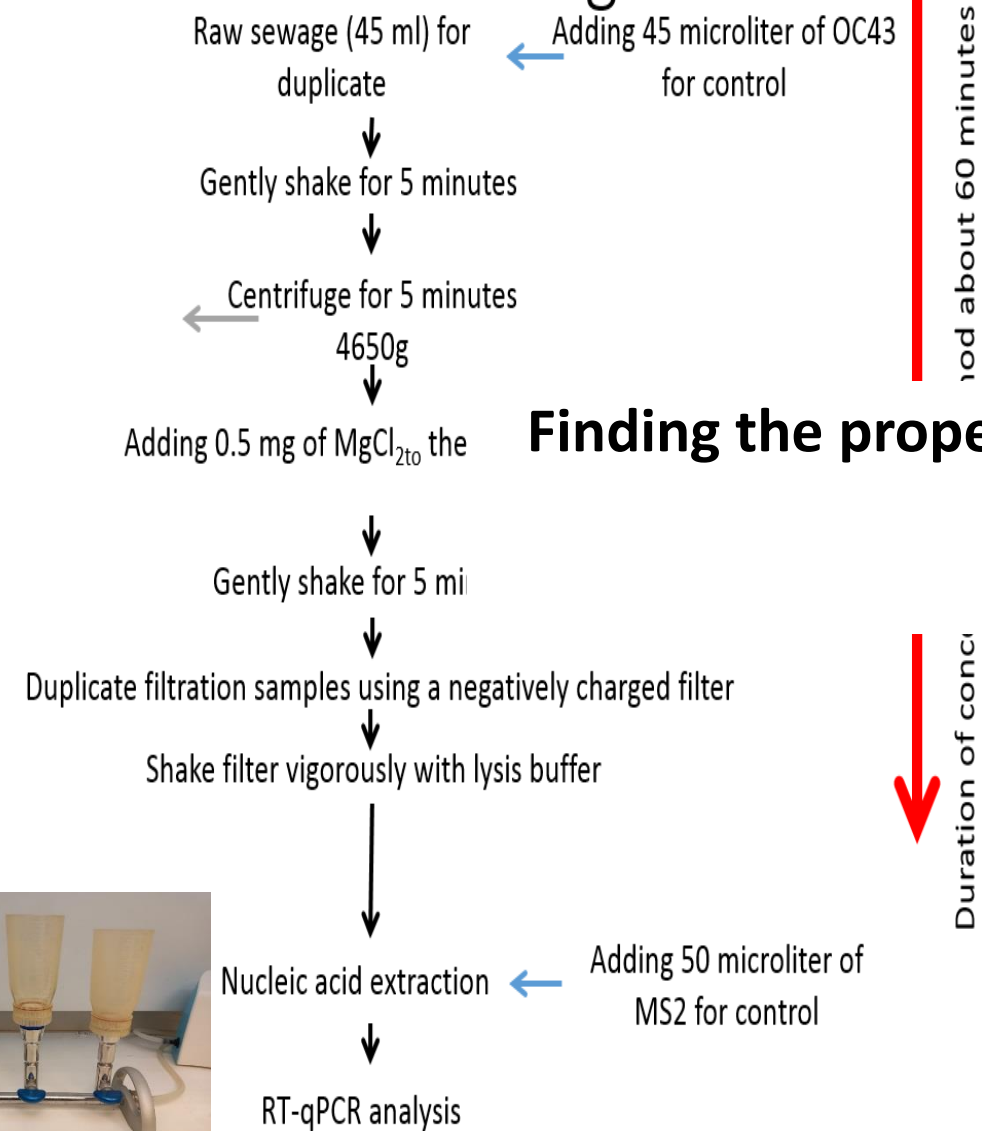


- Sampling from wastewater treatment plant or pipeline or sludge?
- Continuous sampling, Composite sampling or grab sampling?
- When do we sample in the day?
- What is the population catchment area of the sampling?
- How do we process the samples?



Sewage concentration methods for different viruses

Respiratory viruses concentration method

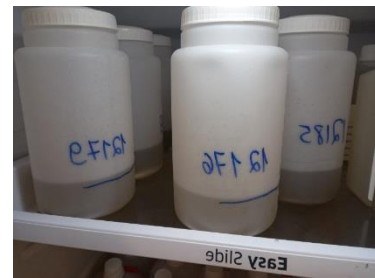
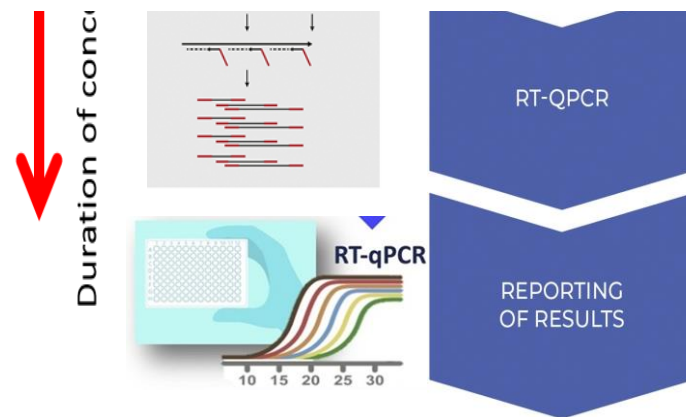


