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Workers Memorial Day — April 28, 2012

Workers Memorial Day recognizes those workers who have died or sustained work-related injuries or illnesses. In 2010, a total of 4,547 U.S. workers died from occupational injuries (*1*), and each year, approximately 49,000 deaths are attributed to work-related illnesses (*2*). For 2010, the Bureau of Labor Statistics reported that approximately 3.1 million workers in private industry and 820,000 in state and local government had a nonfatal occupational injury or illness (*3*). In 2010, an estimated 2.7 million workers were treated in emergency departments for occupational injuries and illnesses, and approximately 110,000 were hospitalized (CDC, unpublished data, 2012).

Economists are working to calculate the costs associated with occupational injuries and illnesses in the United States. Recent research estimates the cost of fatal injuries at $6 billion and the cost of fatal illnesses at $46 billion. Nonfatal injuries and illnesses are estimated to cost $186 billion and $12 billion annually (*4*). Additional information on workplace safety and health is available from CDC at http://www.cdc.gov/niosh.

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Short Sleep Duration Among Workers — United States, 2010

Insufficient sleep can have serious and sometimes fatal consequences for fatigued workers and others around them (*1–3*). For example, an estimated 20% of vehicle crashes are linked to drowsy driving (*3*). The National Sleep Foundation recommends that healthy adults sleep 7–9 hours per day. To assess the prevalence of short sleep duration among workers, CDC analyzed data from the 2010 National Health Interview Survey (NHIS). The analysis compared sleep duration by age group, race/ethnicity, sex, marital status, education, and employment characteristics. Overall, 30.0% of civilian employed U.S. adults (approximately 40.6 million workers) reported an average sleep duration of ≤6 hours per day. The prevalence of short sleep duration (≤6 hours per day) varied by industry of employment (range: 24.1%–41.6%), with a significantly higher rate of short sleep duration among workers in manufacturing (34.1%) compared with all workers combined. Among all workers, those who usually worked the night shift had a much higher prevalence of short sleep duration (44.0%, representing approximately 2.2 million night shift workers) than those who worked the day shift (28.8%, representing approximately 28.3 million day shift workers). An especially high prevalence of short sleep duration was reported by night shift workers in the transportation and warehousing (69.7%) and health-care and social assistance (52.3%) industries.

INSIDE

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Targeted interventions, such as evidence-based shift system designs that improve sleep opportunities and evidence-based training programs on sleep and working hours tailored for managers and employees (*4*), should be implemented to protect the health and safety of workers, their coworkers, and the public.

NHIS collects information about the health and health care of the noninstitutionalized, civilian population in the United States using nationally representative samples. Interviews are conducted in respondents' homes. Questions about average sleep duration,* employment status, and industry of employment are asked of a randomly selected adult within each family in the household as part of the core sample adult questionnaire that changes little from year to year. For this study, short sleep duration was defined as ≤6 hours of sleep in a 24-hour period, on average. NHIS obtains verbatim responses from each of the employed, randomly selected, adult respondents (aged ≥18 years) in the subsample regarding his or her employer's type of business (industry). These responses are reviewed by U.S. Census Bureau coding specialists who assign 4-digit industry codes based on the 1997 North American Industrial Classification System. This analysis used the 21 simple 2-digit industry recodes provided in the NHIS public dataset. In 2010, CDC's National Institute for Occupational Safety and Health (NIOSH) sponsored supplemental questions in NHIS about occupational health, including a question about the usual shift worked.

For this analysis, the usual shift worked was categorized as regular daytime, regular night, or other (regular evening, rotating shift, or some other schedule). Weighted data were used to produce national estimates of short sleep duration by industry of employment and usual shift worked. Point estimates and estimates of corresponding variances were calculated using statistical software to account for the complex sample design. Statistical significance was defined as $p<0.05$. Results based on fewer than 10 workers are not shown because of the instability of these estimates. Estimates are based on data collected from 15,214 sample adults employed at the time of interview who reported their average sleep duration. The final sample adult response rate was 60.8%.

Short sleep duration (average ≤6 hours per 24-hour period) was reported by 30.0% of employed U.S. adults (approximately 40.6 million workers) (Table 1). The majority of workers included in the survey (72.6%), reported that they usually worked a regular daytime shift; 3.7% worked a regular night shift, and 23.5% worked some other shift.† Workers who usually worked the night shift were significantly more likely to report short sleep duration (44.0%) than those who worked the day shift (28.8%) or some other shift (31.6%). However, this translates into approximately 2.2 million night shift workers with

* NHIS asked, "On average, how many hours of sleep do you get in a 24-hour period?" Answers were recorded as whole numbers of hours.

