# HRWM NEWS

## Health Related Water Microbiology Specialist Group Newsletter

*Volume 22 – December 2020*

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## Message from our chair

Dear colleagues and friends of the HRWM family!

COVID-19 continues to have our society firmly under control. The pandemic is demanding a lot from all of us, both individually and on the societal level. There is hope to cope well with this serious situation gives, since many scientific teams are working together worldwide to conduct basic research to find out more about this virus, to establish strategies for infection control, and to develop drugs and vaccines to combat this disease.

Our SG HRWM was and is also actively contributing to this task. Apart from the fact that a number of our members are successfully working and publishing on this topic, we held a successful webinar on July 21, 2020, on COVID-19 Wastewater-based Epidemiology. The webinar can still be listened to (https://iwa-network.org/learn/covid-19-wastewater-based-epidemiology/ ). Many thanks to Rosina, Anna Maria, Veronica, Scott and Daisuke for their excellent contributions.

Another activity in this field is the participation of our SG HRWM in the IWA COVID-19 Task Force. In the last two meetings of our HRWM Management Committee (MC) in September and November 2020 we had to make some essential organizational decisions with the help of the IWA headquarters. This primarily concerns the holding of our biennial symposium, which was to take place in Darwin Australia in September 2021. Together with the organizing team for our 21st HRWM Symposium represented by Darryl Day, Amy Dysart and Anne Roiko, we decided to postpone this by one year to September 4-9, 2022. Currently it is not possible to predict what the pandemic situation will be like in September 2021, so it would be very difficult to organize a congress, and its holding is uncertain.

Instead, we will organize a series of three to four on-line workshops / webinars in September 2021. **We kindly ask you all to submit suggestions for topics, speakers and contributors until February 1, 2021, to our secretary Daisuke Sano.** The best proposals will be selected and formed to a weekly series! As a very positive prospect, we can look forward that we all will meet again at the 21st HRWM symposium in Darwin in September 2021.

Another decision concerned the voting and appointment of the next Management Team (MT) and Management Committee (MC), which so far always took place in connection with our biennial symposium. After long discussions and consultation by the IWA Headquarters, a vote was held within the MC. The unanimous result showed that the current composition of the MT and MC will be maintained in order to provide good support for the next Symposium 2022 in Darwin and to allow a smooth transition for the next board. We believe that we have acted in the best interest of all HRWM members.

The fact that there is a wonderful newsletter twice a year is thanks to Maronel Steyn, who is constantly collecting contributions and putting them into a beautiful form. We wish you a pleasant reading!

Please keep sending in contributions, we are already collecting material for the next newsletter. Contributions for our website, managed by Daisuke Sano, are very welcome, too (https://hrwm-watermicro.com ).

At the end of this very unusual year 2020, I would like to thank the MT members Rosina Girones and Hiro Katayama for their continuous support and Daisuke Sano for his excellent work as secretary. My thank goes to the MC members for helpful exchange of opinions and contributions and to all of you as HRWM members.

I am looking forward to our virtual meeting at the HRWM workshops in September 2021 and a personal reunion of the HRWM family in Darwin 2022. I think the personal contact and exchange are what we miss most in these times.

I wish you and your families all a happy and healthy year in 2021!

Warm regards
Regina Sommer
HRWM Chair

**Photo of Management Committee taken at the 20th HRWM symposium in Vienna, happily spending time together. Phot credit: Zsolt Marton**

# COVID-19 Taskforce of Japan Society on Water Environment

- **Article credit: Daisuke Sano**

Wastewater-based epidemiology (WBE) has gotten a lot of attention, also in Japan. The COVID- 19 Taskforce has been organized under the President of Japan Society on Water Environment (JSWE) since May 5, 2020. In total 16 top researchers have joined in this JSWE COVID-19 Taskforce. The taskforce chair is Prof. Emer. Tatsuo Omura, Tohoku University, and the secretary general is Assoc. Prof. Ryo Honda, Kanazawa University. The mission of this taskforce is to establish a standard protocol of WBE for SARS-CoV-2, disseminate academic information with regards to WBE in Japan to the world, collaborate with related international communities, including IWA COVID-19 Taskforce, provide with information exchange platforms, and organize seminars about WBE protocols. Please contact with Dr. Ryo Honda (rhonda@se.kanazawa-u.ac.jp) if you are interested in the status of SARS-CoV-2 WBE in Japan.

