

A network diagram with nodes and connecting lines, rendered in shades of blue and cyan, set against a dark blue background. The nodes are represented by small circles, and the lines are thin, creating a complex web of connections.

7 December 2021, Dutch Israeli Mini Symposium

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# High-resolution monitoring of SARS-CoV-2 circulation through sewage surveillance

Dr Frederic Béen

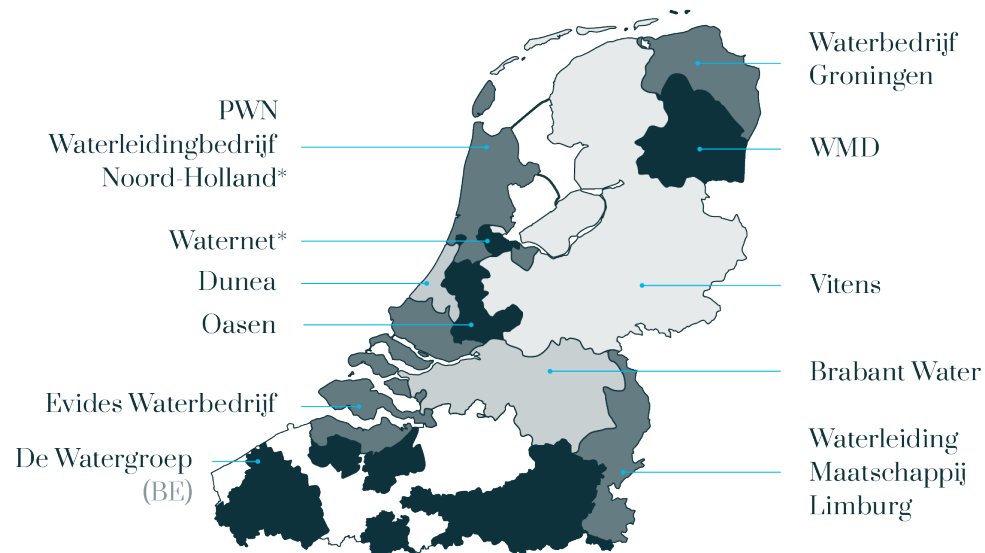
KWR Water Research Institute

**KWR**

Bridging Science to Practice

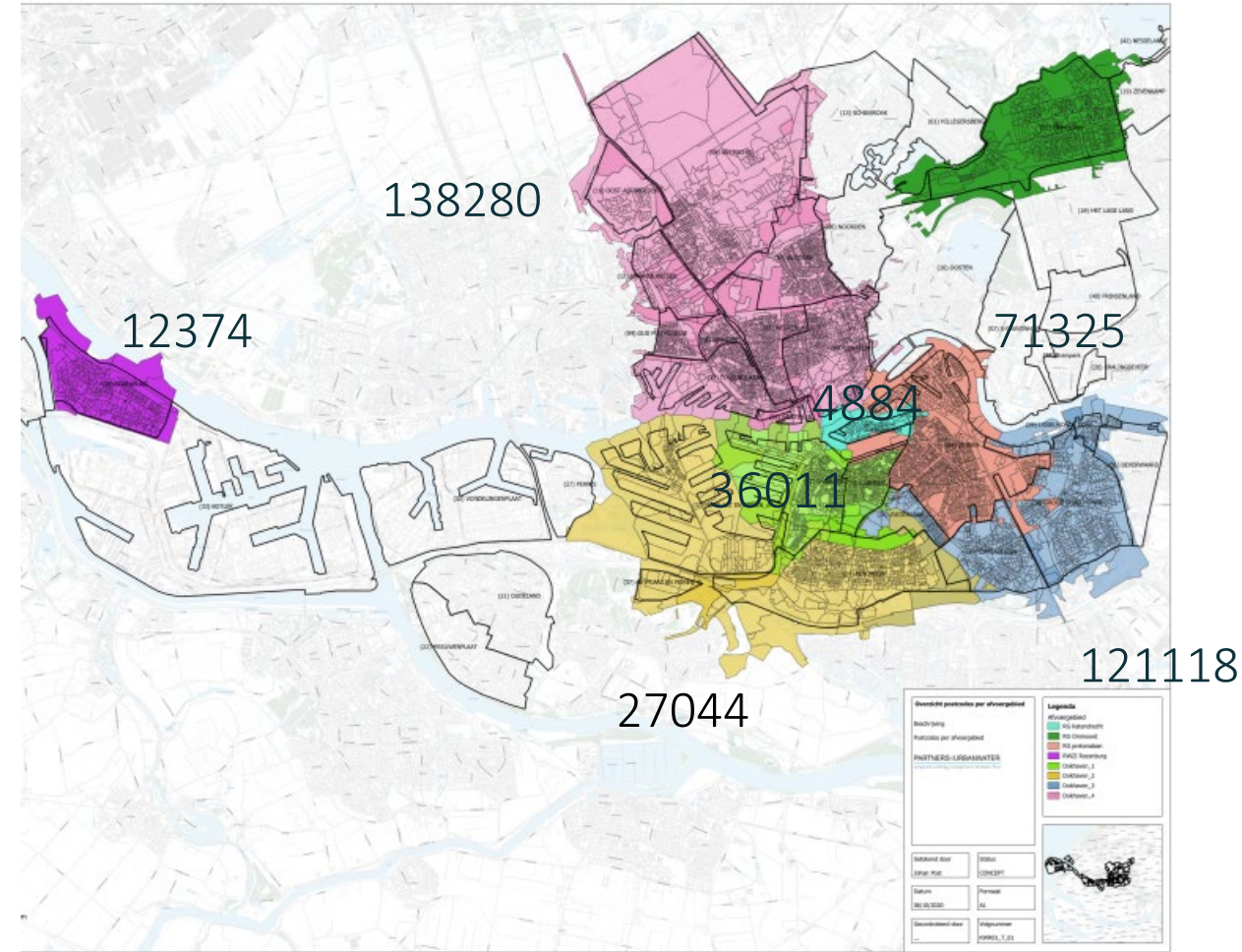
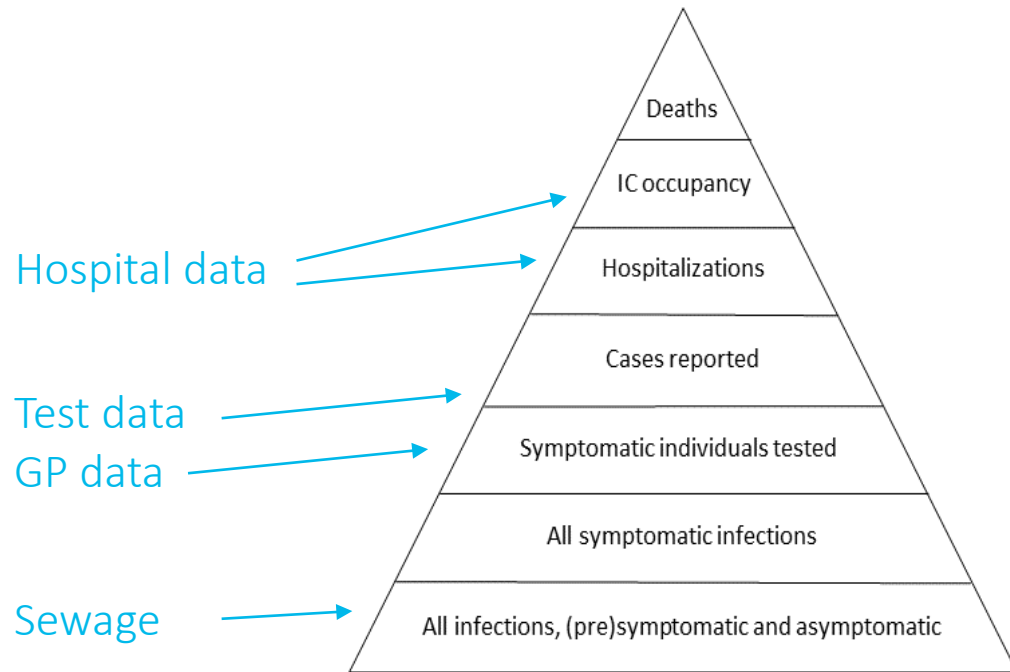
# Research at KWR

