

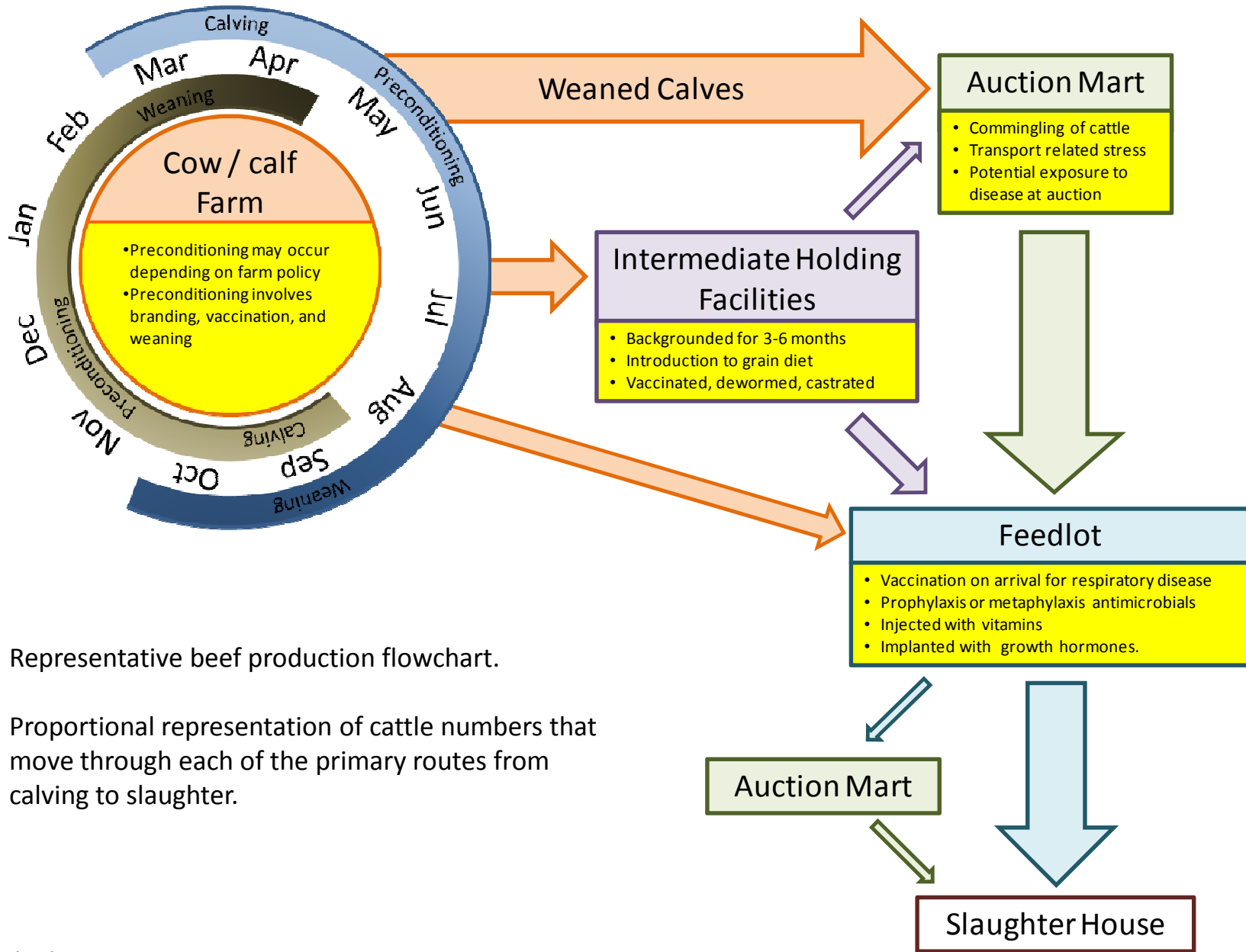
A review of alternative practices to antimicrobial use for disease control in the commercial feedlot

Ribble CS, Stitt T, Iwasawa S, Toews L, Stephen C

Centre for Coastal Health
900 5th Street, Nanaimo BC
V9R 5S5

Canadian Cattle Herd

- 11.1 million beef cattle nationally (July 2008)
 - 44% raised/fed in Alberta
 - 3.46 million head of cattle fed for slaughter nationally, 2.29 million in Alberta alone
 - 11 feedlots with capacities >20,000 head of cattle each can accommodate up to 34.9% (~ 796,000 head) of all the cattle on feed in Alberta (as of 2000)
- Canada's global 'footprint'
 - 12th for beef cattle production
 - 3rd largest exporter
- Annual US per capita red meat consumption: ~27 kg



Representative beef production flowchart.

