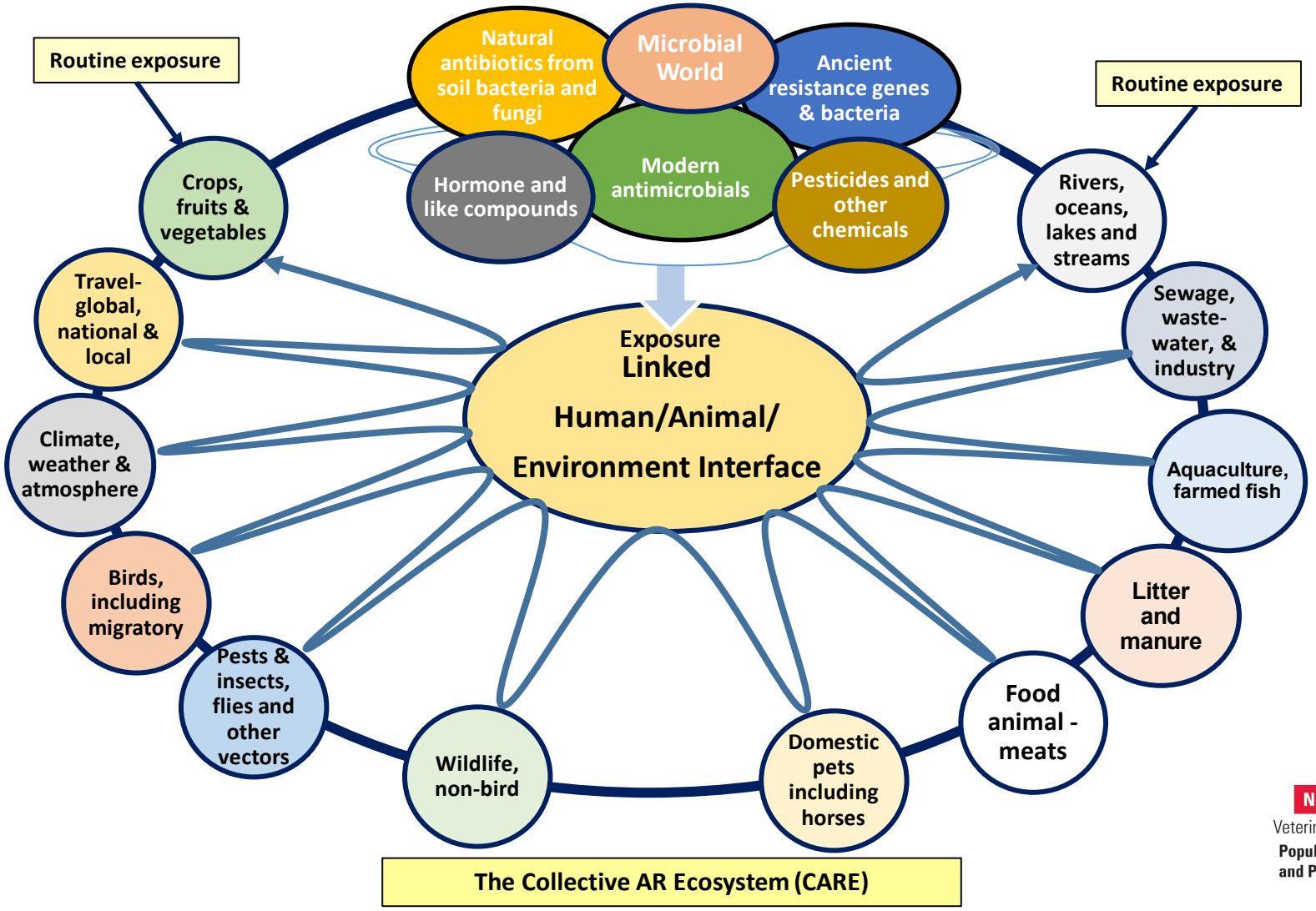
# The Collective Antibiotic Resistance Landscape through a One Health Lens

**Paula J. Fedorka-Cray, PhD and Shivaramu Keelara, DVM, PhD**

North Carolina State University, College of Veterinary Medicine
Department of Population Health and Pathobiology,
Raleigh, NC

NC STATE Veterinary Medicine




NC STATE
Veterinary Medicine
Population Health and Pathobiology

# Artificial Intelligence

- To collect accurate insights, knowledge, and trends in antimicrobial resistance (AMR) and infectious diseases (ID) from data source
  - Publications, news media and available online data on AMR