- Research Institute of the Dutch public drinking water companies and a Belgian company
- Joint research programme
- Internationally active



# Use case: understand COVID-19 dynamics

- High resolution:
- Time: 3/week
  - Space: city districts
  - Matched population



# High-resolution monitoring

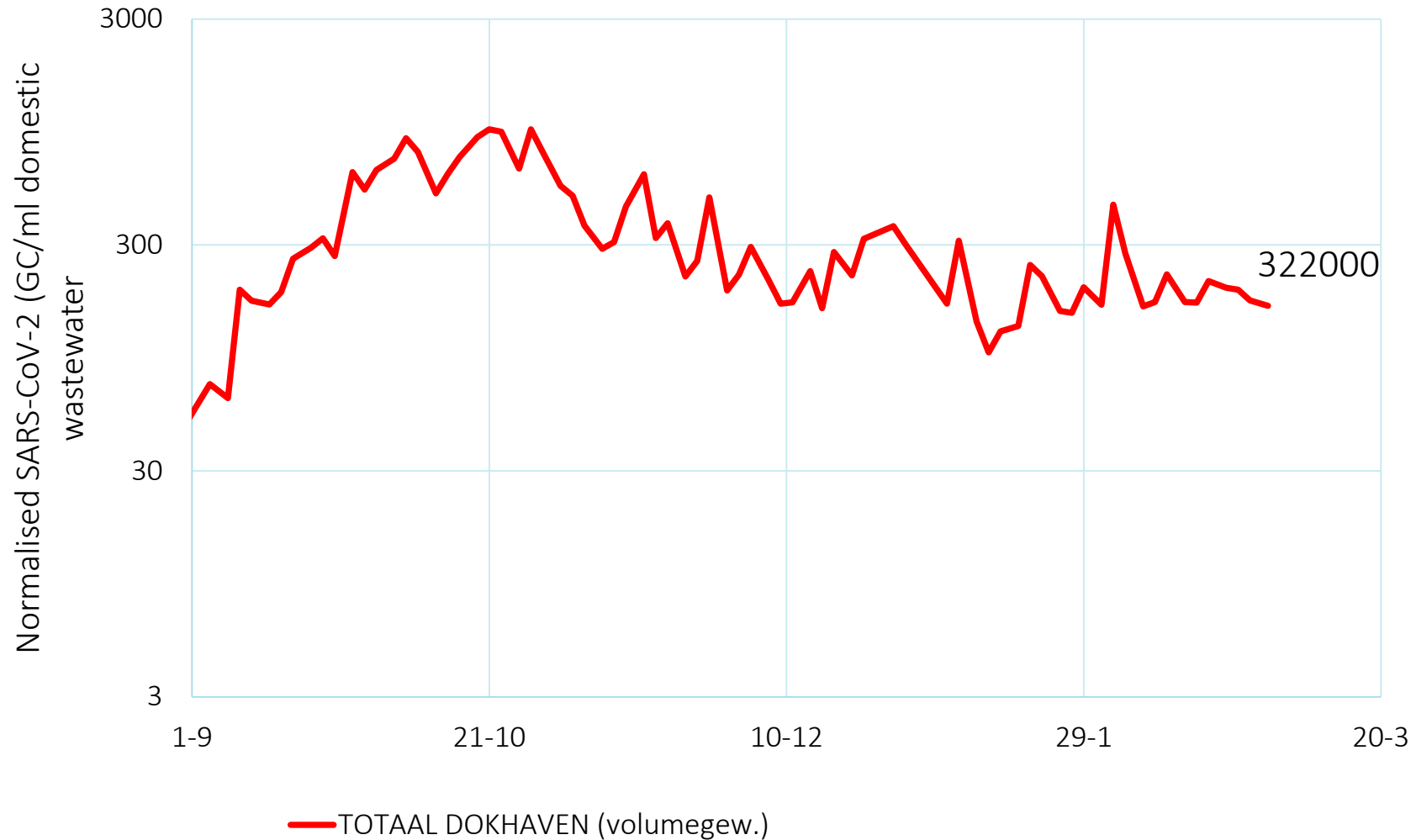
- High spatial and temporal resolution
- Wastewater treatment plants and pumping stations (i.e. in the neighbourhoods)
- Link to "above ground" data
  - By postcode
  - Correspondence with doctors' data
  - Syndromic surveillance
  - Stool sampling
  - Genotyping

