EU Wastewater Observatory for Public Health
Townhall X: Wastewater Witchers and Watchers
November 17, 2023

Hokkaido University

Wastewater Banking:
Proof of the Concept by Retrospective Analysis of SARS-CoV-2 and Other Viruses

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“Wastewater banking”: archiving community-level public health information

Wastewater banking is the method capable of preserving samples that reflect community-level infection status.

Respiratory viruses (influenza A virus, RSV) (Ando et al., 2023)

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Impact of the COVID-19 pandemic on the prevalence of influenza A and respiratory syncytial viruses elucidated by wastewater-based epidemiology

Hiroki Ando [a], Warish Ahmed [b], Ryo Iwamoto [c,d], Yoshinori Ando [c], Satoshi Okabe [a], Masaaki Kitajima [a,*]

Gastroenteritis viruses (noro, sapo, rota, Aichi) (Ando et al., 2023)

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Tracking the effects of the COVID-19 pandemic on viral gastroenteritis through wastewater-based retrospective analyses

Hiroki Ando [a], Warish Ahmed [b], Satoshi Okabe [a], Masaaki Kitajima [a,*]

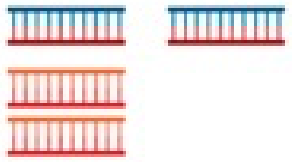
EPISENS-M: a highly sensitive method suitable for wastewater banking

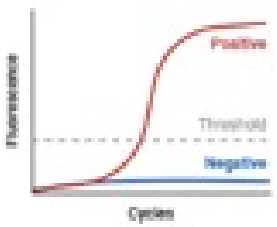
EPISENS-S (Ando et al., 2022)

Wastewater
↓
Centrifugation, pelleting
↓
RNA extraction
↓
RT, preamplification
↓
qPCR

Solid

SARS-CoV-2 PMMoV





Improved (higher sensitivity)

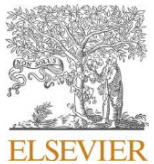
EPISENS-M (Ando et al., 2023)

Filtration

Membrane

➢ space-saving (suitable for banking)

Bead-beating



Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Full length article

Wastewater-based prediction of COVID-19 cases using a highly sensitive SARS-CoV-2 RNA detection method combined with mathematical modeling

Hiroki Ando [a], Michio Murakami [b], Warish Ahmed [c], Ryo Iwamoto [d,e], Satoshi Okabe [a], Masaaki Kitajima [a,*]

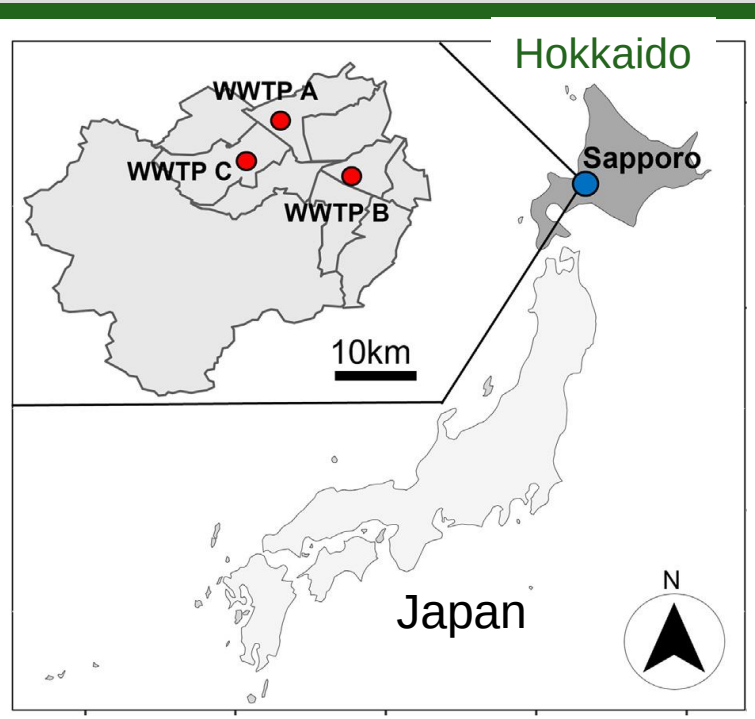
Proof-of-concept study in Sapporo, Japan

