SILENT SPRING INSTITUTE

RESEARCHING THE ENVIRONMENT AND WOMEN'S HEALTH

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Emerging Contaminants in Cape Cod Drinking Water
Frequently Asked Questions

Regulations

Are there regulations for these chemicals?

No. There are currently no enforceable regulations for any of the organic chemicals that were tested as part of this study. For three chemicals that were detected, the EPA and some state agencies have developed health-based guidelines. These guideline values are designed to indicate levels in drinking water that pose little to no health risk. No samples exceeded any of these health-based guideline values.

Why doesn't EPA or the state regulate these chemicals?

Drinking water regulations are established after extensive scientific studies to understand the health effects of chemicals and the levels that may be harmful. Much of this information is lacking for many emerging contaminants.

Is the state or federal government going to regulate these chemicals?

The EPA currently regulates 90 chemicals in drinking water. In the future, the EPA may include more emerging contaminants in their list of regulated chemicals in drinking water. The EPA's most recent Candidate Contaminant List (the list of chemicals being considered for future regulations) included two chemicals we detected (PFOA and PFOS), as well as several hormones and an antibiotic. Drinking water regulations are established after extensive scientific studies to understand the health effects of chemicals and the levels that may be harmful. Much of this information is lacking for many emerging contaminants.

Safety and health

Is my water safe to drink? Can I use my tap water to make formula for my baby?

If your drinking water meets current U.S. drinking water standards, then it is considered safe according to the Safe Drinking Water Act. Suppliers are required to meet these current regulations.

There are no enforceable regulations for any of the emerging contaminants that we measured. Because we can't be sure these low levels pose no risk, there are reasons to try to reduce exposures to these chemicals, including through drinking water.

While the presence of a chemical alone does not necessarily mean that it is harmful, it is very difficult to study the long term effects of low levels of exposures to chemicals, especially in combinations, so it is difficult to know whether these low levels are safe or harmful.

The chemical levels that we detected were all less than 1 ppb (parts per billion, one ppb = 1 µg/L = 1000 ng/L). Many other organic chemicals, such as volatile organic compounds, are typically regulated in drinking water only at levels above 1 ppb. For pharmaceuticals, even the highest levels detected in well water samples were many orders of magnitude lower than the amounts found in a typical dose of a medicine, and it would take millions of cups of water to contain the same amount of medication as is found in a single daily dose. Some of the other chemicals we detected are found in household products. For these chemicals,

touching the product directly or breathing in household dust and air may be much more important routes of exposure.

Anticipating the effects of low level exposures to chemicals such as pharmaceuticals and endocrine disruptors in humans is difficult. For example, exposures that occur at sensitive developmental stages (for instance, in fetuses and infants) may have greater effects than exposures during other life stages, but chemical safety tests are usually done on adult animals. Furthermore, while people are exposed to complex mixtures of chemicals, most studies focus on one chemical at a time, so we have limited understanding of the potential health effects of mixtures of pharmaceuticals and other chemicals at low levels. In addition, pharmaceuticals are intended to be biologically active at very low levels and often have side effects that are not taken into account when considering only intended doses.

Can I give this water to my pets/fish?

For the chemicals we detected, we do not have information suggesting adverse effects on fish or other animals at the levels we measured. In some studies, natural and pharmaceutical estrogens from wastewater has been shown to affect fish at very low concentrations (0.005 ppb), but we did not detect these estrogens in any of the samples we tested even though we used methods that could measure levels that were 10 times lower, down to 0.0005 ppb.

I have a private well – should I be worried?

If you own a private well, you can get your water tested for contaminants that are regulated in drinking water. The Massachusetts Department of Environmental Protection (MassDEP) recommends annual testing of private wells for bacteria and nitrate/nitrite, and less frequent testing for other types of contaminants. If you have nitrate levels above 0.5 mg/L, this indicates that your water may be impacted by human activities such as septic system discharges or fertilizers. If the nitrate levels in your well are above 0.5 mg/L, you might consider getting a solid block carbon filter for your drinking water. See “Do filter pitchers or other home filtration devices remove these chemicals?” for additional information.

Additional information for private well owners is available from MassDEP at: http://www.mass.gov/dep/water/drinking/mapwell2.htm.

We plan to test several private wells for these emerging contaminants in the coming year. Please contact us if you have a private well and would like to be considered for this new study.

I have (or someone I know has) a disease – could this have been caused by the drinking water?

