CRB
SHORT SUBJECTS
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Common Pharmaceuticals in California Water

In a recent study of 1,231 groundwater samples gathered from California public drinking water supply sources over a six-year period, five pharmaceutical drugs were frequently found in detectable concentrations. The detected level of pharmaceuticals in the water sampled was low when compared to the levels of pesticides and other contaminants in water.[1] This Short Subject discusses the potential impact of these pharmaceuticals upon environmental and human health, identifies methods for detecting them, and shares a short list of these drugs.

Potential Impacts

Just because a drug is found in water does not mean it is harmful. Detection and identification are the first steps of a larger process to evaluate the potential impact of a pharmaceutical. Data may be collected for each drug to determine its perceived risk. Experts in the scientific community review and evaluate the data.

Each drug is then ranked and prioritized in the context of other detected pharmaceuticals and potential risk to human health. Type of exposure is also assessed; that is, how much of the drug is needed for a negative effect, and how long you must be exposed to it. Consequently, while it may be alarming to know drugs are in water, the relative risk might be low.

Water sources throughout the United States are known to contain some pharmaceuticals in large enough concentrations that the U.S. Environmental Protection Agency (EPA) has classified these pharmaceuticals as contaminants of emerging concern. These include estrogenic hormones, antimalarial drugs, and antibiotics.[2]

EPA designation as a contaminant of emerging concern is not solely presence- or concentration-based. Other factors potentially mitigate for deleterious effects, such as how frequently the compound occurs and the inability to identify the source of the compound.

Detection Methods

Approximately 16,000 wells were sampled as a part of the 2011 study to detect pharmaceuticals in California's water supply.[1] Limited resources and an unlimited number of compounds means that it is not possible to identify every extant compound in a water sample, consequently researchers pre-select a small set of pharmaceuticals as part of the design of their study and look solely for those.

Using a technique known as high-performance liquid chromatography, the chemical components of each drug are extracted and separated from the other constituents in each water sample. Once separated, the compounds are ionized and a second technique, mass spectrometry, is used to identify and measure the concentrations of a compound in water.

List of Pharmaceuticals in H_2O

In just over two percent of the water sampled, the following five pharmaceuticals have been found in detectable, measurable, and frequent concentrations.[1, 3] Note that these compounds are not designated as contaminants of emerging concern.

Carbamazepine: Carbatrol, Equetro, Tegretol
a mood stabilizer and anticonvulsant used for epileptic seizures, facial nerve pain, mania

Acetaminophen: Anacin, Panadol, Tylenol
an analgesic and antipyretic used to relieve moderate pain, reduce fever

Sulfamethoxazole: Bactrim, Septra
an antibiotic used for bacterial infections, urinary tract infections

Codeine: Airacof, Robitussin, Vanacof
an analgesic and antitussive used to relieve pain, suppress coughing

Trimethoprim: Primsol, Proloprim, Trimpex
an antibiotic used for urinary tract infections, for pneumonia when combined with other drugs

Table 1: Common Pharmaceuticals in H_2O and Their Potential Health Effects			
Type of Drug	**Pharmaceutical Name**	**Potential Human Health Effect**	**Environmental Health Effect**
Analgesic	**Acetaminophen**[1,3,4]	**nausea, liver damage**	**threat: aquatic species**
	Codeine [1,3,4]	**respiratory depression**	**unknown**
Antibiotic	**Erythromycin** [2,3,4]	**heart issues, liver damage**	**threat: aquatic species**
	Sulfamethoxazole [1,3,4]	**nausea, liver damage**	**threat: aquatic species**
	Trimethoprim [1,3,4]	**nausea, rash, birth defects**	**threat: aquatic species**
Anticonvulsant	**Carbamazepine** [1,3,4]	**heart issues, birth defects**	**threat: aquatic species**
Antimalarial	**Quinoline** [2,3,4]	**respiratory distress**	**threat: aquatic species**
Estrogenic Hormone	**17alphaestradiol** [2,3,4]	**cancer**	**threat: aquatic species**
	17alphaethynylestradiol [2,3,4]	**cancer**	**threat: aquatic species**
	17betaestradiol [2,3,4]	**cancer**	**threat: aquatic species**
	19norethisterone [2,3,4]	**cancer**	**threat: aquatic species**
	Equilinen [2,3,4]	**cancer**	**threat: aquatic species**
	Equilin [2,3,4]	**cancer**	**threat: aquatic species**
	Estriol [2,3,4]	**cancer**	**threat: aquatic species**
	Estrone [2,3,4]	**cancer**	**threat: aquatic species**
	Mestranol [2,3,4]	**cancer**	**threat: aquatic species**
Vasodilator	**Nitroglycerin** [2,3,4]	**low blood pressure, shock**	**unknown**

Table 1 offers a list of the most prevalent, detectable pharmaceuticals found in water in the 2011 study[1] and on the Third Contaminant Candidate List. Grouped by type of drug, this table lists the name of each pharmaceutical and identifies the *potential* human and environmental health effects of each individual drug if it is present in large enough concentrations to be a definitive risk.

To estimate the risk presented by the five pharmaceuticals found in California's water, scientists placed the detected concentration levels for each drug in context: using pre-established benchmarks, comparing therapeutic doses, or situating the results of their particular study in relation to other studies.

For all of the drugs in the study, they concluded that the detected concentrations were low and it was not likely that these drugs would have an impact on human health. However, they noted that estrogenic hormones may present a threat to aquatic species.[1]

Endnotes

1. 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.
2. Third Contaminant Candidate List. 2009. U.S. Envrironmental Protection Agency.
3. U.S. National Library of Medicine, Drug Information Portal. Accessed Nov. 15, 2013.
4. U.S. National Library of Medicine, Toxicology Data Network, Hazardous Substances Database. Accessed Nov. 18, 2013.

This short subject was requested by the Senate Committee on Environmental Quality. senv.senate.ca.gov.

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