PHYSICIANS FOR SOCIAL RESPONSIBILITY

PESTICIDES

What Health Care Providers Should Know

DRINKING WATER FACT SHEET #5

Why Is There Concern About Pesticides in Drinking Water?

Pesticides pose a health threat not only because of their toxicity, but also because of their widespread use in the U.S. There are now about 21,000 registered pesticide products, with almost 900 active ingredients. In a typical year, about 1.2 billion pounds of conventional pesticides and other chemicals are used in the U.S. for pest control in agriculture, residences, industrial, and commercial settings.[1] As a result of their extensive use over the last half-century, pesticides are ubiquitous in our environment, and human exposure is virtually inevitable. National population-based surveys of pesticide urinary metabolites in adults indicate widespread exposure to pesticides.[2,3,4]

Drinking water can be a significant source of chronic pesticide exposure, especially in agricultural regions where large quantities of pesticides are used.[5] Researchers at the U.S. Geological Survey (USGS) found pesticides in more than 95% of stream samples and almost 50% of ground water samples collected throughout the U.S.[6] Ground water contamination is critically important because 38% of the water used for public water supplies is obtained from ground water sources.[7] The USGS investigation also found that peak seasonal surface water concentrations of pesticides frequently exceeded federal drinking water standards in agricultural areas.[6] Levels and occurrence of pesticides in surface water and ground water vary considerably with the seasons and local geology, with highest concentrations often occurring in spring and early summer following rainfall.[8,9]

What Are the Health Effects of Pesticides?

For many pesticides, our understanding of human health effects is based largely on occupational or accidental exposures, or laboratory animal studies, in which doses can be relatively high. Effects such as weight loss, organ damage, muscle degeneration, neurological damage, and cancer have been documented based on such studies. In fact, more than 160 pesticide active ingredients have been classified as known or suspected carcinogens by EPA and other organizations.[10] However, environmental exposures to pesticides, such as through drinking water, usually involve relatively low concentrations that may occur over long periods of time. While the human health effects associated with chronic, low-level pesticide exposures are not yet well understood, a growing body of scientific evidence suggests that environmental pesticide exposures are associated with neurological and reproductive damage, effects on growth and development, birth defects, endocrine disruption, cancer, and other adverse effects.

Given the ubiquitous nature of pesticides in our environment, this emerging evidence raises serious public health concerns. Every effort must be made to use precautionary strategies to minimize or prevent pesticide exposures while further evidence is collected through research. This fact sheet summarizes health effects information for many of the most commonly found pesticides in public drinking water supplies, and offers suggestions on ways that health professionals can help to reduce this public health threat.

Triazine Herbicides

The triazine class of pesticides includes some of the most widely used agricultural herbicides, including atrazine and simazine. Atrazine has been found in up to 97% of surface water-supplied drinking water systems in Midwestern states.[5] (Table 1). A study by the Environmental Working Group estimated that atrazine contaminates tap water delivered to 10.4 million people in seven Midwestern states.[11]

The triazine pesticides simazine, cyanazine, and propazine are classified as "possible human carcinogens" by the EPA. Atrazine was also in the same category until it was recently downgraded by the EPA to "not likely to be a human carcinogen."[12] The International Agency for Research on Cancer (IARC) has stated that atrazine "is not classifiable as to its carcinogenicity in humans," but that there is "sufficient evidence in experimental animals for carcinogenicity of atrazine."[13] Recent studies have suggested a possible association between exposure to triazine herbicides in drinking water and increased risk for breast cancer[14] and stomach cancer.[15] There is also limited epidemiological evidence of associations between triazine pesticide exposure and ovarian cancer and non-Hodgkin's lymphoma.[16]

According to EPA, lifetime exposure to atrazine at levels above the drinking water standard has the potential to cause weight loss; cardiovascular damage; retinal and some muscle degeneration; and mammary tumors.[17] Atrazine has also been shown to cause chromosomal damage at low concentrations (comparable to the EPA drinking water standard) in animal cell cultures.[18] Several recent studies have added to the evidence that atrazine and other triazine herbicides are endocrine disruptors.[19,20,21] Long-term human exposure to simazine can cause tremors; damage to testes, kidneys, liver, and thyroid; gene mutations and cancer.[22] An epidemiological study in Iowa found an association between maternal exposure to triazine herbicides in drinking water and intrauterine growth retardation and low birth weight.[23] (See PSR's drinking water fact sheet on atrazine for further information about this particular pesticide).