Enterovirus concentration method

- 500ml of homogenized sewage to plastic container.
- Use PEG for flocculation for over night.
- 300 ml concentration with

Finding the proper method for the pathogen concentration from sewage?

partials with saline





Israel Environmental Surveillance for polio virus and the beginning of the first wave of SARS CoV 2

Around 20-25 sewage samples a month.

Israel

North (2)

Haifa (1)

Central of Israel Region (5-7)

Jerusalem (4)

South(3)

Palestinian authority

7-9 cities

Gaza

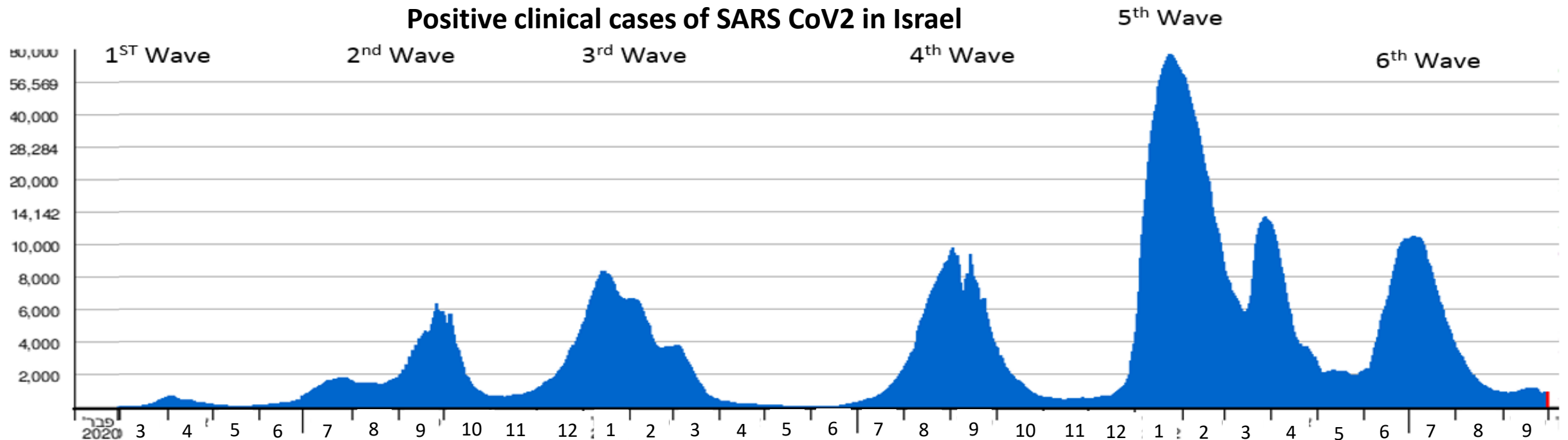
4 cities



SARS CoV 2 Wastewater surveillance in Israel

- **Raw sewage monitoring** (Feb till Aug 2020 – first wave and beginning of the second wave) monitoring based on **polio environmental surveillance + selected locations**
- **Increases of routine surveillance** (Sep2020- Dec 2021) at less once a week sampling.
- **Intensive national wastewater surveillance** (December 2021 –Aug 2022) 120 manholes sampling twice a week.
- **Reduced national wastewater surveillance** (Aug 2022- Dec 2022) 60 manholes sampling twice a week.

Positive clinical cases of SARS CoV2 in Israel



Israel national Environmental Surveillance for SARS CoV 2

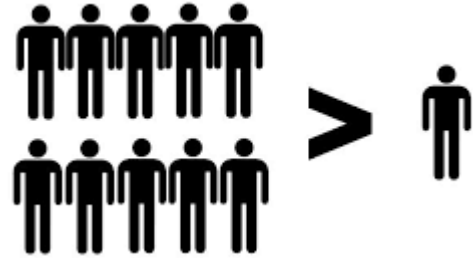
1. Around 120 sewage samples from manholes twice a week from February till August 2022.
15 WWTP twice a week.
2. Today around 60 sewage samples from manholes twice a week
15 WWTP twice a week.
3. 4 lab for concentration and molecular analysis.
4. Sequencing all positive samples once a week with NGS.
5. Tracking dominant variants with qPCR



