



Multi-strain Shiga toxin-producing *E. coli* Outbreak Associated with Agritourism in Loudoun County, Virginia, 2022



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Presentation Objectives

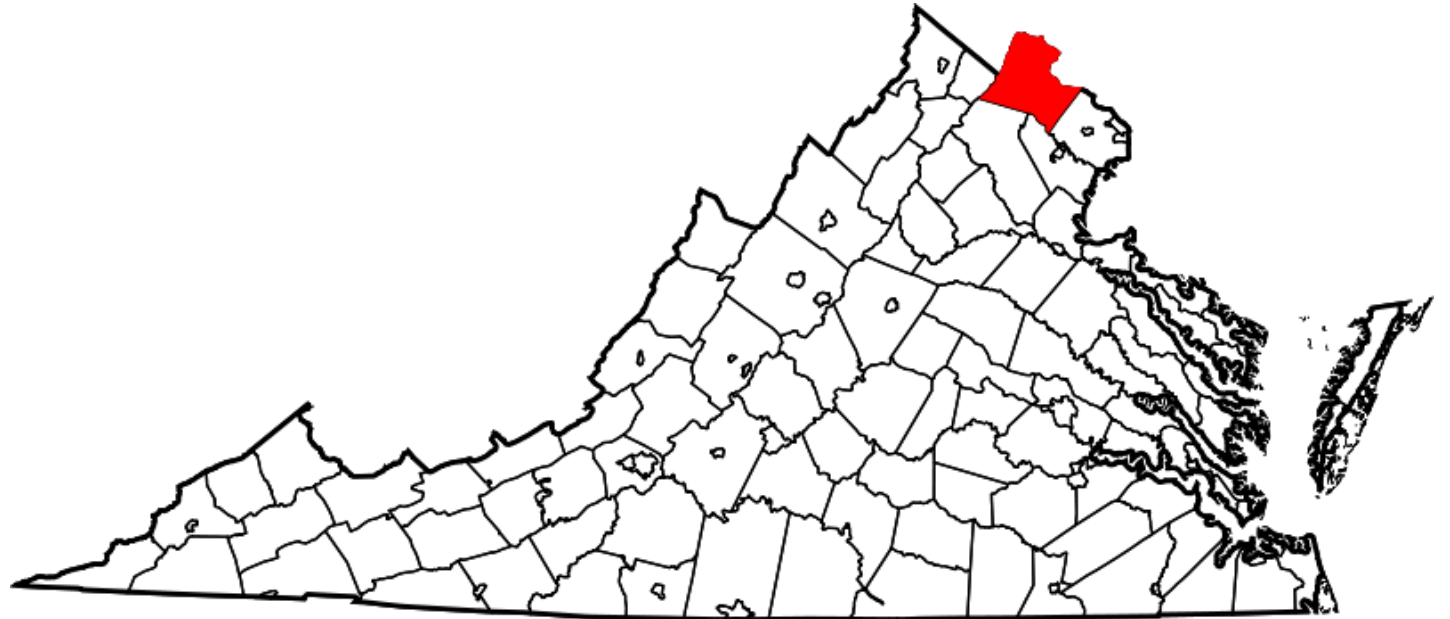
1. Identify 3 main risk factors for STEC infection in agritourism settings
2. Discuss the role of whole genomic sequencing in zoonotic outbreak investigations
3. Describe 3 disease prevention best practices for agritourism settings

Setting the Stage...



