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PROJECT FINAL REPORT

Grant Agreement number: 604069

Project acronym: AquaVir

Project title: Portable Automated Water Analyser for Viruses

Funding Scheme: Collaboration Project

Period covered: from 2013-11-01 to 2016-10-31

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[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

Final publishable summary report

1. Executive summary

Water-borne viral diseases pose high risks for public health worldwide. The urban wastewater contains a large number of pathogen viruses, and even the most advanced wastewater treatment cannot remove all virus particles.

The conventional biological water quality indicators do not provide adequate information about the presence of pathogenic viruses. The currently available reliable virus test - based on molecular biology - is expensive, time consuming and labor intensive, thus limited to few laboratories with sophisticated facilities and well-trained personnel, even though the protection of water networks against pathogenic viruses is crucial.

In the AquaVir project we aimed to develop a novel, cost effective, portable, on-site detection system, which is capable for monitoring human enteric viruses in different freshwater bodies.

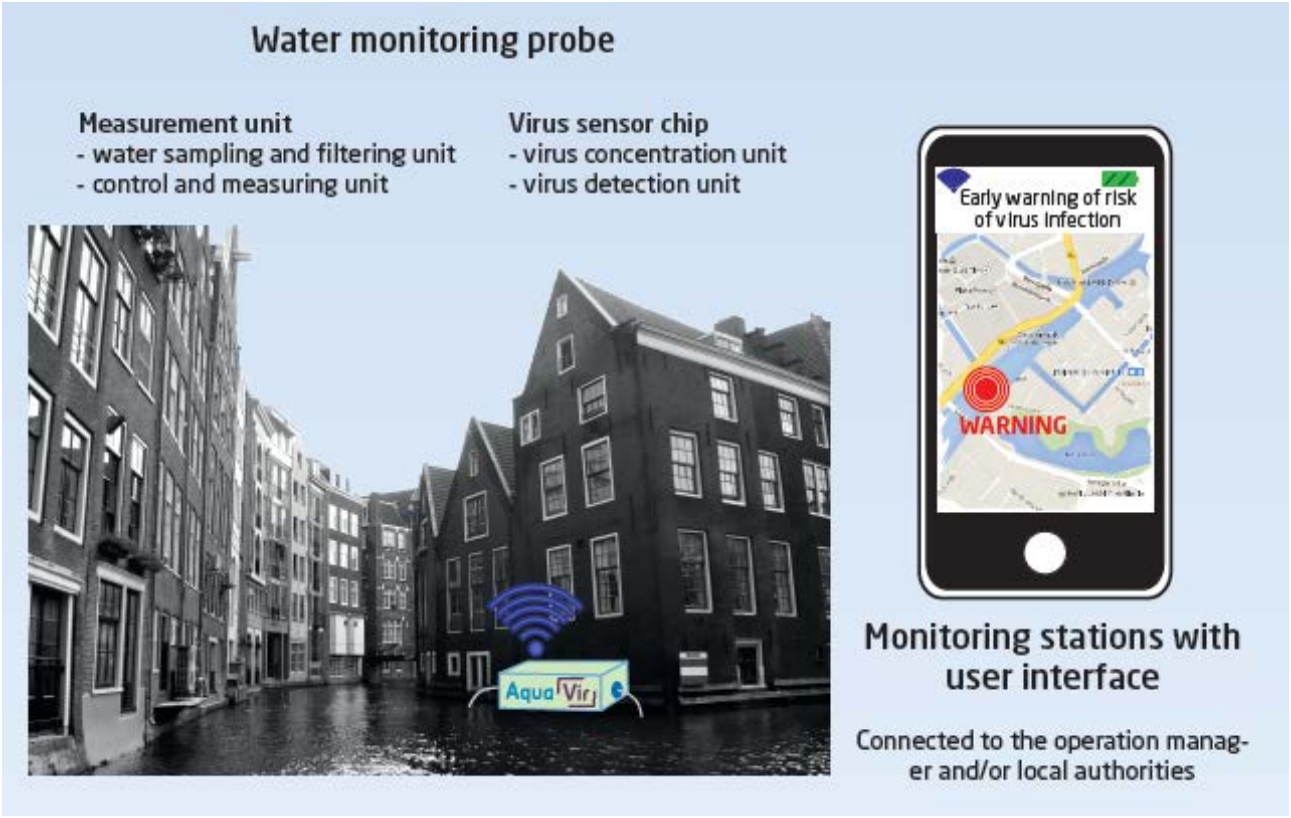
The Portable Automated Water Analyser for Viruses (AquaVir) is a three-year FP7-funded project designed to develop a monitoring system for detecting pathogenic viruses in different water sources. In the project 14 partners from universities, research institutes, manufacturers, laboratories, end-users and standardization bodies worked together from Denmark Germany, Portugal, Romania, Sweden, Belgium, Hungary, and Italy.

