TEXAS TECH UNIVERSITY®

The Science of Antibiotic Use and Resistance: From Clarity to Confusion

Guy H. Loneragan

Angers, France

Juin 23 and 24, 2015

SteakExpert
9èmes journées

Purpose of Presentation

- To serve as an introduction to subsequent presentations
- Antimicrobial use and resistance
  - Our own studies in cattle production
  - Interpretation of population-level data
  - From clarity to Confusion
    - How then ought we make decisions?

Antibiotic Use in the U.S.

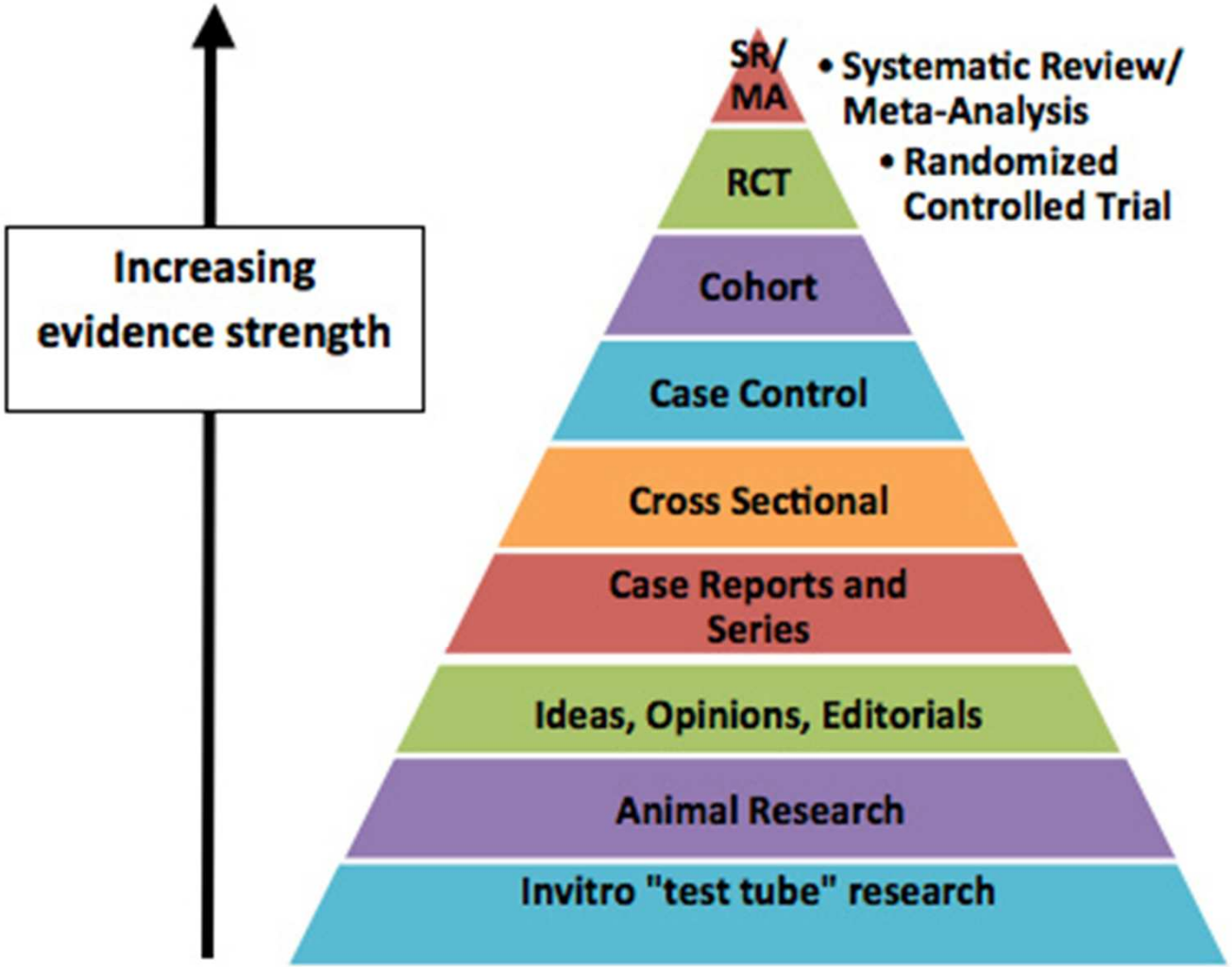
- Treatment of ill animals
- Control and prevention of disease
- Growth promotion

- ~40% of use is with non-medically important drugs
  - ~60% of drugs are considered medically important
- 97% of all use is without a veterinary prescription
  - Most under direction of diet formulator (nutritionist)

Information Needs

- Mission: preserve the efficacy of antibiotics into the future for the benefit of others
  - Human and veterinary medicine
- Questions presented broadly to our group:
  - Does antibiotic use in animals select for antibiotic-resistant bacteria?
  - If so, so what?
    - Does it impact public health?