† 5.3% of employed adults worked a regular evening shift, 9.5% worked a rotating shift, 8.7% worked some other shift, and data were missing for 0.2%.

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short sleep duration compared with approximately 28.3 million day shift workers with short sleep duration. Among workers in all shifts, workers in the middle age groups of 30–44 years (31.6%) and 45–64 years (31.8%) were significantly more likely than workers aged 18–29 years (26.5%) or ≥65 years (21.7%) to report short sleep duration (Table 1).

Non-Hispanic black workers (38.9%), non-Hispanic workers of other races (35.3%), and non-Hispanic Asian workers (33.2%) were significantly more likely to report short sleep duration than non-Hispanic white workers (28.6%) or Hispanic workers (28.8%). Workers who were widowed, divorced, or separated (36.4%) were significantly more likely than workers who were currently married (29.4%) or those who had never been married (28.2%) to report short sleep duration. Workers with educational status equivalent to a high school diploma (33.7%) or some college (33.8%) were significantly more likely than workers with less (29.1%) or more (26.7%) education to report short sleep duration.

The prevalence of short sleep duration was significantly higher among workers with more than one job (37.0%) than among those with one job (29.4%), and significantly higher among workers who worked more than 40 hours per week (36.2%) than among those who worked 40 hours or less (27.7%). When stratified by shift, similar patterns were observed among day shift workers and workers with non-day or non-night schedules (evening, rotating, or other) regarding differences in short sleep duration by demographic characteristics (Table 1).

Among workers on all shifts, workers employed in the manufacturing industry sector (34.1%) were significantly more likely, and workers employed in "other services" industries (24.1%) were significantly less likely, to report short sleep duration than workers in all industries combined (30.1%) (Table 2). Among night shift workers, workers employed in the transportation and warehousing sector (69.7%) were significantly more likely, and workers employed in arts, entertainment, and recreation industries (9.8%) were significantly less likely, to report short sleep duration than night shift workers in all industries combined (44.0%) (Table 2). The prevalence of short sleep duration among night shift workers in the health-care and social assistance sector (52.3%) also was notably high, although not significantly different from the prevalence among all night shift workers.

Reported by

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What is already known on this topic?

According to National Health Interview Survey (NHIS) data from 2004–2007, the prevalence of self-reported short sleep duration (≤6 hours per day) among U.S. workers increased over the past 2 decades and varied by industry and occupation; however, 2010 was the first year that the NHIS included a question about the usual shift worked.

What is added by this report?

Data from the 2010 NHIS substantiate previous findings and indicate that, among all adult workers, 30.0% report short sleep duration. Those who usually worked the night shift had a much higher prevalence of short sleep duration (44.0%) than those who worked the day shift (28.8%). An especially high prevalence of short sleep duration among night shift workers was found in the transportation and warehousing (69.7%) industry.

What are the implications for public health practice?

Because short sleep duration is associated with various adverse health effects and with decreased workplace safety, targeted interventions are needed to increase the proportion of adults who get sufficient sleep. In-depth examination of work hours and scheduling with respect to industry can guide employers in the design of schedules that afford more opportunity for workers to sleep. Evidence-based training programs on sleep and working hours tailored for managers and employees promote better sleep habits for workers on any shift.

Editorial Note

In recognition of the importance of adequate sleep to public health, *Healthy People 2020* includes objective SH-4: "Increase the proportion of adults who get sufficient sleep."[§] A previous study using NHIS data from 2004–2007 reported that the prevalence of self-reported short sleep duration among U.S. workers had increased during the past 2 decades and varied by industry and occupation (*5*). That study found a high prevalence of short sleep among workers employed in industries likely to have nonstandard work schedules (e.g., manufacturing and transportation and warehousing), but those earlier findings were limited by a lack of data on individual workers' shifts.

In 2010, NHIS included a question about the usual shift worked. In 2010, the overall prevalence of short sleep duration remained high among workers in manufacturing. The prevalence also appeared high among workers in transportation and warehousing, mining, utilities, and public administration, but these rates were not significantly different from the prevalence among all workers, possibly because of small subsamples in these sectors. Among all workers, those who usually worked the night shift had a much higher prevalence of short sleep

[§] Defined by *HealthyPeople 2020* objective SH-4 as ≥8 hours for those aged 18–21 years and ≥7 hours for those aged ≥22 years on average during a 24-hour period. Available at http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=38.

