TEXAS TECH UNIVERSITY®

Guy H. Loneragan

Fighting Foodborne Illness. *Salmonella*: An Academic Perspective

USDA Agricultural Outlook Forum 2012
Crystal Gateway Marriott
Washington, DC, 23-24FEB2012

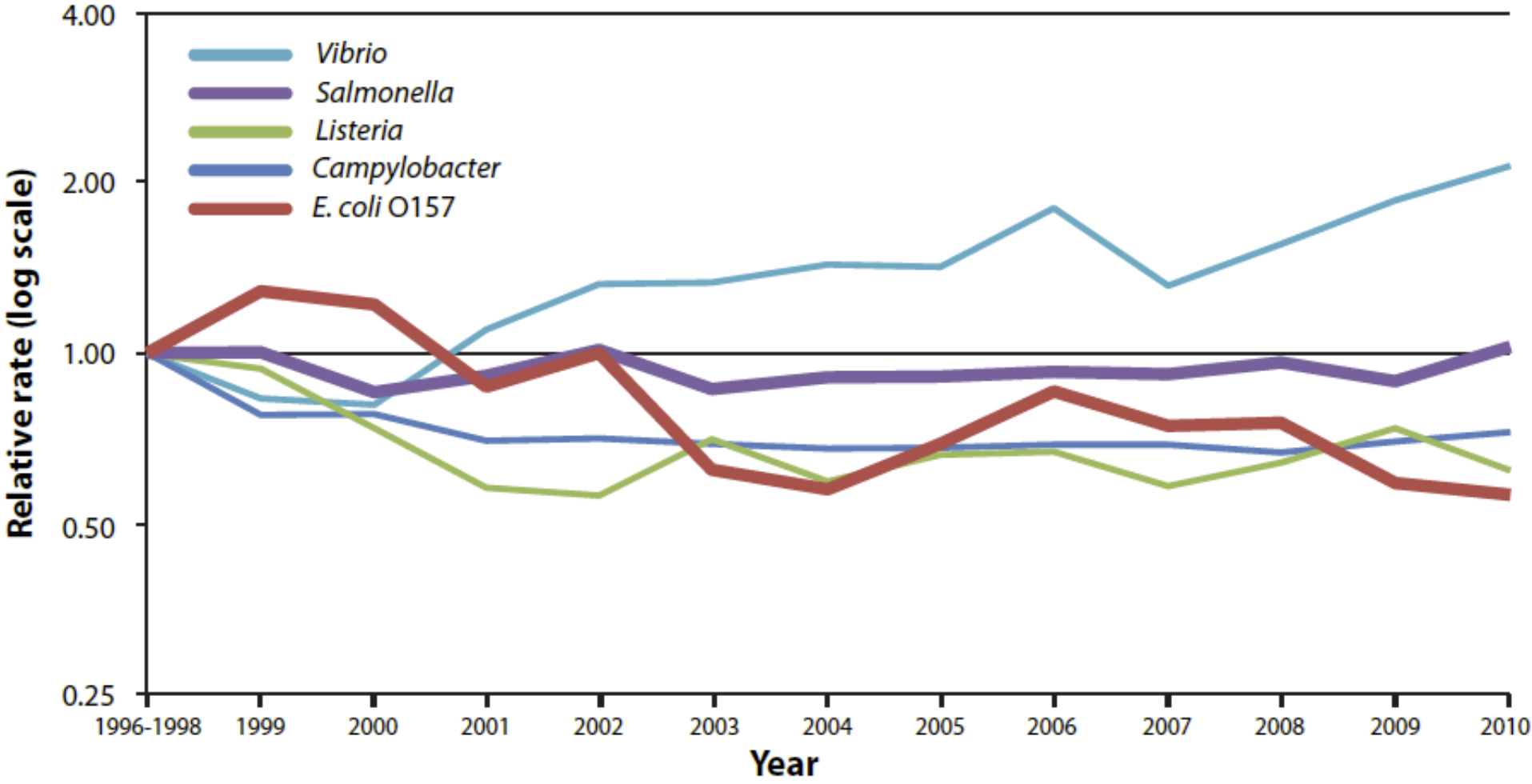
Outline of Presentation

- How *Salmonella* challenges our paradigms
  - Live animal to carcass contamination
  - A spectrum from commensal to pathogen
- Pre-harvest approaches to *Salmonella* control
  - Prevalence, incidence, and duration of infection
- How should we define risk?
  - Different definitions drive different actions
- From the perspective of beef production

