Effect-based monitoring: Perception & barriers to implementation

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Introduction

In the last ten years, effect-based monitoring (EBM) of water quality has known great scientific developments. *In vitro* bioassays based on human cell lines may now be used to measure early adverse effects of water contaminants, or their mixtures, even at low concentrations. **Although this has been acknowledged by regulatory agencies such as the WHO (1), there is yet no breakthrough of *in vitro* bioassays for regulatory water quality management**. Current regulations continue to focus on specific priority chemicals although we know water contains very diverse and complex chemical mixtures. This poster addresses existing water quality legislation with regards to bioassays, and readiness for EBM implementation based on a survey conducted among water sector stakeholders in 2020. This work is a work package of the collaborative research project "Effect Based Monitoring in Water Safety Planning".

This GWRC project "Effect Based Monitoring in Water Safety Planning" is

a collaboration between GWRC, KWR, Veolia, Suez, UFZ and Griffith University. The project addresses the implementation of *in vitro* bioassays for monitoring of micropollutants in water and wastewater treatment installations at a global scale, profiling experiences and case-studies from Europe, Australia, North America and South-East Asia. **Three other presentations summarise work from this project at this conference: Effect-based monitoring in global water safety planning (platform presentation), literature review of global case studies (poster), and Water Safety Plan protocol development (poster).**

Existing water quality legislation

Despite increasing scientific recognition of the added value of EBM (2), this approach is not included in most water quality legislations. The only exception is the Policy for Water Quality Control for Recycled Water of the California State Water Boards (3), which recommends specific bioanalytical screening tools with reporting limits, guidance for interpretation and related response actions. The potential of EBM is however clearly acknowledged in the Australian Guidelines for Water Recycling (4), Australian Drinking Water Guidelines (5) and the WHO Guidance on potable reuse (1), albeit without making the effect-based methods explicit or providing guidance for interpretation.

This GWRC project and the Dutch Water Quality Knowledge Impulse (6) are ongoing actions to demystify bioassays by developing protocols and supporting documents, to support broader uptake of an *in vitro* bioassay approach. It is recommended to water sector stakeholders and scientists to share this with policy makers at the pre-regulatory science to policy interface, such as the Common Implementation Strategy for the Water Framework Directive (WFD).

Methodology

In 2020, we ran a survey among a global panel of stakeholders from the water sector and gathered 63 responses from 19 countries and 32 companies or institutes (Fig 1). The objectives of the survey were to share information on EBM and gather stakeholder perspectives, identify the priority reasons to start using EBM more broadly and acknowledge the main barriers to implementation.

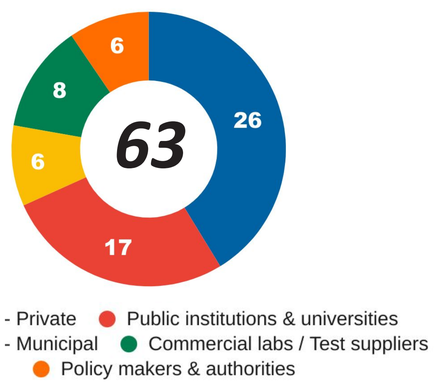

Fig 1: Respondent organisations

"Which micropollutants are you most concerned about?"