❑ Wastewater samples

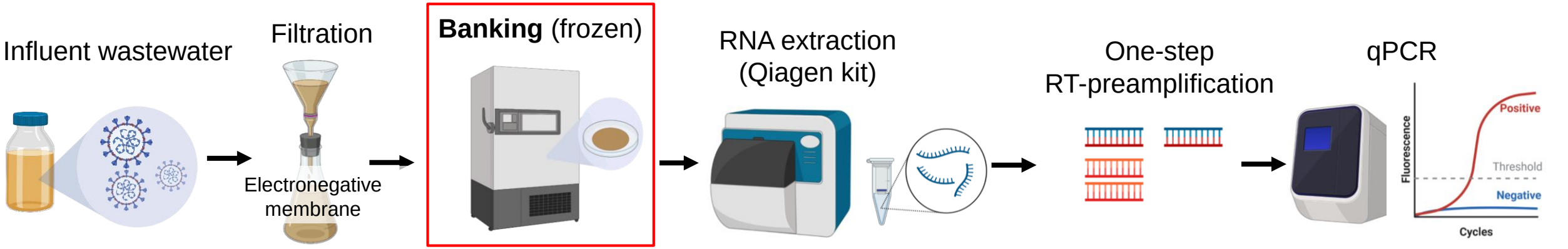
- 3 plants in Sapporo

❑ Target viruses

- Respiratory viruses
  - SARS-CoV-2
  - Influenza A virus
  - RSV
- Indicator virus
  - PMMoV
- Gastroentetitis viruses
  - Norovirus
  - Sapovirus
  - Group A rotavirus
  - Aichi virus