Salmonella as a Food-borne Pathogen

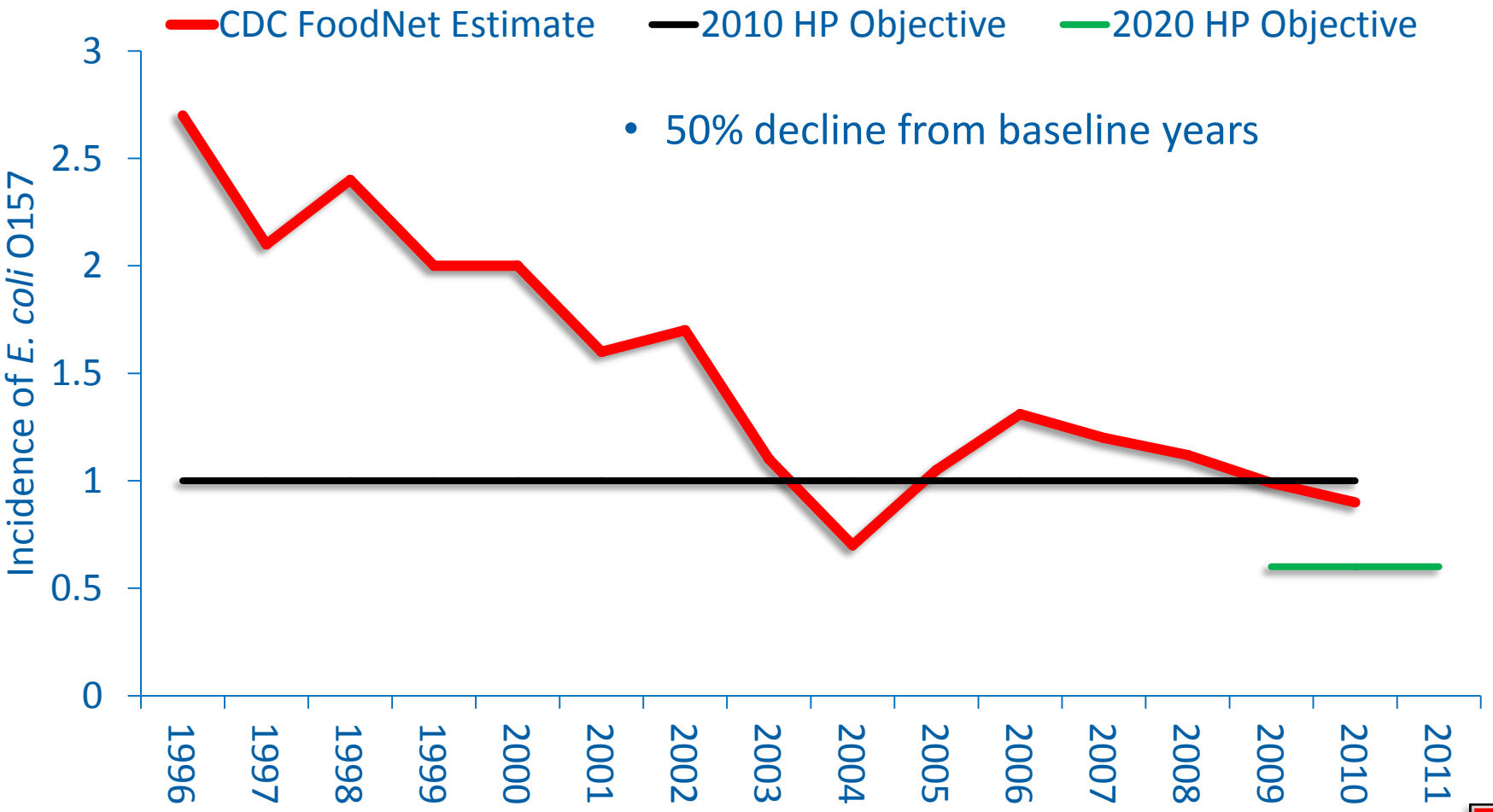
- The sky is not falling
  - The US enjoys a very safe food supply but all agree that there is room for improvement
- *Salmonella* continues to cause significant morbidity in the US as well as globally
  - US incidence ~17 reported cases/100,000/yr
    - CDC 'counted' cases
  - With under reporting/diagnosis, incidence estimated to be closer to 1 case/300 person-yr
    - Scallan *et al*. *Emerg Infect Dis*. 2011 17:7-15
- Clearly we have room for improvement
  - Particular with *Salmonella*