Loudoun County

- Northern Virginia – 25 miles west of Washington D.C.
- 515 square miles
- 420,959 residents
- \$2 billion in tourism revenue in 2019



Loudoun County

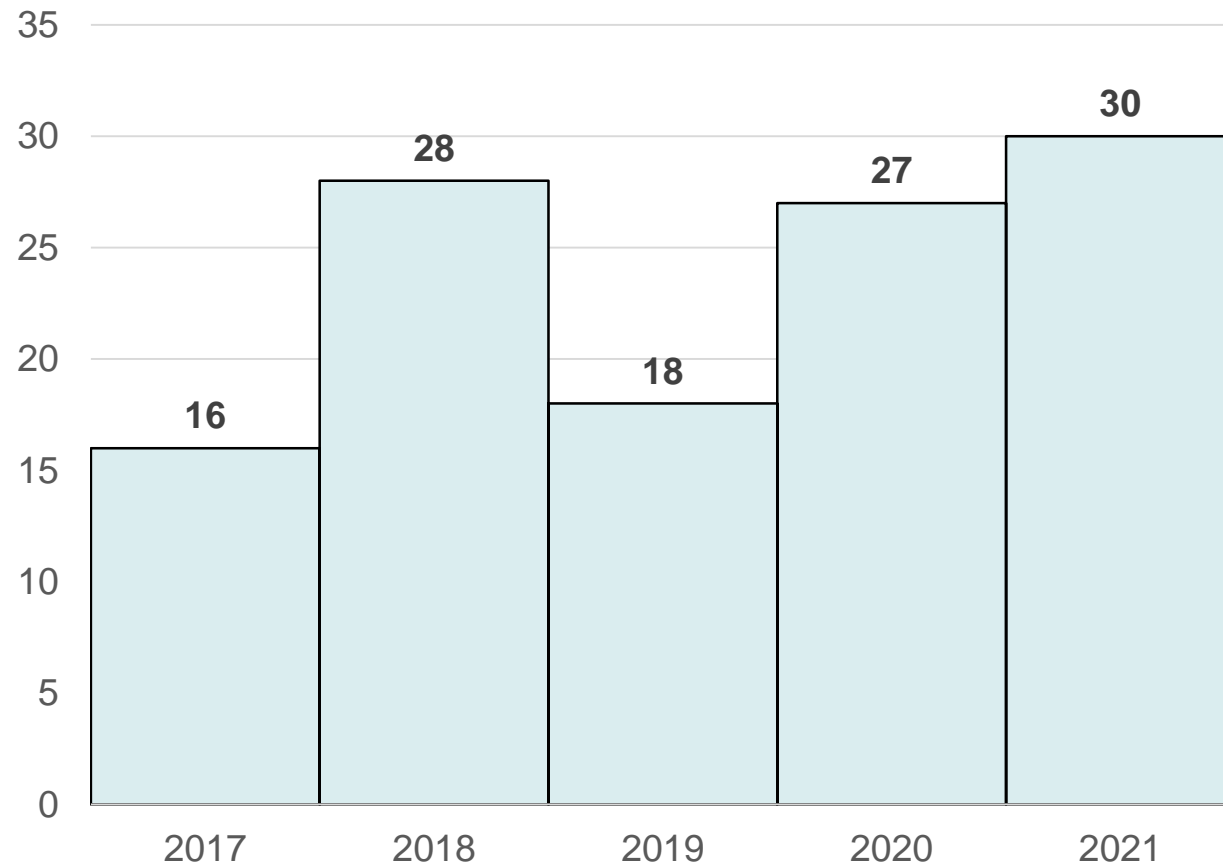
- Northern Virginia generates the most agri-tourism revenue of all 10 state regions
- Loudoun farm businesses make up 51 percent of the Northern Virginia's agri-tourism venues
- Agritourism provides opportunities to experience rural activities, but can present a risk for zoonotic transmission of disease to humans.



