Science-based response lacking in chemical disasters

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Three new studies suggest that when communities are hit with disasters that contaminate drinking water the official decision-making and response often lack scientific basis.

The result has been an inability to fully anticipate public health risks and effectively rid plumbing systems of contaminants, sometimes exposing residents to toxic chemicals, said Andrew Whelton, an assistant professor in Purdue University's Division of Environmental and Ecological Engineering and Lyles School of Civil Engineering.

Since 2014 more than 1.5 million people across the nation have received drinking water tainted with crude oil, diesel fuel, algal toxins and coal-washing chemicals.

"Numerous contamination incidents have been caused by chemical spills from storage tank ruptures, pipeline breaks, rail car and truck accidents, as well as algal blooms," Whelton said.

His team has been examining recent disasters in which tainted drinking water was distributed to homes. The goal is to develop techniques and tools to help communities respond more effectively, said Whelton, who will discuss some of the results of three studies on Wednesday (May 13) during the American Water Works Association Central District spring meeting in Danville, Indiana.

Some of the drinking water catastrophes studied were a January 2014

chemical spill in West Virginia; an August 2014 toxic algal bloom in Western Lake Erie; a December 2014 accident involving a petroleum-based solvent in Washington, D.C.; a January 2015 crude oil pipeline accident in Glendive, Montana; and an April 2015 diesel spill in Nibley City, Utah.

In one study, Purdue graduate student Karen Casteloes discovered that plumbing system flushing procedures did not account for low-flow faucets and water heaters of all sizes, suggesting that residents who followed official guidelines may have still had unsafe water in their homes. Casteloes also worked with Randi Brazeau, a Metropolitan State University of Denver researcher.

Research results also will be presented at a National Science Foundation sponsored chemical spill workshop, Fostering Advances in Water Resource Protection and Crisis Communication, Lessons Learned from Recent Disasters, on May 27-29 in Shepherdstown, West Virginia.

After reviewing 40 drinking-water emergencies, Casteloes developed a model that can be used to properly flush plumbing systems depending on their design. When Casteloes applied the model to the West Virginia and Montana spills, her results revealed flushing guidelines issued by the authorities would not have reduced contamination to safe levels for some homes, specifically manufactured and single-family homes that contained water-saving fixtures and large water heaters.

"The larger your water heater and greater number of low-flow fixtures you have in your home, the longer you need to flush your plumbing system," Whelton said.

Casteloes said "a significant need" exists for more analysis following a drinking water chemical contamination incident because unsafe water can remain in some homes.

In another study of eight oil spills, Purdue graduate student Xiangning Huang reviewed the response practices of water utilities, states, and the federal government. She found that approaches used by authorities varied considerably, and no guidance exists on which tests should be run in response to certain types of spills.

Huang said that in the wake of the Nibley City, Utah, spill and growing use of hydraulic fracturing, there is a need to address this ambiguity.

The researchers also found that testing is conducted for chemicals that have established drinking water limits, but not for unregulated chemicals that also may pose health risks.

"Responders need rapid analytical tools for characterizing unregulated contaminants in air and water, predicting air exposure risks and chemical fate in waterways, and in water systems," she said, recommending that a full screening of the spilled products be performed before deciding whether the water is safe and how to decontaminate water systems.

A third study examined in-home drinking water testing data from the 2014 West Virginia chemical spill. Whelton and University of South Alabama graduate student LaKia McMillan collected and analyzed data from a variety of universities, private companies, and nonprofit organizations and compared them to data obtained by responders.

"We found that more than 10 chemicals not listed on any material safety data sheet were spilled from the Freedom Industries tank into the Elk River," Whelton said.

The contaminant methyl 4-methylcyclohexanecarboxylate (MMCHC) was present in the drinking water 13 to 30 days after the spill.

"No safe drinking water exposure limit was established for MMCHC.

The long-term health impacts of this chemical exposure remain unstudied," Whelton said. "Responders only tested drinking water for three ingredients."

Whelton said the findings of the three studies emphasize the need for improvements in chemical spill response, and in-home water testing is essential. The research was funded by the National Science Foundation RAPID grant 1424627. Some of the work has been featured by NSF's Science Nation magazine.

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