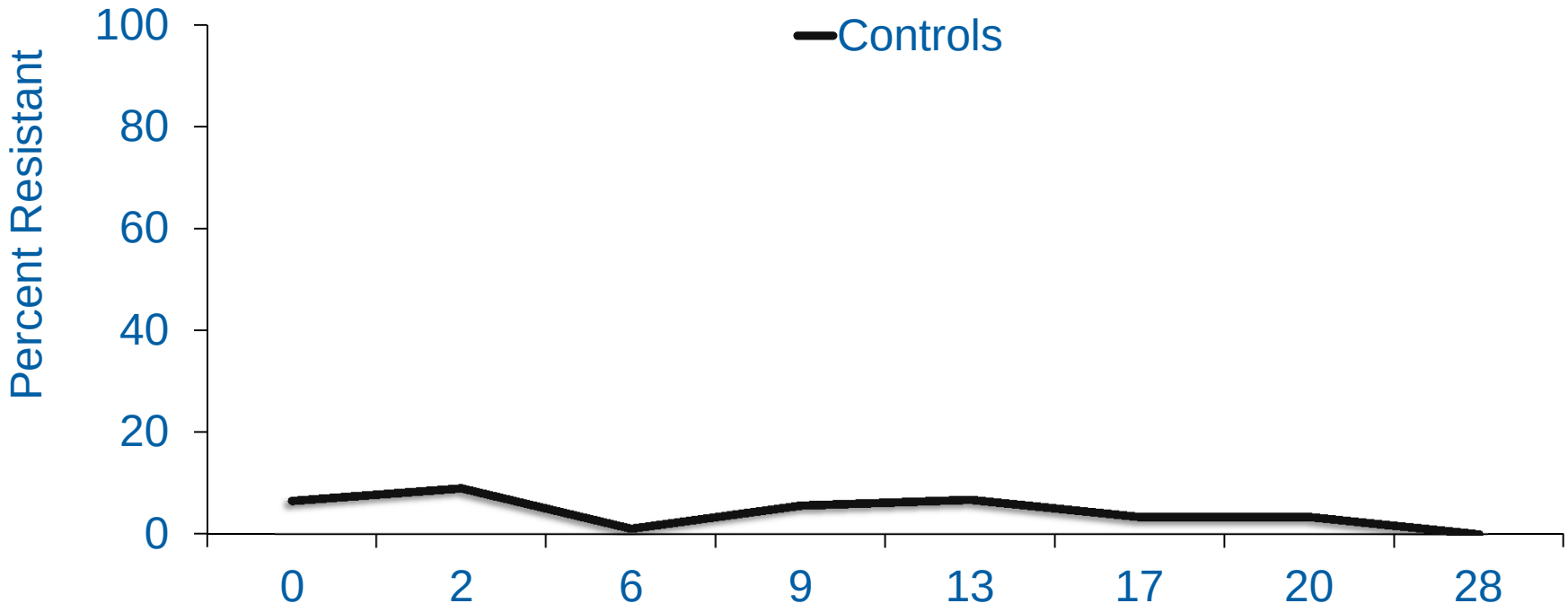
Strength of Evidence



https://perioatuit.files.wordpress.com/2013/05/evidence-pyramid.jpg

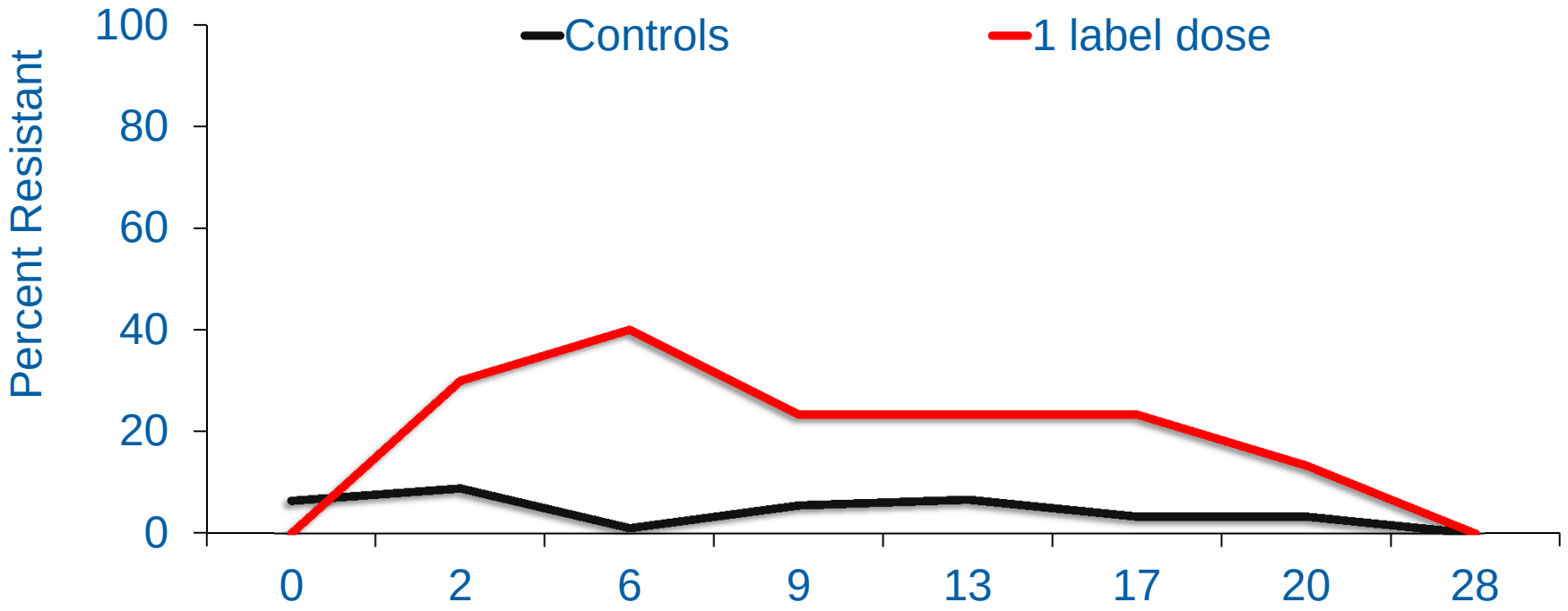
AMR Research: Ex 1

- Injectable long-acting ceftiofur (Excede)
- 10 animals in a pen
  - 5 administered once or 3 consecutive regimens
  - 5 animals served as unexposed controls



