

# Pharmaceuticals in the Water

A look at an emerging and pressing issue

Nina Savransky ninsense@brandeis.edu  
Professor Laura Goldin  
Senior Essay ENV 98

## **Introduction:**

As the Earth's population increases, so does the need for adequate amounts of freshwater (Oki and Kanae, 2006). With roughly 6.6 billion people currently occupying the earth, competition for the earth's limited freshwater supply is growing rapidly (U.S. Census Bureau, *World PopClock*; Oki and Kanae, 2006). Although most of the earth is comprised of water only 2.5% of it is freshwater and even less than that is suitable and available for drinking (Oki and Kanae, 2006). Countries across the world are realizing that careful water management is imperative for future generations and it is quickly becoming a highly controversial natural resource across the world (Gleick, 2004). Current initiatives are recent, however, and the realization of their essential role in our lives has not prevented us from abusing our water sources (Gleick, 2004).

Relative to other resources it is not as expensive and there are relatively few regulations that govern its use and management (Daughton, 2004). This has led to wasteful utilization and irresponsible contamination of our water, which has inadvertently led to various conflicts and health hazards (Schwarzenbach *et al.*, 2006). Currently, there are thousands of industrial and natural chemicals that are polluting our water supply

(Schwarzenbach *et al.*, 2006). Specifically in the case of pharmaceuticals, personal care products, hormones, pesticides and other chemical compounds that are released into the water supply, unprecedented health hazards are coming to light that were previously neglected, incurring a rising need for increased legislature (Daughton, 2004). Across the globe, studies are being carried out in order to ascertain the gravity of the situation and the action that needs to be taken in response to this new threat to our drinking water (Schwarzenbach *et al.*, 2006).

The issue of pharmaceuticals in the water first became public knowledge in the 1980s when researchers from Seattle to Berlin started reporting the presence of antibiotics and hormones in the environment (Quick, 2005). Only in the 1990s, however, did the implications of aspirin, nicotine and caffeine leaching into the water supply reach the public (Quick, 2005). To this day, caffeine and nicotine along with various pharmaceuticals are not managed carefully because they are not acknowledged as dangerous wastes (Goldbaum, 2005). Instead of being treated as toxic or hazardous they are overlooked entirely and current disposal methods do not go much farther than spilling them down the drain or into the toilet (Goldbaum, 2005). In this situation, the pharmaceuticals go through standard wastewater processes, which filter the water for nitrates, phosphates and carbons but neglect to filter any antibiotics, anti-cholesterol, psychoactives, hormones or other potentially harmful drugs (Smith, 2005).

Diana Aga, Ph.D. assistant professor of chemistry at the University of Buffalo and leader of a team of chemists that have identified metabolites of antibiotics and medical imaging agents in wastewater treatment plants, has noted that it is only in the past five or six years that people have been able to identify pharmaceuticals and their metabolites at

the part per billion or part per trillion dosage that they exist in waste water (Goldbaum, 2006). The analytical chemistry techniques used today show that even if the active ingredient of a pharmaceutical is not detected in the effluent, it may be because it has broken down into compounds that may still have disastrous ecotoxicological effects (Goldbaum, 2006). Treatment facilities that manage waste water are designed to target and minimize the prevalence of nitrates, phosphates and organic carbon (Smith, 2005). They are not intended to filter out chemicals from personal care products and various drugs that end up in the treated waste water and back in the tap (Goldbaum, 2006).

In this paper I will be describing the issue of chemical contaminants in our water system, where they are coming from, what effects they are having on the environment and on people and what is being done to alleviate the situation in the United States. Finally, I will conclude with an analysis of wastewater treatment, the need for safer chemical alternatives to current compounds, and the need for interception of water contaminants before they get to the water system.

## **Current Pharmaceutical Statistics**

Waste production is on the rise, especially in developed countries that have a high level of manufacture (Schwarzenbach *et al.*, 2006). In the United States alone, antibiotic use has increased greatly. In 1997, when the US population consisted of 270 million people, the country used 4,800,000 kg of antibiotics just for humans (Smith, 2005). This was roughly two thirds the amount of antibiotics that was procured for farm animals (7,234,000 kg) that same year (Smith, 2005).

From 2003 to 2004 drug sales increased by 8.3% as the amount of money being spent on drugs in the US went from \$217.3 billion to \$235.4 billion (IMS, *IMS Reports 8.3 Percent Dollar Growth in 2004 U.S. Prescription Sales*). In 2004, the annual percent increase of drug sales through the year 2008, as calculated by IMS, was 7.5% to 8.5%. The following year, the sales of prescription drugs increased from \$238.9 billion in 2004 to \$251.8 billion in 2005 (IMS, *IMS Reports 5.4 Percent Dollar Growth in 2005 U.S. Prescription Sales*). With the production and consumption of pharmaceuticals on the rise, it is not surprising that there is also an increase of pharmaceutical compounds in our water systems. Though concentrations of pharmaceuticals in various water sources are considered very small (see Table 1), it is these minute concentrations that are having a major impact on the environment (Daughton, 2005).

Table 1: Environmental concentrations of Pharmaceuticals	
Drinking water	0.3 ug/L
Surface water	2 ug/L
Groundwater	1 ug/L
Municipal sewage (treated)	10 ug/L
Biosolids (treated)	10,000 ug/kg
Agricultural soils	10 ug/kg

Table 1: Concentration of pharmaceuticals in various environments as of 2005. Treated biosolids have the highest concentration of pharmaceuticals while drinking water has the lowest concentration. (Smith. 2005)

There are many ways in which pharmaceuticals may end up in our water supply (See Figure1). Many pharmaceutically active compounds are excreted unchanged or only slightly altered after they have been ingested and processed by the body (Heberer, 2002). They may break down to polar molecules in the body and break up further in the

wastewater treatment system, leading to the introduction of unforeseen chemical compounds back into natural aquatic environments (Daughton, 2004).

