



## Fact sheet no 4: Development of a “European” map of viruses in water

### Introduction

Enteric viruses are generally transmitted to humans orally, multiplying in the throat and the intestinal mucosa and are discharged into the sewerage system with feces onto the surface waters from which drinking water is produced in many cases. In order to prevent water-borne viral outbreaks the different types of waters should be carefully monitored (Tani et al. 1992). So without a developed monitoring system the risk of viral outbreak is considered to be high. However, in many countries of the EU virus monitoring is made only if a viral outbreak occurs. The presently available virus determination methods are time and cost consuming and usually do not allow real-time measurements and do not lead to development of an early warning system that can help to prevent and identification of endemic diseases.

### Objective

The general problem is that we have only limited knowledge of the risk of viral infection in Europe. The FP6 Project “VIROBATH” aimed at investigating viruses in bathing waters involving many countries (Wynn-Jones et al. 2011). The objective of this project is to develop a nanotechnology-based cheap, real-time and online method which is able to detect Norovirus GI and GII, Hepatitis A virus and Rotavirus selectively. These are more infectious enteric viruses causing infection or illness in a dose/person of 1-10 viral particles.

### Investigated water types

During the present project the following water types have been investigated: (1) Raw and treated sewage at different stage of the treatment process; (2) Surface waters loaded with sewage water; (3) Surface waters with limited sewage loads; (4) Transboundary surface waters; (5) Natural and thermal bathing waters; (6) Plant washing waters. (7) Flushing waters during an urban floods caused by heavy rains.

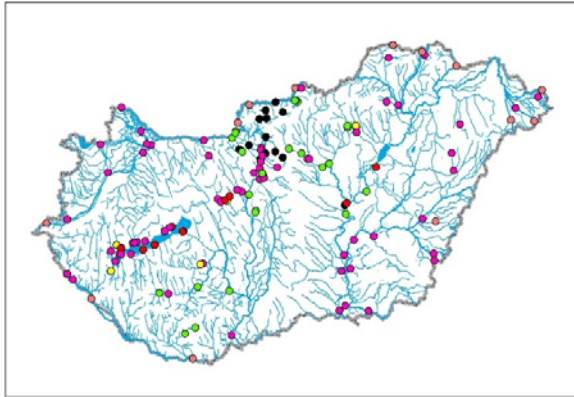
### Sampling and sample handling

Water samples were taken in different countries (the number of samples are indicated in bracket): Hungary: (269, see Fig. below), Italy: (24), (3) Portugal: (2), Sweden and Denmark: (51). As an example, sampling sites in Hungary are seen in Figure below. Adequate volume of samples was pre-concentrated for viruses using modified “VIROBATH” method (Wynn-Jones et al. 2011). Determination of viruses was done using nested qPCR method which gives semi-quantitative results for our virus types. The final step of the sample processing is gel chromatography using positive and negative control.

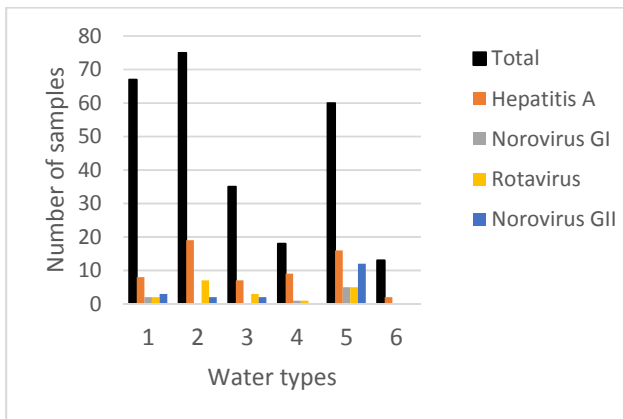
### Results

The results show that the occurrence of the investigated four virus types is not homogenous. Viruses can be found in each water types but the presence of the viruses can vary in time and space. The viruses can present in waters due to excretion product of human population into the environment.





Sampling sites in Hungary, 2016



Results of the virus analysis (HUN samples only) 1: Survey monitoring; 2: Periodic monitoring; 3: Natural bathing waters; 4: Thermal waters; 5: Sewage waters; 6: Transboundary waters

The occurrence of gastro enteral viruses is more frequent in wastewaters and the concentration of viruses does not decrease very much during the treatment process. The post sedimentation tank can be more effective in virus removal. The final disinfection using free chlorine or UV light is not always efficient in virus inactivation. Usually all the four virus types cannot be found in a particular water sample together. The Hepatitis A virus was the most

frequent one in the samples. The Norovirus (GI and GII) could be found in much less samples. Medium frequency characterizes the Rotavirus. Generally, the occurrence of viruses in Hungarian waters is considered to be low (see Graph above).

## Recommendations

The recommendations are: (1) Development of a nation-wide virus monitoring system is essential to decrease the risk of the viral outbreaks; (2) The main virus occurrences can be expected in sewage water, in sewage impacted surface waters and in thermal spas; (3) Virus monitoring for enteric viruses should focus on those water types where the consumption of water or direct contact with humans is evident.

At policy level the virus monitoring should be introduced into the regular water quality monitoring system. The monitored viruses should be the more infectious gastro enteric types, poliovirus and other dangerous viruses. EU standards should be developed at each parts of the virus monitoring. It is essential to develop risk maps for EU demonstrating the polluted areas having different risks of virus infection.

## References

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Wyn-Jones, P.A., Carducci, A., Cook, N., D'Agostino, M., Divizia, Fleischer, J.M., Gantzer, C., Gawler, A., Girones, R., Höller, C., de Roda Husman J A-M., Kay, D., Kozyra, I., López-Pila, J., Muscillo, M., Nascimento, S-J., Papageorgiou, J., Rutjes, S., Sellwood, J., Szwedzyk, S., Wyer, M. (2011): Surveillance of adenoviruses and noroviruses in European recreational waters. - *Water Res.* 45: 1025-1038.

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