The Aquavir Virus Monitoring system is intended to detect virus particles in a concentrated water sample on basis of electrical readout. The measurement data can be sent to a monitoring station.

We have developed a computer controlled automated system, which consists of a water sampling and filtering unit and a virus concentration and detection unit based on the input from the end-user partners and on the required virus detection limits.

The system comprises two plastic chips as core components fabricated with state-of- the-art mass producible micro- and nanotechnologies. In these chips, the viruses are concentrated and detected, respectively. The data from the measurements can be sent to a monitoring station, which is used for early warning and risk assessment for infections by the pathogenic viruses. The obtained data ensures the prevention of further infections and outbreak of the pathogenic viruses.

We have also developed a standardization document, a CEN Workshop Agreement (CWA) for detection viruses in water. The standardization strategy provides a map on the standardization landscape on national, European and international level as well as the differentiation to industry standards.



The main expected impact of the project is that the system will radically improve the water quality monitoring and thereby will give safe water for the society.

2. Summary description of project context and objectives

1.1. Background and Objectives

The Portable Automated Water Analyser for Viruses (AquaVir) is a three-year FP7-funded project designed to develop a monitoring system for detecting pathogenic viruses in different water sources.

Enteric viruses exist frequently in various types of environmental water samples, such as wastewater, bathing water, ground or surface water and drinking water, constituting a primary source of gastroenteritis or hepatitis outbreaks.

The infection by enteric viruses is associated with considerable costs resulting from hospitalization and loss of time at work.

Pathogenic viruses cannot replicate outside of the host, but - based on their structures and composition - are generally much more resistant than bacteria or other microorganisms, they can survive extreme conditions for long time in the environment. The primary source of pathogens waterborne viruses is the urban wastewater. Human faecal materials of infected persons discharged to the urban wastewater, contain large number of pathogen viruses (10^7-10^{11} virus/gram faeces).

The small sizes and the extreme resistance of the enteric viruses causes that even the most advanced wastewater treatment technologies - such as membrane bioreactors with tertiary treatment including filtration, heat and UV light inactivation and chlorination - cannot fully eliminate viral particles.

Microbial water quality often varies rapidly in time and over a wide range. Short-term peaks in pathogen concentration may increase the disease risks considerably and may trigger outbreaks of waterborne disease. Water-borne viral diseases are important risks in the climate change, which causes floods and extreme climate events.

The problem of microbiological/virological measurements in water samples is the time requirement of the laboratory analyses, which is typically 24-72 hours after sampling. By the time the microbial contamination is detected, many people have already been exposed to the infection. Therefore an on-site continuous virus-monitoring probe is crucial for the human health.

The conventional biological water quality indicators do not provide adequate information about the presence of pathogenic viruses[2]. The currently available reliable virus test - based on molecular biology - is expensive, time consuming and labour intensive, thus limited to few laboratories with sophisticated facilities and well-trained personnel, and not used routinely.

The AquaVir project aimed to deploy nanotechnology in affordable, mass-produced sensor for continuous monitoring of pathogen viruses in water. The applications include monitoring of raw water, process water for the food industry, wastewater discharge, irrigation water, bathing water, surface water and aquacultures.

The project included also i) laboratory and field tests ii) development an early warning system, iii) exploitation possibilities at the end-users, iv) economical assessment for positive production capacity and v) preparation for standardisation.

The results of the project will radically improve the water quality monitoring and contribute to creating new standards. Standardisation is an important tool for bringing the results beyond the research community and to the market.

The product design is based on the input of the end-users including the user-friendliness, adaptable to other water quality indicators and maintenance and further development strategies.

The core components of the virus-monitoring probe in AquaVir project are two microfluidic plastic chips for concentration and selective detection of viruses, respectively. The detection chip is a consumable product that has to be replaced regularly (every time if viruses are detected or in normal cases after several weeks) depending on the contamination in water to be monitored. The project includes the development of a method for manufacturing of the two chips in cost effective way.

[2] E. M. Symonds et al. Eukaryotic Viruses in Wastewater Samples from the United States, Applied And Environmental Microbiology, Mar. 2009, p. 1402.

1.2. Technical description of the developed system

The system consists of a Water Sampling and Filtering Unit (WSFU) and a Concentration and measuring system (CMS), which includes a Virus Concentration Unit (VCU) and a Virus Detection Unit (VDU). The different units are described in the following sections.

The overview of the sensor system can be seen on Figure 1.

