Safety Risks and Prevention Measures Involving Livestock Waste Storage, Handling, and Transportation

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Thursday, November 4th, 2021

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Outline

- Introduction
- Background & Literature Review
- Case Studies
- Research Problems & Gaps
- Research Objectives
- Methods
- U.S. Study Findings
- Recommendations
- Q & A

Source: Idaho Statesman News

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Introduction

1. **“Far better to prevent than to cure”**
   Dr. Ramazzini, father of occupational medicine
1. Development of Purdue Agricultural Confined Space Incident Database (PACSID)
2. Primary focus on grain-related incidents, secondary manure storage
3. Nearly 500 cases involving livestock waste storage, handling, and transport documented to date

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Literature Review

- Boolean logic model used to select specific search terms and to identify key search factors and relative significance
- Terms used involved “asphyxia”, “suffocation”, “drowning”, “spreader”, “fell into”, “rescued from”, ……etc
- A comprehensive literature review was conducted on any study that might be related to livestock waste storage, handling & transport
- An aggressive search was conducted to identify additional cases using google alerts, on-line detection and notification services, news clippings, published articles and prior civil litigation cases.

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Case Study

VA. July, 2007

Manure pit's deadly gas kills 5 in Va.

Farmers gather at the scene of an accident at the Showalter farm near Bridgewater, Va., Tuesday after four members of a family, including two children, and a farmhand died of methane gas poisoning. Scott Showalter, 34, was trying to unclog a pipe in a manure pit.

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Source: Denver Post News

Case Study

Three brothers were trapped in livestock farm’s manure pit after being overcome by fumes have died, Ohio, August 2021

Brothers Gary, Todd and Brad Wuebker were fixing a manure pump before they passed out from the fumes.

Source: NBC News

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Research Problem

- There is a gap in current understanding of the problem, its scope and frequency, and the most effective strategies to prevent future incidents.
- Lack of standard incident or injury reporting model

Source: OSHA

Photo source: Purdue Extension

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Research Objectives

The specific goal of this research was to address the gap in understanding the frequency & severity of incidents

1) Developing a consistent way to identify, document and code cases involving storage, handling, and transport of livestock waste
2) Summarizing all known U.S. cases, both fatal and non-fatal, documented in the PACSID
3) Identifying the most significant risks contributing to livestock waste storage handling and transport-related incidents
4) Providing evidence-based recommendations and mitigation strategies to enhance the effectiveness of current injury prevention measures

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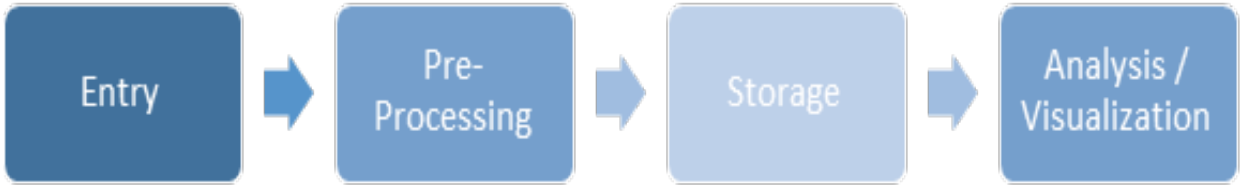
Methods – Database Analysis



- Purdue University's Agricultural Confined Space Incident Database (PACSID)
  - Case collection started in 1975
  - Contains more than 2400 confined space incidents
  - Cases are collected from Google alerts, web searches, news clipping services, death certificates, OSHA incident database, NIOSH-FACE database, and interviews.
- Livestock waste-related cases were analyzed and summarized to understand trends
  - Each case was reviewed and coded using standard scheme coding form

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INCIDENT REPORTING FORM DEVELOPED

Appendix 1

Agricultural Confined Space Incident Report Classification Form for Manure Storage, Handling and Transport Related Injuries & Fatalities

PACSID ID: _____

Source of Date for Incident Identification (Check all that apply):

- ☐ Published research article
- ☐ Phone/personal interview
- ☐ Electronic media (TV, Radio)
- ☐ News clippings
- ☐ Google alerts/on-line sources
- ☐ Other_____

