

# Tennessee Fair and Animal Exhibition Safety: Reducing Disease Risks for Visitors

*Workshop sponsored by*



Department of Agriculture  
Ellington Agricultural Center  
Nashville, TN 37204  
615.837.5103

**UT** | **Extension**



*It's About Time!*

# Tennessee Fair and Animal Exhibition Safety: Reducing Disease Risks for Visitors

## *Overview of Zoonotic Diseases*



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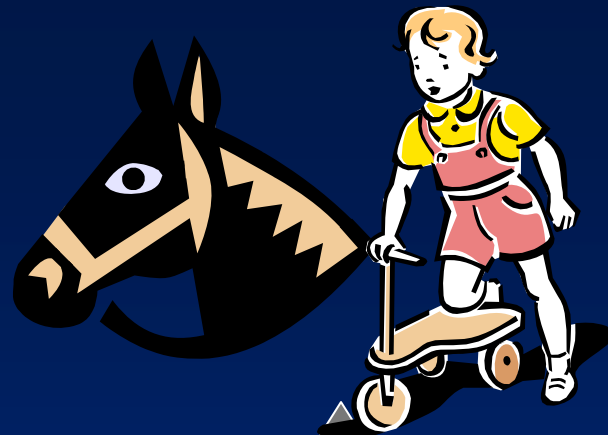
# Overview

- **Introduction to zoonotic diseases**
- **Factors and features in emergence of zoonoses**
- **Examples of recent zoonotic disease outbreaks**
- **Recent fair associated outbreaks**

# Zoonotic Diseases

- **Zoonoses: “Those diseases and infections which are naturally transmitted between vertebrate animals and man.”**

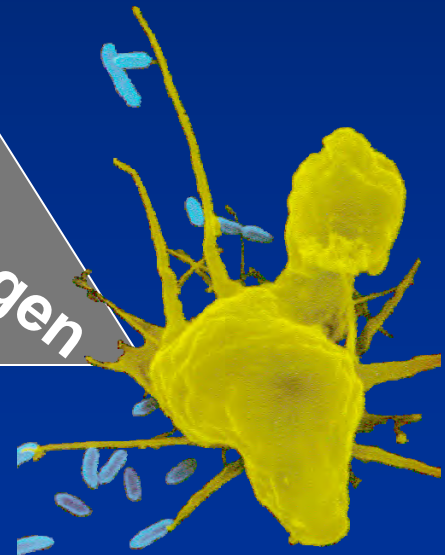
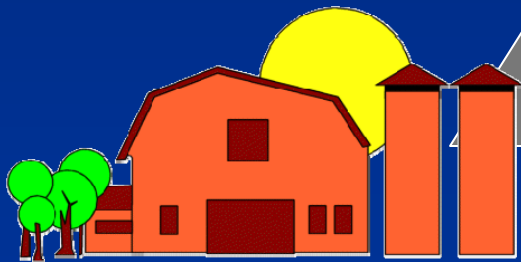
*Ref: The Emergence of Zoonotic Diseases, Workshop Summary. Institute of Medicine report, National Academy Press, 2002*



Host

Environment

Pathogen



# Zoonotic Diseases: Old News

- 10,000 years ago, plagues on Egypt?
- New social order due to agriculture
  - Animal domestication
  - Increases in zoonotic infectious diseases
  - Epidemics



# **“Emerging” Zoonotic Diseases**

- **Emerging zoonoses may include**
  - **Old diseases, new hosts**
  - **Old diseases, new areas**
  - **New diseases**

# Emerging Zoonoses

- 1415 species of infectious agents reported to cause disease in humans
  - Viruses, prions, bacteria, rickettsia, fungi, protozoa, helminths
- 868 (61%) are known to be zoonotic
- 175 species considered “emerging”
- 132 (75%) are known to be zoonotic

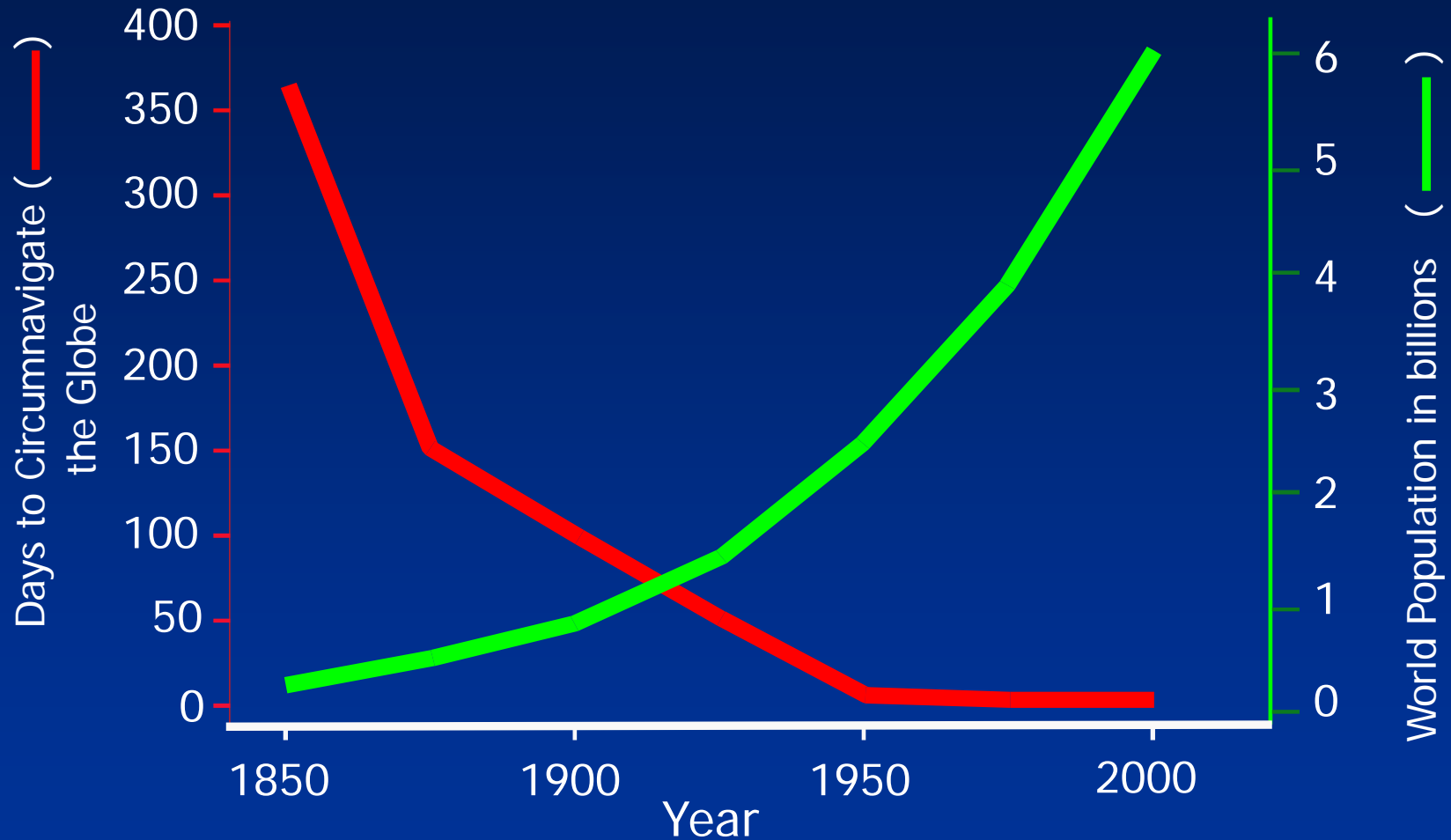
*Taylor et al. Risk factors for disease emergence. 2001, Philosophical Transactions, The Royal Society, London*