Shiga toxin-producing *E. coli* (STEC)

- **Shiga toxin-producing *E. coli* (STEC):** bacteria living in the intestines of humans and animals (e.g. goats!) which produce toxins that can lead to illness
- **Transmission:** Fecal-oral
- **Incubation period:** 1-10 days, usually 3-4 days after exposure
- **Symptoms:** Diarrhea (bloody), vomiting, stomach cramps, fever, chills
 - Young children, older adults, and those with weakened immune systems more at risk for severe illness
 - Hemolytic-uremic syndrome (HUS): serious sequelae of STEC Infection

STEC Cases Loudoun County 2017-2021:



*2021 Data is Preliminary

Spring 2022 – STEC and baby goats

- 4/1/22: positive STEC lab from 5-year-old, parent reports feeding baby goats with bottled milk at Farm X in Loudoun on 3/26/22
- 4/11/22: positive STEC lab from 10-year-old, parent reports cuddling baby goats at Farm X in Loudoun on 4/3/22. Reports goats as “visibly sick with loose stool”
- Parent of second child reports sibling and two friends also ill with same symptoms



5 individuals from 3
different households

All visited Farm X prior to
illness

All reported:

- Cuddling baby goats
- Bottle feeding baby goats
- Baby goats having “loose stool running down legs”

Outbreak
identified!

Investigation Team

Multidisciplinary team coordinated by Regional Epidemiologist including:

- District Director
- Regional Epidemiologist
- Veterinary Epidemiologists
- Foodborne Epidemiologists
- DCLS
- VDACS
- LCHD Communicable Disease Team
- LCHD Epidemiologists
- Risk Communication Manager

Investigation Methods

- Case identification and investigation
 - Press release and direct communication to Farm X visitors
 - REDCap survey posted on Farm X website, social media, and included in communications
- Site visit to Farm X by Veterinary Epidemiologists and LCHD Epidemiologists
 - Collection of fecal samples from goats
 - Assessment of environmental conditions
- Laboratory investigation by DCLS
 - Culture, bacterial isolation and typing, Whole Genomic Sequencing (WGS)
- Survey of farm visitors to identify risk factors

A photograph of several baby goats huddled together in a stone enclosure. The goats are of various colors, including brown, black, and white. They are all looking towards the camera. The text is overlaid on the image.

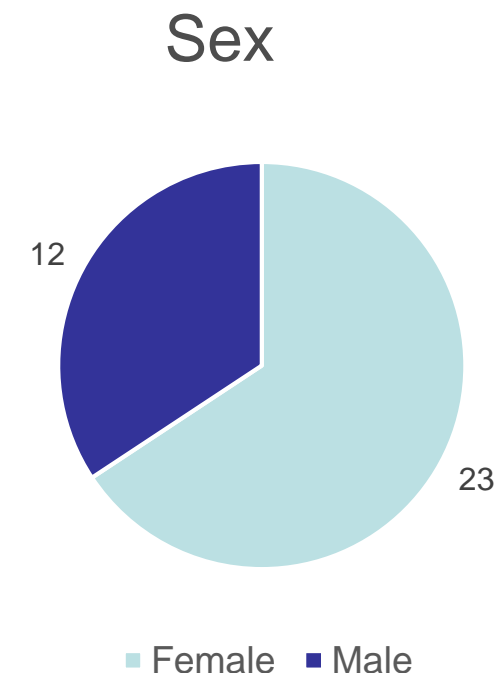
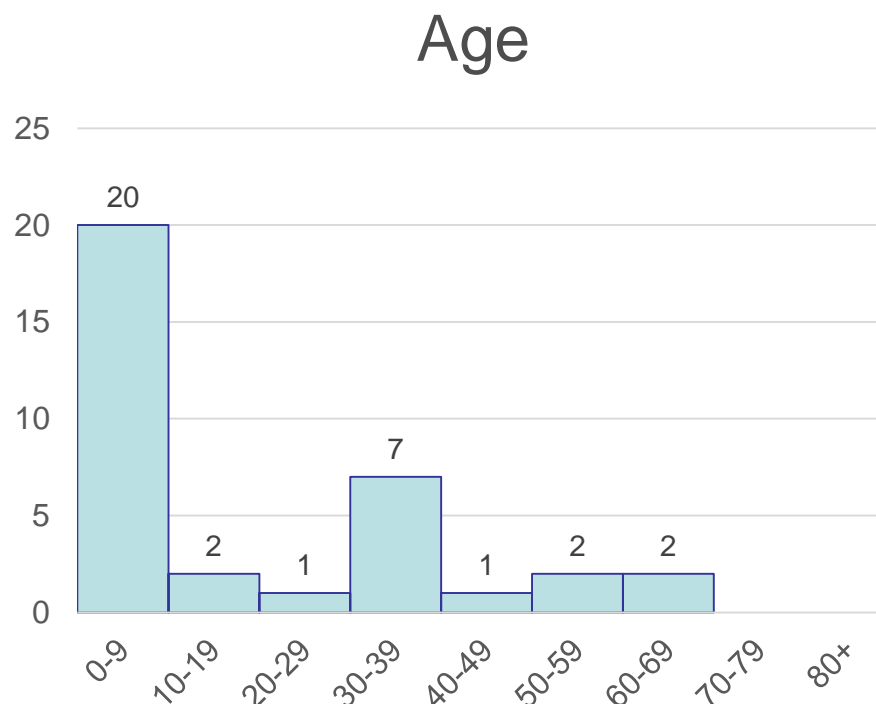
Our baby goats love visitors & are
available for snuggling in March
& April every year!