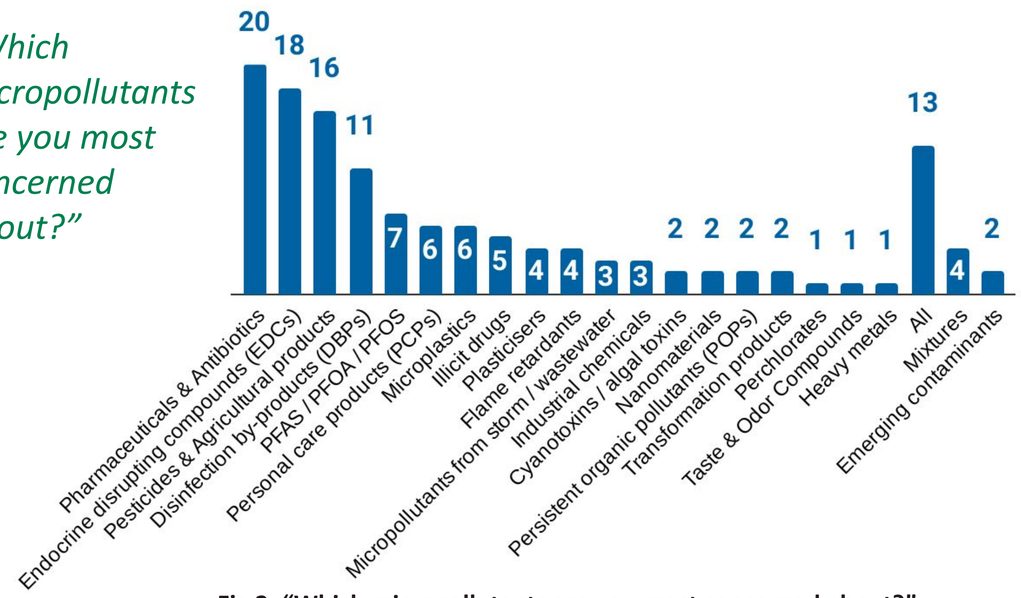

Fig 2: "Which micropollutants are you most concerned about?"

Survey results

Current practices for water safety

Concern among respondents for micropollutants was high but it was comparatively low for mixtures, contaminants of emerging concern (CECs), and transformation products (Fig 2). Water Safety Plans (WSP) or Hazard Analysis Critical Control Point (HACCP) methods are largely applied (>75%) for drinking water risk assessment and management. Respondents noted the following strengths and weaknesses:

>> Strengths: source to tap approach, guarantees safe drinking water in the short term, control of pathogens, transparency;

>> Weaknesses: not comprehensive (*i.e.*, only targeted compounds), not robust regarding micropollutants nor mixtures, no assessment of long-term effects, inertia between awareness on pollutants and regulation.

Views on effect-based monitoring

Most respondents (75%) believe that EBM would improve water quality monitoring and public confidence in drinking water. Most (80%) also think that EBM can support risk assessment and management, complementary to targeted chemical analysis, and they would recommend bioassays. A bias in the survey is that stakeholders most receptive to EBM are more likely to have replied to the survey.

"Why would you implement EBM for water quality monitoring?"

The main reasons brought up for using EBM were assessment of treatment performance or, changes in raw water quality, routine monitoring, and communication to the public on water safety (Fig 3).

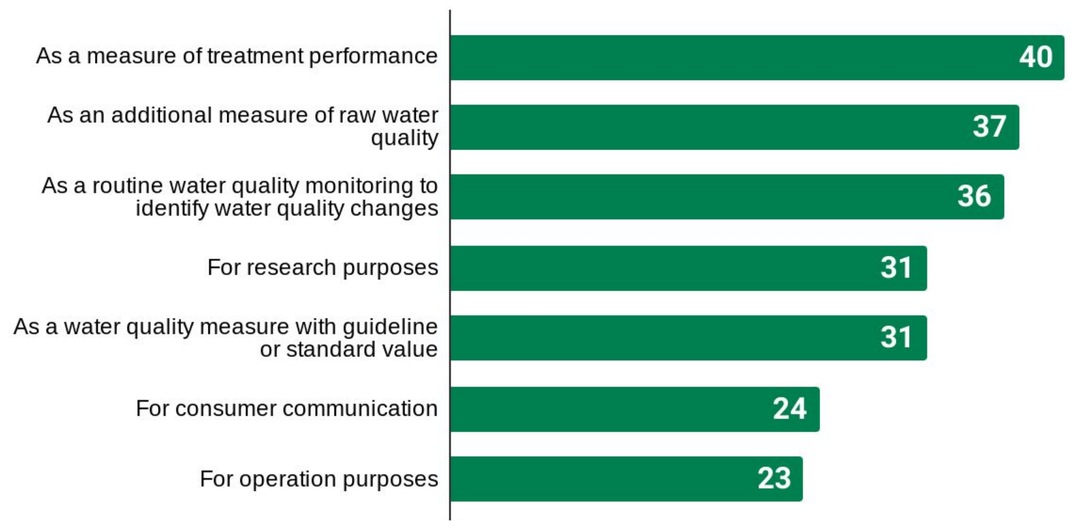

Fig 3: "Why would you implement EBM for water quality monitoring?"