US Trends from FoodNet

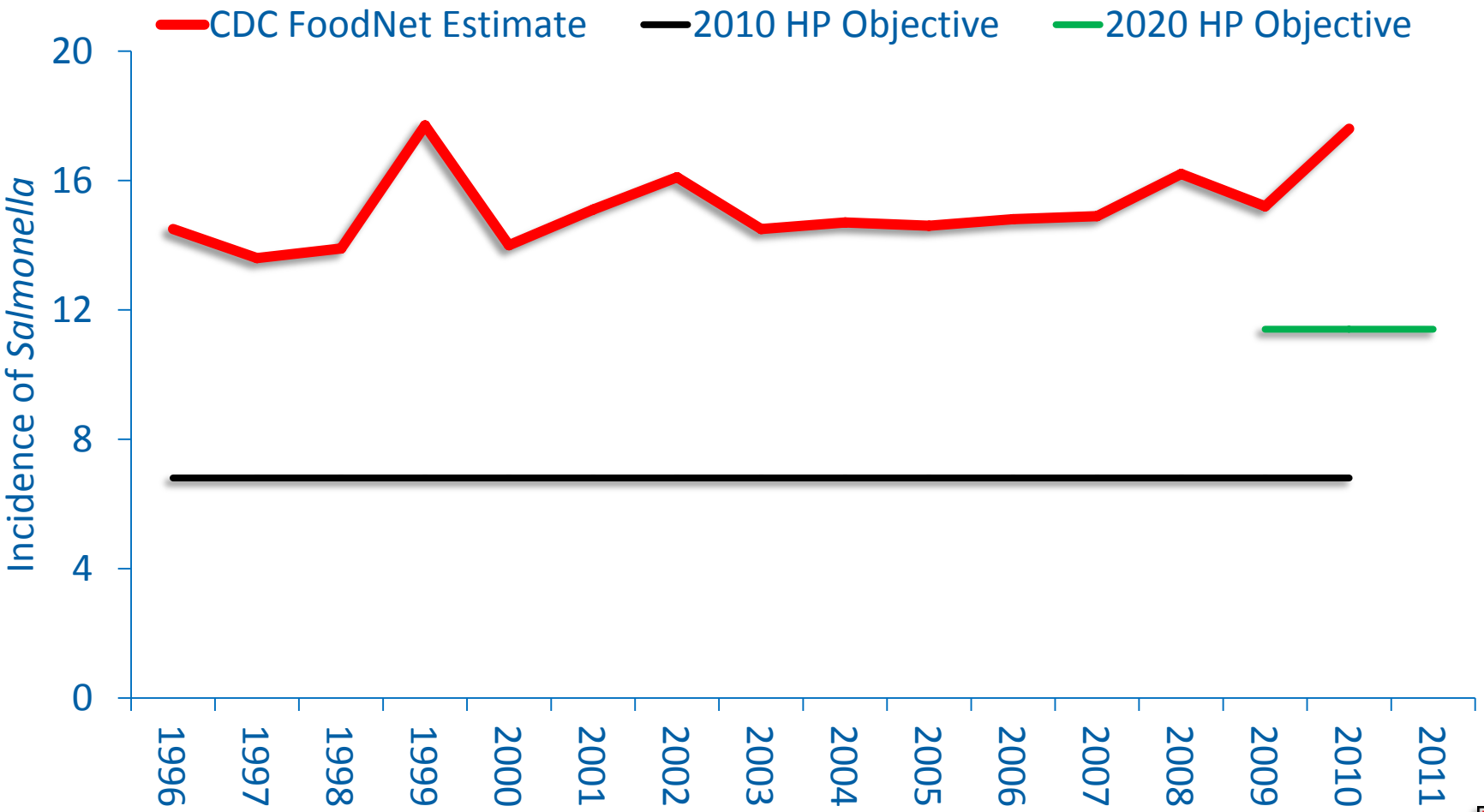


CDC Factsheet: Trends in Foodborne Illness, 1996–2010

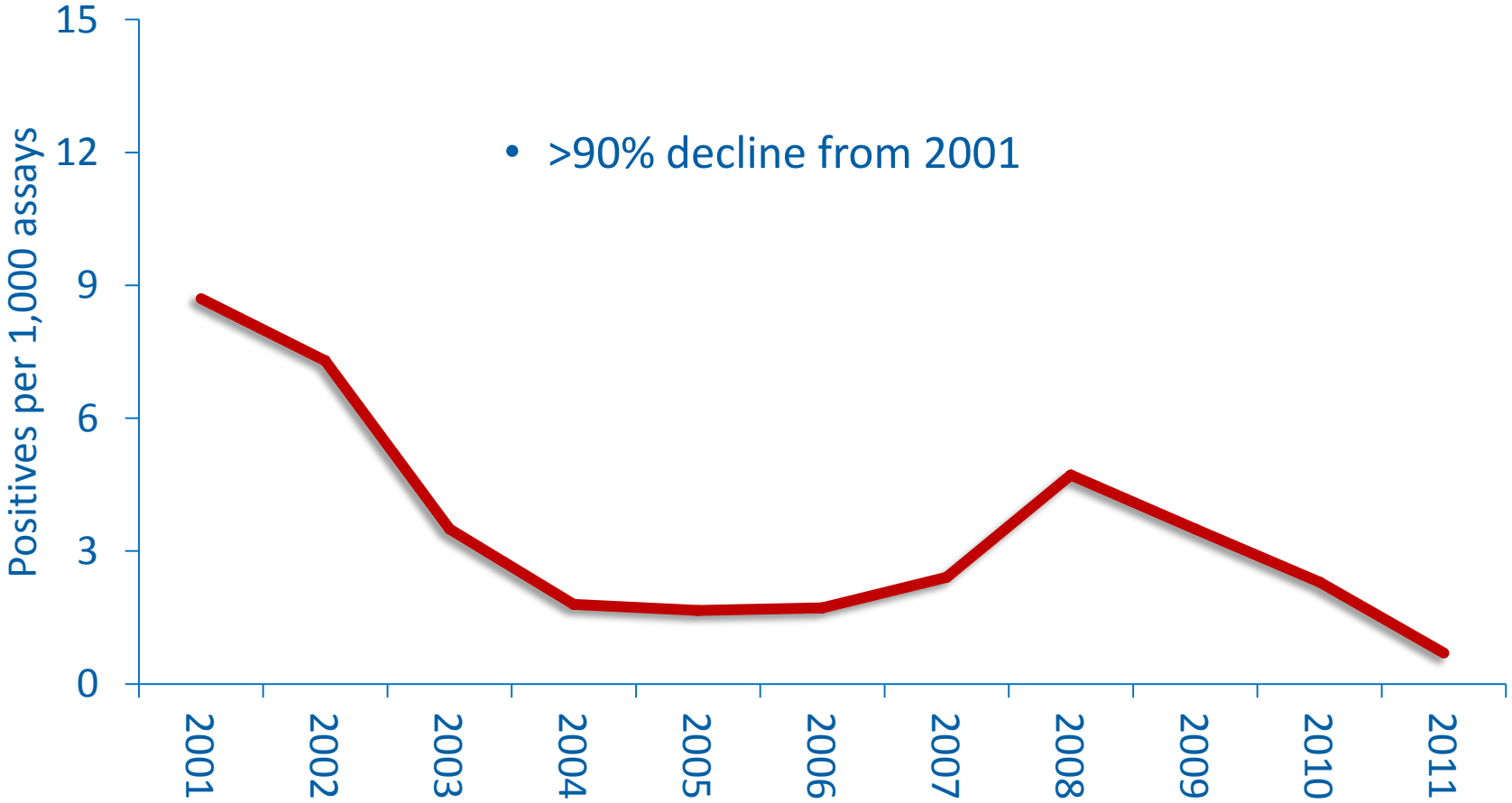
E. coli O157: FoodNet



Salmonella: FoodNet

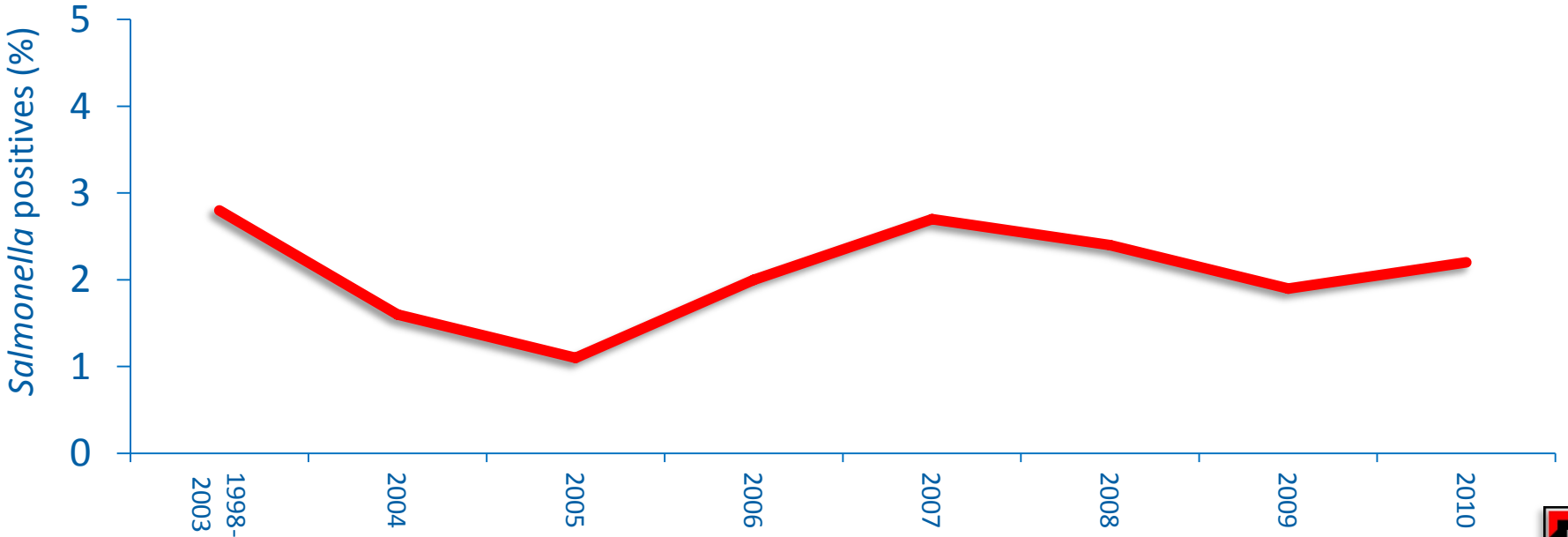


E. coli O157: USDA/FSIS



Salmonella: USDA/FSIS

- No observable change from baseline years
  - 2.2% of 9,256 GB samples positive for *Salmonella*
  - Montevideo #1 serotype



Challenging our Paradigms

- Why observe meaningful improvements in one pathogen yet not in another?
  - *Salmonella* is similarly susceptible to interventions
    - Many studies validate interventions against *Salmonella*
  - Improbable that it tolerates HACCP plans
- *Salmonella* may be evading our system by hiding out in the lymph nodes
  - Harhay, Loneragan, Edrington, Brashears, Gragg