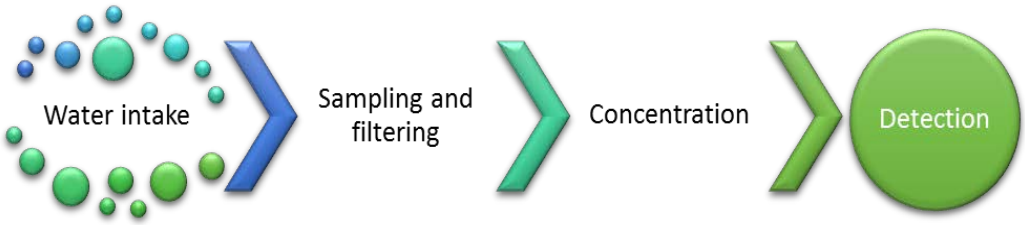


Figure 1 The sensor system for virus detection

Water sampling and filtering unit

The Water sampling and filtering has the function to collect the raw water from the original source. In the next step the water will be filtered through a rough filter to remove the large objects and particles. After this, a pre-concentration step is included, in which the water is slowly filtered through a glass wool filter. An elution buffer is used for recovering the viruses from the glass wool. The collected sample is stored in a sample reservoir for further processing.

Concentration and measuring system

The concentration unit

The concentration unit is utilized in an effort to further increase virus concentration in the liquid sample to improve the limit of detection (LOD) of the system. The principle is to push the virus particles towards the centre of a microchannel, where a fraction of the liquid containing all the virus particles is collected. The remaining liquid is discarded and thereby increasing the virus concentration in the sample liquid and decreasing the total sample volume, while retaining the virus particles. With careful electrode design, the virus particles are pushed towards to the middle of the channel and divided into three, they are then collected in the central channel. The concentration factor can be optimized by adjusting the flow rate in the three channels. By dividing the flow into 45 %, 45 % and 10 % fractions, one can achieve a 10-fold increase in virus concentration. In the AquaVir chip 128 parallel channels are used to increase the throughput. These chips can be stacked up for futher improvement of turnout.

The detection unit

The detection unit is a single-use inexpensive plastic chip, which has the function of selectively and accurately detecting the targeted viruses. In the sensor chip several sets of electrodes are exposed to a liquid sample. The electrodes are functionalized with the specific recognition molecules (aptamers) that have high affinity to the pathogens to be detected. The recognition molecule, the aptamer is a short oligonucleotide sequence (single stranded DNA) with a function similar to antibodies. The detection of the target pathogens is based on electrical measurement. There is a possibility to detect different analytes in the same time on the different electrodes. After detection of any pathogen or after a pre-defined running time, the detection chip should be replaced with a new one.

1.3. The achieved results

- In the project both the detection chip and the concentration chip have been developed based on micro- and nanotechnological methods.

- The description of the process and tests protocols for mass production of these chips has also been achieved.

- The two chips have been produced with in advanced industrial processes for the pilot testing.

- A computer controlled prototype sensor systems have been developed for controlling the concentration chips and for measuring the water samples with the detection chip.

- The project has included laboratory tests of the different components of the sensor system.

- A RT-qPCR to detect norovirus and rotavirus was developed in the project as a reference method.

- In the project an early warning model and epidemic risk assessment have been developed, providing with exploitable possibilities at the end-users.

- The feasibility of the AquaVir system and economical assessment for positive production capacity was also investigated.

- A CEN Workshop Agreement (CWA, a standardization document) has been developed regarding virus detection in water

- Over 300 water samples have been collected and pre-concentrated in different countries from different water sources. These samples were divided into two parts. One part was analyzed with classical laboratory methods by one of the chosen partner´s lab, and the other part came for testing in laboratory with the AquaVir system.

3. Main S&T results/foregrounds

The project aimed to develop and test an inexpensive nanotechnology-based virus-monitoring unit, capable of detecting waterborne viruses in different water bodies.

The virus monitoring system is able to semi-continuously analyse the pathogenic virus content of the water automatically for longer periods giving alarm signal to a remote observer if the virus concentration is increasing. Inexpensive, disposable and mass-producible chips are used, which have to be exchanged when needed (either regularly or in case when viruses have been detected).

The product design is based on the input of the end-users including the user-friendliness, adaptable to other water quality indicators and maintenance and further development strategies.

The main achievements in the reported periods are described below.

In WP2, WP3, WP5 and WP6 the project was focusing on the development and fabrication of the monitoring system. The achieved results in the period are:

- Both the detection chip and the concentration chip have been developed based on micro- and nanotechnological methods.