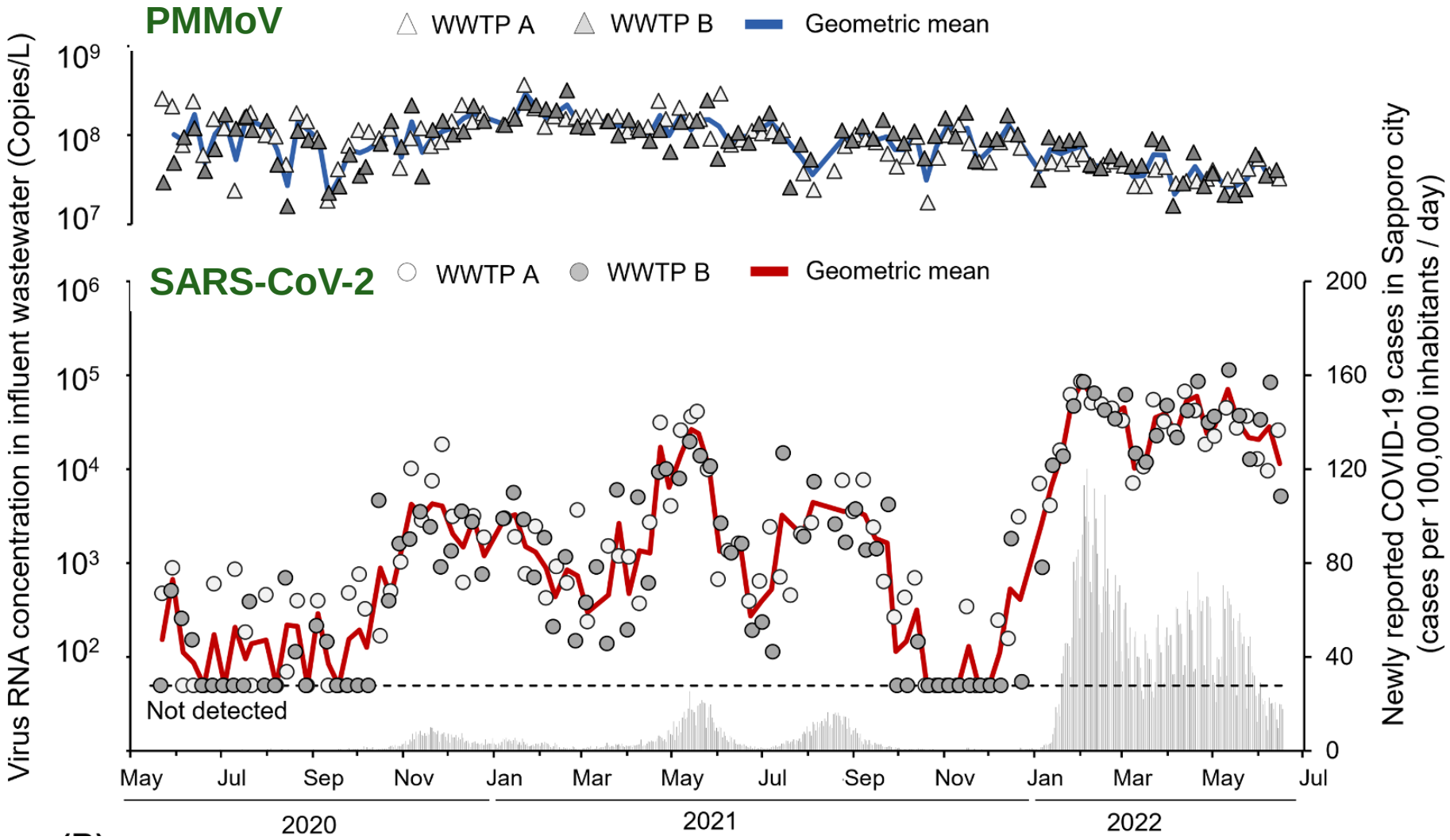


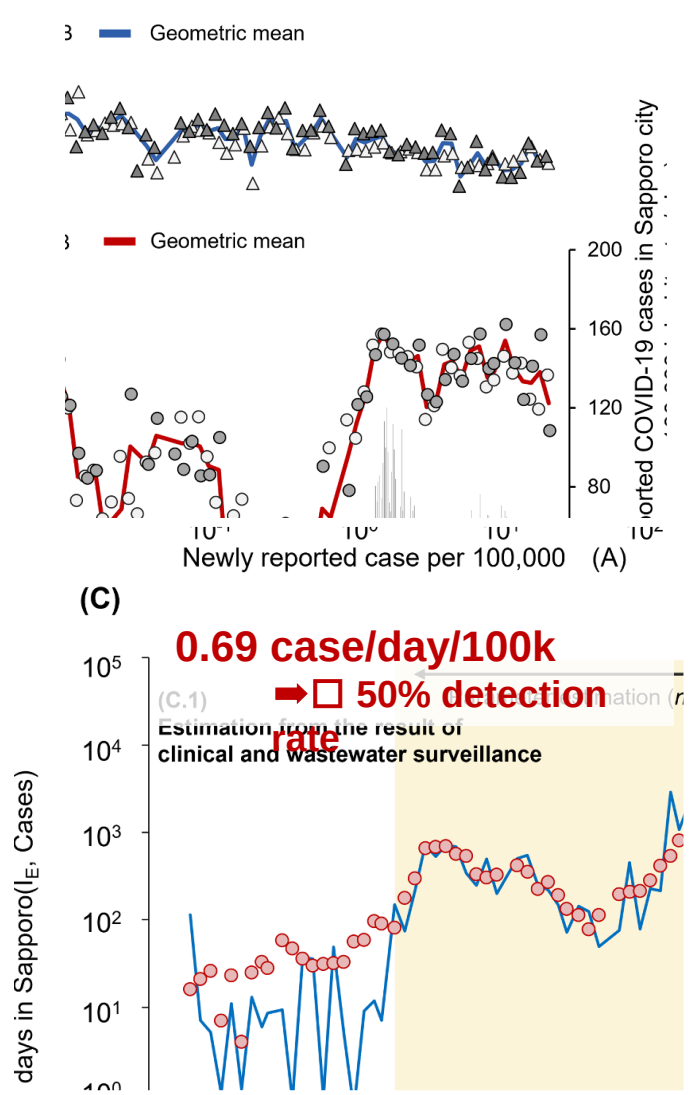
2018 October~



EPISENS-M method

Dynamics of SARS-CoV-2 in wastewater determined by EPISENS-M method

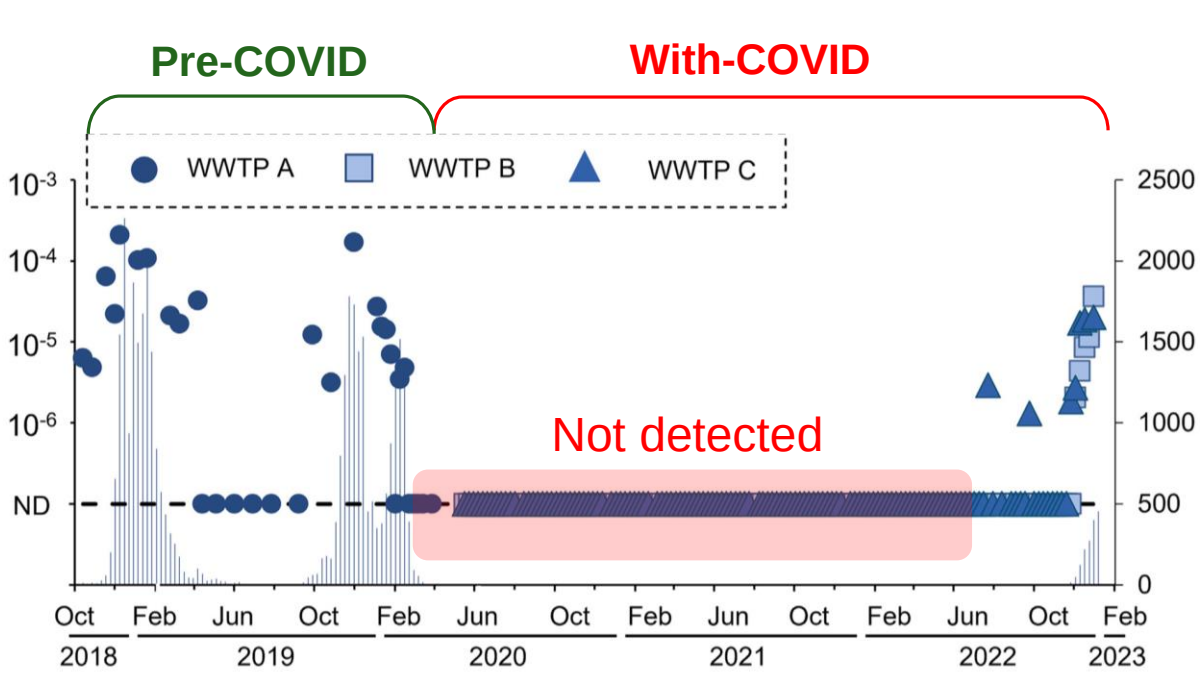




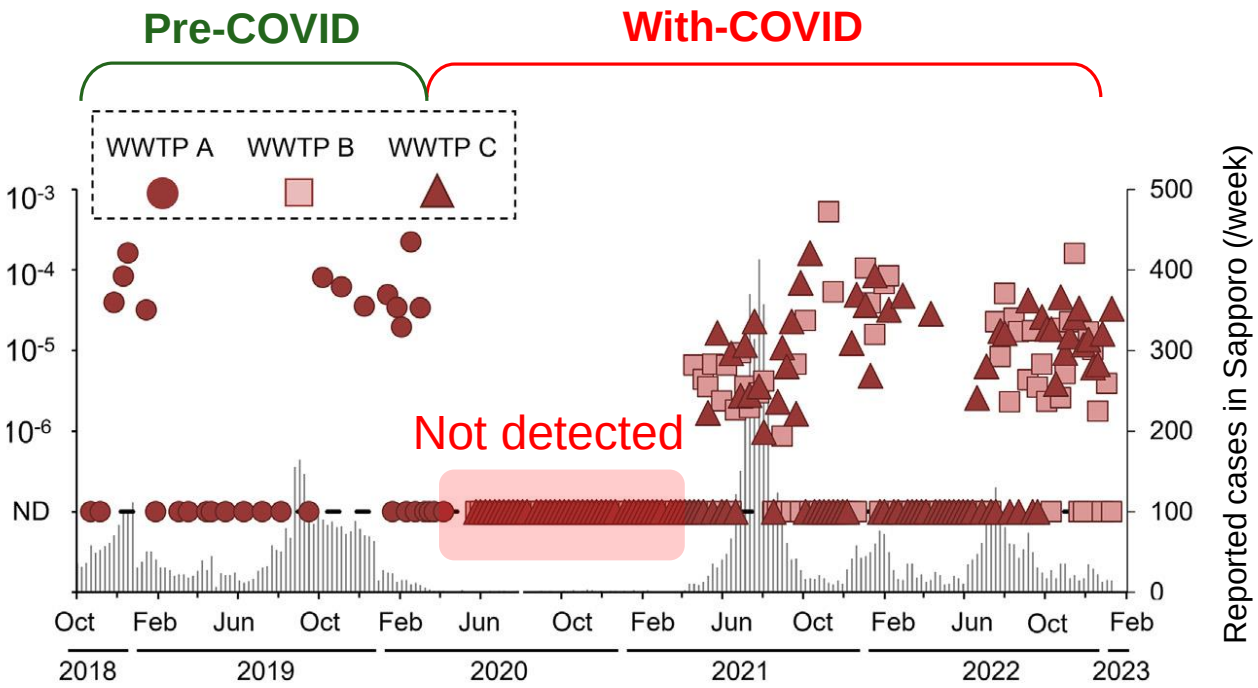
Ando H, Murakami M, Ahmed W, Iwamoto R, Okabe S, Kitajima M*. Wastewater-based prediction of COVID-19 cases using a highly sensitive SARS-CoV-2 RNA detection method combined with mathematical modeling. *Environment International*, 173, 107743, 2023.