# Journal of Water and Health Special Issue "Antimicrobial Resistance in the Water Environment" to be published

- **Article credit Maronel Steyn, Tasha Santiago-Rodrigues, Daisuke Sano, and Gary Toranzos**

Antimicrobial Resistance (AMR) has been raised as important for the international agenda. AMR is not only an immediate major threat to global health but also impacts global economies. More than 700,000 people worldwide die each year because of AMR resistance. While the relative role of the environment is unclear at this stage, an important first step is to identify hotspots of AMR spread and human exposure, and explore (via modelling) possible benefits of actions aimed to cut/reduce the load of AMR agents into various environments. The Journal of Water and Health will publish a Special Issue related to AMR in the water environment, in which seven papers feature a mixture of primary research, reviews and commentaries, including, but not limited to the detection, monitoring and surveillance of AMR genes in various water types, sewage, activated sludge and in wastewater reuse. The occurrence and distribution of antimicrobials, antibiotic resistant bacteria and antibiotic resistance genes was determined by a variety of techniques using the latest information available in both developing and developed countries. Guest editors of this special issue are: Tasha Santiago-Rodriguez, (Diversigen Inc., USA), Daisuke Sano (Tohoku University, Japan) and Gary A. Toranzos (University of Puerto Rico, Puerto Rico).

Maronel Steyn

Tasha Santiago-Rodriques

Daisuke Sano

Gary Toranzos

# Update on quantifying the antibiotic concentrations which can lead to evolution of antibiotic resistance in aquatic environments

- **Article contributed by Mohan Amarasiri[1], Takashi Furukawa[1], Daisuke Sano[2], Kazunari Sei[1]**

**1 - School of Allied Health Sciences, Kitasato University, Japan.**

**2 - Department of Civil and Environmental Engineering, Tohoku University, Japan.**

Antibiotic concentrations in aquatic environments are usually lower than minimum inhibitory concentrations (MIC). However, studies have shown that selection can occur at antibiotic concentrations much lower than the MICs. Minimum selective concentration (MSC) is the lowest antibiotic concentration where the resistant strain is enriched over the susceptible strain 1. Two recent articles have focused on determining the MSCs and lowest observed effect concentrations (LOEC) of antibiotics in aquatic environments using complex microbial communities.

By analysing wastewater treatment plant influent microbial community, significant positive selection for ermF gene was observed at 750µg/L for three macrolide antibiotics (azithromycin, clarithromycin, and erythromycin); which was lowest among the evaluated antibiotic resistance genes (ARGs) when estimated using qPCR, and MSC of 514.1µg/L was calculated for erythromycin. Meanwhile, MSC estimated for ciprofloxacin based on intI1 for the same community was 10.77 µg/L 2. Predicted no effects concentration (PNEC) of ciprofloxacin was determined as 1.077 µg/L which was lower than some of the reported environmental concentrations, suggesting the selection for fluoroquinolone resistance in such environments.

Instead of determining the MSCs for each bacterial strain, a recent study utilized the reduction in growth rate of a bacterial community at different antibiotic concentrations to predict selection for AMR and to evaluate the LOEC of antibiotics, hypothesizing that significant reduction of bacterial growth is indicative of selection occurring (SELection Endpoints in Communities of bacTeria; SELECT assay) 3. PNEC for resistance (PNECR) and risk quotient (RQ) which is the predicted or measured environmental concentration divided by PNEC was calculated for 8 antibiotics. RQs of <0.1, 0.1 to <1, and >1 were defined as having low, medium or high risk of selection for antimicrobial resistance. SELECT assay complimented the study by Stanton et al. on the unacceptable risk of ciprofloxacin by showing both RQMED and RQMAX values greater than 1. Trimethoprim, azithromycin, and cefotaxime also had RQMAX values greater than 1 while none of the other antibiotics had RQMED values greater than 0.1. The results compliment the recommendation of ciprofloxacin in European Union Water Framework Directive watchlist.