- The nanotechnological method used in the concentration chip is filed in a patent application on. 1 March 2016.

- Description of the process and tests protocols for mass production of the microfluidic chips has also been achieved.

- The two chips have been produced with advanced industrial processes in the required numbers for the pilot testing.

- The High Level Product and Architecture Specifications for the AquaVir Sensor System have been described.

- A computer controlled prototype sensor systems have been developed for controlling the concentration chips and for measuring the water samples with the detection chip based on the Architecture Specifications.

In WP4, WP7 and WP8, the plan was the validation of the prototype monitoring system in laboratory and test on field, including building up a conceptual sensor-models system for early warning of risk of infection. The achieved results are:

- Collection, pre-concentration and laboratory analysis of more than 300 water samples from different sources and form different countries.

- Laboratory tests of the different components of the sensor system.

- Development of an early warning model and epidemic risk assessment, providing with exploitable possibilities at the end-users.

- Preliminary tests of few water samples for noroviruses with the developed detection unit. Although the number of the analysed samples did not allow making statistical conclusions, the results are promising. Further analysis is going on beyond the AquaVir project.

In WP9 a market analysis have been planed. The achieved result is:

- The feasibility of the AquaVir system and economical assessment for positive production capacity has been investigated.

WP10 includes the activities in dissemination, exploitation and standardization. The achieved results are:

- The results from the project have been published on conferences, on exhibitions and in Fact sheets for wider audience (end-users and authorities).

- The work on the standardization strategy for the AquaVir project. A CEN Workshop Agreement (CWA) has been developed regarding virus detection in water. A CEN Workshop Agreement (CWA) is a standardization document published by the European Committee for Standardization (CEN). The workshop is open for everyone and a contribution by direct participation of interested parties is explicitly desired.

The results from the WPs are described in the followings:

WP2: System engineering and scientific coordination

***Objectives**:*

– Scientific coordination and meetings

– Specification of end-user requirements, agreement on overall system specifications and

Results:

- Target Product Profile including end user requirements have been developed for the AquaVir monitoring system
- High Level Product and Architecture Specifications have been defined for the AquaVir system.
- System verification test have been defined for the AquaVir system.
- The system verification test has been conducted with good results.

WP3: Design of virus sensor

Objectives:

- To design a microfluidic chip for concentration of the viruses from the water
- To develop a the virus capturing microchip
- To develop a technique for mass-production of conductive polymer microelectrodes
- To develop a fast method for the functionalization of conductive polymer electrodes with aptamers for selective detection of virus particles
- To integrate the virus concentration unit with the virus capturing unit
- To develop and injection molding processes for mass production of the virus sensor chip

Results:

- The virus detection unit (VDU) is developed and tested in laboratory
- The virus concentration unit (VCU) is developed and tested in laboratory
- The electrode fabrication and functionalization methods for mass production are developed and tested.
- The design of the virus concentration unit is optimized for mass production by injection molding
- Simplified glass wool filtration method was developed and tested for the pre-concentration of the viruses, which has also been integrated into the AquaVir monitoring system.

WP4: Early warning of risk of virus infection

Objectives:

- To develop an integrated sensor-model concept for early warning of water related risks of virus infections
- To setup a prototype for an early warning system based on sensor measurements and dynamic hydraulic/hydrodynamic models
- To optimize and evaluate the early warning system prototypes
- To develop Graphical User Interface for the Monitoring Station

Results:

- Conceptual models for surface drinking water supply (Case: KOV) and urban flooding (Case: Copenhagen) including estimation of the analytical requirements for the different application scenarios
- The scientific background for describing the decay of NoV, RoV and HaV has been been established.
- A hydraulic model of the sewage system for a selected area of Copenhagen (Nørrebro) has been established and connected to a surface 2D model.
- Health risk assessment was successfully integrated in the hydraulic models.
- A graphical interface was successfully developed in cooperation with Philips and DELTA

WP5: Virus Sensor prototyping

Objectives:

- To create mold concepts for mass production of plastic parts
- To develop an injection molding process for the sensor and the virus concentration unit
- To develop a concept for electrode fabrication
- To define an assembly process suitable for mass production

  To define an electrode functionalization method suitable for mass production
- To manufacture functional prototypes

Results:

- The injection molding concept is defined and the tools are produced.
- The parts of the detection chip and the concentration chips are manufactured.
- The concept of electrode printing is defined and the electrodes are fabricated on both chips
- The electrode functionalization methods is developed and used in the detection chips

- The detection and the concentration chips have been assembled with gluing and with thermal bonding, respectively.

