

Pharmaceuticals in Water: An Overview

Pharmaceuticals in water is a complex issue that remains the focus of sustained, continued study. Despite a large volume of scientific research, the definitive risks of active pharmaceutical ingredients to human health are largely unknown.¹ Detection of low-level concentrations of pharmaceuticals and personal care products (PPCPs) in California drinking water² has raised interest in finding safe ways to dispose of unwanted, unused medications. This Short Subject presents a brief overview of this important topic: how PPCPs enter our water supply, a summary of relevant legislation, basic terminology, and key regulatory agencies.

PPCP POINTS OF ENTRY

Pharmaceuticals and personal care products enter our water supply directly and indirectly through their manufacture and use by humans for health, personal and veterinary purposes. Flushing and disposing of unused medications, bathing, swimming, washing, and excretion are not the only routes PPCPs may travel to ultimately emerge in detectable concentrations in our environment. Discharge of wastewater from drug producers and hospitals, leakage from aging or inadequate sewage and septic systems, urban runoff from landfills, stormwater from cities, and agricultural uses of pharmaceuticals as antibiotics and agents to control pests are other ways PPCPs may enter our water supply.²

RELEVANT LEGISLATION

Due to dual regulatory structures (water quality, pharmaceuticals), strategies for reducing the occurrence of PPCPs involve the cooperation of many stakeholders. In California, the regulatory path to clean, safe, drinking water began with the creation of the State Water Resources Control Board in 1967 and the passage of the Porter-Cologne Act in 1969. Federal efforts include the 1972 Clean Water Act, the 1974 Safe Drinking Water Act, and the 1976 Resource Conservation and Recovery Act, which authorized the U.S. Environmental Protection Agency (EPA) to regulate hazardous wastes in water.

Table 1: Top 12 Pharmaceuticals in Water³

17alpha-estradiol	estrogenic hormone
17alpha-ethynylestradiol	estrogenic hormone
17beta-estradiol	estrogenic hormone
19norethisterone	progestronic hormone
Equilenin	estrogenic hormone
Equilin	estrogenic hormone
Erythromycin	antibiotic
Estriol	estrogenic hormone
Estrone	estrogenic hormone
Mestranol	estrogenic hormone
Nitroglycerin	used in pharmaceuticals
Quinoline	antimalarial

In 1996, the Safe Drinking Water Act was amended to include pharmaceuticals; a regulatory shift that required the publication of Contaminant Candidate Lists. The EPA prepares these lists every five years. The most recent list published in 2009 contained 12 pharmaceuticals. Table 1 offers a list of these drugs. Nine of the drugs on the list are hormones used for human and veterinary purposes.³

Public awareness in California has led to interest in fostering ways to reduce the presence of these contaminants in water. In 2007, Senate Bill 966 (Simitian) cleared a regulatory pathway for statewide disposal programs. National recognition of the issue resulted in the Secure and Responsible Drug Disposal Act of 2010. In July 2012, the Alameda County Board of Supervisors passed an ordinance to require drug producers to submit plans for take-back programs and to operate those programs, becoming the first county in the nation to mandate this type of product stewardship.

BASIC TERMINOLOGY

Acronyms used to discuss PPCPs in water are:

- API: active pharmaceutical ingredient**
the type of drug present and detectable
- ADI: acceptable daily intake**
the amount of exposure considered safe for a particular drug
- CEC: contaminant of emerging concern**
a drug that may present a health risk
- EDC: endocrine disrupting chemical**
a drug that specifically targets the endocrine system (e.g. birth control pills)
- PPCP: pharmaceutical/personal care product**
drugs and products for personal hygiene
- TDI: tolerable daily intake**
the level of exposure a body can tolerate on a daily basis

When referencing water, these terms are prevalent:

- Effluent: waste water**
the product of sewage and septic systems
- Source: water before treatment**
rivers, lakes, and other bodies of water
- Treated: water after treatment**
water that has been prepared for drinking
- Impaired: an unhealthy body of water**
a water source that has too many contaminants to be safe for human use and consumption
- Nonpoint source: runoff, stormwater**
water polluted from an unidentifiable contributor
- Point source: factories/industrial waters**
water polluted from an identifiable contributor
- Total Maximum Daily Load**
the amount of chemicals a body of water can tolerate without being declared impaired

Concepts associated with PPCPs in water are:

- Product and environmental stewardship**
water quality is a shared responsibility by all stakeholders involved
- PharmEcovigilance**
incorporating ecological concerns into pharmaceutical management practices
- Extended producer responsibility**
the idea that responsibility for PPCPs extends beyond manufacture and sale

REGULATORY AGENCIES

Many agencies are part of the regulatory conversation concerning this issue:

LOCAL

Cities, Counties, Special Districts
municipal, urban/rural, and specific water uses

Tribal Governments

all types of water use, water rights

STATE

California Environmental Protection Agency
water quality, water contaminants

California Food and Drug Administration
agricultural water use

State Water Resources Control Board
water rights, water quality

California Department of Toxic Substances Control
household pharmaceutical waste collection

California Department of Water Resources
State Water Project, flood control, water planning

California Department of Public Health
water quality, safe drinking water

California Public Utilities Commission
water rates, water service quality issues

FEDERAL

U.S. Environmental Protection Agency
water quality, water contaminants

U.S. Food and Drug Administration
agricultural water use

U. S. Geological Survey
water testing, water contaminants

ENDNOTES

1. Shane Snyder, et al. 2008. *Toxicological Relevance of EDCs and Pharmaceuticals in Drinking Water*. American Water Works Association Research Foundation.
2. Miranda S. Fram and Kenneth Belitz. 2011. "Occurrence and Concentrations of Pharmaceutical Compounds in Groundwater Used for Public Drinking-water Supply in California." *Science of the Total Environment*, Vol. 409, No. 18.
3. Third Contaminant Candidate List. 2009. U.S. Environmental Protection Agency.

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