Above methods can be used to rapidly determine PNECR which hints about antimicrobial resistance (AMR) hotspots, and also in regulatory decision making to determine allowable antibiotic concentrations in water environments leading to reduced occurrences in AMR development. Above studies also highlight the importance of evaluating additive or synergistic effects of compounds which can lead to lower PNECR and higher RQ values.

1. Gullberg, E. et al. Selection of resistant bacteria at very low antibiotic concentrations. PLoS Pathog. 7, e1002158 (2011).
2. Stanton, I. C., Murray, A. K., Zhang, L., Snape, J. & Gaze, W. H. Evolution of antibiotic resistance at low antibiotic concentrations including selection below the minimal selective concentration. Commun. Biol. 3, 467 (2020).
3. Murray, A. K. et al. The 'SELection End points in Communities of bacTeria' (SELECT) Method: A Novel Experimental Assay to Facilitate Risk Assessment of Selection for Antimicrobial Resistance in the Environment. Environ. Health Perspect. 128, 107007 (2020)

# News on Quality Control of UV-Devices for Drinking Water Disinfection -

## Harmonization of quality standards in Europe

**- Article Credit: Regina Sommer**

The increased acceptance of UV drinking water disinfection is attributed, amongst other reasons, to the better understanding of the process and the higher quality assurance of the UV disinfection devices. Establishment of quality standards on the requirements, including validation testing and certification of commercial UV devices, have provided the basis for the safe application of UV irradiation as primary disinfection for drinking water supply.

So far, the Austrian national standards ÖNORM M 5873-1 (low pressure UV radiation; versions 1996, 2001), ÖNORM M 5873-2 (medium pressure UV radiation; version 2003) and the Work sheet W 294; versions 1997, 2006) by the German Association for Gas and Water (DVGW) have had been established in Europe.

The regulations are based on the following basic prerequisites and principles:

(1) The knowledge of the UV resistance of pathogens and indicator microorganisms relevant in water hygiene based on exactly controlled UV inactivation laboratory studies

(2) Standardized UV (duty) radiometers for the surveillance of the irradiation process during practical operation, measurement in W/m². These radiometers need to be annually controlled by means of a reference radiometer traceable to a national calibration office.

(3) A full scale biodosimetric validation test under well-defined operation conditions by variation of water flow, UV-254 nm transmittance of the water and the UV lamp power.

(4) A UV-254 nm calibrated microorganism serving as biodosimeter to measure the Reduction Equivalent Fluence (J/m²) representing the microbicidal effective UV fluence (dose).

After careful consideration and negotiations over several years, a harmonization between the Austrian and German regulations has recently been achieved. This facilitates from now on the tasks of waterworks operators, of the manufacturers of UV devices and of the authorities for the benefit of the drinking water consumers.

The UV devices validated by the ÖNORM/DIN standard offer a guaranteed UV-254 nm fluence of at least 400 J/m² during operation. International studies show that by applying this fluence a 4 to 6 log inactivation of the most relevant water-borne pathogens is achieved. If the risk assessment of the water supply system reveals the necessity of enhanced inactivation conditions, e.g. if the occurrence of adenoviruses must be expected, a multi-barrier disinfection is recommended. In this case, UV radiation is combined e.g. with a chlorine dioxide treatment. In this way, the respective advantages of each individual technique, the high potential of UV radiation to inactivate protozoa and the high virucidal efficiency of chlorine-based disinfectants, can be perfectly combined. However, it has to be pointed out, that an application of UV irradiation below a REF of 400 J/m² cannot be recommended, since a fluence below 400 J/m² is needed to overcome the photoreactivation of bacteria. Repair of UV damages and regaining infectivity of bacterial pathogens would be the consequences. Information on validation of UV devices by biodosimetric measurement can be found: www.uv-team-austria.at

**References**

ÖNORM M 5873-1:2020 / DIN 19294-1:2020: Devices for the disinfection of water using ultraviolet radiation Part 1: Devices equipped with UV low pressure lamps - Requirements and testing.

ÖNORM M 5873-3:2020 / DIN 19294-3:2020: Part 3: Reference radiometers for devices equipped with UV low pressure lamps - Requirements and testing.

