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Drugs Are in the Water. Does It Matter?

By CORNELIA DEAN

Correction Appended

Residues of birth control pills, antidepressants, painkillers, shampoos and a host of other compounds are finding their way into the nation's waterways, and they have public health and environmental officials in a regulatory quandary.

On the one hand, there is no evidence the traces of the chemicals found so far are harmful to human beings. On the other hand, it would seem cavalier to ignore them.

The pharmaceutical and personal care products, or P.P.C.P.'s, are being flushed into the nation's rivers from sewage treatment plants or leaching into groundwater from septic systems. According to the Environmental Protection Agency, researchers have found these substances, called "emerging contaminants," almost everywhere they have looked for them.

Most experts say their discovery reflects better sensing technology as much as anything else. Still, as Hal Zenick of the agency's office of research and development put it in an e-mail message, "there is uncertainty as to the risk to humans."

In part, that is because the extent and consequences of human exposure to these compounds, especially in combination, are "unknown," the Food and Drug Administration said in a review issued in 2005. And aging and increasingly medicated Americans are using more of these products than ever.

So officials who deal with these compounds have the complex task of balancing reassurance that they take the situation seriously with reassurance that there is probably nothing to worry about. As a result, scientists in several government and private agencies are devising new ways to measure and analyze the compounds, determine their prevalence in the environment, figure out where they come from, how they move, where they end up and if they have any effects.

In many cases, the compounds enter the water when people excrete them or wash them away in the shower. But some are flushed or washed down the drain when people discard outdated or unused drugs. So a number of states and localities around the country have started discouraging pharmacies, hospitals, nursing homes and residents from disposing of drugs this way. Some are setting up "pharmaceutical take-back locations" in drugstores or even police stations. Others are adding pharmaceuticals to the list of hazardous household waste, like leftover paint or insecticides, periodically collected for safe disposal, often by incineration.

For example, Clark County, Wash., has a program in which residents with unwanted or expired drugs can

take so-called controlled substances, like prescription narcotics, to police stations or sheriffs' offices for disposal. They can drop noncontrolled drugs at participating pharmacies, and 80 percent of the pharmacies in the county participate.

In guidelines issued in February, three federal agencies, including the E.P.A., advised people with leftover medicines to flush them down the drain "only if the accompanying patient information specifically instructs it is safe to do so." Otherwise, the guidelines say, they should dispose of them in the trash (mixed with "an undesirable substance" like kitty litter to discourage drug-seeking Dumpster divers) or by taking them to designated take-back locations.

Worries about water-borne chemicals flared last summer when researchers at the United States Geological Survey said they had discovered "intersex fish" in the Potomac River and its tributaries. The fish, smallmouth and largemouth bass, were male but nevertheless carried immature eggs.

Scientists who worked on the project said they did not know what was causing the situation, or even if it was a new phenomenon. But the discovery renewed fears that hormone residues or chemicals that mimic them might be affecting creatures that live in the water.

In a survey begun in 1999, the agency surveyed 139 streams around the country and found that 80 percent of samples contained residues of drugs like painkillers, hormones, blood pressure medicines or antibiotics. The agency said the findings suggested that the compounds were more prevalent and more persistent than had been thought.

Meanwhile, the Food and Drug Administration started looking into the effects of residues of antibiotics and antiseptics in water, not just to see if they might affect people but also to assess their potential to encourage the development of drug-resistant bacteria.

Reports of contamination with pharmaceutical residues can be alarming, even when there is no evidence that anyone has been harmed. In 2004, for example, the British government reported that eight commonly used drugs had been detected in rivers receiving effluent from sewage treatment plants. A spokeswoman for the Department for Environment, Food and Rural Affairs said it was "extremely unlikely" that the residues threatened people, because they were present in very low concentrations. Nevertheless, news reports portrayed a nation of inadvertent drug users — "a case of hidden mass medication of the unsuspecting public," as one member of Parliament was quoted as saying.

Christian Daughton, a scientist at the Environmental Protection Agency and one of the first scientists to draw attention to the issue, said P.P.C.P. concentrations in municipal water supplies were even lower than they were in water generally because treatments like chlorination and filtration with activated charcoal alter or remove many chemicals. Dr. Daughton, who works at the agency's National Exposure Research Laboratory in Las Vegas, said he believed that if any living being suffered ill effects from these compounds, it would be fish and other creatures that live in rivers and streams.

Dr. Daughton and Thomas A. Ternes of the ESWE-Institute for Water Research and Water Technology in Germany brought the issue to scientific prominence in 1999, in a paper in the journal Environmental Health Perspectives. They noted that pollution research efforts had focused almost exclusively on "conventional"

pollutants — substances that were known or suspected to be carcinogenic or immediately toxic. They urged researchers to pay more attention to pharmaceuticals and ingredients in personal care products — not only prescription drugs and biologics, but also diagnostic agents, fragrances, sunscreen compounds and many other substances.