Impact of the COVID-19 pandemic on other respiratory diseases

Influenza A virus



RSV-A&B

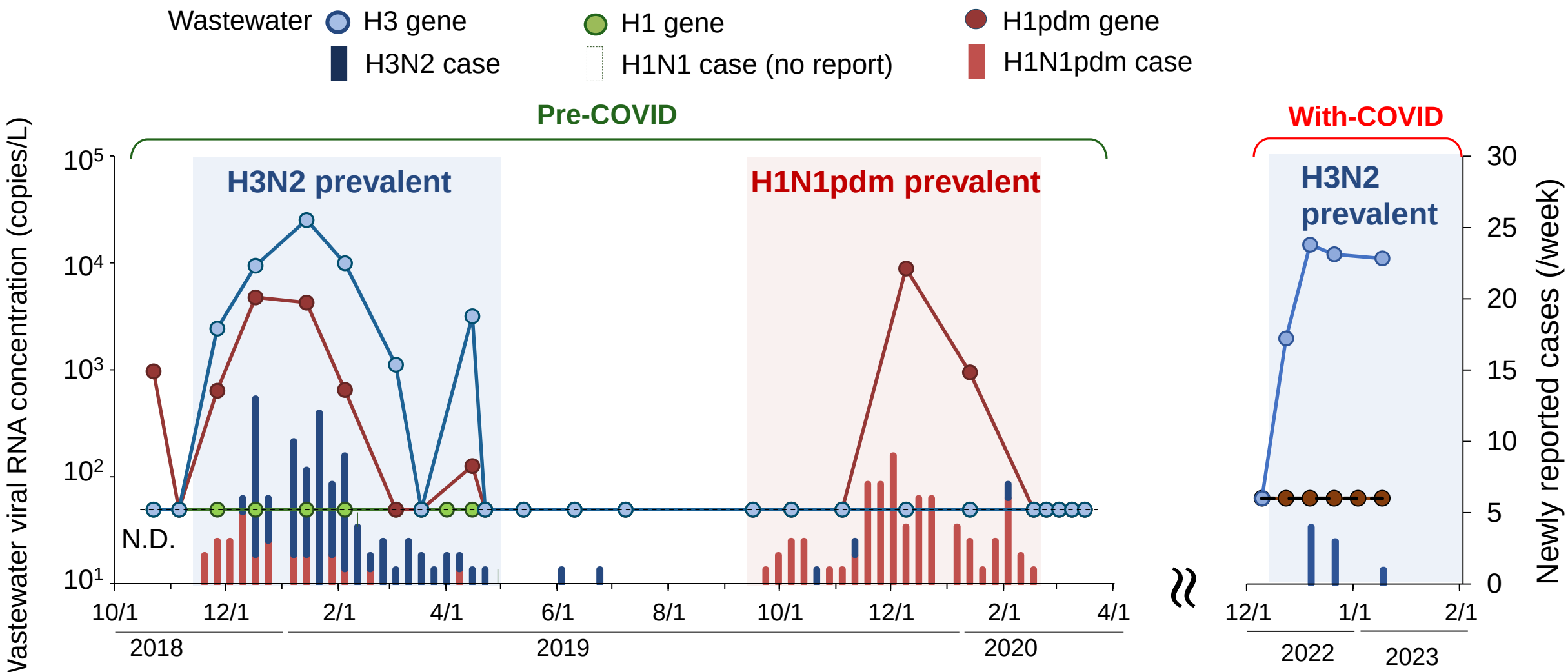


PMMoV-normalized viral RNA concentration in wastewater

❑ **Disease prevalence substantially declined because of countermeasures for COVID-19 (side benefit)**