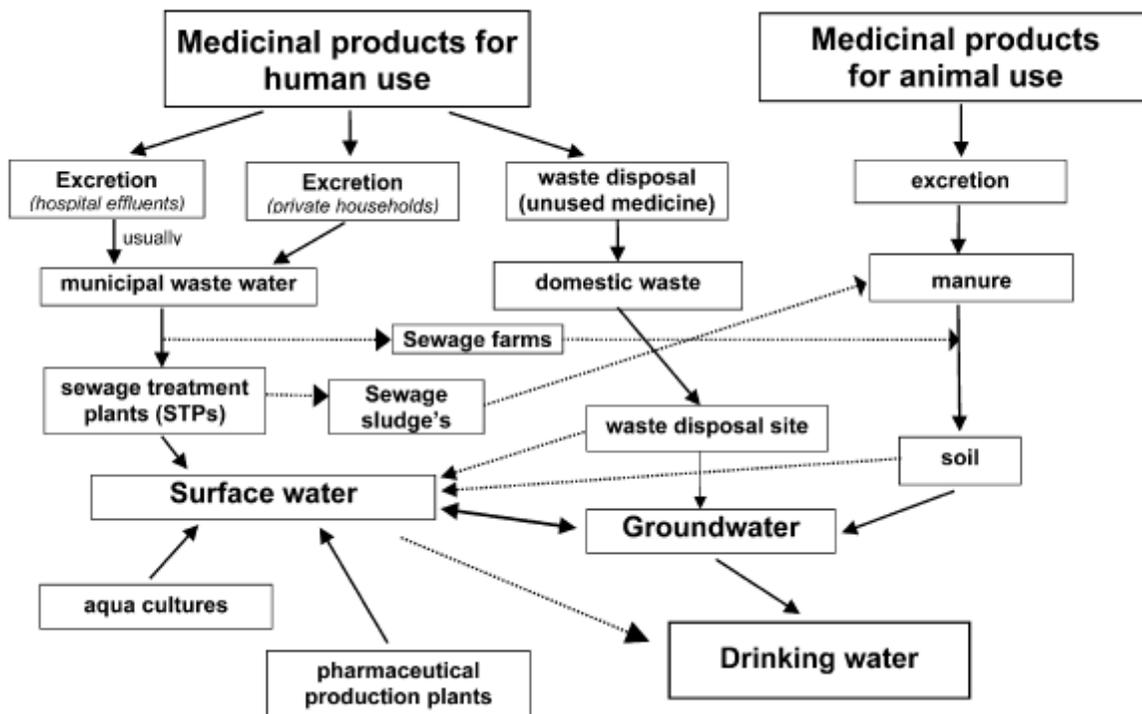


Figure 1: Possible pathways that pharmaceuticals could take to end up in our drinking water (Heberer, 2002).

Effluents from municipal sewage treatment plants are thus the main source of contamination of rivers, streams and various other water sources (Heberer, 2002). Not surprisingly, the compounds that come out of waste water treatment plants do not biodegrade in the environment (Schwarzenbach *et al.*, 2006). To the contrary, these chemicals often bioaccumulate in soils, plants, animals and other aquatic life forms (Schwarzenbach *et al.*, 2006). Due to a natural phenomenon called recharge<sup>1</sup> they may end up in groundwater aquifers, thus finding their way into our drinking water (Heberer, 2002).

<sup>1</sup> Recharge, particularly groundwater recharge, is a term used for the natural or artificial process of precipitation percolating down to restore the saturation of an aquifer (EPA, *Terminology Reference System*).

Leachates from landfills are another source of medical chemical contamination. Only landfills that contain chemicals deemed hazardous wastes are built to keep effluent from leaking out of them (EPA, *Hazardous waste identification*). The United States Environmental Protection Agency (EPA) designates wastes to four different categories, F, K, U and P depending on their hazardous severity<sup>2</sup> (EPA, *Hazardous waste identification*). It is according to these classifications that the EPA designates what type of landfill the waste may go to. Only the most toxic chemicals end up at landfills that sequester them away from the environment (EPA, *Hazardous waste identification*).

Agriculture is also responsible for a large amount of pharmaceutical deposits in aquatic environments (Heberer, 2002). Chemical feed additives in livestock fodder are included for breeding purposes. Just as in humans, however, these chemicals are not absorbed completely by the body and are excreted into the environment (Daughton, 2005). Unlike the human situation, livestock manure enters directly into the environment instead of circulating through waste treatment facilities (Heberer, 2002). Veterinary drugs administered to animals as preemptive efforts to keep livestock healthy or as treatment for various ailments also get excreted and follow the same pathways into water systems (Heberer, 2002).

Due to past regulations not taking environmental contamination into consideration, many hazardous practices were allowed to carry on without proper

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<sup>2</sup> F, K, U, P Listed Wastes:

F- Non Specific Source Wastes generated by different industries. Solvents used in research laboratories, pharmacies and morgues (methanol, acetone, and methylene chloride)

K-Generated by specifically identified industries. Not usually health care facilities

U- discarded commercial chemical products. These chemicals must be unused and commercial grade, 100% pure, and the only active ingredient in formation.

P- Like U listed but are considered acutely hazardous. 1 kg generated per month will define a large quantity generator (EPA, *FKUP hazardous wastes*)

monitoring or restriction (Heberer, 2002). Past contaminated sites, especially those considered to be superfund sites,<sup>3</sup> may be partially responsible for the amounts of pollutants we find in the environment today (Heberer, 2002).

## **Research**

Though traces of pharmaceutical compounds were found in sewage treatment plants and effluent from landfills in the 1980s it wasn't until the 1990s that active drugs in the form of hormones, antibiotics, antiseptics, analgesics, chemotherapy and beta blocking heart medications were found in water sources that were later used for imbibing (Daughton, 2004). Waste water, ground water and streams throughout Europe were noticed to contain the above mentioned pharmaceuticals in addition to prescription and non prescription drugs, animal and plant steroids, detergent metabolites, products of oil use and combustion, flame retardants, personal care products and other chemicals that are now known as organic wastewater contaminants or OWCs (Barnes *et al.*,2000).

### ***The USGS Study of 1999-2000***

The first nationwide investigation of hormones, pesticides, antibiotics, steroids, detergent metabolites and other chemical compounds was completed by USGS in 1999 (Barnes *et al.*,2000). The Water Quality Study encompassed 139 streams within 30 states testing for 95 pharmaceuticals and other organic wastewater contaminants (OWCs). The testing was slightly biased in that many sites were located near to or downstream of

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<sup>3</sup> A Superfund site is a toxic waste location that may have been unregulated in the past. These may be sites of chemical spill or dumps that have accumulated a lot of hazardous waste. These sites are designated superfund sites by the Environmental Protection Agency (EPA) and are set aside for special monitoring and cleanup (EPA, *Superfund*).

urbanized centers or places that had a lot of livestock (Barnes *et al.*,2000). The results of this reconnaissance were still daunting, however, showing that many agricultural, industrial, and domestic effluents carry organic substances into streams (See Figure 2) (Barnes *et al.*,2000).

Of the 95 OWCs tested for, 82 were found in at least one of the streams (Kolpin *et al.*, 2000). One or more OWCs was found in 80 % of the streams and 13 % of the streams had 20 or more OWCs detected in them (Barnes *et al.*,2000). The study was the first to test the susceptibility of streams to chemical contaminants and the occurrence of the same OWCs in different places throughout the country (Kolpin *et al.*, 2000). The various methods in which the pharmaceuticals were tested provided good examples of testing strategies, research priorities and ideas for future studies (Kolpin *et al.*, 2000). The findings themselves spurred many private research experiments on toxins in the water systems (Barnes *et al.*,2000).

