

## The Danger in Your Water

By Timothy Gower

**Fluoride has been tied to bone cancer, lower IQs, and osteoporosis. So why is it still being added to your water?**

One fall day in 2004, Lea Anne Burke got a call from a neighbor. Had she heard that the city council was talking about adding fluoride to their water supply in Snohomish, WA? For years, the northern end of town had received fluoridated water from the nearby city of Everett. But nonfluoridated water from the Pilchuck River ran through pipes on the south side of Snohomish, where Burke, her husband, and their two little girls live.

Burke, 33, is a soccer mom and vice president of the local PTA. She studied environmental science in college and learned enough about fluoride to be convinced that she didn't want it flowing from the taps in her home. She won't even let her family brush with fluoride toothpaste. So Burke joined a small group of citizens who, last year, persuaded the city council to abandon its plan to fluoridate the water. "Until it's proven safe, why do it?" asks Burke

If you have only ever known fluoride as a champion cavity fighter that keeps your pearly whites strong, Burke's concerns may sound off the wall. After all, two-thirds of US cities and towns fluoridate water, and most US dentists agree that it prevents tooth decay. In fact, in 1999, the CDC named the fluoridation of community water one of the top 10 public health achievements of the 20th century.

Yet, controversy and doubts about its safety have dogged fluoride ever since the first US city, Grand Rapids, MI, began adding it to its water supply in 1945. And now, several reports published earlier this year have tarnished fluoride's brilliant veneer. In March, a panel of dentists, toxicologists, and epidemiologists assembled by the National Research Council (NRC) determined that the level of fluoride allowed in community drinking water in this country is too high. In a cruel irony, the panel found that children who consume water containing the highest level of fluoride permitted by the EPA might actually be damaging their teeth; there was even a hint that it might depress IQ. What's more, the panel stated that consuming water with that amount of fluoride over a lifetime could weaken bones and increase the risk of fractures. And just 2 weeks after the NRC report made headlines, a Harvard study suggested that fluoridated water could cause a rare form of bone cancer in young boys.

The two reports have helped fuel the passions of fluoridation opponents, a group made up of scientists and concerned citizens. They claim that adding fluoride to drinking water may have made sense once but is unnecessary now because it is available in other forms, such as toothpaste. Drinking the stuff, they say, exposes millions of Americans to needless health risks. "Fluoridation should be abandoned," says dentist Hardy Limeback,

PhD, DDS, head of preventive dentistry at the University of Toronto and a member of the panel that wrote the NRC's fluoride report. "It could turn out to be one of the top 10 mistakes of the 21st century."

If Limeback and other top-notch researchers at respected universities are now concerned that we're getting too much fluoride, should you be worried, too?

For starters, read the label on a tube of toothpaste: *Keep out of reach of children under 6 years of age. If more than is used for brushing is accidentally swallowed, get medical help or contact a Poison Control Center right away.*

Poison? Indeed, some forms of fluoride are used in high concentrations to kill rats and crop-eating insects. Municipal employees who add fluoridation chemicals to public water systems must wear protective clothing and respirators. Industrial workers regularly exposed to fluorine, the gas form of fluoride, have suffered skin, lung, and gastrointestinal problems; it has even been fatal for some.

But at the doses most people get, fluoride behaves differently: About half of it exits quickly through the urine, while the remainder settles into the bones or teeth. The 1 mg of fluoride per liter of water (1 mg/L) recommended by the government for water systems is equal to just 1 part per million (or 1 ppm). That scant dose of fluoride has been added to water since the 1940s to fight tooth decay, and early research suggests it did the job well. A 1962 study of Newburgh, NY, one of the first communities to fluoridate its water, found that cavity rates dropped by 70% over a span of 15 years.

That sort of success sounds impressive--but it's no longer relevant, opponents say. When fluoridation began, scientists believed that fluoride needed to be ingested to fight cavities, so that it could be incorporated into the enamel of developing teeth before they erupted through a baby's gums. However, most dental researchers today agree that throughout our lives, fluoride works best when it's applied directly to the teeth, where it not only shores up dental enamel but also shields it from damaging acid produced by bacteria in the mouth. That means today's fluoride toothpastes, rinses, tablets, and other dental products can do the job. At the very least, since most Americans today brush at least once a day, fluoride dental products have diluted some of the benefits of drinking fluoridated water.

