

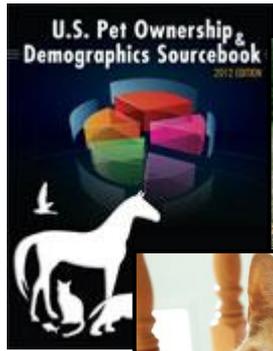
# Antimicrobial Resistance in Companion Animals

## What's Hot and What's the Risk?



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# U.S. Pet Ownership



**70,000,000 dogs**



**74,100,000 cats**

	<u>Dogs</u>	<u>Cats</u>	<u>Birds</u>	<u>Horses</u>
Percent of households	<b>37.2%</b>	<b>32.4%</b>	<b>3.9%</b>	<b>1.8%</b>
Average number per household	1.7	2.2	2.5	3.5

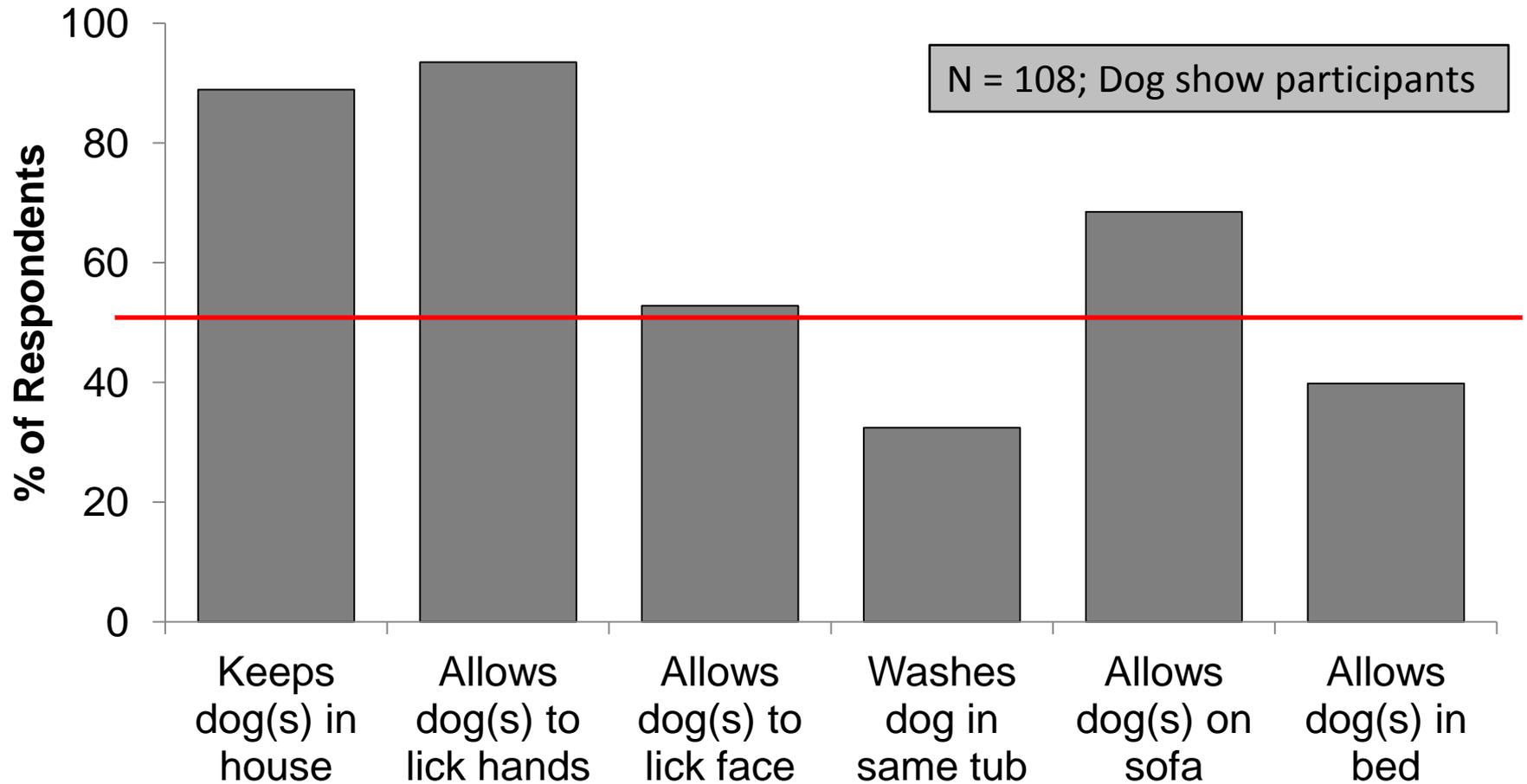
American Veterinary Medical Association , 2007