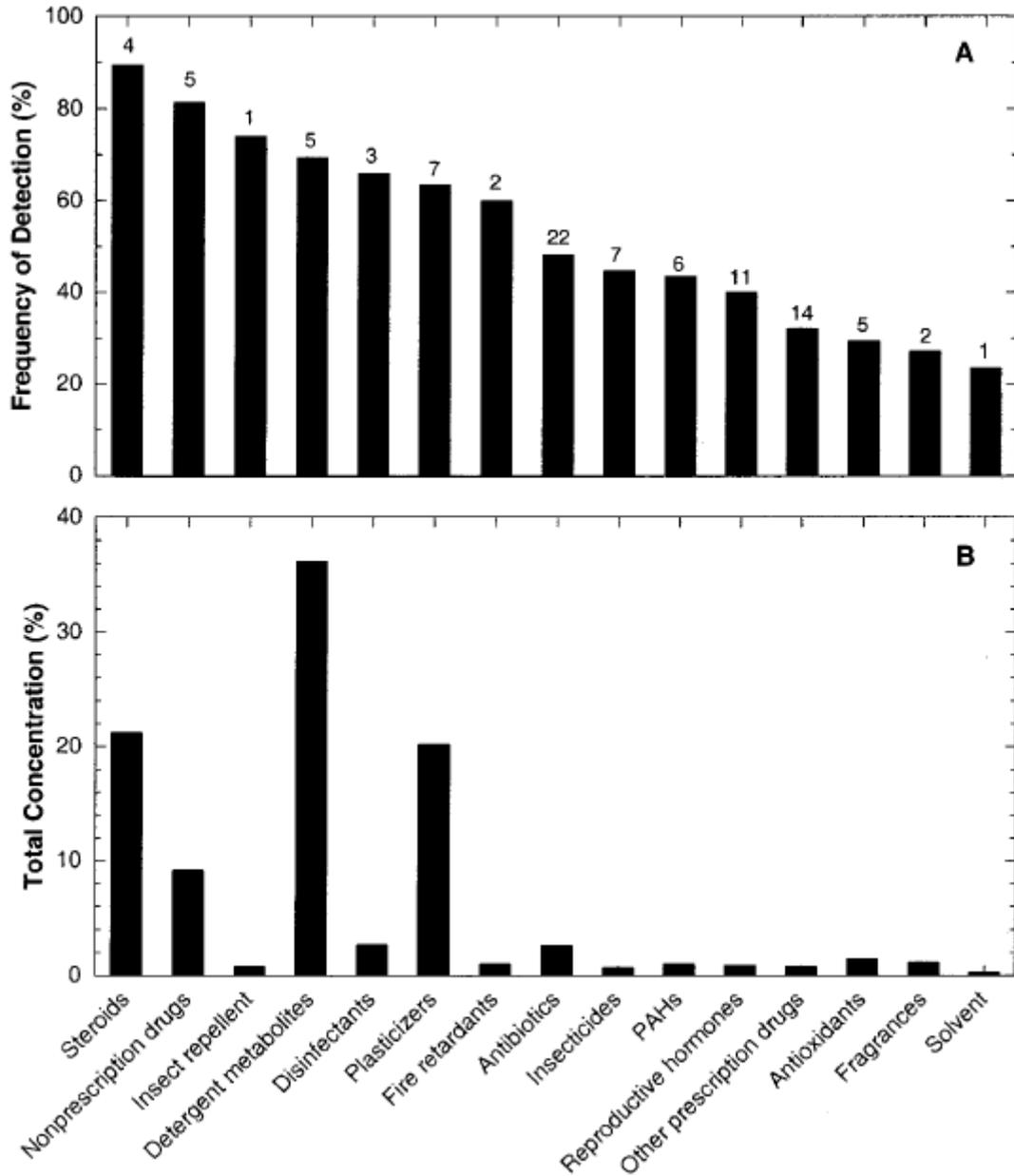


Figure 2: Frequency of detection of various Organic Wastewater Contaminants and their concentrations. The numbers above the bars represent the number of chemical compounds that were tested for in each category (Kolpin *et al.*, 2000).

### **Aquatic Life**

Pharmaceuticals and personal care products that are spilled down the drain, flushed down the toilet, or introduced directly into rivers have a large impact primarily on the aquatic life they come into contact with (Heberer, 2002). Even at small

concentrations, the side effects of chemical contaminants are debilitating to marine ecosystems (Quick, 2005). This is becoming an internationally recognized burden as studies throughout Europe and the United States have produced data showing the effects of hormones such as those found in female contraceptives (the pill) and hormone replacement therapy (HRT) on fish and other aquatic life forms (Macrae, 2006).

The hormones are excreted by people on the medication or are found in soaps and detergents, the compounds of which mimic estrogen (Macrae, 2006). They survive the sewage treatment plants and are released into our waterways, affecting the wildlife they come into contact with (Trubo, 2005). The result is an abnormal rise in changes in fish exposed to these hormones. Male fish change sexes at an alarmingly high rate, sometimes producing eggs and female tissue (Trubo, 2005). If they produce sperm at all, there is little of it and its quality is inadequate when it comes to fertilizing females' eggs (Davis, 2005). Female fish are affected as well, producing abnormal eggs that are incapable of becoming fertilized or adopting male characteristics (Davis, 2005).

Rebecca Klaper, researcher at the University of Wisconsin-Milwaukee's Great Lakes Water Institute was concerned about the effects of pharmaceuticals being introduced into rivers and lakes (Quick, 2005). She carried out an experiment on fathead minnows, a long silver fish that is native to Wisconsin (Quick, 2005 and Grimm, 2007). She introduced the fish into a body of water containing a dose of one part per billion of antibiotic (Quick, 2005). This particular dosage has been observed in various water bodies throughout Europe and South America, as well as several lakes in North America (Smith, 2005). For reference, the dosage was equivalent to several drops in a container as large as an oil tanker (Quick, 2005).

Though Klaper had planned to carry out the experiment for a week, it had to be terminated within 24 hours because the fish were starting to die (Quick, 2005). They had released a milky mucous in response to the stress that the antibiotic had put on their system (Quick, 2005). The mucous and other piscine secretions created conditions in which the fish could not survive if they remained in the water (Quick, 2005). Particular concerns arose when Klaper analyzed her research to find that some of the same biochemical pathways were activated in both fish and humans by the specific drugs (Grimm, 2007).

Further experiments on fathead minnows showed various responses to specific drugs. Medications such as Lipitor and Zocor, which act as lipid inhibitors in humans, caused the fish to leave fat in their eggs (Grimm, 2007). This affected the reproduction of the eggs. Antidepressants such as Prozac caused behavioral changes in the male fish. According to Klaper, they did not properly prepare the females for laying their eggs (Grimm, 2007). If this process continued to be disrupted, the cycle of egg laying and reproduction could be greatly hindered.

Klaper went on to do experiments with daphnia, a small shrimp-like organism that is considered a keystone species<sup>4</sup> to see the effects common pharmaceuticals would have on biological food chains in water bodies (Quick, 2005). Commonly used drugs disrupted the sex ratios of the daphnia causing a slowing in their feeding behavior and a decline in their population (Quick, 2005). Because daphnia are a main food source for other aquatic organisms, a decline in their population takes a toll on the entire food chain and serves as

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<sup>4</sup> A keystone species is one that has a disproportionate effect on its ecosystem relative to its size. Keystone species greatly affect the feeding structures of many animals within their ecosystems as well.

a warning that something is wrong (Quick, 2005). Klaper is not the only one doing these studies, however.

Scientists at the University of Georgia found that exposure to antidepressants caused a retardation of fish and frog development (PETA, *Pharmaceuticals in the water supply*). The developmental delay was most disastrous in tadpoles that dry out and die if their metamorphosis takes too long (PETA, *Pharmaceuticals in the water supply*).

Meanwhile, scientists at the University of Colorado found that intersex characteristics were present in sucker fish (Human, 2006). These fish contained both male and female parts and were difficult to tell apart (Human, 2006). The same phenomenon has been reported in the Potomac River in the eastern United States (Grimm, 2007). Throughout the country, smallmouth bass researchers have reported that 80% of the male bass are growing eggs (Grimm, 2007). This is due to the hormone drugs as well as estrogen or estrogen mimicking chemicals that are present in the water (Daughton, 2004).

Aside from daphnia and fish it is possible that these drugs could be harmful to humans (Daughton, 2005). Aquatic scientists are struggling to come up with concrete evidence that the effects on fish are indicative of what will happen to humans should they be exposed to low doses of chemicals in the drinking water over long periods of time.