Proportional representation of cattle numbers that move through each of the primary routes from calving to slaughter.

Infectious Disease in the Feedlot

- Timing of major causes of morbidity and mortality in North American feedlots
 - Within 2-3 weeks post-arrival, associated with:
 - Pneumonia
 - Later in the feedlot cycle, attributed to:
 - *Histophilus somnus*, AIP, bloat, liver abscess
 - ***Majority of antimicrobial use on feedlots is within the first 30 days post-arrival***
- For every 1000 calves entering a feedlot, approximately:
 - 7.2 die from pneumonia
 - 2.9 die of digestive tract disorders
 - 2.5 die from other causes

Antimicrobials/AMR in the Feedlot

- Antimicrobials are used in feedlots for
 - Disease prevention (metaphylaxis)
 - Disease control (parenteral therapy)
 - Growth promotion (in-feed)
- Level and cause of AMR in feedlots is under debate
- In Canada, production is concentrated in a relatively small number of producers predominantly located in Alberta & Saskatchewan
- **Opportunities exist for significant impact on the control of AMR's if new best practices for infection control can be identified and implemented**

Our Objectives

- Are there management practices that reduce the incidence of:
 - Illness and mortality due to pneumonia, especially in high-risk feedlot calves, but do not involve the administration of antimicrobials?
 - Liver abscesses in feedlot cattle, but do not rely on in-feed or sub-therapeutic antimicrobial use?
- Assumption:
 - By reducing antimicrobial use, one would reduce the potential for antimicrobial resistant bacteria to emerge and persist in the feedlot setting

- 2820 unique abstracts from 5 search engines
- 387 papers identified as relevant

Subject Category	Number of papers	Percent of total
Management to reduce feedlot disease	142	37
Background and introduction papers	76	20
AMR studies involving <i>E.coli/Salmonella/Campylobacter</i>	73	19
Effect of therapeutic use of antibiotics in feedlot	34	9
Does AMR increase or decrease in the feedlot?	22	6
Reducing pathogen load in the feedlot	14	4
Management to reduce antimicrobial use	13	3
Effect of sub-therapeutic use of antibiotics in feedlot	7	2
AMR causes	6	2
Total	387	

Management to reduce feedlot disease sub-categories	Number of papers	Percent of total
Risk factors for disease development at the feedlot	36	25
Vaccination upon arrival at the feedlot	33	23
Disease and infection management at the feedlot	28	20
Nutritional management	17	12
Pre-conditioning & vaccination before the feedlot	14	10
Other	14	10
Total	142	

Risk factors for disease development at the feedlot sub-categories	Number of papers	Percent of total
Pathogens	20	56
General	10	28
Behaviour	3	8
Mixing	2	6
Transportation	1	3
Total	36	

Risk Factor Papers

- Some observational studies were useful for:
 - Understanding the epidemiology of bacterial diseases in the feedlot
 - Developing hypotheses about alternative disease management strategies
- Risk factors for respiratory disease:
 - Recently weaned calves 6-8 months old, from multiple farms that are sold through & commingled in auction marts
 - Higher occurrences of pneumonia in late October & November
- Feedlots use these variables to:
 - Classify incoming calves as high risk
 - Treat them with metaphylactic antimicrobials at arrival

Vaccination on Arrival

- Only 7/33 (21%) relevant papers passed our exclusion criteria
 - The protective effect of vaccines vary with pathogen, animal source and type of vaccine administered
 - Vaccination generally does not eliminate the target disease, but can sometimes reduce morbidity, mortality and/or treatment costs
 - Many vaccine trials resulted in inconclusive, marginally significant or no demonstrable benefit
 - No study was found that evaluated the contribution of vaccination to reducing AMR in feedlots.
- High incidence of BRD despite routine on-arrival vaccination
- Therefore, antimicrobial agents continue to be used on-arrival in high-risk calves

Disease & Infection Management

- 28 papers with highest likelihood of presenting information about management techniques not involving vaccination, nutrition, or antimicrobial use
 - 9 presented evidence from new data collected by the authors
 - **None** provided useful information for the design of effective disease management strategies for the large modern feedlot

