

# Don't



Today, new medications are being manufactured constantly. And with this increased production comes increased usage. Regardless of how medications make their way into the wastewater stream, inadvertently by excretion or purposefully by disposal, increased usage means increased amounts in the environment.

There is no best answer for what to do with unused or expired medications, but one thing is for sure, it is no longer recommended to flush them down the sink or toilet. Sewage treatment plants weren't designed to remove these chemicals, and many drugs are showing up in our surface and groundwater.

Surprisingly, no specific government guidelines exist for the disposal of drugs by the consumer. The U.S. Food and Drug Administration and the U.S. Environmental Protection Agency (EPA) regulate the disposal of pharmaceuticals at the manufacturers' level. However, there are few good recommendations for consumers.

Some state and local agencies have come up with their own drug disposal legislation. The

California Waste Prevention Information Exchange recommends the return of drugs to pharmacies via take-back programs, but these programs are not present in all communities. In Maine, a state mail-back program has been proposed where patients will be provided with prepaid mailers to be sent to a secure address where only Drug Enforcement Agency (DEA) officers will handle the unwanted medications.

Although details vary from state to state, at least 26 states have created some sort of program that allows the return of prescription drugs in original packaging from state programs, nursing homes, or other medical facilities to be redistributed to needy residents. Be sure and check with your local health department or EPA office for any special rules that apply to your area.

Some communities have household hazardous waste programs, the same ones that accept old motor oil and batteries, that accept unwanted medications, however the incineration costs are often prohibitive and

the legality issues of working with controlled substances are problematic.

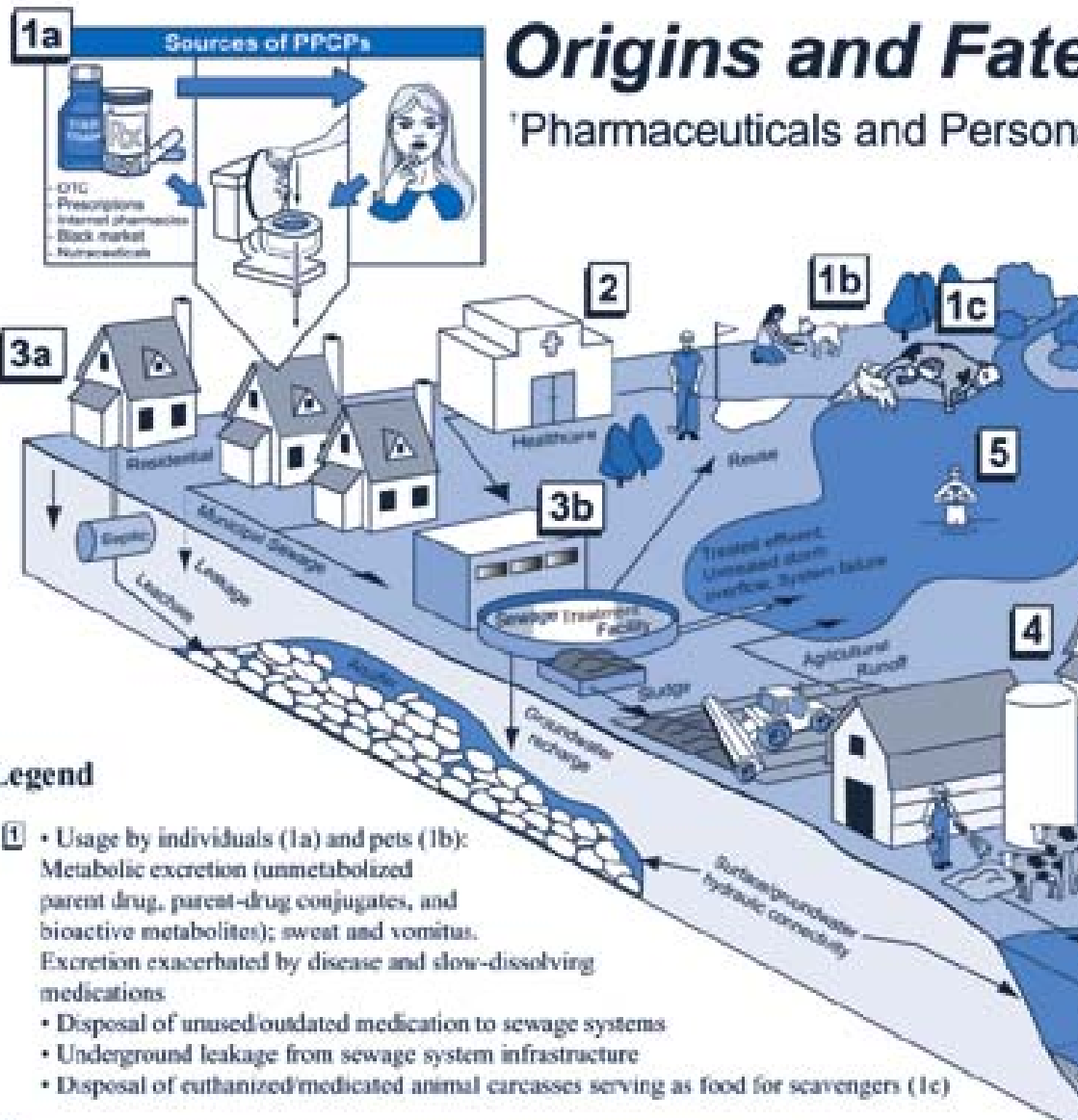
Pharmacy take-back programs are a great idea but they are not widely available and here too the legalities involved make them difficult to set up. For private citizens, one option is to throw drugs into the trash. This is not preferable, but it is less harmful to the environment than disposal into the wastewater stream. To do this safely and reduce potential for abuse:

1. Keep drugs in the original container (with safety lids).
2. Scratch out patient information on labels.
3. Place liquids in glass bottles in plastic re-sealable bags to contain leakage.
4. Add some water to dry tablets or capsules to dissolve them slightly.
5. Place in the trash as close to garbage pick up time as possible.

Source: [www.epa.gov/nerlesd1/chemistry/ppcp/images/pharmacist.pdf](http://www.epa.gov/nerlesd1/chemistry/ppcp/images/pharmacist.pdf) (Accessed March 8, 2007)

# Origins and Fate

'Pharmaceuticals and Personal



## Legend

- 1** • Usage by individuals (1a) and pets (1b): Metabolic excretion (unmetabolized parent drug, parent-drug conjugates, and bioactive metabolites); sweat and vomitus. Excretion exacerbated by disease and slow-dissolving medications
  - Disposal of unused/outdated medication to sewage systems
  - Underground leakage from sewage system infrastructure
  - Disposal of euthanized/medicated animal carcasses serving as food for scavengers (1c)
- 2** • Release of treated/untreated hospital wastes to domestic sewage systems (weighted toward acutely toxic drugs and diagnostic agents, as opposed to long-term medications); also disposal by pharmacies, physicians, humanitarian drug surplus
- 3** • Release to private septic/leach fields (3a)
  - Treated effluent from domestic sewage treatment plants discharged to surface waters, re-injected into aquifers (recharge), recycled/reused (irrigation or domestic uses) (3b)
  - Overflow of untreated sewage: from storm events and system failures directly to surface waters (3b)
- 4** • Transfer of sewage solids ("biosolids") to land (e.g., soil amendment/fertilization)
  - "Straight-piping" from homes (untreated sewage discharged directly to surface waters)
  - Release from agriculture: spray drift from tree crops (e.g., antibiotics)
  - Dung from medicated domestic animals (e.g., feed) - CAFOs (confined animal feeding operations)
- 5** • Direct release to open waters via washing/bathing/swimming
- 6** • Discharge of regulated/controlled industrial manufacturing waste streams
  - Disposal/release from clandestine drug labs and illicit drug usage