The difference in the developmental stage at the time of exposure and the duration of the exposure are the key factors in the difference between pharmaceutical effects on humans and aquatic life (Grimm, 2007). Fish are exposed to a mixture of chemical compounds at a very early stage, while the pharmaceuticals are meant for the consumption of adult human beings whose bodies are not as affected by the drugs (Grimm, 2007). The fish are

also constantly exposed to the contaminants while humans would be exposed to minute levels of these compounds in their drinking water (Grimm, 2007).

## **Fish as Indicators**

Fish are considered to be the canaries in the coal mine indicator for chemicals that enter our water system (Biello, 2007). Not only are they the first to be affected by waste water contaminants, they also store the chemicals within them and pass the contaminants on to animals or people that eat them (Schwarzenbach *et al.*, 2006).

Conrad Volz, co-director of exposure assessment at the University of Pittsburgh Cancer Institute's Center for Environmental Ecology, completed an experiment testing for cancer causing reagents in fish (Biello, 2007). The study consisted of fish donated by fishermen in the Pittsburgh area. In all they collected 21 samples of catfish and 6 white bass as well as some store bought fish to use as controls (Biello, 2007). The donated fish were found along the Allegheny and Monogahela rivers, near large sewer outflows. The researchers bathed a breast cancer cell line containing estrogen receptors in extract from the skin, fat and flesh of the fish (Biello, 2007). The experiment tested for hormones, which would cause the cancer cells to proliferate. As a control, pure estrogen was spread on the cell line as well (Biello, 2007).

The cells multiplied under the control and in 5 cases of catfish and 2 cases of the bass (Biello, 2007). The fish whose extracts produced the highest amount of cell growth were the ones found at the conjunction of the water carrying the sewer outflow and the water carrying the sewage treatment plant's outflow (Biello, 2007). This place is called

the Point and according to Volz it "is the largest concentration of combined sewer outflows in the US" (Biello, 2007).

Volz credits the sewage for the amount of estrogenic compounds found in our wastewater (Biello, 2007). Since ingested hormones are not completely absorbed by the body, they are excreted into our waste water system along with antibacterial soaps and plastics. While the effects on humans have not been fully proven, the effects on fish are clear. In Volz's study, the gender of the fish could not be determined because they had both male and female parts (Biello, 2007). The store bough fish not only made the cancer cells grow, it also had higher levels of arsenic, mercury and other pollutants (Biello, 2007).

### ***Evidence of Human Health Hazards***

Though there are many hypotheses, it has yet to be scientifically proven that drugs in the water could cause serious health risks in human beings (Biello, 2007). In the long run, as the wastewater that is released into the rivers and lakes is the same that some people drink every day the concern lies most with young children or babies still in the womb (Quick, 2005). Hormone replacement therapy, birth control pills and other medications that introduce hormones into the water seemingly have a greater impact on the offspring of exposed adults than the adults themselves (Quick, 2005).

These hormones break down to become Endocrine Disrupting Chemicals (EDCs) (Daughton, 2004). The endocrine system includes glands such as the thyroid, adrenals, ovaries and testicles and endocrine disruptors are chemicals that interfere with the normal function of the endocrine system (Trubo, 2005). They mimic, block, and incite various responses in the hormones of their host (Trubo, 2005). The potential threat of such

disruption in human beings could lead to low sperm counts in men, infertility in women, genital deformities, hormonally triggered human cancers, neurological disorders such as attention deficit hyperactive disorder (ADHD), lowered IQ and increased rage reaction especially in young children and newborns (Ourstolenfuture [OSF], 2006). The EPA currently tests for approximately 90 chemicals, making sure that they are not present in our water supply due to their health hazards (Trubo, 2005). The chemicals the EPA does not test for, however, may be contributors to major health hazards in humans as well (See Table 2). In this paper I focus on several chemicals that have recently been reported about. Though there is much research going on currently and every week brings new reports of pharmaceuticals having hazardous effects on animals and humans, I am using several chemicals as representatives of the entire scope of pharmaceuticals that find their way into our water supply.

Table 2: Various chemicals, examples of where they are found and health problems resulting from their ingestion

Origin/usage	Class	Selected examples	Related problems
Industrial chemicals	Solvents	Tetrachloromethane	Drinking-water contamination
	Intermediates	Methyl-t-butylether	
	Petrochemicals	BTEX (benzene, toluene, xylene)	
Industrial products	Additives	Phthalates	Biomagnification, long-range transport
	Lubricants	PCBs (polychlorinated biphenyls)	
	Flame retardants	Polybrominated diphenylethers	
Consumer products	Detergents	Nonylphenol ethoxylates	Endocrine active transformation product (nonylphenol)
	Pharmaceuticals	Antibiotics	Bacterial resistance, nontarget effects
	Hormones	Ethinyl estradiol	Feminization of fish
	Personal-care products	Ultraviolet filters	Multitude of (partially unknown) effects
Biocides	Pesticides	DDT	Toxic effects and persistent metabolites
		Atrazine	Effects on primary producers
	Nonagricultural biocides	Tributyltin	Endocrine effects
		Triclosan	Nontarget effects, persistent degradation product (methyl-triclosan)

Geogenic/natural chemicals	Heavy metals	Lead, cadmium, mercury	
	Inorganics	Arsenic, selenium, fluoride, uranium	Risks for human health
	Taste and odor	Geosmin, methylisoborneol	Drinking-water-quality problems
	Cyanotoxines	Microcystins	
	Human hormones	Estradiol	Feminization of fish
Disinfection/oxidation	Disinfection by-products	Trihalomethanes, haloacetic acids, bromate	Drinking-water-quality, human health problems
Transformation products	Metabolites from all above	Metabolites of perfluorinated compounds	Bioaccumulation despite low hydrophobicity
		Chloroacetanilide herbicide metabolites	Drinking-water-quality problems

Table 2: List of several examples of common water pollutants. Water contaminants are not targeted in our wastewater facilities and are released back into the environment causing large ecotoxicological effects on aquatic life (Schwarzenbach *et al.*, 2006).

Scientists at University of California, San Francisco and the Collaborative on Health and Environment have found that there is growing evidence of the similarity between effects of pharmaceuticals on laboratory animals and people (Hileman, 2007). Due to such chemicals as bisphenol-a (BPA) and various phthalates, there is evidence that the male reproductive may be faced with serious damage (Hileman, 2007).

## **Bisphenol A**

Bisphenol-A (BPA) was created in the 1930s as a synthetic estrogen but was not in great demand until industry chemists in the 1950s found that it had a commercially beneficial quality (Hileman, 2007). When added to plastics, it had the ability to make them shatterproof. Today, it is found in baby bottles, the lining of tin cans, Nalgene bottles and other hard plastic products. Even at low levels, it acts as a hormone,

disrupting the normal activity of chromosomes, especially in young children (Hileman, 2007).

In March of 2007, the Environmental Working Group, a non profit research organization located in Washington DC, reported that out of approximately 100 samples of canned food tested all were found to be leaking bisphenol-A (Fischer, 2007). The Environmental Working Group did a study comprised of finding the amount of bisphenol-A in bean, soup, tomato sauce, tuna and infant formula cans (Fischer, 2007). Fifty five cans were tested, the results showing that concentrations as high as 10 to 18 parts per billion were contained in cans of chicken soup and infant formula (Fischer, 2007).

