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Editorial

Connecting the dots – Anthropogenic pollutants, emergence of pathogens, antibiotic resistance, and emergency preparedness from an ecological perspective



There is an old say “The solution to pollution is dilution” and was extensively exercised in the past by the industries who used to discharge toxic wastes into the river streams or other water bodies. It is still the practice in developed countries with some recommendation concerning environmental health, but in most underdeveloped and developing countries the environmental laws are not always followed strictly. The impact of the pollution is often considered local and forget the bigger picture, the ultimate impact on Mother Nature.

A group of 8 senior scientists, 15 PhD or post-doc students and 11 professionals met to discuss new frontiers of research in the field of water and health in 10th International Water and Health Seminar that held from June 25th to June 27th, 2018 in Cannes, France. A modified Nominal Group Technique was used for the first time in this seminar to identify medium- and long-term research priorities in water and health (Setty et al., 2019). Priorities were given to identify the factors that changing the research needs and possibilities leading to the identification of problems/questions within different research themes. This special issue of the International Journal of Hygiene and Environmental Health has been prepared to share the concerns and questions discussed in the meeting.

The objectives of this seminar are to:

- create a safe environment for sharing ideas between young and internationally recognized scientists
- have cross-disciplinary dialogues to find knowledge gap in water and health research
- exchange knowledge between academics and the water industries

PhD students and postdoctoral researchers presented their research on antibiotic resistance, emerging pollutants and pathogens, climate change and associated human health effects, rapid and onsite diagnosis methods, community engagement in research and in emergency preparedness. The senior academics and industry professionals tried to identify the deficiency in current practices and water safety regulations.

As scientists, it is our duty and responsibility to identify problems, seeking for solution and disseminating knowledge. Event like this one represents a remarkable example of what scientists should do. An in-depth discussion on the research priorities in the Water and Health area indicated water reuse, holistic risk assessment and sanitation among the topics for imminent investigation (inter alia Ferrero et al., 2019; Wolf et al., 2019).

One the specific topic addressed in the seminar is the emergence of antimicrobial resistant pathogens, which represents a serious threat to public health. The World Health Organization (WHO) emphasized on the need for action by the government and private sectors to work

fighting against this problem (Aidara-Kane et al., 2018; Padiyara et al., 2018). The resistance to antimicrobials develops naturally over time but the uncontrolled use of antibiotics and other antimicrobials (as a food additive in poultry, cattle industries and fish farming) is accelerating the process and improper management of waste (human and animal) may cause the surface and ground water contaminated with these pathogens. The constant environmental pressure due to the presence of antimicrobials may also increase the fitness of these pathogens and may not respond to the existing water treatment process. In addition, the climate changes and increase demand for water emphasize on the sustainable water reuse policy. Use of storm water and treated wastewater locally more as a standalone unit may also save energy and provide the possibility to confine any contamination rather than using a centralized system. Moreover, the current water treatment practices only aim to remove the enteric bacterial, viral and protozoan pathogens and do not concern about the free-living-amoebae that could support the growth of opportunistic water based respiratory pathogens like *Legionella*, nontuberculous-mycobacteria in treated water systems, the main disease burden in the developed countries (Lu et al., 2015; McClung et al., 2017). Knowledge on the anthropogenic pollutant and their affect in shifting the natural microbial community composition would help to understand ecological changes and may help to develop strategies and policies to protect the source water as well as public health (Ashbolt, 2015).

Emergency preparedness helps to recover from the aftermath of a natural disaster. Certain water-borne disease outbreaks are very common after a natural disaster, like the cholera outbreaks in Haiti (Frerichs, 2016; Von Seidlein and Deen, 2018) and Nepal (Nelson et al., 2015) after the earthquakes and the increased bacteria diseases especially leptospirosis in Puerto Rico after the Hurricane, Maria (Oda et al., 2018). Onsite and rapid diagnosis method and engaging community may accelerate the case reporting and prevent transmission of the diseases or reduce the overall recovery time and health cost. Understanding the local infrastructure, location of the possible contamination sources and empowering local community (knowledge translation and dissemination) should be given priority in developing an emergency preparedness protocol.