In 1990, researchers at the National Institutes of Health compared the dental records of 16,000 children between ages 5 and 17. Half lived in fluoridated communities; the rest did not. They found that the kids who grew up drinking fluoridated water had just 18% less tooth decay than the other children.

Fluoride skeptics add that even this relatively unimpressive statistic loses much of its luster when you examine the numbers more closely. The study showed that children in fluoridated communities had 0.6 fewer decayed tooth surfaces--or about half of one cavity--than those who didn't drink fluoridated water. "That's not much of a benefit," says toxicologist Tim Kropp, PhD, of the Environmental Working Group, a Washington, DC-

based nonprofit organization that opposes water fluoridation. Especially when you consider that too much fluoride can harm teeth.

## **Mottled Teeth and Lower IQs**

The protective qualities of fluoride were first discovered in communities where the soil contained naturally high levels. What drew scientists' attention: the locals' stained or mottled teeth. Only later was it recognized that they also had fewer cavities. Both the strength and the unsightliness, it turned out, seemed to be due to fluoride exposure as their teeth were developing.

Many dentists consider the staining, called dental fluorosis, to be strictly a cosmetic concern because it's usually mild--chalky streaks or splotches on one or more teeth. Still, the NRC panel determined that about 10% of kids living in communities where the drinking water is close to the EPA upper limit of safe exposure, 4 mg/L, develop severe dental fluorosis; that means not only yellow and brown stains on their teeth but also pits in their enamel, increasing the risk of cavities. Rates of dental fluorosis appear to be on the rise--the CDC says the percentage of Americans between ages 6 and 19 with fluorosis jumped from 23% in the late 1980s to 32% today. To prevent severe dental fluorosis, the NRC panel advised the EPA to lower the allowable amount of fluoride in drinking water. "We have now said to the EPA that the level you guys think is okay could damage the enamel of children," says University of Kansas Medical Center Professor Emeritus John Doull, PhD, a toxicologist and chairman of the NRC panel.

Concerns about relatively mild forms of fluorosis must be balanced against the benefits of the mineral, argues fluoride researcher Steven Levy, DDS, of the University of Iowa College of Dentistry. But it's wrong to dismiss the streaks and splotches out of hand, he says, given how focused people are on the appearance of their teeth.

Levy questions a common practice among many pediatricians and pediatric dentists: prescribing fluoride supplements to children who live in nonfluoridated communities. The American Dental Association (ADA) still recommends daily supplements for such kids from the time they're 6 months old to age 16. But 5 years ago, the CDC issued guidelines stating that even in communities without fluoridation, the only children who should get supplements are those with a high risk of cavities, such as kids with a family history of serious tooth decay. Levy says it may also be appropriate to follow the ADA's guidelines on supplements if a dentist suspects that a child's parents are not inclined to encourage healthy dental habits.

Some experts believe that giving fluoride pills and drops to any child is a mistake. "It's clearly demonstrated that they are a fluorosis risk," says Brian Burt, PhD, a University of Michigan School of Public Health dental epidemiologist. "You're getting more risk than benefit, so I don't see any need for them."

Burt's reasoning seems particularly sound given another concern in the NRC report: Several studies from China have found a persistent link between high levels of fluoride and IQ deficits in children. In one study, children in a town with about 2.5 mg/L of

fluoride in the water tested 8 points lower on average than children in a village whose water had just trace amounts of it. Some animal studies have suggested that fluoride can harm brain cells, though the chemical interaction isn't yet completely clear. The report concluded that the "consistency of study results appears significant enough to warrant additional research."

One problem in determining fluoride's potential harm, if any, is that it's not clear how much we get from other sources. Virtually all foods contain at least a trace: Fluoride is a component of soil, so it turns up in fruit, vegetables, and grains. But how much there is depends on where a crop was grown, because the fluoride content of soil varies from one region to another. Agricultural pesticides and irrigation water often contain fluoride, too, which is incorporated into plants. Water given to chickens, cattle, and other farm animals may also be fluoridated.