# Factors in Emergence

- **Microbial adaptation and change**
- **Host susceptibility to infection**
- **Climate and weather**
- **Changing ecosystems**
- **Economic development and land use**
- **Technology and industry**
- **International travel and commerce**

# Speed of Global Travel in Relation to World Population Growth



From: Murphy and Nathanson. Semin. Virol. 5, 87, 1994

# Commerce- Importation of live animals into the US, 2002

- 38,000 Mammals
  - 28 species of rodents
- 365,000 Birds
- 2 million Reptiles
- 49 million Amphibians
- 216 million Fish



U.S. Fish & Wildlife Service Data

# Recent zoonotic disease outbreaks

# Monkeypox

- Orthopoxvirus, related to smallpox
- Restricted to Africa (West Africa, Dem. Rep. Congo)
- Zoonotic disease
  - Wildlife reservoir unknown
  - Antibodies to virus found in rodents
  - Primates and humans accidental hosts
- Clinically resembles smallpox
  - Vesicular rash
  - Case fatality < 15%
  - Lymphadenopathy
  - Limited potential for human-to-human spread



# 2003 Monkeypox Outbreak Characteristics

- 47 human cases in 5 states
- All cases reported contact with sick prairie dogs
- No clear person-to-person spread
- High hospitalization rate for quarantine/infection control issues
- **Over 25% of cases occurred in veterinary staff**
- First outbreak of monkeypox in humans outside Africa

# Skin Lesions, Index Case (3 year old child)

Marshfield Clinic, WI



*NEJM Reed KD et al. 2004, 350:342-50*



## Wisconsin Animal Dealer, Primary lesion



*NEJM Reed KD et al. 2004, 350:342-50*

# Prairie Dogs (*Cynomys* sp.)



White-tailed prairie dog  
*C. leucurus*



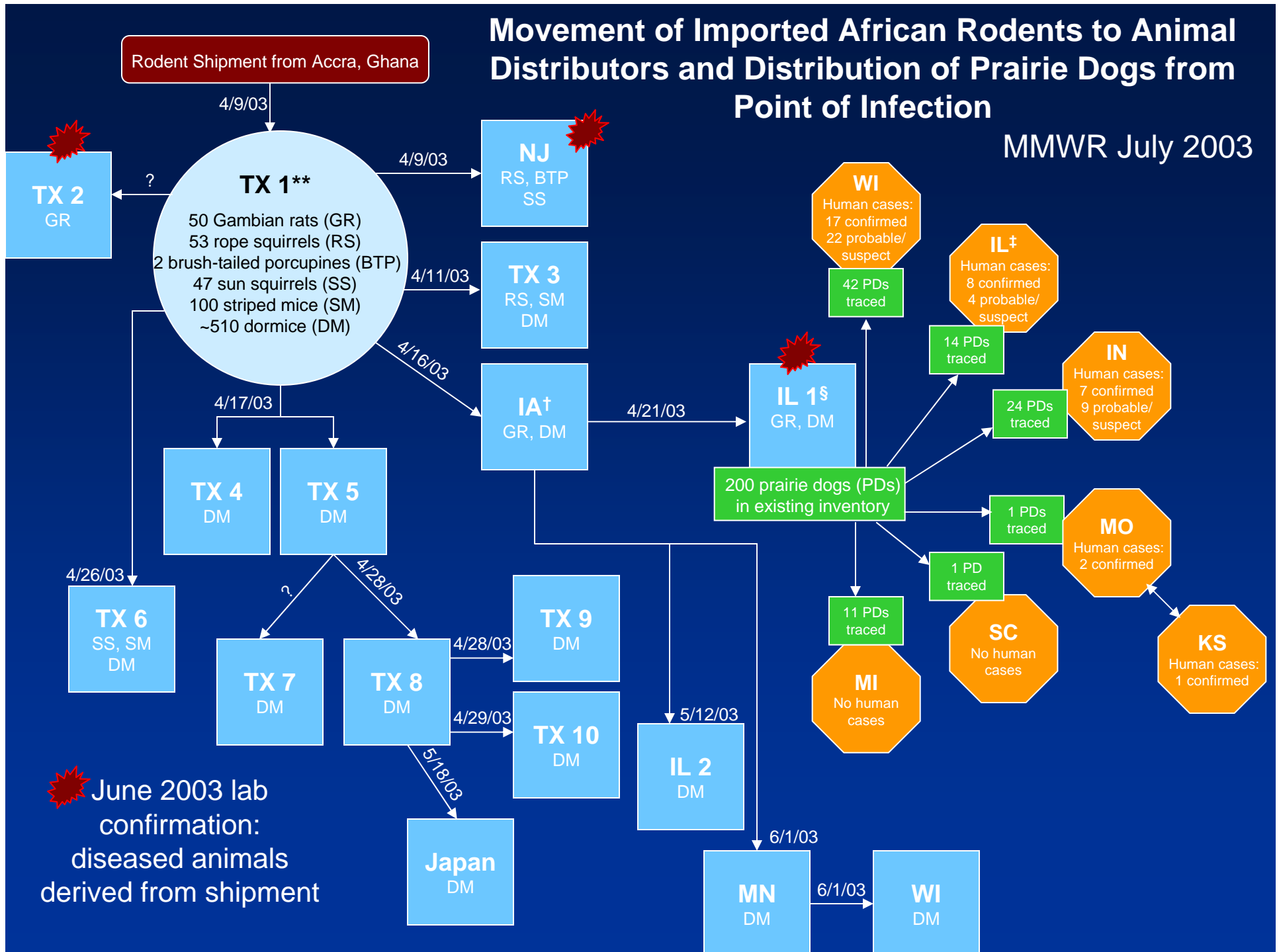
Utah prairie dog  
*C. pavidens*

# Animal Traceback

- All sick prairie dogs were traced to an IL dealer
- IL dealer had African rodents (Gambian rats and dormice) on the premises
- Traced movements of all prairie dogs and African rodents
- Tracing capabilities limited
  - Cash sales, often no record
  - Trade at swap meets- widespread distribution
  - Dealer recall limited
  - Exposure without ownership (petting, etc)

