

# CONCLUSIONS

## The EU Sewage Sentinel System for SARS-CoV-2 (EU4S)

*Solutions and Science for Support*

5<sup>th</sup> Town Hall Meeting

7 July 2021



# The EU Sewage Sentinel System for SARS-CoV-2 (EU4S)

## *Solutions and Science for Support*

### *5<sup>th</sup> TOWN HALL Meeting*

WEBEX Meeting – 7<sup>th</sup> of July, 2021; 13:30-18:30 CET

*Chaired by Bernd Manfred GAWLIK (EC JRC), Ismahane REMONNAY (VEOLIA) and Andrea RUBINI (Water Europe)*

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## Context of the Event

Following the publication of the of the [EC's Recommendation of 17 March 2021 on a common approach to establish a systematic surveillance of SARS-CoV-2 and its variants in wastewaters in the EU](#), wastewater-based surveillance activities in Europe and beyond, gained significantly momentum as well as a growing media attention. Parallel to this development, the international community of practice reported an increasing number of success stories, where wastewater-based epidemiology of SARS-CoV-2 was useful to anticipated counter-measures in case of local re-emergence of the virus.

At the same time, the question whether sewage surveillance is able to detect variants of concern triggered an increased interest in the application of Next-Generation-sequencing or digital-droplet PCR. Indeed, an ad hoc assessment of the European Commission employing for the first time the network of the EU Sewage Sentinel System for SARS-CoV-2 (EU4S) revealed the presence of the delta variant in larger scale than expected from clinical tests.

In parallel, private-to-private and private-to-public solutions started to appear. The dialogue between the sectors of health and water though, remains a critical bottleneck.

Since surveillance of SARS-CoV-2 in wastewater can provide important complementary and independent information to public health decision-making process in the context of the ongoing COVID-19 pandemic, the Commission provided some seed funding to its member states aiming at further development of a pan-European approach integrating systematically the national testing strategies for the detection of the SARS-CoV-2 virus.

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## Event Summary

This Fifth Town Hall Meeting took place as WEBEX Web-Conference on 7 July 2021. Organized by the European Commission, the event followed the first meeting of the National Contact Points appointed by the Member States in the context of the EC Recommendation. EC JRC (Bernd Manfred Gawlik), Water Europe (Andrea Rubini) and VEOLIA (Ismahane Remonnay), the latter two organisations representing the public and private water sectors, chaired the Town Hall jointly. Meeting statistics documented a total of 392 attendees to the virtual event, which was recorded.

## e-Exhibition

In order to showcase the use of wastewater-based surveillance an e-Exhibition was organized. Using the LEARNING DEVELOPMENT TOOLBOX and organised into five thematic areas (Business Solutions, Science Advances, Case Studies, Decision Support and a Pin Board) this virtual space presented the combined knowledge of the respective Community of Practices on wastewater-based surveillance of the virus. The e-Exhibition, which will be kept open continuously, allows for direct engagement between the exhibiting organization and the Town Hall Community. It can be accessed without registration at the following link: <https://my.ltb.io/#/showcase/jrc-sustainable-resources>. On occasion of this Town Hall Edition, a total of 32 stacks were exhibited (for more details check the list below).

## Opening and European Dimension

In his opening address Giovanni De Santi (EC JRC) stressed the fact that sewage surveillance of SARS-CoV-2 relies on an interactive and interdisciplinary nature of all actors. The role of the Joint Research Centre in this endeavor can only be to bring these together and channel the scientific knowledge and technological know-how to the policy making process.

Subsequently, Peter Wagner (EC SG), who chairs the EC Covid-19 Coordination Group put sewage surveillance into a larger context. Since it is unlikely that the virus will completely disappear and will be around, instruments are needed to continuously monitor the situation. While the tool is indeed an important additional surveillance instrument of the pandemic and its status, it has an enormous potential with regard to other threads. In all of this, the presence of the public health sector is equally important, as is the communication to the interested layperson. The technology also appears to have a high technology-readiness level, and actions promoting further market as well as the growing number of examples being reported also in this event, are demonstrating this.