Case Investigations

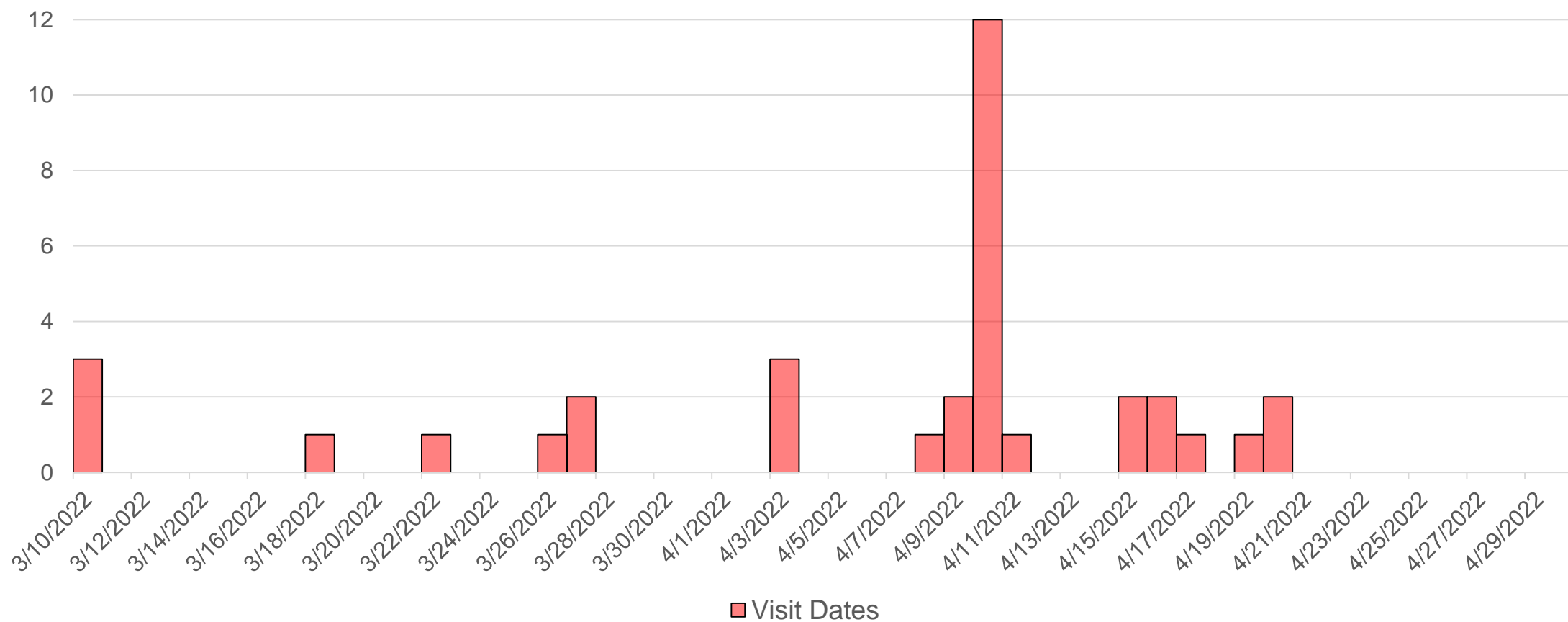
35 Cases Identified (7 confirmed, 28 probable)