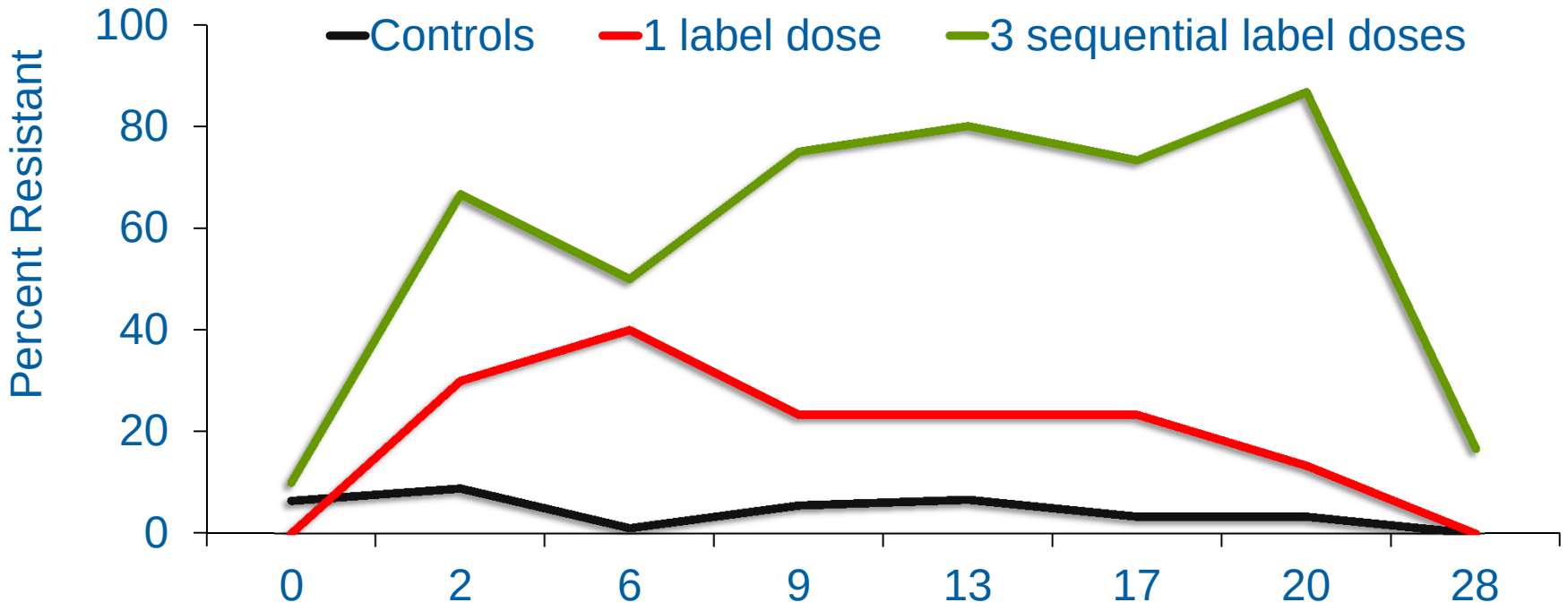
AMR Research: Ex 1

- Injectable long-acting ceftiofur (Excede)
- 10 animals in a pen
  - 5 administered once or 3 consecutive regimens
  - 5 animals served as unexposed controls



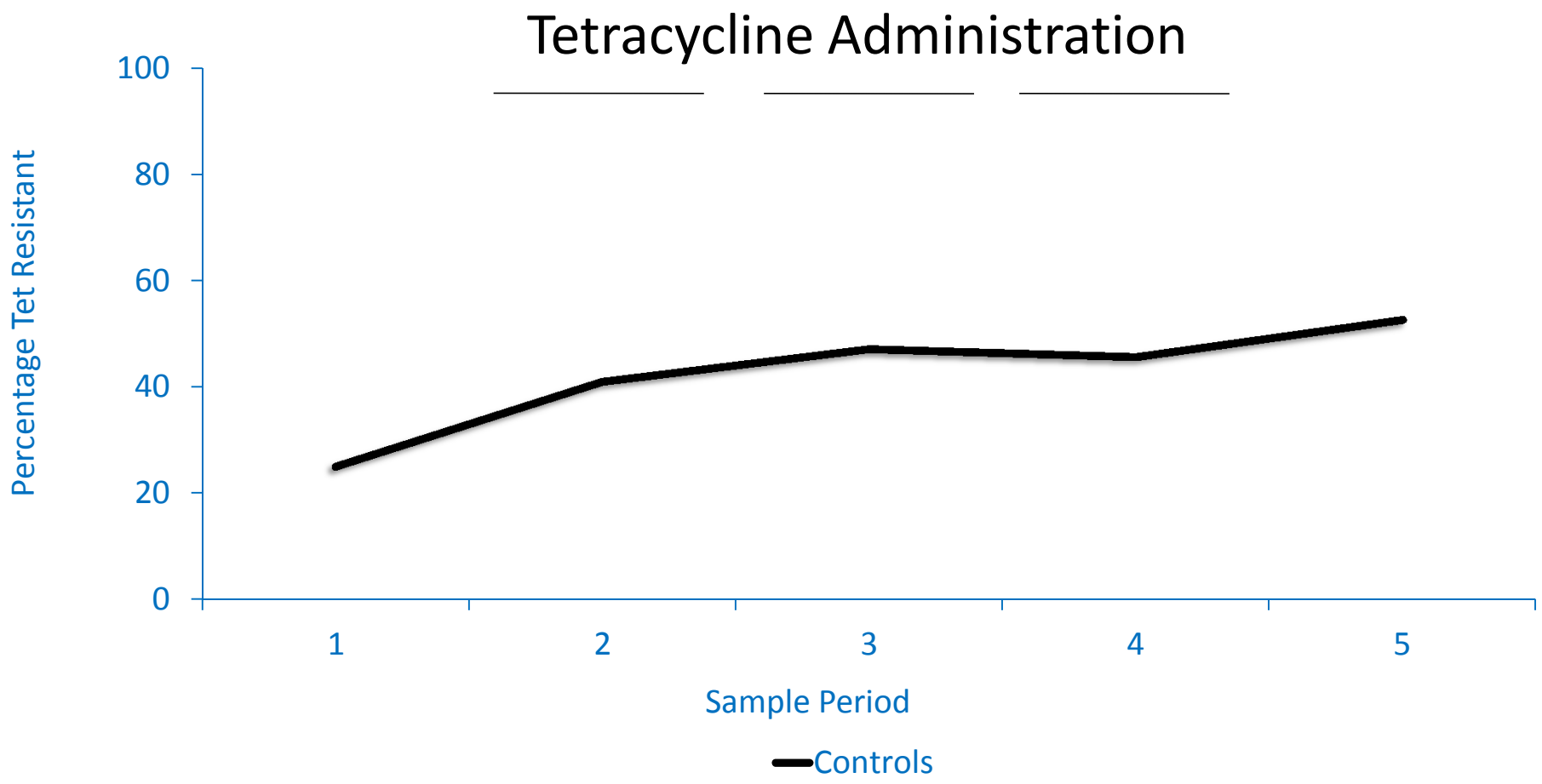
AMR Research: Ex 1

- Injectable long-acting ceftiofur (Excede)
- 10 animals in a pen
  - 5 administered once or 3 consecutive regimens
  - 5 animals served as unexposed controls