Michel Sponar (ENV) summarised the developments since the publication of the EC Recommendation and announced the creation of a Digital European exchange platform (DEeP) as a tool to connect the different national, regional and surveillance programs. Parallel to this status reports are gathered from the National Contact Points and grant agreements to provide further seed funding are being prepared.

Guy van den Eede (EC JRC) provided an overview on other activities conducted by the JRC in the Covid-19 crisis, such as provision of reference materials. The development of a matrix reference material in the specific context of the SARS-CoV-2 sewer surveillance could be added indeed to the running activities. He also highlighted the problems related to correlate the viral load in wastewater to incident cases and its limitations. He concluded that the detection of the virus RNA in wastewater is a useful early warning system useful to understand the types of variants circulating a certain population.

M. de Graaf and M. Koopmans (Erasmus Medical Center) presented the Versatile Emerging infectious diseases Observatory (VEO) as a tool to estimate the infection pyramid to prepare for silent epidemics. The presentation was then followed by an overview from S. Lackner on findings of the joint pan-European study under the EU Sewage Sentinel System revealing the presence of variants of concern among the delta variant in some 60 European municipalities.

The following presentations provided an insight into the wastewater surveillance programme in the UK, Switzerland, Austria, Latvia, Spain, Portugal, Slovenia, and France. In these presentations particular attention was paid to the detection of variants of concern as well as the graphical presentations of findings.

### International dimension

The session on the international dimension was opened by presentation from SUEZ Spain presenting solutions for population health management based on wastewater-based epidemiology.

The Wastewater SARS Public Health Environmental REsponse (W-SPHERE) Global Data Center was then shown as a research effort to advance environmental surveillance of sewage to inform local and global efforts for monitoring and supporting public health measures to combat SARS-CoV-2 and diseases in general.

Colleagues from the US EPA provided then an insight into the quantitative and qualitative assessment from a statewide network for wastewater monitoring in Ohio, which is connected to the US National Wastewater Surveillance System (NWSS).

Bilge ALPASLAN KOCAMEMI presented an update on the Nationwide wastewater-based COVID-19 including an insight into city-based live distribution maps, variants and real-time government dashboard for the public in Turkey . CenrEAU Canada and Québec City shared then experiences gained in the use and transfer of SARS-CoV-2 data for decision-making by public health authorities. In particular, the integration of SARS-CoV-2 wastewater surveillance into public health strategies allowed to better target homeless and marginalized populations in the area.

### Application and solutions

Practical applications and private-to-public as well as private-to-private solutions were at the centre of this last session, which was started by a presentation from SGS, a globally operating service provider for measurement and testing. Magnus BERGLUND, indeed, presented the opportunities arising from extracting the biological and chemical information encoded in (untreated) wastewater. The comparison of novel and commercial solutions for sequencing low-concentration mixtures of synthetic SARS-CoV-2 variants in wastewater was the subject of Terry BURKE's talk. Terry shared insights stemming from this comparison, results of which are already uptaken by the NHS National Surveillance activity. The globally acting companies PROMEGA, BIORAD and HACH then shared an update about their latest product developments, including information on performances and requirements for deployment, which increasingly become accessible to a wider audience.

The session concludes with two updates on regional and local scale, respectively, i.e. for the Lombardy region and A Coruña, both of which contributed to the overwhelming evidence that wastewater-based surveillance reliably can trace and track variants in urban wastewater samples.

EC then announced the next Town Hall for Oct 14 and 15, for proposals can be suggested. The eExhibition will continue and further posters can be submitted anytime. Details on the next Town Hall will be shared in due time.