# Movement of Imported African Rodents to Animal Distributors and Distribution of Prairie Dogs from Point of Infection

MMWR July 2003



# Monkeypox Outbreak: Why?

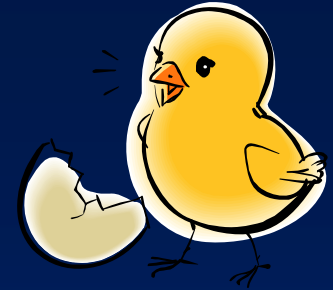
- **Unrestricted importation of animals from Africa**
  - **Wild-caught animals with unknown history**
- **Rapid movement of animals in the exotic pet trade.**
  - **Not regulated by federal statutes**
  - **No requirements to maintain records**
- **Human and Veterinary medicine not familiar with monkeypox**
  - **Did not recognize lesions as smallpox-like**
  - **Delayed reporting of “unusual” illness to state authorities**

# *Salmonella*



- *Salmonella enterica* – bacterial
- Fecal-oral transmission
- Emergence of **antibiotic-resistant strains / outbreaks**
  - Reptile-associated salmonellosis
  - Chick-associated salmonellosis
  - Feline-associated salmonellosis **(AR)**
  - Equine-associated salmonellosis **(AR)**
  - Rodent-associated salmonellosis **(AR)**

# Chicks and Ducklings (*Salmonella*)



- 1999 Michigan (21 cases) and Missouri (40 cases)
  - 6 hospitalizations
- Direct or indirect contact with young fowl
  - Holding, nuzzling, cleaning up feces in home
- Children were the majority of those infected
  - Frequent hand-to-mouth contact and do not practice good hand hygiene

Outbreak of Multidrug-Resistant  
Salmonella Typhimurium Associated  
with Rodents Purchased at Retail Pet  
Stores – United States, December  
2003-October 2004

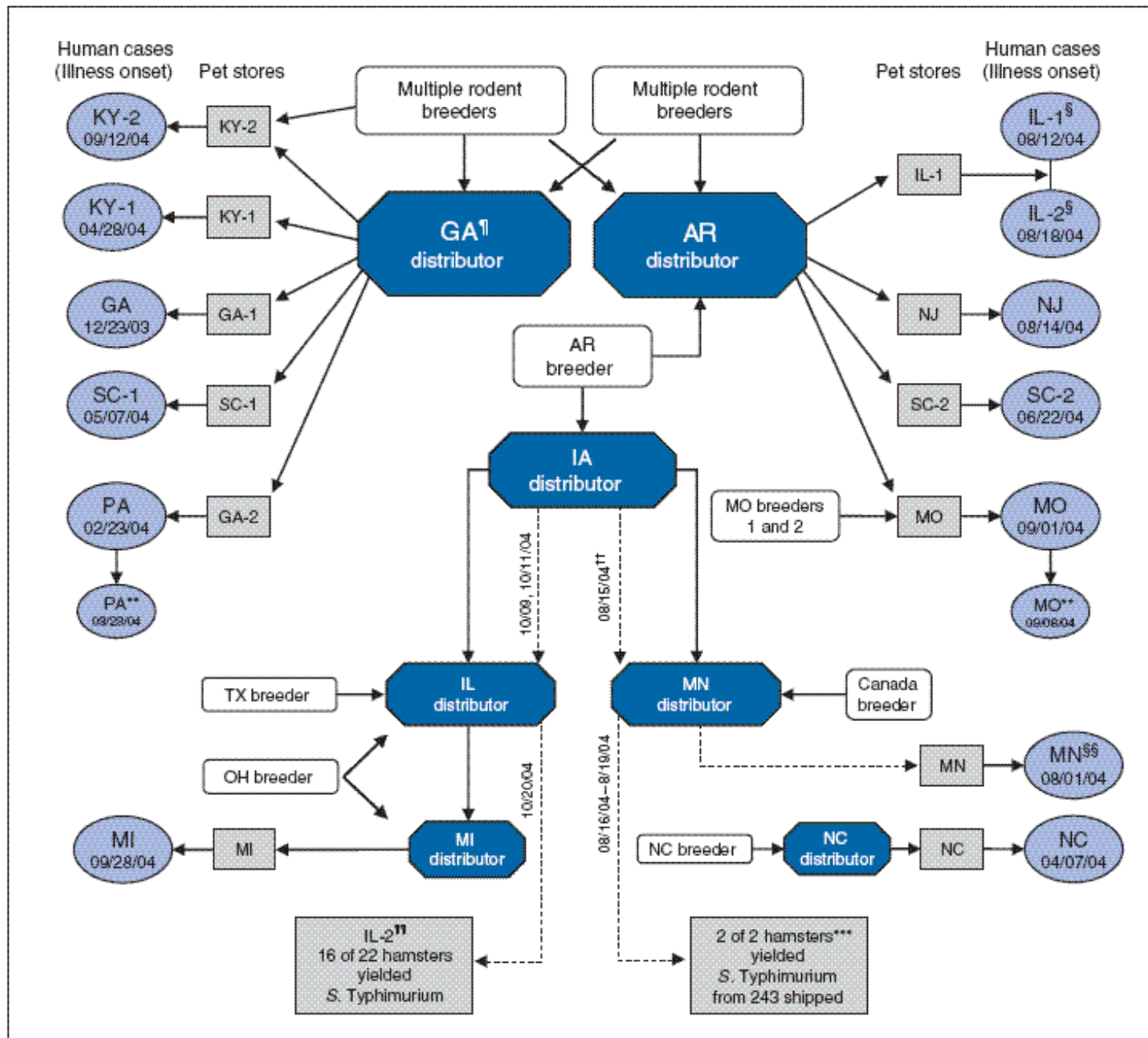




# Overview-- Hamsters

- 28 cases from 19 states, sick hamsters
- First documented salmonellosis outbreak associated with pet rodents, **Antibiotic-resistant strains**
- *S. Typhimurium* from a common source, rodents widely distributed
- Recovery of *S. Typhimurium* from reusable transport containers, cages, and bins contaminated with rodent droppings

FIGURE. Traceback results for pet rodents associated with an outbreak of multidrug-resistant *Salmonella* serotype Typhimurium — 10 states\*, December 2003–October 2004†



# ***Salmonella* – Pennsylvania, 2004**

- **Salmonellosis outbreak in horses**
- **Bacteria was highly resistant to antibiotics**
- **Significant mortality associated with infection**





# Salmonella Advisory from New Bolton Center

## Multi-Drug-Resistant *Salmonella* Newport and Your Horse

In the past decade, multi-drug-resistant strains of *Salmonella* have emerged throughout the world, including the United States, infecting both humans and animals. A new strain, *Salmonella* Newport serogroup C2, is spreading rapidly among dairy farms throughout the United States and southern Canada. Horses are the second most commonly affected species. MDR *S. Newport* recently has been isolated from horse farms in Pennsylvania and New Jersey, and a multi-drug-resistant form of *Salmonella* likely is also present in Kentucky. The *Salmonella* organism frequently is present in seemingly healthy horses, but stress can cause the infection to become active.

Because of the risks MDR *S. Newport* poses for horses, New Bolton Center provides the following pertinent information:

- *Salmonella* is spread by contact with feces or through contaminated food. Humans, horses, livestock, companion animals, and rodents are susceptible to most types of *Salmonella* infection. They can also act as carriers.