- Building an integrated “ONE HEALTH” data base to analyze the “BIG DATA” of AMR and ID

# AMR App

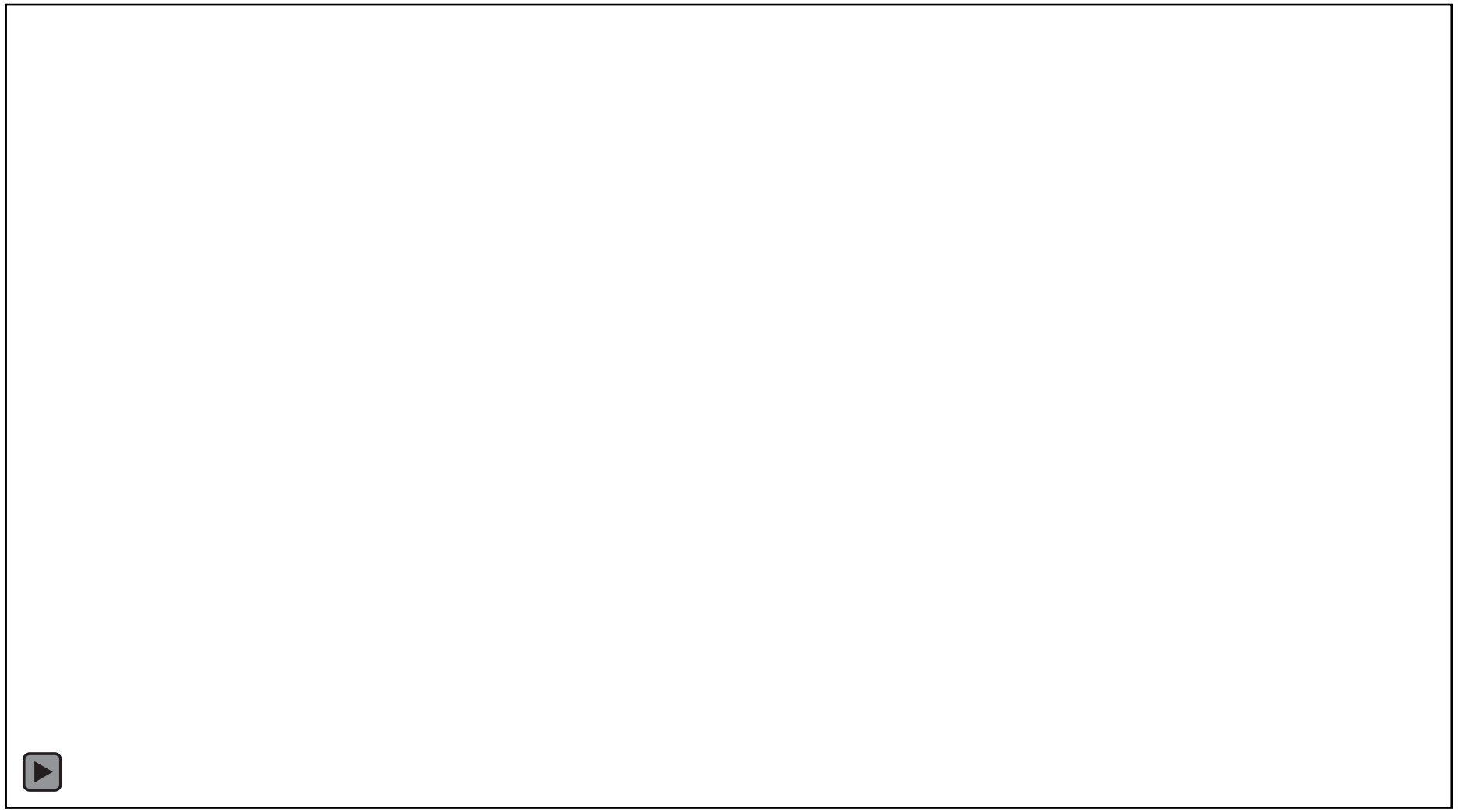
**Customized search engine**

- Control data sources
  - Customized algorithms
  - Trained to seek specific answers