**63.2% of pet owners consider their pets to be family members**



American Veterinary Medical Association , 2012

# The Changing Relationship Between Owners and Pets



Walther et al., 2012

# U.S. Pets and Their Veterinarians

- **Dog** owners average 2.6 visits to their veterinarian each year
  - Average \$356
- **Cat** owners average 1.7 visits to their veterinarian each year
  - Average \$190
- Most common infections
  - Skin (and ear) infections
  - Urinary tract infections
  - Wound infections
  - Respiratory tract infections
- Antibacterial drugs are also used prophylactically to prevent infections prior to surgery

# Use of antibiotics in companion animals

- There is no central registry or survey data to described which medications are used most often
- **Baker et al., 2012**
  - 435 dogs enrolled after admission to a teaching hospital
  - 55.6% had received at least one antimicrobial in the previous 12 month
    - $\beta$ -lactams (72.7%)
      - Cephalexin
    - Aminoglycoside (32.2%)
      - Neomycin
      - Gentamicin
    - Quinolone (23.1%)
      - Enrofloxacin
  - Dose, route, duration were not well documented in medical records



# Monitoring Resistance in Companion Animals

- National monitoring programs for development of antimicrobial resistance in animals generally do not include companion animals
- Where is the data being generated?
  - State veterinary diagnostic laboratories
  - Commercial laboratories
  - Teaching hospital laboratories\*

# Antibiotic Resistant Organisms

- The most common organisms developing resistance in companion animals (dogs, cats, horses)
  - *E. coli*
  - *P. aeruginosa*
  - *Enterococci*
  - *Staphylococcus* species (incl. MRSA)
- Hot topics at NCSU VHC
  - Methicillin-resistant *S. pseudintermedius*
  - ESBL-producing *Klebsiella* and *E. coli*

# Methicillin-Resistant *Staphylococci*

- Methicillin (oxacillin) resistance confers resistance to
  - Pencillins
  - $\beta$ -lactam/ $\beta$ -lactamase inhibitor combinations
  - Antistaphylococcal cepheems
  - Carbapenems
- Mediated by the *mecA* gene and PBP2a protein
- Occurs in multiple staphylococcal species
  - *S. aureus* (MRSA)
  - *S. pseudintermedius* (MRSP)

# Methicillin-Resistant *Staphylococci*

- *S. pseudintermedius* is the predominant *Staphylococci* of dogs
  - 20-90% of healthy canine skin/mucous membranes
  - Most common cause of skin infections
  - Cats can be colonized; less frequent