1. General Incident Information

Date (Month/Day/Year) _____/_____/_____

Time of Injury _____ AM / PM **Weekday of Injury (circle):** S M T W T F S

Address _____

County _____ **State** _____

2. Number of Victims _____

3. Incident Classification

- ☐ Non-fatal
- ☐ Fatal

4. Type of Farm

- ☐ Dairy
- ☐ Swine
- ☐ Beef
- ☐ Poultry
- ☐ Other, specify_____
- ☐ Unknown

5. Victim Information

Name (Last, First): _____ ☐ Unknown

Age: _____ ☐ Unknown

Name (Last, First): _____ ☐ Unknown

Age: _____ ☐ Unknown

Name (Last, First): _____ ☐ Unknown

Age: _____ ☐ Unknown

Name (Last, First): _____ ☐ Unknown

Age: _____ ☐ Unknown

Sex:

- ☐ Male
- ☐ Female
- ☐ Unknown

6. Cause of Injury

- ☐ Suffocation
- ☐ Drowning
- ☐ Asphyxiation
- ☐ Trauma from fire/explosion
- ☐ Trauma from fall
- ☐ Roadway rollover
- ☐ Entangled/caught in machinery
- ☐ Pinned/struck by machine agent
- ☐ Collapsing machine
- ☐ Traffic collision on roadway
- ☐ Machine-related contact with electrical current
- ☐ Machine-related/vehicle related fire, explosion or burn
- ☐ Trauma from equipment failure
- ☐ Machine/vehicle related drowning
- ☐ Unknown
- ☐ Other, specify _____

7. Relationship to Farm

- ☐ Farm/ranch owner or farm operator
- ☐ Farm/ranch hired worker
- ☐ Farm/ranch family member
- ☐ Children at play
- ☐ Rescuers/first responders
- ☐ Visitor
- ☐ Contractor
- ☐ Other, specify _____
- ☐ Unknown

8. Agent / Facility / Equipment / Involved

- ☐ Underground or underfloor manure storage structure
- ☐ Above ground manure storage tank
- ☐ In-ground manure storage (lagoon/pit)
- ☐ Manure transport vehicle (solid manure spreader, liquid transport vehicle)
- ☐ Manure handling equipment (barn cleaner, skid steer, frontend loader)
- ☐ Manure agitation or pumping equipment
- ☐ Fire/explosion
- ☐ Other, specify _____
- ☐ Unknown

9. Contributing Toxic Gases Identified (Exposure to toxic substances/gases)

- ☐ Carbon Dioxide
- ☐ Carbon Monoxide
- ☐ Methane
- ☐ Hydrogen Sulfide
- ☐ Ammonia
- ☐ Non

10. Location of Incident

- ☐ Building/farm house
- ☐ Farm yard
- ☐ Field
- ☐ Roadway/highway
- ☐ Farm unspecified
- ☐ Manure shed
- ☐ Farm road
- ☐ Manure pit/lagoon
- ☐ Sewage pit
- ☐ Other, specify_____

11. Additional Narration:

_____

_____

_____

_____

_____

_____

_____

Completed By: _____ **Date:**_____

***Incidence references attached to this report**

Burden of Livestock Waste

- An estimated # of 297,197 farms that applied manure to app. 24 M. acres, 127,500 being enclosed manure pits
- Annually, 19,000 operators acknowledge being entered pits , 98,000 farm operations have on-site manure storage (USDA. 2019)
- Animal production in the U.S. is valued at over $100 billion annually
- It is estimated that over a billion tons of livestock wastes are produced annually in the U.S.
- The amount of manure generated in the U.S. is estimated to exceed 335 million tons of dry matter per year
- European Union (EU) is producing about 1.4 billion tons per year
- Numerous documented incidents (700), including International
- 13% of US Ag greenhouse gases from decomposition

of manure (Hellerstein, 2019)

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Photo source: OSHA

Hazards of Livestock Waste Storage Systems

- Toxic gases (**H_2S, NH_3, CO_2, & CH_4)**
- Confined spaces
- Manure transport (liquid & solid)
- Entrapment in equipment
- Drowning in manure ponds, & lagoons
- Handling & application-related hazards

Source: Farmers Weekly News

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UNDERGROUND OR UNDERFLOOR STORAGE STRUCTURE

IN-GROUND STORAGE (PIT/LAGOON)

