# Pseudo-Outbreak of Antimony Toxicity in Firefighters — Florida, 2009

Antimony oxides, in combination with halogens, have been used as flame retardants in textiles since the 1960s. Uniforms made from fabric containing antimony are common among the estimated 1.1 million firefighters in the United States. In October 2008, CDC received a report from the fire chief of a fire department in Florida (fire department A) regarding an outbreak of antimony toxicity among 30 firefighters who had elevated antimony levels detected in hair samples. This report summarizes the ensuing health hazard evaluation conducted by CDC to determine the source of antimony exposure. In February 2009, CDC administered questionnaires to and collected urine samples from two groups of firefighters: 20 firefighters from fire department A who did not wear pants made from antimony-containing fabric, and 42 firefighters from fire department B (also located in Florida) who did. All 20 firefighters from fire department A and 41 (98%) from fire department B had urine antimony concentrations below or within the laboratory reference range (*1*). CDC concluded that wearing pants made from antimony-containing fabric was not associated with elevated levels of urinary antimony. Only validated methods (e.g., urine testing) should be used for the determination of antimony toxicity. Accurate and timely risk communication during suspected workplace exposures should underscore the importance of using validated tests, thereby refuting an unproven hypothesis, allaying unsubstantiated concerns, and enhancing public trust.

Firefighters' station uniforms typically are worn throughout a firefighter's shift, which can range from 8 to 48 hours. When responding to a fire, firefighters don turnout gear (i.e., outer protective clothing) over their station uniforms. Station uniforms are made from antimony-containing fabric, or from pure cotton, wool, and other flame-resistant materials. The pants evaluated during this evaluation, made by one manufacturer, consisted of a cotton and antimony trioxide and chloride flame-retardant fiber blend.

Fire department A had used antimony-containing pants for station uniforms since March 1997. In August 2008, unexplained neurologic symptoms of 1 year's duration (including generalized weakness, numbness, and hoarseness) in one long-tenured firefighter prompted him to undergo hair testing for heavy metals by a local physician. This test revealed an elevated antimony level according to the commercial laboratory's reference range. Subsequently, the local firefighters union encouraged all 199 fire department A firefighters to undergo testing for heavy metals. During September–November, a total of 29 of these firefighters independently underwent hair testing for heavy metals conducted by the same local physician at a private laboratory. The hair samples from these 29 firefighters were reported to have elevated antimony levels at an average of 10 times the commercial laboratory's reference range.

The local union suspected that the source of antimony exposure was the uniform pants. On October 6, fire department A suspended its requirement to wear the antimony-containing pants and advised that firefighters wear 100% cotton pants instead. From September 17 to November 11, a total of 44 firefighters from fire department A filed workers' compensation claims related to antimony exposure. Twenty-seven (61%) firefighters reported symptoms they attributed to antimony exposure, including fatigue, headache, muscle cramps, and joint pain. During November 2008–January 2009, print and television media and firefighter websites reported this apparent outbreak of antimony toxicity, causing national concern over the safety of the uniform pants.

In November 2008, CDC launched a health hazard evaluation by requesting and reviewing the workers' compensation claims related to antimony exposure. The half-life of antimony in urine is approximately 95 hours (*2*); therefore, to detect potential absorption occurring with use of antimony-containing pants, CDC investigators determined that a comparison group still using the pants was needed. Many fire departments had discontinued use of the pants because of negative media coverage. However, fire department B, also in Florida, had not reported any symptoms, continued to use the antimony-containing pants, and agreed to participate in the evaluation in January 2009.

During February 2–6, CDC conducted a site visit to measure urine antimony concentrations among firefighters, compare antimony concentrations between firefighters wearing and not wearing antimony-containing pants, and describe occupational factors potentially associated with elevated antimony concentrations. A convenience sample of 112 on-duty and off-duty fire department A firefighters was invited to participate.* Twenty-four (21%) participated (four civilian employees and 20 firefighters, including two who had filed workers' compensation claims). All 42 on-duty and off-duty firefighters from fire department B participated.

After obtaining informed consent, CDC administered surveys to all participants, which included questions concerning demographics, work history, and possible sources of exposure to antimony, such as live fire responses and at-risk secondary occupations. Spot urine samples were collected from all participants. Concentrations of antimony were measured at

* Convenience sample included 42 on-duty firefighters, 50 additional firefighters who had filed workers' compensation claims up until the site visit date, and 20 chief officers and fire inspectors.

CDC by inductively coupled dynamic reaction cell plasma mass spectrometry, in accordance with published protocols (*3*) and were adjusted for urine creatinine. The logarithmic urine antimony concentrations were distributed normally among participants, and this warranted a comparison of the means of the log transformed values for urine antimony concentrations between groups using the Student's t-test.

Fire department A participants generally were older and worked longer as firefighters (Table). The proportion of fire department A (38%) and B (31%) participants that had responded to a live fire, in which they might have been exposed to antimony-containing ash, was similar. Fire department A participants had not worn pants containing antimony during the preceding 4 months, whereas fire department B participants had worn the pants for a mean of 92 hours (the equivalent of nearly four 24-hour shifts) during the preceding 2 weeks. None of the participants reported other activities that might have exposed them to antimony, such as metal smelting or battery manufacturing (*2*).