TABLE 1. Percentage* of employed civilian workers who reported short sleep duration (average ≤6 hours per 24-hour period), by demographic and employment characteristics and usual shift worked — National Health Interview Survey (NHIS), United States, 2010

		All shifts[§]		Regular daytime shift		Regular night shift		Other shift[¶]	
Characteristic	No.[†]	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Total	**15,214**	**30.0**	**(29.2–30.9)**	**28.8**	**(27.8–29.9)**	**44.0**	**(38.8–49.4)**	**31.6**	**(29.7–33.6)**
Sex									
Male	7,435	29.8	(28.6–31.0)	28.8	(27.4–30.2)	41.7	(34.6–49.2)	31.1	(28.5–33.8)
Female	7,779	30.3	(29.2–31.5)	28.9	(27.6–30.3)	46.6	(39.7–53.5)	32.2	(29.4–35.2)
Age group (yrs)									
18–29	3,367	26.5	(24.7–28.3)	24.6	(22.4–27.0)	37.4	(28.3–47.0)	27.9	(24.8–31.3)
30–44	5,366	31.6	(30.1–33.2)	29.4	(27.7–31.1)	51.1	(42.8–59.4)	36.2	(33.0–39.7)
45–64	5,752	31.8	(30.5–33.1)	31.1	(29.6–32.7)	46.4	(39.0–53.8)	32.8	(29.8–36.1)
≥65	729	21.7	(18.4–25.4)	21.1	(17.2–25.7)	0.0	—	23.7	(17.8–30.9)
Race/Ethnicity									
White, non-Hispanic	8,706	28.6	(27.5–29.6)	27.6	(26.4–28.8)	44.8	(38.8–49.4)	29.6	(27.3–32.1)
Black, non-Hispanic	2,211	38.9	(36.1–41.8)	38.1	(34.7–41.6)	45.6	(35.6–55.9)	39.5	(34.0–45.3)
Asian, non-Hispanic	1,008	33.2	(29.7–36.9)	32.7	(29.0–36.7)	42.6	(25.8–61.4)	32.7	(24.3–42.4)
Other, non-Hispanic	294	35.3	(29.0–42.2)	37.4	(29.4–46.1)	28.1	(13.0–50.6)	31.7	(21.9–43.6)
Hispanic	2,995	28.8	(26.9–30.7)	26.4	(24.2–28.8)	42.7	(33.3–52.7)	33.8	(29.5–38.3)
Marital status									
Married/Living with partner	8,209	29.4	(28.3–30.5)	28.2	(27.8–29.9)	47.0	(40.5–53.7)	31.3	(28.8–34.0)
Widowed/Divorced/Separated	3,032	36.4	(34.3–38.5)	35.0	(32.6–37.5)	42.7	(32.3–53.7)	40.0	(35.7–44.4)
Never married	3,947	28.2	(26.4–30.0)	26.7	(24.6–29.0)	39.1	(29.7–49.5)	28.8	(14.2–82.1)
Education									
Less than high school diploma	1,532	29.1	(26.4–31.9)	27.2	(24.0–30.6)	39.9	(27.5–53.9)	33.4	(27.5–39.8)
High school or GED diploma	3,219	33.7	(31.9–35.6)	32.2	(30.0–34.5)	39.9	(30.7–49.9)	37.0	(32.9–41.4)
Some college	4,051	33.8	(32.0–35.5)	32.5	(30.5–34.4)	54.1	(44.6–63.3)	34.7	(31.0–38.6)
College degree	4,773	26.7	(25.2–28.2)	25.8	(24.1–27.4)	44.6	(32.5–57.5)	29.7	(26.1–33.5)
No. of current jobs									
1	13,879	29.4	(28.5–30.3)	28.2	(27.1–29.3)	42.2	(36.8–47.9)	31.2	(29.1–33.4)
>1	1,312	37.0	(34.0–40.0)	36.7	(32.9–40.7)	60.5	(45.6–73.7)	34.5	(29.3–40.1)
Weekly work hours									
≤40	11,203	27.7	(26.7–28.6)	27.1	(26.0–28.3)	38.8	(33.0–45.0)	27.6	(25.6–29.7)
>40	3,910	36.2	(34.3–38.1)	33.4	(31.3–35.5)	58.1	(48.7–66.9)	42.4	(38.2–46.6)

Abbreviations: CI = confidence interval; GED = General Educational Development.
* Weighted using NHIS sample adult weights.
† Unweighted sample.
§ Among workers, 72.6% reported that they usually worked a regular daytime shift, 3.7% worked a regular night shift, and 23.5% worked some other shift.
¶ Includes regular evening shift, rotating shift, and some other shift.

duration than those who worked the day shift, although a much higher number of workers with short sleep duration worked the day shift. An especially high prevalence of short sleep duration among night shift workers was found in the transportation and warehousing and health-care and social assistance industries.