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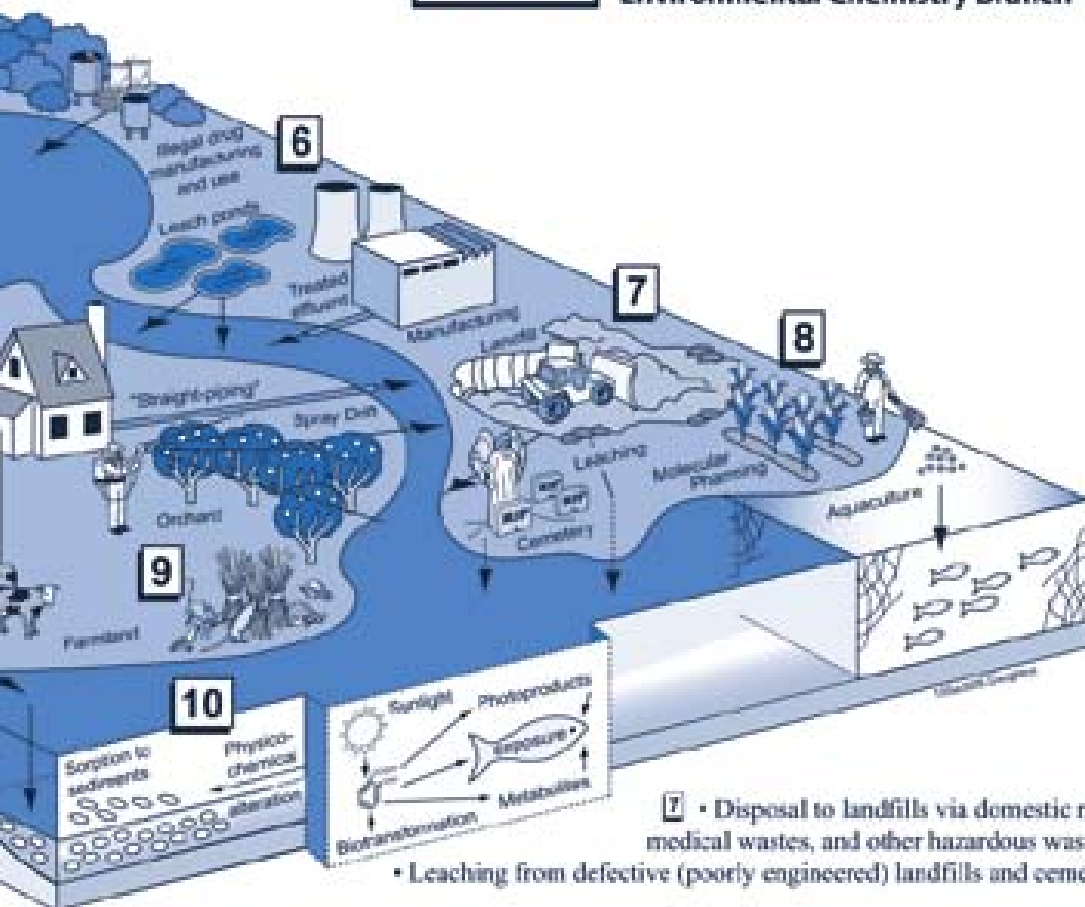
March (original Feb)

# Environmental Fate of PPCPs<sup>†</sup> in the Environment

Personal Care Products



U.S. Environmental Protection Agency  
Office of Research and Development  
National Exposure Research Laboratory  
Environmental Sciences Division  
Environmental Chemistry Branch



- 7** • Disposal to landfills via domestic refuse, medical wastes, and other hazardous wastes  
• Leaching from defective (poorly engineered) landfills and cemeteries
- 8** • Release to open waters from aquaculture (medicated feed and resulting excreta)  
• Future potential for release from molecular farming (production of therapeutics in crops)
- 9** • Release of drugs that serve double duty as pest control agents:  
examples: 4-aminopyridine, experimental multiple sclerosis drug → used as avicide;  
warfarin, anticoagulant → rat poison; azacholesterol, antilipidemics → avian/rodent reproductive inhibitors; certain antibiotics → used for orchard pathogens; acetaminophen, analgesic → brown tree snake control; caffeine, stimulant → *coqui* frog control
- 10** Ultimate environmental transport/fate:
  - most PPCPs eventually transported from terrestrial domain to aqueous domain
  - phototransformation (both direct and indirect reactions via UV light)
  - physicochemical alteration, degradation, and ultimate mineralization
  - volatilization (mainly certain anesthetics, fragrances)
  - some uptake by plants
  - respirable particulates containing sorbed drugs (e.g., medicated-feed dusts)

