Pharmaceutical residues in drinking water

Summary

- Water suppliers in the UK place the highest priority and spend billions every year to provide the very best quality drinking water to their customers.
- The measures UK suppliers take to treat drinking water ensure that the quality meets and exceeds the standards recommended by the World Health Organization and set by the UK's drinking water regulators.
- Pharmaceutical residues may be found in very low quantities in water used as sources for drinking water. These residues get into the water sources mainly after being excreted by patients taking prescribed and non-prescribed medicines. Some residues may reach water sources after being excreted by farm animals.
- The levels of these residues are thousands of times below the level associated with adverse effects in animals and hundreds of thousands of times below human therapeutic doses.
- It is not practical to set formal regulatory standard for pharmaceutical residues in water (either raw water or tap water) at this stage until further research on the costs and benefits of doing so, supported by robust science, is available.
- The public can also help by only disposing of unused pharmaceuticals through approved routes and not throwing them down the toilet or drains.

Background

Where do pharmaceuticals in water come from?
Tiny amounts of pharmaceuticals can enter the sewerage system after being excreted in urine or faeces. In the sewage system most will be further degraded or removed as the sewage is treated before it is put into rivers or the sea. However some residues can remain and may be present, in very low concentrations.

Pharmaceuticals are also widely used in animal and fish farming and can reach the land in slurries from intensive animal rearing, or directly from grazing animals. Pharmaceutical products are regularly administered to livestock for similar reasons as to the human population. These practices add to the total loading of pharmaceuticals in the environment with high risks in areas of livestock rearing and could include point source discharges (from slurry or farmyard washwater) or diffuse sources (following the application of livestock manure to land).

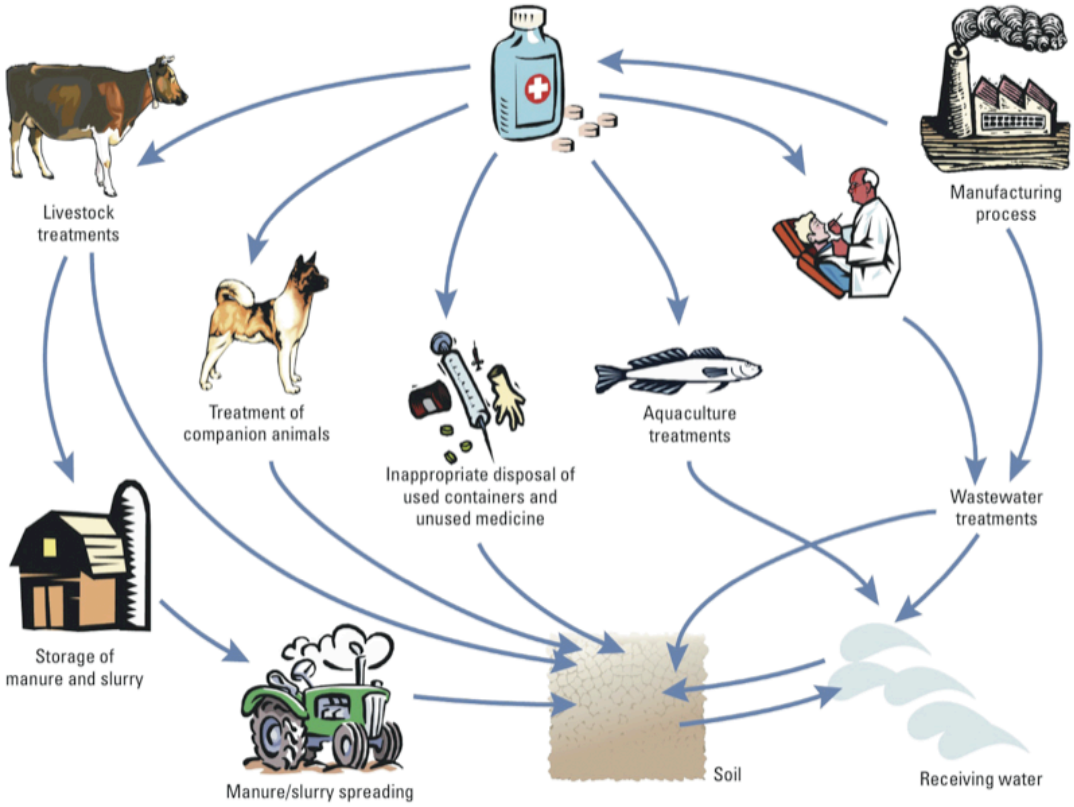

Figure 1 – Routes to the environment of human and veterinary pharmaceuticals
from Environmental Health Perspectives (v120, no9, Sept 2012, p1221) [1]