→ Improved understanding of the link between the 'underground' and the 'surface'

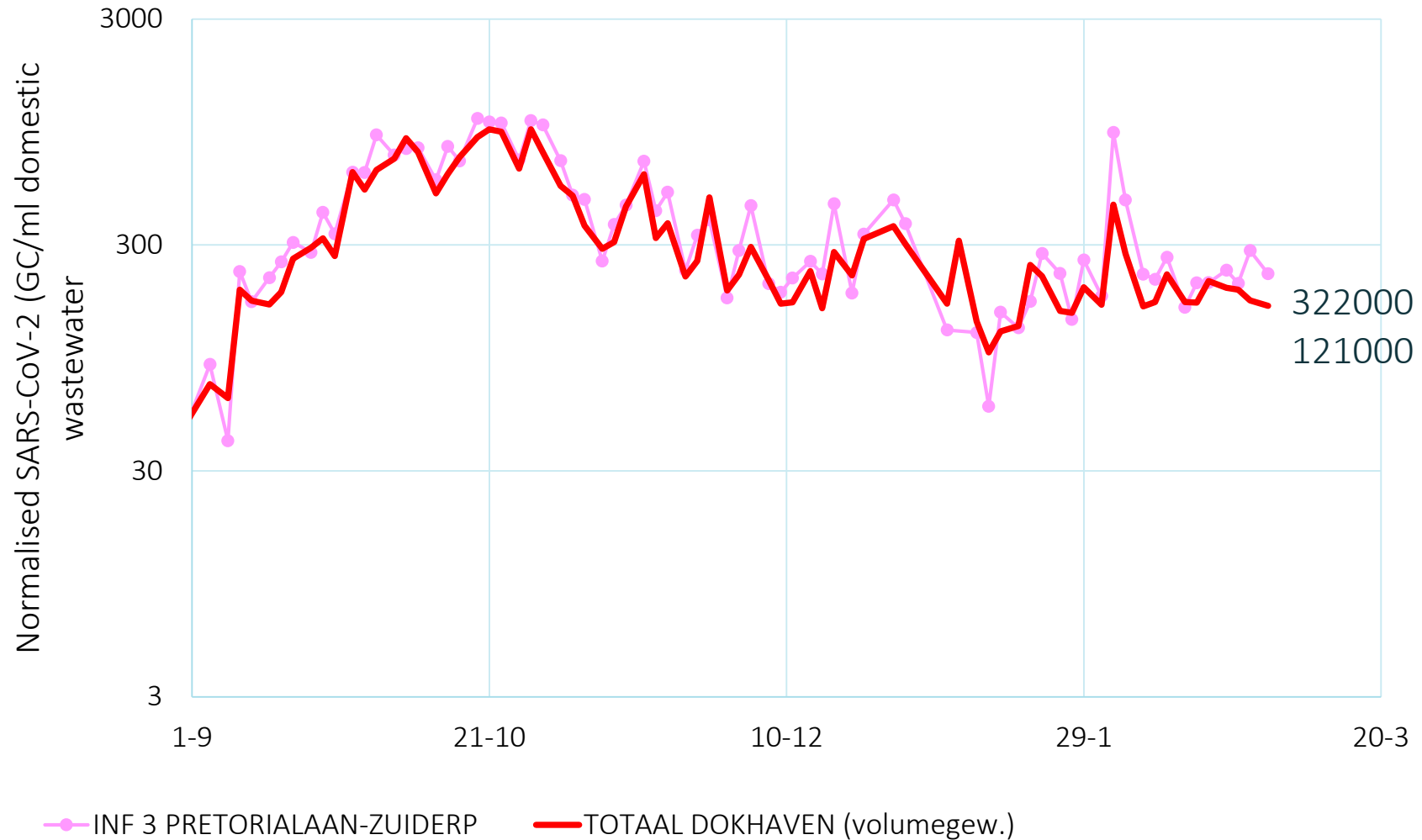


Courtesy of  
Partners4Urbanwater