MANURE HANDLING EQUIPMENT

Manure Pump

Source: http://www.omafra.gov.on.ca

Manure handling by using skid steer & conveyor

Manure Spreader

Manure Agitator

MANURE TRANSPORT VEHICLE (TANK/SPREADER)

Photos' source: Purdue Extension

U. S. Study Findings

1. 459 cases were documented from 1975 - 2019
2. 59% were fatal and the overwhelming majority of victims were male (>85%) with an average age of 37
3. Approximately 26% of victims of these incidents were “secondary victims” or first responders
4. 32% of all cases were due to asphyxiations or suffocation

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U. S. Study Findings (Continued)

5. Drowning incidents in manure storage structures and lagoons were the deadliest type, with 97% being fatal
6. 27% of the cases were due to entanglement in manure handling and transport machinery
7. 20% of all victims were children, youth and young workers 20 years old and younger
8. When documented, incidents involving dairy farms represented 30% of all cases, while 16% occurred on swine farms

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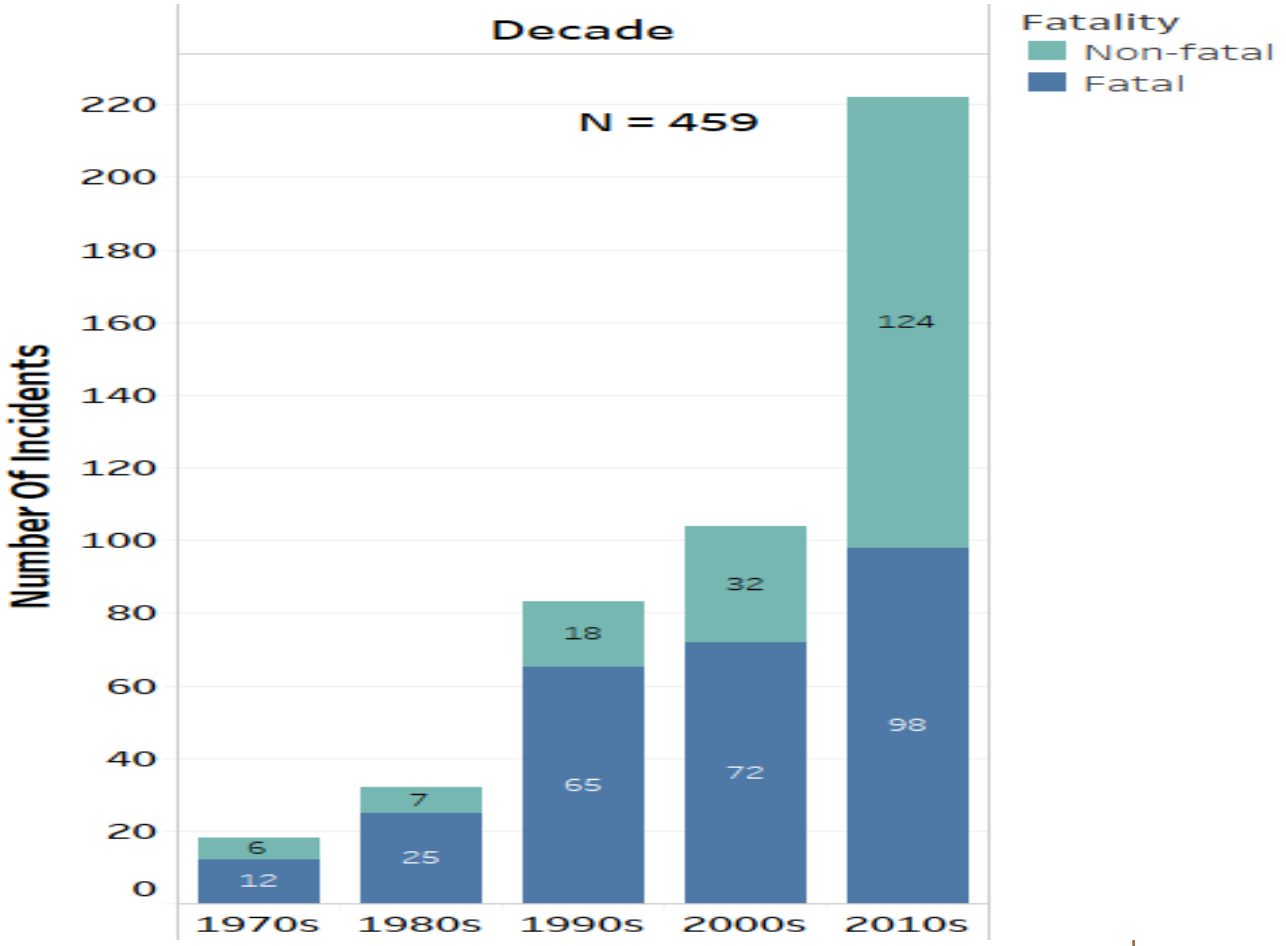
Distribution of livestock waste-related cases by decade from 1975 to 2019



