Pharmaceuticals in the Water Supply

Construction of Proposed Covance Facility in Chandler Threatens to Further Contaminate Arizona's Waterways, Groundwater, and Drinking Water

Introduction

At a June 27, 2006, meeting between Covance Corporate Senior Vice President Wendel Barr and the Chandler Chamber of Commerce, Mr. Barr admitted that Covance removes urine and feces from animals' cages by hosing down the cages and directing the animals' waste into drains that lead to the public sewage system. Based on the number of animals at Covance's facilities in Madison, Wis., and Vienna, Va., as reported by the U.S. Department of Agriculture (USDA)—and factoring in animals who are not covered by the Animal Welfare Act—an extrapolation based on the relative sizes of these facilities, the proposed Covance facility in Chandler would have an estimated animal population of 241,300 each year.

The majority of the animals at the proposed facility will have experimental drugs that have yet to be approved by the U.S. Food and Drug Administration (FDA) as well as toxic compounds such as pesticides and industrial chemicals pumped into their stomachs through oral and nasal gavage tubes. More often than not, the drugs and other compounds will not be completely metabolized by the animals. The excreted drug and chemical residues will then be flushed down the drains and into the sewage system. The health, environmental, and economic consequences of this chemical dumping will be enormous for Chandler and its surrounding areas.

Problem Overview

Contraceptives, painkillers, antibiotics, anti-cancer drugs, blood-pressure medications, and antidepressants have begun showing up in lakes and rivers, groundwater, and drinking water.[1] Because sewage-treatment plants are not designed to handle pharmaceuticals, many drugs—including unused drugs that are washed down sinks or flushed down toilets and incompletely metabolized drugs that are flushed down toilets in human waste or washed down laboratory drains in animal excrement—pass right through sewage- and water-treatment plants into the drinking-water supply.[2] Dr. Christian Daughton, chief of environmental chemistry at the U.S. Environmental Protection Agency's (EPA) National Exposure Research Laboratory in Las Vegas, has said **that drugs rival pesticides with regard to their contribution to water pollution but that while the disposal of conventional pollutants like pesticides is regulated, the disposal of drugs is not. Therefore, drugs flow continuously into waterways from sewage-treatment plants.**[3]

In 2002, the U.S. Geological Survey conducted a landmark study of 139 rivers and streams across the country and determined that 80 percent of them contained one or more pharmaceuticals.[4] Government agencies that are concerned about water quality in the U.S. and professional organizations that are focused on water and wastewater issues are beginning to acknowledge that pharmaceuticals are an emerging environmental and human health issue. Water-protection agencies predict that they will soon have to tackle this new generation of contaminants, and it is expected that the EPA will begin monitoring the presence of pharmaceuticals in our waterways in 2008.[5]

Effects on Human Health

According to an article in the October 2000 issue of the journal *Environmental Health Perspectives*, "The long-term outcome of humans' ingesting

subtherapeutic doses of numerous drugs as well as any dose at all of substances not meant to be ingested remains a major unaddressed issue."[6] Scientists have not yet conducted toxicological studies to evaluate the risks posed by chronic exposure to trace concentrations of drugs.

Dr. Paul Westerhoff, a researcher at Arizona State University whose work has focused on finding ways to remove chemicals from water, speculates that cancer-fighting medicines may pose the largest problem, noting, "These therapeutic drugs are designed to kill human cells …."[7] Other researchers have expressed concern that the release of antibiotics into our waterways may lead disease-causing bacteria to become immune to treatment, which would result in the emergence of drug-resistant diseases.[8]

Chandler residents will find themselves wondering—every time they take a drink of water and every time their children bathe, swim, or play in water—whether the water is safe and whether they, themselves, are test subjects in this foray into uncharted waters.

Some scientists believe that the long-term and synergistic effects of pharmaceuticals and other chemicals are not known and advise people to be cautious in disposing of them. They are especially concerned that many of these drugs have the potential to interfere with hormone production. Chemicals that have this effect are called endocrine disruptors and are attracting the attention of water-quality experts.[9]

Researchers at Italy's University of Insubria designed a cocktail of 13 drugs in order to mimic the mixtures found in several Northern Italian rivers and in wastewater and examined the effects of the cocktail on human cells. Published in the March 2006 issue of *Environmental Science & Technology Online*, **the study found that the cocktail of contaminants inhibited the growth of human embryonic kidney cells. After the cells were exposed for 48 hours, their proliferation was reduced by 10 to 30 percent compared to the control values.**[10]

Treatment Options

According to an article in the January 30, 2006, edition of the *Los Angeles Times*, **"Southern California water-quality officials have learned that an array of hardy pharmaceuticals [is] defying even the most sophisticated sewage treatments in use."**[11] Margaret Nellor, an environmental consultant who specializes in the effluent discharged from sewage-treatment plants, remarked, "Most pharmaceuticals are designed to be tough, because they have to get through your body to have a therapeutic effect."[12] Pharmaceuticals "cling" to water, and different classes of pharmaceuticals cling in different ways, requiring different treatment technologies to remove the various contaminants.