Normalized results of RT qPCR for flow and population size



flow



Population size



Excretion rate



Sewage source

The effect on the RNA signal in sewage

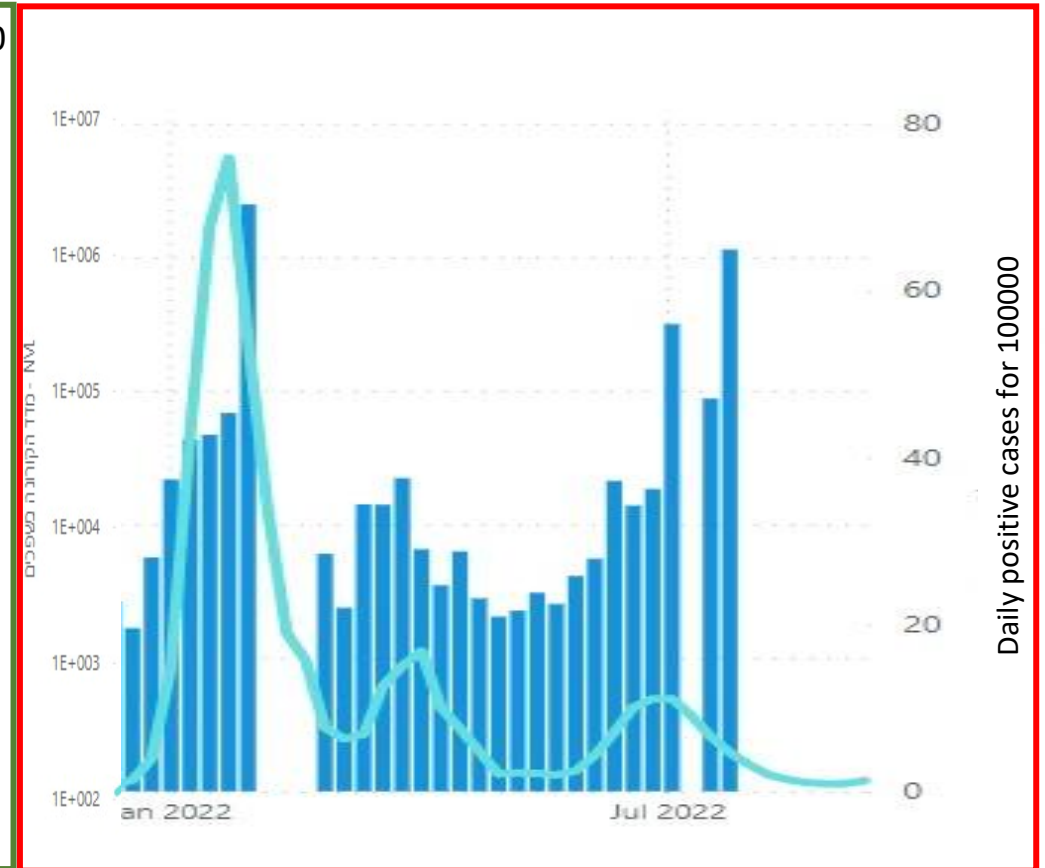
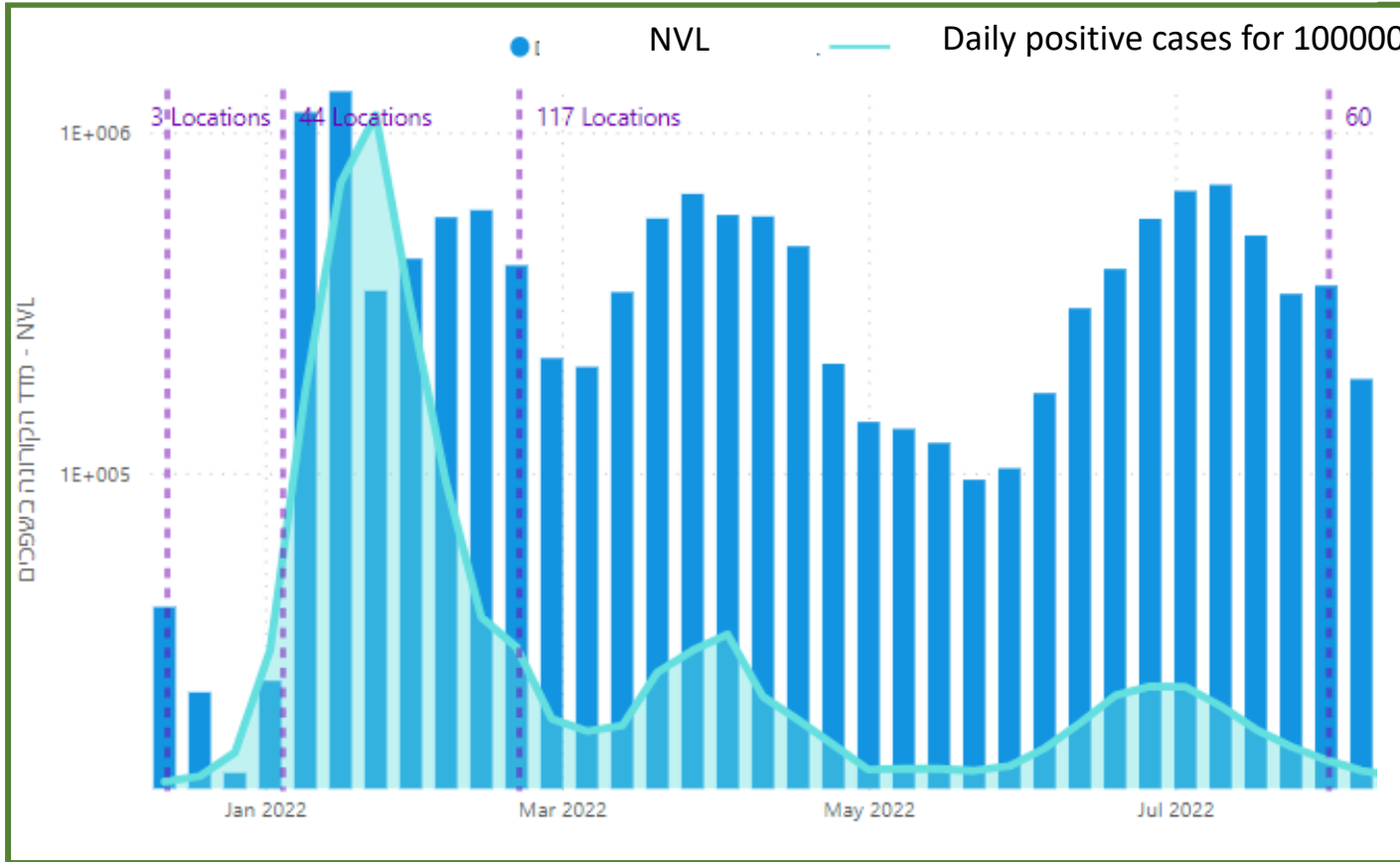
$$\text{Normalized Viral Load (NVL)} = \frac{\text{RNA copy number} \left(\frac{\#}{L}\right) * \text{Commulative sampling flow (L)}}{\text{Population size}/1000}$$

