ESC-010
4-14

Texas A&M AgriLife Extension

Drugs and Personal Care Products

Impacts on Water, People, and the Environment

Jennifer Peterson, Extension Program Specialist II
Mark McFarland, Professor and Soil Fertility Specialist
Diane Boellstorff, Assistant Professor and Water Resources Specialist
Larry Redmon, Professor and State Forage Specialist
Texas A&M Department of Soil and Crop Sciences, The Texas A&M University System

Since the 1980s, researchers have found increasing amounts of aspirin, caffeine, nicotine, shampoos, soaps, and other pharmaceuticals and personal care products (PPCPs) in surface water—the water in streams, rivers, lakes, and oceans.

PPCPs are the products that people use for health or cosmetic reasons as well as those used in agriculture to increase the growth or improve the health of livestock. PPCPs include:

- Cleaning products
- Cosmetics
- Drugs, both prescription and over-the-counter, for people and animals
- Fragrances
- Lotions
- Sunscreens
- Vitamins and other nutraceuticals

Very little research has been conducted on how PPCPs in surface water affect the health of people or the environment. However, what we do know points to the need for people and businesses to dispose of their PPCPs safely.

Research on PPCPs in surface water

Many studies have found drugs and personal care products in surface water. For example, the U.S. Geological Survey tested surface water for 95 of these products in 2004. Eighty percent of the streams tested had one or more PPCPs.

In 2006, Colorado State University researchers tested surface waters downstream of livestock operations and fields fertilized with manure. The water contained increased levels of antibiotics.

Although water supplies have contained PPCPs for decades, the EPA still classifies them as emerging contaminants because we do not yet know exactly where they all come from, how often they occur in surface waters, or how they affect the health of people and the environment.

Sources of PPCPs in the environment

Major sources of PPCPs in the environment include hospitals, drug manufacturers, animal production facilities, and individuals.

PPCPs enter water supplies via human or animal wastes; by people swimming, showering, bathing, or participating in other activities that bring the human body into direct contact with water; and by people washing products down drains or flushing them down toilets (Fig. 1).

Municipal waste treatment plants contribute trace amounts of PPCPs because their treatment methods cannot remove 100 percent of them from wastewater.

Although PPCPs are found mostly in surface waters, they can also seep into groundwater, which is the water stored in underground aquifers.

Effects of PPCPs on human health

Few studies have been conducted on how many and how concentrated PPCPs are in the environment. We also do not know the health risks