WP6: System integration and prototype manufacturing

Objectives:

- To develop a Control and Measuring Unit (CMU)
- To develop a Water Sampling and Filtering Unit (WSFU)
- To test an verify the measuring system
- To integrate the total measuring system
- Manufacturing of prototype Water Monitoring Probe (WMP)
- Integration of data transmission with monitoring station

Results:

- The Control and Measuring Unit (CMU) has been developed, manufactured and verified
- The Water Sampling and Filtering Unit (WSFU) has been developed, manufactured and verified
- The total monitoring system has been integrated
- Four prototypes of Water Monitoring Probe (WMP) have manufactured
- The data transmission has been integrated with the monitoring station

WP7: Laboratory test

Objectives:

- Lab test of the prototype virus sensor
- Lab test of the final prototype virus sensor

Results:

- Development of standardized methods for validation of the virus sensor.
- URV and BME in collaboration with DTU and PBC developed a pre-concentration unit in order to find solution for the challenge that the virus particles tend to attach to larger particles.
- Laboratory test of the detection chip have been performed for the salinity and pH of the water and the stability of the sensor for longer time period in flowing water.
- Samples have been analysed with the detection unit with promising results.

WP8: Field test and validation

Objectives:

- Field test of the Water Monitoring System
- Seasonal dependence of virus concentration

Results:

- Systematic collection of 365 water samples from different sources in different countries
- Concentration of viruses in smaller volume of water for analysis with the simplified filtration method
- Laboratory analysis of the water samples and freezing one part of the samples for further analysis with the AquaVir system
- Evaluation of the laboratory analysis data for an "European" map of viruses

WP9: Feasibility study

Objectives:

- To assess the production capacity for the sensor (consumable) and for the control unit (equipment)
- To assess the economic feasibility of the developed Water Monitoring System.

Results:

- A market survey have been performed: It shows three potential markets: detection in raw water intake to produce drinking water, detection in treated water after waste water treatment and detection in the laboratories from different types of water, for example recreational/bathing water, raw water or waste water.

WP10: Dissemination and exploitation

Objectives:

- To disseminate the results of the project to academia, governmental end-users and industry
- To prepare for exploitation of the results
- To disseminate the results to academia and industry
- To contribute to standardisation

Results:

- The project website have been updated with Fact Sheets about the results of the project: http://www.aquavir.eu/fact-sheets
- Research articles, conference papers have been published
- The road map for exploitation has been evaluated
- Exploitation workshops have been organized
- CEN Workshop Agreement have been drafted and published

4. The potential impact

The key trends in the water quality sensor market demonstrate the need for reliable, portable sensors for on-site monitoring of water quality and transferring the data to a remote observer in real time.

The developed virus monitoring system fulfils the requirements for a reliable, portable sensor and therefore could supply the lack on the market for water monitoring.

The materials in the sensor are inexpensive plastics, and the sensor is reagent-free with an electrical readout, hence the system is cost-effective. Since the proposed nanosensor can be adapted for detection of any other contaminants in the water, a development of a portable multi-sensor using inexpensive chips could reduce the costs of the monitoring requirement by the Water Framework Directive.

The availability of regular, routine, on site water test for enteric viruses as the result of AquaVir could reduce the spread of the waterborne infections.

The regular water quality test can reduce the pathogen contaminations in the drinking water, agriculture, fishery and food production.

In the European Union, pertinent legislation is manifested as a series of acts principally relating to environmental protection and water and wastewater managements. Whilst these pieces of legislation (typically in form of Directives) serve to provide Europe-wide standards, individual countries are able to interpret the Directives nationally and determine their implementation plans within the framework provided.

The European countries are responsible for employing the relevant water and wastewater treatment technologies to comply with the treatment standards of various EU Water Directives. Driven by strict regulations, it is required to develop reliable sensor technologies that can effectively monitor different water quality parameters, including pathogens.

Unfortunately, in these directives (and neither in the WHO guidelines) the determination of the pathogen virus contamination levels is not standardized and therefore not required. Because of the high resistance of the viruses to temperature, chemicals and disinfection, the E. coli or, alternatively, thermo-tolerant coliforms are not reliable indicators for the presence/absence of pathogen viruses in water bodies.

The results of this project will greatly contribute to improve monitoring and early warning of health risks related to water source, and minimize the viral infections in Europe. In addition, the sensor would be valuable in quality assessment of the many small water supplies.

The AquaVir sensor system will help people to have access to clean water, which is a major problem worldwide. The low cost virus sensor could be used in African and Asian countries where the quality of water, intended for drinking, is poor. Also Albania and the Slavic countries could encourage virological monitoring of heavily polluted surface waters.

The developed early warning system and “European” map of virus contamination of surface/bathing waters can also be used by the water works for prediction/prevention of virus contamination of different water bodies.

