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DEPARTMENT OF PUBLIC HEALTH

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TO: Lori Mathieu, Section Chief, Drinking Water

FROM: Meg Harvey, Unit Supervisor, Site Assessment and Chemical Risk

SUBJ: Amston Lake Water System elevated copper incident

DATE: January 10, 2013

This Letter Health Consultation (LHC) was prepared to document involvement of the Environmental and Occupational Health Program (EOHA) in an exposure situation involving elevated copper concentrations in a small public drinking water system in southeastern CT.

Statement of Issues

In early January 2012, the CT DPH Drinking Water Section (responsible for regulating public drinking water systems) requested assistance from EOHA in responding to elevated copper concentrations in a public water system serving approximately 325 people in the towns of Hebron, Lebanon and Colchester, CT. This LHC summarizes the exposures and risks from the elevated copper, describes interventions performed to reduce exposures, and details the community education and outreach activities that were conducted.

Background

In late November 2011, the operator of the Amston Lake Water System (ALWS) received a customer complaint of blue staining of plumbing fixtures and skin rashes following showering/bathing (CT DPH Drinking Water Section Public Water System Emergency Incident Report Form, 1/6/12). In response, the ALWS collected a tap water sample from the customer's home, which indicated that copper was elevated above the US Environmental Protection Agency's Action Level for copper (1.3 mg/L). Two nearby homes were also tested and were found to have copper concentrations above the Action Level. This testing was followed by first

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draw water samples (tap water that had been sitting in the pipes for at least 6 hours) from 9 homes on December 29, 2011. Of the 9 homes tested, 7 exceeded the Action Level. The highest copper concentration was 5.63 mg/L. Lead levels were also analyzed and none of the samples exceeded the EPA Action Level of 0.015 mg/L. The water system operator reported the data to CT DPH's Drinking Water Section and the Drinking Water Section immediately requested assistance from the CT DPH ATSDR unit. Based on the copper levels in the water system, CT DPH's ATSDR unit concurred with the ALWS proposal to issue a "do not drink" advisory. The advisory was issued on January 6, 2012 and an alternative water source was provided to the community. Over the next several weeks, extensive copper and pH testing was conducted. Treatment to lower the pH was performed and on January 18, 2012, copper levels were consistently lower than the Action Level, pH levels were stable and the advisory was lifted. During and after the advisory, there was a high level of concern among some residents about health effects from copper exposure. To address these concerns, CT DPH's ATSDR unit spoke with residents directly, assisted with preparation of a fact sheet and participated in a public availability session that was attended by over 50 residents.

Discussion

Exposure and Data Evaluation

Of the 12 homes tested in November and December 2012 (3 initial homes and 9 follow up homes), 10 had copper concentrations exceeding the EPA Action Level of 1.3 mg/L. The highest copper level was 5.62 mg/L.

Historic water quality data from the ALWS indicates that copper levels were unlikely to have been elevated prior to the time when customers first noticed blue stains in their plumbing and made a complaint. This is because a drop in pH levels in the water system occurred concurrently with the rise in copper levels in late November 2011. Prior to that time, quarterly and monthly pH levels in the water system were within normal range. It is hypothesized that in late November 2011, something caused a sudden drop in water pH, which caused copper to leach from the water pipes. Exposure ended on January 6, 2012 with issuance of the "do not drink" advisory. Therefore, the period of time when customers could have been exposed to elevated copper was brief (4-6 weeks at most).

After the advisory was issued, water testing for copper, lead and pH continued. Samples included first draw and grab samples. Grab samples were taken after running the tap for a short while first. Samples were taken from a representative number of homes throughout the water distribution system. The highest copper concentration measured was 10.1 mg/L, which was measured in a first draw sample six days after the advisory was issued. As would be expected, grab samples had much lower copper concentrations than first draw samples. However, there were exceedances of the Action Level even in grab samples. Across the approximately 100 homes that were tested, about 4% of the grab samples exceeded the copper Action Level (maximum copper concentration of 2.8 mg/L). In the first draw samples, 42% exceeded the copper Action Level (maximum of 10.1 mg/L). Because these copper concentrations were measured after issuance of the "do not drink" advisory, we assumed that no residents were actually exposed to these levels.