It is rarely possible to link cancer or other diseases in individuals or small groups with specific exposures that may have caused them. Even when studying large populations, it is difficult to link environmental factors with diseases because environmental exposure measures for a relevant period in the past are usually unavailable or uncertain. In addition, disease causation cannot be determined solely from observational human studies. In other words, it is possible that an environmental factor appears to be related to a health effect without directly causing it.

Silent Spring Institute previously found no association between breast cancer risk and women’s patterns of exposure to historically elevated nitrate levels (as a marker of wastewater contaminants) in public supply wells on Cape Cod. This study was limited because nitrate data were not available far into the past, and we could not estimate exposure for participants who lived off Cape or used private wells.

A recent paper by scientists at Boston University reports elevated breast cancer for women in the 1980s and early 1990s in Hyannis compared with other Upper Cape areas and associates this increase with contaminants in the Hyannis Water System supply. These contaminants could include wastewater-related chemicals from the Barnstable wastewater treatment plant and septic systems, and/or industrial contaminants from contaminated groundwater under the airport. Again, these studies do not provide definitive information of a link or of an absence of a link between these contaminants and breast cancer. See "Is my water safe to drink?" for additional information.

Silent Spring Institute studies breast cancer. Has Silent Spring Institute research found that chemicals in drinking water can cause breast cancer?

Silent Spring Institute research focuses on understanding links between environmental factors and breast cancer. Our Cape Cod water research is designed to understand how endocrine disruptors and other wastewater contaminants get into the environment and how people may be exposed. See the answer to the previous question for additional information.

How we did our study

Why did you test untreated water instead of tap water?

The goal of this study was to learn how wastewater from septic systems is affecting the groundwater that supplies drinking water to the Cape community. By collecting raw water samples, we were able to connect factors such as land use in the well recharge area with the chemicals in the water samples. This helped us identify factors that make wells more vulnerable and to develop future plans to better protect Cape drinking water wells.

Are the same chemicals found in my tap water?

For most of the water districts in our study, we did not analyze any tap water samples from the distribution system. Tap water in each Cape Cod water distribution system is a mixture of water from all the wells that provide water for that district. Because we chose to test more wells that were likely to be impacted by wastewater, the chemical levels in the wells we tested may be higher than the levels in the distribution systems on average. Water from wells with relatively high chemical levels will be diluted by the water from other wells that have lower levels.

Some water districts add chlorine as a disinfectant before water enters the distribution system. Previous studies have shown that chlorine can react with some of these chemicals, reducing their levels but potentially leading to the formation of new, secondary chemicals, some of which are known to be harmful.

For districts in which we did test a distribution system sample, it is important to keep in mind that this is a single sample, and may not represent the levels throughout the system, and that chemical levels may also vary over time.

How did you pick these chemicals?

In recent years, with the development of improved capabilities for measuring trace levels of emerging contaminants, there has been an effort to measure these chemicals in drinking water supplies, as well as in surface waters, groundwater and wastewater. Based on what others have reported, we developed a list of chemicals that were among the most frequently detected in other locations. We placed extra weight on studies that had been done on Cape Cod, and in other groundwater systems.

Based on this list, we identified several commercial laboratories who could run the samples. No single laboratory was able to measure all of the chemicals that we wanted to test, but we were able to run many of the chemicals of interest. Chemicals of interest included pharmaceuticals, which can be found in wastewater because they are excreted from our bodies without being absorbed or are flushed without being used, as well as several commercial chemicals that were of interest because they are known to be hormone disruptors (endocrine disrupting compounds) or have other health effects.

Are there other chemicals that weren't tested for that could also be in my water?

There is no way to test for every chemical that might possibly be in a water sample. Our results provide an indication of which wells might be most impacted by wastewater contamination, and these wells are more likely to also contain other chemicals that we didn't test for.

Why didn't you test all the wells?

Measuring trace levels of emerging contaminants requires specialized equipment and facilities, and only a few commercial laboratories are able to do these types of analyses. Unfortunately, these analyses are very expensive, so we couldn't test all of the wells in each district.

From this study, we will get a better sense of the characteristics of wells that are most impacted by wastewater. For example, we will get a better sense of whether we can predict which wells are most impacted based on chemical markers of wastewater, such as nitrate and boron, and on the extent of residential land development close to the wells, which may indicate the amount of septic system discharges. Using these markers, we can identify additional wells that we may prioritize for future testing.

Sources

How do emerging contaminants get into wastewater?

The excretion of drugs that are not absorbed by our bodies is generally considered the largest source of pharmaceuticals in wastewater. Flushing of unwanted or expired medications also contributes to pharmaceuticals in wastewater.