Outcomes

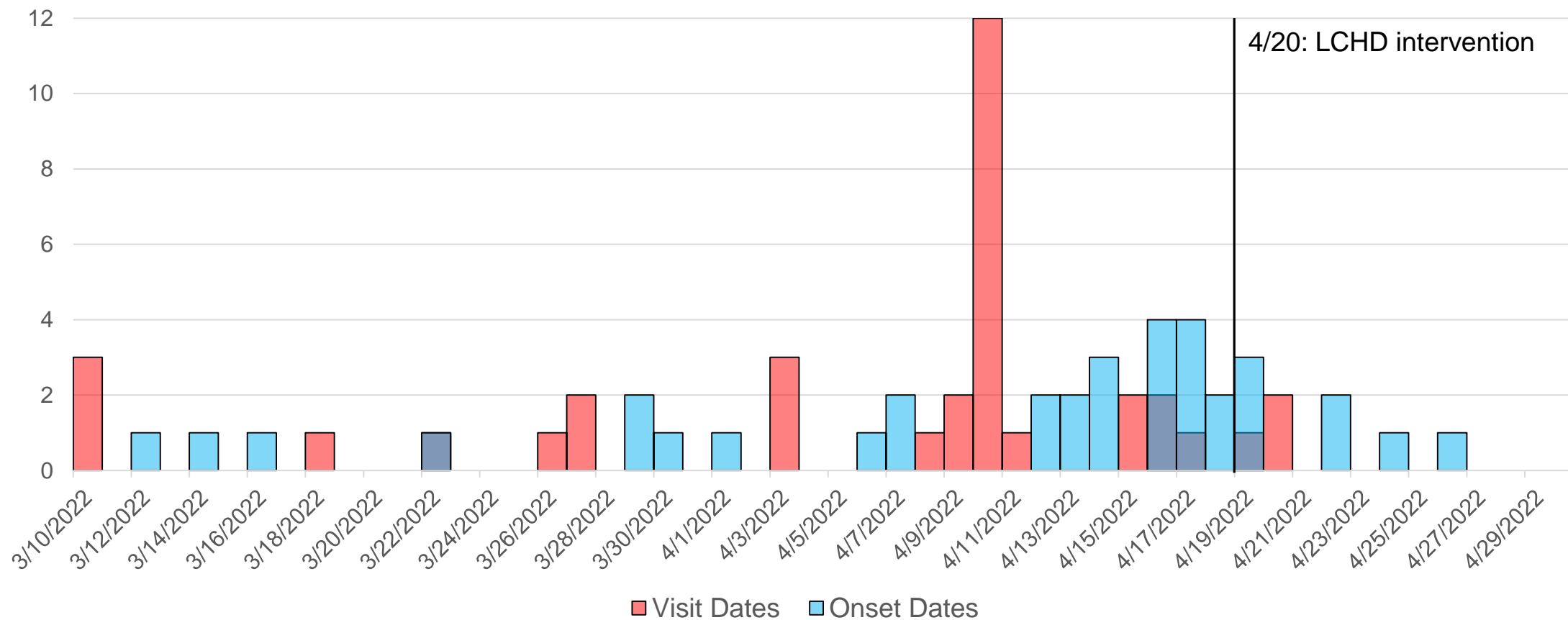
Symptoms	Number
Diarrhea	35
Fever	13
Bloody Diarrhea	7
Hospitalized	2
HUS	1



Timeline: Farm Visit Dates



Timeline: farm visit dates and onset dates



Site Visit Observations

- Goat pen immediately adjacent to farm store where food is consumed
- Hand washing stations not ideal for small children
- Very young goats are brought into the pen where the public can interact with them
- Straw bedding was clean and dry on top, but deeper layers were soaked in urine and feces.