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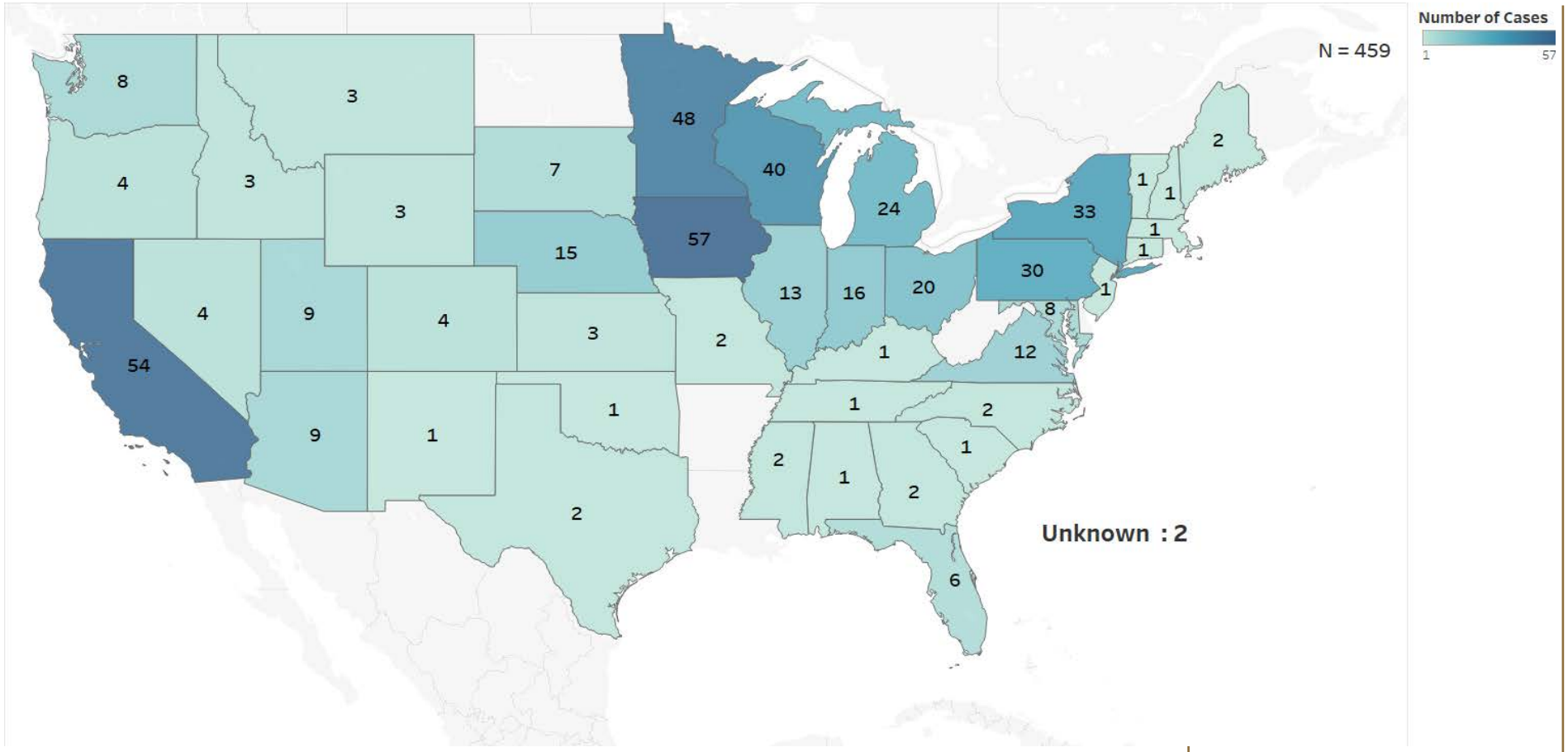
Distribution of livestock waste-related cases by state from 1975 to 2019