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## Conclusions

The Town Hall Mechanism proved to be a necessary and useful exchange platform ensuring information sharing, updates and knowledge brokering around the topic of the wastewater-based surveillance practices for SARS-CoV-2 and its variants. It connects state-actors, research and academia, with the private and public sector, but also the interested lay person. Thus, it may serve also a model of engagement beyond the current pandemic and address other emerging topics including pathogens, AMR or chemicals. This fifth edition of the Town Hall delivered a series of take-home messages and conclusions, defining the actions of the forthcoming weeks and months. The main task – at least for Europe – is now the systematic integration and connection implemented actions. The EC Recommendation C(2021) 1925 final indeed forms an appropriate framework for this and the provided seed funding needs now to be used for connecting the national and regional activities with the aim to create a one-stop access at EU Level. More specifically the following conclusions can be drawn the event:

### Implementing the EC Recommendation: Actions

#### EU Member States

Using an EU Survey, Member States report about the state of play and degree wastewater-based surveillance programs are implemented and data are used as additional data sources in the management of the crisis. Likewise, the establishment of National Contact Points (NCPs) formed as binomial teams involving both the public health and wastewater sanitation authorities will trigger a better dialogue between the two sectors.

The continuation of exchange of best-practices will further promote a bottom-up and across-country harmonization of data uptake, while allowing different methods for measurement and testing. In this process, the experience gained in non-EU countries should be considered and uptaken.

To facilitate these processes, Member States are encouraged to continue and deepen their interaction with Commission services. It might be useful at this early stage to look beyond and untap the potential for emerging threats. The forthcoming work in the framework needs to tackle open questions with regard to governance, structure and connection of the so-called Super-sites”, the data flow and system and obviously the financing.

#### European Commission

EC confirmed its role as knowledge-broker and technical facilitator in the aforementioned processes. The design and implementation of the Digital European Exchange Platform (DEeP) as core of the EU Sewage Sentinel System for SARS-CoV-2 is now a priority. This needs to be done in liaison with WHO and respective global initiatives. Global interoperability must be a common objective, indeed, to ensure the buying in of the health sector

This endeavor has to happen at three layers:

- Data interoperability and exchange by the creation of a federated data infrastructure allowing for the display of reported national, regional or local data streams which communicates in an easy-to-understand status and trends of viral load in wastewaters. This is necessary for further epidemiological analyses of the observations. It also requires an open data standard, which ideally is connected to ongoing or already existing de facto standards,

e.g. as the Canadian data model.

- Collaborative activities on the ground, which since the beginning of the pan-European effort were at the core in connecting running surveillance programmes and projects. From the results of the presented findings of the Adhoc assessment on variants-of-concern in 54 European municipalities emerges a need to create a set of so-called super-sites addressing specifically transportation hubs. These sites (ca. 12) should focus on the comparative assessment of wastewaters' viral load capturing the influence of transportation hubs such as airports, harbors or other situations where resident communities are exposed to travelers or commuters. EU Neighboring countries should be considered in these reflections
- Clustering, communication and engagement across scientific disciplines, actors and the citizens in the widest possible level. This is done through the organization of the Town Hall Series, but also participation in similar events and information to the press. Clustering events might also be organized and included in relevant R&I projects

In this process, the uptake of the technology by private actors is not only a proof of the high technology readiness level, but also a development which the Commission will seek to stimulate further.

### Private-to-public and private-to-private solutions

The positive resonance on the eExhibition initiative as well as a number of talks indicated a growing number of applications and solutions from the private sector. This refers not only to the direct collaboration for the development and deployment of variant-specific PCR testing solutions, but also for stand-alone and easy-to-use surveillance systems. In addition, digitalization of support data through the use of apps or data visualization plays a role.

The water sanitation infrastructure indeed is increasingly identified as an area where additional services based on the information encoded in wastewater is at the origin. In order to stimulate this development, a roundtable involving private sector actors is suggested.

In particular, the touristic sector (skiing resorts, hotels), but also sports and entertainment industry (large events, recreational parks) are possible targets for such solutions, which aim at facilitating a life with the virus.