Lab Results - Multi-strain Outbreak

- Human specimens – 7 sent to DCLS for culture, typing, and WGS
 - O103:H2 – isolated from 2 specimens
 - O111:H8 – isolated from 5 specimens
- Pooled goat specimens – 9 sent to DCLS for culture, typing and WGS
 - O103:H2 isolated from 3 pooled specimens
 - O111:H8 isolated from 5 pooled specimens
 - 2 pooled specimens provided isolates of both O103:H2 and O111:H8
- Cultures were not obtained from environmental samples

Lab Results - WGS Comparison

<i>O103:H2</i>	Case 4	Goat Pool 7a	Goat Pool 3a	Goat Pool 3b	Goat Pool 3c	Case 2	Goat Pool 8a	<i>O111:H8</i>	Case 1	Case 3	Case 5	Case 6	Goat Pool 4a	Goat Pool 7b	Goat Pool 7c	Goat Pool 4b	Goat Pool 6	Goat Pool 8b	Case 7	Goat Pool 5
<i>O103:H2</i>																				
Case 4	0	0	0	0	0	1	1		1718	1724	1730	1732	1719	1731	1724	1727	1721	1723	1727	1724
Goat Pool 7a	0	0	0	0	0	1	1		1722	1726	1733	1735	1722	1735	1725	1731	1721	1724	1730	1724
Goat Pool 3a	0	0	0	0	0	1	1		1712	1715	1722	1723	1711	1724	1715	1721	1713	1715	1719	1713
Goat Pool 3b	0	0	0	0	0	1	1		1716	1720	1726	1730	1716	1729	1722	1725	1717	1720	1725	1721
Goat Pool 3c	0	0	0	0	0	1	1		1708	1713	1721	1722	1709	1720	1712	1720	1710	1713	1718	1712
Case 2	1	1	1	1	1	0	2		1716	1721	1728	1728	1716	1728	1719	1725	1718	1720	1725	1718
Goat Pool 8a	1	1	1	1	1	2	0		1711	1719	1722	1724	1713	1723	1717	1722	1712	1715	1720	1716
<i>O111:H8</i>																				
Case 1	1718	1722	1712	1716	1708	1716	1711		0	0	0	0	0	0	0	0	0	0	1	1
Case 3	1724	1726	1715	1720	1713	1721	1719		0	0	0	0	0	0	0	0	0	0	1	1
Case 5	1730	1733	1722	1726	1721	1728	1722		0	0	0	0	0	0	0	0	0	0	1	1
Case 6	1732	1735	1723	1730	1722	1728	1724		0	0	0	0	0	0	0	0	0	0	1	1
Goat Pool 4a	1719	1722	1711	1716	1709	1716	1713		0	0	0	0	0	0	0	0	0	0	1	1
Goat Pool 7b	1731	1735	1724	1729	1720	1728	1723		0	0	0	0	0	0	0	0	0	0	1	1
Goat Pool 7c	1724	1725	1715	1722	1712	1719	1717		0	0	0	0	0	0	0	0	0	0	1	1
Goat Pool 4b	1727	1731	1721	1725	1720	1725	1722		0	0	0	0	0	0	0	0	0	0	1	1
Goat Pool 6	1721	1721	1713	1717	1710	1718	1712		0	0	0	0	0	0	0	0	0	0	1	1
Goat Pool 8b	1723	1724	1715	1720	1713	1720	1715		0	0	0	0	0	0	0	0	0	0	1	1
Case 7	1727	1730	1719	1725	1718	1725	1720		1	1	1	1	1	1	1	1	1	1	0	2
Goat Pool 5	1724	1724	1713	1721	1712	1718	1716		1	1	1	1	1	1	1	1	1	1	2	0