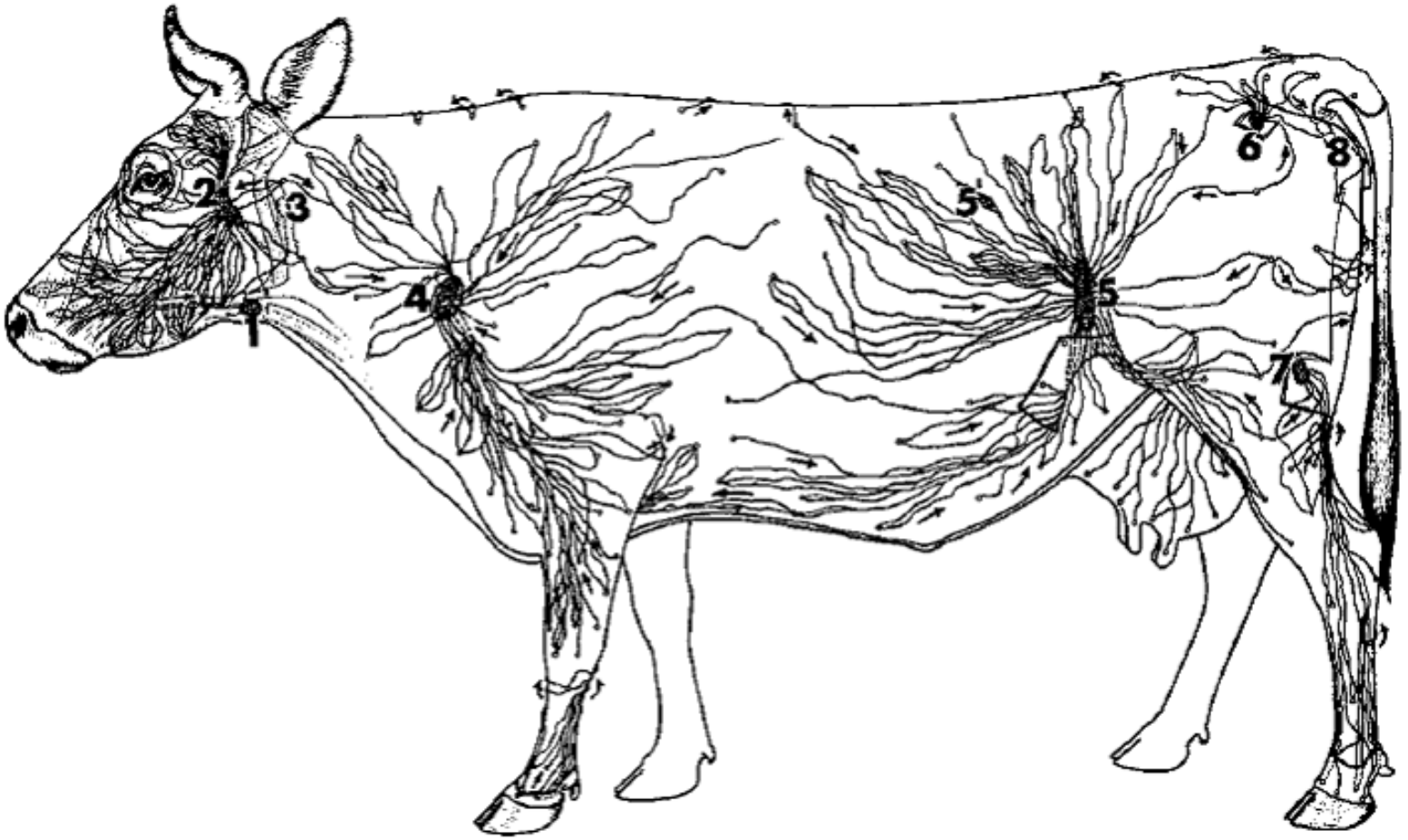


FIGURE 34–1. Superficial lymph flow of the cow.

1, Mandibular ln.; 2, parotid ln.; 3, lateral retropharyngeal ln.; 4, superficial cervical ln.; 5, subiliac ln.; 5′, lnn. of paralumbar fossa; 6, gluteal ln.; 7, popliteal ln.; 8, tuberal ln. (After Baum, 1912.)

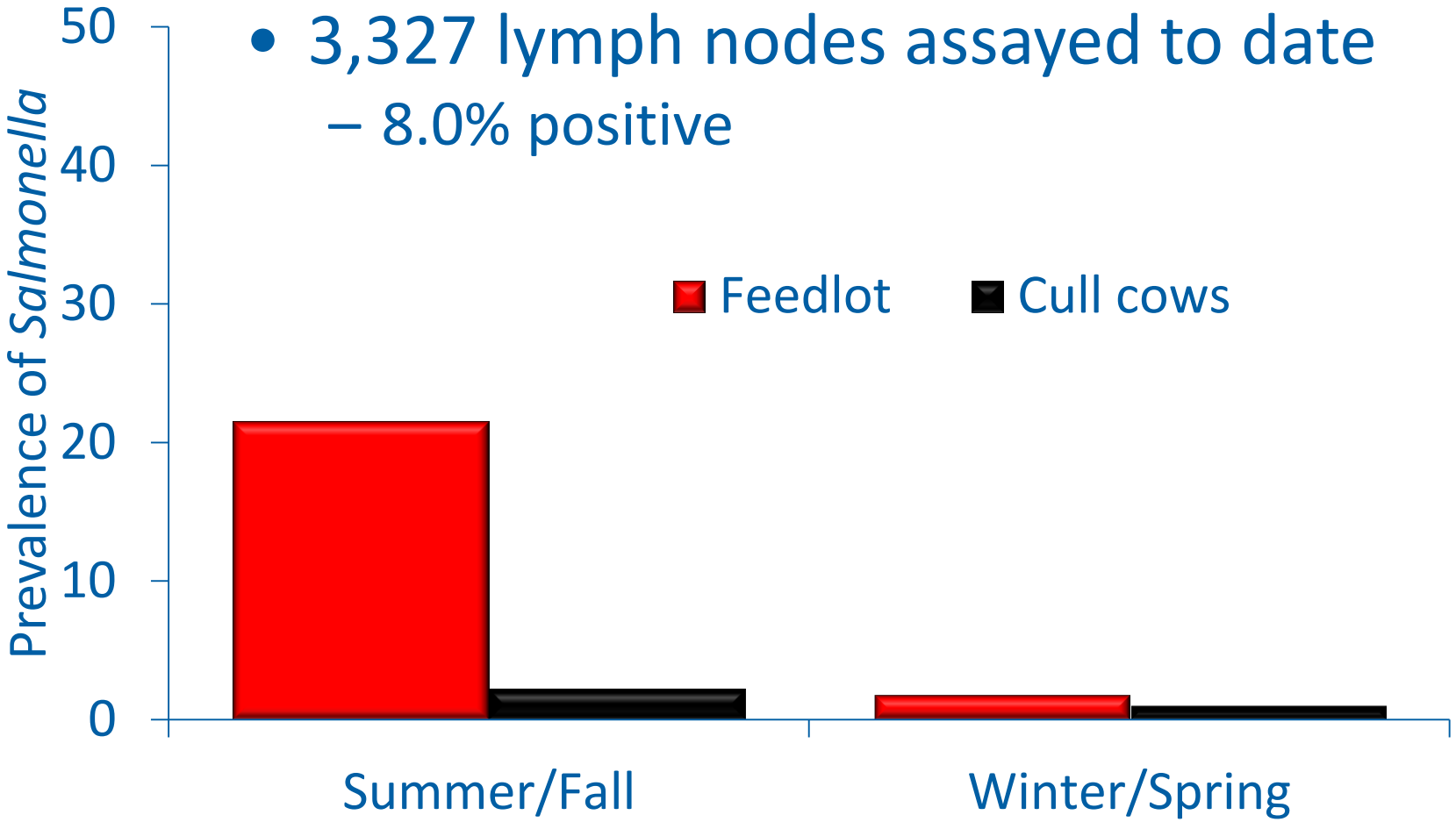
From: Ruminant Lymphatic System (Saar and Getty) In Anatomy of the Domestic Animals. Eds Sisson and Grossman

