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CENTERS FOR DISEASE CONTROL AND PREVENTION
NIOSH

Request for Assistance in Preventing Organic Dust Toxic Syndrome[1]

The National Institute for Occupational Safety and Health[2]

The National Institute for Occupational Safety and Health (NIOSH) requests assistance in preventing organic dust toxic syndrome (ODTS), an acute respiratory illness in agricultural workers who inhale contaminated organic dust. This Alert describes four case reports in which a total of 29 agricultural workers developed ODTS following inhalation of organic dusts contaminated with microorganisms. Information about ODTS is urgently needed by agricultural workers and employers, cooperative extension agents, rural veterinarians, physicians, and other health care providers. NIOSH therefore requests that editors of trade journals, safety and health officials, labor unions, and agricultural employers bring this Alert to the attention of all workers who are at risk. Your assistance in this effort will help prevent occupational disease among the 3.4 million agricultural workers in the United States-one of the stated goals of the 1991 Surgeon General's Conference on Agricultural Safety and Health [DHHS 1992].

Agricultural workers are at risk for developing respiratory illness from exposure to inhaled dusts. One of the most common illnesses is ODTS, a respiratory and systemic illness that may follow exposures to heavy concentrations of organic dusts contaminated with microorganisms [doPico 1986; Parker et al. 1992]. An estimated 30% to 40% of workers exposed to organic dusts will develop the disease [dopico 1986; Rask-Andersen 1989].

Despite its common occurrence among agricultural workers, ODTS is not a widely recognized illness because only serious cases or clusters of cases are likely to come to a physician's attention. ODTS is a general term that includes all of the following conditions:

- Precipitin-negative farmer's lung disease [Edwards et al. 1974]
- Pulmonary mycotoxicosis [Emanuel et al. 1975]
- Grain fever in grain elevator workers [doPico et al. 19821
- Silo unloader's syndrome [Pratt and May 1984]
- Mill fever in cotton textile workers [Rylander et al. 1987]
- Inhalation fever [Rask-Andersen and Pratt 1992]

ODTS typically occurs where a large amount of organic dust is present in the air. The syndrome often occurs in small clusters and affects most individuals who are exposed to heavy concentrations of organic dust contaminated with microorganisms [Brinton et al. 1987]. ODTS appears to result from inhaling particles and toxins produced by microorganisms such as gram-negative bacteria (Pseudomonas species, Enterobacter agglomerans, and Klebsiella species), thermophilic organisms (Aspergillus fumigatus and Micropolyspora faeni), and fungi [Schenker et al. 1991]. Endotoxin[1] is a com-mon component of organic dust in agriculture [Olenchock et al. 1990; Dutkiewicz 1987] and may be involved in the development of ODTS.

Although the focus of this Alert is on ODTS, agricultural workers should be aware that they are at risk for other important respiratory illnesses or hazards such as the following:

- Silo filler's disease, an acute toxic inflammation of the lung caused by exposure to oxides of nitrogen in freshly filled silos [Grayson 1956; Horvath et al. 1978]

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- Farmer's lung disease (or hypersensitivity pneumonitis), an immunologic lung response involving microbial antigens in moldy hay [Campbell 1932; Parker et al. 1992]
- Bronchitis
- Death by asphyxiation (suffocation)
- Inhalation of toxic gases (in manure pits, for example) [NIOSH 1990]

CURRENT OSHA REGULATIONS

Cotton dust is the only specific agricultural dust for which the Occupational Safety and Health Administration (OSHA) has a standard. This standard protects workers in general industry against byssinosis, a chronic lung disease [29 CFR[2] 1910.1043]. OSHA also has a standard for nonspecific dusts: 15 milligrams per cubic meter (mg/m^3) for total dust and 5 mg/m^3 for respirable dust [29 CFR 1910.1000].

NIOSH has recommended exposure limits for cotton dust, grain dust, and wood dust [NIOSH 1992b], but these limits may not adequately protect workers exposed to organic dusts contaminated with microorganisms.

HEALTH EFFECTS OF ORGANIC DUST

Agricultural workers may develop ODTS after inhaling dust from contaminated organic materials. The syndrome is characterized by fever occurring 4 to 12 hours after exposure and flu-like symptoms such as general weakness, headache, chills, body aches, and cough. Shortness of breath may also occur.

Listening to the chest usually reveals normal breathing sounds, and chest X-rays are usually normal. Pulmonary function may be impaired, and an increase in the number of white blood cells is common. Antibodies commonly associated with certain allergic lung diseases such as farmer's lung are usually not present.

No specific therapy is needed to treat ODTS. However, the syndrome may often be misdiagnosed as acute bronchitis, influenza, or farmer's lung disease, which may lead to unnecessary therapy with antibiotics or anti-inflammatory medication. ODTS usually disappears within 24 hours to a few days after the worker is removed from exposure. Repeated episodes of ODTS can occur after reexposure to contaminated organic dusts. No deaths from ODTS have been reported.

