

## April Update from the Field 2023: Handling facilities for livestock

### **Farm-Related Injuries and Fatalities Involving Children, Youth, and Young Workers during Manure Storage, Handling, and Transport**

Nour, M. M., Field, W. E., Ni, J. Q., & Cheng, Y. H. (2021). Farm-Related Injuries and Fatalities Involving Children, Youth, and Young Workers during Manure Storage, Handling, and Transport. *Journal of agromedicine*, 26(3), 323–333. <https://doi.org/10.1080/1059924X.2020.1795034>

Manure storage, handling, and transport facilities and equipment have been associated with life threatening hazards on many livestock farms. These hazards have been documented in prior research as including 1) exposure to toxic manure gases or lack of adequate oxygen in enclosed structures, which can be fatal to both humans and livestock; 2) below and above ground liquid manure storage structures that have the potential risk for drowning and falling; and 3) mechanical hazards associated with manure handling and transport equipment, including entanglement, road collisions, rollover, and equipment failure. Over the past 40 years, Purdue University's Agricultural Safety and Health Program (PUASHP) has collected, documented, and maintained data regarding agricultural-related injuries and fatalities associated with agricultural confined spaces in the United States. As part of ongoing surveillance, a total of 369 fatal and non-fatal cases relating to manure storage, handling and transport equipment, and facilities have been documented. Of these, 89 have involved children, youth, and young farm workers ages (birth-21) documented between 1975 and 2019. The purpose of this study was to summarize these 89 documented cases to better understand contributing factors and to develop recommendations for evidence-based strategies to reduce the frequency and severity of these incidents. Though recognized as not comprehensive for all incidents of this type, the data represent the largest data set known to exist, providing insight into previously unstudied hazards facing children and youth living and working on, and visiting farms as non-workers. Findings in this study include: there has been an increase in the documented frequency of these incidents, which may be due, at least partially, to enhanced or more aggressive surveillance efforts; 57% of the cases were fatal; incidents involving underground or inground manure storage facilities were the most frequent type; incidents involving manure transport vehicles were higher than expected; 33% of the victims were five years of age and younger; and July was the month with the most documented incidents. Recommendations for future injury prevention strategies include incorporation of information on manure-related hazards in curricula targeting children and youth, more aggressive enforcement of child labor laws that currently prohibit the employment of youth to work in manure storage structures or to be involved in their operations, and greater use of physical and administrative controls, including safety signage, fencing, gates, and covers to restrict access to manure storage structures.

### **Evaluation of Short-Term Exposure Levels on Ammonia and Hydrogen Sulfide During Manure-Handling Processes at Livestock Farms**

Park, J., Kang, T., Heo, Y., Lee, K., Kim, K., Lee, K., & Yoon, C. (2020). Evaluation of Short-Term Exposure Levels on Ammonia and Hydrogen Sulfide During Manure-Handling Processes at Livestock Farms. *Safety and health at work*, 11(1), 109–117. <https://doi.org/10.1016/j.shaw.2019.12.007>

**Background:** Ammonia and hydrogen sulfide are harmful gases generated during aerobic/anaerobic bacterial decomposition of livestock manure. We evaluated ammonia and hydrogen sulfide concentrations generated from workplaces at livestock farms and determined

environmental factors influencing the gas concentrations. **Methods:** Five commercial swine farms and five poultry farms were selected for monitoring. Real-time monitors were used to measure the ammonia and hydrogen sulfide concentrations and environmental conditions during the manure-handling processes. Monitoring was conducted in the manure storage facility and composting facility. Information on the farm conditions was also collected through interview and walk-through survey. **Results:** The ammonia concentrations were significantly higher at the swine composting facilities (9.5-43.2 ppm) than at other manure-handling facilities at the swine and poultry farms, and high concentrations of hydrogen sulfide were identified during the manure agitation and mixing process at the swine manure storage facilities (6.9-19.5 ppm). At the poultry manure-handling facilities, the ammonia concentration was higher during the manure-handling processes (2.6-57.9 ppm), and very low hydrogen sulfide concentrations (0-3.4 ppm) were detected. The air temperature and relative humidity, volume of the facility, duration of manure storage, and the number of animals influenced the gas concentrations. **Conclusion:** A high level of hazardous gases was generated during manure handling, and some levels increased up to risk levels that can threaten workers' health and safety. Some of the farm operational factors were also found to influence the gas levels. By controlling and improving these factors, it would be possible to protect workers' safety and health from occupational risks.

#### **Summary of Known U.S. Injuries and Fatalities Involving Livestock Waste Storage, Handling, and Transport Operations: 1975-2019**

Nour, M. M., Cheng, Y. H., Field, W. E., Sheldon, E., & Ni, J. Q. (2022). Summary of Known U.S. Injuries and Fatalities Involving Livestock Waste Storage, Handling, and Transport Operations: 1975-2019. *Journal of agricultural safety and health*, 28(1), 65–81. <https://doi.org/10.13031/jash.14615>

There is limited published research exploring the frequency and causes of livestock waste-related fatalities and injuries among farm operators and workers. While there has been ongoing surveillance of mortality and morbidity involving agricultural confined space-related incidents, such as grain storage facilities, few resources have been invested in estimating the frequency of livestock waste-related incidents, which are often reported as primarily involving confined spaces. Existing surveillance efforts have historically underreported fatal cases, injuries, and near misses and misclassified these incidents as non-farm related. For nearly 40 years, the Purdue Agricultural Confined Spaces Incident Database (PACSID) has been used to document agricultural confined space-related incidents, of which manure storage and handling activities have accounted for 22% of the cases documented. The specific goal of this study was to address the gap in the current understanding of the frequency and severity of injuries associated with livestock waste storage, handling, and transport by: (1) developing a consistent way to identify, document, and code these cases; (2) summarizing all known U.S. cases, both fatal and non-fatal, currently documented in the PACSID; (3) identifying the most significant risks contributing to livestock waste storage, handling, and transport-related incidents; and (4) providing evidence-based recommendations and mitigation strategies to enhance the effectiveness of current injury prevention measures. The PACSID and other sources were mined for relevant data, and an aggressive effort was made to document additional cases through a variety of surveillance methods. A total of 459 individual U.S. cases from the study period (1975 to 2019) were identified, coded using a uniform coding system, and summarized. Overall, cases were documented in 43 states, with 66% (302 cases) documented in heavily agricultural and, more

specifically, historically strong dairy production states. Of the cases reviewed, 59% were fatal, males ages 21 to 30 and dairy farm workers were identified as high-risk populations, 20% were identified as under the age of 21, and 49 incidents involved multiple victims. Farm injury data limitations and underreporting were problematic, especially during the early years of the study period. However, the findings provide a foundation for recommending safer workplace safety and health practices, evaluating existing engineering and regulatory standards, assessing the impacts of current injury prevention efforts, and redesigning farm safety programs, especially those targeting livestock workers, to reduce the frequency and severity of these incidents.