## **Micky; 4 year old FS pug**

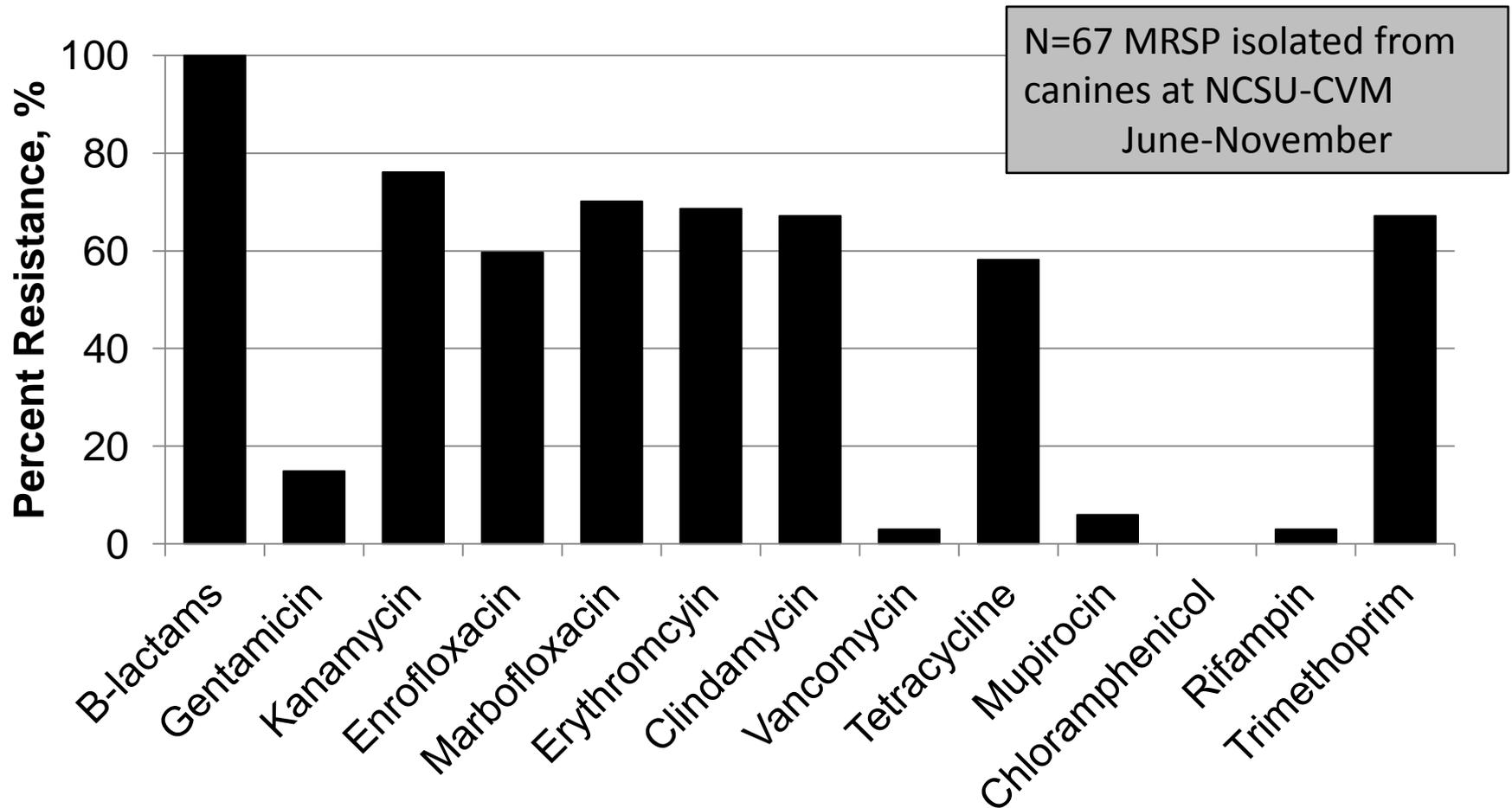
Previously responded to  
Cephalexin; Clavamox  
Now failing to respond to Cefpodoxime



# Methicillin-Resistant *S. pseudintermedius*

- Pinchbeck et al. (2006)
  - Results suggest most *S. pseudintermedius* strains associated with pyoderma are endogenous
- MRSP carriage can last more than one year after clinical infection is “cleared”
- Concurrent resistance to other antimicrobial classes is common
  - Bryan et al. (2012) suggest the majority of pyoderma cases resolve regardless of methicillin susceptibility