Likewise, globally active water operators can play an important role in capacity development beyond high resource settings, an option to be explored further. The active involvement of the already contributing water associations (Water Europe, EUREAU, AQUA PUBLICA) and major actors (e.g. VEOLIA, SUEZ) is crucial for this, since these actors have a strong interest to recall the primary target of wastewater sanitation: public health.

### Open science questions

While the technology-readiness-level has reached market uptake, there are still some science questions to be addressed further and in a more detailed way.

## Standardisation vs. Guidance

Standards are voluntary agreements, typically made by stakeholders, on a product, a service or a process and the related process of standardization is indeed part of the knowledge economy that underpins industry and society in Europe and beyond. The standardization process is facilitated by Standardisation Organization and is based on transparency, openness and consensus-building. Typically, a standard is the last step in a longer pre-normative process, identifying and documenting best-practices and addressing also equivalency of protocols and procedures.

Due to the extremely rapid development of the pandemic, but also the rollout of wastewater-based monitoring of SARS-CoV-2, many processes were revealed to be too slow to deliver the necessary outcome. This does not mean that they are unnecessary, but intermediate solutions are needed. This applies to the necessary guidance for operators of wastewater-based surveillance, which was announced and which take place in close coordination with WHO and other Public Health Actors.

A better integration of the pre-normative and rapid development of a guidance for operators and the parallel development of formal standards, e.g. through ISO are indicated.

## Identification of variants

Unlike clinical samples, wastewater typically contains a mix of different variants, identification of which requires the reliable spotting of characteristic elements of the RNA. For this purpose, ECDC and WHO have published in March 2021 [Methods for the detection and identification of SARS-CoV-2 variants](#), which now need to be adopted to the realm of wastewater surveillance. The findings observed during the Pan-European Adhoc Assessment offered a first opportunity to do so. In the period until the next Town Hall, the possible approaches will require further discussion and exchange among the practitioners.

## Stability of samples

While mRNA as biological substrate is less stable than for instance DNA, reliable quantification requires a certain stability or at least document and known acceptable instability of what metrology calls “the measurand”, i.e. the parameter used for quantification of related matter through a measurement principle. Experience so far has de facto demonstrated that once a sample has been taken, short-term stability of the mRNA seems to be best and ensured at 4°C, while issues do exist at higher temperatures as well upon unthawing after deep-freezing.

The average annual sewage temperature at origin varies typically between 30°C and 35°C but decreases significantly during the flow to the sewage treatment plant, but remains typically between 10-15°C outside the summer period. During summer typically it stays though still below 20°C. These processes are well documented and for instance to recover energy from wastewater.

Likewise, the sewer residence time defines the exposure to this temperature, which for instance for the US was estimated as a national median to be 3.3 h. Compared to the typical time needed to generate the analyte data (ca. 48 h) this can be deemed to be relatively negligible and being compensated by the continuous shedding of the virus. Nevertheless, for a better validation of analytical data, the existing knowledge base requires further work and should be addressed. In this context the documentation of (national) reference laboratories could be beneficial.

## Predictive power of through viral loads in wastewater

In order to illustrate that wastewaters mirror with some anticipation the pandemic situation, often correlations between viral loads and incident cases, hospitalization rates or others are used. This is useful to show parallels, or to trigger anticipated clinical investigations if wastewater-based concentration increases. However, an accurate prediction of clinical cases is not possible and care must be taken in the communication to explain this properly. As expressed repeatedly, wastewater-based observations are providing additional insights into processes, but are not a tool to predict the future.

A challenge in the building of a Digital European Exchange Platform will be the integration of data from different sources. However, since the objective is the qualitative description of a status of viral load and the trends in time, different measurement approaches come to the same conclusion if handled according to common principles of sampling. These aspects will need to be elaborated further.