Chemicals found in personal care products that are applied to our skin can be washed down the drain during showering, as well as during laundering of clothes that come into contact with these products.

Other chemicals are associated with household products and can end up in wastewater through washing and laundering. For example, organophosphate flame retardants are often added to furniture, while the perfluorinated compounds PFOS and PFOA are commonly used in stain resistant or nonstick products, including clothing and cookware.

Some chemicals can end up in wastewater from industrial operations, or can directly enter the groundwater through runoff.

How did chemicals in wastewater get into the drinking water supply?

The shallow unconfined groundwater aquifer on Cape Cod is known to be vulnerable to contamination from wastewater. The majority (around 85%) of residences use septic systems to treat their wastewater. While some chemicals break down in septic systems, many don't fully break down, so they are released into the groundwater. Discharges from

centralized wastewater treatment plants are also released into groundwater. These discharges also can contain emerging contaminants.

Once these chemicals end up in the groundwater, they can travel through the relatively porous sandy soils of the aquifer. The soils are relatively acidic and generally have low levels of organic matter. This means that chemicals won't stick much to the soil particles (as they would if there was more organic matter), and there isn't as much breakdown as there might be in other types of soils. As the Cape's population continues to grow, this means there is more and more wastewater being discharged into the aquifer, and more potential for contamination.

Aren't public wells protected from contamination?

There are a number of regulations intended to protect public water supply wells from contamination. Massachusetts wellhead protection requirements do not allow any kind of development within 400 feet (Zone I) of a public water supply well, although for some Cape wells pre-existing development is present in these areas. Land use activities that are known threats to water quality, such as large-scale hazardous and solid waste facilities, are prohibited within the Zone II, the area likely to contribute groundwater to a public supply well. In addition, new development of other potential sources of groundwater contamination, such as wastewater treatment plants and Title 5 septic systems, must meet certain standards. However, zoning restrictions established to protect the Zone IIs from new development are not always enforced and prior land uses are often "grandfathered" in despite the zoning restrictions. These pre-existing uses include high density commercial and residential development, wastewater treatment plants and industrial areas.

I'm concerned about NStar's plan to use chemical herbicides to maintain their right-of-ways. Did you find any herbicides in the drinking water?

Five herbicides were included in the drinking water testing. All of these herbicides are commonly used for lawn care. In addition, one of these herbicides, Triclopyr, is among the herbicides that NStar intends to use to control the growth of vegetation along power line right of ways (ROWs). We did not detect herbicides in any of the drinking water samples, but we did not target wells near the NStar ROWs and were not able to test for all the herbicides used in the NStar program.

Are septic systems the only source of the chemicals you detected?

While septic systems are likely the primary source of these chemicals, some other types of sources also may be important. In particular, the Barnstable Municipal Airport may be a source of two perfluorinated chemicals. The highest concentrations of two perfluorinated chemicals, PFOS and PFOA, were found in samples collected from two wells and a distribution system known to be contaminated by a plume of petroleum hydrocarbons and volatile organic compounds from the Barnstable Municipal Airport. Treatment of water from these two wells effectively reduces the levels of regulated contaminants, but is not effective for chemicals with low volatility, such as PFOS and PFOA. Studies in other locations have shown that groundwater downgradient of airports can be contaminated by PFOS and PFOA, which are found in some fire-fighting foams. Discharges from the wastewater treatment plant in Barnstable contribute water to the Hyannisport well, as do a large number of septic systems. Construction activities may also be a source of certain organophosphate flame retardants.

Treatment at the household level

Do filter pitchers or other home filtration devices remove these chemicals?

In general, filtration products that contain a solid carbon block filter have been shown to effectively reduce levels of many types of organic contaminants, although results are different for each individual chemical. Filter pitchers that contain granular activated carbon will also remove organic contaminants. Some water filters are independently tested for dozens of organic contaminants to demonstrate their effectiveness, although the specific emerging contaminants that we measured are not routinely tested.

Many water suppliers do not recommend home filtration systems. Improper use, for example not changing filters as frequently as recommended, can lead to pathogens and other contaminants that have accumulated on the filter being released into the filtered water.

Does boiling my water remove these chemicals?

No, these chemicals cannot be removed by boiling.

Can I have my tap water tested for these chemicals?

The types of analyses used to measure trace levels of pharmaceuticals and other emerging and unregulated contaminants can only be done by a small number of commercial laboratories, and the analyses are expensive and not usually done on one sample at a time.

Should I switch to bottled water?

Public drinking water supplies must test their water for a wide range of contaminants on a regular basis. While they are not required to test for emerging contaminants, they test for many other chemicals, including volatile organic compounds and disinfection by-products (chemicals that are produced when chlorine or other disinfectants are added to water).