The differences between national and WWTP surveillance

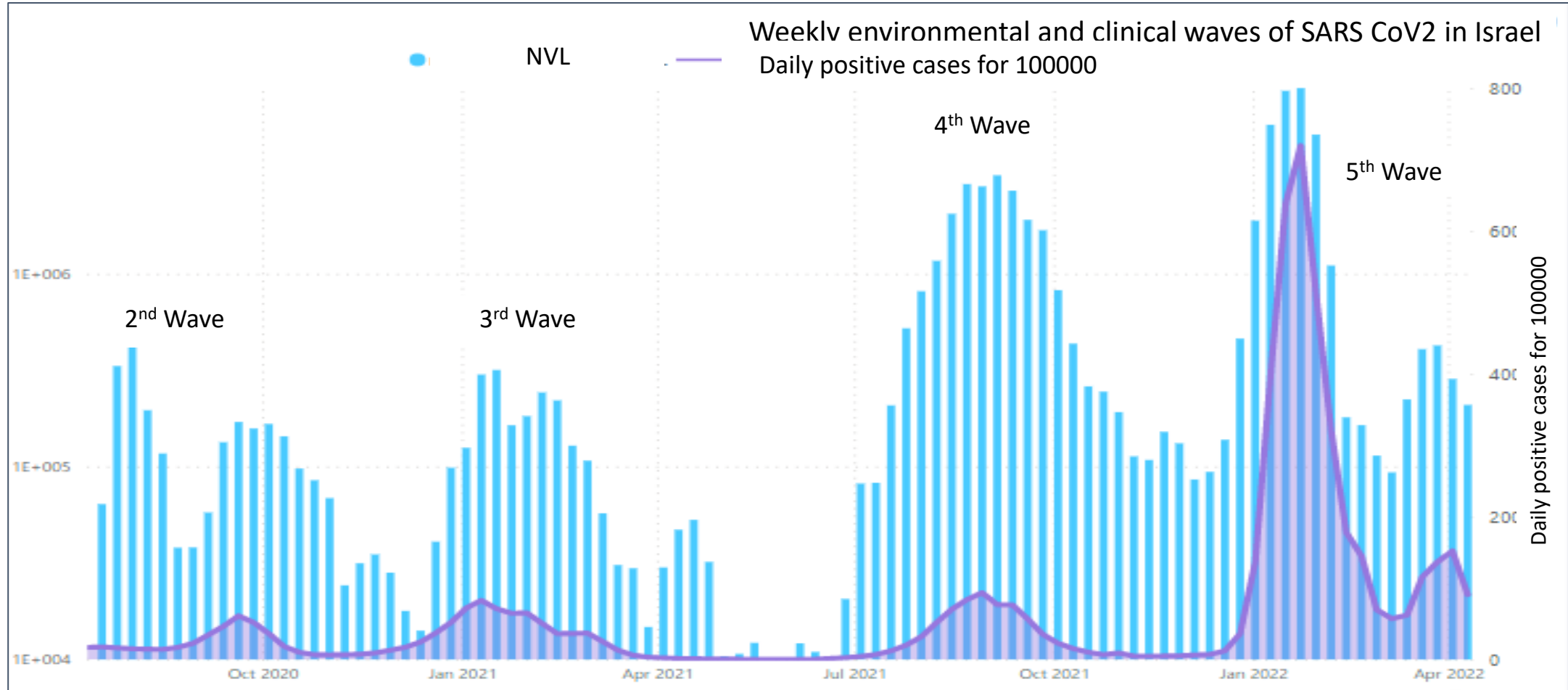
Weekly environmental and clinical waves of SARS CoV2 in Israel