## Save-the-Date

- The next tentative dates for forthcoming updates via the TOWN HALL Format have been scheduled for the following dates:
  - Town Hall VI: 14th and 15<sup>th</sup> of October, 2021: Launch Platform (tentative), National Viewers
  - Town Hall VII: 18/19 Jan 2022 (tbc)



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## Agenda of the Meeting

- 13:30            **Launch of the e-Exhibition**  
*“Solutions and Science for SARS-CoV-2 Sewage Surveillance”*
- European Dimension*
- 14:00            **Welcome and Opening of the 5<sup>th</sup> TOWN HALL**  
*Giovanni DE SANTI, European Commission, JRC*
- 14:10            **Wastewater-based surveillance as part of the EC pandemic measures**  
*Peter WAGNER, European Commission, SG*
- 14:20            **The HERA Incubator and the EC Recommendation on SARS-CoV-2 Sewer Surveillance – Status update**  
*Yoline KUIPERS, European Commission, DG SANTE*  
*Michel SPONAR, European Commission, DG ENV*
- 14:25            **Wastewater-based epidemiology – A critical view from the metrological perspective**  
*Guy VAN DEN EEDE, Robert KÖBER, European Commission, JRC*
- 14:35            **VEO case study SARS-COV-2: "Estimating the infection pyramid to prepare for silent epidemics"**  
*Marion KOOPMANS and Miranda DE GRAAF, Erasmus Medical Centre, Rotterdam, the Netherlands*
- 14:45            **Hunting for Mutations of SARS-CoV-2 in Wastewater - A pan-European study under the EU Sewage Sentinel System**  
*Susanne LACKNER, Technical University of Darmstadt, Germany*
- 14:55            **The UK Wastewater Surveillance Programme - An insight into variants detection and bioinformatics at the NHS Joint Biosecurity Centre**  
*Mathew BROWN, Joint Biosecurity Centre, a part of NHS Test & Trace, London, United Kingdom*
- 15:05            **SARS-CoV-2 surveillance in Switzerland: interpreting our data for public health actors and the general public**  
*Tamar KOHN, Swiss Federal Institute of Technology Lausanne, Switzerland*
- 15:15            **The Austrian wastewater-based Corona dashboard**  
*Hans Peter STÜGER, Austrian Agency for Health and Food Safety, Graz, Austria*
- 15:25            **Detection of SARS-CoV-2 in wastewater and importance of population size assessment in smaller cities: an exploratory case study from Latvia**  
*David FRIDMANIS, Technical University Riga, Latvia*
- 15:35            **Epidemiological surveillance of SARS-CoV-2 in Spain**  
*Pilar DOMINGO-CALAP RAMÓN Y CAJAL, Environmental and Biomedical*

*Viruses Lab Institute for Integrative Systems Biology (I2SysBio), University of Valencia, Spain*

15:45 **COVIDTECT: Latest modelling results and genomic surveillance of SARS-CoV-2 in wastewater, Portugal**

*Mónica CUNHA, Faculty of Sciences, Lisbon University, Portugal*

15:55 **Chronology of a nation-wide monitoring - The Slovenian case**

*Denis KUTNJAK, National Institute of Biology, Slovenia*

16:05 **Monitoring SARS-CoV-2 variants alterations in Nice neighborhoods by wastewater nanopore sequencing**

*Pascal BARBRY, CNRS and Adèle Lazuka, VEOLIA, France*

16:15 **Evolution of SARS-CoV-2 B.1.1.7 Variant through the Spanish National SARS-CoV-2 Wastewater Surveillance System (VATar)**

*Susana GUIX, Rosa M. PINTO and Albert BOSCH, Universitat de Barcelona, SPAIN*

*International dimension*

16:25 **SUEZ Spain solutions for population health management based on wastewater-based epidemiology**

*Angel VILLANUEVA, Raquel MURIENTE, SUEZ, Spain*

16:35 **Quantitative and Qualitative Assessment from a state-wide network for SARS-CoV-2 Wastewater Monitoring**

*Nichole BRINKMAN, Scott KEELY, Maitreyi NAGARKAR, Michael JAHNE, US EPA, Office of Research and Development, USA*

16:45 **Wastewater SARS Public Health Environmental REsponse (W-SPHERE) Global Data Center**