They theorized that chronic exposure to low levels of these compounds could produce effects in water-dwelling creatures that would accumulate so slowly that they would be "undetectable or unnoticed" until it was too late to reverse them. The effects might be so insidious, they wrote, that they would be attributed to some slow-moving force like evolution or ecological change.

Initial efforts concentrate on measuring what is getting into the nation's surface and groundwater. The discharge of pharmaceutical residues from manufacturing plants is well documented and controlled, according to the E.P.A., but the contribution from individuals in sewage or septic systems "has been largely overlooked."

And unlike pesticides, which are intentionally released in measured applications, or industrial discharges in air and water, whose effects have also been studied in relative detail, the environmental agency says, pharmaceutical residues pass unmeasured through wastewater treatment facilities that have not been designed to deal with them.

Many of the compounds in question break down quickly in the environment. In theory, that would lessen their potential to make trouble, were it not for the fact that many are in such wide use that they are constantly replenished in the water.

And researchers suspect that the volume of P.P.C.P.'s excreted into the nation's surface water and groundwater is increasing. For one thing, per capita drug use is on the rise, not only with the introduction of new drugs but also with the use of existing drugs for new purposes and among new or expanding groups of patients, like children and aging baby boomers.

Also, more localities are introducing treated sewage into drinking water supplies. Researchers who have studied the issue say there is no sign that pharmaceutical residues accumulate as water is recycled. On the other hand, the F.D.A. said in its review, many contaminants "survive wastewater treatment and biodegradation, and can be detected at low levels in the environment."

Some say the spread of these substances in the environment is an example of how the products of science and technology can have unintended and unpredictable effects. In their view, when the knowledge about these effects is sketchy, it is best to act to reduce risk, even if the extent of the risk is unknown, an approach known as the precautionary principle.

Joel A. Tickner, an environmental scientist at the University of Massachusetts, Lowell, says that it is a mistake to consider all of these compounds safe "by default," and that more must be done to assess their cumulative effects, individually or in combination, even at low doses.

In his view, the nation's experience with lead additives, asbestos and other substances shows it can be costly — in lives, health and dollars — to defer action until evidence of harm is overwhelming.

Others say the benefits of action — banning some compounds, say, or requiring widespread testing or treatment for others — should at least equal and if possible outweigh their costs.

“You have to somehow estimate as well as possible what the likely harms are and the likely benefits,” said James K. Hammitt, a professor of economics and decision sciences at the Harvard Center for Risk Analysis.

And while it is possible that some of the tens of thousands of chemicals that might find their way into water supplies are more dangerous in combination than they are separately, Dr. Hammitt said in an interview, “it’s perfectly possible that they counteract each other.”

Anyway, he said, assessing their risk in combination is a mathematical problem of impossible complexity. “The combinatorics of this are truly hopeless.”

Given all this uncertainty, policy makers find it difficult to know what to do, other than continuing their research. Studies of “the fate and transport and persistence” of the P.P.C.P.’s will allow scientists to make better estimates of people’s exposure to them, Dr. Zenick said, and “to assess the potential for human health effects.”

But even that normally anodyne approach comes under question because of something scientists call “the nocebo effect” — real, adverse physiological reactions people sometimes develop when they learn they have been exposed to something — even if there is no evidence it may be harmful.

“The nocebo effect could play a key role in the development of adverse health consequences from exposure even to trace elements of contaminants simply by the power of suggestion,” Dr. Daughton wrote recently in a paper in a special issue of Ground Water Monitoring and Remediation, a publication of the National Ground Water Association, an organization of scientists, engineers and businesses related to the use of groundwater.

In fact, the idea that there are unwanted chemicals in the water supply has many characteristics that researchers who study risk perception say particularly provoke dread, regardless of their real power to harm. The phenomenon is new (or newly known), and the compounds are invisible and artificial rather than naturally occurring.

But scientists at agencies like the Geological Survey say it is important to understand the prevalence and actions of these compounds, even at low levels. If more is known about them, agency scientists say, researchers will be better able to predict their behavior, especially if they should start turning up at higher concentrations. Also, the Geological Survey says, tracking them at low levels is crucial to determining whether they have additive effects when they occur together in the environment.

Comprehensive chemical analysis of water supplies “is costly, extraordinarily time-consuming, and viewed by risk managers as prompting yet additional onerous and largely unanswerable questions,” Dr. Daughton wrote in his paper last year.

But it should be done anyway, he said, because it is a useful way of maintaining public confidence in the water supply.

“My work is really categorized as anticipatory research,” he added. “You are trying to flesh out a new topic, develop it further and see where it leads you. You don’t really know where it leads.”

Correction: April 7, 2007

An article in Science Times on Tuesday about residues of pharmaceuticals and personal care products in the nation’s waterways misstated the given name of a scientist at the Environmental Protection Agency. He is Christian Daughton, not Christopher.