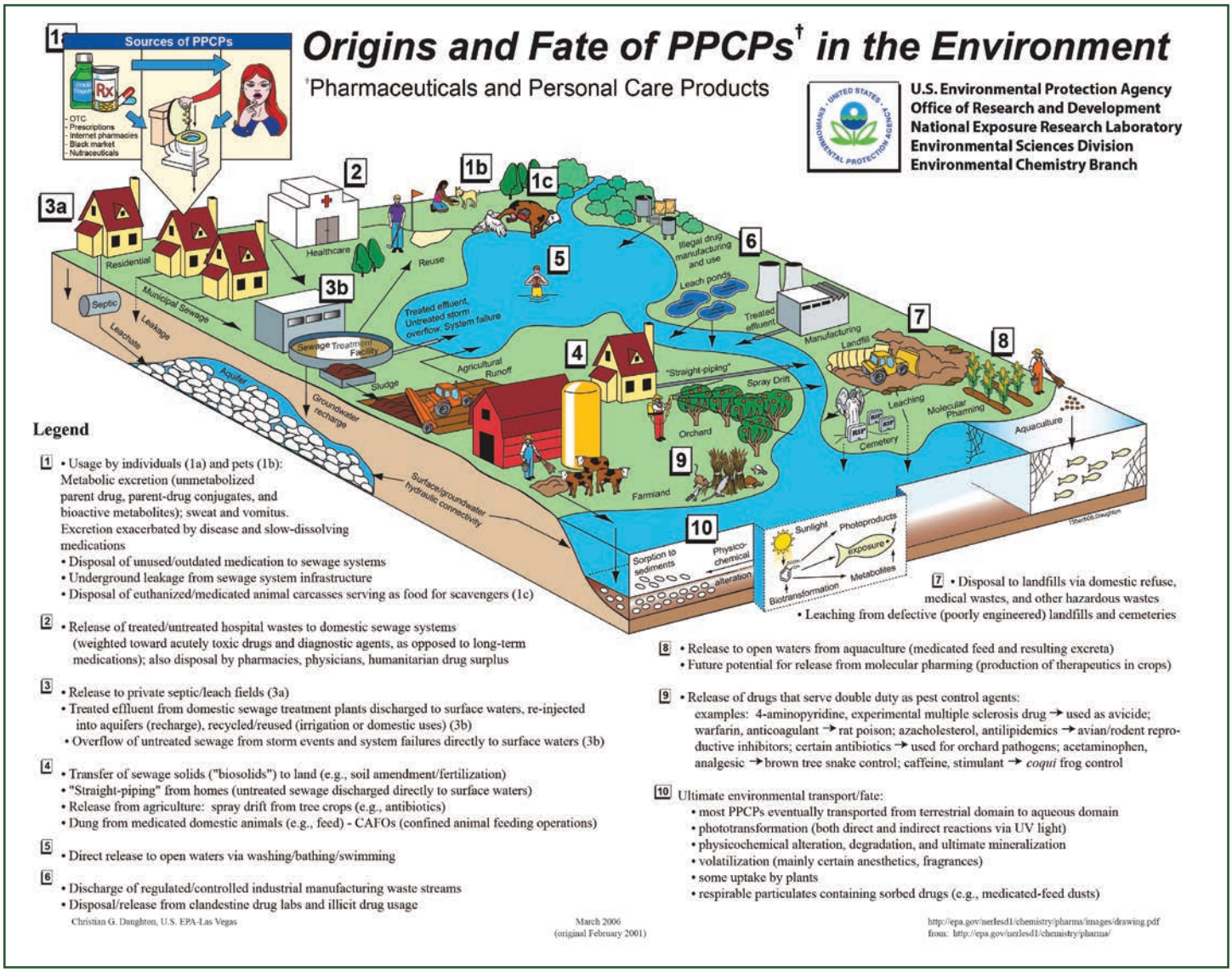

Figure 1. The origin, fate, and control of PPCPs in the environment (EPA, 2006).

to people who are exposed to PPCPs in drinking or recreational waters.

However, the U.S. Federal Drug Administration (FDA) requires extensive research on the drugs developed for people. We know their effects on humans and other mammals. Because of these studies, some scientists have concluded the current levels of exposure to PPCPs in the environment pose little risk to human health. In fact, people consume far lower rates of drugs via drinking water every day than through medicinal dosages.

Other scientists caution that we do not know the true effects on human health because little research has been done on how mixtures of these chemicals affect people. We also do not know the impacts of being exposed to small amounts of these continually over long periods. Another concern is that PPCPs in drinking water affect people for whom these drugs were not intended or approved.

Effects on the environment

PPCPs pose concerns for the environment because we don't know what happens when they are mixed, how they react when they accumulate in plant and animal tissue, or whether they may cause harm even at low concentrations. The ingredients and metabolites (substances created when these ingredients are broken down) of many PPCPs remain in the environment for very long periods.

Researchers have linked these products with changes in animal development and behavior. Some fish develop more slowly, frogs undergo

metamorphosis later, and other aquatic animals behave and reproduce differently. Recent studies suggest that antidepressants—including Prozac, Zoloft, Paxil, and Celexa—in surface waters can slow the development of frogs and fish. Antidepressants also affect the spawning, development, and overall behavior of shellfish and other aquatic organisms.

Synthetic estrogen hormones from birth control pills and hormone replacement drugs can change fish populations. In 2006, researchers at the University of Colorado–Boulder found high levels of estrogen in Boulder Creek below the city's wastewater treatment plant. Also in the creek were white sucker fish with both male and female body parts and fish populations with higher proportions of females to males.