*Joan B. ROSE, Michigan State University, USA*

*Gertjan MEDEMA, KWR, The Netherlands*

*Vajra ALLANPATH, Seattle, USA*

*Panagis KATSIVELLIS, Venthic Technologies, Athens, Greece*

*Doug MORRIS, PATH, Seattle, USA*

*Krystin KADONSKY City of Tampa, Tampa, USA*

*Colleen C. NAUGHTON, University of California, Merced, USA*

16:55 **Current state-of-play in Nationwide Wastewater-Based COVID-19. Surveillance of Turkey: City-based live distribution maps, Variants and Real-time government dashboard for public**

*Bilge ALPASLAN KOCAMEMI, Marmara University - Turkish Water Institute (SUEN), Turkey*

17:05 **Collecting, quality-ensuring and transferring SARS-CoV-2 data for decision-making by public health authorities - The Québec experience**

*Peter VANROLLEGHEM, CentrEau, Canada*

17:15 **Integration of SARS-CoV-2 wastewater surveillance into public health strategies for protecting environments welcoming homeless and marginalized populations**

*Dr Slim HADDAD, Direction de Santé Public, Centre intégré universitaire de*

santé et de services sociaux de la Capitale-Nationale, Québec City, QC,  
Canada

#### Applications and Solutions

- 17:25      **Wastewater - a reflection of society**  
*Magnus BERGLUND, SGS, Worldwide Company*
- 17:35      **Comparison of novel and commercial solutions for sequencing low-concentration mixtures of synthetic SARS-CoV-2 variants in wastewater**  
*Terry BURKE, Sheffield University, UK*
- 17:45      **Molecular tools for Sewage Surveillance to Track COVID-19**  
*Brigitta SAUL, Subhanjan MONDAL, Nathan FEIRER, Promega Corporation, Worldwide Company*
- 17:55      **The use of ddPCR to Detect and Quantify SARS-Cov-2 Variants in wastewater samples using ultra-sensitive mutation detection markers**  
*Eddy VAN COLLENBURG, BIORAD, Worldwide Company*
- 18:05      **Monitoring for SARS-CoV-2 in WW**  
*James HARBRIDGE, Aaron ANSON, HACH, Worldwide Company*
- 18:15      **SARS-CoV-2 RNA in urban wastewater samples to monitor the COVID-19 epidemic in Lombardy, Italy**  
*Sara CASTIGLIONI, Silvia SCHIAREA, Laura PELLEGRINI, Valeria PRIMACHE, Cristina GALLI, Laura BUBBA, Federica MANCINELLI, Marilisa MARINELLI, Danilo CEREDA, Emanuela AMMONI, Elena PARIANI, Ettore ZUCCATO, Sandro BINDA, Istituto Mario Negri, Milan, Italy*
- 18:25      **seqCOVIDBENS: Following SARS-CoV-2 variants in A Coruña, Spain,**  
*Margarita POZA DOMINGUEZ, Instituto de Investigación Biomédica (INIBIC) - Complejo Hospitalario Universitario (CHUAC), A Coruña, Spain*
- 18:35      **The way forward**  
*Bernd Manfred GAWLIK, European Commission, JRC, Italy*  
*Ismahane REMONNAY, VEOLIA, Worldwide Company*  
*Andrea RUBINI, Water Europe, European Association*
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- 19:00      **End of Meeting**

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## List of e-Posters

### CASE STUDIES

Cristina González Ruano (P-TH5-1)

**National Wastewater Surveillance System for early detection of SARS-CoV-2 in Spain. VATar COVID-19 Project** (post not completed for TH5)

Pascal Barbry (P-TH5-3)

**CNRS/Institut Pasteur/Veolia: Journey to a sustainable future for water cycle- based epidemiology**

Herbert Oberacher (P-TH5-7)

**Lessons learned from regular monitoring of 64 sampling sites in western Austria**

Lopez Martin, Andrea (P-TH5-12)

**Wastewater-based surveillance of SARS-CoV-2 in the region of Navarra**

Margarita Poza (P-TH5-31)