Ando H, Ahmed W, Iwamoto R, Ando Y, Okabe S, Kitajima M*. Impact of the COVID-19 pandemic on the prevalence of influenza A and respiratory syncytial viruses elucidated by wastewater-based epidemiology, *Science of the Total Environment*, 880, 162694, 2023.

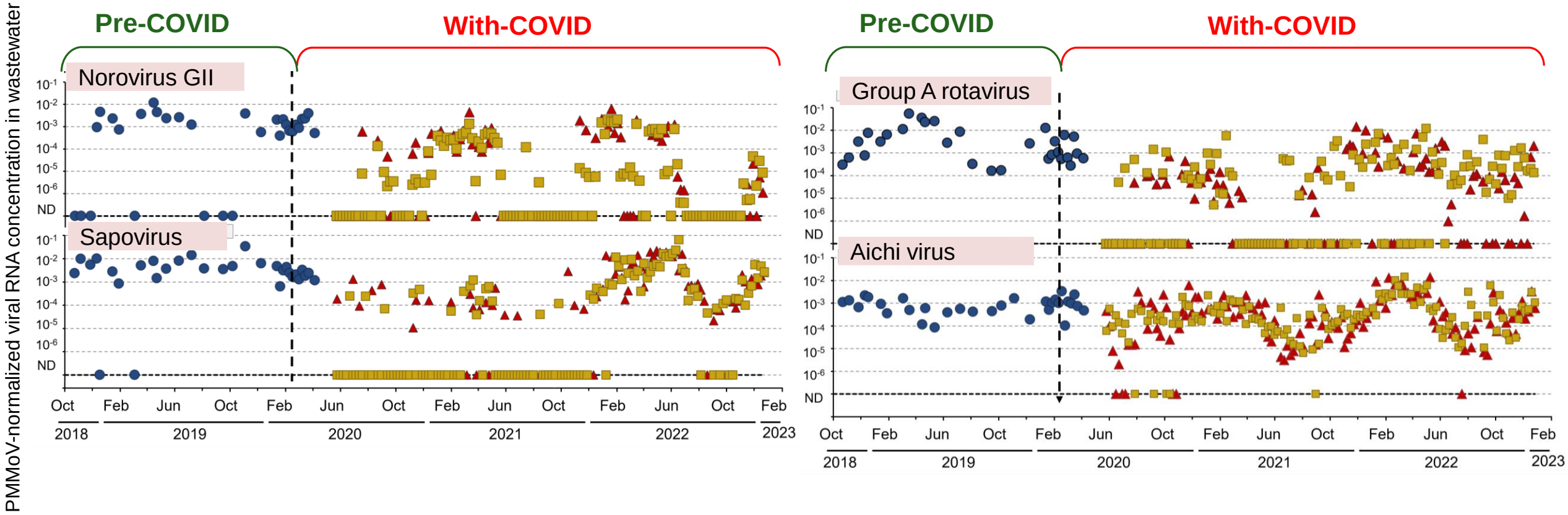
Tracking prevalent subtypes of seasonal flu via WBE