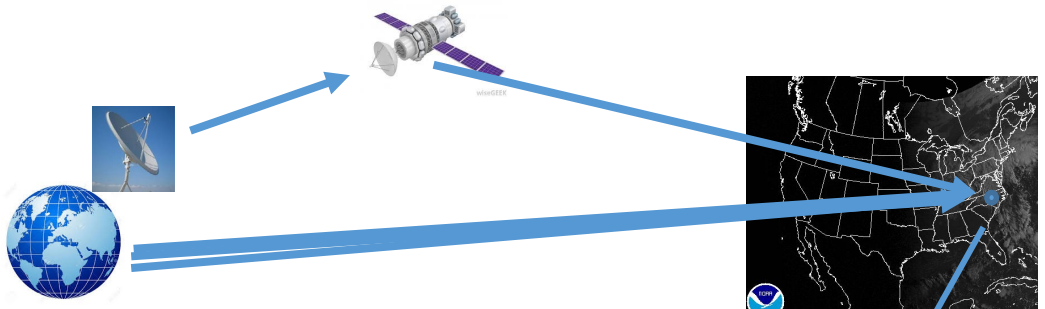
**Public search engine**

- Google, yahoo, Bing, etc
  - Generic page rank algorithm
  - Highest ranked pages as search response

# AMR Genie



NC STATE Veterinary Medicine



**Global Data Sets**
- Existing
- Real time

Examples of Data Sets/Streams:
- Antimicrobial Resistance
- Infectious disease
- Sequence data
- GIS
- Weather/climate
- Wildlife migrations
- **Migratory birds**

Analysis

Compilation of overlapping data sets

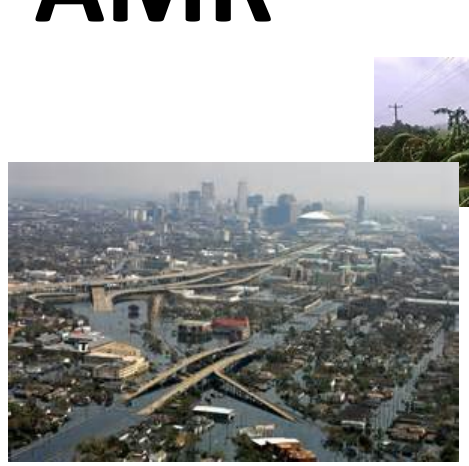
**Outcome and Impact:**
- **Short and long term analysis**
- **Assimilation of complementary and supportive data**
- **Facilitation of rapid diagnostic development**
- **Generation of new knowledge**
- **Enhanced collaboration**
- **Improved mitigation and control strategies**