Previous research has suggested many reasons for associations between short sleep duration and work factors such as usual shift worked and industry of employment. Although the effects of work might interact with lifestyle factors and stress at home, some studies have suggested that work factors remain important after adjusting for many potential confounders (*6, 7*). In addition to the quantity of hours worked affecting the opportunity for sleep, the timing of hours available for sleep can affect sleep duration through circadian disruption. Attempts to sleep during daylight hours, when melatonin levels decline and body temperature rises, usually result in shorter sleep episodes and more wakefulness (*8,9*).

Differences in the industry sectors of employment with the highest prevalence of short sleep duration after stratification by usual shift worked suggest that industry factors and shift factors both might influence workers' sleep opportunities. For example, manufacturing workers on all shifts combined have a high prevalence of short sleep duration compared with all workers in all sectors, but manufacturing employees working night shifts are not significantly different than night shift workers overall with respect to the prevalence of short sleep duration. On the other hand, the especially high prevalence of short sleep duration among transportation and warehousing workers on the night shift suggests that characteristics of night shift work specific to this sector might exist that have a particularly detrimental effect on sleep duration.

The findings in this report are subject to at least four limitations. First, average sleep duration (in whole hours) is self-reported, and no distinction is made between the amount of sleep obtained on work days compared with nonwork days. Second, differences in the prevalence of short sleep duration among workers working different shifts and employed in different industries might be confounded by other nonoccupational variables (e.g., age or

TABLE 2. Percentage* of employed civilian workers who reported short sleep duration (average ≤6 hours per 24-hour period), by industry sector and usual shift worked — National Health Interview Survey (NHIS), United States, 2010

		All shifts¶		Regular daytime shift		Regular night shift		Other shift**	
Industry sector†	No.§	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Agriculture, forestry, fishing, and hunting (11)	184	26.2	(19.3–34.5)	26.9	(17.9–38.4)	—§§	—§§	23.2	(11.9–40.2)
Mining (21)	67	41.6	(26.1–59.0)	33.6	(15.3–58.7)	—§§	—§§	40.9	(21.9–63.0)
Utilities (22)	130	38.0	(28.4–48.6)	38.0	(28.0–49.1)	—§§	—§§	32.3	(14.7–57.0)
Construction (23)	923	29.0	(25.8–32.5)	27.9	(24.4–31.6)	—§§	—§§	38.3	(29.5–47.8)
Manufacturing (31–33)	1,402	34.1	(31.2–37.1)	33.5	(30.2–36.9)	41.4	(29.6–54.3)	34.5	(28.2–41.4)
Wholesale trade (42)	356	30.7	(25.2–36.8)	29.7	(23.8–36.5)	35.7	(12.0–69.4)	36.9	(23.5–52.6)
Retail trade (44–45)	1,532	30.3	(27.3–33.5)	28.8	(24.9–33.0)	36.4	(24.6–50.1)	31.7	(26.9–37.0)
Transportation and warehousing (48–49)	626	32.7	(28.4–37.3)	30.8	(25.4–36.8)	69.7	(50.8–83.7)	29.1	(22.1–37.2)
Information (51)	394	28.3	(23.6–33.5)	29.3	(23.9–35.5)	—††	—††	21.4	(12.9–33.3)
Finance and insurance (52)	670	27.4	(23.4–31.8)	26.5	(22.5–30.8)	—††	—††	32.4	(19.6–48.5)
Real estate, rental, and leasing (53)	298	28.1	(22.4–34.7)	26.5	(19.8–34.4)	—††	—††	29.6	(18.9–43.2)
Professional, scientific, and technical service (54)	1,007	28.2	(25.4–31.2)	27.9	(24.9–31.1)	—††	—††	30.3	(22.7–39.2)
Management of companies and enterprises (55)	9	—††	—††	—††	—††	—††	—††	—§	—††
Administrative support, waste management, and remediation services (56)	717	29.7	(25.9–33.8)	26.3	(22.0–31.1)	29.8	(15.2–50.0)	38.4	(30.9–46.5)
Education services (61)	1,500	27.3	(24.6–30.1)	26.9	(24.0–30.0)	31.7	(12.0–61.2)	30.1	(23.2–38.0)
Health care and social assistance (62)	2,196	32.0	(29.7–34.3)	28.9	(26.5–31.5)	52.3	(42.9–61.6)	36.6	(31.9–41.7)
Arts, entertainment, and recreation (71)	309	30.7	(25.2–36.9)	31.2	(23.8–39.8)	9.8	(2.2–33.8)	32.0	(23.8–41.5)
Accommodation and food service (72)	1,027	28.4	(25.0–32.0)	31.5	(26.4–37.1)	37.8	(25.9–51.4)	24.2	(20.1–28.8)
Other services, except public administration (81)	808	24.1	(20.6–28.1)	22.2	(18.4–26.5)	—††	—††	29.4	(21.7–38.5)
Public administration (92)	836	34.3	(30.1–38.8)	32.9	(28.1–38.0)	44.1	(24.4–65.9)	38.9	(29.8–48.7)