According to the CDC, the typical American gets 1 to 3 mg of fluoride per day, though experts say that is a very rough estimate. "There's a huge variation in levels of intake," says Levy. He leads a team that has been studying the diets of about 700 children in Iowa (roughly 70% of them in fluoridated communities) to get a more accurate picture of consumption of fluoride in this country. His research has already yielded some worrisome findings: About one-quarter of the children are swallowing twice as much fluoride each day as they should be.

## **Bone Troubles**

Adults could face other troubling consequences. A report last year in the *American Journal of Medicine* described a woman who developed a rare condition that is known to be caused by overexposure to fluoride: skeletal fluorosis, which produces stiff, painful bones and joints and can be crippling in its later stages. The woman's doctors were puzzled by her symptoms until they discovered the cause. Every day for much of her adult life, she drank 1 to 2 gallons of double-strength instant iced tea. Tea leaves, it turns out, absorb a great deal of fluoride from soil, though levels vary depending on the region where they are grown and the season in which they are harvested.

It takes a lot of fluoride to begin developing skeletal fluorosis--at least 10 mg a day for 10 years. But endocrinologist Michael P. Whyte, MD, of the Washington University School of Medicine, the lead author of the report, says a person can get into the danger zone without quaffing gallons of tea every day. Whyte and his colleagues analyzed 10 types of instant tea for fluoride content. They found a range: Two brands contained only about 1 mg/L--Lipton Instant Diet Iced Tea Mix (Decaffeinated Lemon) and Schnucks Instant. However, most of the teas had at least twice that amount of fluoride, and one popular brand, Lipton Instant, had 6.5 mg/L. (Likewise, brewed tea can contain anywhere from 1 to 6 mg/L of fluoride, depending on the variety used, the water, and the brewing time.)

Picture a lifelong iced tea lover who guzzles a liter (about 1 quart) of a high-fluoride brand made with fluoridated water every day. Whyte suspects the scenario may not be so

unusual in hot climates. "That's 7.5 mg. That's getting close to 10 mg a day," he says. "That could start to be associated with symptoms of skeletal fluorosis."

Even lower amounts of fluoride, consumed over enough time, can be problematic. Doull's NRC panel determined that a lifetime of drinking water at the EPA's 4 mg/L upper limit seems to increase the risk of bone fractures. Just 200,000 Americans live in communities where the water supply naturally contains that much fluoride (mostly areas located in South Carolina, Texas, Oklahoma, and Virginia). But an additional 1.4 million live in communities where concentrations naturally range from 2 to 3.9 mg/L.

Even the CDC's recommended target of 1 mg/L of fluoride may increase the danger of bone ills: In 1992, researchers from the University of Utah reported in the *Journal of the American Medical Association* that elderly men were 41% more likely to fracture a hip if they lived in a community where the water contained that amount than if they lived in areas with lower levels; women's risk increased by 27%. (Although the authors didn't ask specifically how long the residents had lived in the towns studied, all were settled communities with little migration in or out.) Joseph L. Lyon, MD, a University of Utah professor of family and preventive medicine and lead author of the study, says findings like his are why adding fluoride to drinking water makes no sense, especially because its benefits can be obtained with toothpaste and other fluoride dental products. "You are imposing risk on all individuals who use a public water system," says Lyon.

The Harvard fluoride study from earlier this year provides yet another reason to question the safety of the 1mg/L standard. Researchers compared 103 people who were diagnosed before age 20 with a rare kind of bone cancer called osteosarcoma with a similar group of people who did not have the disease.

They discovered that young boys who grew up drinking water containing at least 0.7 mg/L of fluoride were up to 5 1/2 times more likely to develop osteosarcoma than boys whose drinking water contained less. (The cancer is more common in boys--risk didn't seem to increase in girls.) Even water with a moderate concentration of fluoride (0.3 to 0.69 mg/L) appeared to boost risk in boys more than threefold.