National SARS CoV 2 surveillance

WWTP SARS CoV 2 surveillance



Integration of the surveillances in Israel

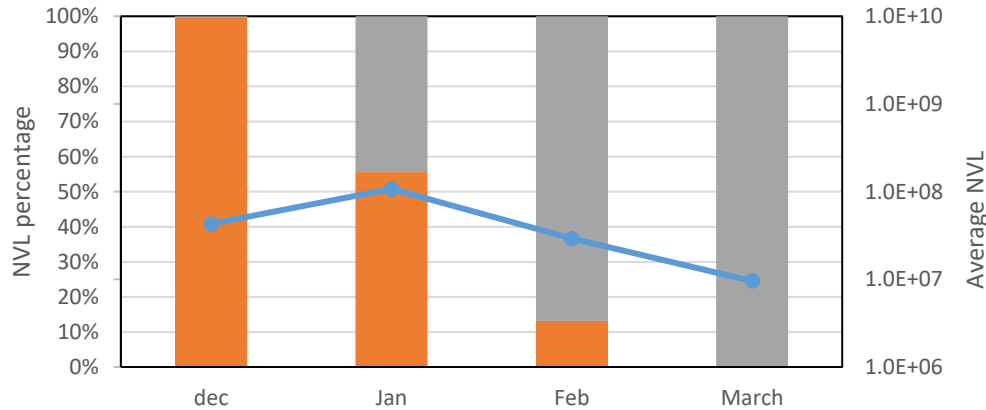


Alpha variant taking over Israel 2020-2021

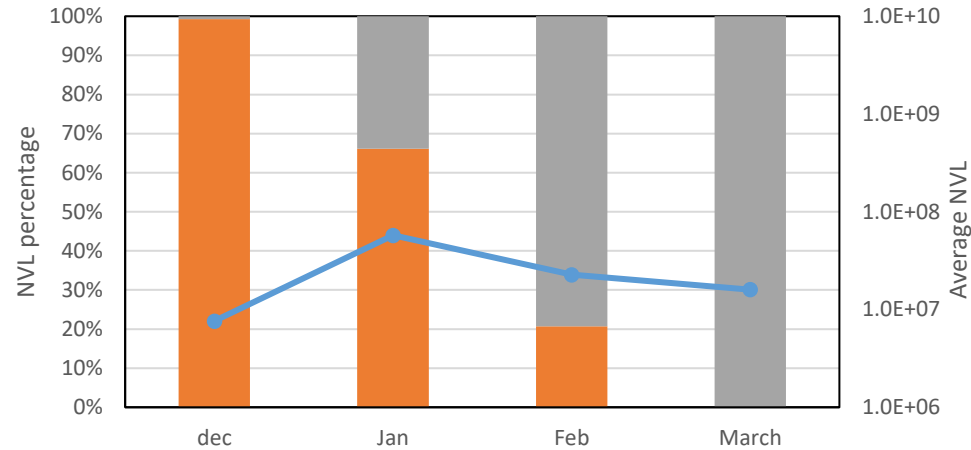
Specific rtPCR test for known variant can show trends in the population.

Wastewater SC-2 averaged normalized viral load in different regions of Israel.