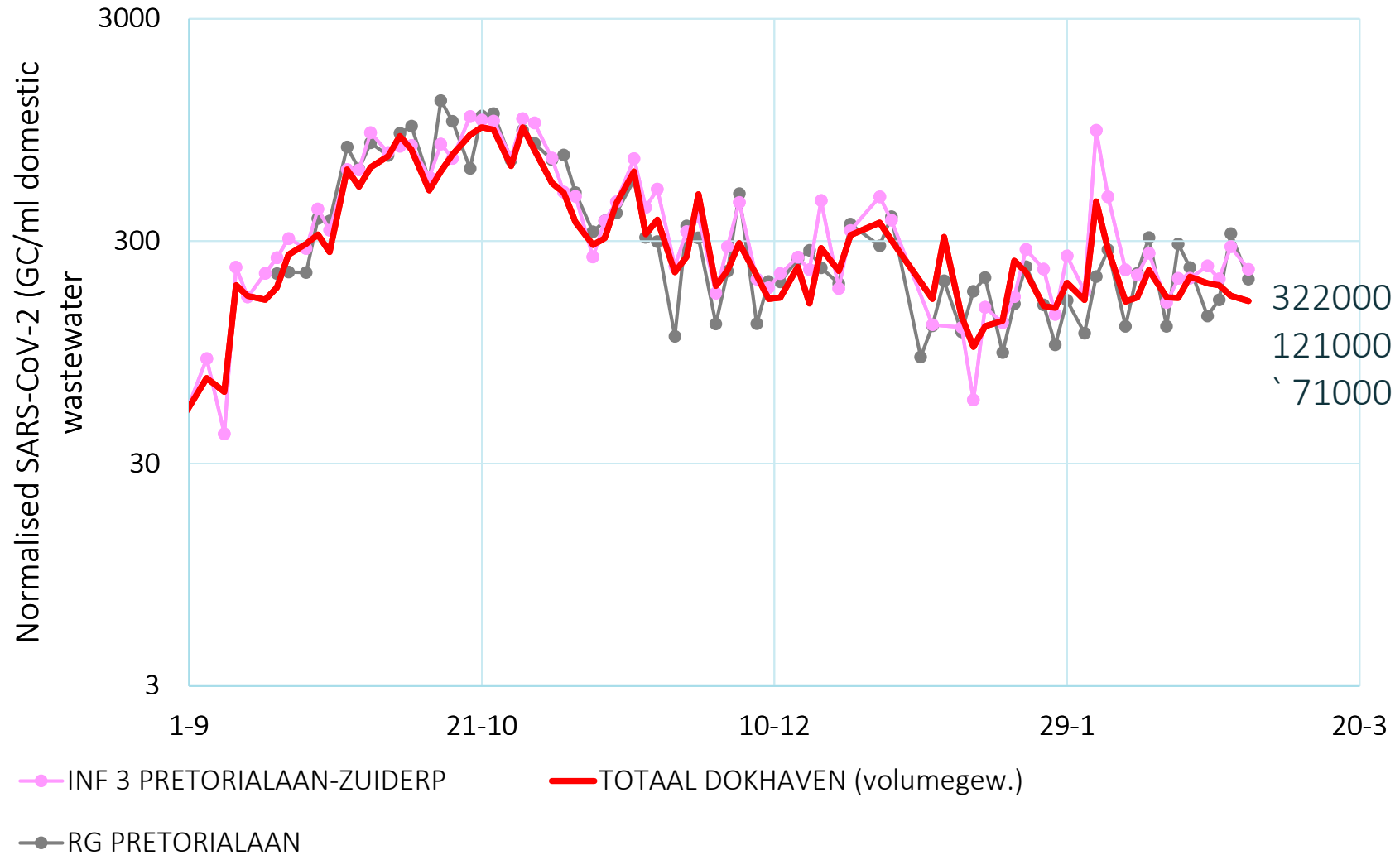
# Population size affects sewer signal dynamics



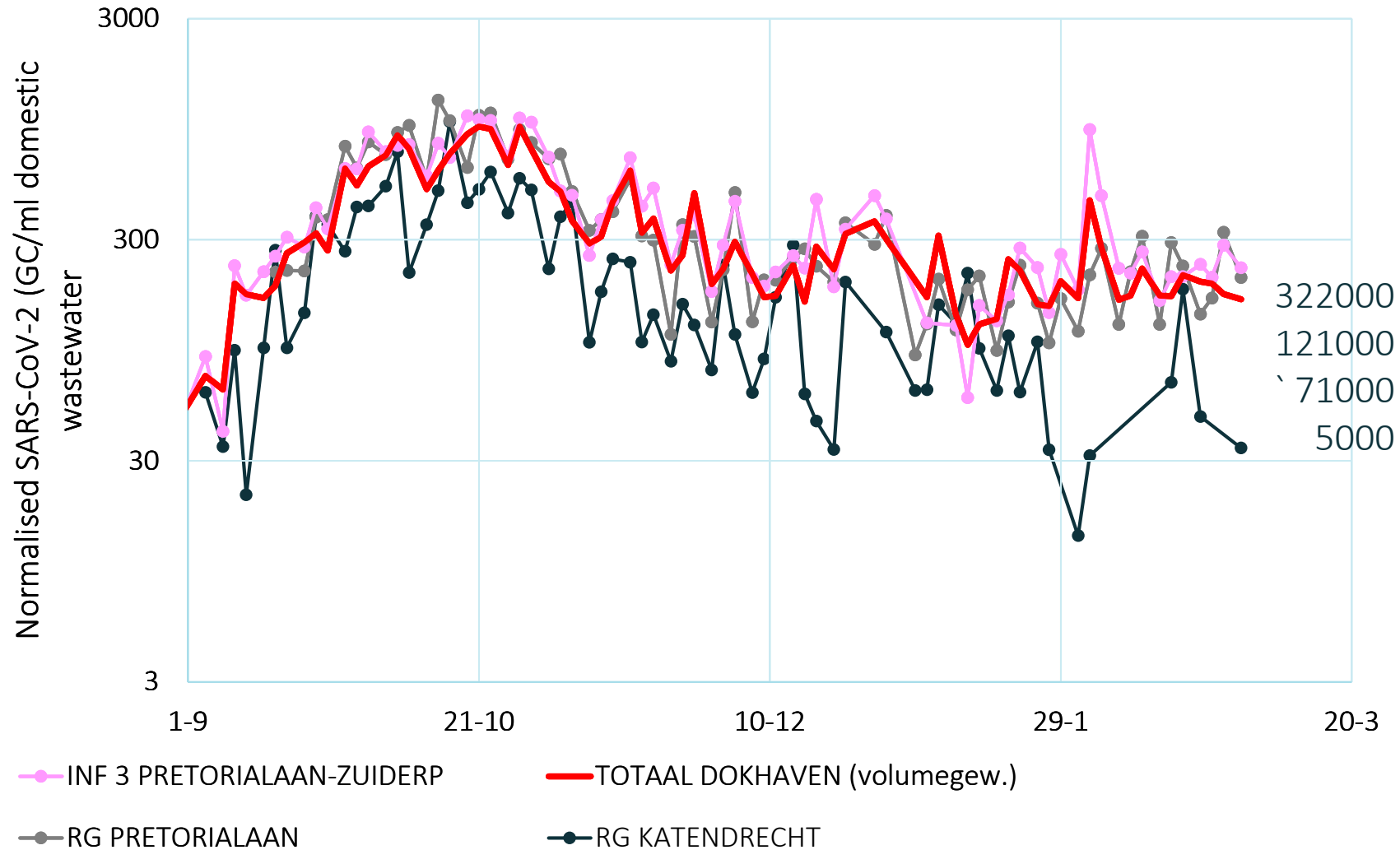
# Population size affects sewer signal dynamics



