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Consider the Source

Farm runoff, chlorination byproducts, and human health

Executive Summary

Chlorinating tap water is a critical public health measure that saves thousands of lives each year by reducing the incidence of waterborne disease. But chlorination is no substitute for cleaning up America's waters.

By failing to clean up rivers and reservoirs that provide drinking water for hundreds of millions of Americans, EPA and the Congress have forced water utilities to chlorinate water that is contaminated with animal waste, sewage, fertilizer, algae, and sediment, in order to provide water free of disease-causing microorganisms. Chlorine combined with the organic matter in this pollution produces harmful byproducts, collectively referred to as chlorination byproducts (CBPs). In spite of the diligent efforts of the water utilities to filter and clean the water before they chlorinate, CBP levels remain high in the water consumed by millions of people each day. Approximately 240 million Americans drink tap water contaminated with some level of CBPs.

A compelling body of scientific evidence - nearly 30 peer-reviewed epidemiologic studies - links chlorination byproducts to increased risks of cancer. At current levels in U.S. tap water, EPA estimates that CBPs cause up to 9,300 cases of bladder cancer each year. A growing body of science links CBPs to miscarriages and birth defects, including neural tube defects, low birth weight, and cleft palate. Other health problems from CBP exposure may include other cancers (rectal and colon), kidney and spleen disorders, immune system problems and neurotoxic effects (63 FR 69390-69476).

Industrial water pollution is not a major contributor to CBPs in tap water. Instead the main causes are sediments, nutrients, and pollution from agricultural and urban runoff, and in some small systems, excess use of chlorine. Until Congress and the EPA act to limit pollution from farms and urban runoff so that water entering drinking water treatment plants is much cleaner than it is today, CBPs will remain at unacceptably high levels.

Farm runoff, chlorination byproducts, and human health

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This first ever national analysis of chlorination byproducts in tap water from both large and small cities, conducted by the Environmental Working Group (EWG), shows that although most water suppliers are in compliance with current and future drinking water standards:

- More than 137,000 pregnancies each year are at increased risk of miscarriage and birth defects each year from exposure to CBPs in tap water.*
- Since 1995, more than 16 million people in 1,258 communities have been served water containing chlorination byproducts for 12 months in a row at levels above the legal limit going into effect in January 2002.*
- A handful of large cities with a history of high CBP levels account for a significant portion of the population at risk, including Washington, DC suburbs, Philadelphia, Pittsburgh suburbs, and San Francisco ([Table 1](#)).
- The problem is not confined to large cities. More than 1,100 small towns (fewer than 10,000 people) have reported potentially dangerous levels of CBPs in their tap water over the past six years. Pregnant women living in small towns supplied by rivers and reservoirs are more than twice as likely to drink tap water with elevated levels of CBPs as women in larger communities. Historically, systems serving fewer than 10,000 people have been exempt from all federal health standards for CBPs.

Despite significant population-wide exposures to CBPs, a survey of federal and state-level efforts to monitor and track consumers' exposure to CBPs and related health effects shows that the U.S. fails to collect essential tracking data at a national level that could provide key insight on causes and other critical information on miscarriages and birth defects linked to CBPs.

EWG and U.S. Public Interest Research Group's (U.S. PIRG's) compilation of survey information finds that 10 states and Washington, DC either have no birth defects surveillance system at all, or cursory systems that miss an estimated 90 percent of the cases. Not a single state has an active, well-funded system in place to track first-trimester miscarriages, which account for 90 percent of all miscarriages and which also have been linked to CBP exposures.

The need for a nationwide health tracking network

In 1998, EPA completed a revision of the health standard governing two groups of chlorination byproducts in tap water. The new rule makes three major changes in policy. First, it eliminates the long

standing exemption from health standards for systems serving less than 10,000 people; second, it lowers the amount of trihalomethanes (THMs, the most prevalent chlorination byproducts) allowed in tap water from 100 parts per billion on average over the course of a year, to 80 ppb; and third, it regulates haloacetic acids, another major class of chlorination byproducts, and two other byproducts called chlorite and bromate, for the first time.