ODTS CASE REPORTS

The following cases highlight examples of ODTS.

Case No. 1: Nine workers affected

Eleven male workers, aged 15 to 60 years, moved 800 bushels of oats from a poorly ventilated storage bin in Alabama [Parker et al. 1988]. The oats were reported to contain pockets of powdery white dust. Work conditions were described as extremely dusty, and all workers wore single-strap disposable masks while inside the bin. The workers shoveled the oats for 8 hours in groups of two or three for shifts of 20 to 30 minutes. Within 4 to 12 hours, all nine who worked inside the bin became ill with fever and chills, chest discomfort, weakness, and fatigue. Eight reported shortness of breath, six had nonproductive coughs, five complained of body aches, and four developed headaches. The two workers who remained outside the storage bin developed no symptoms. Six of the ill workers saw a doctor within the first 2 days of symptoms. The following abnormal physical signs were reported: body temperature greater than 100.4°F (38.0°C) in two workers, crackle sounds in the lungs of two workers, and wheezing sounds in one worker. Chest X-rays were normal in all six workers. Symptoms disappeared in all affected workers in 2 to 12 days.

Airborne dust generated in the laboratory from the bulk oats contained 39.5 mg/m^3 of respirable dust. Endotoxin content in the respirable dust was elevated to 325.7 endotoxin units/mg of dust.

Despite an initial diagnosis of farmer's lung disease, the rate of illness among those who entered the bin (100%, or 9 of 9) is typical of ODTS.

Case No. 2: One worker affected

A previously healthy 52-year-old man entered an emergency room with a fever of 101.8°F, body aches, and marked difficulty in breathing 12 hours after shoveling composted wood chips and leaves [Weber et al. 1990]. He was treated with oral glucocorticoids and improved over 3 days. Blood tests did not show that he was suffering from farmer's lung disease.

Using respiratory protection, investigators recreated the exposure and made extensive environmental measurements. Peak exposures to respirable dust were greater than 80 mg/m^3 of air. Endotoxin concentrations ranged from 244 to 16,300 endotoxin units/m^3-concentrations previously associated with illness.

High concentrations of gram-negative bacteria were also present [Olenchock et al. 1991].

Case No. 3: Fourteen workers affected (silo unloader's syndrome)

A retrospective study of hospital visits for farm-associated lung injury in a rural county in New York over an 11-year period revealed 26 cases of respiratory illness in 23 individuals [Pratt and May 1984]. Fourteen of these individuals suffered fever of short duration. Illness was most often associated with a 1 - to 3-hour respiratory exposure that occurred during the preparation of silos for mechanical unloading. During removal of the moldy top silage, the workers developed burning in the eyes and throat, headache, and cough. They attributed these symptoms to the white powder or "fog" arising from the moldy material. High fever, chest discomfort, weakness, and nonproductive cough followed within 4 to 12 hours. Blood tests failed to show that these workers suffered from farmer's lung disease.

A subsequent environmental study of five silos [May et al. 1986] revealed that workers unloading silos encounter total dust concentrations ranging from 0.2 to 138mg/m with concentrations at the silo base generally similar to those in the headspace. Respirable dust concentrations ranged from 0.2 to 24 mg/m^3, and microorganism counts ranged from 10^5 to $10^9/M^3$. Thermophilic bacteria were the most prevalent organisms of those cultured.

Case No. 4: Five workers affected

Five workers at a municipal golf course became ill with an influenza-like syndrome within hours of manually unloading a trailer truck filled with wood chips [CDC 1986]. The wood chips were stored in an enclosed, 40-foot trailer. Eleven workers participated in the unloading process. Although fresh chips had been ordered, the vendor included old chips that had been stored in the front of the trailer for approximately 1 year. Chips unloaded from the front were visibly contaminated, and growth cultures revealed a wide variety of bacteria and fungi.

All five workers who became ill had worked in very dusty conditions without respiratory protection while unloading the front of the trailer. The onset of illness ranged from 4 to 16 hours after beginning work. None of the workers were hospitalized, but one reported to a local emergency room, and two were too ill to work the following day. Within 48 hours, symptoms were greatly improved; within 72 hours, all affected workers had completely recovered.

The six workers who did not become ill included three who had unloaded fresh chips from the back of the trailer, one supervisor who had briefly checked on the unloading process, and two workers who finished unloading the front of the trailer the next morning using air-purifying respirators.

CONCLUSIONS

The cases described in this Alert reveal the seriousness of exposure to contaminated organic dust among agricultural workers and others. Because many agricultural workers find it difficult to seek medical attention and because many physicians fall to recognize occupational respiratory diseases, ODTS is probably much more common than documented.