Abbreviation: CI = confidence interval.
* Weighted using NHIS sample adult weights.
† As designated in the 2007 North American Industry Classification System; available at http://www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007.
§ Unweighted sample.
¶ Among workers, 72.6% reported that they usually worked a regular daytime shift, 3.7% worked a regular night shift, and 23.5% worked some other shift.
** Includes regular evening shift, rotating shift, and some other shift.
†† Results based on <10 workers are not shown.

race/ethnicity). Third, broad industry categories were used for this analysis. A drawback to using broad industry categories is that they aggregate workers who likely have substantially different working conditions. On the other hand, using narrower industry categories would result in smaller subsamples, leading to wider confidence intervals and more estimates that are too unstable to report. Finally, the final sample response rate was only 60.8%.

Because short sleep duration is associated with various adverse health effects (e.g., cardiovascular disease or obesity) (*1*), decreased workplace and public safety, and impaired job performance (*2,3,10*), targeted interventions are needed to increase the proportion of adults who get sufficient sleep.¶ In-depth examination of work hours and scheduling with respect to industry can guide employers in the design of schedules that increase the probability that workers will be able to sleep during their rest times. For example, rotating workers forward from evening to night shifts rather than backwards from night to evening shifts makes it easier for circadian rhythms to adjust so that workers can sleep during their rest times (*4*). NIOSH currently is developing evidence-based training programs on sleep and working hours tailored for managers and employees in the manufacturing, mining, nursing, retail, and trucking industries. Further explorations of the relationship between work and sleep are needed.

¶ Additional information is available at http://www.cdc.gov/sleep/index.htm.

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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

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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.

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Severe Coinfection with Seasonal Influenza A (H3N2) Virus and *Staphylococcus aureus* — Maryland, February–March 2012

On March 5, 2012, the Maryland Department of Health and Mental Hygiene (DHMH) and the Calvert County Health Department were notified of three deaths following respiratory illness among members of a Maryland family. One family member (patient A) experienced upper-respiratory symptoms and died unexpectedly at home. Two others (patients B and C) sought medical care for fever, shortness of breath, and cough productive of bloody sputum and died during their hospitalizations. All three family members had confirmed infection with seasonal influenza A (H3N2) virus. Patients B and C had confirmed coinfection with methicillin-resistant *Staphylococcus aureus* (MRSA), which manifested in both patients as MRSA pneumonia and bacteremia. DHMH and the Calvert County Health Department, in collaboration with the District of Columbia Department of Health, local hospitals, and CDC, conducted an investigation to determine the cause of the illnesses and identify additional related cases. Three additional family members with influenza were identified, two of whom were confirmed to have influenza A (H3N2) and required hospitalization, but neither was coinfected with MRSA, and both recovered. Influenza vaccination remains the best method for preventing complications from influenza; when influenza infection is suspected, treatment with influenza antiviral agents is recommended in certain cases. In addition, when high clinical suspicion for serious *S. aureus* coinfection exists, empiric coverage with antibiotics, including those with activity against methicillin-resistant strains, should be instituted.

Case Reports

Patient A experienced upper-respiratory illness at the end of February and died 4 days later at home. Patient A had not gone to the hospital or seen a clinician but did receive a prescription for levofloxacin 1 day before death. Patients B and C, both family members of patient A, went to a hospital 3 days after patient A's death, with fever, cough productive of bloody sputum, and pleuritic chest pain. Chest radiographs of both patients were notable for extensive bilateral infiltrates with focal areas of consolidation. Patient B was treated with ceftriaxone and azithromycin, and patient C was treated with ceftriaxone, ciprofloxacin, levofloxacin, and vancomycin. Their conditions quickly worsened, and they required intubation; both died the day after admission.