❑ **Prevalent subtypes can be elucidated by WBE.**

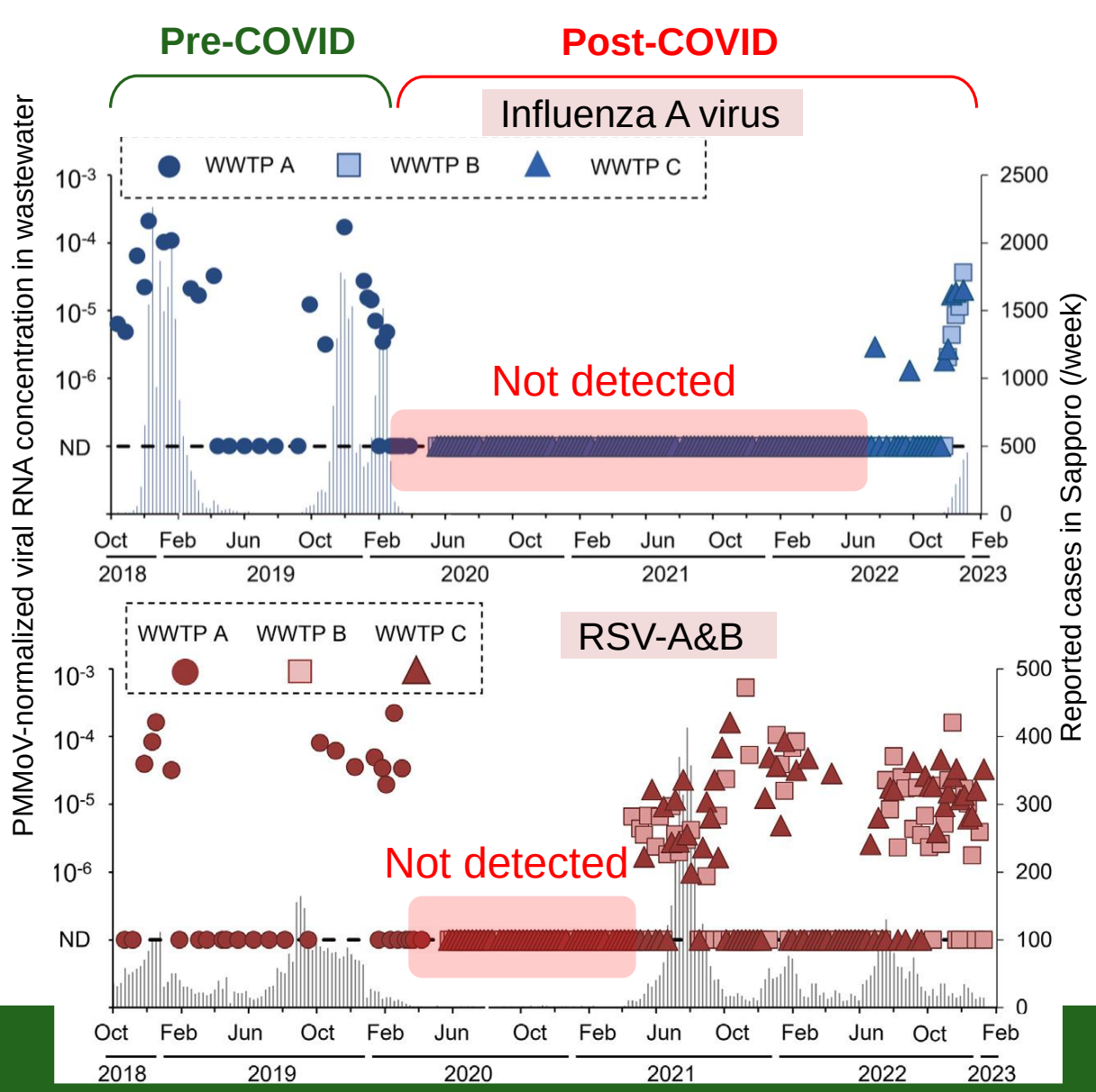
Ando H, Ahmed W, Iwamoto R, Ando Y, Okabe S, Kitajima M*. Impact of the COVID-19 pandemic on the prevalence of influenza A and respiratory syncytial viruses elucidated by wastewater-based epidemiology, *Science of the Total Environment*, 880, 162694, 2023.