One of the objectives of the project was to develop a standardization document, called CWA, is to disseminate and exploit project results. The CW (CEN Workshop Agreement) is a standardization document published by the European Committee for Standardization (CEN). It is an agreement that is developed and approved in a CEN workshop. The workshop is open to everyone and a contribution by direct participation of interested parties is explicitly desired.

Defining the detection process in a CWA enhances sustainable exploitation of the project results and makes them accessible for any stakeholder in the field of water analysis.

The CWA addresses a wide range of stakeholders, by defining a system that describes how viruses can be detected in water.

The CWA defines a sensor system that monitors unacceptable levels of rotavirus, norovirus and hepatitis A virus in various types of water intended for human use. The system is characterised by the attributes: rapid, simple and economic.

Even though the application of the CWA is voluntary the project consortium of AquaVir highly recommends its use as a guideline on how to ensure high-quality results when detecting viruses in water. The following stakeholders have been considered as main target groups for the use and application of the defined sensor system for monitoring viruses in water:

– Developers / operators / producers of sensor chips
– Water supply companies
– Environmental authorities
– Health care companies and the public health sector
– Authorities and companies from the disaster management and civil protection
– Companies from the food industry
– R&D community
– Peace keeping military force

Posing a high risk of viruses in different kinds of water is not just a national or regional problem. This topic is relevant on European and even international level. Publishing a standardization document enhances the importance of a sustainable virus detection to minimise the risk of infection of serious diseases dramatically.

5. Use and dissemination of foreground

Section A (public)

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES

NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[3] (if available)	Is/Will open access[4] provided to this publication?
1	*Performance Improvement by Layout Designs of Conductive Polymer Microelectrode Based Impedimetric Biosensors*	*Rozlosnik N*	*Electroanalysis*	*26/6*	*John Wiley & Sons*	*International*	*2014*	*1400–1408*	**DOI** 10.1002/ elan.201400062	no
2	*Sundhedsrisiko ved oversvømmelser*	*Anders Erichsen, Gerald Heinicke, Claus Jørgensen*	*Vand og Jord*	*22/4*	*Forlaget Nepper & Stagehøj*	*Denmark*	*2015*	*143-147*		*no*

[3] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).
[4] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
NO.	Type of activities[5]	Main leader	Title	Date/Period	Place	Type of audience[6]	Size of audience	Countries addressed
1	*Flyer*	*DTU*	*AquaVir project*	*1-5-2014*	*Denmark*	*Scientific* *Industry* *Other*	*~200*	*EU*
2	*WEB page*	*DTU*	*aquavir.eu*	*1-12-2013*	*Denmark*	*All*	*NA*	*EU*
3	*Publication*	*DTU/DIN*	*Standardization in research and innovation projects: AquaVir,*	*2014*	*CENELEC*	*Scientific* *Industry* *Policy makers* *Other*	*NA*	*EU*
4	*Conference*	*Rozlosnik N*	*A researcher's experience with standardization in research and innovation*	*22-01-2014*	*Denmark*	*Civil Society* *Industry*	*70*	*Denmark*

[5] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[6] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

5	*Conference*	*Rozlosnik N*	*AquaVir: Industrial Technologies 2014*	*9-11-04-2014*	*Greece*	*Scientific* *Industry* *Policy makers* *Other*	*800*	*EU*
6	*Conference*	*Rozlosnik N*	*Standardization in research and innovation, European Conference "Standards: Your Innovation Bridge*	*30-10-2014*	*Brussels*	*Scientific* *Industry* *Policy makers* *Other*	*300*	*EU*
7	*Conference*	*Kirkegaard J, Cherré S, Olsen M H, Rozlosnik N*	*All-plastic biosensors: New approach for diagnostics and environmental monitoring*	*10 - 13 May 2015*	*Portugal*	*Scientific* *Industry* *Policy makers* *Other*	*300*	*EU*
8	*Conference*	*Rozlosnik N, Olsen M H, Kirkegaard J and Dimak M*	*Polymer based Lab-on-a-chip systems for monitoring viruses in water bodies and in human diagnostics*	*18-19 May 2015*	*Denmark*	*Scientific* *Industry*	*400*	*EU*