For More Information Contact:  
George D. Widener Hospital for Large Animals  
New Bolton Center  
382 West Street Road  
Kennett Square, PA 19348  
For appointments and  
New Bolton Center's 24-hour Emergency Service  
610-444-5800  
[www.vet.upenn.edu/widener](http://www.vet.upenn.edu/widener)

- *Salmonella* can cause any or all of the following: diarrhea, depression, loss of appetite, fever, and colic. Foals are especially vulnerable. If your horse exhibits any of these symptoms, contact a veterinarian immediately.
- MDR *Salmonella* Newport is shed in feces, saliva, and milk of clinically ill animals. It may also be shed through the same routes by apparently healthy animals.
- MDR *Salmonella* Newport can persist in the soil for at least one year. Once introduced on premises, it is very difficult to remove.

## How to protect horses from becoming infected with *Salmonella*

- *Salmonella* can be introduced to premises on the shoes or contaminated clothing of people. Change your shoes and clothing before entering your stables when returning from horse events or other farms. Limit visitor access.
- Attempt to isolate new horses and those returning from events or other farms from those in the stable for up to two weeks. Because of the tremendous movement of horses, considerable risk exists for spread of the disease.
- Place a foot dip containing disinfectant in front of the isolation stall (a plastic container at least large enough for one foot at a time). Have every one dip their feet as they enter and leave the stall. Change disinfectant daily or sooner if it becomes dirty. Disinfectants will not work if high levels of shavings, straw, dirt, or feces are present. Disinfectants can be purchased from a veterinary supply store; be sure they are intended for killing *Salmonella*, and follow the directions for mixing, disposal, and precautions.
- When feeding and cleaning, attend to isolated animals last, then change and wash clothing. Use boots that can be thoroughly washed. Do not mix feed or water buckets.

- Thoroughly clean the walls and surfaces within the horse's environment with detergent, such as Tide. Diluted bleach (2 oz. per 1 gallon of water) then can be poured over or mopped onto surfaces, allowed to sit, and rinsed off an hour later. This cleaning procedure can be done on trailers as well.
- Wash hands before and after leaving the isolated animals. Alcohol-based hand rubs also are effective and can be placed outside individual stalls.

## Suggestions for isolation of a horse infected with *Salmonella*

New Bolton Center veterinarians recommend the following procedures to limit contamination. After your horse has been diagnosed with *Salmonella*, follow your veterinarian's instructions. As facilities tend to vary considerably, you should work with your veterinarian to devise a specific customized plan. Remember that anything the horse touches is potentially contaminated. This includes all surfaces of the stall, the waterers, the feeders, and the ground.

- Wear gloves and wash hands thoroughly after handling your horse or anything that has been in contact with your horse.
- Wear separate clothing and shoes when handling your horse or cleaning its stall. This clothing should not be worn when handling any other horses on the property and should be washed separately.
- Provide a plastic bag for separate disposal of your latex gloves and any materials used in treatment of your horse. Feces, used bedding, and uneaten feed should be collected separately and not placed on pastures or hay fields for fertilization or allowed to drain into any water system.

Feces should be removed as often as possible to minimize contamination of soil and noncleanable surfaces in the stall (2-3 times daily is adequate). Proper composting, burning, and burying are ideal disposal methods for feces, bedding, and feed.

- Provide a foot dip with disinfectant in front of your horse's stall.

Your veterinarian will prescribe a schedule of fecal sample collection and testing to monitor the animal's recovery. Once your horse is negative, we recommend removing it from the isolated area, cleaning and disinfecting that area as described above, and leaving the area empty for at least four weeks before reintroducing animals.

## How to protect yourself from infection

MDR *Salmonella* Newport infections in humans have increased sharply over recent years. Hygiene is the single most important way to protect yourself against becoming contaminated with *Salmonella*.

Hand washing before and after contact with all animals is vital. If you are potentially exposed to the organism, here is what you need to know:

- Typical symptoms of *Salmonella* infection usually occur between 6 and 48 hours after exposure and include nausea, vomiting, abdominal cramps, diarrhea, fever, and headache—with fever and diarrhea being the most prominent. Always consult a physician if you experience any of these symptoms.
- Children, the elderly, pregnant women, and anyone with compromised immune function are most vulnerable to more serious disease.

The principles of hygiene, limiting contamination, and general good husbandry practices laid out above are applicable to all species and would also be effective in controlling salmonellae other than MDR *S. Newport* and similar organisms.

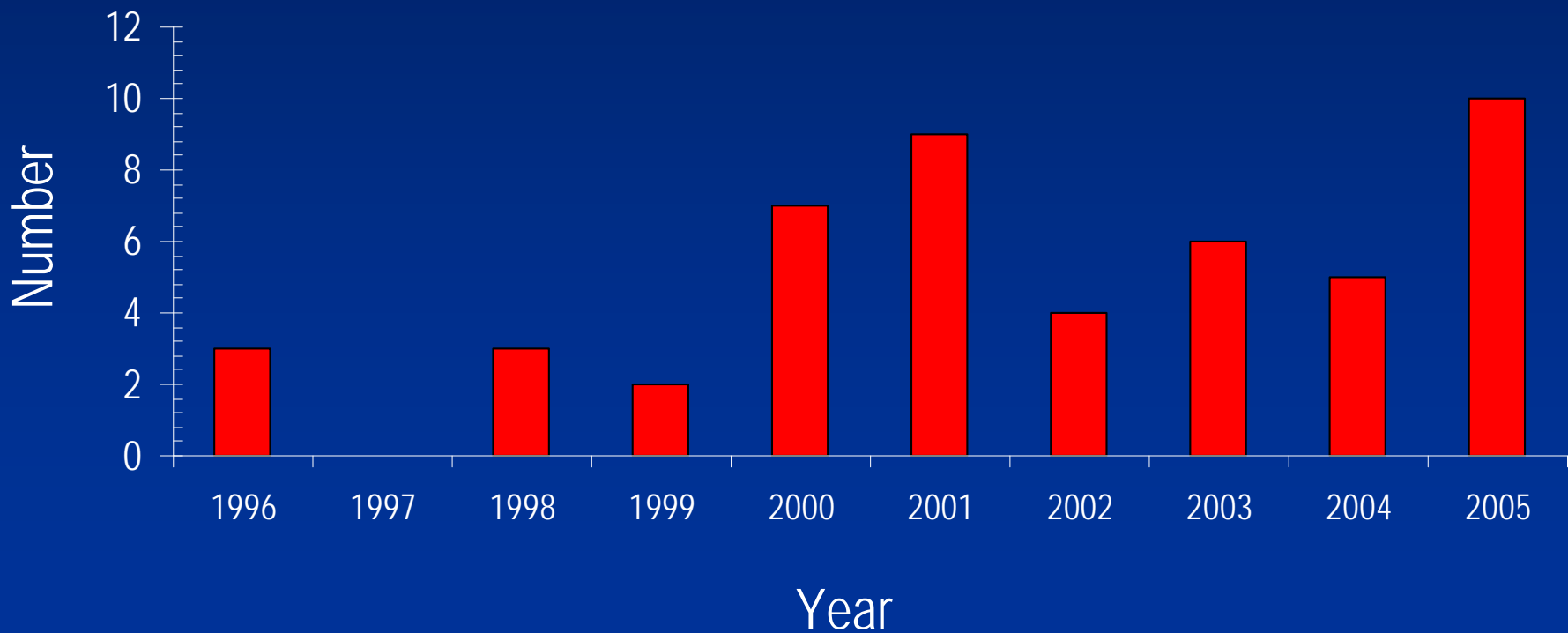
<http://www.vet.upenn.edu/newsandevents/news/salmonellaadvisory.pdf>