"What are the barriers to broader EBM implementation?"

Respondents also noted their hesitation with regards to EBM implementation (Fig 4). The major concerns were: cost as EBM added to routine chemical monitoring, lack of support from regulatory authorities, lack of recognized trigger values for drinking water, and lack of guidelines and operational documents. **Yet most respondents noted they believe EBM can be more cost effective.**

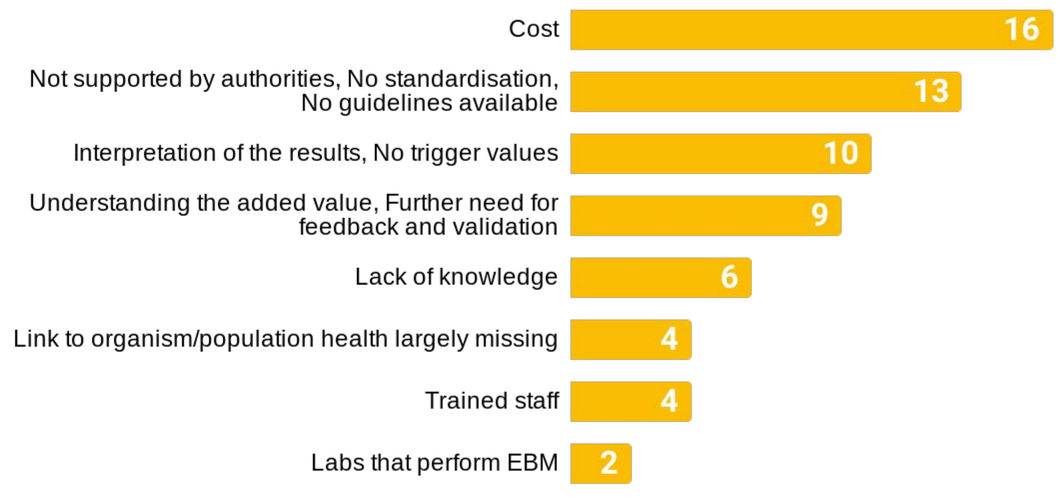

Fig 4: "What are the barriers to broader EBM implementation?"

Conclusions

The majority of survey participants stated that EBM would improve water quality monitoring and public confidence in drinking water. Nevertheless, some important barriers prevent broader uptake: lack of support from regulatory authorities, lack of guidelines, and extra costs. Other work packages in this GWRC project aim to tackle these issues, with the final objective of facilitating the application of EBM in a Water Safety Planning context. Trigger values are further investigated through the case studies, clear guidance on EBM for drinking water quality assessment is developed, and recommendations for water safety planning are being considered within the context of WSP. **Please check the project's other posters, and our platform presentation.**

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References

(1) World Health Organization 2017 *Potable reuse: guidance for producing safe drinking-water*. World Health Organization, Geneva. (2) Brack, W., Aissa, S.A., Backhaus, T. et al. Effect-based methods are key. The European Collaborative Project SOLUTIONS recommends integrating effect-based methods for diagnosis and monitoring of water quality. Env Sci Eur 31, 10 (2019); (3) Water Quality Control Policy for Recycled Water | California State Water Resources Control Board; (4) www.waterquality.gov.au/guidelines/recycled-water; (5) www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines; (6) Water Quality Knowledge Impulse | Kennisimpuls Waterkwaliteit www.stowa.nl/kennisimpuls