# Population size affects sewer signal dynamics

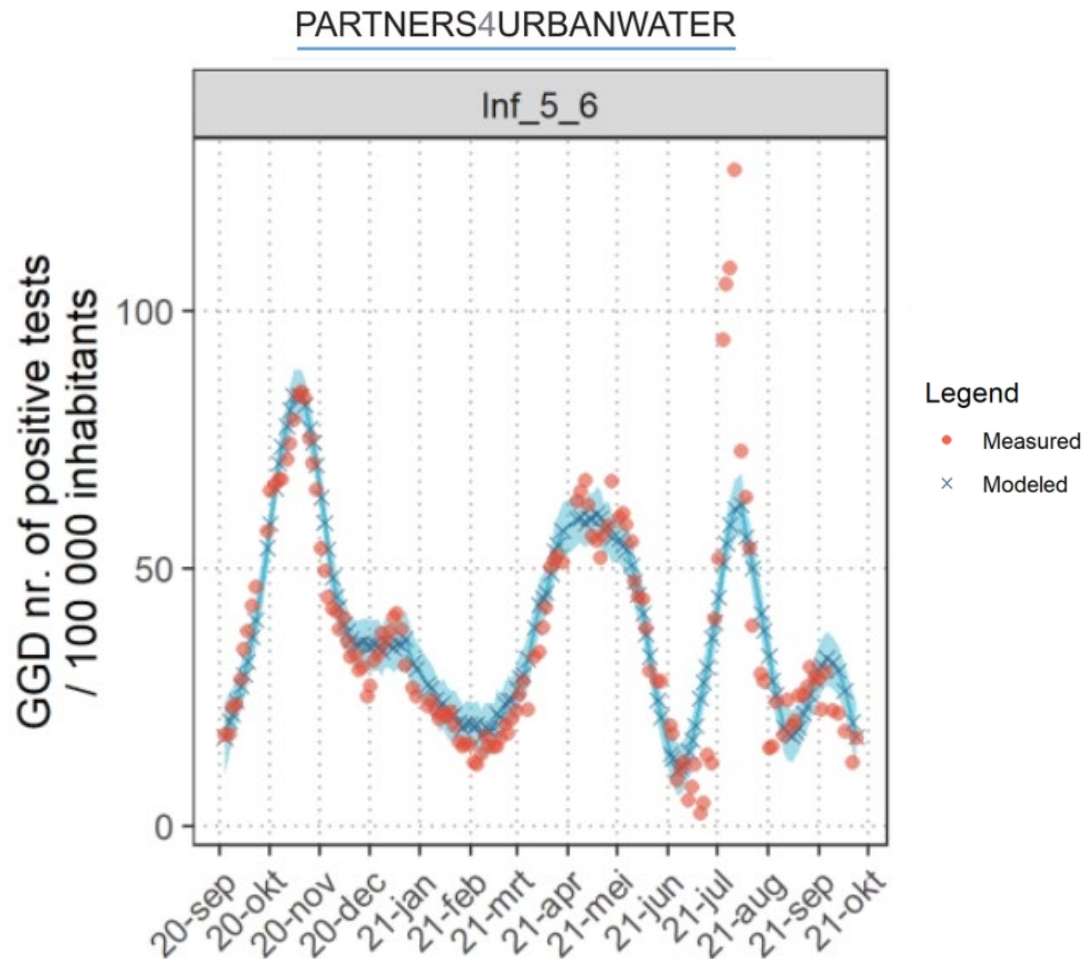


# Population size affects sewer signal dynamics





# Relation between concentration in wastewater and newly reported cases



Normalization of wastewater concentration

- Flow (with EC and CrAssphages)

Normalization of newly reported cases

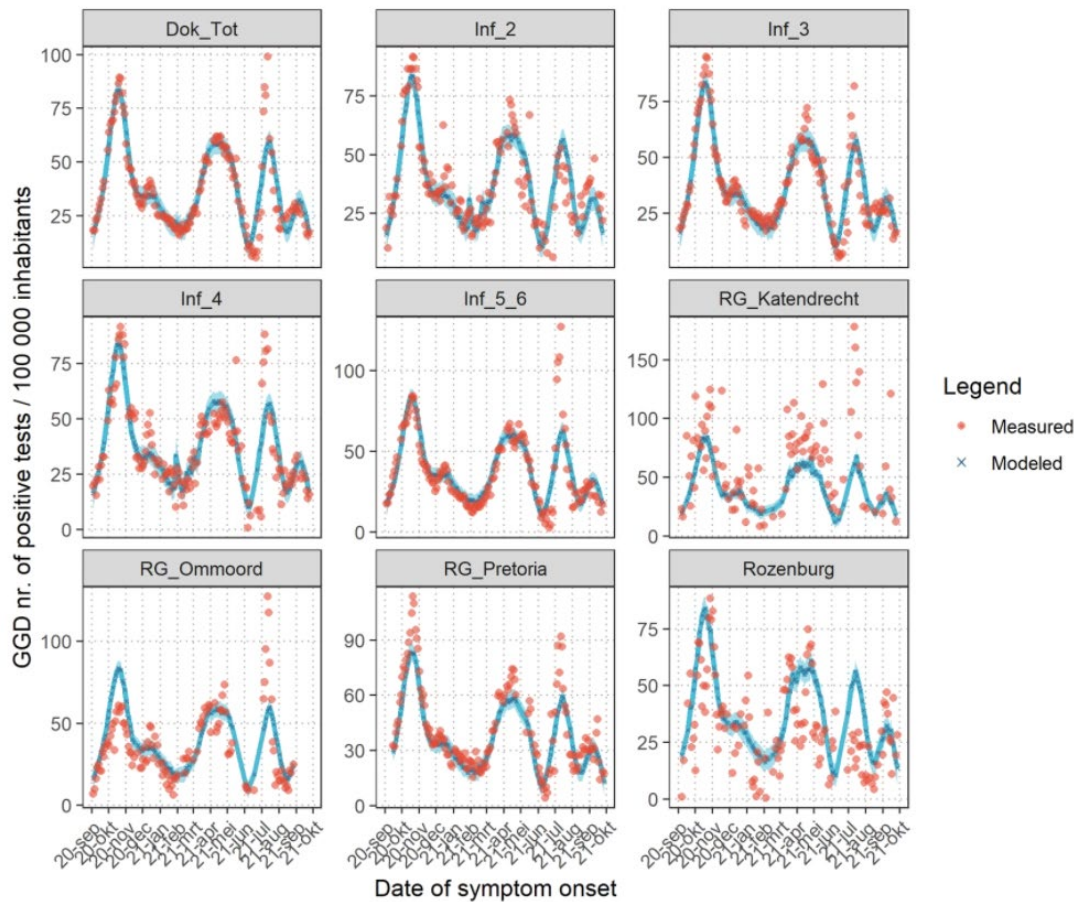
- For test delay (to symptom onset day)
- For test behaviour (#tests per 100,000)