Chlorophenoxy Herbicides

Chlorophenoxy herbicides are widely used for control of broadleaf weeds in agriculture; control of vegetation along roadsides, railways, and utility rights-of-way; and maintenance of parks, golf courses, and home lawns and gardens. The chlorophenoxy herbicides 2,4-D and dicamba are among the most commonly occurring pesticides found by EPA in U.S. public drinking water systems.[5] (Table 1). According to EPA, chronic exposure to 2,4-D above the federal drinking water standard has the potential to cause damage to the nervous system, kidneys, and liver.[24] Agricultural use of 2,4-D has also been linked to mortality from several types of cancer,[25,26] although EPA has classified 2,4-D as having "inadequate evidence for carcinogenicity in humans." Epidemiological studies have also reported an association between exposure to 2,4-D and non-Hodgkin's lymphoma.[27,28] Chronic exposure to 2,4-D has also been linked to immune system suppression[29,30] and endocrine disruption.[31]

Organochlorine Insecticides

The organochlorine insecticides aldrin and dieldrin were widely used in the U.S. from the 1950s to the early 1970s. Most uses for aldrin and dieldrin were banned in 1975, based on potential for carcinogenicity in humans, and they are no longer produced in the U.S. Lindane has not been produced in the U.S. since 1977, but is still imported for restricted uses. Despite these restrictions, organochlorine insecticides are still found in drinking water supplies (Table 1) because they are highly resistant to degradation in the environment. These insecticides have been associated with lymphoma, leukemia, soft tissue sarcoma, neuroblastoma, and cancers of the pancreas, breast, and lung.[32,33] A number of other health effects have been associated with chronic exposure to organochlorine insecticides. Animal studies suggest that these compounds may cause birth defects and may decrease fertility.[34] Long-term exposure can cause liver damage,[33, 35] and lindane has shown endocrine-disrupting properties.[36,37,38]

Organophosphate Insecticides and Other Pesticides

In addition to the pesticides described above, a wide variety of other pesticides commonly contaminate treated drinking water and water sources. The herbicides alachlor and metolachlor have been frequently detected in public drinking water derived from surface water.[5] According to USGS data, certain organophosphate insecticides, including chlorpyrifos, diazinon, and malathion, are commonly found in streams and rivers, but are not often detected in ground water.[39] Despite their frequent occurrence as surface water contaminants, EPA has not established drinking water maximum contaminant levels (MCLs) for these insecticides and does not require that they be monitored in public water supplies. Many of the long-term health effects of low-dose exposure to these chemicals are not yet known. However, the failure to monitor and regulate these chemicals in drinking water raises serious public health concerns, given the potential for these chemicals to cause effects such as cancer, birth defects, behavioral effects, and neurological damage.

Are Pesticides of Greater Concern to Certain Populations?

Studies have shown that resident farm families, farm workers, and their children are among those most highly exposed to pesticides.[40] However, populations such as pregnant women, infants, and children may be more susceptible to the adverse effects of pesticides than the general population. Infants that are fed formula reconstituted with contaminated tap water may be at significant health risk, particularly in areas of the Midwestern U.S. where tap water contamination with herbicides is common.[11] There is also evidence to suggest that children may be at increased risk of cancer from pesticide exposure.[32, 41]

Children are disproportionately exposed to pesticides because they eat and drink more than adults in relation to their body weights.[42] Behaviors such as crawling and hand-to-mouth contact by toddlers and young children can also increase exposure to pesticides in the home. In a comprehensive evaluation of childhood pesticide exposure, a committee of the National Academy of Sciences (NAS) concluded in 1993 that there are significant differences in the toxicity of pesticides between children and adults. Children have immature metabolic systems and are generally less able than adults to detoxify pesticides. The NAS committee also determined that, on occasion, childhood exposures to pesticides through food and diet can exceed safe levels.

Table 1. Commonly Occurring Pesticides in U.S. Public Drinking Water Systems

(Based on data presented in U.S. EPA report, *A Review of Contaminant Occurrence in Public Water Systems,* Office of Water, November 1999)