Nutritional Management

- Liver abscesses are one of the most commonly cited reasons for the use of in-feed antimicrobials in feedlots
- 10 papers dealt specifically with liver abscesses
- Vaccination for this bacterial disease has had mixed results
- Medicated feeds remain the most common approach to reducing the prevalence and severity of liver abscesses due to:
 - The absence of effective vaccination
 - Current feeding protocols require rapid transition to high energy feeds

Preconditioning

- Some evidence that vaccination & weaning of calves at their source cow-calf farms several weeks prior to being shipped to a feedlot reduces disease at the feedlot
- However:
 - Consistency and size of the effect has been difficult to establish, at least in part due to design challenges
 - Historical inability of the auction market transfer system to consistently provide a premium for vaccinated calves
 - Preconditioning has not become an effective disease management strategy for feedlot owners in North America

Recommendations

- Establish a working group of stakeholders to look for funding sources for
 - intervention studies to test the effectiveness of disease control strategies not involving antimicrobial use
 - basic epidemiological studies of the bacterial diseases in the feedlot
 - research on antimicrobial use strategies
- Explore how real and widespread the so-called ‘November effect’ is, how much AMR might have to do with the phenomenon and, ultimately, what to do about it
- Examine which triggers for mass medication are most effective while limiting the overall ‘load’ of mass medication

Recommendations

- Examine long-term effects of metaphylactic antimicrobial use in the feedlot on treatment efficacy and AMR within and across different feedlots
- Liaison with researchers already exploring antimicrobial cycling or rotation in human hospital settings
- A program of multiple methods that can be applied in an adaptive fashion is needed



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Questions?

AMR Studies in Feedlots

- 23 papers published between 1988 and 2009
 - Only 2 papers looked at bovine respiratory pathogens

Administered Antimicrobial	VDDC	Typical Feedlot Use	Number of Papers*	Evaluated Organism	Number of Papers*
None			8	<i>Escherichia coli</i>	10
Monensin	IV	Growth promotion, in-feed	7	Campylobacter sp.	5
Tylosin	IV	Growth promotion, in-feed	6	Salmonella sp.	4
Chlortetracycline	III	Growth promotion, in-feed	5	Enterococcus sp.	2
Sulfamethazine	III	Growth promotion, in-feed	4	<i>Pasteurella multocida</i>	2
Oxytetracycline	II/III	Both	4	Not identified	2
Virginiamycin	IV	Growth promotion, in-feed	2	<i>Histophilus somni</i>	1
Tilmicosin	II	Respiratory disease, injection	2	<i>Leptospira hardjo</i>	1
Florfenicol	III	Respiratory disease, injection	1	<i>Mannheimia hemolytica</i>	1
Procaine Penicillin	I	Respiratory disease, injection	1	Yersinia sp.	1
Trimethoprim	III	Respiratory disease, injection	1		
Tetracycline	III	Growth promotion, in-feed	1		

* Some papers evaluated multiple antibiotics

VDDC: Veterinary Drug Directorate's Categorization of Antimicrobial Drugs based on the Importance in Human Health.

* Some papers evaluated multiple organisms

AMR Studies in Feedlots (continued)