**Disease outbreaks  
associated with fairs and  
animal exhibits**

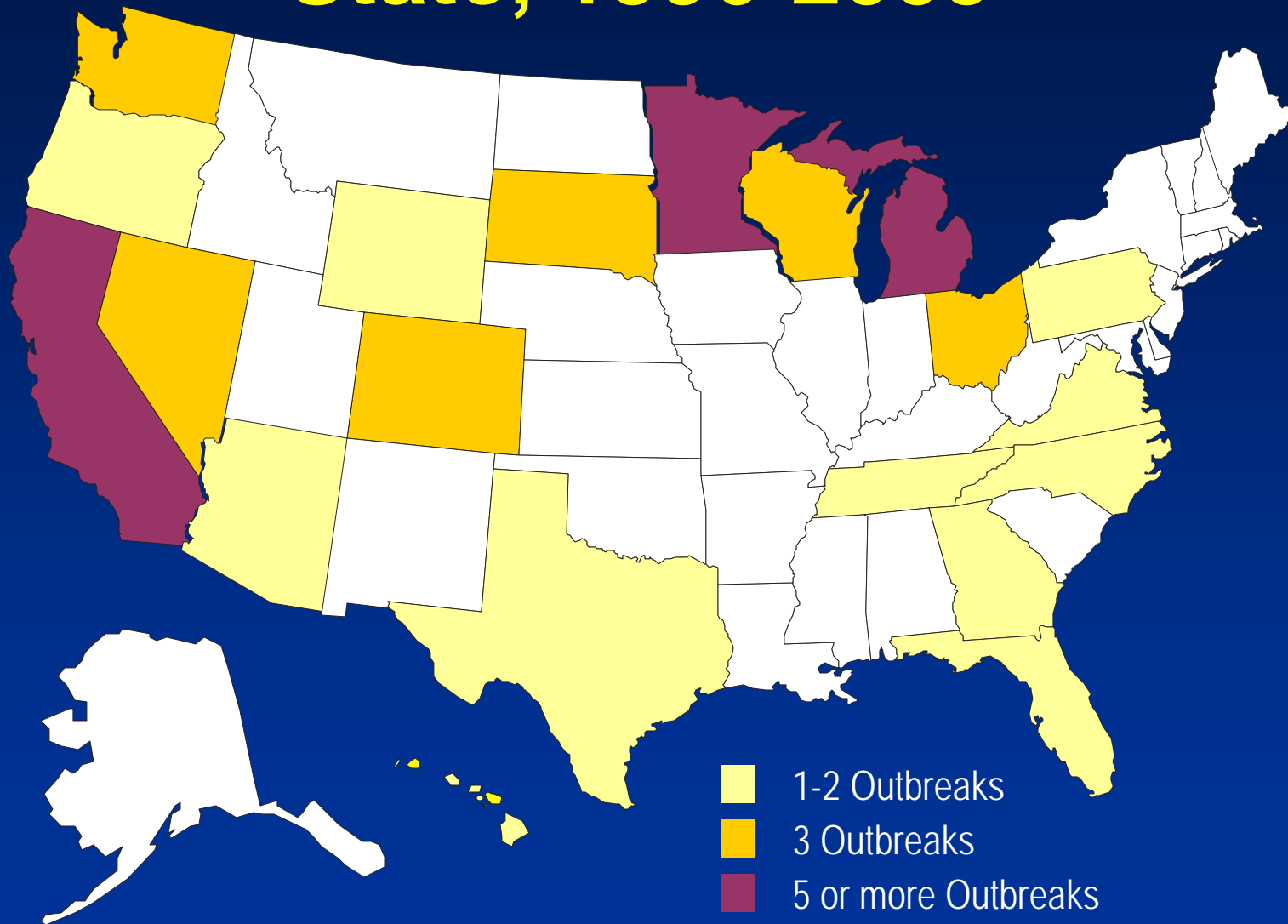
# Outbreaks associated with animal exhibits

- **Bender *et al*** JAVMA, April 1, 2004,
  - Summarized outbreaks: 1995 – 2000
  - 10 published outbreaks, State public health veterinarian survey: 16 additional outbreaks
  - Enteric pathogens: *E. coli* O157, *Salmonella*, *Campylobacter*
  - Animal species: Cattle, Sheep, Goats
- **CDC review**: 54 disease outbreaks identified in the United States from 1996-2005