The effectiveness of health standards for CBPs and other environmental contaminants is limited by the lack of reliable data on environmentally caused disease. In spite of the growing body of evidence linking CBPs to miscarriages, birth defects, and cancers, EPA lacked solid data on incidence rates for most of these effects, as well as exposure data to CBPs in tap water, throughout the standard setting process. The United States lacks a nationwide health tracking network that could provide reliable data on disease rates, pregnancy outcomes, and levels of exposure to environmental contaminants potentially responsible for harm.

Because of these data limitations, EPA formally considered the risks of just one cancer, bladder cancer, when setting the new health limits for CBPs. The agency made no estimate of the risk or potential reduction in the rates of other cancers, birth defects or miscarriages during the entire process (63 FR 69390-69476). The result is most likely an underestimate of the actual risk, and new health standards that may not significantly reduce the incidence of adverse health effects from CBPs.

EPA's ability to quantify just one of the many health effects linked to CBP exposures (bladder cancer), illustrates how our country's patchwork of health tracking programs ultimately hampers public health officials, forcing decisions that more often than not are based on just a fraction of the public health impacts from environmental contaminants. Tracking disease is a cornerstone of public health protection, and has been used effectively to identify and stop infectious disease outbreaks for decades. Nationwide, the tools of tracking and monitoring have not been consistently applied to chronic disease; birth defects and other conditions ranging from Alzheimer's Disease to asthma to miscarriage remain inadequately tracked in the U.S.

Findings

Health Risks from Chlorination Byproducts

From 1979 to the present, the only chlorination byproducts regulated and consistently monitored in tap water have been four compounds together known as trihalomethanes, or THMs. Our analysis of THM levels in public water supplies from 50 states and Washington, DC

shows that:

Hundreds of mostly small utilities across the country have high levels of THMs in finished tap water:

- Between 1995 and 2001, more than 1,200 public water supplies serving 16.2 million people reported at least one consecutive 12 month period with THM levels over the 80 ppb health standard that will go into effect beginning in January 2002. More than 1,000 (80 percent) of these systems, and all of the 50 cities with the highest THM levels ([Table 9](#)), served fewer than 10,000 people, the official EPA cutoff for small systems. EPA estimates that long-term exposures at these levels cause up to 7,000 cases of bladder cancer each year nationwide.
- More than 1,500 systems reported quarterly (3 month) averages of 80 ppb or greater during the period analyzed; 1,109 of these were small systems. Substantial evidence indicates that 3 month levels over 80 ppb present elevated risks of miscarriages or birth defects. ([See Figure 1](#) for a national map depicting relative elevated risk at a county level.; [See Chart 1](#) for a description of health effects and cities facing potentially elevated risks).
- The maximum THM levels measured in some small water systems were nearly nine times the amount allowed over the course of a year ([Table 8](#)) and long term averages have been as high as 430 ppb, compared to the 80 ppb level going to effect in January 2002 ([Table 9](#)). Because small systems in most states have been exempt from all health standards for chlorination byproducts, small rural drinking water systems have likely delivered water with dangerously high THM levels for years.

Some large cities also have serious problems with chlorination byproducts:

- A number of big cities have THM problems as well, including Washington, DC suburbs, Philadelphia, Pittsburgh suburbs, and San Francisco ([Table 1](#)). In metropolitan Philadelphia and Washington, DC (including its Montgomery, MD counties) elevated THM levels put a total of 22,000 pregnancies at increased risk for birth defects or miscarriage each year.
- In 40 cities ranging in population from 55,000 to 2 million, more than 500 pregnancies are at an increased risk for birth defects or miscarriage each year ([Table 1](#)).
- On the whole, chlorination byproduct levels in the 100 most contaminated large systems show no decline during the period analyzed, although some individual water suppliers are working to reduce CBP levels in anticipation of new health standards.

A handful of states contain the majority of water systems with the highest levels of CBPs:

- Texas, Pennsylvania, Maryland, New Jersey, and Massachusetts account for well over half (87,000) of the at-risk pregnancies in the 42 states analyzed ([Table 2](#) and [Table 7](#)).
- In six states and Washington, DC more than one out of every 10 pregnancies are at increased risk for birth defects and miscarriage due to high levels of chlorination byproducts in tap water ([Table 3](#)).