9	*Conference*	*Jørgensen C*	*A new methodology for dynamic modelling of health risks arising from wastewater influenced urban flooding - Case studies: Dhaka and Copenhagen*	*EGU 2015*	*Austria*	*Scientific* *Industry*	*300*	*EU*
10	*Conference*	*Kirkegaard J, Olsen M H, Dimaki M and Rozlosnik N*		*26/6*		*Scientific* *Industry*		
11	*Interview*	*Coris/ O. Lefèvre*	*Market receptivity of AquaVir product*	*20th of October 2016*	*CELABOR Private laboratory (Research and testing center in food, packaging and environmental technologies)*	*Scientific*	*1*	*Belgium*
12	*Interview*	*Coris/ O. Lefèvre*	*Market receptivity of AquaVir product*	*20th of October 2016*	*ISSeP Scientific institute , public services (Reference laboratory for water testing in Belgium)*	*Scientific*	*3*	*Belgium*

13	*Interview*	*Coris/ O. Lefèvre*	*Market receptivity of AquaVir product*	*9th of November 2016*	*SPGE Public Water Management Company (coordination and financement of the water sector in Wallonia)*	*Scientific*	*1*	*Belgium*
14	*Conference*	*Dimaki, M; Olsen, M H; Svendsen, W E; Rozlosnik, N*	*Sub 100 nm particle upconcentration in flow using electrical forces*	*21 Oct 2015*	*Microfluidics Congress 2015, London*	*Scientific*	*500*	*UK*
15	*Conference*	*Kirkegaard, Julie; Olsen, Mark Holm; Dimaki, Maria; Rozlosnik, Noemi*	*All Polymer Lab-on-a-chip System for Virus Detection in Water*	*21 Oct 2015*	*Microfluidics Congress 2015, London*	*Scientific*	*500*	*UK*
16	*Conference*	*Jørgensen et al.*	*Modelling of water quality and risk of infection during urban flooding. A novel flood risk management tool*	*28 Jan.2016*	*DWF Annual meeting,* *Copenhagen*	*Scientific*	*100*	*Denmark*

17	*Conference*	*Jørgensen et al*	*A new methodology for dynamic modelling of health risks arising from wastewater influenced urban flooding - Case studies: Dhaka and Copenhagen*	*17 Apr. 2015*	*EGU 2015, Vienna*	*Scientific*	*11.000*	*Austria*
18	*Webinar*	*Anders Erichsen*	*What types of models are available and what can be achieved by modeling water quality and water quality scenarios?*	*28 Oct. 2015*	*DHI-UNEP Water Quality Webinar*	*Scientific*	*100*	
19	*Conference*	*Jørgensen et al*	*Dynamic modelling of infection risks during wastewater influenced urban flooding*	*28 Jun-1 July 2016*	*Novatech 9th Int conference. Lyon*	*Scientific*	*500*	*France*

20	*Conference*	*Jørgensen et al.*	*Dynamisk modellering af sygdomsrisiko ved oversvømmelse nu og i fremtiden og muligheder for modellers anvendelse i forbindelse med skybrudssikring*	*5 Oct 2015*	*IDA Miljø møde*	*Scientific* *Industry* *Policy makers* *Other*	*200*	*Denamrk*
21	*Conference*	*Heinicke et al.*	*A transport and inactivation model for indicator organisms and pathogens in the river Göta älv, Sweden.*	*28-30 Sept 2016*	*10th Nordic Drinking Water Conference,* *Reykjavik*	*Scientific*	*200*	*Island*

Section B (Confidential[7] or public: confidential information to be marked clearly)

Part B1

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights[8]:	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)
Patent	*Yes*	*Filing date:* *1-03-2016*	*16157983.4 - EPO*	*Concentration of nanoparticles in flow conditions by dielectrophoresis*	*Noemi Rozlosnik, Maria Dimaki, Mark Holm Olsen, Winnie Svendsen (DTU Nanotech)*

[7] Note to be confused with the "EU CONFIDENTIAL" classification for some security research projects.

[8] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

Part B2

Type of Exploitable Foreground[9]	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application[10]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
Commercial exploitation to R&D results	*Duplex RT-qPCR to detect RotavirusA and Norovirus GII*	*No*	*None*	*RT-qPCR primers and probes mix for detection of rotavirus A and Norovirus GII*	*1. Medical*		*none*	*CORIS BioConcept (owner)* *l*

Beside the overall general goals of the project, several results from the project can also be used in other fields such as medical diagnostic, water cleaning, and particle concentration for various applications.

The patent application on the innovative solution for concentrating nanoparticles smaller than 200 nm has the option for usage in many applications, not only in water industry. These fields include concentration viruses or other pathogens in body fluids, e.g. urine, blood plasma, etc. in medicine, collecting and concentrating nanoparticles from air for analysis, manipulating nanoparticles for deposition to surfaces, testing the efficiency of different filtering methods.

The challenge in manufacturing of small structures through holes (in µm sizes) in mass production is also solved during the project, which also has wide application possibilities.

