



SHORT SUBJECTS

ENVIRONMENTAL SCIENCE SERIES

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Reducing Pharmaceuticals in California Water

Most scientists agree that low concentrations of pharmaceuticals in water are not likely to significantly affect human health. However, the environmental impact of pharmaceuticals has led to interest in reducing these compounds. This Short Subject looks at methods for removing pharmaceuticals in water: wastewater treatment technologies, disposal practices, and take-back programs. It also presents information about drug collection efforts in other states and countries.

TREATMENT TECHNOLOGIES

Pharmaceuticals enter our water supply directly and indirectly through their manufacture and use by humans for health, personal, and veterinary purposes. Waste water from human activities is treated at a sewage facility and then released into the environment. A wide variety of water treatment technologies are available that effectively reduce the concentrations of pharmaceuticals in water.

Constructed wetlands directly treat contaminants in the natural environment. Removal systems target sediments and soil, relying on processes of sorption and biodegradation. Biologically-based treatment technologies involve activated sludge (increasing solids retention time, use of upflow anaerobic sludge blankets), membrane bioreactors, biofiltration, and/or inhibition of biological treatment processes.

Other treatment technologies use chemicals or more physical methods. These include membrane processes (ultrafiltration, nanofiltration, reverse osmosis, forward osmosis, ion exchange, and adsorption) and chemical oxidation (such as ozone, advanced oxidation processes, electrochemical oxidation, potassium permanganate, and chlorine).

Alternative removal methods such as photolysis, photocatalysis, and enzymatic treatment are also used. Removal efficiencies vary according to method and drug. When methods are combined using a multibarrier approach, removal efficiencies increase significantly.¹

Table 1. Drug Collection Efforts for Selected States⁴

State and Department	Program Information	Disposal Details
Colorado Dept of Public Health and Environment	Pilot collection program excludes controlled substances	Tamper-resistant collection boxes
Florida Dept of Environmental Protection	Educational materials, website	Incineration in Waste-to-Energy Facilities
Iowa Dept of Natural Resources Board of Pharmacy	Take-away program via community pharmacies	Incineration at disposal facility
Maine Dept of Environmental Protection	Mail-back return-envelope system	High-heat incineration
Massachusetts Dept of Environmental Protection	Encourages local collection program participation where possible	Follows federal guidelines for disposal
New York Dept of Environmental Conservation	Public awareness campaign, take-back events	Incineration in Waste-to-Energy Facilities, trash
Texas Commission on Environmental Quality	Under legislative review	Under legislative review
Washington Group Health Cooperative	Pilot program of pharmacy-based return	Incineration

DISPOSAL PRACTICES

A study published in 2009 found that Californians use the following methods to dispose of their unwanted and unused pharmaceuticals²:

45 percent: Throw out with the trash

28 percent: Flush down toilet/pour down sink

12 percent: Store at home

5 percent: Return to pharmacy

5 percent: Take to hazardous waste center

Regardless of which disposal method is used, each one has its own particular impact upon the environment.³

Throwing away pharmaceuticals may delay, but not deter, the impact of the drug in the environment, due to potential leaching from landfills. Flushing or disposing of a medication in a toilet or the sink leaves the responsibility for removing the residue or compound in the hands of a treatment facility.

Storing them at home reduces their threat to the environment, but it increases the potential for their nonmedical use or abuse in the home. Not all pharmacies are willing or able to take back unused and/or unwanted pharmaceuticals. Not all medications are considered controlled substances, thus a hazardous waste center may not accept some drugs for incineration.

TAKE-BACK PROGRAMS

The primary goal of take-back programs is safe, environmentally-sensitive disposal of unused and unwanted pharmaceuticals. These voluntary collection programs are event based (National Take-Back Day) or ongoing (continuous collection of pharmaceuticals at a pharmacy or hazardous waste center).

Table 1, Drug Collection Efforts for Selected States, shares information about what other states are doing to collect unused and unwanted pharmaceuticals.

Consumer disposal of pharmaceuticals might be by mail, community pharmacy based, or by tamper-resistant collection boxes. Funding for these programs is often provided by an assemblage of public governmental agencies and private industry partners.⁴

Table 2, Drug Collection Efforts for Selected Countries, looks at how other countries handle pharmaceuticals.

Notice that programs are national or regional, and all are pharmacy based. Funding for these programs comes from government, industry, or closely-related organizations and associations.⁴

Challenges and barriers to the successful collection of home-generated pharmaceuticals include estimated collection costs, inadequate awareness and public participation, inadequate long-term funding, and a complicated regulatory/statutory environment.⁴

Country	Program Information	Other Details
Australia	National pharmacy-based return program	Government and industry funded
France	National pharmacy-based return program	Private sector funded and managed
Portugal	National pharmacy-based return program	Funded by pharmaceutical associations
Spain	National pharmacy-based return program	Managed by nonprofit; funded by industry
Sweden	National state-owned pharmacy-based return program	Government managed and financed
Canada Alberta	Province-based pharmacy return program	Funded by industry
Canada British Columbia	Province-based pharmacy return program	Managed by stewardship organization
Canada Nova Scotia	Province-based pharmacy return program	Administered by pharmacy association
Canada Ontario	Province-based pharmacy return program	One-way collection containers; pharmacy destroys drugs
Canada Saskatchewan	Province-based pharmacy return program	Managed by pharmacists association

ENDNOTES

1. Katherine Y. Bell, et al. 2012. "Emerging Pollutants-Part II: Treatment." *Water Environment Research*, Vol. 84, No. 10.
2. Matthew Kotchen, et al. 2009. "Pharmaceuticals in wastewater: Behavior, preferences, and willingness to pay for a disposal program." *Journal of Environmental Management*, Vol. 90.
3. Susan T. Glassmeyer, et al. 2009. "Disposal practices for unwanted residential medications in the United States." *Environment International*, Vol. 35.
4. CalRecycle. 2010. *Report to the Legislature: Recommendations for Home-Generated Pharmaceutical Collection Programs in California*.

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

The California Research Bureau is a division within the California State Library, providing in-depth research and nonpartisan public policy analysis to members of the State Legislature and the Governor. www.library.ca.gov/crb.

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