Time

NC STATE
Veterinary Medicine
Population Health and Pathobiology

# 5 Unique Opportunities for Study of AMR

- Hurricanes
- Floods
- Drought
- Fire
- Volcanic eruptions



usnews.com
Hurricane
Katrina

cnnphilippines.co
m
Phili

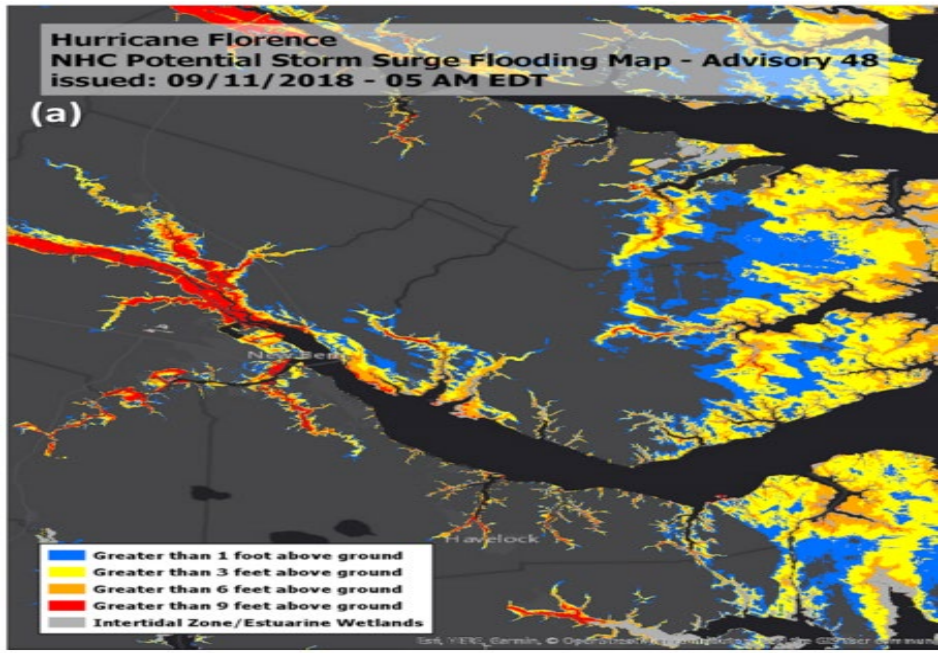
Kstp.com
Greenville, NC

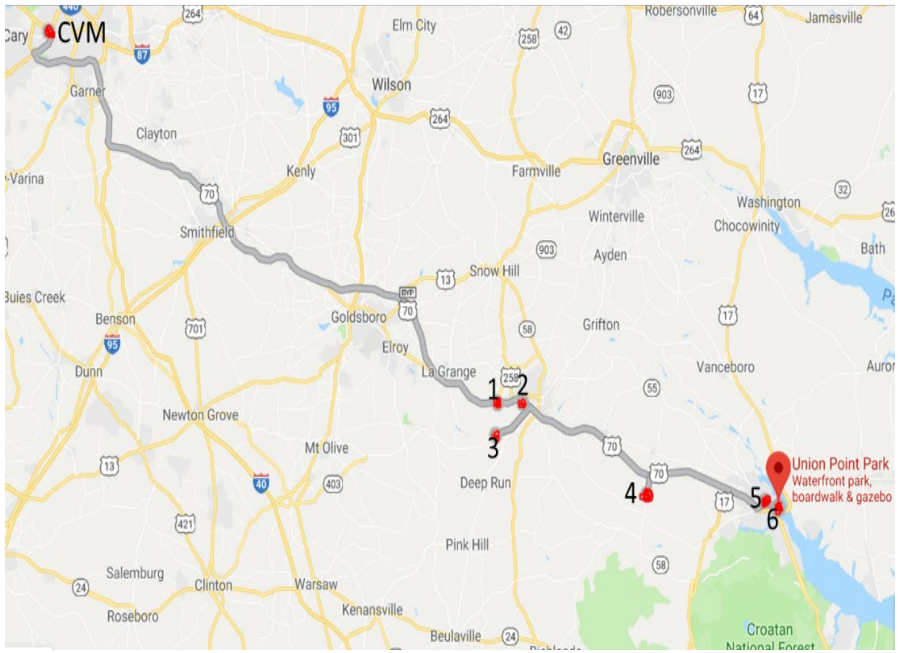
Strangesounds.org
Indonesia

netnewsledger.co
m
Ontario Forest
Fires

- In each case
  - Environment has been reset

# Sampling locations



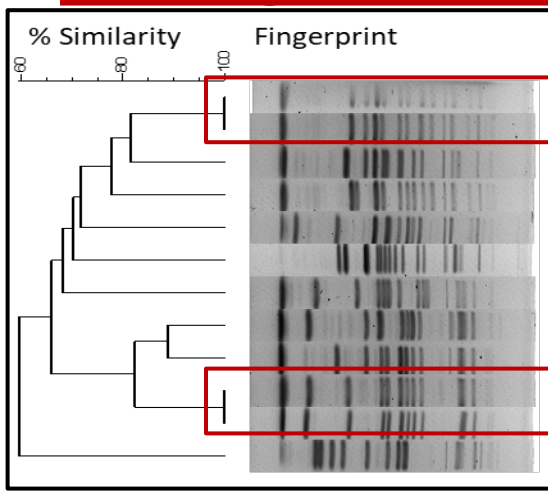

**Sampling sites:** 1) poultry production, 2) Neuse river, 3) residential area, 4) swine farm, 5) human hospital and 6) a recreational park.

**Sample collection:** 10gm of soil (n=10) and 10ml of water samples (n=10) each month over a period of 12 months (November 2018- October 2019).