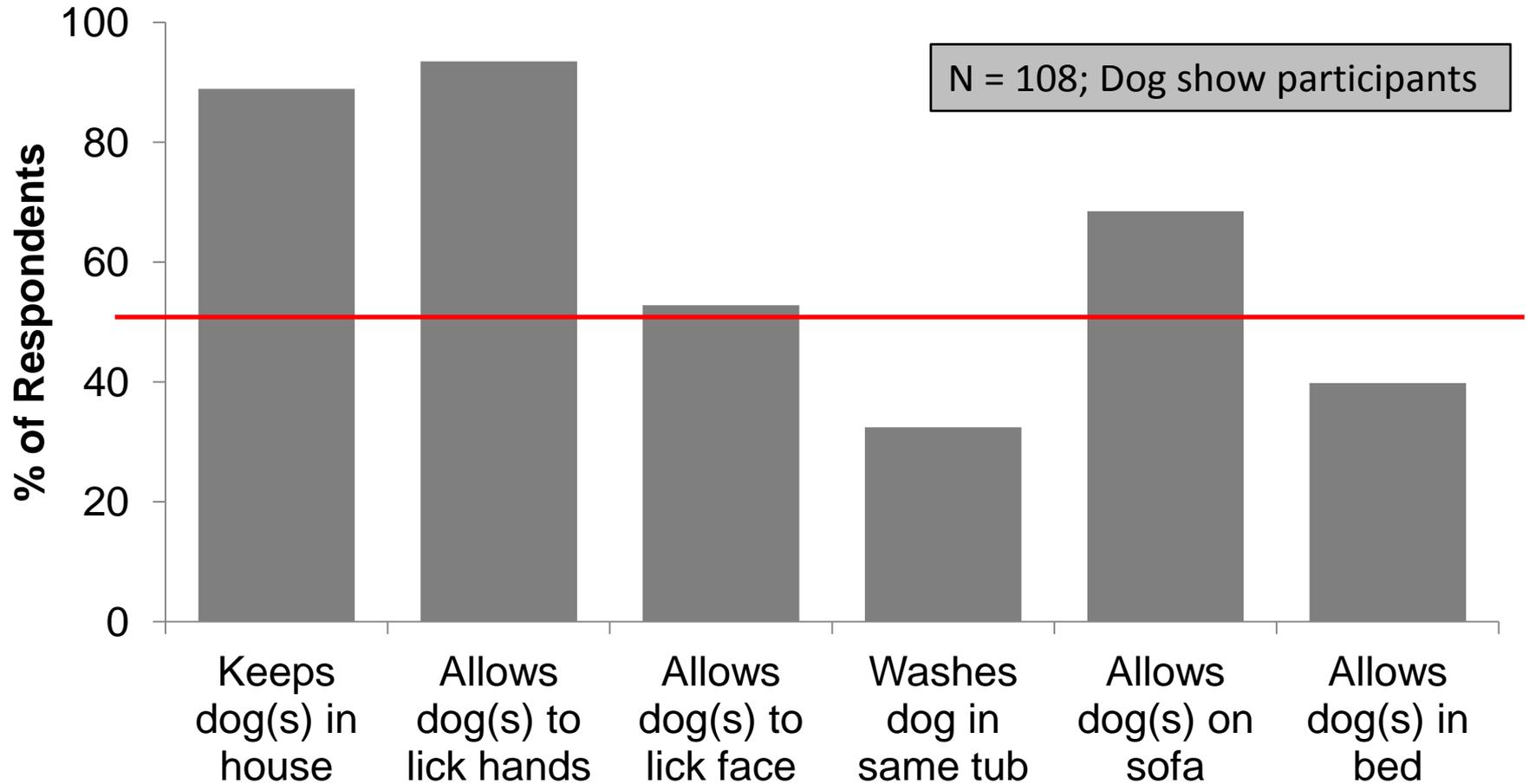
# MRSP Resistance to Other Antimicrobial Classes