#### The Good that Fluoride Does

The Harvard bone cancer study made a big splash, coming 2 weeks after the NRC report. And that drives fluoride advocates crazy, because they feel it didn't tell the whole story. The authors of the NRC report had looked at the study results prepublication and stated that there is still no way to confirm or refute the link between fluoride and bone cancer. Two studies in the early 1990s had suggested a connection, while several others found none. Likewise, lab research designed to determine if--and how--fluoride might promote bone cancer has produced mixed results.

That's true of all the worrisome findings on fluoride, say proponents. Although individual studies have linked exposure to high levels of fluoride with certain medical conditions, several large scientific reviews have failed to conclusively link any major disease to drinking water that contains the government's recommended concentration of 1 mg/L of

fluoride, notes dentist and epidemiologist Jayanth V. Kumar, DDS, director of oral health surveillance and research for the New York State Department of Health.

What's more, opponents understate the true value of fluoridated water in fighting cavities, says dentist and epidemiologist John Stamm, DDS, a professor of dentistry at the University of North Carolina at Chapel Hill and a spokesman for the ADA. Stamm asserts that the primary finding of the 1990 NIH study mentioned earlier--in which fluoridated water appeared to reduce tooth decay rates by only about a half cavity, on average--is misleading. The youngest children in the study were just 5 years old, suggesting that their permanent teeth had not been in place long enough to develop serious tooth decay. With so few cavities to count, there were only tiny differences between younger children in the fluoridated and nonfluoridated communities, making the overall difference look small.

The results were more striking among older children, Stamm notes. For example, kids who were 17 at the time of the study had 1.6 fewer cavities if they had grown up drinking fluoridated water. Is that enough to make fluoridation worthwhile? "Sure, absolutely," says Stamm, who--like most other dentists--argues that constantly bathing the teeth with fluoridated water complements the cavity-fighting work of fluoride dental products.

But for skeptics like Hardy Limeback and Tim Kropp, 1 1/2 fewer cavities seems like a very questionable reward given the potential risk. And they point out that an important British report often used to defend fluoridation actually casts doubts on its safety and benefits. In 2000, what's come to be known as the York Review examined 214 studies probing the effectiveness and safety of water fluoridation. Though the review found that adding fluoride to drinking water helps fight cavities, University of York research fellow Paul Wilson called the overall quality of studies his group analyzed "really poor." Many were biased or used outdated scientific methods, he says, so it's impossible to say whether fluoride is safe or a threat. "There is currently a lack of reliable evidence to make a definitive judgment either way," he says.

That review was published 55 years after fluoride was first added to US water systems. The NRC report released earlier this year finds essentially the same thing--there's a troubling lack of evidence proving or disproving fluoride's safety. Even knowing that fluoride fights tooth decay, you may find it unsettling to hear scientists express uncertainty about the possible dangers of something you swallow every day.

Beyond the issues surrounding water fluoridation, however, there is some reassurance: The Environmental Working Group says using fluoride-based dental products make sense, and even Limeback uses fluoride--topically--in his dental practice. Given lingering concerns about the omnipresent compound, a reasonable person may simply decide that she doesn't want herself or her family to swallow fluoride, but instead apply it directly to her and her kids' teeth, where it matters most. For those who eat right and brush regularly, that may be plenty to keep teeth healthy.

If you live in a community with fluoridated water, such a decision will mean filtering your taps or drinking nonfluoridated bottled water (see "10 Steps to Cutting Back on Fluoride"). We're probably years away from a serious reappraisal of fluoridation. Dental epidemiologist Burt, who has suggested reducing the concentration of fluoride added to water systems, says dentists greeted his suggestion with little enthusiasm. The 1 mg/L standard, he says, "has become enshrined, given almost the status of divine revelation in some quarters. There's a feeling that we can't monkey with this."

Lea Anne Burke might be considered a heretic, then. "I'm always suspicious when people tell me, 'You have to do this.' Tell me why and show me some good science. With my children's health at stake, you have to give me some really good reasons." Burke has plenty of company: In 2005, cities in nine states--California, Colorado, Iowa, Missouri, New York, Ohio, Oregon, Utah, and Washington--voted to reject, abandon, or prohibit water fluoridation.