

Concentrated Animal Feeding Operations: Health Risks to Farmers and Workers

Just 5% of U.S. farms account for 54% of its beef and dairy cattle, swine, and poultry, concentrating manure as well as animals.¹ These industrial-scale operations, called CAFOs (concentrated animal feeding operations) or factory farms, produce 575 billion pounds of manure dry matter yearly.² Manure concentration contributes to air and water pollution, and likely to antibiotic resistance, impacting farmers and farm workers, as well as their neighbors.



About 700,000 Americans working in CAFOs are exposed to degrading manure and bedding that can create a toxic mixture of gases such as hydrogen sulfide (H₂S), and airborne particles containing dust from animal feed, hair and dander, feces, bacteria and bacterial toxins.^{3,4} Extensive evidence demonstrates harm to workers from these exposures. Asthma, bronchitis, sinus infections, and short-term and persistent declines in lung function are widespread. High concentrations of H₂S gas from manure pits have killed dozens. Routine, long-term exposure to H₂S, even at much lower levels, may lead to permanent declines in brain and nervous system function, and depression and other mood changes. Cumulative health impacts on workers exposed to *multiple* CAFO air pollutants are likely, but rarely studied.

Pollutants from decomposing manure

► **Dust particles and toxins.** Small particles—around 50% of CAFO dust particles—pose a significant respiratory hazard because they penetrate deeper into lungs, carrying toxic gases adsorbed onto them.^{5,6} **Endotoxins** are parts of bacteria remaining toxic long after the organism dies. Even at low concentrations in dust, they can affect white blood cell counts, cause fever and respiratory distress, and worsen asthma.⁷ Endotoxins may be a more significant contributor to workers' problems with chronic cough and bronchitis than is dust.⁸

► **Volatile organic compounds (VOCs).** Of 331 VOC and gas compounds found in odorous air samples from North Carolina swine facilities, 157 are known airway irritants.⁹ Exposure to VOC mixtures can have additive effects, so that sub-irritant levels of individual compounds can cause airway irritation when combined.¹⁰

► **Ammonia.** At moderate to high exposures, ammonia can cause severe cough, and lung inflammation and scarring, edema and death, respectively. Ammonia adsorbs onto dust particles inhaled deep into lungs, where it can irritate tissue even at low concentrations.³ Ammonia impedes lung cilia from clearing dust particles, leading to worse than additive impacts from dust and ammonia exposure together.⁷

► **Hydrogen sulfide.** Over half of swine manure pits may be capable of producing environments poisoned with H₂S.¹¹ H₂S is a cyanide-like gas that prevents cells from using oxygen. Acute effects include eye and respiratory irritation at air concentrations of 20 parts per million (ppm), nausea and vomiting at 50 ppm, dizziness at 200 ppm, and loss of consciousness and perhaps death at 500 ppm and above.¹²



Photo: USDA

Asthma and other respiratory problems. Manure-related air pollutants can inflame tissue around the airways (bronchial tubes), increasing mucus production. Chronic inflammation can permanently scar the lungs. Either mucus or scarring can reduce airway diameter, making it harder to move air in and out of the lungs. One result is wheezing, or the sensation of being short of breath. CAFO workers exposed to these air pollutants report an interrelated group of respiratory symptoms that may occur simultaneously:

► **Occupational asthma.** 25% of swine workers have occupational asthma – chest tightness, wheezing, and shortness of breath—typically after six or more years of exposure.⁵ Results from chronic inflammation, not allergies.

► **"Asthma-like syndrome."** A collection of symptoms—chest tightness, wheezing, cough, and fever—displayed by workers returning after two or more absent days. Documented in 11% of Iowa confinement workers.¹³

► **Sinusitis.** Inflamed, swollen sinus passages and eustachian tubes (leading to the middle ear) producing symptoms—headache or tooth pain, head congestion, difficult nasal breathing, and "popping" ear—reported by about 25% of confinement workers.¹⁴