Recommendations

Minimizing Risk

Agricultural workers and employers should minimize the risk of exposure to organic dusts by taking the following precautions:

- Be aware of the health effects of breathing organic dust. Symptoms of ODTS occur 4 to 12 hours after exposure and may include fever, weakness, headache, chills, body aches, cough, and shortness of breath.
- Inform your doctor about recent dust exposures when seeking treatment for respiratory illness.
- Carefully harvest and store agricultural products to minimize spoilage.
- Use automated or mechanized equipment to move decayed materials.
- Use local exhaust ventilation and wet methods of dust suppression to minimize exposure to organic dusts. For example, adding a quart of water to the cut side of bedding hay or straw before chopping is an effective method for reducing dust levels (but avoid overusing water) [NIOSH 1992c].
- Use the following engineering controls to reduce the dust exposure of silo unloaders [Jensen et al. 1993]:

    - Design the silo to provide for product turnover and to provide unfavorable conditions for microbial growth.
    - Design the conveyor to prevent spills of material and to ventilate dust effectively.

Table 1. NIOSH recommended respiratory protection for workers exposed to organic dust

Type of respirator*	APF**
Any air-purifying respirator with a high-efficiency particulate air filter	10
Any powered, air-purifying respirator with a high-efficiency particulate air filter or,	25
Any supplied-air respirator equipped with a hood or helmet and operated in a continuous-flow mode	25
Any air-purifying, full-facepiece respirator with a high-efficiency particulate air filter	50
Any powered, air-purifying respirator with a tight-fitting facepiece and high-efficiency particulate air filter	50
Any supplied-air respirator equipped with a half-mask and operated in a pressure-demand or other positive-pressure mode	1,000
Any supplied-air respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode	2,000
Any self-contained breathing apparatus equipped with a full facepiece and operated in a pressure demand or other positive-pressure mode	10,000
Any supplied-air respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode	10,000

* Only NIOSH/MSHA-certified equipment should be used.

** Assigned protection factor. The APF is the minimum anticipated level of protection provided by each type of respirator [NIOSH 1987b]. For example, an APF of 10 means that the respirator should reduce the air concentration of dust by a factor of 10 (or to 10% of the concentration without respiratory protection).

  - Use ventilated loading spouts when filling trucks and railroad cars with silage.

- Use appropriate respirators approved by NIOSH and the Mine Safety and Health Administration (MSHA) when exposure to organic dust cannot be avoided (see the following section on respiratory protection).
- Do not wear contaminated work clothes inside the home. Prevent exposure of family members to dusts and other toxic materials by removing contaminated clothes outside.

RESPIRATORY PROTECTION

Respirators should not be used as the only means of preventing or minimizing exposures to airborne contaminants. NIOSH recommends that workers be protected by controlling dust at its source and by using controls such as ventilation and wet dust suppression. However, when exposure to organic dust cannot be avoided, engineering controls should be supplemented with the use of appropriate NIOSH/MSHA-approved respirators.

Agricultural activities may generate a wide range of respirable dust concentrations. For example, respirable dust concentrations during bedding chopping have been measured at 1.6 to 2.5 mg/m^3 [Olenchock et al. 1990], whereas they may be as high as 24 mg/m^3 during silo unloading [May et al. 1986]. Working in confined spaces or enclosed locations can increase dust concentrations.

Because of this wide range of potential exposures and because there are no applicable exposure limits for organic dusts contaminated with microorganisms, NIOSH recommends that exposed workers wear the most practical respirator with the highest assigned protection factor (APF). Table 1 lists NIOSH-recommended respirators and their APFs. Air-purifying respirators should be worn with high-efficiency particulate air (HEPA) filters.

Powered, air-purifying respirators (PAPRs) are the most protective type of air-purifying respirator. Workers exposed to organic dusts have been adequately protected by PAPRs [Lenhart and Reed 1989; Clark 1986; Anderson et al. 1989; van Assendelft et al. 1985] and less effectively protected by other types of air-purifying respirators [Lenhart and Cole 1993; Műller-Wening and Repp 1989; Dykewicz et al. 1988; Solley and Hyatt 1980].

For additional information about respirator selection, consult the NIOSH Respirator Decision Logic [NIOSH 1987b]. Workers should use respirators certified by NIOSH and MSHA [NIOSH 1992a].

When respirators are used, the employer must establish a comprehensive respiratory protection program as outlined in the NIOSH Guide to Industrial Respiratory Protection [NIOSH 1987a] and as required in the OSHA

respiratory protection standard [29 CFR 1910.134]. Important elements of these programs are as follows:

- An evaluation of the worker's ability to perform work while wearing a respirator
- Regular training of personnel
- Periodic environmental monitoring
- Respirator fit testing
- Maintenance, inspection, cleaning, and storage
- Selection of appropriate respirators certified by NIOSH and MSHA
- Employers should evaluate the respiratory protection program regularly.

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We greatly appreciate your assistance in protecting the health of U.S. workers.

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1. A cell-wall component of gram-negative bacteria.

2. Code of Federal Regulations. See CFR in references.