# Number of Disease Outbreaks Associated with Animals in Public Settings by Year in the United States, 1996 - 2005

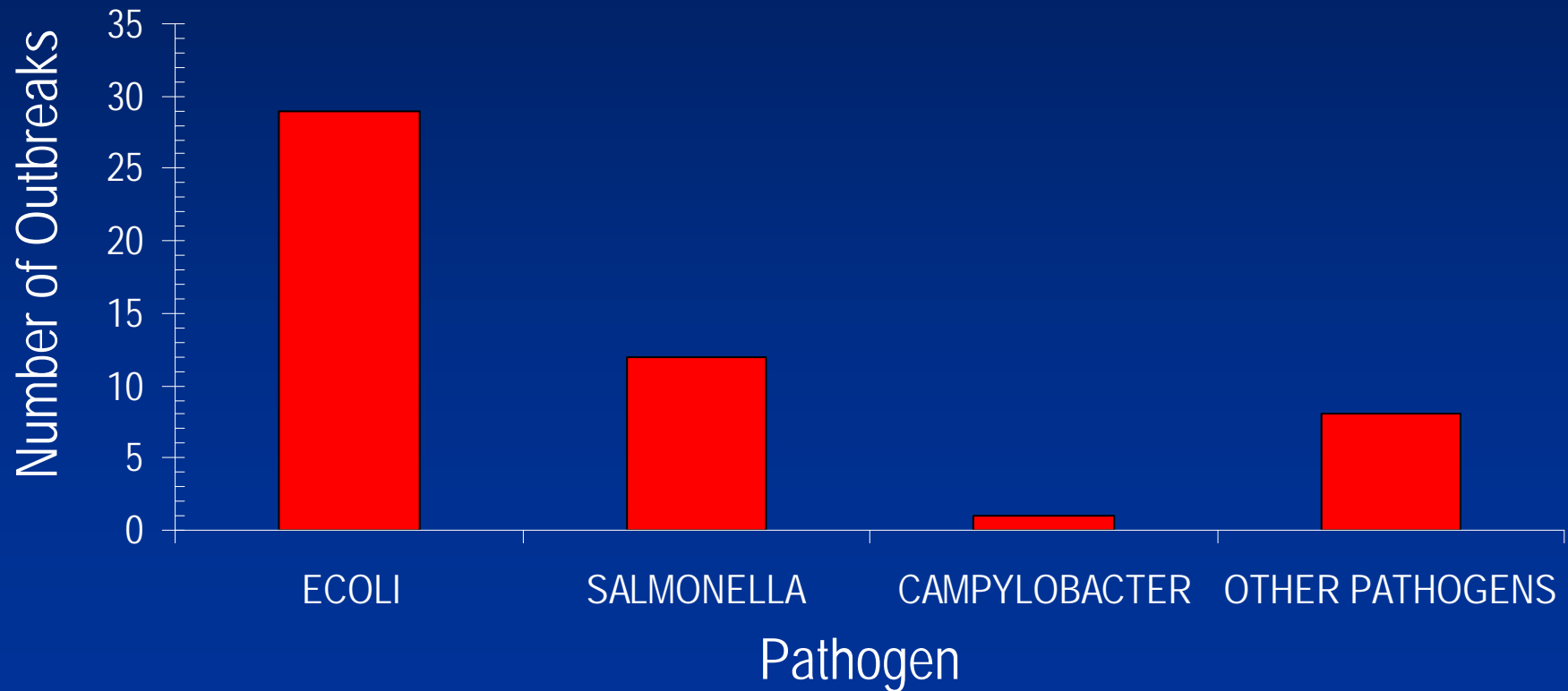


# Number of Outbreaks (n=54) by State, 1996-2005





# Total Number of Outbreaks by Pathogen in the United States, 1996-2005



**How common are *E. coli* O157  
and *Salmonella* at fairs?**

RESEARCH

# **Shiga-toxigenic *Escherichia coli* O157 in Agricultural Fair Livestock, United States**

James E. Keen,\* Thomas E. Wittum,† John R. Dunn,‡ James L. Bono,\* and Lisa M. Durso\*

**Emerging Infectious Diseases •  
[www.cdc.gov/eid](http://www.cdc.gov/eid) • Vol. 12, No. 5, May 2006**

- **USDA State & county fair survey, Summer 2002**
- **Goal: estimate the prevalence of enteric pathogens in livestock at fairs**

# Various species sampled



Cattle



Swine



Sheep



Goats



Other livestock



Pest flies

# ***E. coli* O157 & *Salmonella* prevalence**

## ***Salmonella:***

- 29 (91%) of 32 fairs
- 558/2914 = 19.1% of livestock

## ***E. coli* O157:**

- 31 (96.9%) of 32 fairs
- 233/2914 = 8.0% of livestock
  - 11.4% of 1,407 cattle
  - 1.2% of 1,102 swine
  - 3.6% of 364 sheep / goats
  - 5.2% of 154 fly pools

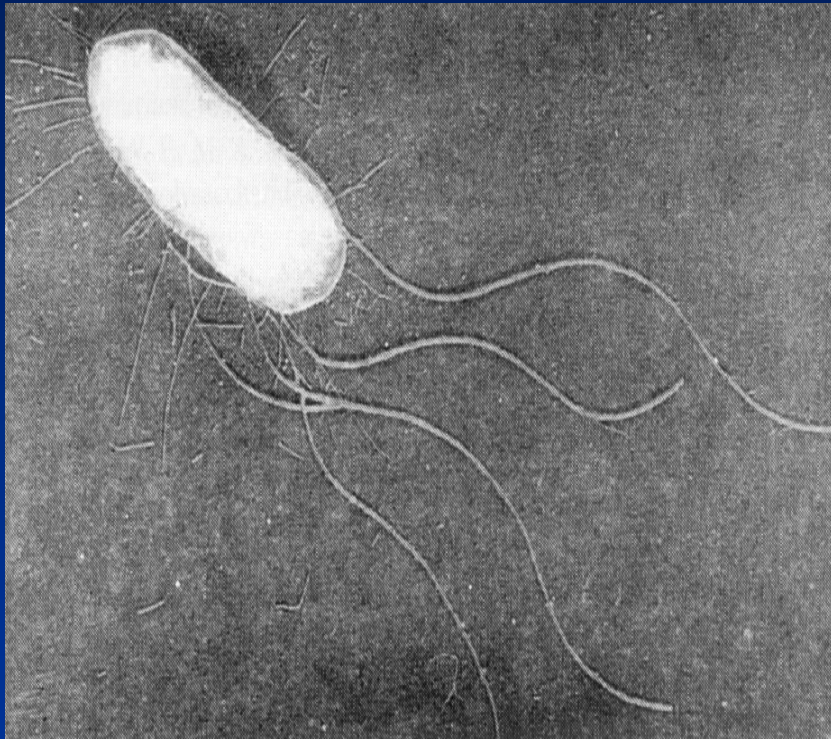


# Summary: USDA Study, 2002

- **No way to predict fecal positive animals without laboratory testing**
- **Transmission may occur between species, flies**
- **Pathogens persist in the environment**
- **Common at fairs!!**



# ***E. coli* O157: important human pathogen**



- Diarrhea
- Hemorrhagic colitis
- Hemolytic Uremic Syndrome (HUS/TTP), kidney failure in children and elderly