**UV device under full scale biodosimeter investigation at the Water Test Center Wiental, Austria (Photo credit: Thomas Haider)**

# European Geosciences Union General Assembly Announcement

- **Article credit Regina Sommer**

The next **European Geosciences Union General Assembly vEGU21: Gather Online (#vEGU21)** will take place entirely online from 19 to 30 April 2021.You are invited to submit abstracts to the following session:

**Session HS2.3.5: Fate and transport processes of pathogens and emerging contaminants at multiple scales**
***Invited Speaker: Liping Pang***
**Conveners**: Julia Derx, Fulvio Boano, Jennifer Drummond, Margaret Stevenson

This session aims to bring together communities from hydrological, microbiological and chemical sciences to increase the understanding about the dominant processes controlling faecal indicator, pathogen and contaminant fate and transport at larger scales. Consequently, we welcome contributions that aim to close these knowledge gaps and include both small and large-scale experimental, with the focus on

- the fate and transport of faecal indicators, pathogens and emerging contaminants in rivers, groundwater and estuaries
- Hydrological, physically based modelling approaches
- Methods for identifying the dominant processes and for transferring faecal indicator, pathogen and contaminant transport parameters from the laboratory to the field or catchment scale
- Investigations of the implications of contamination of water resources for water safety management planning and risk assessment frameworks

**For full details**
see: https://meetingorganizer.copernicus.org/EGU21/session/39644 ; **The deadline for abstract submission is January 13, 2021**
Instructions for abstract submission can be found here.

# Hygiene Quality of Natural Swimming Pools

- **Article credit: Susan Petterson and Nicholas Ashbolt**

Natural swimming pools (NSP) (or ponds with no residual disinfectant) have become increasingly popular in the last 20 years for both private and public use, however there are hygiene concerns over the fate of human-released enteric pathogens. In their most pure form, a natural swimming pond is an artificial pool constructed for the purpose of recreational bathing, without any form of chemical disinfectant. Water is 'cleaned' by pumping it through a series of natural or constructed biofilters and/or wetlands. In-situ elimination of pathogens is assumed to occur by zooplankton predation, biofilm sorption/sedimentation processes and natural solar radiation/UV inactivation.

The first public NSP in Canada was proposed for Edmonton's Borden Park in 2015. Given that the proposed design fell outside the existing regulatory conditions for swimming pools, Alberta Health commissioned a screening level risk assessment in 2016 to explore the potential human health risks from faecal pathogens. In collaboration with Nick Ashbolt and Qiaozhi Li at University of Alberta, we undertook a desktop risk assessment based on the pool design and existing information in the literature. Our work has recently been published in Water Research (https://www.sciencedirect.com/science/article/pii/S0043135420310368), highlighting the many important unknowns associated with pathogen fate within natural systems.

**Borden Park Natural Swimming Pool: Natural filtration system being established. Photo credit: City of Edmonton**

In September 2019, Susan Petterson was Invited to present this research at the international convention of the IOB (IOB is the international organization for natural bathing waters and is the umbrella organization for swimming pond experts (https://iob-ev.com/) in Warsaw, Poland. There was a great deal of support from the group for the risk-based approach and the need for further scientific research on the hygienic quality of bathing waters. Importantly, there is a need for natural disinfection barriers for swimming pools to be recognised within recreational water quality guidelines, with recommendations for assessing safety and managing bather risks.

**Susan presenting at the 10th International Swimming Pond congress in Warsaw, Poland.**

The pool in Edmonton has been open to the public since July 2018 and is popular with the locals. There are clear hygienic guidelines for users which you can find on the pool's website: https://www.edmonton.ca/activities_parks_recreation/borden-park-outdoor-pool.aspx

**Borden Park Natural Swimming Pool in use. photo credit: Diego Romero CTV News Edmonton.ca Digital Journalist (https://edmonton.ctvnews.ca)**

**Become an IWA member**

Not yet a member and interested in joining IWA and specifically HRWM? Then click on the link below and see how you can become a member of this family.
http://www.iwa-network.org/membership.php

# Catalan Surveillance Network of SARS-CoV-2 in Sewage, interactive map and free access database

- **Article credit: Rosina Girones**

The Catalan Institute for Water Research (ICRA) is coordinating the Catalan program for the surveillance of SARS-CoV-2 in sewage. The program started in early July as an early warning tool to anticipate COVID-19 outbreaks in Catalonia. The results on the concentration of viral gene markers across the territory are provided in an online platform (sarsaigua.icra.cat), discussed weekly with the Public Health Agency of Catalonia (ASPCAT) and the Catalan Water Agency (ACA) and are used as a complementary indicator in the decision-making process.