All three patients were aged >50 years, including one aged >65 years; one patient had a history of smoking, and one was a current smoker. Two had known multiple comorbidities, including one requiring chronic low-dose corticosteroids. Two of the three had been vaccinated against seasonal influenza.

Laboratory and Epidemiologic Investigations

Rapid influenza diagnostic testing (RIDT) was performed on a nasopharyngeal specimen from patient B only and was negative, but testing by reverse transcription–polymerase chain reaction (RT-PCR) from upper- and lower-respiratory tract specimens was positive in all three patients for influenza A (H3N2) virus. Testing of original samples at DHMH and CDC indicated that the virus was a typical human seasonal influenza A (H3N2) virus (not an H3N2 variant virus), similar to other influenza A (H3N2) viruses circulating in Maryland and nationally this season. Blood and sputum cultures from patients B and C yielded MRSA. Further testing demonstrated that the MRSA isolates were indistinguishable by pulsed-field gel electrophoresis and were identified as part of the USA300 pulsed-field type. None of the patients had a known history of skin or soft-tissue infections. Extensive testing of upper- and lower-respiratory specimens did not reveal any other infectious agents.

The family members all lived in a small town with a population of <2,000 persons. Patients A, B, and C had extensive and frequent contact with each other and with other members of their extended family, some of whom had experienced upper-respiratory illnesses during the weeks preceding the deaths. DHMH, the Calvert County Health Department, and the District of Columbia Department of Health investigated all reports of severe illnesses among persons known to be associated with the family. In early March, three additional family members (patients D, E, and F) were identified with influenza virus infection. Patient D had a positive RIDT result from an upper-respiratory tract specimen. Patients E and F had negative RIDT results; however, RT-PCR testing was positive for influenza A (H3N2) virus. Although patients E and F were hospitalized, neither they nor other family contacts had pneumonia or MRSA infection. One of the three had been vaccinated against seasonal influenza. Other family members who reported upper-respiratory illness either were not tested or had negative RIDT results, with some confirmed negative by RT-PCR.

What is already known on this topic?

Bacterial coinfection with *Staphylococcus aureus* is a known complication of influenza that can be fatal.

What is added by this report?

Three members of one family were infected with seasonal influenza A (H3N2) and died. Two had methicillin-resistant *S. aureus* pneumonia and also bacteremia. All were aged >50 years, and two had chronic illnesses.

What are the implications for public health practice?

Vaccination remains the best method for preventing influenza-related complications. When high clinical suspicion for bacterial coinfection exists in patients with influenza, empiric treatment with antibiotics should be considered in addition to antiviral agents with activity against influenza. If antibiotics are used, consideration should be given to including antimicrobials with activity against *S. aureus,* including methicillin-resistant strains.

Public Health Actions

In accordance with CDC guidelines, antiviral chemoprophylaxis was recommended for contacts at greater risk for serious influenza complications. No special recommendations for antiviral chemoprophylaxis or MRSA decolonization were made. Through press releases and other media statements disseminated in Maryland and the District of Columbia, residents were urged to practice hand hygiene and respiratory hygiene with cough etiquette, get vaccinated for seasonal influenza if they had not yet done so, and seek medical care in accordance with CDC guidance if ill with symptoms of influenza or pneumonia.* In addition, guidance on testing, treatment, and chemoprophylaxis was disseminated to health-care providers locally and throughout Maryland. No additional cases of severe influenza and *S. aureus* coinfection have been reported.

Reported by

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* Available at http://www.cdc.gov/flu/about/disease.

Editorial Note

Bacterial coinfection with *S. aureus* is a known complication of influenza that has been described since the 1918 influenza pandemic (*1*). These infections can be caused by methicillin-susceptible and methicillin-resistant strains. Although these reported cases occurred in three older persons, two of whom had comorbidities, coinfection with *S. aureus* can occur among otherwise healthy children and adults and has been associated with high mortality rates (*2,3*). This familial cluster of invasive MRSA with influenza highlights the potentially serious consequences of these coinfections.

Patients described in this report had severe, rapidly progressive, respiratory disease with bloody sputum. The rapid worsening of symptoms soon after illness onset and the subsequent severe outcomes are consistent with simultaneous coinfection with influenza and MRSA rather than a biphasic infection course (i.e., influenza infection followed by *S. aureus* infection); simultaneous coinfection has been reported previously (*4*). Health-care providers should consider the possibility of influenza and *S. aureus* coinfection, particularly among patients with severe or rapidly worsening disease or with imaging indicative of cavitary or necrotizing pneumonia; this recommendation applies especially when influenza is known to be circulating in the community[†] (*5*). Empiric treatment for both organisms should be considered for patients with these features (*5*).