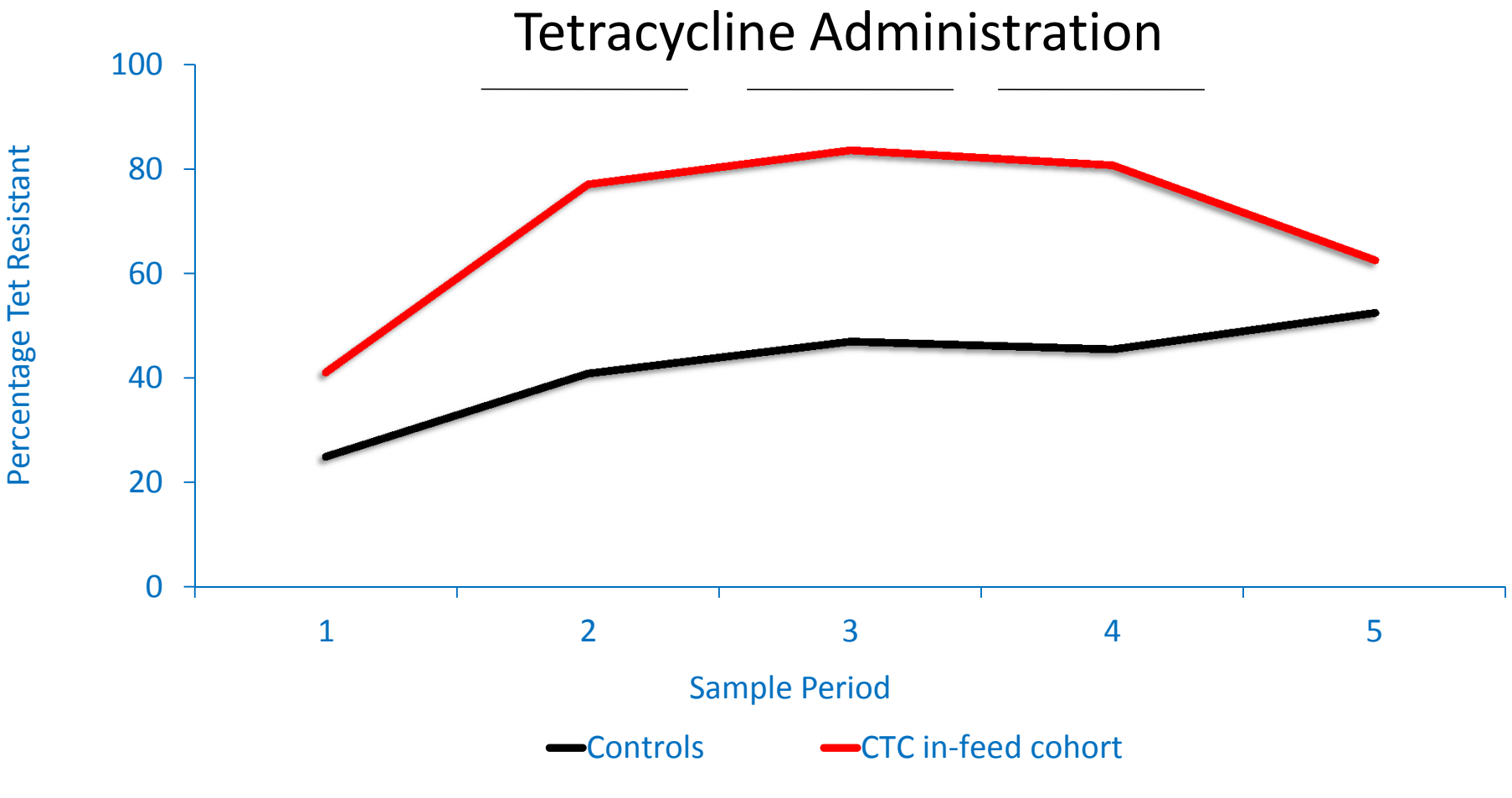
AMR Research: Ex 2

- Study performed in feedlot animals
  - *Used an antibiotic in the feed for short interval*

