Characterization of aerosolized metals released during high-temperature dispersion of canisterized CS riot control agent
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Introduction
Law enforcement-related training typically involves the use of actual riot control agents (RCA). Law enforcement personnel train with the RCA α-chlorobenzylidene malononitrile (CS). The Chemical Weapons Convention treaty defines RCAs as agents that can rapidly produce sensory irritation or disabling physical effects in humans that disappear within a short time following termination of exposure. This study focused on CS which was accepted as the standard RCA in the United States in 1959 (Boardman et al., 2008). The most widely accepted method for CS field-dispersal is high-temperature dispersion from a canister. Previous studies identified acid gas and semi-volatile organic air contaminants, some of which are potentially harmful thermal degradation products, as a result of high-temperature dispersion from metal canisters and from capsules (Kluchinsky, Savage, Fitz, & Smith, 2002; Kluchinsky, Sheely, Savage, & Smith, 2001). The purpose of this study was to characterize aerosolized metals released during high-temperature dispersion of CS canisters; thereby, further defining the exposure footprint associated with exposure to CS RCA canister-related operations. It was hypothesized that the high-temperature dispersion of CS RCA canisters would result in the generation of aerosolized metals in concentrations harmful to human health.

Materials and Methods (continued)
and CS canister pin and spoon were removed (Figure 1) to initiate high-temperature dispersion resulting in a CS concentration of 45 ppm (Figure 2). Gas chamber air was collected at a rate of 4 L/min for 5 minutes in an effort to collect 20 L of air per sample and minimize potential filter overload. After sampling was concluded, the cassettes were removed from the pumps and transported to the lab for analysis by inductively coupled plasma-mass spectrometry (ICP-MS). This is a deviation from the NIOSH method 7300 of analysis which calls for inductively coupled argon plasma-atomic emission spectrometry (ICP-AES), because analysis by ICP-MS is much more sensitive than analysis by ICP-AES.

Results (continued)
The results of the filter analysis showed the following metals to be below the level of quantification (LOQ): aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, selenium, and silver. Lead was determined to be present in levels above the LOQ in 4 of the 8 samples (Graph 1).

Results
The presence of lead was shown and varied in concentration based on pump location and air current dynamics present in the chamber (Figure 3). Sampling was conducted under the assumption that a single RCA canister was representative of the total population of that type of RCA canister. The resultant concentrations produced by a single canister were found to be below occupational exposure limits for trainees. However, trainers are commonly exposed to more than one canister and should be placed in a medical surveillance program.

References