


Wastewater-based monitoring of SARS-CoV-2 variants at Helsinki-Vantaa Airport

Town Hall X “Wastewater Witchers and Watchers”, 17.10.2023

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Introduction

- At the beginning of 2023, THL conducted a four-month long surveillance of SARS-CoV-2 variants at Helsinki-Vantaa airport
- The surveillance was commissioned by the Ministry of Social Affairs and Health
- The aim of the effort was to find whether airport surveillance would be a viable way to detect emerging variants early
- This also acted as a test on whether Helsinki-Vantaa airport could work as a surveillance spot for infectious diseases and resistant bacteria in the future
- Passive samplers were also tested as an alternative for grab samples

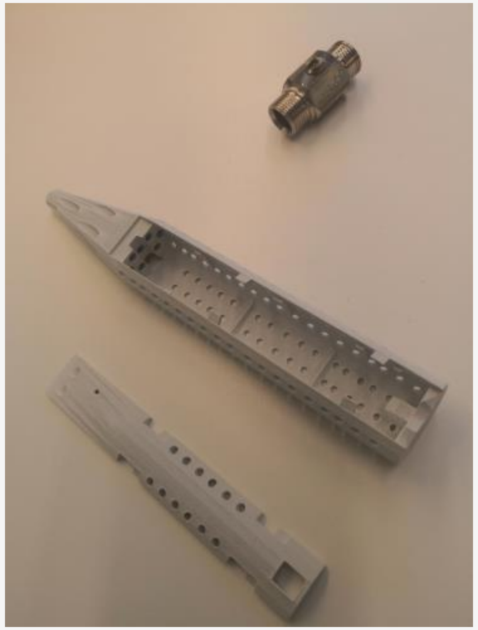
Sampling locations

- Four different sampling spots were utilized
  - Sampling spots consisted of terminals as well as the emptying spot of lavatory trucks
- Sampling was done using both grab samples and passive samplers
- Samples were taken weekly from each sampling location
- Grab samples were taken once every Monday, passive samples were collected over a weekend
- For comparison, a 24-hour composite sample was taken weekly from Viikinmäki WWTP
  - Viikinmäki WWTP covers Helsinki as well as surrounding areas

Author: Aatu Dorochenko, https://commons.wikimedia.org/wiki/File:Helsinki_airport_new_departure_hall_entrance.jpg

Methods

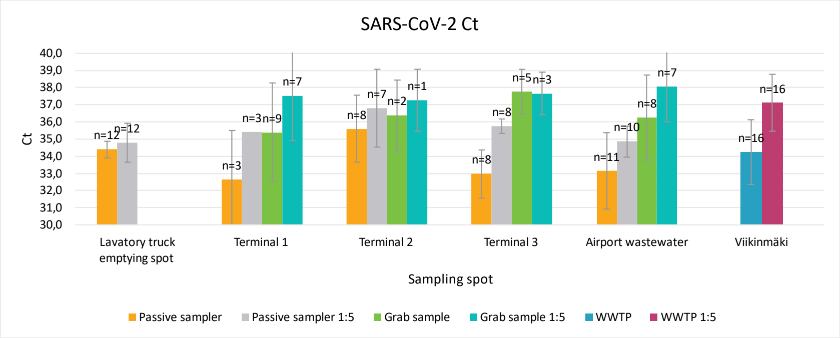
- Nucleic acid was extracted from the samples and used to synthesize cDNA, which was subsequently sent for sequencing
  - Also qPCR for SARS-CoV-2, crAssphage, and PMMV
- Amplicon library was generated with Artic v.4.1 primer set, which was sequenced with Illumina platform.
- Adapters were trimmed from the resulting sequence data with Cutadapt and reads were mapped with BWA_MEM
- SARS-CoV-2 and mutations in the samples were identified with iVar-tool
- FastQC and MultiQC were used for quality control