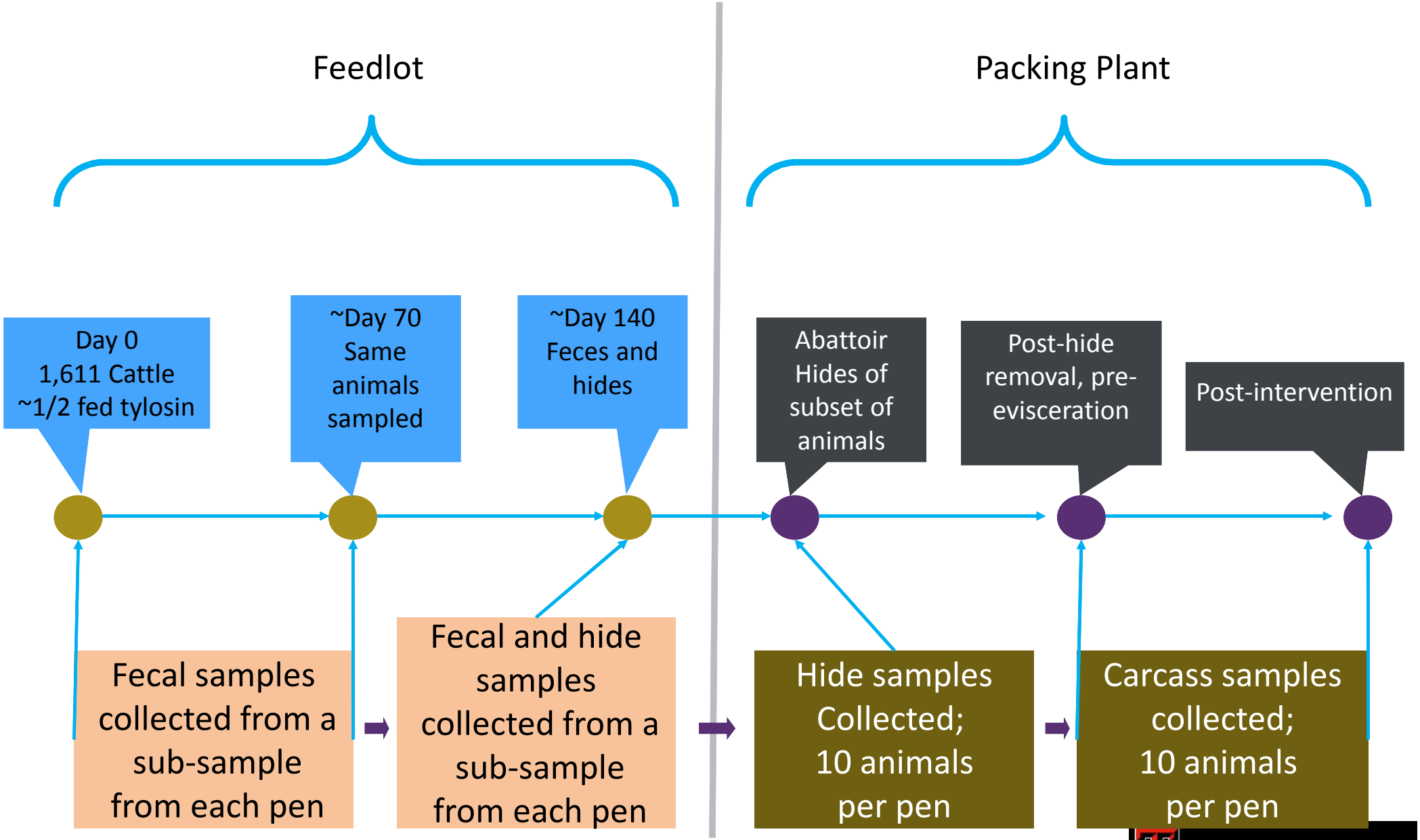


AMR Research: Ex 2

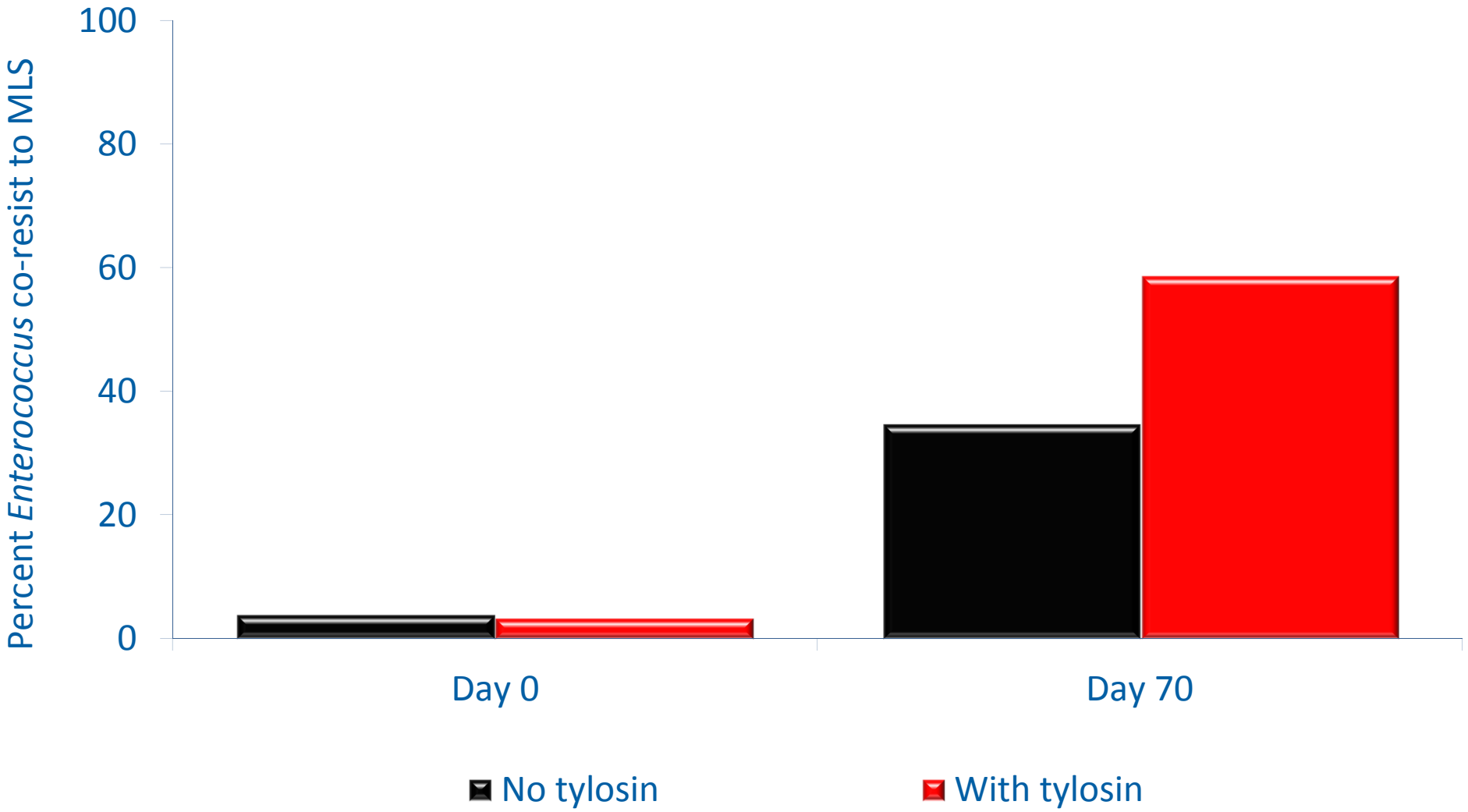
- Study performed in feedlot animals
  - *Used an antibiotic in the feed for short interval*