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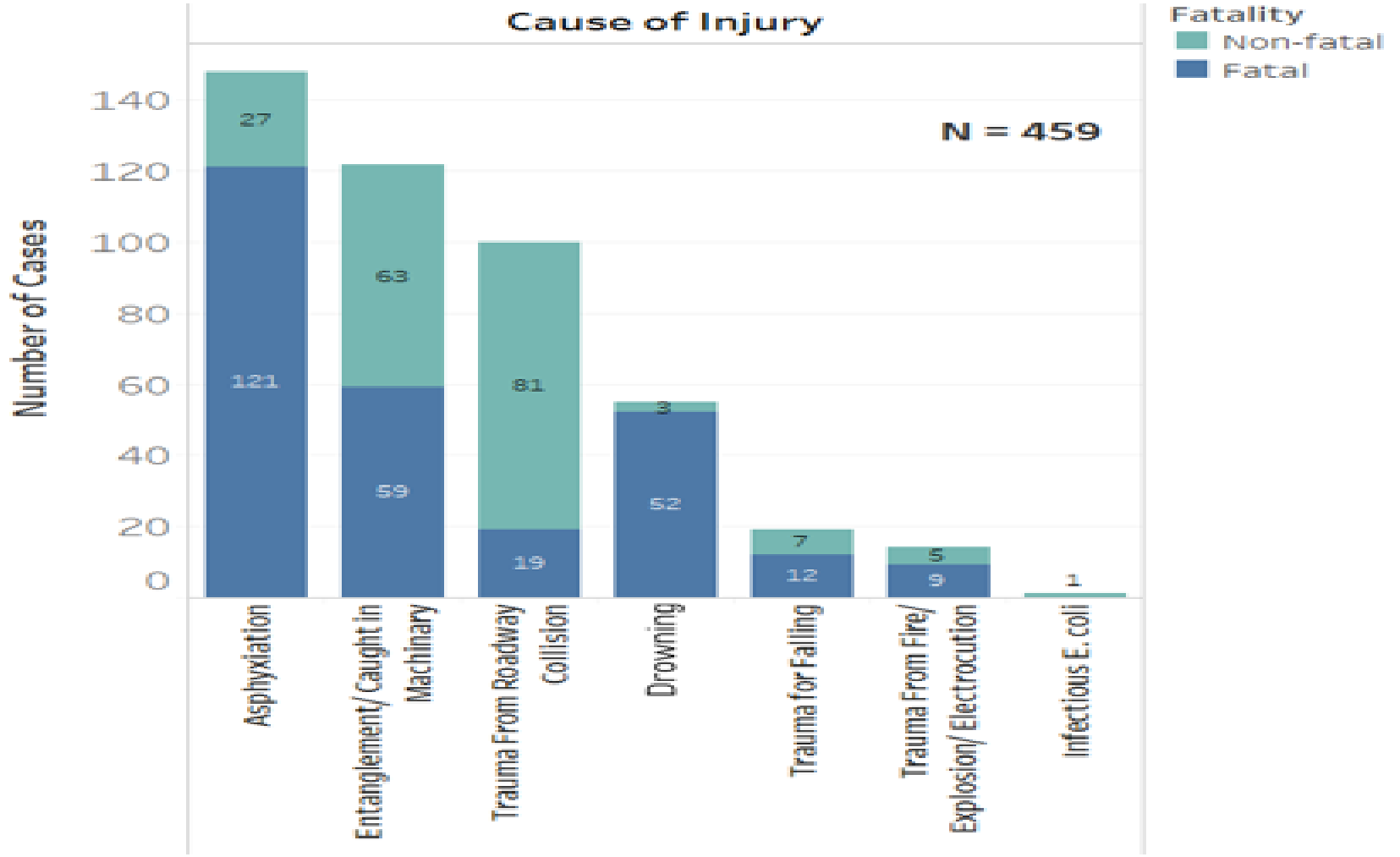
Distribution of U. S. livestock waste-related cases by cause of injury