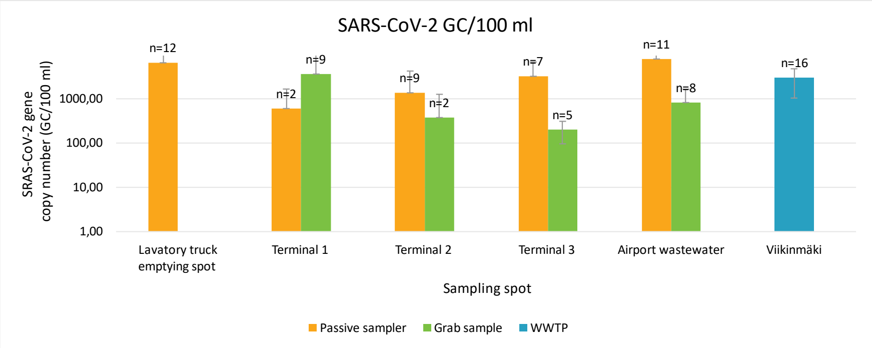


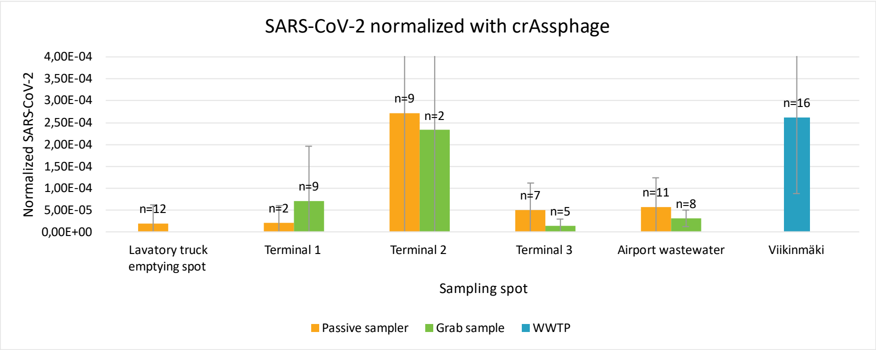
Source for 3D-models: Schang, C et al. Passive Sampling of SARS-CoV-2 for Wastewater Surveillance. *Enviro. Sci. Technol.* **2021,** *55*, 10432-10441

Results

- Passive samples were found to have generally more Sars-CoV-2 copies across all sampling spots (excluding Terminal 1), compared to grab samples
    - This also applied when the results were normalized with CrAssphage copy numbers
    - This can also be seen in the Ct-values from qPCR runs, where the passive samples have generally lower values
- Interestingly, Terminal 2 and 3 yielded higher copy numbers compared to Viikinmäki WWTP composite sample even after normalization
    - However, this can partially be explained with lower n-number
- No grab samples were taken from lavatory truck emptying spot.