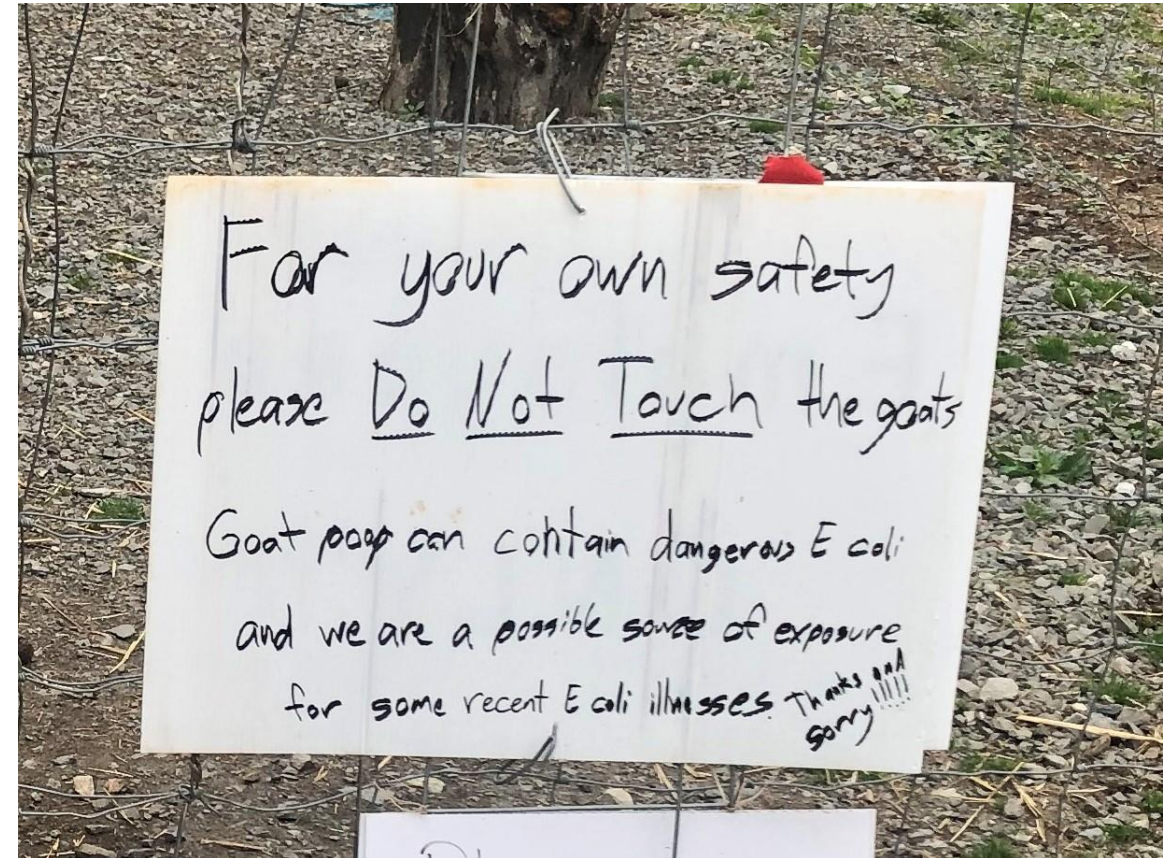
Conclusions

- **Etiology:** STEC O103:H2 and O111:H8
- **Route of transmission:** animal to human through contact with baby goats and surroundings at Farm X
- **Risk Factors (based on lit review/observations):**
 - Very young, ill goats in public display pen
 - Pack bedding in barn allowing for build-up of STE environment
 - Handwashing station at farm not adequate for children
 - Signage/education to customers not adequate