A total of 56 WWTPs serving 193 municipalities are sampled throughout the country, representing 80% of the Catalan population. Territorial equilibrium is guaranteed by monitoring at least 1 WWTP per county. Thirty-six WWTPs are sampled weekly and 18 fortnightly. A 24-hour, flow-proportional composite samples are collected at the entrance of each WWTP every Tuesday and send to reference laboratories for the analysis of SARS-CoV-2 genetic biomarkers, namely: i) the Laboratory of Viruses Contaminants of Water and Food led by Prof. R. Gironés (https://is.gd/rNmGr1 ); ii) the Laboratory of Enteric Viruses led by Prof. A. Bosch (https://is.gd/GFSH7W) and iii) the Biotechnology Area of EURECAT (https://is.gd/SFz7q4 ).

Weekly results on the concentration of SARS-CoV-2 target genes in wastewater are visualized in the on-line platform developed ad-hoc by EURECAT in collaboration with ICRA (Figure 1). This platform integrates both the data generated by the laboratories and the metadata generated during sampling. Data visualization includes an interactive map of the sampled territory showing the level of

SARS-CoV-2 prevalence in wastewater and detailed graphs with the concentration of different gene targets (N1, N2, and IP4) over time. All data are freely available for investigation purposes at the Zenodo on-line repository (https://zenodo.org/record/4244774).