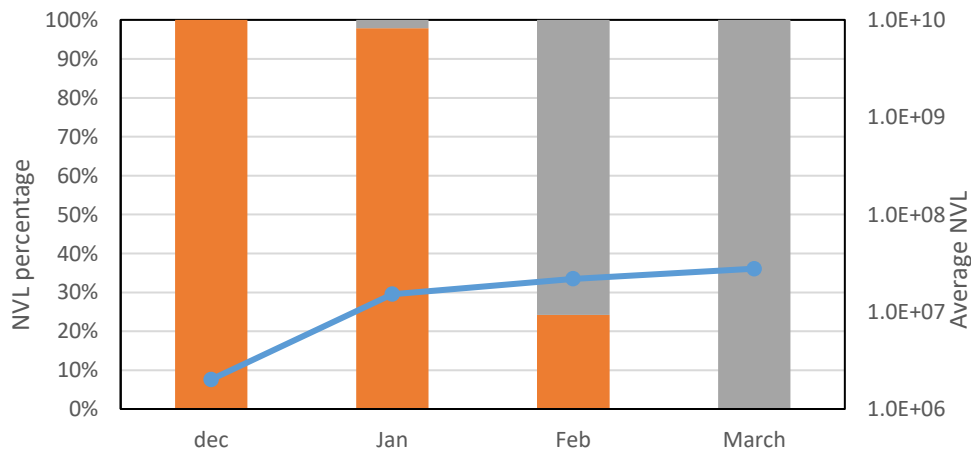
Northern region



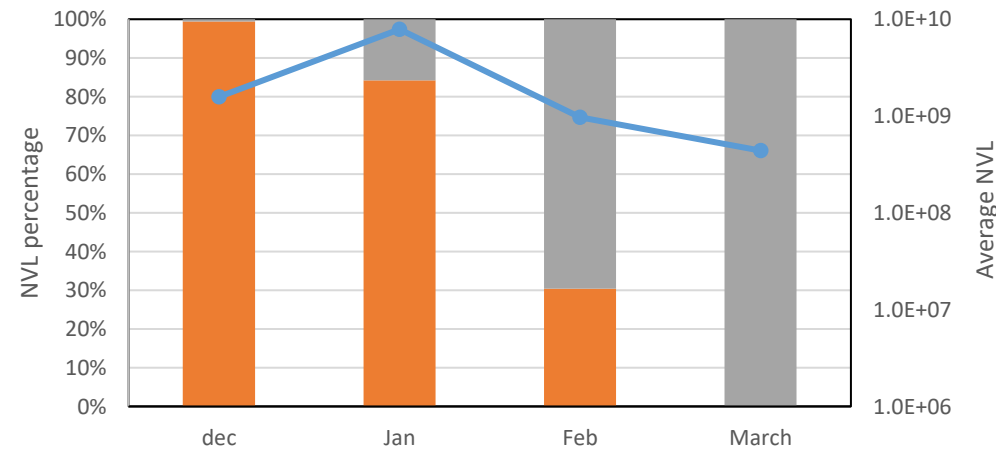
Central region



Southern region



Jerusalem region

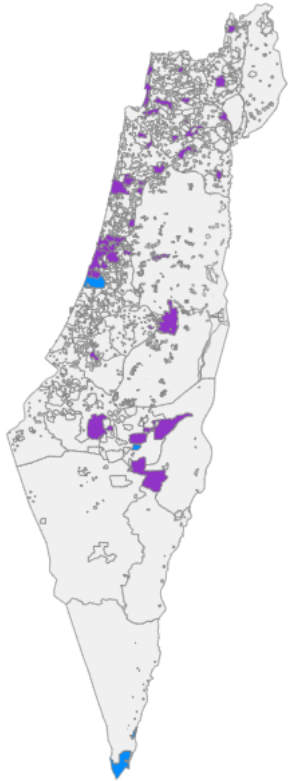


■ N_{WT}
■ N_{B.11.7}
—●— E avg

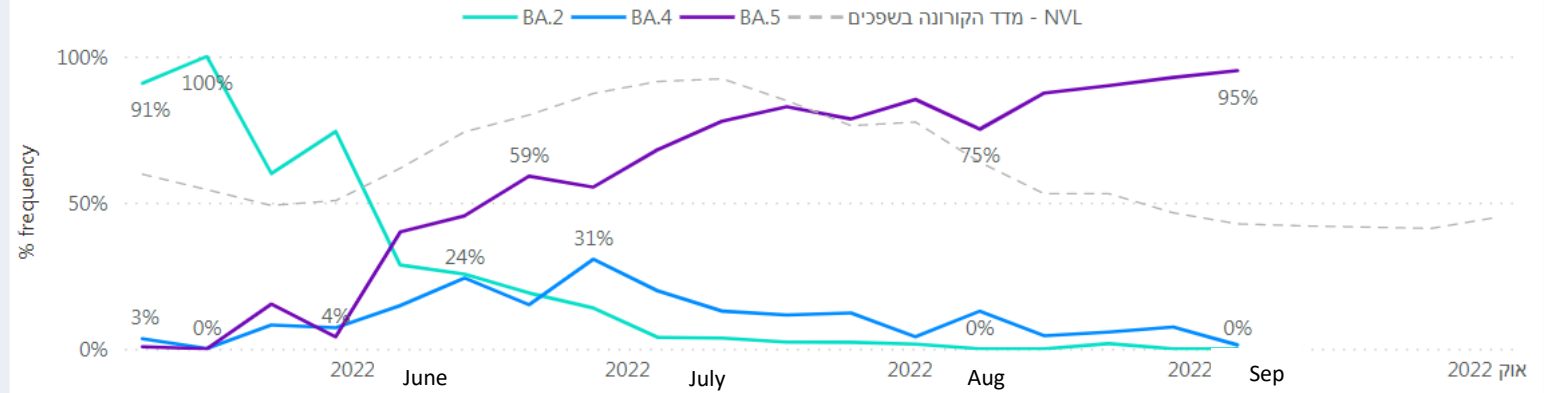
SARS CoV 2 variants surveillance in Israel

