Occupational Phosphine Gas Poisoning at Veterinary Hospitals from Dogs that Ingested Zinc Phosphide — Michigan, Iowa, and Washington, 2006–2011

Zinc phosphide (Zn_3P_2) is a readily available rodenticide that, on contact with stomach acid and water, produces phosphine (PH_3), a highly toxic gas. Household pets that ingest Zn_3P_2 often will regurgitate, releasing PH_3 into the air. Veterinary hospital staff members treating such animals can be poisoned from PH_3 exposure. During 2006–2011, CDC's National Institute for Occupational Safety and Health (NIOSH) received reports of PH_3 poisonings at four different veterinary hospitals: two in Michigan, one in Iowa, and one in Washington. Each of the four veterinary hospitals had treated a dog that ingested Zn_3P_2. Among hospital workers, eight poisoning victims were identified, all of whom experienced transient symptoms related to PH_3 inhalation. All four dogs recovered fully. Exposure of veterinary staff members to PH_3 can be minimized by following phosphine product precautions developed by the American Veterinary Medical Association (AVMA) (*1*). Exposure of pets, pet owners, and veterinary staff members to PH_3 can be minimized by proper storage, handling, and use of Zn_3P_2 and by using alternative methods for gopher and mole control, such as snap traps.

In 2006 and 2008, the Michigan Department of Community Health contacted NIOSH regarding two separate events of PH_3 poisoning among veterinary staff members. In 2011, the Washington State Department of Health and the Iowa Department of Public Health each notified NIOSH of events causing cases of occupational PH_3 poisoning. A poisoning case was defined as two or more acute adverse health effects consistent with PH_3 toxicity in a person exposed to PH_3 generated from Zn_3P_2. Cases were categorized by certainty of exposure, reported health effects, and consistency of health effects with known toxicology of the chemical (*2,3*). Eight poisoning cases were identified from the four events reported, and all poisonings were determined to be low severity.* NIOSH sought additional cases from various sources, including the SENSOR-Pesticides listserv and aggregated database, the AVMA members-only website, and participants in an October 2011 zoonotic diseases telephone conference call. No additional events or cases were identified.

Case Reports

Event A. On May 3, 2006, a 70-pound (32-kg) dog that had consumed rodenticide containing Zn_3P_2† was brought into a veterinary hospital in Michigan. Vomiting was induced in the examination room using hydrogen peroxide, and two hospital workers were poisoned. The first worker was a female technical assistant, aged 53 years, with no noted comorbidities, who experienced shortness of breath, difficulty breathing, headache, and nausea. The second worker was a female office manager, aged 61 years, with a history of diabetes and congestive heart failure. She developed shortness of breath, difficulty breathing, headache, and lightheadedness. The state poison control center advised both victims to ventilate the room and move to fresh air. No other medical care was received. Both recovered completely and lost no time from work.

Four other exposed staff members experienced only one symptom each (i.e., chest tightness, chest pain, or headache). All six workers had been exposed by entering the examination room or a nearby area. Decontamination was conducted by disposing of the vomitus in an outdoor trash container and ventilating the room. All symptoms abated as soon as fresh air was circulated in the examination room and other areas of the veterinary hospital.

Event B. On March 10, 2007, a convulsing dog, breed and weight unknown, was brought into an Iowa veterinary hospital after consuming an unknown brand of mole pellets containing Zn_3P_2. The dog had been sedated for lavage when it emitted PH_3, and one female staff member, aged 20 years, was poisoned. After the exposure, she reported dizziness and headache but did not receive medical care. She was back at work the next day with a slight headache. One other staff member experienced only eye irritation and did not meet the case definition for poisoning.

The veterinary hospital was evacuated, and the city fire department's hazardous materials team was called for decontamination. The veterinarian notified the state poison control center the same day, and the poison control center notified the Iowa Department of Public Health.

*Severity of poisoning cases can be categorized into four groups, using standardized criteria for state-based surveillance programs: low, moderate, high, and death. In low-severity cases, the poisoning usually resolves without treatment and <3 days are lost from work. Additional information is available at http://www.cdc.gov/niosh/topics/pesticides/pdfs/pest-sevindexv6.pdf.

†Sweeney's Poison Peanuts Mole and Gopher Bait II, U.S. Environmental Protection Agency (EPA) registration no. 149-16.

Event C. On August 21, 2008, a 62-pound (28-kg) dog was brought into a Michigan veterinary hospital after ingesting three Zn_3P_2 pellets.[§] A female veterinarian aged 42 years with a history of multiple sclerosis induced the dog to vomit in a poorly ventilated room. She experienced multiple poisoning symptoms, including respiratory pain, headache, dizziness, chest pain, sore throat, and nausea. Fifteen hours after exposure, she visited a hospital emergency department and was admitted overnight for observation. She later reported that complete symptom resolution took approximately 2.5 weeks.