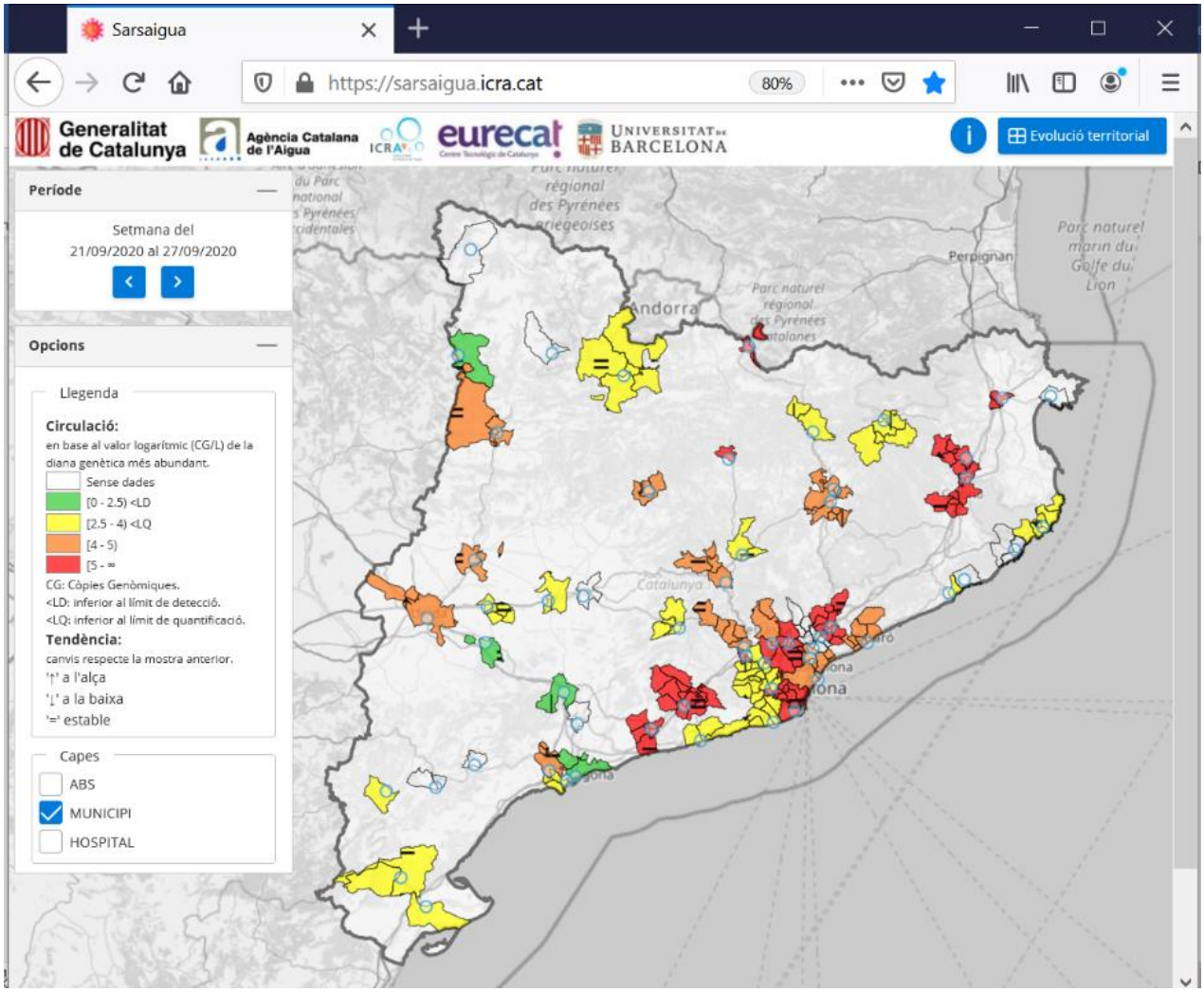



**Figure 1: Visualization of results for the WWTP monitored by the surveillance program. Color codes refer to the absolute concentration (in gene copies/L) of the most abundant genetic marker reported weekly (from green (below limit of detection) to red (>5 log units)). Available at https://sarsaigua.icra.cat.**

# Getting to know the YWP Chapter from Austria

- **Article credit: Anita Schandl, president of YWP Austria and Katalin Demeter, TU Wien and YWP committee member**

## A Brief History

The YWP Austria, founded in 2008, are a group of over 100 committed members from various institutions and fields across the water sector. We offer a strong network and great opportunities to broaden horizons. Workshops on a wide range of water topics are held twice a year. There the participants can exchange ideas, present their activities and talk to various water professionals. In order to facilitate an informal exchange of ideas, excursions are organised once or twice a year, while relaxed get-togethers are held bi-monthly in three cities. Our national activities are complemented by bi-national workshops with neighbouring countries (Germany, Czech Republic, Hungary), as well as an exchange with the mother organisation, the IWA Austria. We always look for opportunities to get to know other national YWP chapters to discuss experiences and eventually build a strong cooperation. You can contact us at ywp@a-iwa.at and read more about our activities at www.a-iwa.at/ywp, on Facebook (Austrian Young Water Professionals) and Twitter (@YWPAustria) as well as using #YWPAustria.

**Current board members of YWP Austria (left to right: Anna Pomassl, Sarah Kudaya, Anita Schandl, Teresa Garstenauer, Katharina Steinbacher). The board is elected every two years, with the next election scheduled for November 2020.**

## Panel discussion and pub quiz: events during the 2019 HRWM Symposium

The 20th Symposium on Health-Related Water Microbiology was held in Vienna, Austria last year. We, the Young Water Professionals Austria, were honoured and excited to be part of the organising committee and to contribute two events to the rich programme of the conference. The Panel Discussion on SDG6 “Clean water and sanitation” was part of the main programme. Our synthesis of the conference abstracts’ relation to the SDG6 targets served as the basis of the discussion. The audience participated in the lively debate via online voting. The YWP Evening started off with the excitement and fun of a water-related pub quiz. The over 100 participants were assigned to teams

randomly, ensuring that everyone could meet new people. Long discussions and a lot of dancing followed!