**seqCOVIDBENS: Following SARS-CoV-2 variants in A Coruña, Spain**

Federica Cariti (P-TH5-32)

**Sewage reveals SARS-CoV2 spread in Canton of Ticino during the onset of the pandemic**

Arianna Azzellino (P-TH5-39)

**May territorial and WWTPs' characteristics influence the correlation of wastewater viral traces with the epidemic curve? Case studies from the Lombardy Region.**

Elisa Poznanski (P-TH5-38)

**Surveillance of SARS-CoV-2 in South Tyrolean wastewater: a case-study in Italy**

## **BUSINESS SOLUTIONS**

Pierre Mongeon (P-TH5-2)

**Oclair Environnement (The CETo application)**

Núria Zamorano-López (P-TH5-5)

**TRACKER: an innovative tracking and predictive GIS tool for environmental surveillance**

Brigitta SAUL (P-TH5-8)

**Molecular tools for Sewage Surveillance to Track COVID-19**

Adela Fernandez-Ayela (P-TH5-14)

**Rapid on-site SARS-CoV-2 wastewater testing solutions**

James Harbridge (P-TH5-18)

**Monitoring for SARS-CoV-2 in wastewater**

Sami Oikarinen (P-TH5-29)

**Quality Control for Coronavirus (SARS-CoV-2) monitoring in wastewater (QCWWC)**

Maryam Thahidi (P-TH5-21)

**Torpedo-bases passive sampling of SARS-CoV-2 for protecting environments welcoming vulnerable populations**

SGS Industries and Environment (P-TH5-6)

**Wastewater analysis: an early warning system**

Stefan Kreihlsler (P-TH-26)

**Visualisation of data monitored in waste water regarding COVI-19 for contact tracing**

## **SCIENCE ADVANCES**

Labaqua (P-TH5-15)

**Wastewater genomic surveillance of SARS-CoV-2**

Karin Yaniv (P-TH5-16)

**SARS-CoV-2 improved primers and probes and RT-qPCR detection assay for variants of concern B.1.1.7, B.1.351, P.1 and B.1.617**

Gertjan Medema (P-TH5-22)

**Droplet Digital RT-PCR to detect SARS-CoV-2 signature mutations of variants of concern in wastewater**

Susanne Lackner (P-TH5-24)

**Temporal dynamics of SARS-CoV-2 mutations from wastewater samples**

Olivera Maksimović Carvalho Ferreira (P-TH5-3)

**Screening and comparison of concentration methods for monitoring of SARS-CoV-2 in wastewater**

Adele Lazuka (P-TH5-21)

**Veolia and partners actions for contributing to COVID-19-Wastewater Based Epidemiology Surveillance**

Laura Van Poelvoorde (P-TH5-40)

**Strategy and performance evaluation of low-frequency variants calling from SARS CoV-2 in wastewater using targeted deep Illumina sequencing.**

#### **DECISION SUPPORT**

Giuseppina La Rosa (P-TH5-9)

**The SARI Project - Rolling out wastewater surveillance of SARS-CoV in Italy**

SARSAIGUAo (P-TH5-10)

**What's behind the Catalan Surveillance Network**

Niels Nicolai (P-TH5-13)

**Open Data Model for collecting, quality-ensuring and sharing SARS-CoV-2 data and metadata**

Bilge Alpaslan Kocamemi (P-TH5-19)

**Nationwide Wastewater-Based Covid-19 Surveillance of Turkey**

Simona Tavazzi (P-TH5-20)

**The EU Sewage Sentinel System for SARS-CoV-2**

Kirsi-Maarit Lehto (P-TH5-28)

**Wastewater-based surveillance tool for SARS-CoV-2, influenza and MDR bacteria – WastPan –portal**

Colleen C. Naughton (P-TH5-33)

**Global Data Center for Wastewater and SARS-CoV-2**

Matthew Wade (P-TH5-34)

**The English Wastewater Programme for COVID-19 Surveillance and Outbreak Response**