Three other workers also were poisoned. A female aged 30 years with a history of asthma had been next to the dog during treatment and developed dizziness, cough, and pain on deep breathing. Her symptoms persisted for 2 days. Two other female workers, aged 30–39 years, experienced headache and dizziness after working with the dog. All four women promptly called the state poison control center for advice and did not miss work. Two other staff members experienced only headaches; their symptoms did not meet the case definition.

Later the same day, firefighters used a handheld 4-gas monitoring device to detect whether hazardous levels of oxygen, carbon monoxide, hydrogen sulfide, or combustible gases were present in the veterinary hospital. No hazards were found; however, the device was not designed to measure PH_3. The Michigan Department of Community Health notified AVMA of both the 2006 and 2008 events and published a fact sheet for veterinarians and pet owners.[¶]

Event D. On July 8, 2011, a female dachshund, weight unknown, was playing outdoors when she vomited behind some bushes and collapsed. Her owners rushed the limp dog to a Washington veterinary hospital. She was unresponsive and had diarrhea, a weak pulse, pinpoint pupils, and a temperature of 107°F (41.7°C). Subsequently, the semicomatose dog vomited onto paper towels. The owners initially reported no exposure of the dog to Zn_3P_2; however, later the same day, the owners brought in a package of gray pellets,[**] recalling that the product had been applied in their yard 2 weeks earlier.

A female veterinary technician, aged 34 years, who sniffed the dog's vomitus on the paper towels to determine whether it smelled like food, immediately developed abdominal pain and nausea. The gastrointestinal symptoms persisted for only 20 minutes, and she did not seek medical care. Suspecting Zn_3P_2 toxicity, the veterinarian (who, along with other staff members, had experienced no symptoms) retrieved the vomitus about 20 minutes after it was put in the trash, placed it in a plastic bag, sealed it, froze it, and sent it to the Washington State Department of Health.

[§] Dexol Gopher Killer Pellets 2, EPA registration no. 192-205.

[¶] Available at http://www.michigan.gov/documents/mdch/zinc_phosphide_316718_7.pdf.

[**] Force's Mole RID, EPA registration no. 12455-30-814.

What is already known on this topic?

Zinc phosphide (Zn_3P_2) is a rodenticide that interacts with stomach acid to release phosphine (PH_3) gas. A great potential for toxicity exists when Zn_3P_2 is ingested and PH_3 is inhaled.

What is added by this report?

Four events of poisoning associated with Zn_3P_2 occurred in veterinary hospitals during 2006–2011. These events are the first reported cases of occupational PH_3 poisoning among veterinary hospital staff members treating dogs that had ingested Zn_3P_2.

What are the implications for public health practice?

Veterinary staff members need to be aware of this occupational hazard and the phosphine product precautions posted on the American Veterinary Medical Association website. Moreover, pet owners and clinicians also are at risk for PH_3 poisoning through interaction with animal or human patients who have ingested Zn_3P_2. Using alternative methods of gopher and mole control, such as snap traps, could reduce unintentional rodenticide poisoning.

The victim reported the event to the state poison control center 3 hours after exposure. The Washington State Department of Health sent the frozen vomitus to the State Department of Labor and Industries' Industrial Hygiene laboratory for energy dispersive radiographic analysis to qualitatively assess for phosphorus and zinc. Phosphorus was detected but not zinc (limit of detection for zinc was 0.1%). However, when zinc was measured using inductively coupled plasma spectrometry testing, it was detected at 0.003%. The Washington State Department of Health subsequently published an account of the event, including AVMA's precautions, in a Washington veterinary association newsletter (*4*).

Reported by

Abby Schwartz, MPH, Michigan Dept of Community Health. Robert Walker, MS, Iowa Dept of Public Health. Jennifer Sievert, Washington State Dept of Health. Geoffrey M. Calvert, MD, Div of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health; Rebecca J. Tsai, PhD, EIS Officer, CDC. ***Corresponding contributor:*** *Rebecca J. Tsai, rtsai@cdc.gov, 513-841-4398.*

Editorial Note

Zn_3P_2, a dark gray, crystalline, inorganic rodenticide, is highly toxic when ingested as a result of stomach production of PH_3, a colorless, flammable, toxic gas (*5*). The amount of stomach acid is directly correlated with the quantity of PH_3 produced (*6*). Workers at risk for PH_3 poisoning include veterinary and clinical staff members treating animal and human patients who ingest Zn_3P_2 (*1,7*). In humans, inhalation of high concentrations of PH_3 can be fatal (*8*) because

