National Institute of Environmental Health Sciences
Your Environment. Your Health.

Drinking Water and Your Health

Drinking water in the U.S. comes from a variety of sources, including public water systems, private wells, or bottled water.

Worldwide, nearly 2 billion people drink contaminated water that could be harmful to their health.[1] Though more of a concern in developing countries, safe drinking water is a U.S. public health priority.

Possible sources of drinking water contamination are:

- Corroded water pipes that leach harmful chemicals, such as lead
- Hazardous waste sites and industrial discharges
- Pesticides and fertilizers from agricultural operations
- Naturally occurring hazardous chemicals, such as arsenic
- Sewage and food processing waste

Health Effects

Examples follow of potential drinking water contaminants and reported health effects, which can range from subtle to severe depending on the chemical and total exposure.

- **Arsenic** – a known human carcinogen associated with skin, lung, bladder, kidney, and liver cancer[2]
- **Lead** – behavioral and developmental effects in children; and cardiovascular and kidney problems[3]
- **Hydraulic fracturing (fracking) chemicals** – damage to the immune[4] and reproductive systems[5]
- **Pesticides** – neurodevelopmental effects and Parkinson's disease[6]

What is NIEHS Doing?

As a global public health issue, drinking water studies are a priority for NIEHS and the interagency National Toxicology Program (NTP), located at the institute. Topics include:

- **Fluoride** – NTP is evaluating potential neurobehavioral and endocrine effects from fluoride in drinking water.
- **Microplastics** – Grant recipients at the University of South Carolina research potential health effects from exposure to microscopic plastic particles in water.
- **PFAS** – NTP is evaluating some of these industrial-use chemicals to understand their effects on metabolism, biological activity in cell-based systems, and health effects related to cancer and the immune system.

Conducting Timely Research

Time-sensitive grants offered by NIEHS enable researchers to quickly start studies after natural and human-made disasters, or emerging environmental public health threats. For example, researchers have:

- Measured exposures in Colorado Springs' residents whose water was contaminated with the PFAS perfluorohexane sulfonate.
- Analyzed water in North Carolina's Cape Fear River for contamination by the PFAS GenX.
- Coordinated research efforts and provided scientific information about testing lead in drinking water for residents of Flint, Michigan.
- Studied a chemical spill (4-Methylcyclohexanemethonal, known as MCHM) into West Virginia's Elk River that showed its water was safe to drink. Potential contamination levels at the time would have been too low to cause harm.[7]

Protecting Public Health

Public water supplies are usually monitored by local government for contaminants. Federal research supplements public knowledge. For example:

- Researchers discovered some Mid-Ohio River Valley residents have higher PFAS blood levels than most Americans, and industrial releases to the Ohio River may be a major source of exposure.[8]
- A collaboration among NIEHS, U.S. Environmental Protection Agency, and U.S. Geological Survey found widespread tap water contamination at home and workplace locations in 11 states.[9]

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Grant recipients of the NIEHS Superfund Research Program study the health effects of potentially hazardous substances and effective ways to clean up those substances from waterways. For example:

- Studies by Dartmouth College scientists on the sources and levels of arsenic exposure in New Hampshire contributed to development of a new state law lowering the limit for arsenic in drinking water.[10]
- Researchers at the University of California, Berkeley, study drinking water quality problems. Industrial and agricultural activities might result in chemical contaminants in drinking water such as nitrate, arsenic, pesticides, and chromium, particularly in rural and socioeconomically disadvantaged communities in California.[11]
- People who obtain drinking water from private wells should have the water quality tested regularly. A Columbia University study found 41% of well owners in central Maine have never tested for arsenic.[12]
- In North Carolina, about 3 million people, representing one-third of the state's population, drink water from private wells. Researchers at the University of North Carolina at Chapel Hill are developing a new filtration device for removing arsenic and other chemicals from well water.[13]

Advancing Solutions

NIEHS seeks practical, scientific solutions to protect community health and the environment. Small Business Innovation Research and Small Business Technology Transfer grants support commercial technology development to improve public health. For example:

- ANDalyze sensors can detect specific heavy metals, such as cadmium, copper, and uranium, in water supplies.
- NanoAffix developed a handheld device for real-time, onsite detection of lead in tap water.

Learn More About Drinking Water

U.S. Centers for Disease Control and Prevention
Drinking Water Guide
www.cdc.gov/healthywater/drinking

U.S. Environmental Protection Agency
Drinking Water Requirements
www.epa.gov/dwreginfo

Treating PFAS in Drinking Water

Effective ways to remove PFAS from water include activated carbon treatment, ion exchange resins, and reverse osmosis. These technologies can be used in public treatment facilities, water systems in buildings, or homes. Read more from the EPA: epa.gov/pfas/treating-pfas-drinking-water

For more information on the National Institute of Environmental Health Sciences, go to **www.niehs.nih.gov**.

1 Progress on Drinking Water, Sanitation, and Hygiene (WHO). https://www.who.int/mediacentre/news/releases/2017/launch-version-report-jmp-water-sanitation-hygiene.pdf. (Last accessed March 23, 2020)

2 NTP. 2016. Report on Carcinogens, Fourteenth Edition.; Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service. ntp.niehs.nih.gov/go/roc14

3 Agency for Toxic Substances and Disease Registry. 2007. Toxicological profile for Lead. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

4 Boule LA, et al. 2018. Developmental exposure to a mixture of 23 chemicals associated with unconventional oil and gas operations alters the immune system of mice. Toxicol Sci; doi:10.1093/toxsci/kfy066 [Online 01 May 2018].

5 Sapouckey SA, et al. 2018. Prenatal exposure to unconventional oil and gas operation chemical mixtures altered mammary gland development in adult female mice. Endocrinology 159(3):1277–1289.

6 Pesticides (NIEHS). www.niehs.nih.gov/health/topics/agents/pesticides. (Last accessed March 23, 2020)

7 West Virginia Chemical Spill (NIEHS) www.niehs.nih.gov/health/materials/west_virginia_chemical_spill_508.pdf. (Last accessed March 23, 2020)

8 Herrick RL, et al. 2017. Polyfluoroalkyl substance exposure in the Mid-Ohio River Valley, 1991-2012. Environ Pollut 228:50-60.

9 Bradley PM, et al. 2018. Reconnaissance of mixed organic and inorganic chemicals in private and public supply tapwaters at selected residential and workplace sites in the United States. Environ Sci Technol. 52(23): 13972-13985.

10 Dartmouth SRP Center Informs Protective Limit for Arsenic in Water (NIEHS). www.niehs.nih.gov/research/supported/centers/srp/phi/archives/publicpolicy/dartmouth. (Last accessed March 23, 2020)

11 University of California, Berkeley, Superfund Research Program Community Engagement Core. tools.niehs.nih.gov/srp/programs/Program_detail.cfm?Project_ID=P42ES0047055065. (Last accessed April 6, 2020)

12 Flanagan SV, et al. 2015. Influences on domestic well water testing behavior in a Central Maine area with frequent groundwater arsenic occurrence. Sci Total Environ 505:1274-1281.

13 Novel Filtration Devices for Arsenic Reduction (NIEHS). tools.niehs.nih.gov/srp/programs/Program_detail.cfm?Project_ID=P42ES0310075716. (Last accessed April 6, 2020)