NC STATE
Veterinary Medicine
Population Health and Pathobiology

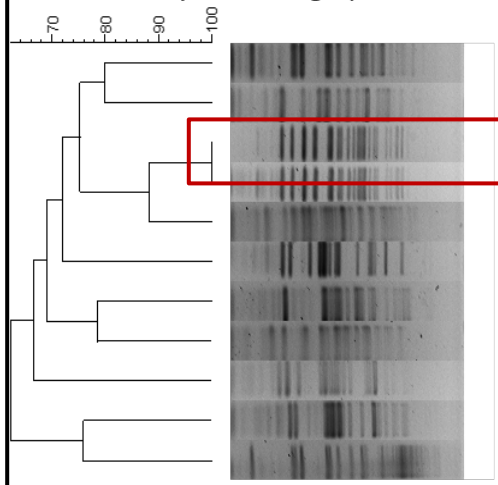
NC STATE Veterinary Medicine

# Genotypic similarity among *Salmonella* isolates




| Fingerprint | Date | Location | Source | Lab ID | Bacteria | AMR Pattern |
|---|---|---|---|---|---|---|
| | 11/15/2018 | P2 | Soil | FASL001 | Salmonella | Pansusceptible |
| | 12/12/2018 | P2 | Soil | FASL019 | Salmonella | STR |
| | 12/12/2018 | P2 | Soil | FASL022 | Salmonella | Pansusceptible |
| | 11/15/2018 | P2 | Soil | FASL004 | Salmonella | Pansusceptible |
| | 01/07/2019 | P2 | Soil | FASL028 | Salmonella | STR |
| | 04/22/2019 | P1 | Water | FASL040 | Salmonella | Pansusceptible |
| | 11/15/2018 | P4 | Soil | FASL010 | Salmonella | STR |
| | 11/15/2018 | P3 | Water | FASL016 | Salmonella | Pansusceptible |
| | 12/12/2018 | P6 | Water | FASL025 | Salmonella | Pansusceptible |
| | 11/15/2018 | P2 | Water | FASL013 | Salmonella | Pansusceptible |
| | 04/22/2019 | P2 | Soil | FASL037 | Salmonella | Pansusceptible |
| | 02/11/2019 | P6 | Soil | FASL034 | Salmonella | STR |

# Genotypic similarity among ESBL *E.coli* isolates




| Fingerprint | Date | Location | Source | Lab ID | AMR Pattern |
|---|---|---|---|---|---|
| | 03/11/2019 | P3 | Soil | FESBL061 | AMP-AXO-AZI-CHL-FIS-STR-SXT-TET-XNL |
| | 03/11/2019 | P6 | Soil | FESBL067 | AMP-AZI-CIP-FIS-GEN-NAL-STR-SXT-XNL |
| | 03/11/2019 | P6 | Water | FESBL070 | AMP-AXO-CHL-CIP-FIS-GEN-NAL-STR-SXT-XNL |
| | 03/11/2019 | P6 | Water | FESBL073 | AMP-AXO-CHL-CIP-FOX-GEN-NAL-STR-SXT-TET-XNL |
| | 01/07/2019 | P6 | Soil | FESBL025 | AMP-AXO-CIP-FIS-GEN-NAL-STR-SXT-TET |
| | 03/11/2019 | P6 | Soil | FESBL064 | AMP-AXO-FIS-XNL |
| | 01/07/2019 | P6 | Water | FESBL034 | AMP-AXO-CIP-FIS-GEN-NAL-SXT-TET |
| | 03/11/2019 | P3 | Soil | FESBL055 | AMP-AXO-CIP-FIS-GEN-NAL-TET-XNL |
| | 11/16/2018 | P2 | Water | FESBL001 | AMP-AXO-CHL-FIS-STR-TET-XNL |
| | 12/12/2018 | P6 | Water | FESBL016 | AMP-AXO-FIS-SXT-XNL |
| | 03/11/2019 | P3 | Soil | FESBL058 | AMP-AXO-AZI-CHL-CIP-FIS-GEN-NAL-STR-SXT-TET-XNL |

**Legends:** **P1- Poultry production; P2- Neuse river; P3- Residential area; P4- Swine farm; P5-Human hospital; P6-Recreational park; AMP-Ampicillin; AZI –Azithromycin; AUG-Amoxicillin-clavulanic acid; AXO- Ceftriaxone; CHL-Chloramphenicol; CIP-Ciprofloxacin; FOX-Cefoxitin; FIS-Sulfisoxazole; GEN-Gentamicin; NAL-Nalidixic Acid; STR-Streptomycin; SXT-Trimethoprim/Sulfamethoxazole; TET-Tetracycline; XNL-Ceftiofur**

NC STATE Veterinary Medicine

# Thank you and Questions?

NC STATE Veterinary Medicine