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Causations for Entering Manure Storage Facilities

- Maintenance, to clean, clear or unclog manure
- Repair equipment
- Pumping or agitating
- Children at play
- Contractors employed for construction tasks
- Commercial manure hauling

Below ground pit

Above ground storage tank

Lagoon

Photos' source: Purdue Extension

OTHER ISSUES ABOUT MANURE HANDLING, TRANSPORT, AND STORAGE

Manure spills

Rescue cows from manure pit in Sweden

FRIDAY JUNE 8, 2018 12:01 AM

Cows at Berks farm overcome by gas fumes from manure pit

Firefighters used large fans to ventilate the building in Perry Township, but one cow had died.

Dairy fined $16,800 for manure spill that shut down Tillamook Bay

News

Manure spill in Fond du Lac County creek kills fish

Limitations

- The lack of any type of central required reporting process will continue to ensure under reporting of livestock waste-related incidents
- Under reporting, especially during early decades of the study, prevented a comprehensive assessment of the problem
- The data were limited due to the inability to conduct additional on-site investigations involving interviews with victims and witnesses
- Incidents, especially non-fatal or “near misses” at large livestock operations are under reported considering the large number of these facilities in terms of storage structures and the large number of workers

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Limitations (Continued)

- Lack of required reporting/documentation
- Most livestock waste storage/handling facilities do not fall under governmental (OSHA) oversight
- Available sources are limited requiring additional investigation
- Multisource surveillance is needed for sufficient documentation for each case such as:
    1. Death certificates
    2. Medical or hospital reports
    3. Coroner reports
    4. Police reports
    5. Motor-vehicle incident reports

Photo source: OSHA

Recommendation

- Do not expose to toxic atmospheres
  Most manure incidents are preventable
  Lock out tag out is critical for safety during maintenance
- For livestock workers, enclosed manure structures are confined spaces that required 3 persons equipped with PPE
- For rescuers, do not attempt to enter without self-contained breathing apparatus (SCBA), life lines,…… PPE
- Servicing manure pits
  - Only qualified people
  - Ventilation system
  - Monitor air quality
  - Safety equipment
  - Standby 2 persons

Photo source: OSHA

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Recommendations

- Safety efforts should target dairy and swine operations and high-risk activities such as maintenance and exposure to liquid manure
- Secondary agricultural education of both parents and youth on the hazards associated with manure storage, handling, and transport
- increase targeted prevention efforts during high-risk times of the years, such as wheat harvest, and should target the 6 states (CA, IA, MN, WI, NY, and PA) with the highest number of documented incidents.
- Continue centralized reporting system and improve the current surveillance and documentation press for conducting more in-depth investigations of incidents, identifying potential trends and patterns

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Recommendations (Continued)

- According to OSHA, ASABE, and ANSI regulations and standards, all confined spaces including livestock manure structures and operations must be considered dangerous
- Manure pit and lagoon guidelines:
  - Fencing
  - Signs
  - Emergency plan
  - Machine guarding
  - Fall prevention
  - Construction planning
  - Employee training
  - “No Entry” areas

Photo source: OSHA

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References:

1. Nour, M. M., Field, W. E., Ni, J. Q., & Cheng, C. (2019). Development of methodology to document and code farm-related injuries and fatalities involving manure storage, handling and transport - with summary of 2017 incidents. *J Agromedicine*, *24*(1), 90-100. doi: 10.1080/1059924X.2018.1539420
2. Nour, M. M., Field, W. E., Ni, J. Q., & Cheng, Y. H. (2020). Farm-Related Injuries and Fatalities Involving Children, Youth, and Young Workers during Manure Storage, Handling, and Transport. *J Agromedicine*, 1-11. doi: 10.1080/1059924X.2020.1795034
3. Nour, M. M., Cheng, Y. H, Ni, J. Q., Sheldon, Ed., & Field, W. E. (2021). Summary of seven central-state region injuries and fatalities involving livestock manure storage, handling, and transport operations: 1976-2019. *J Agric Saf Health*. (in press). (doi: 10.13031/jash.14343) @2021

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Thank You for Your Attention

Any Questions?

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