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Workers' Memorial Day — April 28, 2002

April 28, 2002, has been designated Workers' Memorial Day to remember workers who have died from occupational injuries or diseases. Although workers in the United States are experiencing substantial improvements in occupational health and safety (*1*), occupational injuries and fatalities continue to occur.

During 1980–1998, approximately 109,000 civilian workers died from work-related injuries, an average of 16 deaths per day (CDC, unpublished data, 1998). In 1998, 3.6 million workers were seen in hospital emergency departments in the United States because of injuries that occurred on the job (*2*). In 2000, costs of fatal and nonfatal unintentional work-related injuries were an estimated $131.2 billion (*3*).

Workers' Memorial Day can serve as a reminder of the need to continue efforts to reduce the burden of work-related injuries and illnesses. Data and research findings on occupational injuries and illnesses can help focus such efforts. This issue of *MMWR* presents three reports of work-related injuries, illnesses, and deaths.

Information about causes and prevention of work-related injury and disease is available from CDC's National Institute for Occupational Safety and Health, telephone 800-356-4674, or at http://www.cdc.gov/niosh/homepage.html.

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Fixed Obstructive Lung Disease in Workers at a Microwave Popcorn Factory — Missouri, 2000–2002

In May 2000, an occupational medicine physician contacted the Missouri Department of Health and Senior Services (MoDHSS) to report eight cases of fixed obstructive lung disease in former workers of a microwave popcorn factory. Four of the patients were on lung transplant lists. All eight had a respiratory illness resembling bronchiolitis obliterans with symptoms of cough and dyspnea on exertion, had worked at the same popcorn factory (factory A) at some time during 1992–2000, and had spirometric test results that were lower than normal for both FEV_1 (forced expiratory volume in 1 second) and FEV_1/FVC (forced vital capacity) ratio. Employment durations ranged from 8 months to 9 years. MoDHSS requested assistance from CDC's National Institute for Occupational Safety and Health in evaluating factory A for respiratory hazards to workers. This report summarizes the epidemiologic findings motivating the technical assistance request and preliminary results. The findings of this investigation indicate that workers exposed to flavorings at microwave popcorn factories are at risk for developing fixed obstructive lung disease. Public health authorities, employers, and health-care providers are collaborating to prevent obstructive lung disease in popcorn factory workers.

At factory A, soybean oil, salt, and flavorings are mixed into a large heated tank in a process that produces visible dust,

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respirators while the investigation proceeded, with the minimum recommended respirator being a half-face, nonpowered respirator equipped with P-100 filters and organic vapor cartridges.

In November 2000, CDC conducted a cross-sectional survey of 117 current workers that included interviews, pulmonary-function testing, and air sampling for volatile organic compounds (VOCs) and dusts at factory A. On the basis of national data adjusted for smoking and age, current workers had two to three times the expected rates of respiratory symptoms and self-reports of physician diagnoses of asthma or chronic bronchitis; the rate of obstruction on spirometry was 3.3 times higher than expected (*2*).

Industrial hygiene sampling conducted during the November 2000 survey detected approximately 100 VOCs in the plant air. Diacetyl, a ketone with butter-flavor characteristics, was measured as a marker for exposure to flavoring vapors. The geometric mean air concentration of diacetyl was 18 parts per million parts air (ppm) in the room where the mixing tank was located, 1.3 ppm in the microwave-packaging area, and 0.02 ppm in other areas of the plant. Rates of obstructive abnormalities on spirometry increased with increasing cumulative exposure to airborne flavoring chemicals. Concentrations of total and respirable dust were below SHA-permissible exposure limits (PELs) for particulates not otherwise regulated. No OSHA-PELs or NIOSH-recommended exposure levels exist for diacetyl. To reduce exposures, CDC investigators recommended engineering controls including increased ventilation and isolation of VOC sources.

CDC is conducting repeated air sampling and medical surveillance at 4-month intervals to monitor response to interventions. To date, serial pulmonary function testing has documented excessive declines in FEV_1 and additional persons with airways obstruction among those working in the plant before engineering controls lowered exposures by several orders of magnitude. The adequacy of controls in protecting workers hired since exposures were lowered is being assessed by interval changes in FEV_1.