Scientists found that feeding rats a daily dose of 20 parts per billion resulted in damage in their offspring's reproductive system while the safe exposure dose that is recommended by the EPA is 50 parts per billion (Fischer, 2007). The U.S. Food and drug sample that they base their recommendations on is based on fewer than twenty samples of analysis (Fischer, 2007). While these are the current statistics, the government's aim is to keep the exposures of harmful chemicals 1,000 to 3,000 times below the concentration found to be harmful to laboratory animals (Fischer, 2007).

An organization called Environment California carried out an independent study to see if the use of plastics over long periods of time would reduce their emissions of the chemical. They attempted to simulate used plastic baby bottles to find the amount of bisphenol-A, if any, that was leaking out of them (Fischer, 2007). Baby bottles were baked at 176 degrees for 24 hours. The results showed that the amount of chemicals, BPA in particular, leaking out of the plastic bottles was found to be nearly exactly the

same as in tin cans (Fischer, 2007). The health hazards escalate with the increase of exposure to the chemical.

Incidences in testicular cancer, which primarily affects young men, have risen in industrialized countries (Hileman, 2007). Asian and African countries remain at a constant state of cancer cases while the past 50 years have seen an increase of testicular cancer in Europe. In the past 50 years there have been three to four times more cases of testicular cancer in Europe (Hileman, 2007). Though the research is inconclusive there is reason to believe that the population decline in Scandinavia and various European countries may be due to the rise in the afore mentioned chemical products (Hileman, 2007).

In several European countries, men's semen quality has severely deteriorated (Hileman, 2007). While recent scientific publications have noted that fecundity decreases when a sperm count is lower than 40 million spermatozoa per mL, twenty percent of men between the ages of 18 to 20 have sperm counts that are below 20 million per mL (Hileman, 2007). Forty percent of the same demographic have sperm counts below 40 million per mL. In addition 93 percent of sperm are abnormal in 18 to 20 year old men in Denmark (Hileman, 2007). Conditions such as cryptorchidism, in which the testicles do not descend, and hypospadias, where the opening of the urethra is on the side of the penis rather than the end of it, have also risen considerably (Hileman, 2007). According to Niels E. Skakkebaeks, a physician at Copenhagen University Hospital, 95 percent of testicular cancers are caused by complications with the fetus while it is still in the womb (Hileman, 2007).

Experiments on lab rats are useful in these studies since the development of mammals is similar to that of humans. Since rats reproduce quickly and have many offspring, they are often used in research experiments concerning the effects of chemicals on reproductive processes. Richard M. Sharpe, a research scientist at the Human Reproductive Sciences Unit of the University of Edinburgh, Scotland, exposed rats in their last week of pregnancy to copious amounts of n-dibutyl phthalate (DBP). Sharpe then observed the effects of the chemical on the rats' offspring. The result was an 80 percent rate of abnormality in their germ cell development. Though cancer was not an apparent side effect in the mice, developmental disorders in the fetal stage are the reason for testicular cancers that develop later on (Booth, 2007).

Shana H. Swan, professor of obstetrics and gynecology at the University of Rochester found an annual 1 percent decrease in the sperm count of men in Western Europe and North America for the past 50 years (Stein, 2007). Recent studies have found a similar decline in men in Copenhagen and Boston. This research points to the conclusion that some sort of chemical exposure is responsible for the decline (Stein, 2007). One such group of chemicals is called phthalates. Phthalates are found in most scented personal care products and cleaning products. Although it hasn't been proven, phthalates are considered to have a detrimental effect on the male reproductive system (Stein, 2007).

Recent tests have shown that phthalates and polycyclic fragrances that are added to personal and household products to ameliorate their smells, have been showing up in high quantities in breast milk (Booth, 2007). The possible repercussions this could have for the infants, especially if they are male are daunting to think about.

Donald A. Berry, researcher at the University of Texas has proven that lowering the amounts of hormone use in treating women has led to a decrease in the number of cancer cases each year (Stein, 2007). Estimates calculated during the research process showed that 16,000 fewer cases of breast cancer were being diagnosed each year and this had a direct correlation with the amounts of hormones being consumed by women. The fact that the medical system was doing this to their own patients is astounding to most researchers. It certainly points to the need for drugs to be properly tested before they are put on the market. It also calls for a reduction in the amount of hormone use by women today, who may be unaware of the consequences of their treatments (Stein, 2007).

### **Phthalates, pesticides and estrogen**

In an interview on the links between asthma and prostate cancer and toxic chemicals, Dr. Pete Myers, chief scientist for the Environmental Health Sciences (publisher of Environmental Health News), confirmed that there are very strong connections between the decline of human immune systems and the rise of contaminants in our water (Curwood, 2007). These effects have been noticed especially in developed countries where asthma, various allergies and various cancer cases are on the rise (Curwood, 2007).

Since the human immune system takes cues from estrogen levels in the body to calibrate its sensitivity, an abnormal rise in estrogen would make the system more sensitive (Curwood, 2007). Since estrogen mimicking contaminants are found in the environment in ever increasing amounts several scientists carried out experiments using

cells from mice and humans. They exposed these cells to estrogenic compounds that would have been found in the environment, finding that the immune systems of the cells were greatly affected (Curwood, 2007). Myers speculated that organic pollutants, pesticides and various chemicals used or deposited in our environment have bioaccumulated and are affecting people in the large doses in which they occur in nature (Curwood, 2007).

## Government Policy

Despite the overabundant amount of research that has given fair reason to assume that no pharmaceuticals should be flushed down the toilet or spilled down the drain into our water system, no matter how harmless we think they may be, people are still not complying with these requests. This may be due to the mixed messages that the public receives from the government, which still encourages the flushing of several medications<sup>5</sup>

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<sup>5</sup> Description of each of the thirteen medications the Federal Drug Administration still recommends that American flush down their toilets.

**Actiq** (fentanyl citrate) - A schedule II opioid prescribed to opiate tolerant individuals for extreme cancer pain that is in the form of a lollypop.

**Daytrana Transdermal Patch** (methylphenidate) - A daily patch used for the treatment of ADHD in children.

**Duragesic Transdermal System** (fentanyl) - An opiate pain reliever delivered through the skin via a three-day patch.

**OxyContin Tablets** (oxycodone) - Controlled release tablet of the narcotic pain reliever oxycodone. Prescribed for around the clock pain relief.

**Avinza Capsules** (morphine sulfate) - Extended release morphine, taken once a day to manage moderate to severe pain.

**Baraclude Tablets** (entecavir) - Is used for chronic infection with hepatitis B virus in adults who also have active liver damage.

**Reyataz Capsules** (atazanavir sulfate) - Is an azapeptide inhibitor of HIV.

**Tequin Tablets** (gatifloxacin) - Antibiotic used to treat bronchitis, urinary tract infections, kidney infections, pneumonia, sinusitis, and certain STDs. This drug has been discontinued in the United States.

**Zerit for Oral Solution** (stavudine) - A powder mixed to with water to form a solution used for the management of HIV. Zerit is a nucleoside analogues.

**Meperidine HCl Tablets** - Meperidine is used to relieve moderate to severe pain. Meperidine is in a

(See Figure 2). Additionally the section of the white house website that gives advice on medication disposal uses difficult and confusing language when describing proper waste disposal methods (See Appendix 1). The site uses language such as “Flush prescription drugs down the toilet only if...” which would confuse people who skim over instructions and deduce that they should flush all medications (White House, *Proper Disposal of Prescription Drugs*). The site also uses language that is written at a higher reading level than is common to most of the United States, which further serves to confuse the general public.

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class of medications called narcotic analgesics, a group of pain medications similar to morphine.