Salmonella in Lymph Nodes

Challenging our Paradigms

Funded by the Beef Checkoff

- Collected lymph nodes from 8 plants
- 3,327 lymph nodes assayed to date
  - 8.0% positive



Salmonella in Lymph Nodes

Challenging our Paradigms

Serotype	% (n=266)
Montevideo	44.0
Anatum	24.8
Reading	4.9
Thompson	3.8
Meleagridis	3.0
Kentucky	3.0
C07 NT	2.3
Mbandaka	2.3
Muenchen	1.5
Bredeney	1.1
Infantis	1.1
Newport	1.1

Salmonella in Lymph Nodes

Challenging our Paradigms

Serotype	% (n=266)
Montevideo	44.0
Anatum	24.8
Reading	4.9
Thompson	3.8
Meleagridis	3.0
Kentucky	3.0
C07 NT	2.3
Mbandaka	2.3
Muenchen	1.5
Bredeney	1.1
Infantis	1.1
Newport	1.1

Number 1 and 2 in ground beef but rarely, if ever, cause outbreaks

How Does *Salmonella* get to the Nodes?

Image from UNL Dept of Entomology

- Traditional paradigm is from intestines
- We have observed diversity of serotypes between feces and hides of cattle
  - Some serotypes (e.g., Montevideo) much more likely to be recovered from hides than feces
- It is possible (even probable) that some *Salmonella* gets to the nodes transdermally
  - Biting flies in the summer and fall
  - Montevideo has gene(s) that facilitate survival within insects

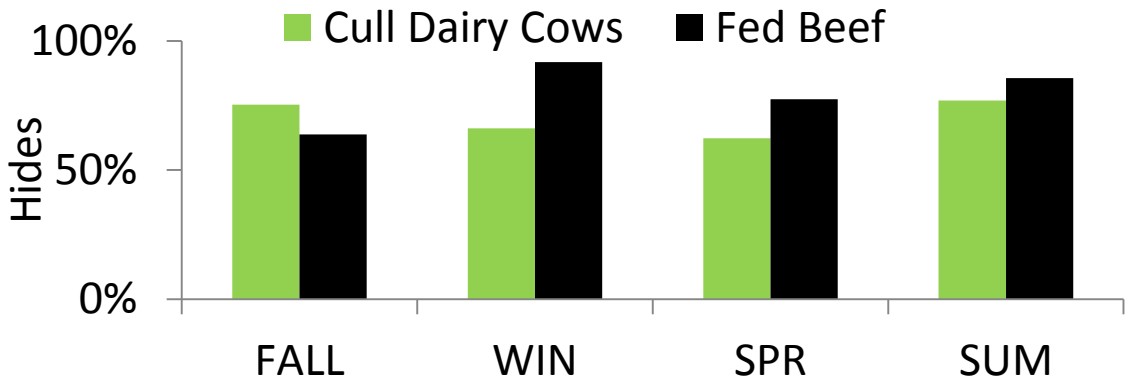
The Challenge

- We should reassess our paradigm of how beef might become contaminated with *Salmonella*
  - Focus has been on preventing hide to carcass
    - Prevent and remove contamination
  - Inspection and PR/HACCP
- *Salmonella*-positive beef samples might not always result from failure of sanitary slaughter
  - Sanitary conditions may result in *Salmonella*
- A consideration of how we approach control

Salmonella – Commensal or Pathogen
Challenging our Paradigms

- '*A Rose by Any Other Other Name*' – re-quoted from Dayna Harhay (and Shakespeare)
- Some *Salmonella* variants are potent pathogens
  - *S*. Newport, Typhimurium, Enteritidis, Heidelberg
  - Some in both animals and people
- *Salmonella* prevalence increases in a southerly gradient (in the northern hemisphere)
  - Most of the increase is not in these serotypes
    - Cerro, Reading, Anatum, Montevideo, Mbandaka
  - 'The most common consequence of infection [in animals] is continued good health' - Hancock
    - May well be part of good health in southern climates

North to South



- *Region*
  - Canada 1.0% 21 feedlots (*FPD* 2010;7:449)
  - Nebraska 9.1% 3 plants (*JFP* 2003;66:1978)
  - TX 30.0% 37 sites (*AEM* 2008;74:345)
- 27% of ~5,100 dairy fecal samples
- Texas Tech 2011 4-feedlot study
  - 60.5% of summer/fall samples positive
    - 30.6, 37.5, 78.8, and 97.0% for the feedlots
- Mexico
  - >80% of fecal samples typically positive

How Might We Approach Control?