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Editorial Note: Bronchiolitis obliterans, a rare, severe lung disease characterized by cough, dyspnea on exertion, and airways obstruction that does not respond to bronchodilators, can occur after certain occupational exposures. Inhalation exposure to agents such as nitrogen dioxide, sulfur dioxide, anhydrous ammonia, chlorine, phosgene, and certain mineral and organic dusts can cause irreversible damage to small airways without affecting chest radiograph and diffusing capacity (*3*).

This investigation initiated by MoDHSS identified a large cluster of conditions resembling bronchiolitis obliterans associated with occupation at a microwave popcorn factory. The results of this investigation raise concern about possible risk for workers in other flavoring and food production industries. Recent reports to CDC document bronchiolitis obliterans cases in the settings of flavoring manufacture and a case of fixed-airways obstruction in a worker at a microwave popcorn factory in Nebraska (CDC, unpublished data, 2001).

Preliminary animal studies at CDC suggest severe damage to airway epithelium after inhalation exposure to high air concentrations of a butter flavoring used in factory A. Further animal studies are planned to determine the causal ingredients in the complex butter-flavoring mixture.

The Food and Drug Administration regulates flavorings based on the safety of the amounts consumed, not the safety of prolonged worker inhalation of high concentrations. CDC has no evidence to suggest risk for consumers in the preparation and consumption of microwave popcorn.

CDC is investigating whether other cases of fixed obstructive lung disease have occurred in workers at other microwave popcorn factories. Health-care providers should report to state health authorities and CDC any cases of suspected occupational respiratory disease in workers exposed to food flavorings.

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Factors Associated with Pilot Fatalities in Work-Related Aircraft Crashes — Alaska, 1990–1999

Despite its large geographic area, Alaska has only 12,200 miles of public roads, and 90% of the state's communities are not connected to a highway system (*1*). Commuter and air-taxi flights are essential for transportation of passengers and delivery of goods, services, and mail to outlying communities (Figure 1). Because of the substantial progress in decreasing

FIGURE 1. A floatplane typical of aircraft used in remote areas of Alaska

Photo/National Park Service file

fatalities in the fishing and logging industries (*2*), aviation crashes are the leading cause of occupational death in Alaska. During 1990–1999, aircraft crashes in Alaska caused 107 deaths among workers classified as civilian pilots. This is equivalent to 410 fatalities per 100,000 pilots each year, approximately five times the death rate for all U.S. pilots (*3*) and approximately 100 times the death rate for all U.S. workers (*4*). As part of a collaborative aviation safety initiative that CDC's National Institute for Occupational Safety and Health (NIOSH) is implementing with the Federal Aviation Administration (FAA), the National Transportation Safety Board (NTSB), and the National Weather Service, CDC analyzed data from NTSB crash* reports to determine factors associated with pilot fatalities in work-related aviation crashes in Alaska. This report summarizes the result of this analysis, which found that the following factors were associated with pilot fatalities: crashes involving a post-crash fire, flights in darkness or weather conditions requiring instrument use, crashes occurring away from an airport, and crashes in which the pilot was not using a shoulder restraint. Additional pilot training, improved fuel systems that are less likely to ignite in crashes, and company policies that discourage flying in poor weather conditions might help decrease pilot fatalities. More detailed analyses of crash data, collaborations with aircraft operators to improve safety, and evaluation of new technologies are needed.

Aircraft crash reports are compiled by NTSB and entered into a database maintained by FAA's National Aviation Safety Data Analysis Center. Crashes in which pilots in command died were compared retrospectively with those in which they survived. All variables, except age, were dichotomized. Wald Chi-squared analyses were then completed. Factors that were evaluated included age, shoulder-restraint use, weather conditions (used as a marker for poor visibility), light conditions (light or dark), aircraft type (plane or helicopter), occurrence of post-crash fire, location (on or off airport), flight experience (median: 4,350 hours, range: 78–20,000 hours), and whether the pilot was an Alaska resident (a surrogate for familiarity with geography and flight conditions in Alaska). The Statistical Analysis System (SAS) software was used to generate odds ratios.

The study identified 675 work-related crashes; in 567 (84%), the pilot survived, and in 108 (16%), the pilot died. The estimated likelihood of pilot death was 14 times higher when a fire occurred than when one did not, seven times higher for flights that crashed in instrument meteorological conditions than for crashes in conditions of greater visibility, and approximately two times higher for crashes that occurred away from an airport or in darkness; the estimated likelihood of a pilot dying was significantly lower when the pilot used a shoulder restraint (Table 1).