Although research on effective wastewater treatment continues, certain methods such as reverse osmosis and the use of granular activated carbon and powdered activated carbon have been found to be effective in removing certain classes of pharmaceuticals from water. However, flocculation with iron chloride and slow sand filtration have been found to be ineffective in removing most classes of pharmaceuticals from water. **Technologies that have been identified as effective in removing drugs from water are relatively expensive; in fact, Orange County, Calif., is spending $500 million to build the world's most advanced sewage-recycling plant.**[13]

In addition to technological and fiscal concerns, there is the problem of deciding which agency will address which issues. Solving the problem of drug contamination in water will require collaboration between the FDA and the EPA, since the FDA does not usually address environmental concerns and the EPA generally does not deal with drug issues.

Wildlife Concerns

Scientists have been analyzing the effects of pharmaceutical dumping on fish and other animals. Dr. David Walker, an environmental biologist at the University of Arizona, has observed, "The female fish are becoming more masculine and the male fish are becoming more feminine over time. It is a possibility that some of the effects we see in these fish can also occur in humans."[14] Dr. Tyrone Hayes, a biologist at the University of California, Berkeley, refers to this phenomenon as "chemical castration and feminization."[15] According to a report authored by the environmental commissioner of Ontario, Canada, exposure to waste drugs has delayed reproduction in female fish; disrupted development of fish's circulatory systems, eyes, and bladders; and caused damage to fish's kidneys and livers.[16] Dr. David Epel of Stanford University's Hopkins Marine Station in Pacific Grove, Calif., has expressed particular concern about new drugs called efflux-pump inhibitors. Designed to keep microbes from rejecting the antibiotics that are intended to eliminate them, efflux-pump inhibitors also impede animals' abilities to get rid of toxins. Epel worries that if pump-inhibiting drugs enter aquatic environments, they might render wildlife vulnerable to concentrations of pollution that had previously been harmless.[17]

According to a 1999 article in *Environmental Health Perspectives Supplements*, medications "could lead to cumulative, insidious, adverse impacts" on aquatic ecosystems—including declining reproduction and survival rates—that can "accumulate over time to ultimately yield truly profound changes," even in protected areas like national parks.[18]

The Covance Connection

If Covance opens a facility in Chandler, the company will infuse hundreds of thousands of animals with drugs and chemicals that will then be dumped into Chandler's public sewer system. According to the Arizona Water Resource, "Some scientists believe arid regions of the West are especially vulnerable to the effects of drug-contaminated effluent. These areas are more likely to have streams that rely almost entirely on effluent for flow, especially during dry months. Further, effluent is extensively used in irrigation and even for recharging drinking water aquifers."[19] Dr. Thomas Ternes, a leading authority on the presence of pharmaceuticals in the environment who is based at the Technical University of Berlin, has noted that sewage effluent may constitute at least half the volume of water in many of the smaller rivers in Germany.[20] Dr. Christian Daughton of the EPA has predicted, "In areas of water scarcity, we'll see more and more reuse of treated sewage to meet drinking water needs." This would increase the likelihood that pharmaceuticals will end up in drinking water.[21]

Drs. Ternes and Daughton wrote in the journal *Environmental Health Perspectives*, **"The enormous array of pharmaceuticals will continue to diversify and grow as the human genome is mapped. Today there are about 500 distinct biochemical receptors at which drugs are targeted. … The number of targets is expected to increase 20-fold (yielding 3,000 to 10,000 drug targets) in the near future." The authors note, "This explosion in new drugs will severely [diminish] our limited knowledge of drugs in the environment and possibly increase the exposure/effects risks to nontarget organisms."**[22]

Conclusion

Around the world, waterways and groundwater basins are becoming virtual drugstores because they contain low doses of hundreds of prescription drugs that are excreted by animals in drug-testing facilities, excreted by humans, and flushed down drains.

The proposed Covance facility in Chandler would introduce a population of animals greater than Chandler's current human population into the city. However, unlike the city's human residents, all the new nonhuman animal residents of Chandler—dogs, primates, rabbits, cats, guinea pigs, pigs, ferrets, mice, and rats—will consume and excrete enormous amounts of test drugs and other chemicals.

Within the next five to 10 years, as government policies fall in line with the science on the emerging threat that pharmaceuticals pose to our waterways, municipalities will be forced to ensure that pharmaceutical contamination of sewage effluent falls within legally mandated levels. The proposed Covance facility in Chandler will test new pharmaceuticals for which water-treatment technologies may or may not exist. Furthermore, the amount of pharmaceuticals dumped by Covance into the sewage system will dwarf the amount produced by Chandler's human population. **By opening its doors to Covance, the city of Chandler will saddle future generations of Chandler residents with an enormous fiscal burden: initial investments in sewage-treatment technologies in order to remove pharmaceutical contamination and continual updates to these technologies in order to handle new classes of drugs that are tested on animals at Covance.** In effect, Chandler residents will find themselves wondering—every time they take a drink of water and every time their children bathe, swim, or play in water—whether the water is safe and whether they, themselves, are test subjects in this foray into uncharted waters.

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