# Zoonotic Transmission

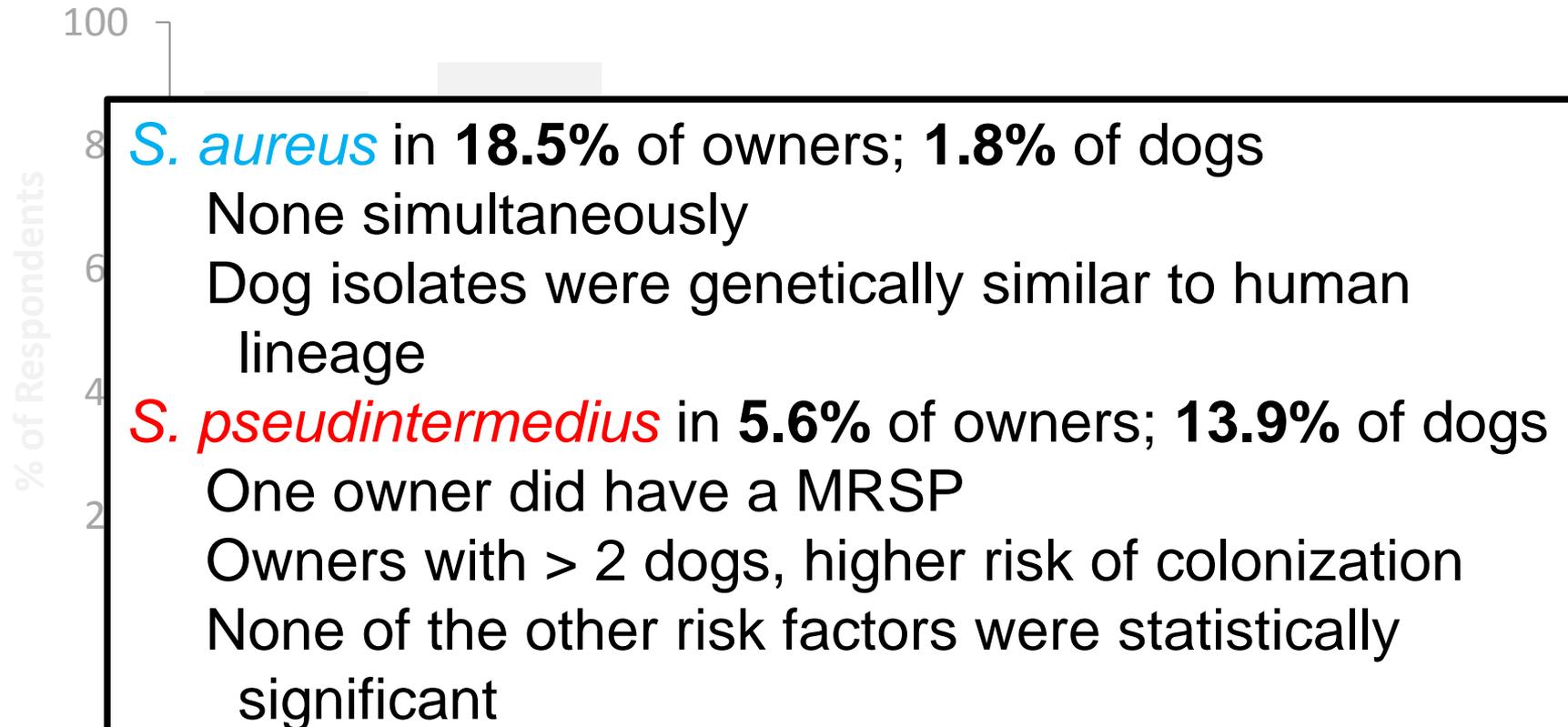
- Zoonotic transmission of *S. pseudintermedius* has been documented
  - Owning a dog is a significant risk factor
    - Especially if it has dermatitis
- Microorganisms residing on the skin or mucosal surfaces are the most likely to be transmitted
  - Sharing environments (bed; sofas; bath tubs)
- The reverse is also true!
  - *S. aureus*

# Zoonotic Transmission?



Walther et al., 2012

# What are we Sharing?



# Extended Spectrum Beta-Lactamases (ESBL)

- **ESBL's** are enzymes mediating resistance to all penicillins and cephalosporins
- *Enterobacteriaceae* can produce ESBL's
  - *E. coli*, *Klebsiella*, *Proteus*
  - Originally observed in HA infections from human hospitals
  - Emergence of these resistant organisms in community strains threatens effective therapy for all Gram negative infections
    - Plasmid associated
    - Associated with resistance to aminoglycosides and TMS
- Little description of these isolates in companion animals
  - Increasingly recognized in food animals

# At NCSU VHC

- Presumptive ESBL organisms are identified based on initial susceptibility to cefpodoxime
  - Confirmatory E-test is used prior to notifying clinicians
  - The specific resistance mechanisms are not being evaluated at this time

	<u>Dogs</u>	<u>Cats</u>	<u>Horses</u>
<i>E. coli</i>	9	3	2
<i>Klebsiella</i>	10	0	1

Isolates from nasal swabs, corneas, wounds, urine

# *Enterococcus*

- Normal inhabitants of the GI tract
  - Not typically associated with severe disease in companion animals
    - Commonly found in UTIs
    - Nosocomial complications
  - Often found in the presence of another pathogen
- Resistance is widespread and of public health importance
  - Resistance develops rapidly
  - Resistance genes are readily shared with other organisms
- Use clinical judgment to decide if this organism is significant prior to treatment

# *Pseudomonas aeruginosa*

- Predominantly associated with skin and ear infections
  - Evidence for increasing resistance to fluoroquinolones in otitis externa cases
  - Rubin et al. (2008)
    - ~30% resistant to fluoroquinolones
    - 10-90% resistance to aminoglycosides
    - Resistance to tetracycline, sulphonamides, and chloramphenicol remain high (>75%)

Charlie; 10 year old  
MC Cocker Spaniel



# Conclusions

- Companion animals are reservoirs for antimicrobial resistant organisms
- We may be under-recognizing their potential contribution to populations of antimicrobial resistant organisms
  - Their association with human health is still unclear
- Work is needed to better describe the relationship between resistant microorganisms in humans and their pets
  - Potential collaboration and a one health approach

Questions?