The RT-qPCR to detect norovirus and rotavirus was developed in the project as a reference method to evaluate the sensor performances. It could be exploited as a molecular biology product (RT-qPCR primers and probes mix) to amplify and detect genetic material of rotavirus A and norovirus GII. As internal validation showed excellent performances, six months' stability is ok and several batches of each reagent have been

[19] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.
[10] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

tested, the release to manufacturing could be quick. After a clinical validation, this product could be marketable to diagnose Rotavirus and Norovirus infections in Human (IVD test). However, some documentation is missing and external validation is necessary for CE registration. Several months will then be required before commercialization.

Another potential impact from AquaVir project comes from the demonstration (proof of concept) of RT-PCR on the new CORIS platform, named TRAPIST. Namely, it means that any type of nucleic acids (DNA or RNA), so any pathogens could be diagnosed with TRAPIST. This opens doors to infinite applications and markets. An increase turnover could be expected.

6. Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	**604069**
Title of Project:	AquaVir, Portable Automated Water Analyser for Viruses
Name and Title of Coordinator:	Noemi Rozlosnik, associate professor

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? * If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***0Yes NO***
2. Please indicate whether your project involved any of the following issues (tick box) :	***YES***
RESEARCH ON HUMANS	
* Did the project involve children?	
* Did the project involve patients?	
* Did the project involve persons not able to give consent?	
* Did the project involve adult healthy volunteers?	
* Did the project involve Human genetic material?	
• Did the project involve Human biological samples?	
• Did the project involve Human data collection?	
RESEARCH ON HUMAN EMBRYO/FOETUS	
* Did the project involve Human Embryos?	
* Did the project involve Human Foetal Tissue / Cells?	
* Did the project involve Human Embryonic Stem Cells (hESCs)?	

* Did the project on human Embryonic Stem Cells involve cells in culture?	
* Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
PRIVACY	
* Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
* Did the project involve tracking the location or observation of people?	
RESEARCH ON ANIMALS	
* Did the project involve research on animals?	
* Were those animals transgenic small laboratory animals?	
* Were those animals transgenic farm animals?	
* Were those animals cloned farm animals?	
* Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
* Did the project involve the use of local resources (genetic, animal, plant etc)?	
* Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
DUAL USE	
• Research having direct military use	NO
* Research having the potential for terrorist abuse	

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	1	
Work package leaders	5	5
Experienced researchers (i.e. PhD holders)	7	10
PhD Students	2	0
Other	6	3

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**8**
Of which, indicate the number of men:	4

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?	○ x	Yes No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
❑	Design and implement an equal opportunity policy	○	○	○	○	○
❑	Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑	Organise conferences and workshops on gender	○	○	○	○	○
❑	Actions to improve work-life balance	○	○	○	○	○
○	Other:					

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

x No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

○ Yes- please specify

x No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

○ Yes- please specify

x No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[11]: 2.3

○ Associated discipline[11]: 1.5 ○ Associated discipline[11]: 1.2

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*	x ○	Yes No

[11] Insert number from list below (Frascati Manual).

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

- ○ No
- ○ Yes- in determining what research should be performed
- ○ Yes - in implementing the research
- x Yes, in communicating /disseminating / using the results of the project

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○	Yes
	x	No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ○ No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- x Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- x Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ○ No

13b If Yes, in which fields?

Agriculture		Energy		Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise		Institutional affairs	
Competition		**Environment x**		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		**Public Health x**	
Customs		Fisheries and Maritime Affairs		Regional Policy	
Development Economic and Monetary Affairs		**Food Safety x**		**Research and Innovation x**	
Education, Training, Youth		Foreign and Security Policy		Space	
Employment and Social Affairs		Fraud		Taxation	
		Humanitarian aid		Transport	

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- x European level
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	**2**
To how many of these is open access[12] provided?	**1**
How many of these are published in open access journals?	**1**
How many of these are published in open repositories?	
To how many of these is open access not provided?	
Please check all applicable reasons for not providing open access:	
x publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[13]: ……	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		**1**
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**
17. How many spin-off companies were created / <u>are planned</u> as a direct result of the project?		**1**
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

x	Increase in employment, or	❑	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	❑	None of the above / not relevant to the project
❑	Difficult to estimate / not possible to quantify		

[12] Open Access is defined as free of charge access for anyone via Internet.
[13] For instance: classification for security project.

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*
Difficult to estimate / not possible to quantify	x

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes x No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes x No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

❑	Press Release	❑	Coverage in specialist press
❑	Media briefing	❑	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
x	Brochures /posters / flyers	x	Website for the general public / internet
❑	DVD /Film /Multimedia	x	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

x	Language of the coordinator	x	English
x	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]