► **Bronchitis.** Airway irritation induced by inflammation. 25% of swine workers report chronic bronchitis, coughing, and phlegm production in three weeks out of a month for two years or more.⁵ Among young swine workers, ages 26 to 35, nearly 19% report chronic cough and 24% report chronic phlegm and wheezing; swine workers as a whole had even greater reported chronic cough, phlegm and bronchitis.¹⁵

► **Organic toxic dust syndrome.** A collection of flu-like symptoms—headache, joint and muscle pain, fever, fatigue, weakness, and irritation of the airways and cells lining small lung sacs—reported by one-third of confinement workers.¹² These symptoms have been reproduced experimentally by exposing subjects to endotoxins.¹⁶

Respiratory symptoms reported by CAFO workers are consistent with objective measures of harm. A study of 257 Iowa poultry workers showed that 39% suffered significant acute declines in the aver-

age rate at which their lungs could move air, and 30% of them had significant declines in their lungs' ability to move air quickly, following exposure to these manure-related air pollutants. Risk of lung function decline increased with exposure to higher concentrations of dust, endotoxins and ammonia.¹⁷ Dust and ammonia exposure together had synergistic adverse effects accounting for 35-61% of total lung function decline.¹⁸

A study of 207 Iowa swine workers also linked air pollutants to lung dysfunction; higher-level exposures were associated with greater lung impairment. This correlation was stronger for workers with more than six years in hog confinement buildings, showing longer-term exposures can cause progressive declines in lung function.¹⁹ Minnesota turkey farmers working over 10 years also had more respiratory complaints and significantly lower levels of lung function on testing than did workers with shorter tenure.²⁰

Poisoning, death and chronic nervous system problems. From 1983 to 1990, hydrogen sulfide (H₂S) killed 24 swine farm workers in the Midwest alone¹¹; at least 15 more workers have died since 1994.^{21,22} Exposure to H₂S around 600 ppm can paralyze the brain's respiratory center, causing death in minutes. Industrial workers surviving H₂S poisoning and unconsciousness may suffer permanent brain damage. Those tested three or more years later have had moderate to severe problems with attention and concentration; varying deficits in memory, learning, and perception; poor planning ability; and reduced muscle (motor) function.^{23,24,25}

Long-term exposure to much lower H₂S levels can cause similar problems. Thirteen former workers (1-3 years' exposure) and 22 neighbors of a crude oil refinery (another source of H₂S) with day-long H₂S emissions averaging less than 9 ppm, reported 10 neurological symptoms with significantly more frequency, including lightheadedness, inability to concentrate, short- and long-term memory loss and mood instability; they also reported significantly higher levels of depression, tension, fatigue and anger.²⁶ Testing

Acute, chronic effects with hydrogen sulfide exposure^{12,27}

Level (parts per million)	Duration of Exposure	Effect
600 ppm	Acute	Rapid death
500 ppm	Acute	Lose consciousness
200 ppm	Acute	Dizziness, increased pneumonia risk
50 ppm	Acute	Nausea, vomiting, diarrhea
20 ppm	Acute	Eye, respiratory irritation
<9 ppm	Chronic	Increased neurological symptoms, neurobehavioral deficits on exam
<5 ppm	Chronic	Poorer balance and color vision; impaired verbal recall and grip strength

revealed they had significantly slower reactions and worse balance, color vision and perceptual motor skills than unexposed individuals. Residents of homes constructed above petroleum deposits, with long-term H₂S exposure of 0.1 to 1.0 ppm (with peaks to 5 ppm), showed poorer balance and color vision, impaired verbal recall, and reduced grip strength.²⁷ Kilburn concludes "the only safe strategy is to avoid all exposures to any dose" of H₂S.

Conclusion. Farmers and workers in CAFOs suffer harm from manure and its related pollutants. Dust particles and bacterial endotoxins in manure dust can exacerbate asthma and directly impact long-term respiratory health. Decomposing manure also creates volatile toxic gases, including ammonia and hydrogen sulfide, that can cause acute respiratory symptoms as well as death at high enough exposures. Long-term, low-level exposure to some manure pollutants can affect mood, and may permanently impair function of the brain and nervous system. Current OSHA standards fail to protect CAFO workers because several hazardous air pollutants are not regulated.³ ●

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