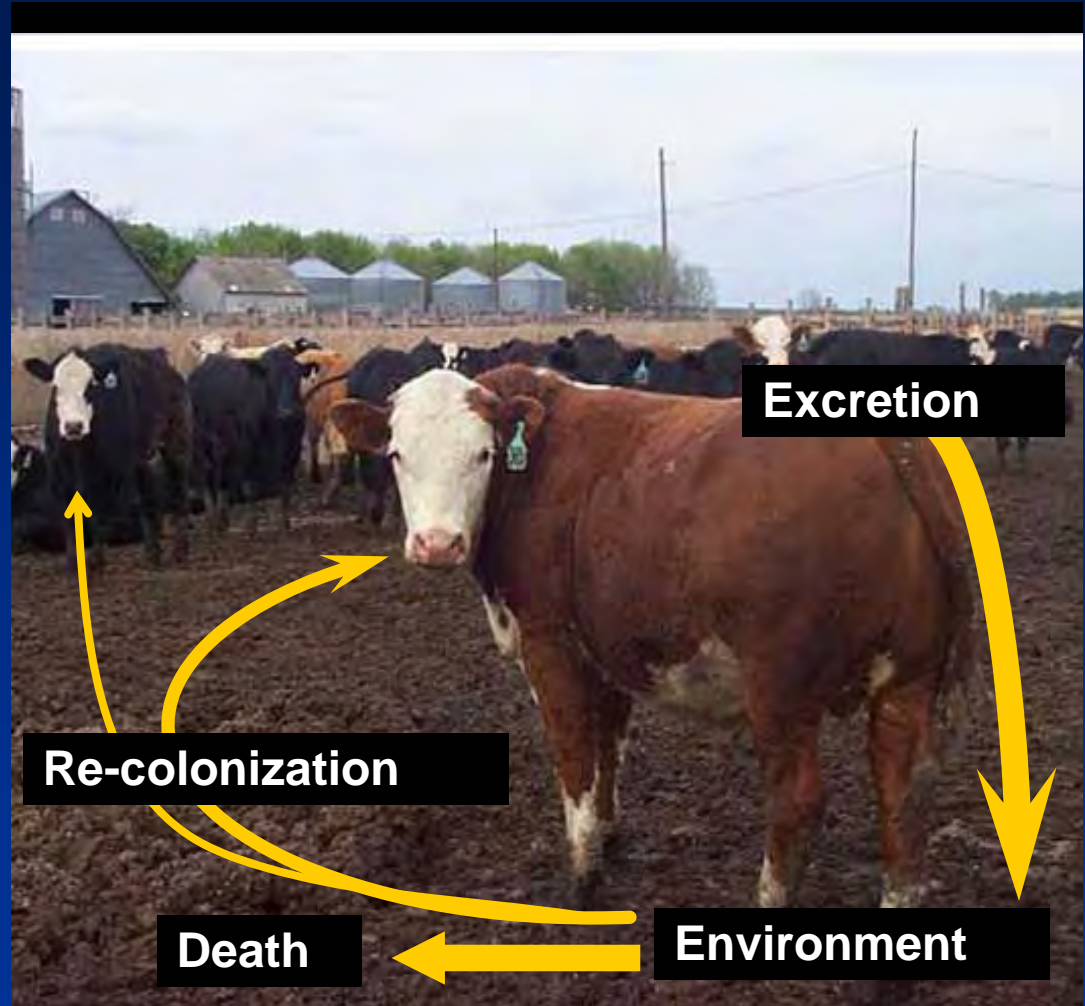
# Two habitat model

## Primary habitat:

- large intestine of ruminants
- warm, constant
- nutrient rich
- vigorous growth

## Secondary habitat:

- Environment (water, soil, sediment)
- cool, fluctuating
- nutrient limiting
- survival





<u>Fair / Petting Zoo Outbreaks</u>	<u>Year</u>	<u># Ill</u>
• Medina county (OH)	2000	27
• Lorain county (OH)	2001	111
• Ozaukee county (WI)	2001	59
• Wyandot county (OH)	2001	88
• Lane county (OR)	2002	60
• Calaveras county (CA)	2002	4
• Fort Bend county (TX)	2003	25
• North Carolina State Fair	2004	108
• Florida (multiple fairs)	2005	63
• Arizona	2005	2
• Others...	2005	



### Outbreaks of *Escherichia coli* O157:H7 Associated with Petting Zoos — North Carolina, Florida, and Arizona, 2004 and 2005

During 2004–2005, three outbreaks of *Escherichia coli* O157:H7 infections occurred among agricultural fair, festival, and petting zoo visitors in North Carolina, Florida, and Arizona. One hundred eight cases, including 15 cases of hemolytic uremic syndrome\* (HUS), were reported in the North Carolina outbreak; 63 cases, including seven HUS cases, were reported in the Florida outbreak; and two cases were reported in Arizona. No fatalities occurred. Illnesses primarily affected children who visited petting zoos at these events. This report summarizes findings from these outbreak investigations, which indicated the need for adequate control measures to reduce zoonotic transmission of *E. coli* O157:H7.

#### North Carolina

On October 29, 2004, the North Carolina Division of Public Health (NCDPH) received a report of a cluster of three HUS cases among children who visited a petting zoo at the North Carolina State Fair (Figure). Approximately 800,000 visitors attended this fair during October 15–24, 2004. The fair had two petting zoos (petting zoos A and B).

NCDPH notified all local health departments to report cases of HUS and other STEC O157 infections. The first case was

FIGURE. A child stands near goats and goat droppings in a petting zoo at the 2004 North Carolina State Fair



Photo/North Carolina Division of Public Health

electrophoresis (PFGE). Twenty patients (19%) were hospitalized, and 15 (14%) had HUS diagnosed.

Systematic environmental sampling of the fairgrounds iden-



# North Carolina State Fair, 2004

- >800,000 visitors between October 15-24, 2004
- Confirmed and probable *E. coli* O157:H7 infections:
  - 108 cases, 15 HUS
  - Median age= 5 years (range 1-61)
- 43 culture-confirmed or HUS
  - Predominant PFGE pattern



- Risk factor study:
  - Attending Petting Zoo B (PZB)
  - Contact with feces / bedding of sheep / goats



# **Environmental investigation at NC state fairground**

- **No animals present 9 days after the fair when study initiated**
- **Goals of Environmental Investigation**
  - **Broadly sample fairgrounds**
  - **Use initial findings to carry out targeted systematic re-sampling**