**Percocet** (Oxycodone and Acetaminophen) - Is a combination of acetaminophen and oxycodone and is a narcotic analgesic, used to treat moderate to severe pain.

**Xyrem** (Sodium Oxybate) - Is a central nervous system depressant used to treat cataplexy (sudden loss of muscle strength) and reduce daytime sleepiness in narcoleptics. Also known as the street drug GHB.

**Fentora** (fentanyl buccal tablet) - A schedule II opioid pain medication used to treat breakthrough pain in cancer patients.



Figure 3: List of pharmaceuticals that are still recommended to be flushed down the toilet by the executive office of the president. The recommendation confuses people as it sends out the message that it is alright to dump medications down the drain and into the waste water system (White House, *Proper Disposal of Prescription Drugs*)

In response to the rising concerns about negative effects on aquatic ecosystems the American Pharmacists Association has come out with a set of steps to follow when disposing of unused medications (See Appendix 2). Although the American Pharmacists Association's comprehensive review of a safe way of disposing pharmaceuticals is clearly written and simple, the site is preaching to the choir. Firstly, only people who already take measures to safely dispose of their drugs and are interested in the latest recommendations are even going to bother looking at the site. Secondly, even if people formerly unaware of safety disposal procedures were to check the site, few, if any, would follow the tedious process of crushing their medications and mixing them with some sort of kitty litter or coffee grounds (assuming that they have one or the other on hand).

Thirdly, even if all the guidelines were to be met by some all star of medical disposal, putting the waste in a plastic bag could lead to leaks in the landfills, if the bag were to break or open. Once rain fell, the chemicals would leak down through the landfill and in the groundwater (Steve Gresitt, personal comment).

## **The Solution**

Many states are recognizing the issue of pharmaceuticals in the water and taking the lead in trying to control the amounts of drugs that flow into the water. Though refined wastewater treatment is an option, it does not encompass all medical chemicals and their metabolites and would be costly (Daughton, 2005). As more and more states start engaging in proactive projects to alleviate the burden on our water sources, the issue is being publicized and the public is becoming aware that the issue of pharmaceuticals ending up in our drinking water could have long lasting and very serious effects.

## ***Unbiased Research***

The company Sciences International Inc. (SI) was fired by the National Institute of Health (NIH) in April of this year, six weeks after an article in the New York Times outlined the ties between the company and the chemical companies it was reviewing while working for at the same time (Cone, 2007). Sciences International had been working on compiling research on bisphenol-A and 19 other chemicals since 1998 (Layton, 2007). At the time the company was fired it was reviewing 500 studies on bisphenol-A for such companies as Dow Chemicals and BASF who are clients of the company as well (Layton, 2007). NIH had requested that Sciences International compile their research to present a summary of whether or not bisphenol-A poses health risks to humans in front of a board of experts (Layton, 2007). In a press release that came out

April 3<sup>rd</sup> from the Environmental Working Group it was noted that SI “not surprisingly” found no problems when conflicts of interest rose with the chemical agencies that were its clients (Ruzicic, 2007).

Firing the company, and dissolving or firing companies that seek to corrupt scientific research is the first step in protecting our natural resources from companies that seek to exploit them for their monetary values. Hiring contractors that have an interest in science rather than politics should be at the forefront of obtaining valid research about these issues. At the national level this is an important step to take, however various states have shown that they too have the power to make a difference.

### ***California:***

San Mateo County has created a way for unused medications to be collected. It started with a white painted mailbox donated to a police station by the local post office (Chiang, 2006). During a four month pilot program the town collected approximately 590 lbs of expired or unused medications in white-painted mailboxes donated by the U.S. Postal Service (Chiang, 2006). The total cost of the program was \$924, which covered the vehicle that picked up the medication and delivered it to the proper waste disposal facility (Chiang, 2006). In the first six months of the actual program, 1,200 lbs of medicine were collected and disposed of at the cost \$1.60 cost per pound (Chiang, 2006). Supervisor Adrienne J. Tissier has lead this project to its current state, in which people can take their unused, expired and unwanted drugs to four locations (Chiang, 2006). Three of these are police stations while the fourth is the sheriff’s office.

The goals of the program are threefold. Firstly, it intends to help senior citizens avoid errors in taking their medications (Chiang, 2006). As senior citizens are more likely to have a greater amount of prescription medications, there is a higher likelihood of mistakes being made in their consumption, especially when medications are expired or no longer needed. The result can be quite dangerous as many medications become health hazards when taken together. The second goal of the program is to reduce the recreational use of pharmaceuticals (Chiang, 2006). Lastly, the program hopes to prevent the ongoing contamination of various water systems, flora and fauna that are exposed to a plethora of eclectic chemicals daily as they are flushed down the toilet or spilled down the drain (Chiang, 2006).

The program was especially placed in law enforcement agencies so that it would be able to accept any and all medications except illegal substances (Chiang, 2006). Once the drugs are collected they are transported to a county law enforcement facility where a licensed hazardous waste collector takes them and incinerates them (Chiang, 2006).

## **Michigan**

Unexpected partnerships are springing up as well. For example, Michigan's Upper Peninsula hosts many religious groups who have banded together every year to collect some form of hazardous waste (Crumm, 2007). This year they have teamed up with the Environmental Protection Agency (EPA), police and pharmacists to host a day of collecting pharmaceutical waste. Many of the participants have come to view nature as God's gift to mankind (Crumm, 2007). Reverend Jon Magnuson, a Lutheran pastor at North Michigan University, hoped that the day of hazardous waste collection would act as an opponent to the widespread feeling of defeat when it comes to environmental

problems (Crumm, 2007). It showed the various communities that participated in the day that if everyone contributed a small amount of time and effort, a major step could be taken to alleviate the earth of what would otherwise have become an environmentally taxing situation (Crumm, 2007).

Carl Lindquist, founder of the Superior Watershed (a prominent environmental non profit in the Upper Peninsula), partnered his organization with the Earth Keepers, which is an interfaith coalition comprised of 140 congregations as well as the local Indian community. Together they organize a yearly event. This year, 19 church parking lots collected 45.7 tons of toxic waste and shipped them to two waste facilities, Delta County and Marquette County (LaPlante, 2007). The 25.5 tons that went to Delta County was a greater amount than the facility has received in 7 years. The 20.2 tons that went to Marquette County was more than the facility acquires in the duration of an entire year (LaPlante, 2007). The wastes included pesticides, herbicides, more than 40 pounds of raw mercury, oil-based paints, paint thinners, car batteries, anti-freeze and many types of strong cleaning agents (LaPlante, 2007).

Funded by USEPA, the Keweenaw Bay Indian Community and the Michigan Department of Agriculture, Earth Keeper began in 2004 as an important initiative in Upper Michigan (LaPlante, 2007). Due to the lack of support from the education system and the fact that only two of the 15 counties had hazardous waste processing facilities, nine faiths (Catholic, Lutheran, Methodist, Presbyterian, Buddhist, Jewish, Unitarian, B'hai and Episcopal) came together to sign a covenant agreeing to work together with various tribes, the local government, and citizen groups (LaPlante, 2007). The covenant's demands encompassed various commitments to improve the area's environmental

stewardship practices, one of which was the annual "Clean Sweep," or hazardous waste collection, event (LaPlante, 2007).

