Enhancing practitioner knowledge and adoption of infection prevention and control measures for both food and companion animal veterinarians

NAS Workshop Session 2 – Part B
June 20, 2017

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Antibiotic stewardship: clinical medicine

- IDSA: “...antimicrobial stewards seek to achieve optimal clinical outcomes related to antimicrobial use, minimize ...adverse events, reduce the costs of health care for infections, and limit the selection for antimicrobial resistant strains.”
Antibiotic stewardship: veterinary medicine

At Texas A&M University:
“Drugs of Last Resort Policy (2007)”

- Stewardship guidelines for:
  - 4th gen cephalosporins, carbapenems, newer FQ, Synercid, linezolid, taz-pip, vancomycin
  - 6-8X per year requests for carbapenems or vancomycin (equine limb perfusion)

- Ongoing CDC-funded project (S.D. Lawhon: PI) on use, resistance in referral vet hospitals (TAMU, NCSU, CU)
WHO List of Critically Important Antimicrobials (2012): Risk Management Recommendations

When a new class of [human] drug comes on the market, it should be considered critically important from the outset unless strong evidence suggests otherwise.

Existing drugs such as carbapenems, linezolid, and daptomycin, which are not currently used in food production, should likewise not be used in the future in animals, plants, or in aquaculture.
Behavior in a theoretical context

“Do or do not, there is no try”  
Jedi Master Yoda

[but there still might be intentions to do so]… Me

• A primer on the Theory of Planned Behavior (TPB)
  – Its extension to antimicrobial prescribing and use practices in clinical and production settings
Theory of planned behavior (TPB): after Ajzen, 1991

Applications

Health care settings

- Studies of physician / dentists prescribing practices
- Studies of patient compliance behaviors
  - Relatively simple interpersonal relations
  - Little concern about competition, very limited social network

http://people.umass.edu/aizen/tpb.html
Extension of the theory to more complex social networks

Social network of salient others’ and their often varied expectations and norms
Extension of the TPB: Intensive Production Agriculture

Intention to Behave

Current Behavior

Attitudes

Perceived Behavioral Control

Moral Norms and Salient Obligations

Subjective Norms and Salient Others

Behavioral Beliefs and Belief Importance

Trust or Confidence in Others

Perceived Behavioral Control

Moral Norms and Salient Obligations

Subjective Norms and Salient Others

Behavioral Beliefs and Belief Importance

Trust or Confidence in Others
I have a **moral duty** to use antimicrobials as therapy

Level of respondent agreement with the statement:
I have a moral duty to treat acutely ill feeder cattle with antimicrobials

<table>
<thead>
<tr>
<th>Feedlot operator</th>
<th>Veterinarian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overwhelmingly agree</td>
<td>Overwhelmingly agree</td>
</tr>
<tr>
<td>3%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Responses do not differ at $P = 0.413$
I have a **moral duty** to use non-therapeutic antimicrobials

Graphs by respondent type:

- **Feedlot operator**
  - **Majority agree**
  - **24%**
  - **10%**
  - **15%**

- **Veterinarian**
  - **Majority disagree**
  - **25%**
  - **15%**
  - **3%**

Responses differ at $P < 0.0001$
Antibiotic stewardship: production agriculture

- **Target bacterial pathogens**
  - Bovine respiratory disease complex
  - *Mannheimia haemolytica*, *Pasteurella multocida*

- **Non-target bacterial pathogens and commensals**
  - Enteric bacteria
  - *Salmonella*, *E. coli*
Antibiotic stewardship: production agriculture

• Individual animals
  – Therapeutic use
    • Treatment

• Groups of animals
  – Therapeutic use
    • Control (metaphylaxis)
    • Prevention (prophylaxis)
A tangible risk analysis framework

Figure 1: A stepwise risk assessment method for estimating the impact on human health from macrolide resistance that develops on poultry farms.

Figure 2: Release assessment schematic: avoiding release of resistance from the farm

Macrolide given to animals

RzD selected above background

RzD escapes from farm

Viable organisms with RzD present in food for further processing

Viable organisms with RzD present in retail meat

Probability of mishandling and presentation to human

Patient gets ill

Patient treated with macrolide

RzD selected above background

RzD escapes from farm

Release assessment: Describes the probability that factors related to the antimicrobial use in animals will result in the emergence of resistant bacteria or resistance determinates (RzD).

Exposure assessment: Describes the likelihood of human exposure to the RzD through particular exposure pathways.

Consequence assessment: Describes the relationship between specified exposures to the RzD (the hazardous agent) and the consequences of those exposures (CVM-defined hazard).

Adapted from Hurd, HS. Microbe 2006
The Dutch experiment: Speksnijder (2017)

Figuur 2. Totale antibioticagebruik op groep A bedrijven (grijze lijn), groep B bedrijven (zwarte lijn) en het Nederlandse gemiddelde (stippellijn) in de studieperiode.
The Dutch experiment: Speksnijder (2017)

Figure 1. Sales figures for antibiotics licensed for therapeutic use in animals in the Netherlands from 1999 up to 2015. Data derived from FIDIN (http://fidin.nl/Beleid/Antibiotica) and (MARAN 2016).