Data from 2001–2004 indicated that approximately 25%–35% of children and adults are colonized with *S. aureus*, but only 1.5% are colonized with MRSA (*6*). MRSA can cause disease in the community among patients with and without health-care exposures, although community-associated MRSA accounts for only 18% of invasive MRSA infections (*7*). Community-associated MRSA most commonly produces skin and soft-tissue infections, which often are caused by USA300 (*8*). These strains present a treatment challenge because they are resistant to beta-lactam antibiotics, which are commonly used to treat outpatient infections. Among families in which someone is known to be infected with MRSA, the infected person should keep wounds clean and covered, and other household members who have direct contact with that person should employ frequent hand hygiene and not share personal items (e.g., towels or razors). Whereas decolonization of colonized persons is sometimes considered in specific circumstances (e.g., cases of recurrent MRSA-related skin infections), its role in preventing *S. aureus* pneumonia is unknown (*5*). Additional information regarding MRSA prevention and treatment is available[§] (*5*).

† Additional information available at http://www.cdc.gov/flu/weekly.
§ Available at http://www.cdc.gov/mrsa/index.html.

For optimal patient management, health-care providers should test persons hospitalized with respiratory illness for influenza, including those with suspected community-acquired pneumonia, especially when influenza is known to be circulating. Testing by PCR is preferred when available because it is more sensitive than rapid antigen tests that can yield false-negative results (*9*). Specimens that can be tested for influenza virus include nasopharyngeal or throat swabs, nasal or endotracheal aspirates, nasopharyngeal or bronchial washes, or sputum specimens. When influenza is suspected, droplet precautions should be practiced (*10*).

Advisory Committee for Immunization Practices guidelines recommend oseltamivir or zanamivir to treat 1) hospitalized patients with suspected or confirmed influenza, 2) outpatients who are at greater risk for influenza complications, and 3) persons with suspected or confirmed influenza who have evidence of severe illness (e.g., signs or symptoms of lower-respiratory tract infection or clinical deterioration), regardless of vaccination status (*9*). Empiric influenza antiviral treatment should be provided to such patients even if test results are not available immediately or if patients are not tested. Although benefits of antiviral treatment are likely to be greatest if treatment is initiated as soon as possible, treatment of hospitalized patients is recommended even >48 hours after illness onset. Approximately 99% of circulating seasonal strains of influenza A (H3N2), A (H1N1), and B viruses that were tested by CDC during October 1, 2011–April 7, 2012 were sensitive to oseltamivir and zanamivir. Postexposure chemoprophylaxis for influenza might be considered on the basis of the exposed person's risk for influenza complications, the type and duration of contact, recommendations from public health authorities, and clinical judgment (*9*). Postexposure chemoprophylaxis should be started ≤48 hours after the most recent exposure (*9*).

The cases in this report are a reminder that influenza and *S. aureus* coinfections, although uncommon, can lead to severe outcomes, including death. Although influenza vaccine is not 100% effective, influenza vaccination remains the best method for preventing influenza and its complications and should be encouraged for all persons aged ≥6 months. In addition to treatment with influenza antiviral agents, antibiotics should be considered when clinical suspicion for bacterial coinfection exists in an effort to reduce severe outcomes.

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Announcements

Campaign to Prevent Falls in Construction — United States, 2012

Deaths and injuries from falls are a major yet preventable public health problem. Among occupations, construction workers face a disproportionate risk from falls. In 2010, approximately 9.1 million workers were employed in construction in the United States, accounting for 7% of the national workforce (*1*). Of the 4,547 U.S. workers who died on the job in 2010, 751 (17%) were employed in construction, the industry sector with the most deaths (*2*). The leading fatal events in construction are falls related to roofs, scaffolds, and ladders.

On Workers Memorial Day, April 28, 2012, in collaboration with a broad range of agencies, organizations, and associations from the construction industry, CDC's National Institute for Occupational Safety and Health will launch a national campaign to address and reduce falls, fall-related injuries, and fall-related fatalities among construction workers. Additional information is available at http://www.cdc.gov/niosh/construction/stopfalls.html.

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Air Quality Awareness Week — April 30–May 4, 2012

CDC is collaborating with the U.S. Environmental Protection Agency (EPA) to urge persons to "Be Air Aware" during Air Quality Awareness Week, April 30–May 4, 2012. May also is Asthma Awareness Month.