Public Health Implications

Human and animal acute and intermediate duration toxicity studies strongly indicate that the gastrointestinal (GI) tract is the most sensitive target of copper toxicity (ATSDR 2004). Case study reports indicate an increased occurrence of nausea, vomiting, and abdominal pain in humans immediately following ingestion of copper-contaminated water or beverages at copper concentrations as low as 3 mg/L (ATSDR 2004, WHO 2004). Our recommendation to issue the "do not drink" advisory was based on the potential for customers to be exposed to copper concentrations exceeding 3 mg/L, which is in the range where acute symptoms cannot be ruled out. In addition, there was an anecdotal report of at least one ALWS customer (a child) who vomited after drinking a large amount of tap water. After the advisory was issued, residents were no longer drinking the water.

Copper is not easily absorbed through the skin and is not volatile. Therefore, during the time that the "do not drink" advisory was in place, other household uses of water such as bathing/showering would not have resulted in any copper exposures of concern (ATSDR 2004). As stated previously, there is good historic pH data to support the conclusion that the period of time when customers could have been exposed to elevated copper was brief (4-6 weeks at most). Copper levels that people were exposed to could have produced acute symptoms such as nausea, vomiting, and abdominal pain but those symptoms would disappear when copper exposure stopped.

The liver and kidney are also targets of copper toxicity. However, with the exception of liver effects in people with rare genetic syndromes[1], liver effects are rarely reported in humans (unless the dose is a lethal dose) (ATSDR 2004). One human study reported no liver effects after an intermediate duration exposure to the equivalent of approximately 6 mg/L copper in drinking water (ATSDR 2004). In animals, liver toxicity after copper exposure has been investigated in several acute and intermediate duration studies. These studies indicate a threshold dose range for liver effects in rats of 8-16 mg copper/kg/day (ATSDR 2004).

The highest copper concentration measured in ALWS water prior to the consumption advisory being issued is 23 times lower than the dose threshold for liver toxicity in rats[2]. After the advisory was issued, the highest copper concentration was still lower (13 times lower) than the liver toxicity dose threshold in animals. Thus, even if someone disregarded the advisory and continued consuming the water, the copper concentration was not high enough to cause liver toxicity.

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[1] Individuals with Wilson's disease, Indian childhood cirrhosis or idiopathic copper toxicosis are unusually susceptible to copper toxicity.

[2] The hepatotoxicity threshold in rats is 8-16 mg copper/kg/day. For a 70 kg adult consuming 2 liters of water/day, this threshold dose range equates to drinking water copper concentrations ranging from 280 mg/L – 560 mg/L. For a 16 kg child drinking 1 liter of water/day, the threshold dose range equates to drinking water copper concentrations in the range of 128 mg/L – 256 mg/L.

There is limited information on the renal toxicity of copper in humans but a number of animal studies confirm that the kidney is also a target of copper toxicity (ATSDR 2004). However, animal studies indicate that kidney effect levels are higher than effect levels for the liver. This suggests that copper concentrations in the ALWS would not have been high enough to cause kidney toxicity either.

Conclusions

1. For a brief period of time (4-6 weeks at most), customers of the ALWS could have been exposed to copper in their tap water at concentrations that could have caused acute, GI tract symptoms such as nausea, vomiting and abdominal pain. These effects would have disappeared once residents were advised to stop consuming the water.

2. Copper concentrations were not elevated enough to cause any other health symptoms such as liver or kidney damage.

3. Residents do not need to seek any medical testing or follow-up as a result of their potential short-term exposure to copper.

Recommendations

No further actions are recommended.

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References:
ATSDR 2004. Toxicological Profile for Copper, Agency for Toxic Substances and Disease Registry, September 2004.

WHO 2004. Copper in Drinking Water, Background document for development of WHO Guidelines for Drinking Water Quality, WHO/SDE/WSH/03.04/88, 2004.