More recent research suggests that PPCPs in manure spread on fields may accumulate in the environment and be taken up by various crops, including Chinese cabbage. In July 2013, the EPA released a report on contaminants in livestock and poultry manure and their effects on water quality (http://water.epa.gov/).

What can you do?

Although the government does not regulate the disposal of household wastes, including medications, consumers can follow the guidelines from the White House Office of National Drug Control Policy on how to dispose of prescription drugs properly:

- Follow any disposal instructions on the drug label or in the patient information that accompanies the medication.
- Do not flush prescription drugs down the toilet or drain unless the label or accompanying patient materials specifically instruct you to do so. For information on drugs that may be flushed, see the FDA website at www.fda.gov.
- For prescription drugs not labeled to be flushed, use community drug take-back programs or household hazardous waste collection events that collect drugs at a central location for proper disposal. Call your city or county household trash and recycling service and ask if a drug take-back program is available in your community. Or visit the Drug Enforcement Agency's website at www.deadiversion.usdoj.gov and click on the "Got Drugs?" icon. Also, some cities and counties provide locked drop boxes for safely disposing of unneeded prescription drugs. For a list of drop-box locations, see http://rxdrugdropbox.org/.
- If a drug take-back or collection program is not available:
  - Take your prescription drugs out of their original containers.
  - Mix the drugs with an undesirable substance such as cat litter or used coffee grounds.
  - Put the mixture into a sealable bag or a disposable container with a lid such as an empty margarine tub.
  - Scratch off or cover any personal information, including Rx number, on the empty containers with black permanent marker or duct tape.
  - Place the empty drug containers and the sealed container with the mixture in the trash.

Protecting people and the environment from PPCPs will depend on individuals using and disposing of products properly:

- Do not buy or use unnecessary products.
- Carefully follow the product disposal guidelines described above.

These efforts can help reduce the potential for PPCPs to reach surface water and drinking water resources.

For more information

Emerging Contaminants in the Environment. U.S. Geological Survey. 2013. Available at http://toxics.usgs.gov/regional/emc/.

How to Dispose of Unused Medicines. White House Office of National Drug Control Policy. 2009. Available at: http://www.whitehouse.gov/ondcp/prescription-drug-abuse.

"Intersex and other Reproductive Disruption of Fish in Wastewater Effluent Dominated Colorado

Streams." By J. D. Woodling, E. M. Lopez, T. A. Maldonado, D. O. Norris, and A. M. Vajda. 2006. *Comparative Biochemistry and Physiology* Part C 144:10–15.

Literature Review of Contaminants in Livestock and Poultry Manure and Implications for Water Quality. Environmental Protection Agency. EPA 820-R-13-002. 2013.

Pharmaceuticals and Personal Care Products: Frequent Questions. Environmental Protection Agency. 2010. Available at: http://www.epa.gov/ppp/faq.html.

"Transfer of Wastewater Associated Pharmaceuticals and Personal Care Products to Crop Plants from Biosolids Treated Soil." By C. Wu, A. L. Spongberg, J. D. Witter, and B. B. M. Sridhar. 2012. *Ecotoxicology and Environmental Safety* 85:104–109.

Water Quality Data for Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams. By K. K. Barnes, D. W. Kolpin, M. T. Meyer, E. M. Thurman, E. T. Furlong, S. D. Zaugg, and L. B. Barber. 2002, 1999–2000: U.S. Geological Survey Open-File Report 02-94.

The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by Texas A&M AgriLife Extension or Texas A&M AgriLife Research is implied.

Texas A&M AgriLife Extension Service

AgriLifeExtension.tamu.edu

More Extension publications can be found at *AgriLifeBookstore.org*

Educational programs of the Texas A&M AgriLife Extension Service are open to all people without regard to race, color, sex, religion, national origin, age, disability, genetic information, or veteran status.

The Texas A&M University System, U.S. Department of Agriculture, and the County Commissioners Courts of Texas Cooperating.

Produced by Texas A&M AgriLife Communications

New