The analysis of pharmaceutical residues in the environment in very low concentrations is difficult, but the development of new advanced methods of chemical analysis has resulted in renewed interest in, and research on, such pharmaceutical residues.

A number of pharmaceuticals have been identified in raw surface water, at concentrations of less than 1 µg/l usually at concentrations less than 100ng/l (Ref. 1). The substances that have been identified most frequently are those that are widely used in large doses, on a daily basis, for long periods (e.g. painkillers, anti-inflammatory agents, anti-epileptics, drugs for lowering serum lipids, and substances used during radiological examination). The pattern of individual substances varies in different countries, reflecting local use, therefore prescription practice and the occurrence of pharmaceutical residues may also differ.

[1] http://ehp.niehs.nih.gov/wp-content/uploads/120/9/ehp.1104477.pdf

What standards exist for pharmaceutical residues in water?
Currently no standards exist to regulate the levels of pharmaceutical substances present in environmental water sources or in drinking water. Whilst this means that there is no statutory duty to monitor tap water for these substances water companies do carry out investigations where risk assessments indicate there could be a problem.

In 2011 the World Health Organization published a report (Ref. 2) drawing upon global expertise in toxicology, water quality, health and pharmacology, and assessing the latest scientific thinking on the presence of medications in drinking water. This report concludes that while sparse data makes analysis difficult, thus far there is very little risk at current levels.

"The substantial margins of safety for individual compounds suggest that appreciable adverse impacts on human health are very unlikely at current levels of exposure in drinking water."

How is the quality of drinking water assured?
There are a number of significant barriers that will reduce, or even eliminate, the potential for pharmaceutical residues to reach drinking water. Apart from considerable dilution, processes such as bacterial degradation and sedimentation in the aquatic environment play an important role in the further reduction of the concentration of such substances. Water abstracted for potable purposes then undergoes additional treatment, often with advanced treatment methods like ozone and activated carbon, all of which would further reduce any trace residues that might be present.

Notwithstanding these barriers, studies in the UK and other parts of the world have shown that in certain circumstances very small amounts of some pharmaceutical residues can reach drinking water. The doses of these pharmaceuticals are usually many milligrams per day, and for most of the substances detected in water the intake would be nanograms per day.

Source control
The combination of existing wastewater and drinking water treatment processes will reduce the concentrations of pharmaceuticals potentially present in drinking water to levels several orders of magnitude below a level that may result in health concerns. However, these processes will not remove all traces completely. Upgrading all wastewater treatment works and drinking water treatment works is technically feasible but costly. Water UK therefore advocates that it is essential that proper control measures are put in place to manage the source of pharmaceuticals before entering the water system. These would include schemes to return unused medications for disposal, supporting research both into green pharmaceuticals and into enhancing the efficiency of uptake of the active ingredients.

Further evidence to support additional actions
Water UK considers that, at this stage, it is not practical to set any formal statutory standards for pharmaceutical residues in drinking water. The available data show that current treatment and other barriers are effective in preventing risks to health from the presence of such substances in raw water at concentrations that do not pose a risk to human health.

Water UK supports the need for further research on both the occurrence of pharmaceutical residues in the environment and their removal in both wastewater and drinking water treatment. By establishing a robust scientific evidence base additional regulations could be considered.

References

Ref 1 - DWI (2011) Ref 70/2/231
'Targeted monitoring for human pharmaceuticals in vulnerable source and final waters'
Ref 2 - WHO (2011) Ref WHO/HSE/WSH/1105, 2011
'Pharmaceuticals in drinking water'

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