- Traditional approach in the plant continues to serve us well
  - Many plans excelling at microbial process control
    - Tremendous improvements in *E. coli* O157
- *Salmonella* might evade systems
  - As sanitary slaughter processes improves, remaining failures not a consequence of sanitary slaughter issues
- Opportunities for control during harvest
  - Selective lymph node removal?
- It might be that effective control requires an evaluation of upstream or downstream options

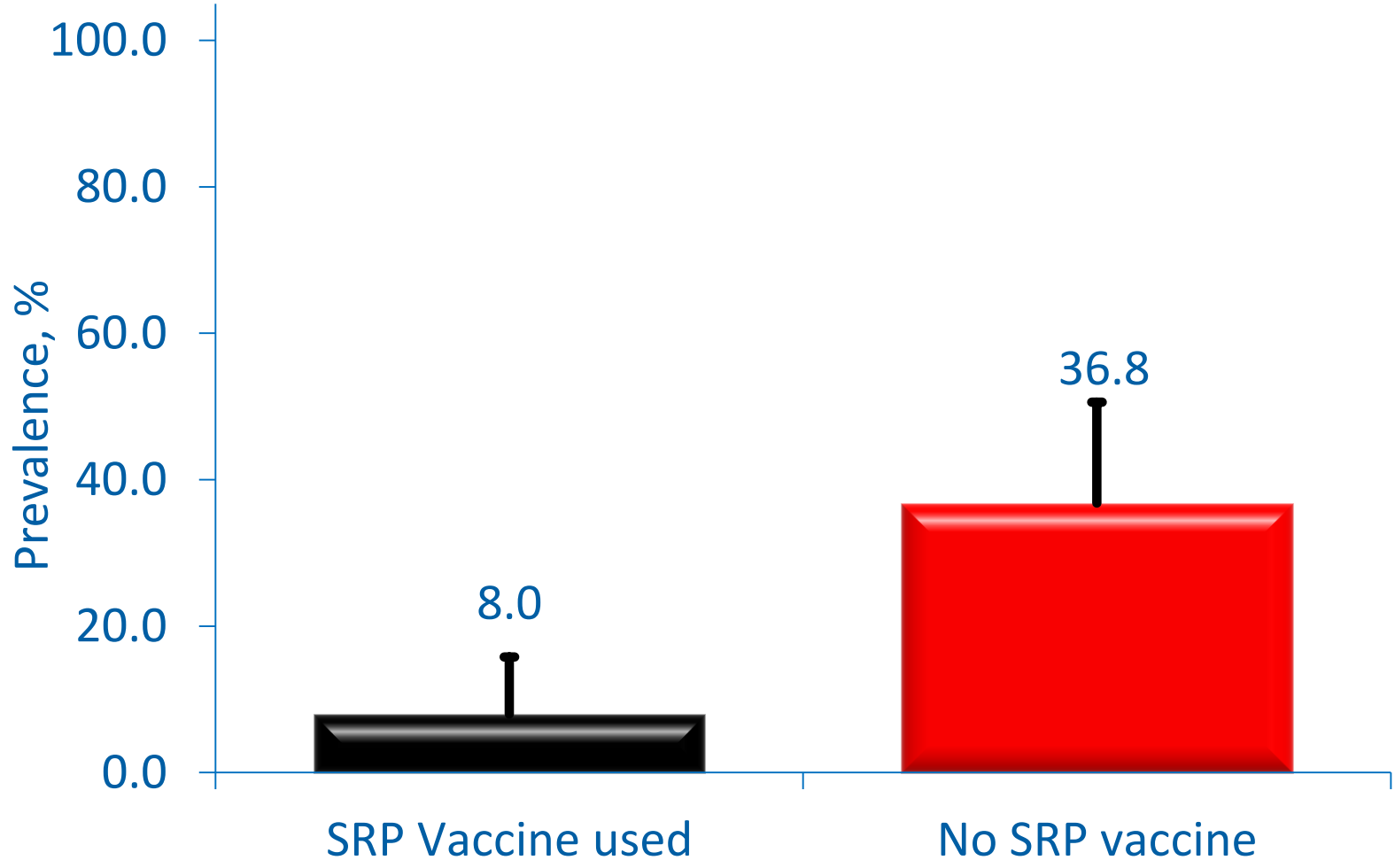
How Might We Approach Control?

- ***Prevalence = incidence * duration of infection***
  - Decrease incidence &/or DOI will decrease prevalence

Salmonella Vaccine

Association with prevalence (*P*=0.05)