Region in Israel

BA.2 BA.4 BA.5



Variants frequencies



אפשרויות בחירה מרובות

Variants frequencies

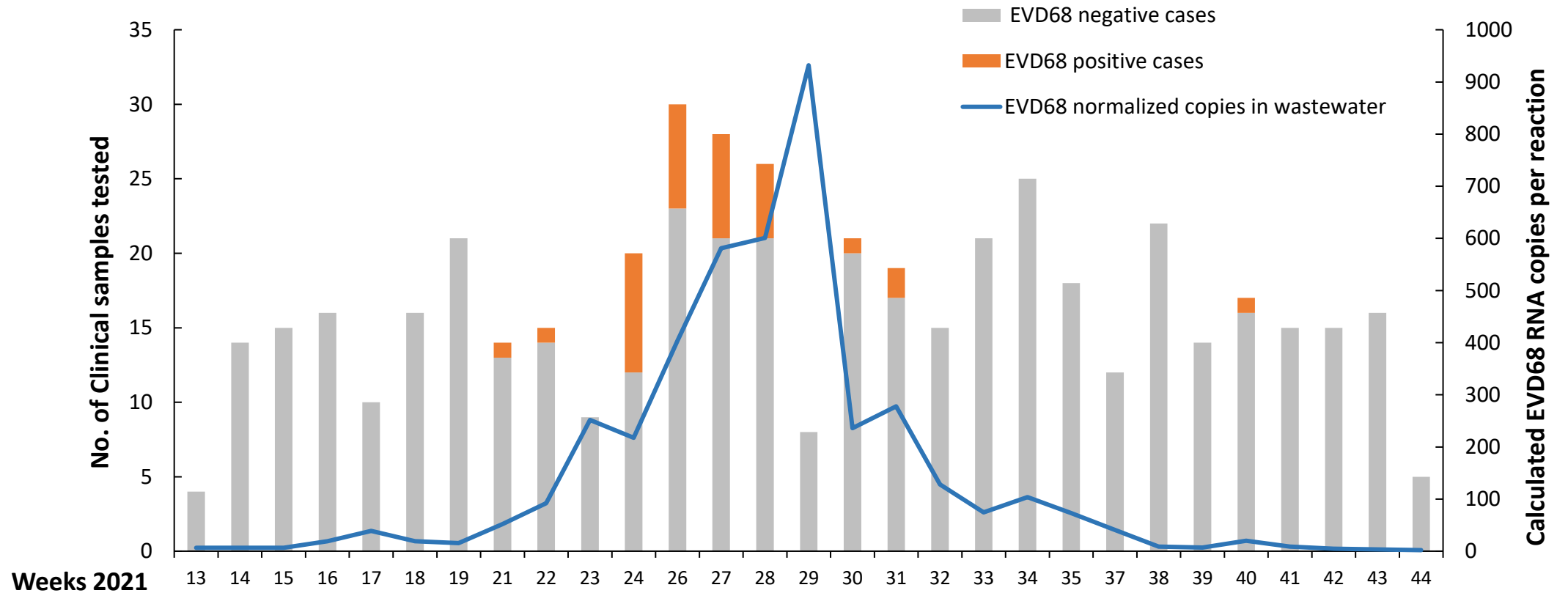
| BA.5 | BA.4 | BA.2.12.1 | BA.2.75 | BA.2 | תאריך ריצוף אחרון | Region in Israel |
|------|------|-----------|---------|------|-------------------|-------------------|
| 90% | 4% | 0% | 4.2% | 0% | 03/09/2022 | Central |
| 98% | 1% | 0% | 0.2% | 0% | 04/09/2022 | North |
| 92% | 2% | 0% | 0.7% | 0% | 04/09/2022 | Haifa |
| 100% | 0% | 0% | 2.3% | 0% | 03/09/2022 | Judea and Samaria |
| 98% | 2% | 0% | 0.0% | 0% | 03/09/2022 | Jerusalem |
| 92% | 12% | 0% | 0.9% | 0% | 03/09/2022 | Tel Aviv |

Enterovirus D68 surveillance in Israel

- Human enterovirus D68 (EV-D68) belongs to Enterovirus D in the Picornaviridae family.
- EV-D68 is associated with acute respiratory infection ranging from mild to severe disease requiring intensive care treatment.
- EV-D68 have been reported to cause acute flaccid myelitis (AFM).
- EVD68 is primarily detected in respiratory tract tissues but also in the gastrointestinal tract.
- EVD68 is currently not monitored routinely.

Enterovirus D68 outbreak in Israel 2021

Quantitation of EV-D68 in Wastewater Vs clinical cases



Wastewater-based surveillance by quantitative RT-PCR may be used as a complementary tool for continuous monitoring of Enterovirus D68 circulation, in parallel with testing of suspicious clinical cases.