Wastewater = newly reported cases

- Also with Alpha and Delta
- Also with vaccination

# Relation between concentration in wastewater and newly reported cases

## PARTNERS4URBANWATER



Normalization of wastewater concentration

- Flow (with EC and CrAssphages)

Normalization of newly reported cases

- For test delay (to symptom onset day)
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Wastewater = newly reported cases

- Also with Alpha and Delta
- Also with vaccination

# Emergence of Variants of Concern (VoC)

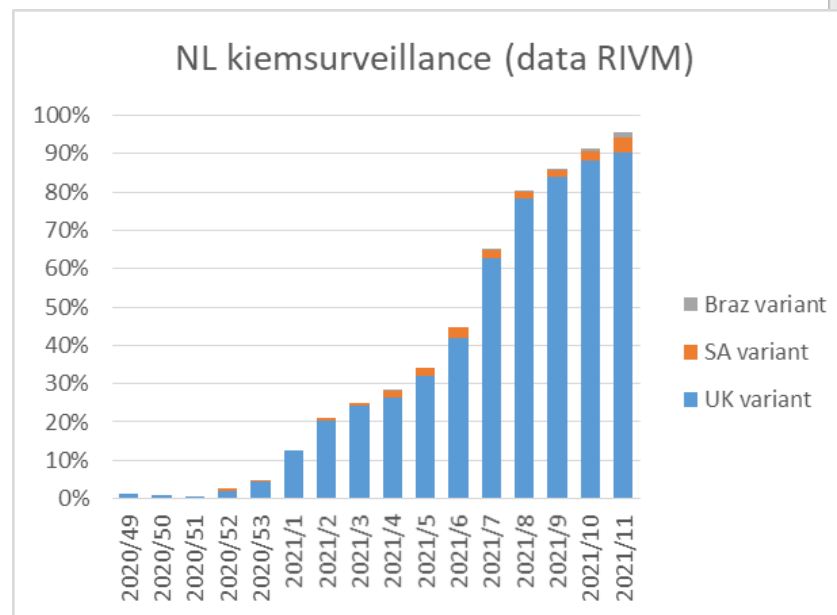
Observe emergence/circulation of new VoC

