



One Health Monitoring of Emerging Hazards

From microbes to microplastics

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Novel Entities & the One Health Approach

Addressing critical issues in human and environmental health can be challenging for researchers and policymakers alike. From climate change to ocean acidification to freshwater use or contamination, environmental stressors are responsible not only for adverse impacts on wildlife and ecosystems, but also on human health (Science, 2015). Researchers have acknowledged that environmental, animal and human health are interconnected and, therefore, must be comprehensively tackled with a multidisciplinary approach. The One Health approach is an integrated way to do this in a balanced and multidisciplinary manner, incorporating a broad range of disciplines and industry sectors, as well as varying levels of governance (WHO). Through One Health, issues such as the spread of zoonotic diseases or the impacts of chemical pollution, are researched and managed with the aim of addressing human, animal and environmental concerns. Ultimately, the One Health framework allows policymakers to better consider the risks, opportunities, trade-offs and co-benefits of proposed solutions to some of the biggest environmental and human health challenges the world is facing today.

Of these challenges, novel entities, which include modified life forms and human-made chemicals that have the potential to negatively affect biological and environmental processes, were addressed at the One Health Monitoring of Emerging Hazards seminar on March 29th, 2023, hosted by the Environmental Research Group in partnership with Imperial College London's Policy Forum. Led by Dr Stephanie Wright, Lecturer in Environmental Toxicology and lead of the ERG's Microplastics Team, and chaired by Dr Helena Rapp Wright, Research Associate on the ERG's Emerging Chemical Contaminants Team. The event featured talks on the monitoring of emerging chemical contaminants, microplastic pollution and emerging fungal threats, highlighting that through the One Health approach, researchers, industry members and policymakers can work together to address these issues and devise solutions that can improve human and environmental health on a local and global level.

"Pollution is responsible for 9 million deaths premature deaths worldwide"

[The Lancet, 2017](#)

Monitoring Emerging Hazards in UK Rivers

Rivers provide the UK public with an array of ecosystem services: water for drinking, washing and cleaning; a place for recreational and cultural activities; food sources and income; and a natural cooling ability that can help combat heatwaves – but our rivers are under threat. From the release of untreated sewage in rivers, to the excessive use of pesticides and fertilisers on agricultural sites to the run-off of oil and tyreware in urban areas, UK rivers face an enormous amount of anthropogenic environmental stressors. Understanding the true threat of these varied pollutants – to animals, humans, and the environment alike – is vital to tackling these hazards. Monitoring is often the first necessary step to assessing the scope of the problem and devising a path of action.

Chemicals Monitoring Data for Environmental Protection: an Environment Agency Perspective

Emerging chemical contaminants are monitored across the country by the Environment Agency (EA) for surveillance of the state of the environment. Chemical contaminants within rivers are a concern for animal, human and environmental health – making it a key issue that can be addressed via the One Health approach. Dr Kerry Simms, a Senior Advisor at the EA who focuses on Emerging Substances in the Chemical Surveillance and Emerging Risks team, presented the EA's work on developing the Prioritisation and Early Warning System (PEWS). This initiative aims to identify and prioritise emerging chemicals of concern with the view to inform timely policy actions.



The hope is that this prioritisation system will help to target regulation towards chemicals, both existing and emerging, which present the greatest risk to the environment.

The PEWS was developed in response to the EA's 25 Year Action Plan and combines environmental monitoring with horizon-scanning work to create an early warning system for identifying emerging chemical issues. The PEWS uses a systematic approach to assess nominated chemicals of concern, subjecting them to a sifting and screening process before assigning them priority based on both the associated risk and the certainty of knowledge about the substance. This systematic process enables emerging chemicals to be followed up with specific intervention strategies, which range from initiating new actions, maintaining pre-existing work, monitoring emerging substances for the first time, adding to target scans and 'parking' substances for review to assess concern. So far, 215 substances have been screened and there is further ongoing work to investigate group screening of similar substances.

Developing the PEWS was a great step for evaluating emerging chemical contaminants in England and the system is likely to extend to cover Scotland, Wales and Northern Ireland. And the EA hopes to develop other research components in conjunction with this system, to improve the amount of monitoring data that is available. To accomplish this, the EA have developed new techniques and approaches such as recent collaborative work developing passive samplers for two groups of chemicals in addition to developing the associated analytical methods to detect and quantify over 200 chemicals. While this targeted approach focused on substances that had previously been identified, there is also a need to develop non-targeted/suspect screening and the EA are developing these methods to identify emerging chemicals of concern and associated breakdown products.

The work by the EA presented by Dr Simms is an example of the new ways in which pollution is being researched and highlighted the interconnected approach that needs to be applied for intervention to be effective.

Microplastics on UK riverbeds – understanding the processes and tackling the problem

Within rivers, riverbeds are of great importance to the UK ecosystems as they provide nutrients and habitats for river-dwelling species, but also aid in nutrient flow and carbon sequestration. Professor Jamie Woodward of the University of Manchester has been researching environmental threats to riverbeds for over three decades.

Extensive research of urban and rural waterways in northwest England has highlighted the strong link between sewage overflow releases, flooding events and microplastics pollution in rivers. Prof Woodward's team discovered microplastic hotspots around combined sewer overflows (CSOs) which allowed them to identify when wastewater was being released by sewage treatment facilities, based on the river flow and dispersion of microplastics (**Science**, 2021). These 'microplastic hotspots' which could prove detrimental to the organisms living in these rivers and the overall health of these freshwater ecosystems.