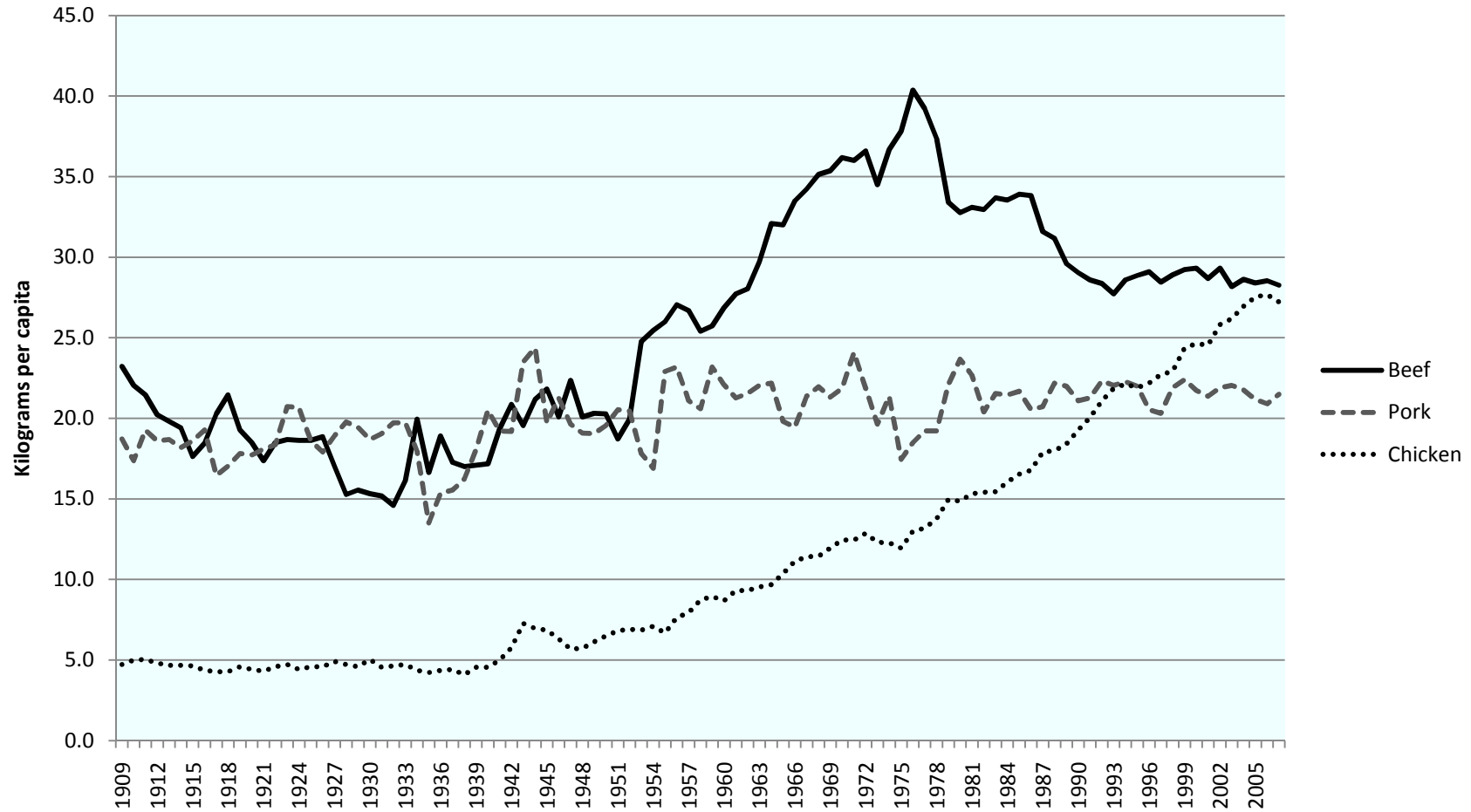
Method of Antibiotic Use	Timing of Antibiotic Use	Number of Papers*
In-feed	Continual	10
Injectable	Initial treatment for BRD	4
Not identified	Not identified	10

* One paper evaluated multiple methods and timing

Type of Study	Number of Papers
Clinical trial	1
Cross sectional study	9
Longitudinal study	2
Prospective cohort study	9
Retrospective cross sectional study	1

Location of Study	Number of Papers
Closed Beef Herd	1
Commercial Feedlot	12
Diagnostic Laboratory	1
Research Facility	9

Annual U.S. per capita food availability of boneless, trimmed (edible) meat: 1909-2007



Beef cattle antimicrobial treatment guidelines (CVMA, 2008)

Disease	Microbial Agents	Treatment Options	VDDC
Bacterial pneumonia undifferentiated respiratory disease	<i>Mannheimia haemolytica</i>	Florfenicol	III
	<i>Pasteurella multocida</i>	Oxytetracycline dihydrate	III
	<i>Histophilus somni</i>	Oxytetracycline hydrochloride	II
	<i>Mycoplasma bovis</i>	Tilmicosin	II
	<i>Mycoplasma spp.</i>	Trimethoprim-sulphadoxine	II
		Tulathromycin	II
		Ceftiofur hydrochloride	I
		Ceftiofur sodium	I
		Ceftiofur crystalline free acid	I
		Danofloxacin	I
	Enrofloxacin	I	

VDDC: Veterinary Drug Directorate's Categorization of Antimicrobial Drugs based on the Importance in Human Health.