PH_3 inhibits oxidative phosphorylation and causes lipid peroxidation damage to cells and tissues (*9*). Damage to the pulmonary, nervous, hepatic, renal, and cardiovascular systems can occur; however, for nonfatal inhalation of PH_3, symptoms usually resolve within 30 days and rarely cause any long-term disabilities (*10*). Because no specific antidote has been identified, persons with PH_3 poisoning are managed with supportive care. Currently, no data have been published regarding the carcinogenic or reproductive effects of PH_3 in humans (*5*). Aluminum, calcium, and magnesium phosphide, which are fumigants and not rodenticides, also exhibit their toxicity through the release of PH_3.

The findings in this report are subject to at least two limitations. First, acute poisoning from Zn_3P_2 products might be underreported. Because symptoms might only last a few hours and can resolve without medical treatment, victims might never associate symptoms with poisoning. In addition, cases in victims who do not seek medical care or advice from poison control centers are not recorded by surveillance. Also, cases are only identified if Zn_3P_2 or PH_3 are listed as responsible for the poisoning. In a veterinary setting, the substance ingested by an animal often is not readily determined. Second, for this report, seven persons who had only one symptom did not meet the poisoning case definition.

The Zn_3P_2 products implicated in three of the four events currently are available for consumer purchase. Although the product labels specified that the pellets should be placed underground in burrows or tunnels, whether the product was applied correctly is unknown. Moreover, even with correct application, dogs might be exposed while digging in treated areas with their paws or by consuming poisoned prey (*5*). The labels also advise veterinarians to induce vomiting using hydrogen peroxide, but they do not advise that vomiting be induced outdoors.

After the Zn_3P_2 poisoning events in Michigan, AVMA posted precautions for veterinarians and pet owners to prevent PH_3 inhalation (*1*). These include remaining upwind and above the poisoned animal if vomiting occurs outdoors (PH_3 is heavier than air) and evacuating the room if vomiting occurs indoors. Veterinarians who induce vomiting in animals that have ingested Zn_3P_2 should do so outdoors. This precaution is not mentioned currently on Zn_3P_2 product labels. Moreover, the risk for Zn_3P_2 toxicity to pets, their owners, and veterinary hospital staff members can be reduced by using alternative methods of gopher and mole control, such as snap traps.

References

1. American Veterinary Medical Association. Phosphine product precautions. Washington, DC: American Veterinary Medical Association; 2011. Available at http://www.avma.org/public_health/phosphine_gas/default.asp. Accessed April 20, 2012.
2. Calvert GM, Mehler LN, Alsop J, De Vries AL, Besbelli N. Surveillance of pesticide-related illness and injury in humans. In: Krieger R, Doull J, Hodgson E, et al, eds. Hayes' handbook of pesticide toxicology. 3rd ed. Boston, MA: Academic Press; 2010:1313–69.
3. CDC. Case definition for acute pesticide-related illness and injury cases reportable to the national public health surveillance system. Cincinnati, OH: US Department of Health and Human Services, CDC, National Institute for Occupational Safety and Health; 2005. Available at http://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef2003_revapr2005.pdf. Accessed April 20, 2012.
4. Washington State Veterinary Medical Association. Exposure to zinc phosphide sickens Washington technician—what you should know. Snoqualmie, WA: Washington State Veterinary Medical Association; 2011. Available at http://wsvma.org/displaycommon.cfm?an=1&subarticlenbr=457#exposuresick. Accessed April 20, 2012.
5. National Pesticide Information Center. Zinc phosphide/phosphine technical fact sheet. Corvallis, OR: National Pesticide Information Center; 2010. Available at http://npic.orst.edu/factsheets/znptech.pdf. Accessed April 20, 2012.
6. Guale FG, Stair EL, Johnson BW, Edwards WC, Haliburton JC. Laboratory diagnosis of zinc phosphide poisoning. Vet Hum Toxicol 1994; 36:517–9.
7. Stephenson JB. Zinc phosphide poisoning. Arch Environ Health 1967;15:83–8.
8. Popp W, Mentfewitz J, Götz R, Voshaar T. Phosphine poisoning in a German office. Lancet 2002;359:1574.
9. Proudfoot AT. Aluminium and zinc phosphide poisoning. Clin Toxicol (Phila) 2009;47:89–100.
10. Brautbar N, Howard J. Phosphine toxicity: report of two cases and review of the literature. Toxicol Ind Health 2002;18:71–5.