## **Wisconsin**

Wisconsin has also recognized the need for interception of pharmaceuticals before they get into the waste water (Grimm, 2007). Jeff Gloyd, director of the LA Crosse County Household Hazardous Waste Program, met with 20 representatives of water management, waste treatment plants, pharmaceutical industries, health care agencies, and city and county officials to propose a waste site for people to come drop off their leftover pharmaceuticals (Grimm, 2007).

Though the project still needs to be approved by the county and the DEA, it would be the first project to offer a year round collection of pharmaceutical waste (Grimm, 2007). The program would provide 55 gallon tanks, stationed at the Household Hazardous Waste Collection Facility, across from the county landfill on highway 16. These containers would be filled with some sort of solvent that would reduce the dumped drugs to a homogenous brown mixture (Grimm, 2007). Gloyd, along with two other staff members, would have to go through training and take an oath in order to be certified to handle controlled substances such as OxyContin and morphine (Grimm, 2007). This would save people a trip to the Sheriff's office to deposit such medications (Grimm, 2007).

*If we can address the issues of over-prescription, non-adherence of medications, and proper disposal (this is the most challenging), then everyone should be happy. -Matthew Mireles*

*So pollution prevention is key for the portion of pharmaceuticals that are unused by hospitals, hospice, or residents, because that's much less expensive than, say reverse osmosis. -Jennifer Jackson*

*Laurie J. Tenace*

*Environmental Specialist*

*Florida Department of Environmental Protection 2600 Blair Stone Road,  
MS 4555*

*Bear in mind as well that there are clearly "body burden more friendly choices" and a single SSRI manufactured by one company comes to mind. Both Celexa and Lexapro are manufactured by one company but one is racemic and the other is isomeric, resulting in a dose of 1/2 the other and hence 50% less body burden and 50% less excretion and 50% less.... 'course I haven't seen any ads yet pointing to this advantage. Most of the "press" on the contrary has been to criticize the isomeric version as a "me too" drug. Stevan Gressitt, M.D.*

## **Suggestions/Conclusion:**

In the absence of definitive data as to whether pharmaceuticals and personal care products (PPCPs) and EDCs in the water will have adverse effects on human health in the long run, the debate rages on of whether to ignore EDCs and other pharmaceuticals or whether to use the precautionary principle. The precautionary principle states that measures should be taken to prevent injury or harm to human and environmental health should they be under potential threat even if the threat has not been scientifically confirmed (Smith, 2005). Others argue that scientific evidence is necessary before taking the first steps to reconcile wastewater treatment issues (Smith, 2005).

With the rise of pharmaceutical use, Dr. Christian Daughton, Chief of the Environmental Chemistry Branch at the Environmental Protection Agency (EPA) National Exposure Research Laboratory has stressed the importance of encouraging stewardship of drugs to decrease their impact on the environment and put an emphasis on preserving human health (Daughton, 2006). The United States as well as some countries in Europe have begun to implement waste management standards and pass laws that will help ensure that fewer chemicals enter the water supply (Daughton, 2006).

In the United States the first conference concerning pharmaceuticals in the environment was held by the EPA National Exposure Research Lab in Las Vegas on March 23<sup>rd</sup> – 25<sup>th</sup> of 2005. The EPA, DEA, PhARMA, Veterans Administration (dealing with pharmacy and safety), various academics and private industries attended to brainstorm priority action points to be further researched such as regulatory changes regarding disposal methods as well as better research methods (Smith, 2005). After this meeting the Joint Commission on Accreditation of Healthcare Organizations (JCAHO)

launched new initiatives, adding healthcare engineers to its survey teams, asking questions about waste disposal and providing proper education and training for JCAHO surveyors on environmental issues (Smith, 2005).

In my opinion, in order to properly deal with wastes there must be a widely accepted definition for what a waste is. The Resource Conservation and Recovery Act enacted in 1976 by the EPA regulates the disposal of wastes and encourages the minimization of waste. It defines hazardous waste and tracks the “cradle to grave” life span of hazardous waste (Smith, 2005). Though this is a great step private households are exempt from the rules of the act. In recent news the Hazardous Drug Group of the National Institute for Occupational Safety and Health (NIOSH) administered under Centers for Disease Control (CDC) released a comprehensive set of guidelines for the complete life cycle of what is considered a “hazardous drug” by OSHA. These guidelines identify what hazardous wastes are and outline the need and process for proper disposal (NIOSH, 2007). In addition the EPA currently defines wastes under four categories, F, K, U, and P, with F being the least dangerous and P being the most based on ignitability, toxicity, corrosivity, reactivity. The disposal of these wastes is allocated to different types of incinerators (EPA, 2004).

Municipal incinerators are permitted to burn municipal garbage and are usually not permitted to handle infectious waste products however they may be allowed to handle non-hazardous pharmaceuticals as long as there are certain volume restrictions (Daughton, 2003). Medical (infectious) waste incinerators are permitted by EPA and the state to accept pathology waste, red bag and red sharps waste as well as trace chemo wastes. They are regulated under the Clean Air Act and use relatively lower

temperatures. The ashes are disposed in a municipal (non-hazardous) landfill which may or may not be lined. Finally, hazardous waste incinerators or Treatment Storage and Disposal Facilities (TSDF) use high temperatures to break molecular bonds (Daughton, 2003). These facilities are authorized to receive the worst of the worst chemicals. The pollutants are scrubbed so that the facility only emits water vapor and ash which can be stored in a lined hazardous waste landfill (Daughton, 2003).

Though incinerating wastes is a viable solution to waste management, they are not governed by the same laws and departments that deal with the water systems (Daughton, 2005). The lack of communication between the environmental organizations has led to a stall in progress toward maintaining a cleaner water supply. Also, potentially hazardous waste that is dumped into unlined landfills does not stay out of the environment (Goldbaum, 2006). Chemicals that may not be considered hazardous waste can seep into the ground and leach into groundwater and streams (Quick, 2005).

In addition to increased communication between the EPA and the DEA as well as other environmental organizations there needs to be a merging of the various departments within the organizations. Managing incinerators based on their air pollution emissions is inadequate when those emissions can affect the water and there are chemicals seeping into the ground from the landfills that the wastes are eventually released into. An increase in research, especially that which will explore long term effects of small doses of pharmaceuticals on the human organism is mandatory to ascertain how large of a threat the pharmaceuticals are causing. Research concerning the effects on terrestrial animals as well as aquatic ones should also be carried out for a full scope on the dangers of releasing drugs and hormones into our ecosystems.

While this research is going on, however, preventative action needs to be taken in order to prevent potential medical conditions from arising. While efforts are currently being implemented to reform our filtration system to target various hormones and chemical compounds, the vast amounts of chemicals that enter our water systems will never be able to be accounted for merely by a filtration system. Instead of disposing of medications that have expired or are no longer necessary, a take back program can be set up with pharmaceutical companies where private industries, healthcare facilities and private households can bring their pharmaceuticals to the companies they came from so that they can be broken down and reused or disposed of properly.

Implementation of green pharmacology should be explored as an option for reducing the amounts of chemicals in our water. As taxpayers would be the ones to finance the altered filtration and incinerator practices, it would be prudent to look to pharmaceutical companies to alter the drugs they produce to ensure that when the drugs break down they will become compounds that are not harmful to the environment or better yet will be absorbed by the body to an extent that only miniscule amounts will be excreted.