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Editorial Note: The results of this study indicate that crashes involving a post-crash fire, flights in darkness or weather conditions requiring instrument use, and crashes occurring away from an airport were significantly more likely to result in a pilot fatality. Conversely, crashes in which the pilot was using a shoulder restraint were less likely to result in a pilot fatality. These findings appear consistent with other studies identifying conditions associated with pilot fatality (*5,6*) .

These findings suggest several possible approaches to reducing pilot death rates in Alaska. Companies should direct pilots to return to base if they encounter weather requiring instrument use and to avoid flying if they are likely to encounter such weather. Additional training in procedures to follow if weather conditions requiring instrument use are encountered unexpectedly should be provided. Use of improved fuel systems that are less likely to ignite following a crash could improve post-crash survivability.

Many aircraft manufactured before July 1978 are not equipped with shoulder harnesses (*7*). Although installing shoulder harnesses in small aircraft manufactured before July 1978 is voluntary by the owner/operator, doing so is often relatively simple and inexpensive (depending on the amount of structural reinforcement needed for each aircraft). FAA requires shoulder harnesses to be worn only for takeoff and

* An aviation crash, defined by FAA and NTSB as an aviation "accident," is "[a]n occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and until such time as all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage."

TABLE 1. Number* of work-related aircraft crash injuries and fatalities, by risk factors — Alaska 1990–1999

Risk Factor	Fatal†	Nonfatal§	OR¶	95% CI**
Fire				
Yes	28	15	13.8††	(6.8–26.2)
No	77	552	1.0	
Unknown	3	0		
Shoulder restraint				
Yes	52	468	0.5††	(0.2– 0.8)
No	19	77	1.0	
Unknown	36	22		
Weather				
IMC§§	37	45	6.5††	(3.9–10.8)
VMC¶¶	66	522	1.0	
Unknown	5	0		
Light conditions				
Daylight	84	490	1.8††	(1.0– 2.9)
Darkness	23	77	1.0	
Unknown	1	0		
Off airport				
Yes	27	218	1.9††	(1.2– 3.0)
No	81	349	1.0	
State				
Non-Alaska	20	67	1.7	(1.0– 3.1)
Alaska	88	495	1.0	
Unknown	0	5		
Flight experience				
>4,350 hours	47	284	0.8	(0.5– 1.2)
≤4,350 hours	60	277	1.0	
Unknown	1	6		
Aircraft type				
Helicopter	9	60	0.8	(0.4– 1.7)
Plane	99	507	1.0	

* Numbers vary because of missing data.
† Number=108.
§ Number=567.
¶ Odds ratio.
** Confidence interval.
†† p <0.05.
§§ Instrument meteorological conditions.
¶¶ Visual meteorological conditions.

landing, but not during flight (*8*). In this study, some crashes were catastrophic events for which no restraint system would provide protective effects; in other crashes, the pilot might have been incapacitated temporarily, preventing escape before fire consumed the aircraft. For crashes in which the initial impact is survivable, using a fastened shoulder harness might decrease temporary incapacitation from crash-related injuries. Recommendations to pilots and FAA that shoulder harnesses be used throughout a flight might reduce fatalities.

The findings in this report are subject to at least one limitation. Information about use of shoulder harnesses was missing for a substantial proportion of fatal crashes, which might have resulted in bias for this variable. Crashes for which information on shoulder-harness use is missing might have been more severe. In very severe crashes, especially those with an ensuing fire, evidence of harness use might have been destroyed.

On a trial basis, FAA is installing improved avionics in commercial aircraft and providing weather observation, data link communications, surveillance, and flight information services to equipped aircraft through the Capstone program (*9*). More detailed analyses of crash data to determine other potential risk factors, collaborations with aircraft operators to aid in the implementation of interventions, and evaluation of new technologies such as ground-proximity warning systems also will be conducted.

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Respiratory Illness in Workers Exposed to Metalworking Fluid Contaminated with Nontuberculous Mycobacteria — Ohio, 2001

In January 2001, three machinists at an automobile brake manufacturing facility in Ohio (plant A) were hospitalized with respiratory illness characterized by dyspnea, cough, fatigue, weight loss, hypoxia, and pulmonary infiltrates. Hypersensitivity pneumonitis (HP) was diagnosed in all three workers. In March 2001, additional employees began seeking medical attention for respiratory and systemic symptoms. In May 2001, union and management representatives requested assistance from CDC's National Institute for Occupational Safety and Health (NIOSH) in determining the cause of the