Another important problem in the water world is the contamination from the so-called “emerging contaminants” such as pharmaceuticals, hormonal drugs and cosmetic products. Pollution from these compounds in surface- and ground-waters is recognized as an environmental issue in many countries, arousing the attention from both the public and scientific communities (Petrie et al., 2015). Increasing amount of these contaminants have been found in water bodies all over the world (Appa et al., 2018; Barbosa et al., 2018; Palli et al., 2017b). In

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this context, main challenges for water scientists are: i) the development of new analytical methods for their detections and quantifications that are faster, have lower limit of detection and require smaller volume of samples (Dugheri et al., 2018); ii) the study for implementing of existing methods at full scale to removal the contaminants from water such as adsorption on activated carbon, filtration with membrane and advanced oxidation processes (Rodriguez-Narvaez et al., 2017) and iii) the development of novel technologies such as fungal treatment (Palli et al., 2017a), adsorption on biochar (Li et al., 2019), or solar advanced oxidation processes (Oller et al., 2014).

It is time to think water smartly. There could be some short-term benefit of the current water policies, but to protect the water resources and the lives on earth, research should be priorities to understand the water ecosystem. In addition to invest in finding water on Moon or Mars, we should also invest to protect the precious resources we have on this blue planet by keeping it blue.

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References

- Aidara-Kane, A., Angulo, F.J., Conly, J.M., Minato, Y., Silbergeld, E.K., McEwen, S.A., Collignon, P.J., WHO Guideline Development Group, for the W.G.D, 2018. World Health Organization (WHO) guidelines on use of medically important antimicrobials in food-producing animals. *Antimicrob. Resist. Infect. Contr.* 7, 7. <https://doi.org/10.1186/s13756-017-0294-9>.
- Appa, R., Mhaisalkar, V.A., Bafana, A., Saravana Devi, S., Krishnamurthi, K., Chakrabarti, T., Naoghare, P.K., 2018. Simultaneous quantitative monitoring of four indicator contaminants of emerging concern (CEC) in different water sources of Central India using SPE/LC-(ESI)MS-MS. *Environ. Monit. Assess.* 190, 489. <https://doi.org/10.1007/s10661-018-6867-0>.
- Ashbolt, N., 2015. Environmental (saprozoic) pathogens of engineered water systems: understanding their ecology for risk assessment and management. *Pathogens* 4, 390–405. <https://doi.org/10.3390/pathogens4020390>.
- Barbosa, M.O., Ribeiro, A.R., Ratola, N., Hain, E., Homem, V., Pereira, M.F.R., Blaney, L., Silva, A.M.T., 2018. Spatial and seasonal occurrence of micropollutants in four Portuguese rivers and a case study for fluorescence excitation-emission matrices. *Sci. Total Environ.* 644, 1128–1140. <https://doi.org/10.1016/j.scitotenv.2018.06.355>.
- Dugheri, S., Palli, L., Bossi, C., Bonari, A., Mucci, N., Santianni, D., Arcangeli, G., Sirini, P., Gori, R., 2018. Development of an automated LC-MS/MS method for the determination of eight pharmaceutical compounds in wastewater. *Fresenius Environ. Bull.* 27, 6394–6402.
- Ferrero, G., Setty, K., Rickert, B., George, S., Rinehold, A., DeFrance, J., Bartram, J., 2019. Capacity building and training approaches for water safety plans: a comprehensive literature review. *Int. J. Hyg Environ. Health.* <https://doi.org/10.1016/j.ijheh.2019.01.011>.
- Frerichs, R., 2016. *Deadly River: Cholera and Cover-Up in Post-earthquake Haiti*. Cornell Un.
- Li, L., Zou, D., Xiao, Z., Zeng, X., Zhang, L., Jiang, L., Wang, A., Ge, D., Zhang, G., Liu, F., 2019. Biochar as a sorbent for emerging contaminants enables improvements in waste management and sustainable resource use. *J. Clean. Prod.* 210, 1324–1342. <https://doi.org/10.1016/J.JCLEPRO.2018.11.087>.