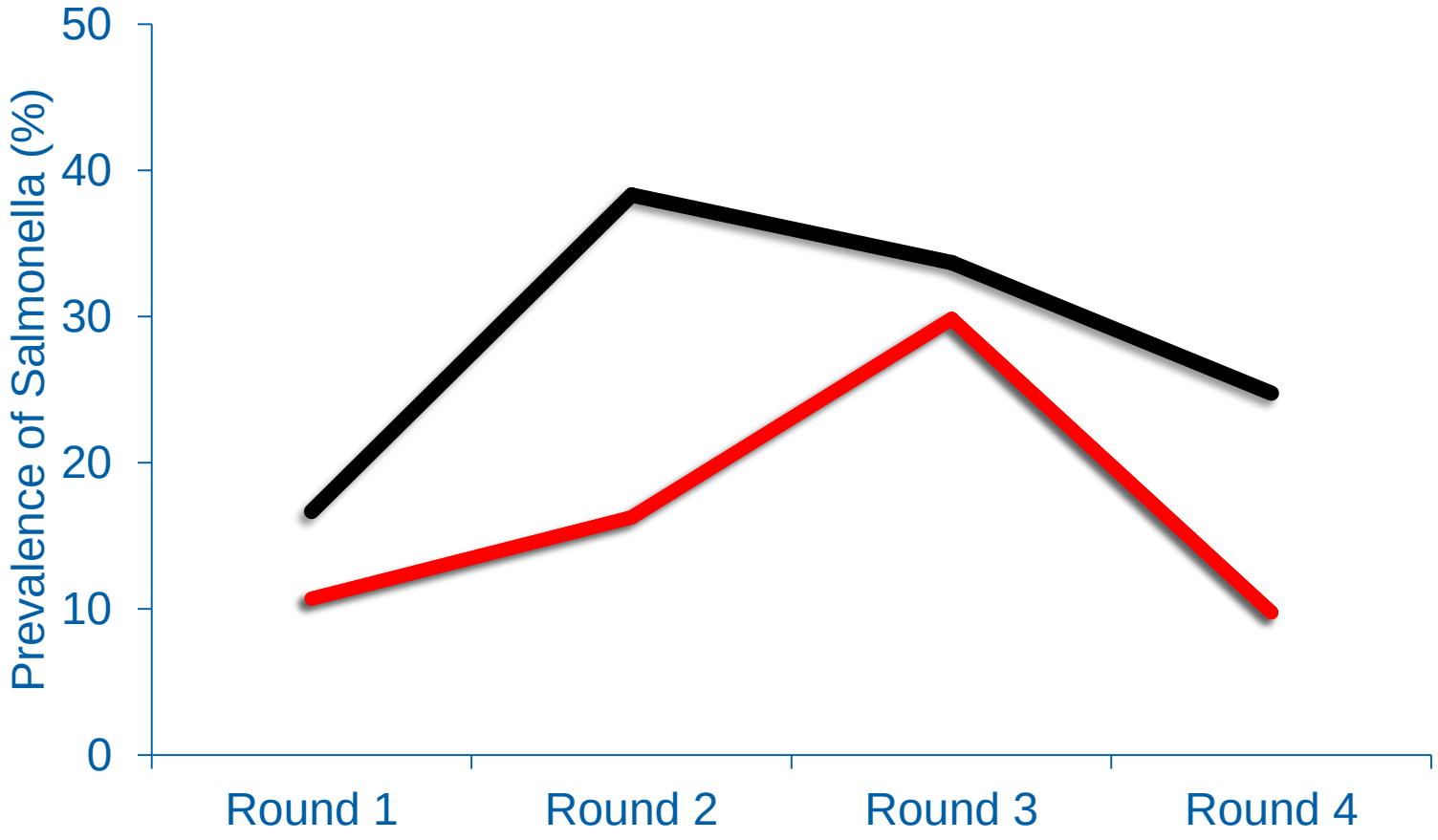
Funded by the Beef Checkoff



Salmonella Vaccine

28.3 versus 16.6%; *P*<0.05

Funded by the Beef Checkoff

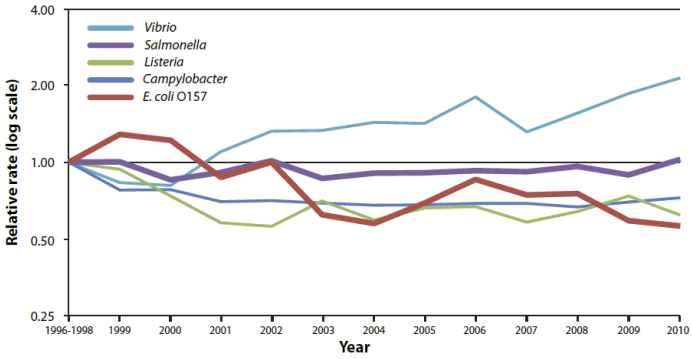


How Might We Approach Control?

- Encouraging early signs that some interventions may decrease prevalence of *Salmonella* in herds of cattle
  - More work is clearly needed

Need for a Discussion of *What is Risk*?

Academic Perspective	Operational Reality of Today
1. All *Salmonella* pose a risk	• Effectively the approach now when USDA/FSIS performs its microbiological performance testing of establishment • Treats *Salmonella* as equal • Some are pathogenic & some apathogenic
2. A subset of serotypes pose a risk (e.g., CSPI's petition: Newport, Hadar, Typhimurium, & Heidelberg)	• At present, no means to identify these with specificity (i.e., exclude others) at the speed needed for commerce
3. Other subsets pose a risk (e.g., highly drug resistant – ACSSuT, or MDR-AmpC – Newport, Typhimurium, Reading, Agona, Anatum, Montevideo, etc.)	• At present, no means to identify these with specificity (i.e., exclude others) at the speed needed for commerce • Captures apathogenic variants • Excludes broadly susceptible pathogens such as some Newport and Enteritidis



- The sky is not falling
  - The US enjoys a very safe food supply but all agree that there is room for improvement
- How do we capture that improvement?
- When it comes to *Salmonella*
  - We need to work outside of our paradigms
    - Hide to carcass
    - *Salmonella* can be both commensal and a pathogen
- Opportunities for control
  - Harvest plant (maybe?)
  - Upstream and downstream of harvest plant
    - Approaches that reduce incidence or DOI

TEXAS TECH UNIVERSITY
College *of* Agricultural Sciences & Natural Resources™

- USDA Ag Outlook Forum organizers (USDA/FSIS)
- Colleagues and funding
  - Dayna Harhay, Sara Gragg, Tom Edrington, Mindy Brashears, and Kendra Nightingale
  - Beef Checkoff Program
  - USDA/NIFA/NIFSI
    - Contract # 2011-51110-31081
    - Texas Tech & USDA/ARS
- Contact Information:

Guy.Loneragan@TTU.edu
Texas Tech University
+1 (806) 742-2805 x 268