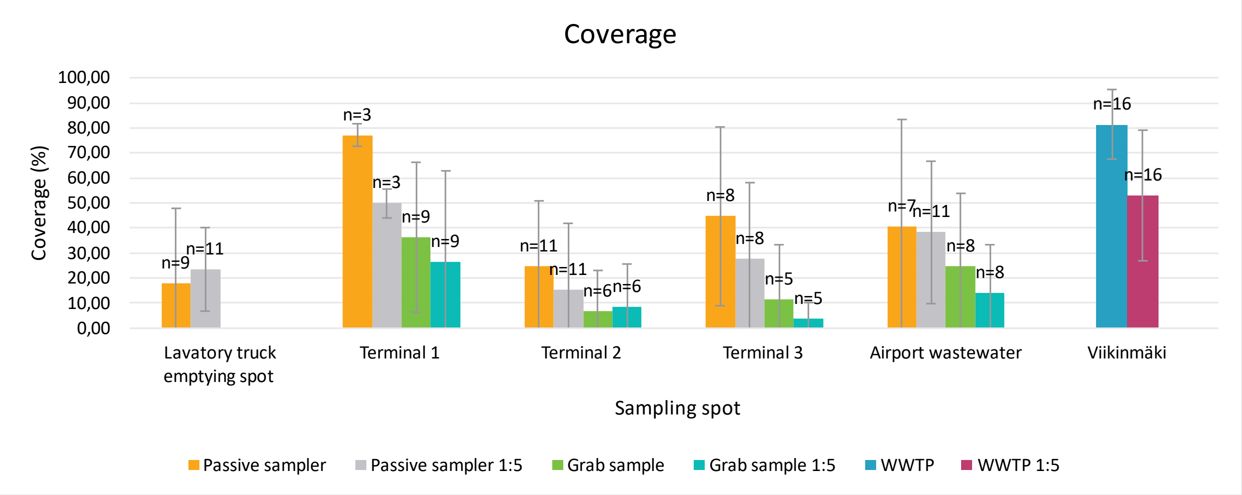


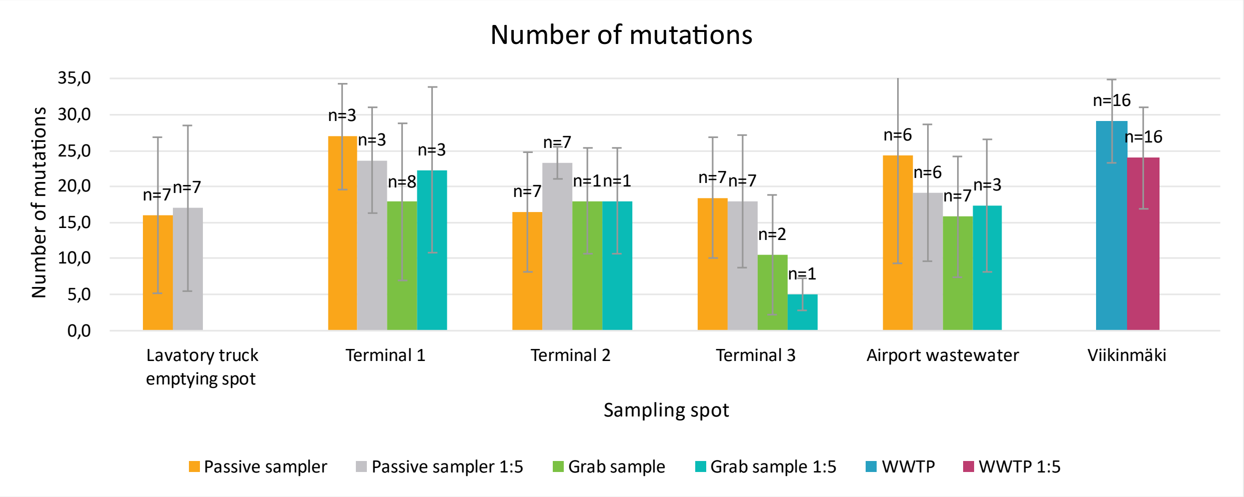




Coronavirus mutations

- Sequencing was done using both undiluted cDNA as well as a 1:5 dilution
- In the airport samples, sequencing coverage was generally higher in passive samples than in grab samples
- However, coverage was lower in samples collected at airport than in WWTP
- The number of mutations was higher in passive samples than in grab samples collected at the airport, but not as high as in composite samples collected from the Viikinmäki WWTP