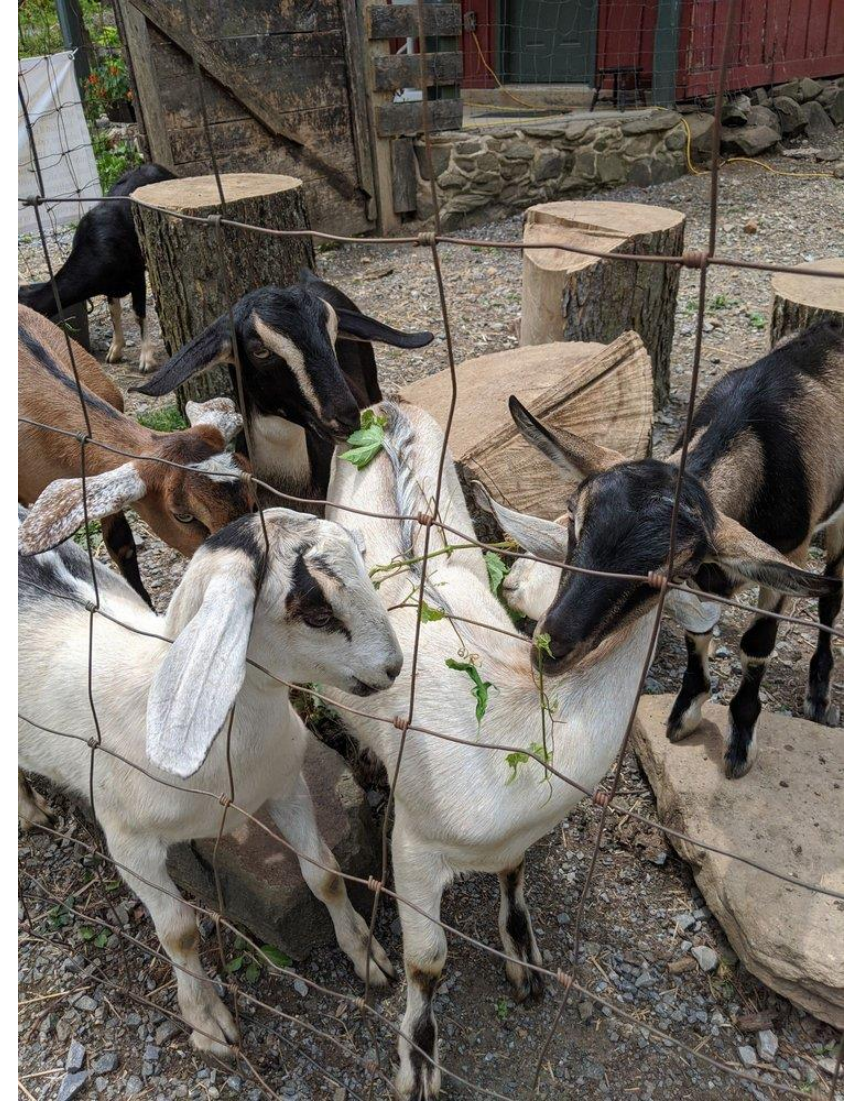
Control Measures/Recommendations

- **Control Measures:** Farm advised to suspend public interactions with baby goats on 4/20/2022
- **Recommendations/Best Practices:**
 - Do not put goats in public pen until stools fully formed
 - Remove ill goats from public pen
 - Provide child friendly handwashing facilities
 - Provide clear signage and education to public (educational materials from VDACS provided to farm)



Limitations

- Continued animal interactions through fence led to additional cases after public interactions were suspended by farm owner
- Risk factor analysis did not show significant results
- Environmental specimens did not yield cultures



Acknowledgements

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Thank you!