In conclusion

- Wastewater surveillance can be used as a tool for monitoring trends of pathogens in the population.
- The concentration method for the different pathogens should be adjusted to the pathogen but the sampling stay the same.
- Wastewater surveillance information can be used for health ministry when the population avoid been tested or no test is done in the community.
- Wastewater surveillance can help detect the spread of new variant using NGS and qPCR.
- Wastewater surveillance can find new unknown pathogens/variants emerging in the population using NGS.



Deputy Director of the Virus
Laboratory



Director of the Virus
Laboratory

Thank you for listening

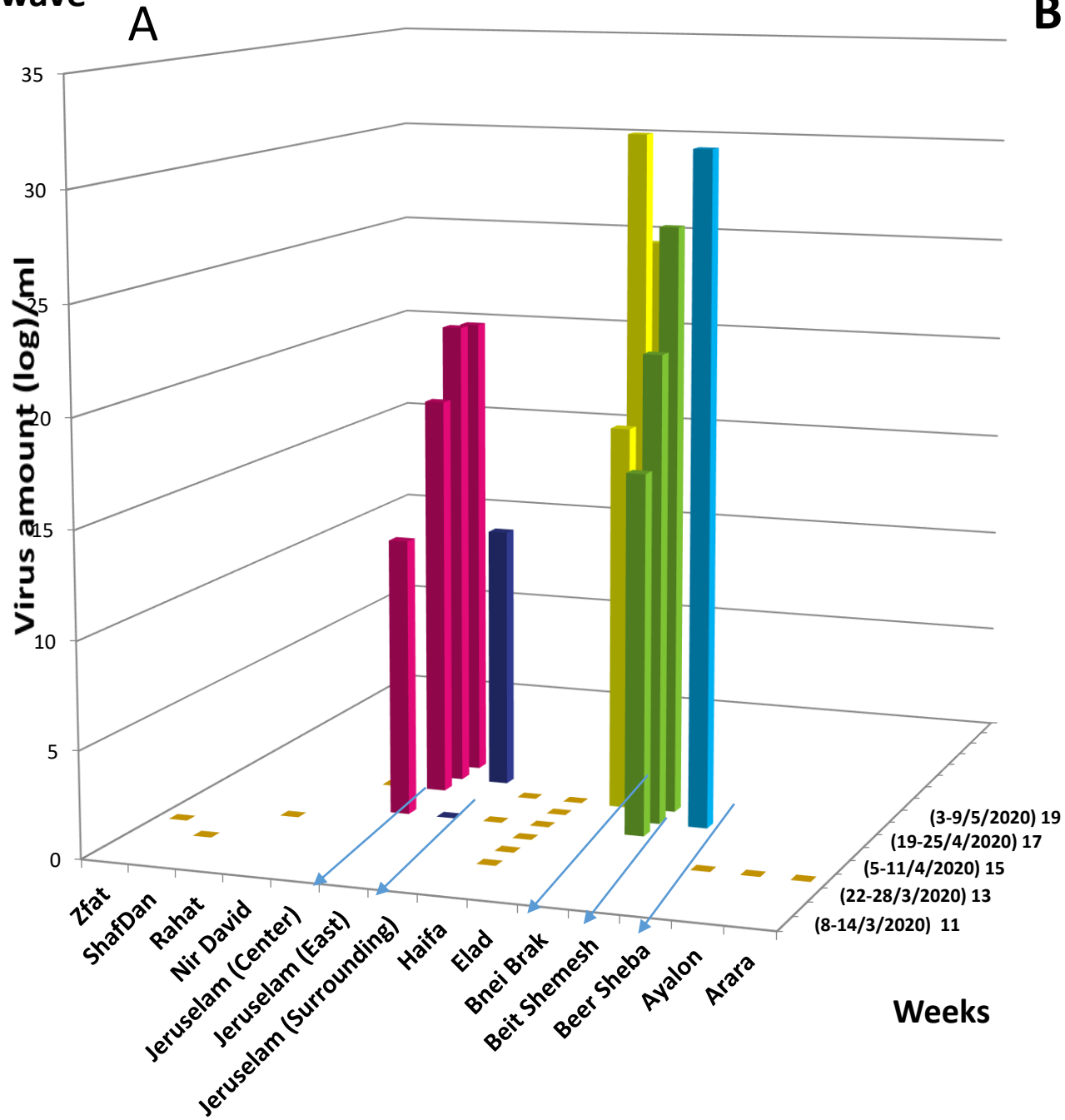
BIG BIG THANKS FOR CVL sewage team:

Merav Weil, Victoria Indenbaum, Oran Erster, Michal Elul, Nofar
levi, Batya Mannasse, Rachel Shirazi and many more.

Ariel Kushmaro lab BGU
Eran Fridler lab Technion
Kando
Alin Sela Brown
Moshe Wein
Ministry of health



First wave



B