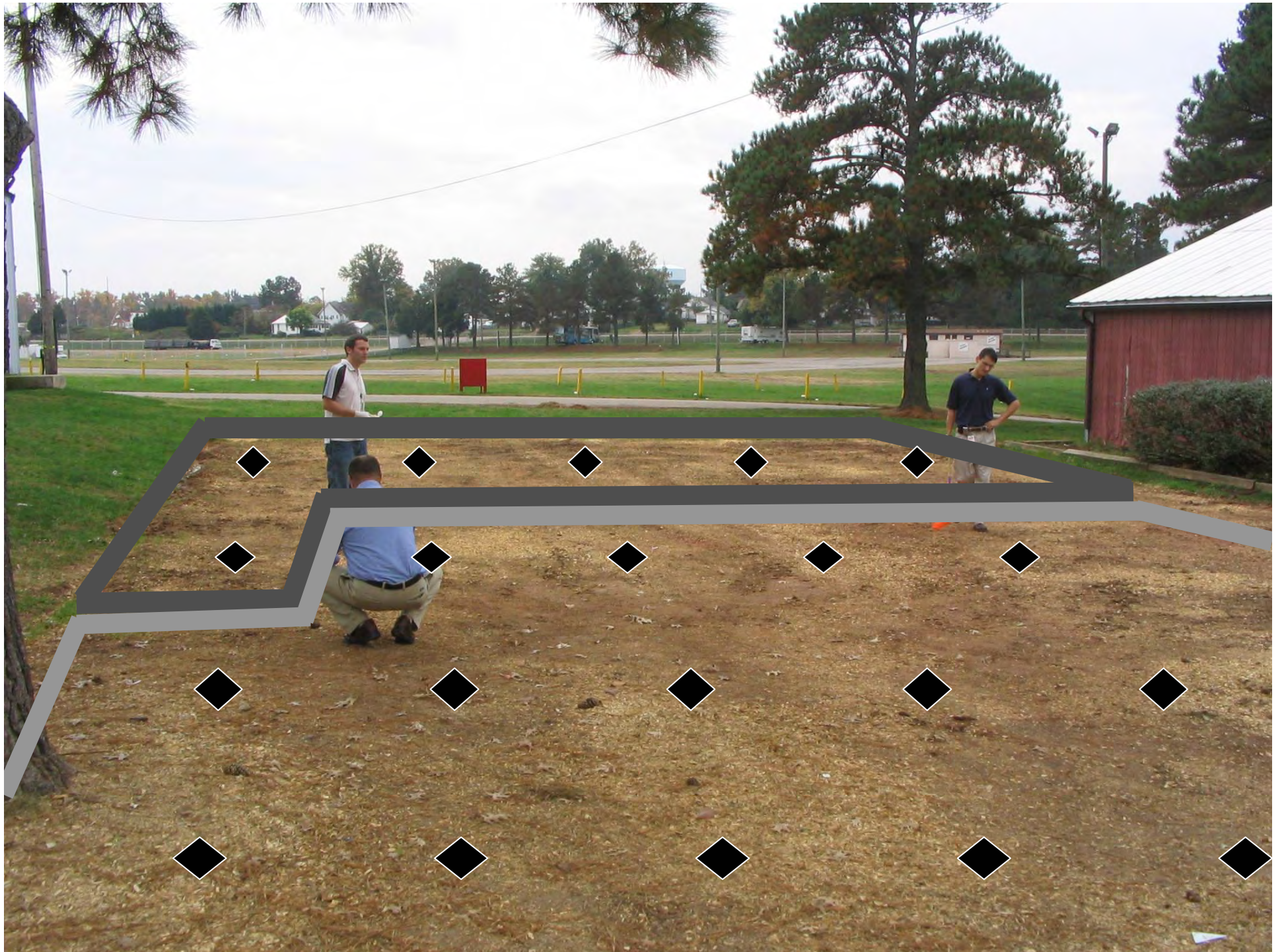
**Petting Zoo B site**

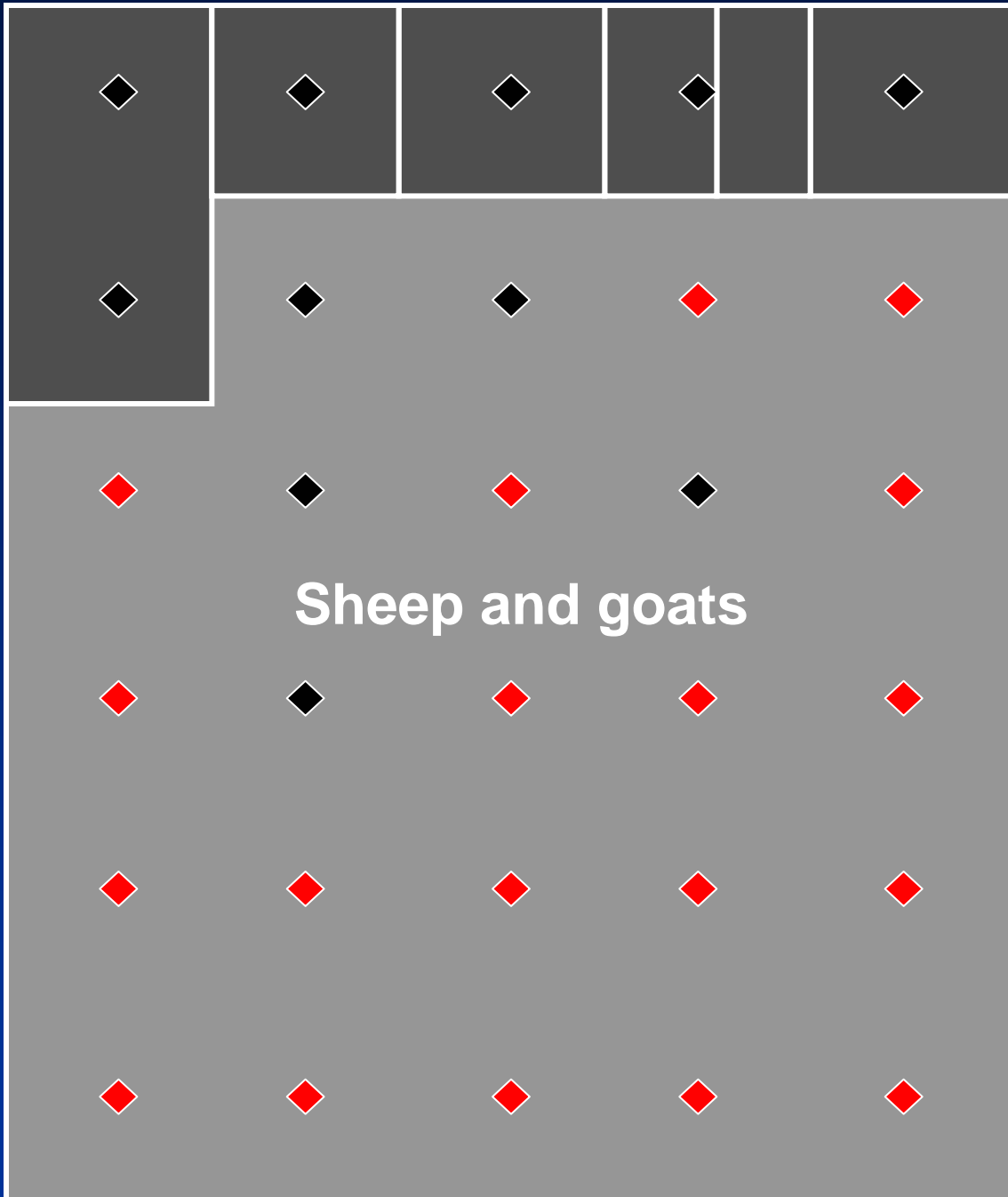


A photograph of an outdoor dirt area, possibly a construction site or a field. Three men are present: one is crouching in the foreground, another is standing to the left, and a third is standing to the right. The ground is covered in brown soil and some dry leaves. In the background, there are trees, a grassy area, and a red building. A grey geometric shape is overlaid on the image, and a grey text box is positioned in the lower right quadrant.

**Sheep and goats**







## Systematic sample of Petting Zoo B

• Soil / shavings sampled 16 days after fair

**Results:** sheep / goat area contaminated with the same subtype of *E. coli* O157

- ◆ *E. coli* O157 positive
- ◆ *E. coli* O157 negative

# Farm Investigation

- Fecal samples sheep / goats / large animals →
  - 12 (60%) of 20 sheep / goat fecals - *E. coli* O157 positive
  - Camel - *E. coli* O157
- Hide swabs - sheep / goats →
  - 0 of 20 hide swabs
- Environmental samples →
  - 10 (63%) of 16 *E. coli* O157 positive

**All 22 isolates indistinguishable from human and fairground subtype**



# Conclusions: NC State Fair

- Isolates from sheep and goats, environment and human cases all matched
- Environment grossly contaminated and accessible to visitors
- Led to new legislation in NC
- “Aedin’s Law”

# Aedin's Law enacted in North Carolina- July 2005

Aedin Gray's story:

30 minutes in the Petting Zoo

- Hemolytic Uremic Syndrome
- 15 days in the pediatric ICU
- Renal function ~35%
- Diabetes



**Aedin's Law provides regulation and health protection of petting zoos at fairs in North Carolina**

# Summary

- Zoonotic diseases continue to emerge
  - Multiple animal species and pathogens
- Disease outbreaks associated with animal exhibits and fairs are increasingly recognized
- *E. coli* O157 outbreaks are well described, cause serious illness
- Disease outbreaks have led to legislation and regulation of animal exhibits in North Carolina

**Questions?**