All fire department A participants (100%) and all but one fire department B participant (98%) had urine antimony concentrations below or within the laboratory reference range of 0.120–0.364 μg/g creatinine for the general population (*1*). The median urine antimony concentration for fire department A participants was 0.059 μg/g creatinine (range: 0.027–0.285 μg/g creatinine) and for fire department B participants was 0.048 μg/g creatinine (range: 0.017–0.366 μg/g creatinine). The means of the log transformed urine antimony concentrations of both fire departments were not significantly different (p = 0.31). One fire department B firefighter had a urine antimony concentration of 0.366 μg/g creatinine, a clinically unimportant difference from the upper limit of the laboratory reference range.

**TABLE. Characteristics of firefighters participating in an evaluation of a pseudo-outbreak of antimony toxicity — Florida, 2009**

| Characteristic | Fire department A (n = 24)* | | Fire department B (n = 42)† | |
|---|---|---|---|---|
| Mean age (yrs) | 49 | | 39 | |
| Mean no. of yrs spent as a firefighter | 26 | | 13 | |
| Mean no. of yrs spent at fire department A or B | 23 | | 11 | |
| | No. | (%) | No. | (%) |
| Male | 23 | (96) | 39 | (93) |
| Participated in a live fire response in preceding 2 wks | 9 | (38) | 13 | (31) |

* Fire department A participants had not worn pants made from antimony-containing fabric during the preceding 4 months.
† All fire department B participants had worn pants made from antimony-containing fabric (mean duration: 92 hours) during the preceding 2 weeks.

### What is already known on this topic?

Although antimony oxides have been used as flame retardants in textiles since the 1960s, no previous studies have been published about the health effects after dermal exposure in humans.

### What is added by this report?

Results of the health hazard evaluation described in this report indicate that wearing pants made from antimony-containing fabric was not associated with elevated concentrations of urinary antimony among 65 persons tested.

### What are the implications for public health practice?

Clinicians should use only a validated method, such as urine testing (not hair testing), to determine antimony toxicity, and officials responding to suspected workplace exposures should use accurate and timely risk communication to refute an unproven hypothesis, thereby allaying unsubstantiated concerns and enhancing the public trust.

CDC investigators concluded that wearing pants made from antimony-containing fabric was not associated with elevated levels of urinary antimony. By October 2009, a total of 77 fire department A firefighters filed workers' compensation claims concerning antimony exposure. Many claims were withdrawn after CDC's final report† was released; the remainder were dismissed by the city. As of October 2009, fire department A has not reinstated the requirement for antimony-containing uniforms; however, other fire departments nationwide continue to use them.

**Reported by:** *M Kawamoto, MD, S Durgam, MS, J Eisenberg, MD, Div of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health; K Caldwell, PhD, Div of Laboratory Sciences, National Center for Environmental Health; M de Perio, MD, EIS Officer, CDC.*

**Editorial Note:** The U.S population is exposed to low levels of antimony, a silver-white metal, every day through food, drinking water, and air (*4*). No studies have been published about the health effects after dermal exposure to or dermal absorption of antimony in humans (*4*). The findings in this report indicate no clinically important elevated antimony concentrations, as evidenced by urine testing, occurred in any firefighters, whether or not they wore antimony-containing pants.

This investigation highlights the importance of using validated methods for toxicity determination. Urine testing is the most reliable validated test for measuring antimony concentrations (*5*). The decision to perform laboratory testing for heavy metals should be based on whether symptoms are consistent with toxicity from these metals and whether a likelihood of exposure exists. Hair testing is not reliable

† Available at http://www.cdc.gov/niosh/hhe.

or valid for measuring heavy metals in the body (except for methylmercury) and does not predict toxicity (*6*). Standards on methods of hair collection, storage, and analysis are lacking. No regulation or certification of laboratories conducting hair analysis exists. Different laboratories have reported different results for hair samples collected from the same person and use different reference ranges (*7*). Hair analysis cannot distinguish between internal (substances inside one's body) and external (substances that might stick to hair, such as ash or hair-care products) exposure. These limitations render hair analysis results uninterpretable. The American Medical Association (*8*) and Agency for Toxic Substances and Disease Registry (*9*) do not recommend using hair testing in diagnosing or guiding treatment for heavy metal toxicity.

Symptoms of chronic antimony toxicity from inhalation or ingestion include headache, dizziness, and pulmonary and gastrointestinal symptoms.[§] The neurologic symptoms reported by the index firefighter were not consistent with antimony toxicity. The fatigue, headache, muscle cramps, and joint pain reported by fire department A firefighters in the workers' compensation claims were nonspecific and likely had unrelated etiologies.

Subjective nonspecific symptoms can trigger concerns about workplace or environmental exposures. Hypotheses for potential exposure sources can be based on inaccurate information. Health-care providers occasionally use invalid medical tests, which can lead to unnecessary, inappropriate treatments and delay appropriate medical care. Hair analysis is one test inappropriately used to propose an environmental and occupational cause for reported symptoms. Other such tests encountered during CDC health hazard evaluations include post-chelation urine testing for metal toxicity, use of peripheral neurofilaments for neurotoxic exposure, measurement of caffeine clearance for hepatotoxic exposure, and use of mold immunoassays for symptoms attributed to mold exposure.

This investigation highlights the public health importance of timely dissemination of accurate information. Before the site visit, investigators distributed information about antimony and the shortcomings of hair analysis. Shortly after the site visit, they posted questions and answers about the evaluation on a CDC website[¶] and on national firefighters unions' websites. Effective risk communication, which underscores the proper use of validated tests, can refute an unproven hypothesis, allay unsubstantiated concerns, and enhance public trust (*10*).

[§] Additional information available at http://origin.cdc.gov/niosh/docs/81-123/pdfs/0036.pdf.

[¶] Available at http://www.cdc.gov/niosh/fire/spotlight.html.

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