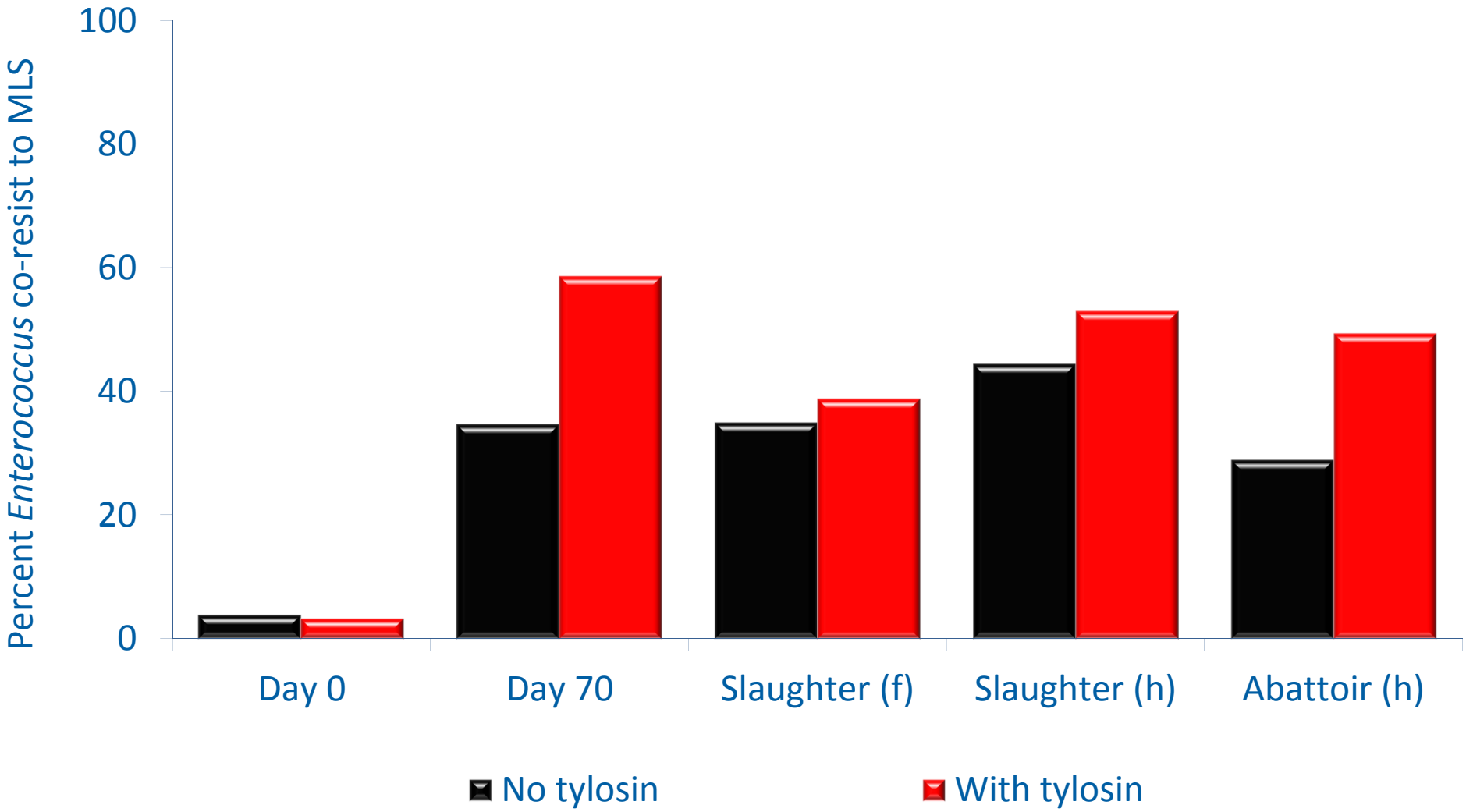
AMR Research: Ex 3



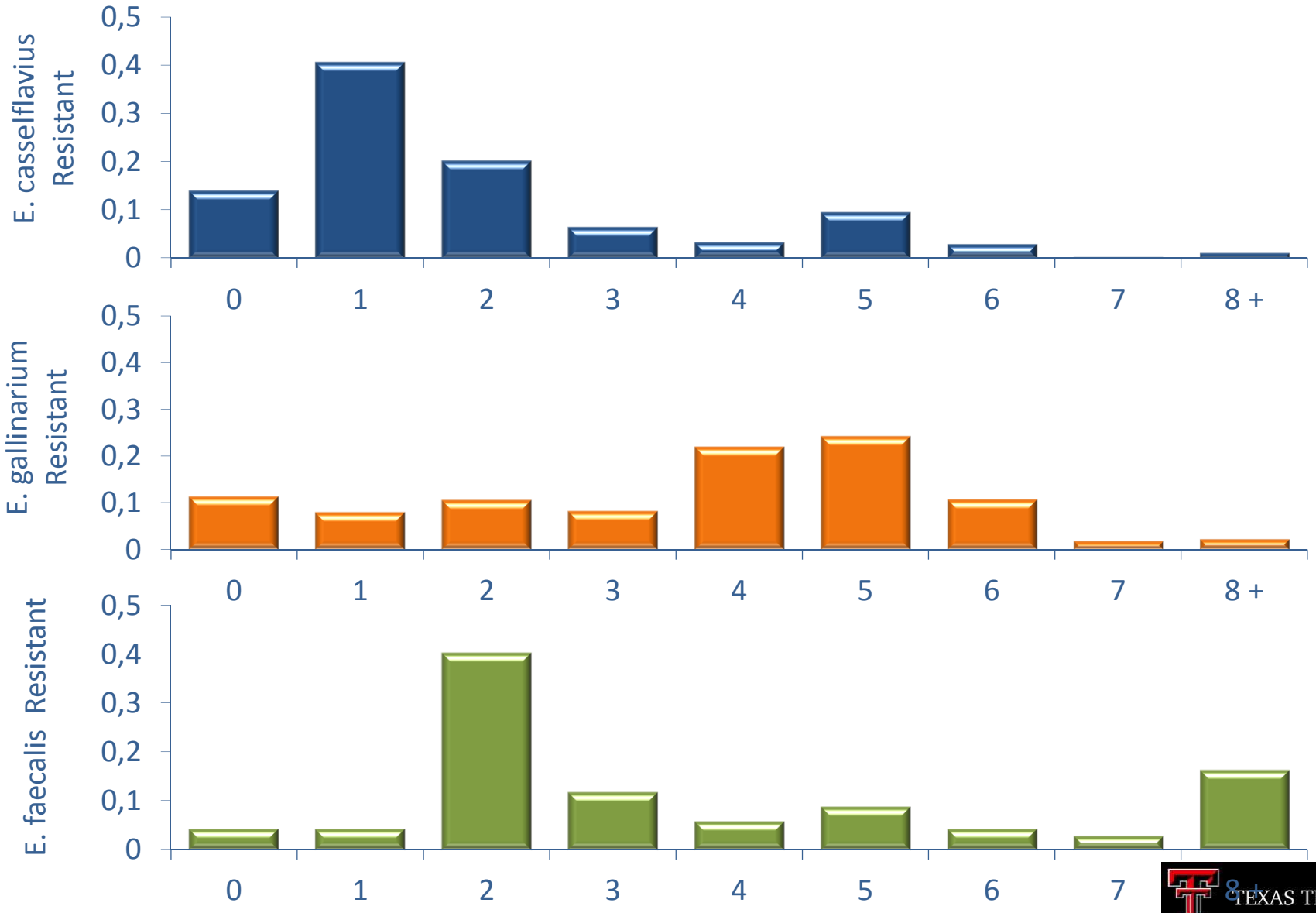
AMR Research: Ex 3



AMR Research: Ex 3



AMR Research: Ex 3

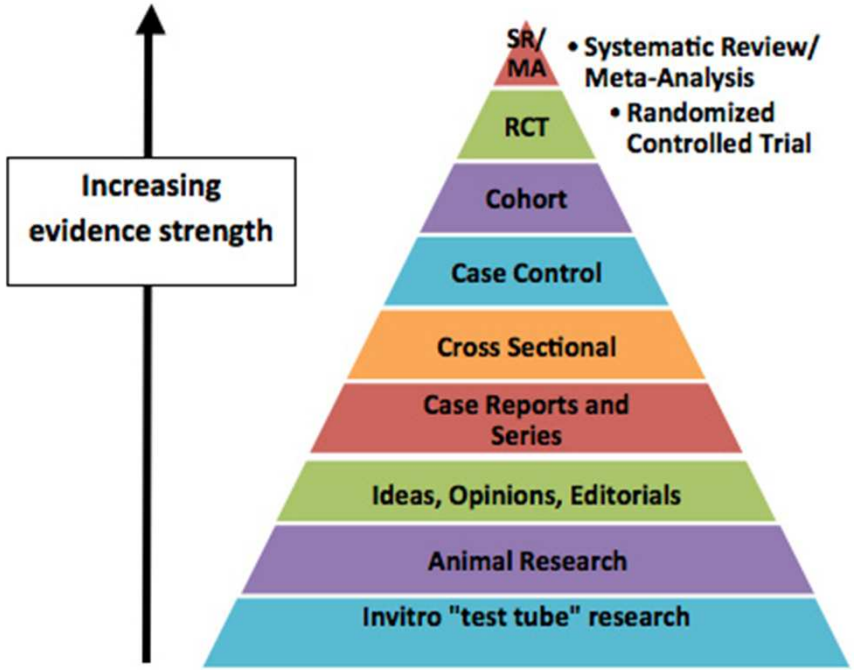


Summary

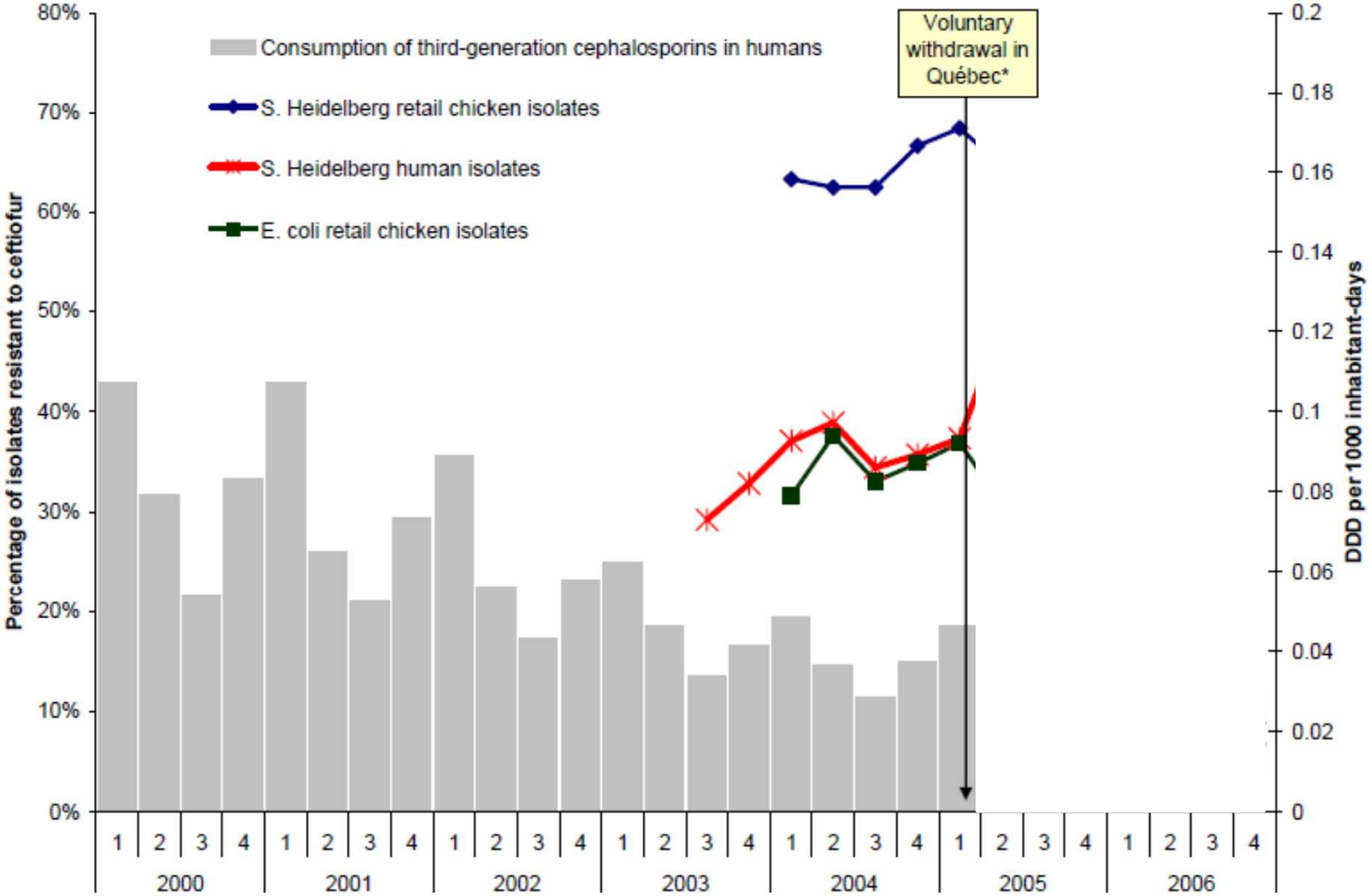
- Antibiotics provide a selection pressure against susceptible bacteria
  - In competitive environments, less susceptible (and sometimes resistant) populations expand
- Effect detectable regardless of if it is:
  - Injectable or in-feed
  - Therapeutic or non-therapeutic
  - On-label or off-label
  - Judicious or injudicious
- A selection pressure is a selection pressure

Information Needs

- So what?
  - Does it impact public health?
  - Unfortunately no experiment can be done to test this
    - Logistically impossible and ethically unsound
  - Have to look to observational studies to try and answer this question