Panel Discussion on SDG6 "Clean water and sanitation"

The winning team of the Pub Quiz at the YWP Evening

## Call for papers to a special issue "COVID-19 and water" in Journal of Water and Health

COVID-19 is an infectious respiratory disease caused by SARS-CoV-2 infection. This special issue will gather cutting-edge studies on the water-related health aspects of SARS-CoV-2 transmission including: characterizing the impact of WASH interventions on disease transmission; quantifying the occurrence and fate of SARS-CoV-2 in water and wastewater; and wastewater surveillance of SARS-CoV-2 to support public health interventions. Studies from low- and middle-income countries are specifically sought and supported. Guest editors are Gertjan Medema (KWR, Netherlands), Eiji Haramoto (Yamanashi University, Japan), John Scott Meschke (University of Washington, USA), and Susan Petterson (Water & Health Pty Ltd and Griffith University, Australia). Publication schedule is as follow:

**Mar. 31, 2021: Due date for short manuscript proposal**

**July 31, 2021: Due date for the full manuscript**

**Oct. 2021: The first evaluation notification**

**Dec. 2021: Special Issue Publication**

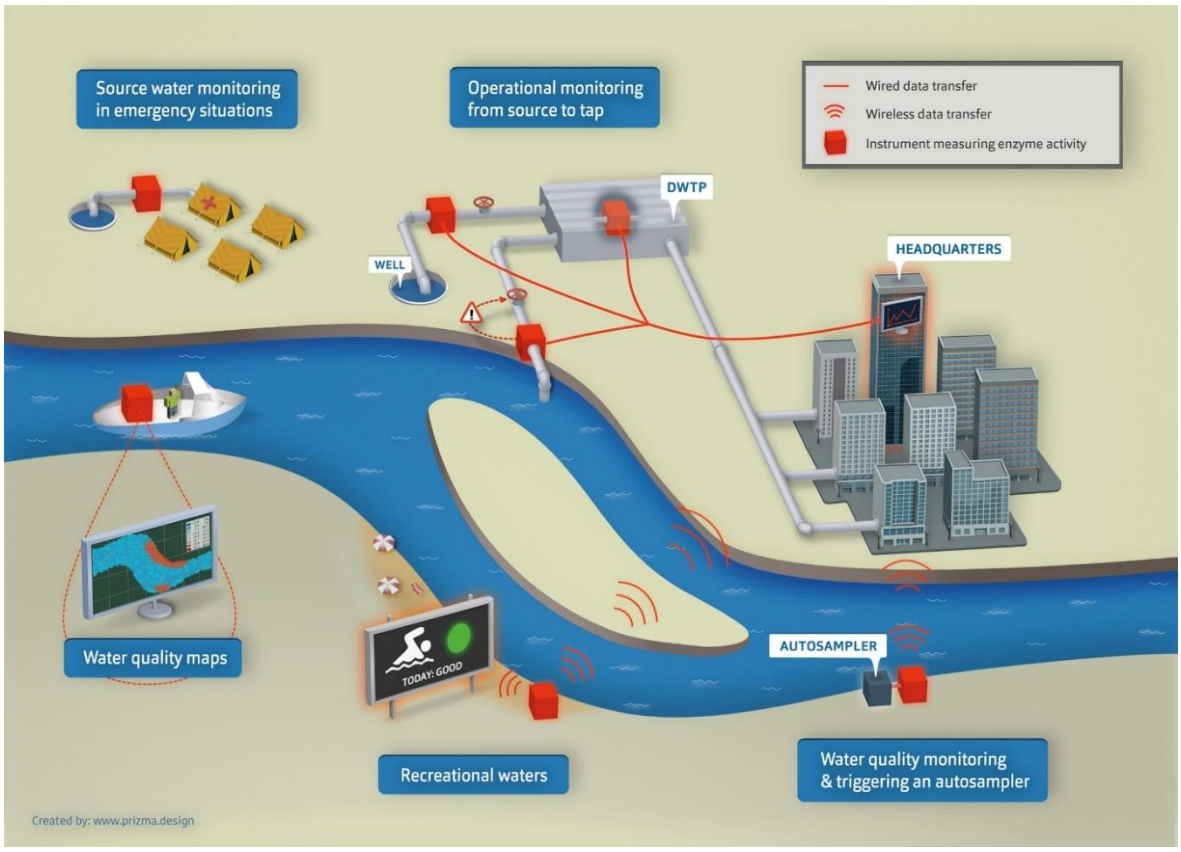
# Automated online monitoring of fecal pollution in water by enzymatic methods – a brief overview