Microplastics in English rivers are not a standalone threat; an array of chemical pollutants are also discharged into the rivers with sewage. In 2020, there were over 400,000 of such incidences, where water companies discharged sewage into English rivers (**BBC**, 2021), attracting the attention of environmental non-profits, such as Surfers Against Sewage and the Rivers Trust, as well as national media outlets. As an issue concerning environmental, wildlife and human health on a national scale, a One Health approach could be utilised to help build a stronger case for reducing and managing sewage discharge events. Environmental research groups exploring chemical and microplastic pollution can be supported by researchers exploring the human health impacts of these pollutants. In turn, policy recommendations and actions can address both environmental and health impacts of microplastics and their associated chemicals, to the benefit of the river environment, and the animal inhabitants and people that depend on them.

Actions co-addressing the issues of microplastics pollution and sewage discharges in English rivers is already ongoing, with researchers contributing evidence and recommendations to the UK government's 2022 **Water Quality in Rivers Report**. The EA is currently developing a microplastic monitoring strategy for surface waters and sediments, which will draw on the existing microplastics data, sources, and pathways to rivers, in conjunction with their new monitoring data, to propose interventions that reduce microplastics pollution entering rivers. The future of environmental pollution research is changing. It will no longer suffice to simply 'understand pollution sources and health effects', but will need to address complex interconnections such as the proliferation of pollution due to lack of infrastructure and the need for political endorsement.

Monitoring Emerging Fungal Threats

Exposure to a degree of mould is healthy and essential, however buried within the biodiversity of fungi exposures, there are those that can cause disease or adverse health effects. Professor Matthew Fisher, an expert on emerging pathogenic fungi at Imperial College London, painted the dynamic picture of mould as yin and yang.

The tragic death of Awaab Ishak in December 2020, which was attributed to exposure to mould growing in his home (BBC, 2022), is an example of the deadliness of unmanaged fungal infestations. It is estimated that 45% of buildings in Europe suffer from mould growth (Brambilla & Sangiorgio, 2020). However, there are currently no guidelines or benchmark tests for investigating mould in buildings, which is essential to

understanding building conditions and mould growth, and subsequently the health effects of mould on humans.

Another increasing issue with One Health implications is how fungi can adapt and evolve to overcome antifungal drugs. Evidence shows that when antifungals with the same mechanisms are increasingly used in both clinical and environmental settings, the fungus in question is more likely to develop the ability to fight off the effect of the medicine, rendering many previously used fungal treatments unviable. An example of this is the increased resistance to azoles, a group of fungicides prescribed for human and animal health care, as well as agricultural and industrial uses. Increased human and plant resistance to azole fungicides has grown tremendously between 1997 and 2017, coinciding with increased use of these compounds in clinical and agricultural settings (Science, 2018). This can threaten the security of our food systems, as they lack the ability to combat fungal infections or outbreaks and also become a public health burden, where opportunistic fungi can infect susceptible or immunocompromised people.

What is needed to progress the understanding of fungal threats, as Professor Fisher identified, are standards and initiatives for monitoring fungi, which will provide insight into the true breadth of the issue and direct policies and actions for remediation. In October 2022, the World Health Organisation published their fungal priority pathogens list, highlighting the need for further research in the field. It forms an important part of the One Health framework, linking environmental and human health, and future policy implications.

Summary & Future Actions

Chemicals, microplastics and fungal pathogens are multifaceted threats that will require collaborative, multidisciplinary actions if they are to be addressed thoroughly. The One Health approach has the potential to engage researchers, industry members and policymakers so that they can devise solutions to safeguard environmental, animal and human health. Significant action is needed from stakeholders in industry and policy.

The One Health approach creates opportunities for actions to address multiple issues at once. Some examples discussed at the One Health Monitoring of Emerging Hazards seminar included:

Regulation

Tightening the permits on wastewater treatment companies to reduce microplastic leakage.

Regulating for greater disclosure and transparency requirements for private companies relating to overflow usage and usage in establish, appropriate conditions

Enhancing building standard regulation to reduce mould and damp that lead to health issues occurring in homes.

Establishing a framework for regulators across human and environmental health spheres to address questions of dual use of drugs in risk assessments.

Monitoring

Monitoring a wider array of chemical threats in order to develop greater understanding of the presence and impact of chemical pollutants in UK waterways.

Standardising methodologies to measure fungal exposure to increase knowledge of exposure pathways and potential adverse outcomes, as well as methods for mitigation.

Research

Developing new clinical antifungals that are not co-opted for environmental use.

About the ERG & the 30th Anniversary Seminar Series

Founded in 1993, the **Environmental Research Group** initially consisted of measurement, modelling and toxicology teams. 2023 is the ERG's 30th anniversary. The group is now located at Imperial College London, and is nine teams strong with over 100 staff members studying air pollution, water pollution, and microplastics in order to better understand the impact of these stressors on our environment and health.

This seminar was the second of six, as part of the ERG's 30th Anniversary Seminar Series. More information on the ERG and the 30th Anniversary celebrations can be found at on the Environmental Research Group website [here](#).

The ERG 30th Anniversary Seminar Series is hosted in partnership with **Imperial Policy Forum**, the College's policy engagement unit. More information about the Environmental Research Group's work on Emerging Chemical Contaminants and Microplastics can be found on the ERG website's research pages linked [here](#).



From left: Dr Helena Rapp Wright, Dr Stephanie Wright, Dr Kerry Sims, Professor Jamie Woodward and Professor Matthew Fisher discuss the challenges and opportunities that arise in applying the One Health approach to the monitoring and management of emerging chemical hazards.