Understand disease, transmission dynamics

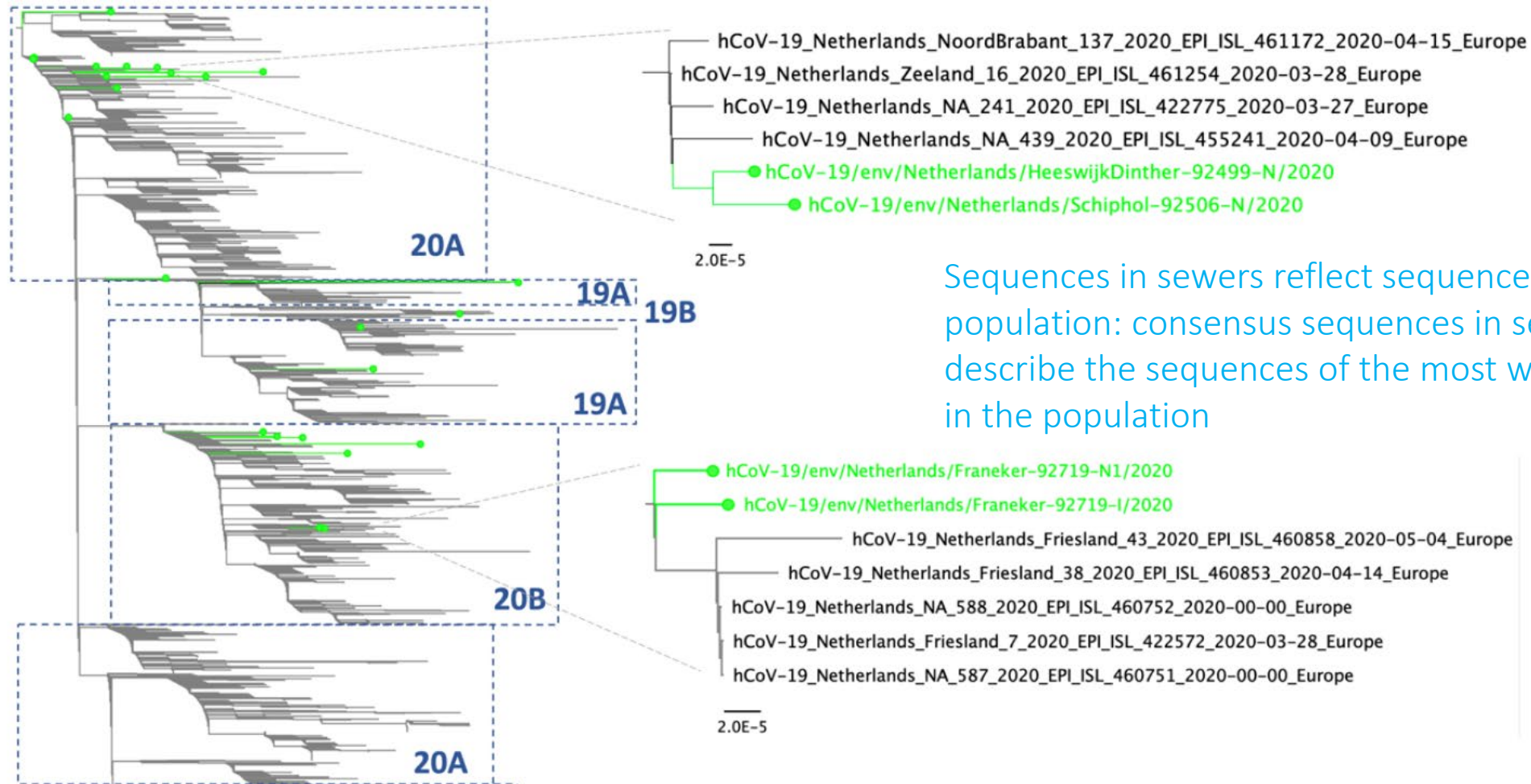
Observe vaccination efficacy to VoC



Image: RIVM

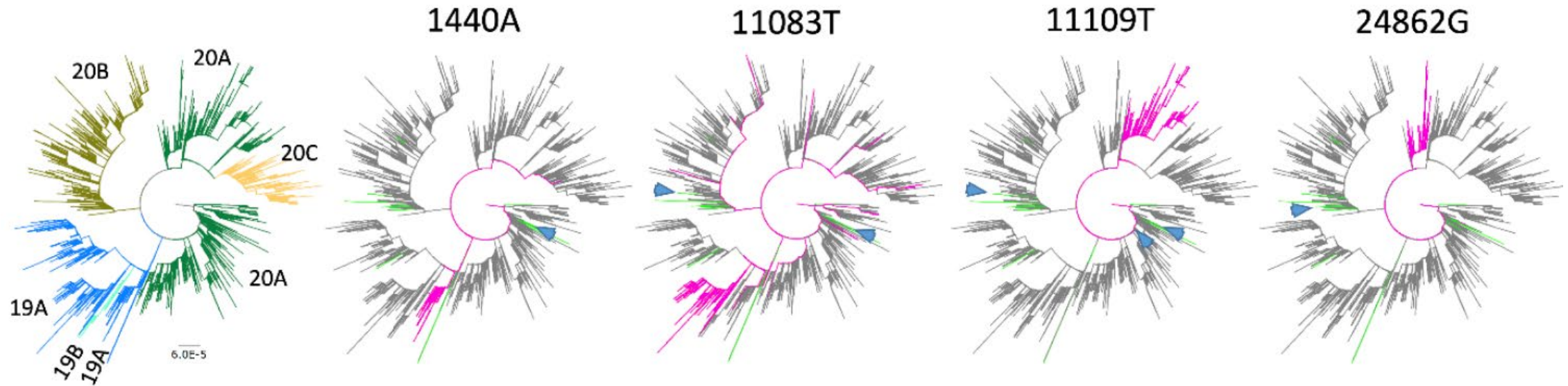


# Use case: circulation of variants



Sequences in sewers reflect sequences in the population: consensus sequences in sewers can describe the sequences of the most widespread virus in the population