Tracking environmental exposures and disease

The failure to systematically track the incidence of disease and reproductive outcomes has undermined the ability of health officials to protect the public from environmental threats like chlorination byproducts and other contaminants in tap water. Our survey of state agencies concludes:

In spite of recent efforts by some state and federal agencies, few comprehensive health tracking programs are up and running:

- Only nine states have active, statewide birth defects surveillance systems in place. Ten states and Washington, DC either have no birth defects surveillance system at all (five states plus DC), or track birth defects only through birth and death certificates, which misses 90 percent of the cases (five states).
- Not a single state has an active, well-funded system in place to track spontaneous abortion (miscarriages that occur prior to week 20 of a pregnancy). California has a program to track all miscarriages among women whose healthcare provider is Kaiser Permanente, and Rhode Island and Virginia attempt to track a portion of the miscarriages in their states. Through our contact efforts with individual state health departments, we identified no other states that make a systematic effort to track miscarriages.

The lack of data on exposure to environmental contaminants is an equally severe constraint on protection of the public health:

- Most studies of the health effects of CBPs have been limited by the fact that water suppliers are required to test for CBPs only four times a year, and of the more than 100 CBPs in public water supplies, only four chemicals called THMs are tested. For researchers studying first-trimester miscarriages, this means that just a single value for THMs is available to serve as a measure of a woman's exposure to the entire set of CBPs in her tap water

through this critical period of pregnancy. In any study, limited exposure data will always tend to mask the full magnitude of health effects.

Recommendations

In an effort to meet new standards requiring lower levels (80 ppb) of chlorination byproducts in tap water, many utilities are switching to a new chlorine compound, chloramine, to control pathogens in tap water. Chloramine is formed from chlorine and ammonia gases.

Chloramine appears to reduce the peak levels of chlorination byproducts, particularly THMs, but at the same time it adds a whole new complex of contaminants to the tap water supply that are very poorly studied. Chloramines are known to be toxic to kidney dialysis patients, who cannot drink chloraminated water, and it is extremely toxic to fish, which die if chloraminated water is used in their tanks. The human health impacts of long term consumption of chloramine byproducts are basically unknown, even as chloramine is being added to the tap water of millions of people nationwide.

The public and policy makers have been led to believe that they must accept either water polluted with pathogens or water contaminated with high levels of chlorination and chloramination byproducts. This is simply not true. Tap water in the United States can meet pathogen standards and be low in CBPs as well.

To achieve this goal and protect the public from potential hazards of chlorination byproducts, we recommend:

The creation of a nationwide health tracking network to track Americans' exposure to chlorination byproducts and also the occurrence of birth defects, miscarriages, and other potential health effects of drinking tap water contaminated with THMs and other chlorination byproducts:

- A growing coalition of public health and environmental groups has requested that Congress appropriate money to the Centers for Disease Control and Prevention (CDC) to create a nationwide health tracking network (Trust for America's Health, 2001). A fully-functioning network is estimated to cost \$275 million; at the time of printing, Congress appeared poised to appropriate \$20 million as an initial down payment to start planning and creating the network. Lawmakers in the U.S. Senate and House of Representatives expect to introduce legislation in 2002, and to request significantly increased appropriations for the health tracking network. Through these processes, members of Congress will have an opportunity to support a proposal that would begin to close gaps in scientists'

and policymakers' knowledge of environmentally-linked diseases, and provide health officials and health care providers with tools to act proactively to prevent CHRONIC disease.

Adequate funding to water utilities for treatment system upgrades and programs to train plant operators in better disinfection (chlorination) techniques, particularly for small drinking water systems:

- Operator education has the potential to reduce the highest CBP levels in smaller drinking water systems and should be aggressively pursued. By itself it will not bring all of these small systems into compliance with the law, and it will not guarantee safe water for the most contaminated systems, but it has the potential to reduce the very highest levels of CBPs.

A major national effort to clean up source water for all surface-supplied drinking water systems in the country:

- Cleaner source water is the critical step to reliably reducing CBP levels while at the same time guaranteeing water as free of pathogens as possible. By failing to clean up drinking water source water, the Congress, EPA, and polluters are forcing water with high levels of CBPs on millions of people. For the majority of the systems with elevated CBP levels (small rural systems), cleaner source water will require definitive action to reduce soil erosion, and nutrient and animal waste runoff from farms and feed lots. For large water suppliers runoff from suburban sprawl and upstream sewage discharges must also be controlled.

Environmental Working Group • 1718 Connecticut Ave., N.W., Suite 600 • Washington, DC 20009 • info@ewg.org