

Pharmaceuticals in the water environment: baseline assessment and recommendations

Research Summary



Pharmaceuticals in the water environment: baseline assessment and recommendations

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PROJECT SCOPE

The research was commissioned by the Centre for Expertise of Waters (CREW) to support the One Health Breakthrough Partnership (OHBP) by addressing the following objectives:

- To establish which pharmaceuticals have been detected in Scotland's waters between 2014 and 2019, and at what concentrations.
- Identify what pharmaceuticals were detected at concentrations that might pose an environmental risk.
- To identify knowledge gaps in terms of compounds analysed, spatial representation or matrix.
- To transfer pharmaceutical information into an accessible database to be used for subsequent mapping and visualisation.

Outputs:

- A baseline assessment of pharmaceutical concentrations in Scotland's waters, which could be used to monitor whether future OHBP activities make a positive impact on environmental pharmaceutical concentrations.
- Recommendations for additional monitoring required to plug data gaps.
- Recommendations for which pharmaceuticals might be prioritised for source control interventions to reduce environmental concentrations.

RESEARCH UNDERTAKEN

Data from a range of sources including published and grey literature, internal company and regulatory datasets were examined. Researchers at other Scottish Higher Education Institutes and the James Hutton Institute were also approached directly to provide relevant data. Mean concentrations for each monitored location were assessed against threshold values for environmental (ecotoxicological)

risk and, for antibiotics, against threshold values above which the substance might act a driver for antimicrobial resistance (AMR). About half of all surface water data pertained to samples targeting high-risk settings, such as immediately downstream from a wastewater treatment works rather than 'typical' environmental concentrations in the water body. This enabled a worst case baseline position to be established.

KEY FINDINGS

- 60 substances in 11 distinct environmental matrices were entered into a database of 3074 data points, providing the first comprehensive representation of Scotland's baseline position for pharmaceuticals in the environment
- Eight substances - ibuprofen, clarithromycin, erythromycin, diclofenac, EE2, metformin, ranitidine, and propranolol - were identified as posing a higher ecotoxicological risk in inland surface waters
- Three substances - clarithromycin, erythromycin, and ciprofloxacin - were identified as posing a higher risk in terms of AMR. Two of these - clarithromycin, erythromycin – also posed a higher ecotoxicological risk
- Monitoring gaps were identified with no data found to be available for 18 Local Authority areas and for 367 of Scotland's catchments. Gaps were particularly prevalent for the Highland region and more rural areas overall. Gaps were also identified for loch, estuarine, coastal waters and groundwaters. For some pharmaceuticals highlighted elsewhere, no data was available
- As far as potential sources are concerned, pharmaceutical concentration data was focused on wastewater treatment plant influents and effluents and some hospitals, with little data available on septic tank discharges and none on other potential sources such as agricultural, aqua-cultural, landfill or manufacturing discharges

APPLICATION OF THE RESEARCH

This research provides a current baseline of pharmaceuticals concentrations in Scotland's inland surface waters and recommendations as to how to improve the baseline dataset in terms of geographical coverage and water type.

This baseline dataset can now be utilised in the development of a visualised mapping tool to support further use by regulators and the water industry. This will support monitoring future changes in environmental concentrations

of pharmaceuticals to provide a mechanism to assess the effectiveness of future intervention measures developed and implemented by the OHBP.

The pharmaceuticals that can be examined by the OHBP to help support environmental concentration reductions are ibuprofen, clarithromycin, erythromycin, diclofenac, EE2, metformin, ranitidine, propranolol and ciprofloxacin.

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ONE HEALTH BREAKTHROUGH PARTNERSHIP

The One Health Breakthrough Partnership (OHBP), established in the Highlands of Scotland in 2017, is a cross-sector initiative that aims to stimulate innovation and impact to help achieve optimal health for people, animals and our environment. This One Health concept recognises that the health of our people is closely interconnected and interdependent with the health of the environment, with water and water quality central to their connectivity.

The OHBP brings together key regional and national stakeholders aiming to stimulate and support innovation in this One Health-Water interface, with a key focus on reducing the concentration of pharmaceuticals in the environment (PIE). This supports the Scottish Government strategic priority to create a more successful country, with opportunities for all to flourish, through increasing sustainable economic growth.

Published by CREW – Scotland's Centre of Expertise for Waters. CREW connects research and policy, delivering objective and robust research and expert opinion to support the development and implementation of water policy in Scotland. CREW is a partnership between the James Hutton Institute and all Scottish Higher Education Institutes and Research Institutes supported by MASTS. The Centre is funded by the Scottish Government.