

Study confirms accuracy of national virus variant monitoring of wastewater

Since 2020, Austria has played an internationally pioneering role in monitoring the COVID-19 pandemic by sequencing virus particles from wastewater samples. A recent study by CeMM Research Center for Molecular Medicine of the Austrian Academy of Sciences, the Medical University of Vienna, the University of Innsbruck, and many other collaboration partners now demonstrates unprecedented detail and accuracy when it comes to analyses of how wastewater reflects virus variant dynamics. This study, published in *Nature Biotechnology*, provides a scientific inventory and new bioinformatics tools to support international surveillance of viral variants.

(Vienna, July 18, 2022) It has long been assumed that wastewater analysis is a suitable complementary approach to monitor epidemiological events. However, many countries have only recently deployed this method of analysis. Andreas Bergthaler, [CeMM](#) Adjunct Principal Investigator and Professor of Molecular Immunology at the [Medical University of Vienna](#) (MedUni Vienna), and his research group have dedicated themselves to evaluate wastewater samples from sewage treatment plants. Their work beginning in 2020 has been in collaboration with partners from other universities and institutions throughout Austria. In the published study, first authors Fabian Amman from CeMM and Rudolf Markt from the [University of Innsbruck](#) were able to show with immense precision of how wastewater data can reflect the distribution of virus variants in the population.

High concordance of virus variants in patient samples and wastewater

For the study, researchers sequenced and analysed a total of 3,413 wastewater samples from more than 90 municipal catchment areas or wastewater treatment plants from December 2020 to February 2022. Altogether, the samples cover more than 50 percent of the Austrian population's wastewater on a weekly basis. Using specially developed software (Variant Quantification in Sewage designed for Robustness, or VaQuERo), researchers were able to derive the spatiotemporal frequency of virus variants from complex wastewater samples. These results were then validated against epidemiological records of more than 311,000 individual cases in collaboration with infectious disease epidemiologists from AGES (Austrian Agency for Health and Food Safety). First author Fabian Amman, a bioinformatician in Bergthaler's research group at CeMM and the MedUni Vienna, explains, "Our results confirm that despite numerous challenges in wastewater analysis, the results provide a very

accurate overview of pandemic activity across an entire country. For each week and catchment area where a particular variant occurred at least once according to the epidemiological reporting system, we see a corresponding signal in the wastewater in 86% of the samples from the same week. Conversely, we see variants that escaped the patient-based system in about 3% of the wastewater samples."

The data generated in the study provide a basis for predicting emerging variants and allow researchers to better determine the reproductive advantage when it comes to variants of concern. Additionally, wastewater monitoring approaches offer another advantage: asymptomatic individuals, as well as individuals who do not take advantage of testing services, can also be represented in the data.

Cooperation as a success factor

In Austria, the possibility of setting up a nationwide monitoring system at such an early stage was due in large part to successful cooperation between research institutions and public agencies. "This is also a success story of what scientific cooperation can achieve," Andreas Bergthaler explains. "In this specific case, this was characterized by collaborations between CeMM and the Medical University of Vienna, the University of Innsbruck, the Medical University of Innsbruck, TU Wien, AGES, and more than ten other institutions that started early and were successfully expanded." Through this cooperation, it has been demonstrated that virus sequencing from wastewater has the potential to contribute significantly to SARS-CoV-2 variant surveillance, pandemic management, and public health at the national level. It is expected that the emphasis from this study will be applied to the analyses of other infectious agents in wastewater in the future, given the level of detail and accuracy of the SARS-CoV-2 results. As such, the unprecedented findings of this study have the potential to contribute to global efforts in infectious disease surveillance.

Attachments:

Photo 1: Fabian Amman and Andreas Bergthaler © Laura Alvarez, CeMM

Photo 2: Sample collection in the wastewater treatment plant © Christian Fischer

Graphic: Graphical abstract © Zsafia Keszei, CeMM.

The Study "Viral variant-resolved wastewater surveillance of SARS-CoV-2 at national scale" was published in Nature Biotechnology on July 18, 2022, DOI: [10.1038/s41587-022-01387-y](https://doi.org/10.1038/s41587-022-01387-y).

Authors: Fabian Amman*, Rudolf Markt*, Lukas Endler, Sebastian Hupfau, Benedikt Agerer, Anna Schedl, Lukas Richter, Melanie Zechmeister, Martin Bicher, Georg Heiler, Petr Triska, Matthew Thornton, Thomas Penz, Martin Senekowitsch, Jan Laine, Zsafia Keszei, Peter Klimek, Fabiana Nägele, Markus Mayr, Beatrice Daleiden, Martin Steinlechner, Harald Niederstätter, Petra Heidinger, Wolfgang Rauch, Christoph Scheffknecht, Gunther Vogl, Günther Weichlinger, Andreas Otto Wagner, Katarzyna Slipko, Amandine Masseron, Elena Radu, Franz Allerberger, Niki Popper, Christoph Bock,

Daniela Schmid, Herbert Oberacher, Norbert Kreuzinger, Heribert Insam, Andreas Bergthaler

*shared first authors

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Andreas Bergthaler studied veterinary medicine in Vienna. After his PhD with Hans Hengartner and Nobel Laureate Rolf Zinkernagel at the University of Zurich and ETH Zurich, he completed his postdoctoral research at the University of Geneva and the Institute for Systems Biology in Seattle. In 2011, he started as group leader at CeMM and in 2016 became ERC Start awardee. Since January 1, 2022, he is Professor of Molecular Immunology at the Medical University of Vienna and CeMM Adjunct Principal Investigator.

The **CeMM Research Center for Molecular Medicine of the Austrian Academy of Sciences** is an international, independent, and interdisciplinary research institution for molecular medicine under the scientific direction of Giulio Superti-Furga. CeMM is oriented towards medical needs and integrates basic research and clinical expertise to develop innovative diagnostic and therapeutic approaches for precision medicine. Research focuses on cancer, inflammation, metabolic and immune disorders, and rare diseases. The Institute's research building is located on the campus of the Medical University and the Vienna General Hospital. cemm.at

Medical University of Vienna (MedUni Vienna) is one of the most traditional medical education and research facilities in Europe. With almost 8,000 students, it is currently the largest medical training center in the German-speaking countries. With 6,000 employees, 30 departments and two clinical institutes, 12 medical theory centers and numerous highly specialized laboratories, it is also one of Europe's leading research establishments in the biomedical sector. meduniwien.ac.at

The **University of Innsbruck** was founded in 1669 and is today, with over 28,000 students and more than 5,000 employees, the largest and most significant research and educational institution in western Austria. Located in the heart of the Alps, the University of Innsbruck offers a perfect environment for successful research and teaching. International rankings affirm the University of Innsbruck's leading role in basic research. In this thriving environment, a wide range of studies across all disciplines are offered at 16 faculties. In numerous partnerships, the university has joined forces with educational and research institutions around the world to promote international exchange in research and teaching. uibk.ac.at/

For further information please contact:

Anna Schwendinger

Head of PR & Communications

CeMM

Research Center for Molecular Medicine
of the Austrian Academy of Sciences

Lazarettgasse 14, AKH BT 25.3

1090 Vienna, Austria

Phone +43-1/40160-70 092

aschwendinger@cemm.oeaw.ac.at

cemm.at