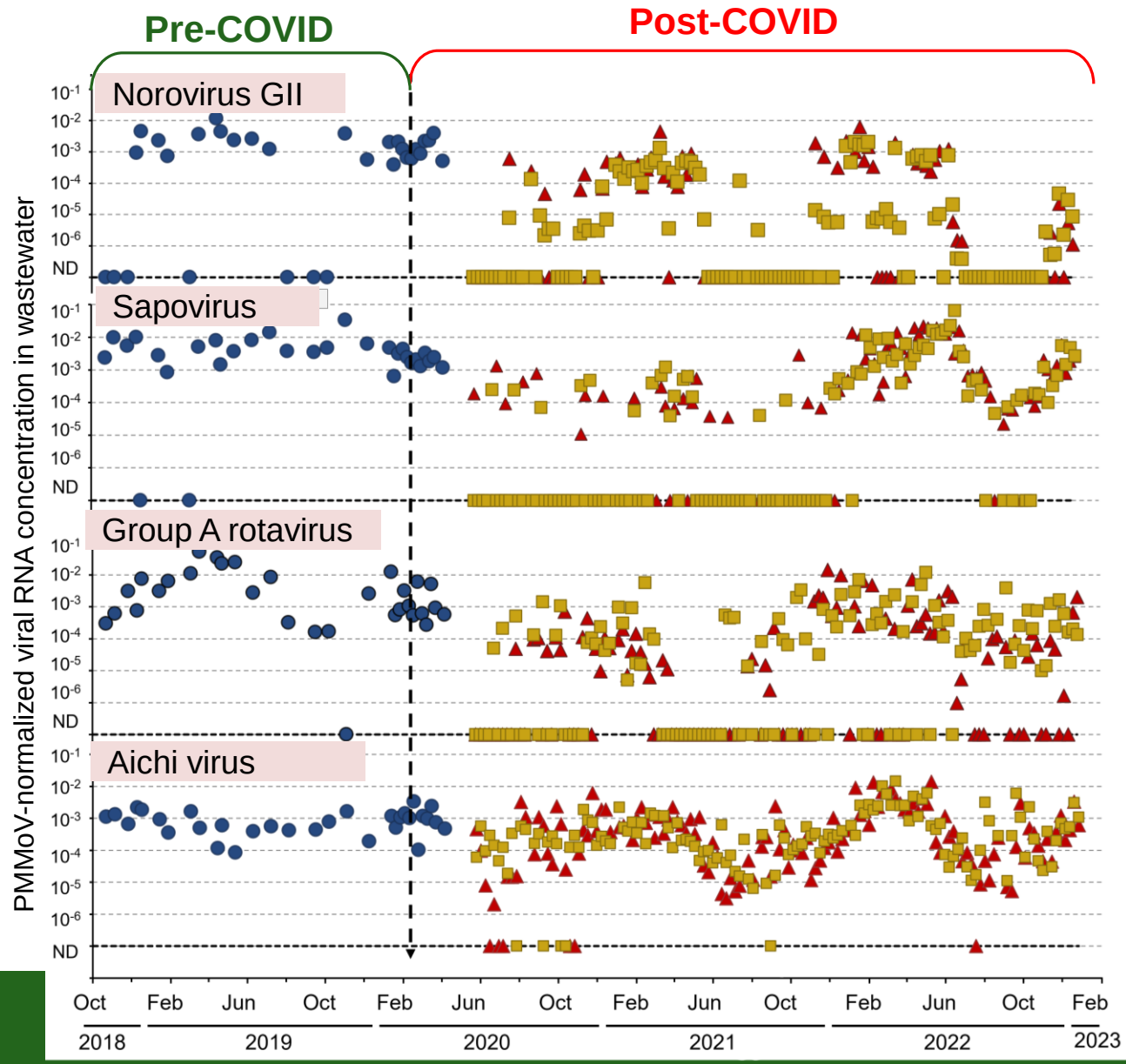
Impact of the COVID-19 pandemic on viral gastroenteritis



- ❑ **Norovirus GII, Sapovirus, Group A rotavirus: declined prevalence during pandemic**
- ❑ **Aichi virus: little affected by the pandemic**

Difference in impact of the pandemic: respiratory vs gastroenteritis viruses





Conclusions
Wastewater banking: proof of concept

1. EPISENS-M: highly sensitive method suitable for wastewater banking

- Membranes allow for space-saving, long-term preservation
- Applicable to SARS-CoV-2 and other viruses (influenza, RSV, gastroenteritis viruses)

2. Demonstrated usefulness of wastewater banking as an archival record of community-level public health information

- Visualized impact of the COVID-19 pandemic on other viral diseases
- Suggested difference in impact of the pandemic between virus types

Wastewater banking preserves samples reflecting population-level infection status for an extended period, with anticipated use as a public health archive in post-COVID society.