



Medicines in the Environment

Over the last decade, advances in analytical technology have enabled detection of trace concentrations of chemicals in the environment, including medicines.¹ Patient and veterinary use of medicines are the principal pathways by which medicines enter the environment. Typically, a fraction of medicines used by patients or given to animals is excreted. In some instances, trace amounts of excreted medicines can then enter aquatic environments. To a lesser extent, medicines may enter the environment through disposal of medicines or from manufacturing discharges.

The issue continues to receive attention, in scientific literature and the media, from governments, regulators, and other stakeholders. At the heart of the issue is whether existing controls (regulatory and other) of medicines are protective of human health and the environment. Based on available evidence, the World Health Organization has concluded that exposure to the trace levels of medicines found in sampled drinking water are extremely unlikely to result in appreciable adverse effects on human health.²

Background

The pathways for medicines entering the environment are well established. Most experts agree that human and animal excretion is the primary way medicines enter bodies of water.³ The remaining sources are a combination of disposal of unwanted medicines (by pouring them down a sink or toilet) and normal manufacturing discharges.⁴

With advances in analytical technology, scientists have been able to detect trace levels of medicines in the aquatic environment. The concentrations of medicines detected in drinking water, typically in the parts per trillion range, are orders of magnitude lower than minimum therapeutic doses.⁵⁻⁷ The World Health Organization (WHO) concluded that the concentrations and health risks are sufficiently low that routine monitoring programs are unnecessary and likely to detract from “other drinking-water concerns that are more acute.”⁸

Since implementation of the EU Environmental Risk Assessment (ERA) Guidelines (2006), a comprehensive ERA data package (chronic effects, fate, and physical-chemical properties) has been developed on most new chemical entities registered for pharmaceutical use in the past five years. This data package covers global registration requirements for those products registered in the U.S. (New Drug Application), in the EU (Marketing Authorization Application), and Canada (New Substances Notification Regulation), as examples. ERAs for established products and generics have been prepared as needed when registered for new indications or registered in new markets.

Although disposal represents a small proportion of the medicines found in the environment, guidance has been developed by both the private and public sectors to ensure that disposal of unwanted medications minimizes potential environmental impacts.^{9, 10} Recommended disposal methods include in-home disposal in household trash (using recommended techniques), medication take-back programs offered in local communities, and flushing of certain medications that may be especially harmful or even fatal if taken by someone other than for whom it was prescribed (e.g., opioids). The Food and Drug Administration (FDA) furnishes a list of drugs that should be flushed down the sink or toilet.¹¹

Human Health and Aquatic Environment Consideration

In 2012, the WHO and expert opinion from FDA officials concluded that trace amounts of medicines measured in water should not be of concern to human health even if consumed for many years.¹² Some studies suggest that in specific situations, chronic environmental exposure of certain species (e.g., fish) to select hormones (e.g., estrogens, androgens), which are excreted naturally by humans and animals as well as after use of contraceptive and hormone replacement drugs by humans, may be linked with environmental effects.¹³ Companies, trade associations, and governments are also actively working to understand and mitigate any potential impact of antibiotic production on antimicrobial resistance (AMR). Further studies are needed to determine if there may be environmental effects arising from chronic exposure to medicines, including antibiotics, in the aquatic environment.

Key Facts and Findings

- On average, medicines detected in U.S. drinking water are below 10 ppt. Caffeine, at 25 ppt, is one exception. Its presence as a result of its use in some drug formulations is far overshadowed by its inclusion in beverages. A person would have to drink more than 5 million 20-ounce bottles of water to get the same amount of caffeine that is present in one cup of coffee (~75 milligrams).¹⁴



- Ibuprofen is one of the drugs most widely detected in water and has been measured at 2.5 ppt. At this concentration, a person would have to drink 2 liters of water a day for over 100,000 years to get the equivalent of a single tablet (200 milligrams).¹⁸

Pfizer's Position

Pfizer has established an Environmental Stewardship Network committed to ensuring that the manufacture, use, and disposal of our medicines do not adversely affect human health or the environment. Pfizer works in partnership with other companies as a member of several trade associations (e.g., Pharmaceutical Research and Manufacturers Association, Biotechnology Industry Association, Consumer Health Products Association, European Federation of Pharmaceutical Industries and Associations), with academic institutions, researchers, and government agencies to ensure relevant science is understood and, where necessary, further advanced to best ensure these activities do not pose risks to human health or the aquatic environment. For example, Pfizer is currently participating in a 10 million euro project created under the European Innovative Medicines Initiative, a public-private partnership aimed to improve our understanding of the environmental profile of medicines.¹⁵ In September 2016, Pfizer and 13 industry partners released a comprehensive plan of action that lays out key commitments we pledge to deliver by 2020 to reduce the rising incidence of antimicrobial resistance. Pfizer maintains a separate policy document on antimicrobial resistance. See Related Pfizer Policies.

How the Public Benefits

Effective management and communication of risk based on sound science should ensure a well-informed public, regulatory community, and industry. Through this approach, our stakeholders should be better assured that controls are protective of human health and the environment.

See Related Pfizer Policies

Product Stewardship: http://www.pfizer.com/responsibility/protecting_environment/product_stewardship.jsp

Antimicrobial

Resistance: http://www.pfizer.com/news/featured_stories/featured_stories_detail/tackling_antibiotic_resistance

¹ WHO (2012).

Technical Report on *Pharmaceuticals in the drinking water* – WHO/HSE/WSH/11.05.

² *Ibid.*

³ Caldwell, D.J. (2015) Sources of Pharmaceutical Residues in the Environment and their Control, from 'Pharmaceuticals in the Environment', 2015, 92-119 Editor(s): R E Hester, R M Harrison. Royal Society of Chemistry, London, UK.

⁴ Heberer T, et al (2002). *Occurrence, fate, and removal of pharmaceutical residues in the aquatic environment: a review of recent research data*. *Toxicol Letter* 131:5-17.

⁸ See note 1.

⁶ What is 1 ppt? It is one nanogram/liter or 10⁻⁹ or, second in 32,000 years or 1 penny in \$10 billion.

⁷ Bruce, GM, et al. (2010). *Toxicological Relevance of Pharmaceuticals in Drinking Water*. *Environ. Sci. Tech.*, 44, 5619–5626.

⁸ *Ibid* reference 1.

⁹ Food and Drug Administration. *How to dispose of unused medicines*.

¹⁰ PhRMA. *Safe Disposal of Prescription Medications and Environmental Protection*.

¹¹ United States Food and Drug Administration. *Disposal of Unused Medicines: What you should know*.

¹² *Ibid* reference 1.

¹³ Sanchez, W, et al (2011). *Adverse effects in wild fish living downstream from pharmaceutical manufacture discharges*. *Environ Int. Nov*; 37(8):1342-8.

¹⁴ See note 3.

¹⁵ Innovative Medicines Initiative (IMI) is a program managed jointly by the European Commission and EFPIA.