Bottled water is not subject to the same level of testing and regulation. While some bottled water may come from pristine water sources, some is simply tap water that may or may not be treated to remove chemicals. Furthermore, bottled water sits for extended periods of time in plastic containers, which may release chemicals into the water. To our knowledge, there are no published reports investigating pharmaceuticals, endocrine disruptors, or other emerging contaminants in bottled water.

Treatment at the district level

Do the water supplies do any treatment to remove these chemicals?

Except in special cases (for instance, direct reuse of wastewater), drinking water treatment plants are not designed to remove emerging contaminants. Some treatment steps, such as disinfection, can remove, react with or transform some emerging contaminants even though they were not designed for that purpose.

pH adjustment: All Cape water suppliers raise the pH of their drinking water to make their water less acidic and less corrosive of pipes. Adjusting the pH of drinking water will not remove emerging contaminants from the water.

Chlorination: Some Cape water suppliers use chlorination as a disinfection step to prevent harmful pathogens from surviving in the water. Various chemicals react very differently to the presence of chlorine. Some chemicals will not react at all with chlorine, meaning that there will not be any removal of these chemicals. Some chemicals do react with chlorine,

which will reduce their levels in the drinking water, but also may lead to the formation of new, secondary chemicals, some of which are known to be harmful.

Ozonation, which is another type of disinfection, tends to be more effective at removing pharmaceuticals and other emerging contaminants, although it is not completely effective. As with chlorination, ozonation can lead to the formation of chemical by-products with unknown toxicity.

Sand filtration: Some Cape water suppliers use sand filtration to remove iron and manganese. In general, sand filtration is not highly effective at removing emerging contaminants, although the levels of some emerging contaminants have been found to be reduced.

Other options: Other treatment options, such as reverse osmosis, can provide higher levels of removal for many emerging organic contaminants. However, these treatment processes are very expensive and energy intensive, and they generate wastewater that also needs to be disposed. Protecting drinking water supplies by limiting pollutant sources in recharge areas may ultimately be more cost-effective than expensive treatment.

"What can I do?"

What should I do with my unused medications?

With the exception of a small number of controlled substances, most medications should not be flushed down the toilet. The U.S. FDA provides guidelines for consumers on proper disposal of medicines. Ask your pharmacy or town Board of Health about local programs for collecting unwanted medications, and encourage local officials to create and publicize such programs. You can also consider asking for trial sizes when you are trying a new prescription medication.

Proper disposal of unused and expired medications is one thing we can do to keep pharmaceuticals from getting into the environment. However, it's important to keep in mind that much of the pharmaceuticals in wastewater actually come from excretion from our bodies when we use medications as directed. Therefore we also need to find ways to prevent wastewater from coming into contact with drinking water supplies.

What steps can I take at home?

Avoid dumping hazardous chemicals in your sink, on the ground or into storm sewers. Ask your town for information about hazardous waste collection days. You can also consider using household products with less toxic and biodegradable ingredients. The Silent Spring Institute web page provides suggestions for reducing the amount of harmful chemicals in your every day life. Go to www.silentspring.org and click on "Take Action."

If you own a septic system, be sure to properly maintain it. MassDEP recommends getting septic systems pumped every 3 years (every year if your home has a garbage disposal). Septic systems should also be inspected at least every 3 years. If your septic system is leaking, it will not provide any treatment of the raw wastewater from your household.

For more information about proper maintenance of septic systems, visit: http://www.mass.gov/dep/water/wastewater/septicsy.htm#care

Consider purchasing household products, clothing and furnishings made from natural fibers and without chemical additives such as dyes, stain-resistant coatings, antimicrobials, flame retardants, and fragrances. Avoid using harmful chemicals in your garden and lawn.

What other steps can I take?

Support land conservation and efforts to limit development near public supply wells. Our study and many others show that reducing the amount of development near public supply wells is the best way to prevent pollution from getting into the groundwater near these wells.

Support efforts to protect the Cape's shallow sole source aquifer from wastewater contamination, especially from septic systems. Installing sewers in public well recharge zones (also known as Wellhead Protection Areas or DEP Zone IIs) will prevent contaminants in septic system discharges from getting into drinking water. Wells with greater evidence of impacts could be considered priorities for Zone II protection efforts or reduced use.

Support efforts to promote more thorough testing of chemicals before they go into production. Chemicals are present in wastewater because they are present in consumer products. However, many of these chemicals have not been thoroughly tested to understand their health effects.