# Use case: circulation of variants

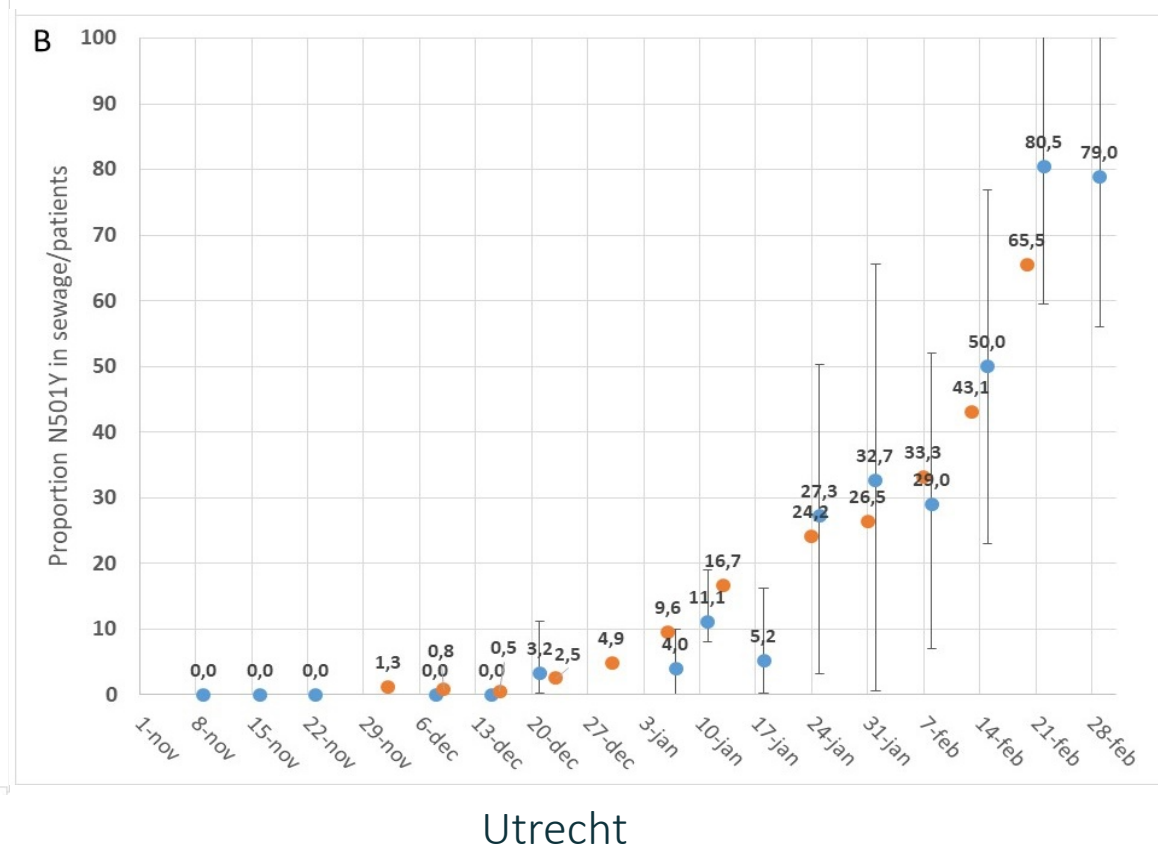
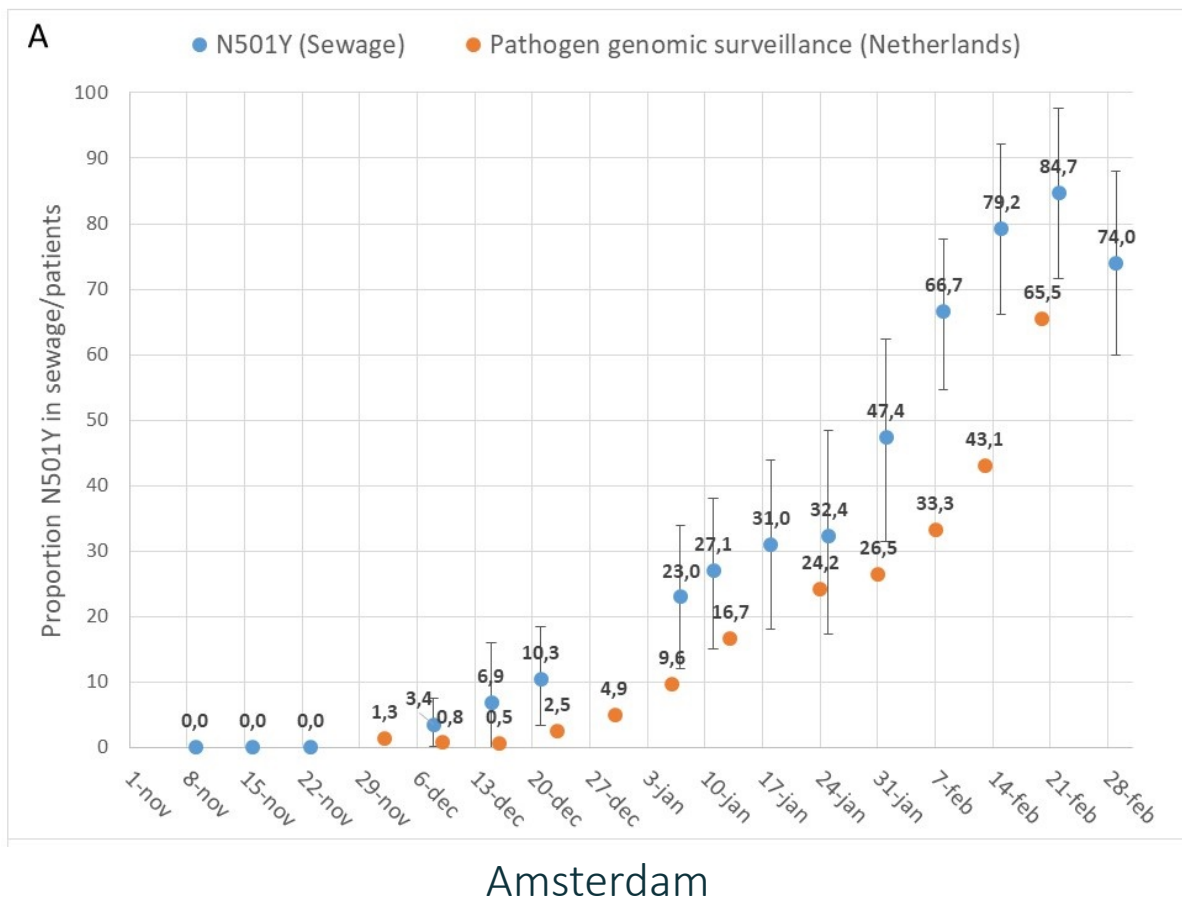


Detection of new mutations in the virus genome that are not observed in patients

Lara et al, 2021, EM INF DIS

# Use cases - Virus variants

## N501Y mutation versus wild type by ddPCR



# Wastewater surveillance is of added value for COVID-19 surveillance

Early warning

Objective population surveillance, independent of human test behaviour

Feasible for emergence of (signature mutations of) VoC

Fast (with ddPCR within days, compared to 3-4 weeks for clinical surveillance with NGS)

Efficient: on population sample, allowing high resolution surveillance





**Erasmus MC**



Miranda de Graaf, Marion Koopmans, Evelien de Schepper, Izquierdo Lara, Claudia Schapendonk, Patrick Bindels, Johan van der Lei, Margreet Vos

**RIJNMOND  
GEZOND** DATA  
BASE



**Rotterdam-Rijnmond**

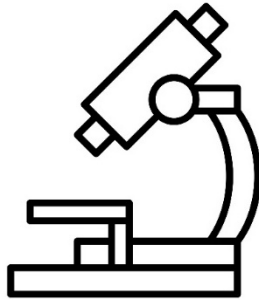
Ewout Fanoy



Rijksinstituut voor Volksgezondheid  
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Ministerie van Volksgezondheid,  
Welzijn en Sport

Eelco Franz, Roan Pijnacker, Christian Carrizosa  
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**KWR**

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Frederic Been, Gertjan Medema

**stowa**

Bert Palsma, Imke Leenen



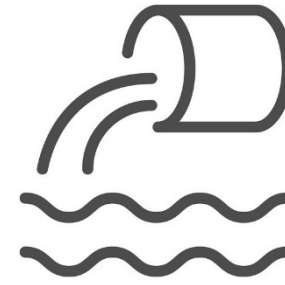
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Hoogheemraadschap van  
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