Overall, there needs to be a nationally accepted ideal for clean water that each state can then adopt and make harsher if necessary for its own benefit. As new research is being released frequently on the matter, there need to be frequent revisions of what the EPA considers to be hazardous waste and a consensus between the various departments under the EPA and the DEA as to the severity of the laws governing wastes in this country. Finally, a move to create new legislature concerning the treatment of the water should occur. Only if we start taking action now and heeding the scientists doing research

on the effects of chemicals in our water will we be able to prevent a potentially dangerous future when it comes to our drinking water and our natural environment.

Appendix 1: Medication disposal guidelines as per the white house.

## Proper Disposal of Prescription Drugs

### Federal Guidelines:

- Take unused, unneeded, or expired prescription drugs out of their original containers and throw them in the trash.
- Mixing prescription drugs with an undesirable substance, such as used coffee grounds or kitty litter, and putting them in impermeable, non-descript containers, such as empty cans or sealable bags, will further ensure the drugs are not diverted.
- Flush prescription drugs down the toilet *only* if the label or accompanying patient information specifically instructs doing so.
- Take advantage of community pharmaceutical take-back programs that allow the public to bring unused drugs to a central location for proper disposal. Some communities have pharmaceutical take-back programs or community solid-waste programs that allow the public to bring unused drugs to a central location for proper disposal. Where these exist, they are a good way to dispose of unused pharmaceuticals.

The FDA advises that the following drugs be flushed down the toilet instead of thrown in the trash:

**Actiq** (fentanyl citrate)  
**Daytrana Transdermal Patch** (methylphenidate)  
**Duragesic Transdermal System** (fentanyl)  
**OxyContin Tablets** (oxycodone)  
**Avinza Capsules** (morphine sulfate)  
**Baraclude Tablets** (entecavir)  
**Reyataz Capsules** (atazanavir sulfate)  
**Tequin Tablets** (gatifloxacin)  
**Zerit for Oral Solution** (stavudine)  
**Meperidine HCl Tablets**  
**Percocet** (Oxycodone and Acetaminophen)  
**Xyrem** (Sodium Oxybate)  
**Fentora** (fentanyl buccal tablet)

*Note: Patients should always refer to printed material accompanying their medication for specific instructions.*

Appendix 1 cont'd: White house press release outlining the steps to take when disposing of unused medications.

## **WHAT EVERY AMERICAN CAN DO TO PREVENT MISUSE OF PRESCRIPTION DRUGS**

### **FEDERAL GOVERNMENT ISSUES NEW GUIDELINES FOR PROPER DISPOSAL OF PRESCRIPTION DRUGS:**

(Washington, DC)—In the face of rising trends in prescription drug abuse, the Federal government today issued new guidelines for the proper disposal of unused, unneeded, or expired prescription drugs. The White House Office of National Drug Control Policy (ONDCP), the Department of Health and Human Services (HHS), and the Environmental Protection Agency (EPA) jointly released the new guidelines, which are designed to reduce the diversion of prescription drugs, while also protecting the environment.

The new Federal prescription drug disposal guidelines urge Americans to:

- Take unused, unneeded, or expired prescription drugs out of their original containers
- Mix the prescription drugs with an undesirable substance, like used coffee grounds or kitty litter, and put them in impermeable, non-descript containers, such as empty cans or sealable bags, further ensuring that the drugs are not diverted or accidentally ingested by children or pets
- Throw these containers in the trash
- Flush prescription drugs down the toilet only if the accompanying patient information specifically instructs it is safe to do so
- Return unused, unneeded, or expired prescription drugs to pharmaceutical take-back locations that allow the public to bring unused drugs to a central location for safe disposal

Abuse of prescription drugs to get high has become increasingly prevalent among teens and young adults. Past year abuse of prescription pain killers abuse now ranks second—only behind marijuana—as the Nation's most prevalent illegal drug problem. While overall youth drug use is down by 23 percent since 2001, approximately 6.4 million Americans report non-medical use of prescription drugs. New abusers of prescription drugs have caught up with the number of new users of marijuana. Much of this abuse appears to be fueled by the relative ease of access to prescription drugs. Approximately 60 percent of people who abuse prescription pain killers indicate that they got their prescription drugs from a friend or relative for free.

John Walters, Director of National Drug Control Policy, said, "Millions of Americans benefit from the tremendous scientific achievements represented by modern pharmaceutical products. But, when abused, some prescription drugs can be as addictive and dangerous as illegal street drugs. The new prescription drug disposal guidelines will help us stop and prevent prescription drug abuse, and the harm it can cause.

Health and Human Services Secretary Michael Leavitt said, "Health care providers, pharmacists, and family should be alert to the potential for prescription drug misuse, abuse, and dependence. In addition to supporting the new prescription drug disposal guidelines, they should address prescription drug misuse honestly and directly with their patients or loved ones when they suspect it. People in need should be encouraged to seek help for drug problems and if needed, enter treatment."

The new Federal guidelines are a balance between public health concerns and potential environmental concerns.

While EPA continues to research the effects of pharmaceuticals in water sources, one thing is clear: improper drug disposal is a prescription for environmental and societal concern," said EPA Administrator Stephen L. Johnson. "Following these new guidelines will protect our Nation's waterways and keep pharmaceuticals out of the hands of potential abusers."

The new Federal prescription drug disposal guidelines go into effect immediately. As part of the National Drug Control Strategy, the Bush Administration has set a goal of reducing prescription drug abuse by 15 percent over three years. In addition to promoting awareness of the risks involved with using prescription drugs for non-medical purposes as well as they need for adults to strictly control access to pharmaceuticals within their homes, the Administration supports the implementation of Prescription Drug Monitoring Programs at the State level. Currently, 33 States have such programs in place.

## **APhA Provides Guidance on Proper Medication Disposal Use with Respect and Discard with Care**

**WASHINGTON, DC**– In response to a growing concern about the improper disposal of unused or expired medications and the recent media coverage about medication misuse, the American Pharmacists Association (APhA) recommends three simple steps that consumers should take to protect their families, community, and the environment:

1. **DO NOT FLUSH unused medications.** Consumers were once advised to flush their expired or unused medications; however, recent environmental impact studies report that this could be having an adverse impact on the environment. While the rule of thumb is not to flush, the Food and Drug Administration (FDA) has determined that certain medications should be flushed due to their abuse potential. Read the instructions on your medication and talk to your pharmacist.
2. **When tossing unused medications, protect children and pets from the potentially negative effects.** APhA recommends that consumers:
  - Crush solid medications or dissolve in water (this applies for liquid medications as well) and mix with kitty litter or a solid kitchen substance, then place in a sealed plastic bag to reduce the risk of poisoning children and/or pets **before** tossing in the trash.
  - Remove and destroy **ALL** identifying personal information (prescription label) from the medication container.
  - Check for approved state and local collection programs or with area hazardous waste facilities. In certain states, you may be able to take your unused medications to your community pharmacy.
3. **Talk To Your Pharmacist.** Research shows that pharmacists are one of the most accessible healthcare professionals. As the medication experts on the healthcare team, pharmacists are available to guide you on how to properly dispose of your unused medications.

Medications play an essential role in our society, but medications are powerful. They should be used with respect and discarded with care. Following these simple guidelines can help protect your family and community, prevent the illegal diversion of unused medications, and minimize a potential negative impact on the environment.

The American Pharmacists Association, founded in 1852 as the American Pharmaceutical Association, represents more than 60,000 practicing pharmacists, pharmaceutical scientists, student pharmacists, pharmacy technicians, and others interested in advancing the profession. APhA, dedicated to helping all pharmacists improve medication use and advance patient care, is the first-established and largest association of pharmacists in the United States.