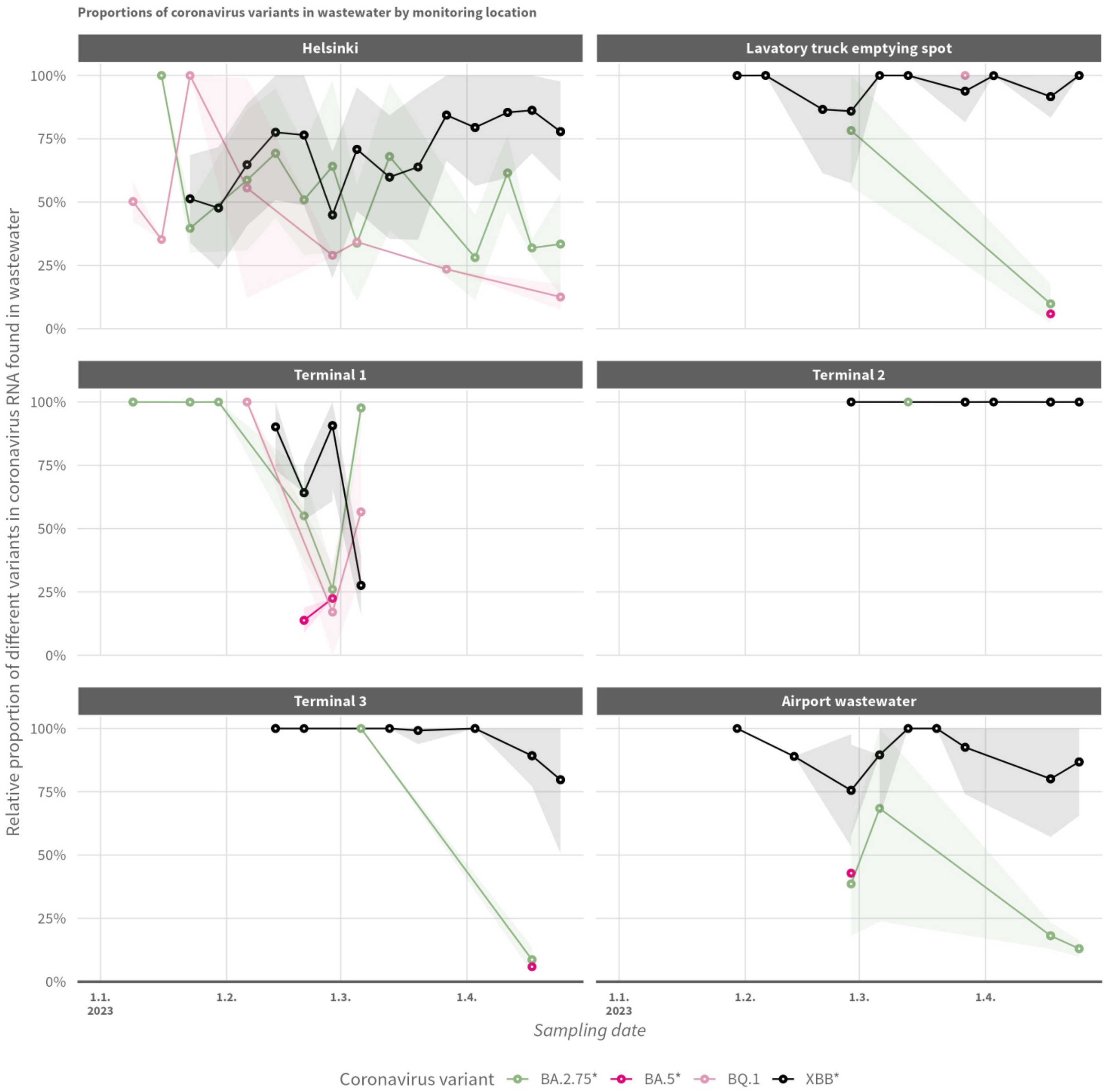




SARS-CoV-2 variants

- Variants detected at the airport wastewater roughly followed the patterns seen in samples from Viikinmäki WWTP at the same time
- XBB* lineage was well represented in both in airport samples and at WWTP
- BA.2.75* was detected, although not as often as in WWTP
- BQ.1 was nearly completely missing in airport samples, while being detected throughout the monitored timeframe in WWTP
- However, BA.5* was found in a few samples in the airport, while being completely absent in WWTP

(* = includes sublineages)



Source: THL 2023

Outcome of the Helsinki airport (HEL) wastewater surveillance pilot 1.1.-30.4.2023

- Airport surveillance showed promise as an additional mean of monitoring the spread of pathogens
- Passive samplers were found to be a preferable alternative to grab samples in spots where composite sampling is not possible
- However, at Helsinki airport, where no wastewater sampling station exist, the composite sampling from Viikinmäki WWTP (that also contains the airport wastewater) was considered as a more viable surveillance option
- Currently, there is no wastewater surveillance at HEL, FI

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Official webpage of the Finnish institute for health and welfare: https://thl.fi/en/web/infectious-diseases-and-vaccinations/surveillance-and-registers/wastewater-monitoring/coronavirus-wastewater-monitoring

Kolehmainen, A.; Tiwari, A; Hokajärvi, A.-M.; Lipponen, A; Pitkänen, T. Wastewater-based monitoring of SARS-CoV-2 variants at Helsinki-Vantaa Airport. *Manuscript is currently in preparation,* **2024**

Thank you for listening!