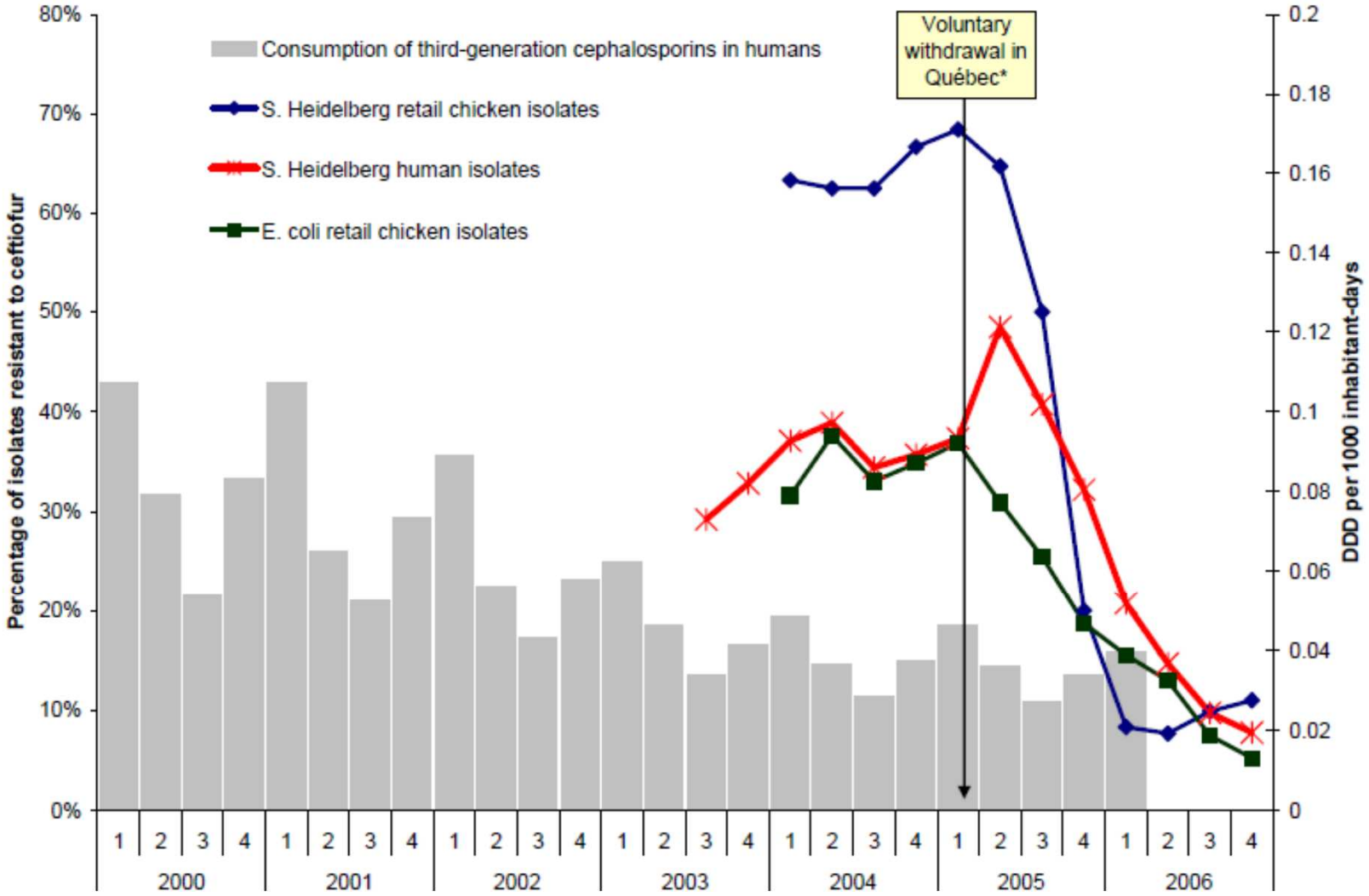


Animal Use and Human Resistance

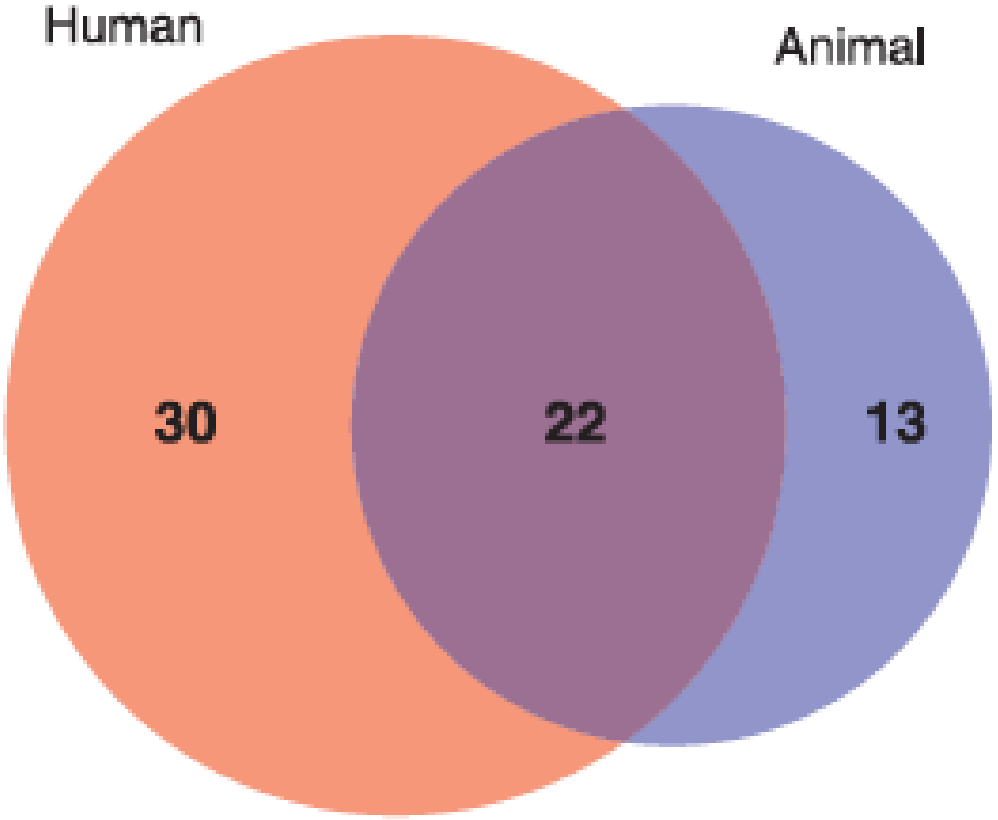


From *Emerg Infect Dis*. 2010;16:48-54

Animal Use and Human Resistance



From *Emerg Infect Dis*. 2010;16:48-54



- Resistance phenotypes were more diverse and tended to be observed first in the human population compared to the cattle isolates
- ‘resistance genes were largely maintained within animal and human populations separately and that there was limited transmission’
  - *PLoS ONE* 6(11):e27220.doi:10.1371
  - *Proc R Soc B*. doi:10.1098/rspb.2011.1975
  - *Science*. 2013;341:1514-7

Outcomes

- Questions :
  - Does antibiotic use in animals select for antibiotic-resistant bacteria?
    - YES >>> high degree of clarity that it does
  - Does it impact public health?
    - Possibly, probably, maybe…
      - High-degree of complexity and conflicting outcomes in observational studies
- Mission: preserve the efficacy of antibiotics into the future for the benefit of others
  - How then ought we act with confusing data?