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Dental offices contribute to methylmercury burden

Bacteria that methylate mercury thrive in wastewater found downstream from dental traps.

Among the array of chemicals that escape down the drain in dental offices, mercury from amalgam fillings has probably received the most attention. Researchers have suspected that formation of methylmercury, the neurotoxic form of mercury, can occur in dental wastewater. Now, in a study published in *ES&T* (DOI: 10.1021/es7027058), researchers find a strong correlation between high levels of methylmercury and the presence of methylating bacteria in dental wastewater.

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Researchers took samples from collecting drums downstream of dental chairs in two Chicago offices, to find out what might be living and methylating in the wastewaters.

Mercury from dental fillings can amount to almost 15% of the total mercury **(PDF: 215 KB)** that a wastewater treatment plant receives, according to previous research by the American Dental Association (ADA). Past estimates have put such releases from the average dental office at up to 35 milligrams a day, from amalgam. Various devices that catch mercury before it heads off to the local water treatment plant have become more efficient, capturing 40–80% of the mercury released from amalgams—depending on their configuration, the office plumbing, and other characteristics. New amalgam separators can grab 99% of the mercury washed out of a patient's mouth.

But the wastewater also may serve as home to sulfate-reducing bacteria such as *Desulfobacteraceae* and *Desulfovibrionaceae* species, both known to methylate mercury at high rates, according to Karl Rockne of the University of Illinois Chicago and co-workers. The team gathered samples from collection tanks serving more than a dozen chairs in two dental offices in the Chicago area. They measured total mercury and methylmercury in both settled and mixed water samples. They then used quantitative polymerase chain reaction to identify the methylating bacteria.

Rockne says at first they were surprised by the total output, which amounts to 5 kilograms (kg) of methylmercury per year for the entire U.S. (The team's previous work estimated 1 kg of total mercury per chair per year.) Their results also showed that ratios of methylated to elemental or ionic mercury were good predictors for the formation of methylmercury; concentrations of methylmercury were up to 10–40 times less than those of total elemental mercury.

The team concluded that sulfate-reducing bacteria were responsible for the methylmercury in the dental wastewater. But they could not pinpoint whether the methylation occurred in people's mouths or further down the line. For future work, the team plans to study other metals in amalgams, including silver, which may be toxic to the bacteria.

Many devices are successful at trapping mercury, but they are not built to gather methylmercury, the authors stress. Controversy associated with human-health effects from mercury-containing dental fillings has resulted in decreased use of such amalgams, says Rockne, but they are still common.

"Theoretically, it's been known [that mercury could be converted] in the wastewater itself into methylmercury," says Rod Mackert, a professor of dental materials at the Medical College of Georgia School of Dentistry and a longtime spokesperson for ADA on the issue of mercury. The new research could be the first direct evidence of where that formation occurs, he adds.

Mark Stone of the Naval Institute for Dental and Biomedical Research and colleagues recently reported **(PDF: 142 KB)** concentrations of metals in dental wastewater, including different bioavailable species of mercury. Stone, who says the new *ES&T* work is important, notes that "other non-sulfate-reducing bacteria that are known methylators of mercury [could be] contributing to the [methylmercury] production."

Mackert emphasizes that the total amount of methylmercury the team found is "infinitesimal," particularly when compared with the overall amounts of total mercury and methylmercury entering the environment from other sources, such as coal burning and gold mining. Nevertheless, last September ADA began encouraging dentists to switch to the more efficient amalgam separators as part of their best management practices advisories. "It seems like a good idea," Mackert says, to stop the metal in its many forms from going to treatment plants at all, where it would end up in the posttreatment sludge, often sold for land applications.

Rockne agrees that "dental traps are only one of the sources of methylmercury to the wastewater system," and a small one at that. But because dental offices have a simple pipe system, solving the problem there is easier than reducing mercury from some other sources, including food and air deposition, he underscores. —NAOMI LUBICK

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