Pesticide Name	Maximum Occurrence in Public Water Supplies		Common Uses	Federal Drinking Water Maximum Contaminant Level (MCL) and EPA Cancer Classification	Chemical Class	Examples of Commercial Products
	SW-Supplied Systems	GW-Supplied Systems				
HERBICIDES						
atrazine	97%	9.2%	Control broadleaf and grassy weeds in corn, sorghum, and other crops	3 ppb; Possible human carcinogen	Triazine herbicide	Aatrex, Atranex, Crisazina
simazine	67%	3.2%	Control broadleaf weeds and annual grasses on crops, lawn, and turf	4 ppb; Possible human carcinogen	Triazine herbicide	Gesatop, Princep, Caliber 90
2,4-dichlorophenoxy-acetic acid (2,4-D)	50%	4.7%	Herbicide on wheat, corn, rangeland, lawns	70 ppb; Not classifiable as to human carcinogenicity	Chloro-phenoxy herbicide	2,4-D
dicamba	28.4%	1.8%	Control broadleaf weeds in grain crops and grasslands; brush control	N/A; Not classifiable	Chloro-phenoxy herbicide	Banvel
alachlor	31.2%	<1%	Herbicide on corn, soybeans, other crops	2 ppb; Probable human carcinogen	Analide herbicide	Lasso, Alanox
metolachlor	65%	1.2%	Control broadleaf and annual grassy weeds in crops, highway rights-of way	N/A; Possible human carcinogen	Acetamide herbicide	Dual, Pennant
INSECTICIDES						
lindane	11.1%	6.5%	Insect control on fruit, vegetables, and wood products; flea and lice dip for animals.	0.2 ppb; Possible human carcinogen	Organo-chlorine insecticide	Gamma BHC or HCH; Kwell
aldrin	14.7%	5.0%	Banned in U.S. Formerly used as soil insecticide to control root worms, beetles, and termites.	N/A; Probable human carcinogen	Organo-chlorine insecticide	none in U.S.
dieldrin	5.9%	10.3%	Banned in U.S. Formerly used in agriculture for soil and seed treatment, and for mosquito, fly control.	N/A; Probable human carcinogen	Organo-chlorine insecticide	none in U.S.

How Are Pesticides Regulated in Drinking Water?

EPA does not regulate levels of many pesticides that commonly occur in drinking water or source water. The EPA has developed MCLs for fewer than 25 registered pesticides. In addition, MCLs are based on single chemical exposures and may not adequately protect against adverse health effects from exposure to mixtures of pesticides or pesticide breakdown products. It is also important to recognize that EPA does not regulate the quality of drinking water from domestic wells. It is the responsibility of the homeowner to have their water tested to ensure it is safe to drink.

The 1993 NAS review of children's exposure to pesticides resulted in the recommendation that EPA change its decision-making process for establishment of acceptable levels of pesticides in food, known as tolerances. Rather than focusing on economics and agricultural practices, decisions should be driven by health considerations. This recommendation led to the enactment of the Food Quality Protection Act (FQPA) in 1996. The FQPA requires that food tolerances for pesticides take into account all exposures to pesticides, including exposure via drinking water. Under this law, aggregate exposure must be safe for infants and children, and pesticide use on food crops is prohibited if the risk from pesticides in drinking water exceeds the safety standards set in the law. This law has particular significance for areas of the Midwest where there is widespread contamination of drinking water supplies by herbicides used in agriculture.[43] In spite of unanimous Congressional passage of the FQPA, recent congressional sessions have seen increasing support for industry-led attempts to dismantle this important legislation.

What Can Health Professionals Do to Reduce the Public Health Threat from Pesticides?

- Urge parents who plan to bottle feed their infants and live in areas where water contamination is known or suspected to use ready-to-feed infant formula instead of formula reconstituted with tap water.
- Encourage patients who use private wells to have their water tested for pesticide contamination. Local health departments or EPA's Safe Drinking Water Hotline can direct well owners to certified laboratories that can perform such tests. If contamination is found, home water filtration/treatment units can be effective at removing pesticides and other contaminants. Contact NSF International (listed below) for information on certified products.
- Encourage your patients to read and ask questions about the Consumer Confidence Report from their water utility.
- Educate yourself about known and suspected health effects of pesticides to prepare yourself for questions from patients.
- Become involved in local, state, and national efforts to *prevent* pesticide contamination of surface water and ground water. Urge your patients and your community to use pesticides as a last defense against pests. Non-chemical control methods and other sustainable alternatives are available to meet many different needs. If they do use pesticides in or around the house, urge them to use caution and to carefully read product safety labels.
- Become an advocate for stronger drinking water protections. Press EPA and Congress to implement health-protective standards for the many pesticides that threaten our drinking water supplies. Advocate for enactment of stronger drinking water "right-to-know" provisions that will inform all consumers—in a timely manner—about pesticide contamination in their drinking water. Become involved in efforts to preserve the vital health protections provided by the FQPA. For assistance in your efforts, contact PSR for a copy of *From Knowledge to Action: A Safe Drinking Water Advocacy Kit.*

Sources of Additional Information and Guidance

- Physicians for Social Responsibility: www.psr.org or www.envirohealthaction.org or (202)667-4260
- Campaign for Safe and Affordable Drinking Water: www.safe-drinking-water.org.
- U.S. EPA Safe Drinking Water Hotline: (800) 426-4791.
- U.S. EPA Office of Ground Water and Drinking Water: (202) 260-5543 or www.epa.gov/ogwdw .
- NSF International: (800) 673-6275 or www.nsf.org.
- Pesticide Action Network – extensive information on pesticides and health: (415) 981-1771 or www.panna.org/.
- National Pesticide Information Center (NPIC) – for science-based information about pesticide products, recognition and management of poisonings, toxicology, and other topics: (800) 858-7378 or http://npic.orst.edu/.

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