- **Article credit: Katalin Demeter, TU Wien and Dr. Andreas Farnleitner TU Wien and Karl Landsteiner University Krems – ICC Water & Health, Austria**

Since fecal pollution patterns may vary greatly on short temporal and spatial scales, the prompt management of public health risks from water resources is a challenge. The fluorescence-based detection of the enzymatic activity of ß-D-glucuronidase (GLUC) has been suggested as a rapid method to monitor fecal pollution. New technological adaptations enable now its automated, near-real-time measurement in a robust and analytically precise manner. Large datasets of high temporal or spatial resolution have been reported from a variety of freshwater resources, demonstrating the great potential of this automated method. However, the fecal indication capacity of GLUC activity and the potential link to health risk is still unclear, presenting considerable limitations. A recent review published in Current Opinion in Environmental Science and Health provides a critical evaluation of automated, online GLUC-based methods and their alternatives. It also defines open questions to be solved before the method can fully support water management. The review is a collaboration among research groups that have extensive experience in the field: Professor Farnleitner's and Professor Kirschner's groups at the ICC Water & Health in Austria (waterandhealth.at), Professor Zessner's group at the Institute for Water Quality and Resource Management at the TU Wien in Austria, and Dr. Burnet at the Polytechnique Montreal in Canada.

Demeter, K., Burnet, J.-B., Stadler, P., Kirschner, A. K. T., Zessner, M., Farnleitner, A. H. (2020). "Automated online monitoring of fecal pollution in water by enzymatic methods." Current Opinion in Environmental Science & Health **16**: 82-91; The article is freely available at: https://doi.org/10.1016/j.coesh.2020.03.002

**Automated GLUC activity measurements in an outdoor setup for online monitoring with high resolution. Photo © Philipp Stadler.**




**Potential applications of rapid online enzymatic methods for the detection of fecal pollution in water.** ***Source: Demeter et al., 2020, Curr Opin Environ Sci Health, 16: 82-91, Figure re-published under CC BY-NC-ND 4.0 licence.***


**Ship-borne measurements of GLUC activity in near-real-time for water quality mapping. Photo © Philipp Stadler**.

# Notification to HRWM Members

## - Management Committee Elections and Way Forward

In accordance with the HRWM SG constitution, the management committee (MC) elections are organized in concurrently with our biennial HRWM symposium.

The Constitution reads as follows:

- The final decision of new MC members will be made at the closed MC meeting with MC members held at biennial HRWM Symposium.
- The new MC members will be announced at the open meeting of the biennial HRWM Symposium.
- The term of each MC member is 4-years, chair and vice chair 2 years, secretary 4 years.

Due to the postponement of the HRWM symposium from September 2021 to September 2022, the management team together with the management committee considered two possible options: 1) To plan and organise an electronic voting, or 2) to prolong the term of the MC and MT members.

With input from IWA Headquarters as well as the HRWM Conference organising committee for 2022, the MT and the MC decided to prolong the term of the current MC members and for elections to take place in time with the HRWM Conference in 2022. Part of the decision was based on the stability the current MC would provide to the Conference organising team.

We believe that we acted in the best interest of the SG as a whole.

# Announcement

## - Seeking YWP Instagrammer to join Management Committee

The Management Committee is seeking 2 – 3 YWP's within the HRWM SG to fulfil certain roles within the Management Committee to improve our Social Media activities. Members of the current Management Committee and Management Team are already fulfilling some roles on our social media platforms such as LinkedIn, Twitter, our website, as well as Facebook. The role of Instagrammer has not been filled.

These roles are set out under the Social Media positions within our Constitution. We are therefore keen to fill these positions by including a few individuals that fits certain criteria to our team. We are seeking young dynamic individuals that have a passion for the work our SG does and that are familiar with and keen to promote our SG via all social media platforms, but especially Instagram.

If you are interested to fill this position, and fits the criteria, please email your CV with a letter to: daisuke.sano.e1@tohoku.ac.jp

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