- Lu, J., Struewing, I., Yelton, S., Ashbolt, N., 2015. Molecular survey of occurrence and quantity of *Legionella* spp., *Mycobacterium* spp., *Pseudomonas aeruginosa* and *amoeba* hosts in municipal drinking water storage tank sediments. *J. Appl. Microbiol.* 119, 278–288. <https://doi.org/10.1111/jam.12831>.
- McClung, R.P., Roth, D.M., Vigar, M., Roberts, V.A., Kahler, A.M., Cooley, L.A., Hilborn, E.D., Wade, T.J., Fullerton, K.E., Yoder, J.S., Hill, V.R., 2017. Waterborne disease outbreaks associated with environmental and undetermined exposures to water — United States, 2013–2014. *MMWR Morb. Mortal. Wkly. Rep.* 66, 1222–1225. <https://doi.org/10.15585/mmwr.mm6644a4>.
- Nelson, E.J., Andrews, J.R., Maples, S., Barry, M., Clemens, J.D., 2015. Is a cholera outbreak preventable in post-earthquake Nepal? *PLoS Neglected Trop. Dis.* 9, e0003961. <https://doi.org/10.1371/journal.pntd.0003961>.
- Oda, G., Matanock, A., Hunter, J.C., Patel, A., Pillai, S., Styles, T., Saavedra, S., Martinez, M., Jones, M., Mecher, C., Ryono, R., Holodniy, M., 2018. Post-hurricane Maria surveillance for infectious diseases in the veterans affairs san juan medical center, Puerto Rico. *Open Forum Infect. Dis.* 5, S168–S169. <https://doi.org/10.1093/ofid/ofy210.458>.
- Oller, I., Polo-López, I., Miralles-Cuevas, S., Fernández-Ibáñez, P., Malato, S., 2014. *Advanced Technologies for Emerging Contaminants Removal in Urban Wastewater*. Springer, Cham, pp. 145–169. https://doi.org/10.1007/978-3-319-58421-8_49.
- Padiyara, P., Inoue, H., Sprenger, M., 2018. Global governance mechanisms to address antimicrobial resistance. *Infect. Dis. Res. Treat.* 11 <https://doi.org/10.1177/1178633718767887>.
- Palli, L., Castellet-Rovira, F., Pérez-Trujillo, M., Caniani, D., Sarrà-Adroguer, M., Gori, R., 2017a. Preliminary evaluation of *Pleurotus ostreatus* for the removal of selected pharmaceuticals from hospital wastewater. *Biotechnol. Prog.* 33, 1529–1537. <https://doi.org/10.1002/btpr.2520>.
- Palli, L., Spina, F., Varese, C., Romagnolo, A., Bonari, A., Bossi, C., Pompilio, I., Dugheri, S., Tili, S., Scozzafava, A., Santianni, D., Caffaz, S., Gori, R., 2017b. Pharmaceuticals in wastewater treatment plants of tuscany: occurrence and toxicity. In: Mannina, G. (Ed.), *Lecture Notes in Civil Engineering*. Springer, Cham, pp. 308–312. https://doi.org/10.1007/978-3-319-58421-8_49.
- Petrie, B., Barden, R., Kasprzyk-Hordern, B., 2015. A review on emerging contaminants in wastewaters and the environment: current knowledge, understudied areas and recommendations for future monitoring. *Water Res.* 72, 3–27. <https://doi.org/10.1016/J.WATRES.2014.08.053>.
- Rodriguez-Narvaez, O.M., Peralta-Hernandez, J.M., Goonetilleke, A., Bandala, E.R., 2017. Treatment technologies for emerging contaminants in water: a review. *Chem. Eng. J.* 323, 361–380. <https://doi.org/10.1016/J.CEJ.2017.04.106>.
- Setty, K., Loret, J.-F., Courtois, S., Hammer, C.C., Hartemann, P., Laffourge, M., Litrico, X., Manasfi, T., Medema, G., Shaheen, M., Tesson, V., Bartram, J., 2019. Faster and safer: research priorities in water and health. *Int. J. Hyg Environ. Health.*
- Von Seidlein, L., Deen, J.L., 2018. Preventing cholera outbreaks through early targeted interventions. *PLoS Med.* 15, e1002510. <https://doi.org/10.1371/journal.pmed.1002510>.
- Wolf, J., Johnston, R., Hunter, P.R., Gordon, B., Medlicott, K., Prüss-Ustün, A., 2019. A Faecal Contamination Index for interpreting heterogeneous diarrhoea impacts of water, sanitation and hygiene interventions and overall, regional and country estimates of community sanitation coverage with a focus on low- and middle-income countries. *Int. J. Hyg Environ. Health* 222, 270–282. <https://doi.org/10.1016/j.ijheh.2018.11.005>.

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