Asthma sufferers are particularly affected by air pollution. One in 12 U.S. residents, or approximately 25.7 million persons, currently has asthma (*1*). Air pollution caused by industrial emissions and automobile exhaust can trigger an asthma attack. Planning activities for times when air pollution levels will be low can help asthma sufferers avoid attacks. Broadcast air quality forecasts and EPA's EnviroFlash (http://www.enviroflash.info) both provide guidance in avoiding high levels of air pollutants.

Persons with asthma are not the only ones susceptible to the effects of air pollution. According to EPA, the average adult breathes >3,000 gallons (>11,000 liters) of air every day. Children breathe even more air per kilogram of body mass and are more susceptible to air pollution. Millions of U.S. residents live in areas where urban smog, very small particles, and toxic pollutants pose serious health concerns. Persons exposed to high enough levels of certain air pollutants might experience burning in their eyes, an irritated throat, or breathing difficulties. Long-term exposure to air pollution can cause cancer and long-term damage to the immune, neurologic, reproductive, and respiratory systems. In extreme cases, it even can cause death (*2*).

Information on Air Quality Awareness Week activities is available at http://epa.gov/airnow/airaware/index.html. Information on Asthma Awareness Month is available at http://www.epa.gov/asthma/awareness.html. Additional information about asthma is available from CDC at http://www.cdc.gov/asthma.

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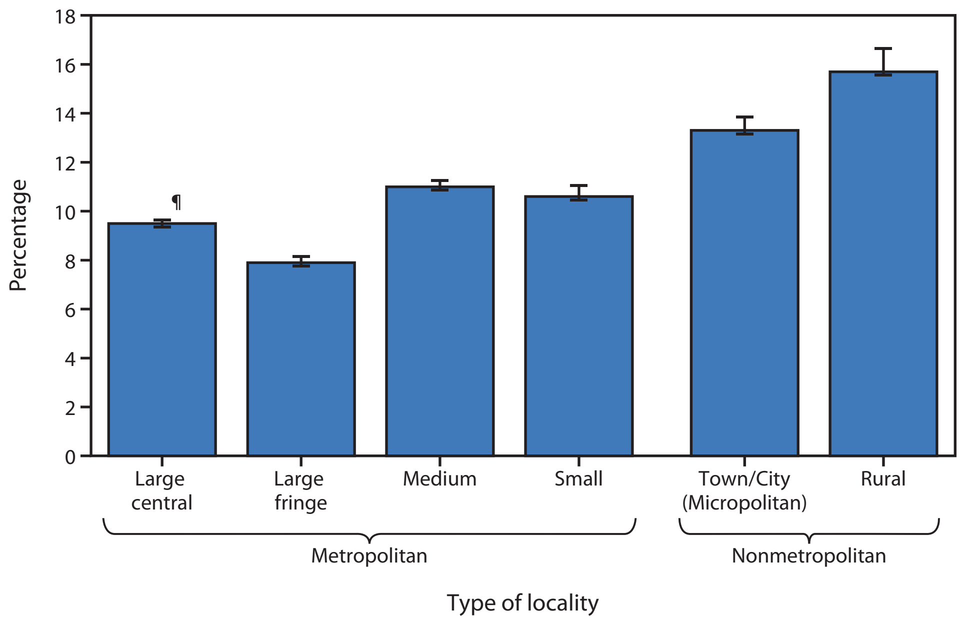
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Adults Aged 18–64 Years Who Reported Fair or Poor Health,* by Type of Locality† — National Health Interview Survey, 2008–2010§



* Respondents were asked, "Would you say your health in general is excellent, very good, good, fair, or poor?"
† Counties were classified into urbanization levels based on a classification scheme that considers metropolitan/nonmetropolitan status, population, and other factors.
§ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and are derived from the National Health Interview Survey family core and sample adult questionnaires.
¶ 95% confidence interval.

The percentage of adults aged 18–64 years reporting fair or poor health during 2008–2010 was lowest among those residing in large fringe metropolitan counties (7.9%) and highest among those in the most rural counties (15.7%). Compared with large fringe metropolitan counties, the prevalence of fair or poor health was 20% higher in large central metropolitan counties (9.5%), 39% higher in medium metropolitan counties (11.0%), 34% higher in small metropolitan counties (10.6%), 68% higher in nonmetropolitan town/city (micropolitan) counties (13.3%), and 99% higher in nonmetropolitan rural counties (15.7%).

Sources: National Health Interview Survey. Available at http://www.cdc.gov/nchs/nhis.htm.

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