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Does our healthcare impact the aquatic environment?

Pharmaceutical contamination in the River Thames

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Pharmaceuticals in the environment

Many of the pharmaceuticals that we take for health reasons will end up in the environment. There is a growing interest in the sources, occurrence and environmental impact of pharmaceuticals in the environment. Major sources include waste from manufacturers, excretion from humans or animals and incorrect disposal of unused pharmaceuticals (Figure 1).

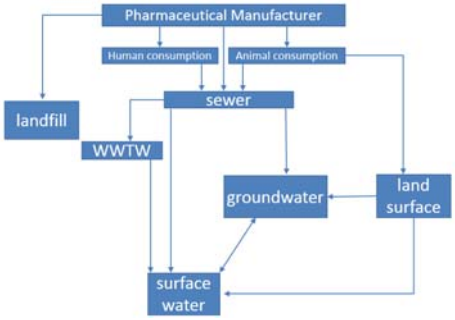

Figure 1. Pharmaceutical pathways. Note: Waste water treatment works is WWTW

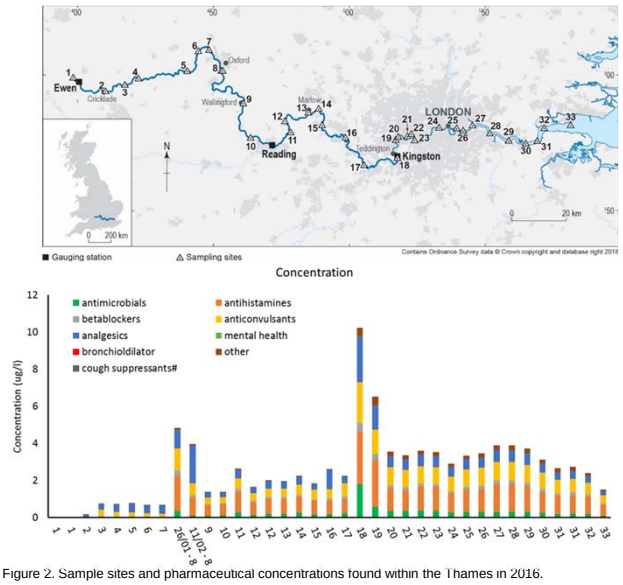

Figure 2. Sample sites and pharmaceutical concentrations found within the Thames in 2016.

The large range of compounds in wastewaters, found typically at µg/L concentrations, are difficult and costly to remove though current treatment options leading to discharge to surface waters followed by dilution and dispersion. Pharmaceuticals have been detected in groundwaters (e.g. Lapworth et al 2018) and surface waters (Figure 2).

At present pharmaceuticals within the aquatic environment are below human therapeutic dose but the effect on aquatic organisms are being increasingly studied. An example of this is the potential risk of antihistamines to the aquatic ecosystem (Kristofco and Brooks 2017) and the effects of nonsteroidal anti-inflammatory drugs on birds (Cuthbert et al. 2007; Prakash et al. 2012).

Pharmaceuticals in the Thames

A recent winter study of the River Thames from source to sea (White et al, in review) using the Environment Agency's LCMS scan showed the widespread occurrence of pharmaceuticals along the whole length of the Thames including at the groundwater dominated source. This study was carried out during high flows when dilution was high. The effects of the input of treated and non-treated waste water were discernible as certain substances, such as paracetamol, are biodegraded within the treatment process but were detected within the river at certain sites.

Perhaps of most concern for human health at present is the occurrence of a number of antimicrobials (AMs) and the potential build-up of associated antibiotic resistance in bacteria. AMs are the most important drugs in human and veterinary medicine to treat infectious diseases, but their widespread use and release into the environment even at low concentrations is of increasing concern. Unlike other contaminants, the level of concentration of an AM is not the only concern, it is the fact that it is in the environment and able to interact with microorganisms that could lead to antimicrobial resistance. Three surface water watch list AM's (erythromycin, clarithromycin, azithromycin) were detected in the survey.

Conclusion

Many pharmaceuticals that are consumed by humans and animals end up in the aquatic environment, often in their original form. We are currently relying on dilution and dispersion as many treatment works do not effectively remove these substances. The presence of AMs within the environment and the potential for increasing antimicrobial resistance is of concern for human health.

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