Measuring antibiotic use in the swine industry

Dr. Peter Davies BVSc, PhD

College of Veterinary Medicine, University of Minnesota

Epitome Consulting, LLC

Antibiotic use (ABU) in food animals
What really matters?

- Are food animal industries doing harm, and how much?

- Are antibiotics used efficiently in food animals?
  - What is effective and necessary for animal health and wellbeing, and food safety?
  - What is philosophically defensible?

- How good is the evidence?
  - Harm to public health
  - Benefits to animal health and/or food safety
  - How best to use antibiotics in food animals

- How to do better, regardless of impact on public health?
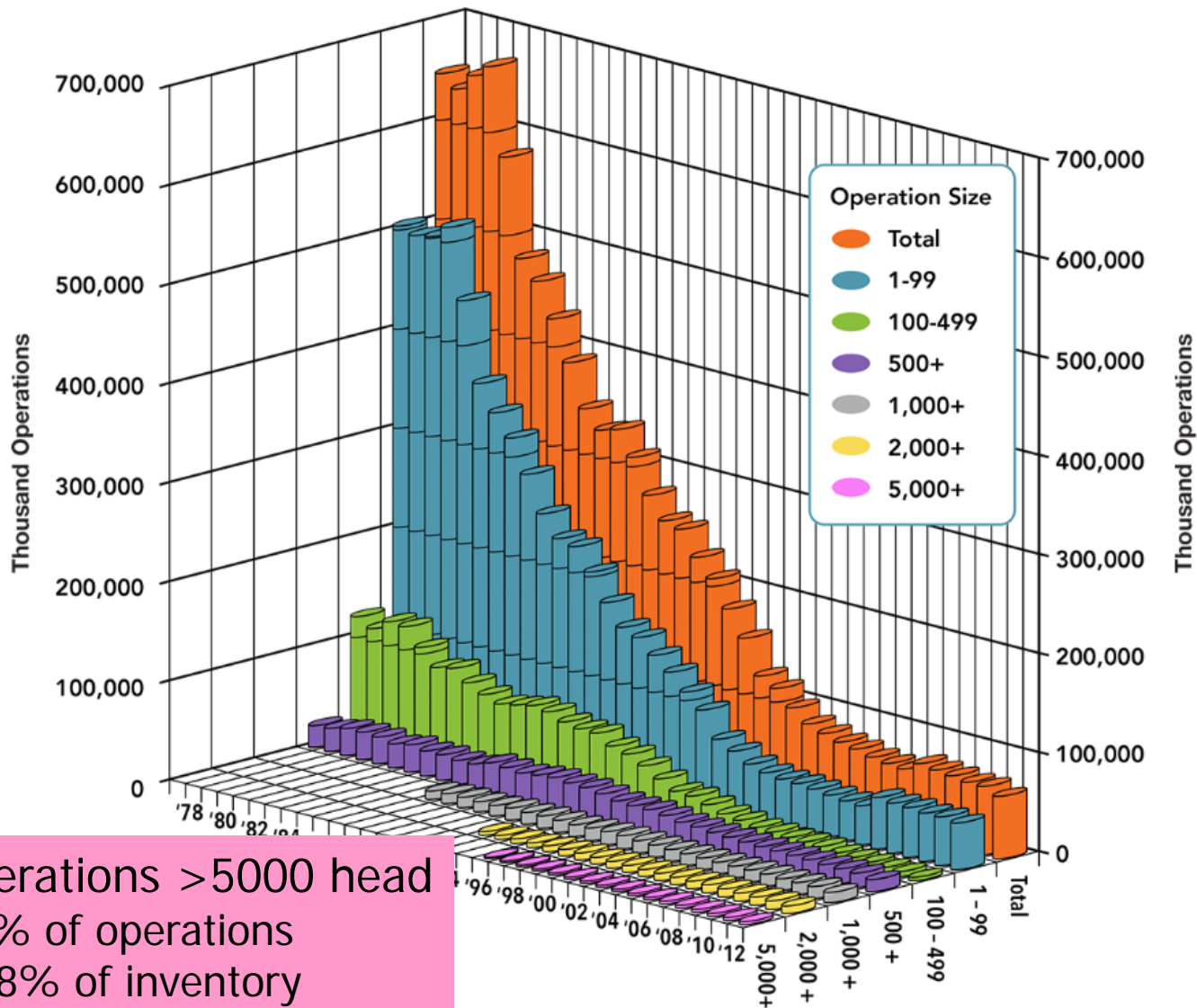
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US Swine industry overview

- ➤ > 60,000 farms
- ➤ ~ 70 million inventory
- ➤ > 110 million animals marketed annually
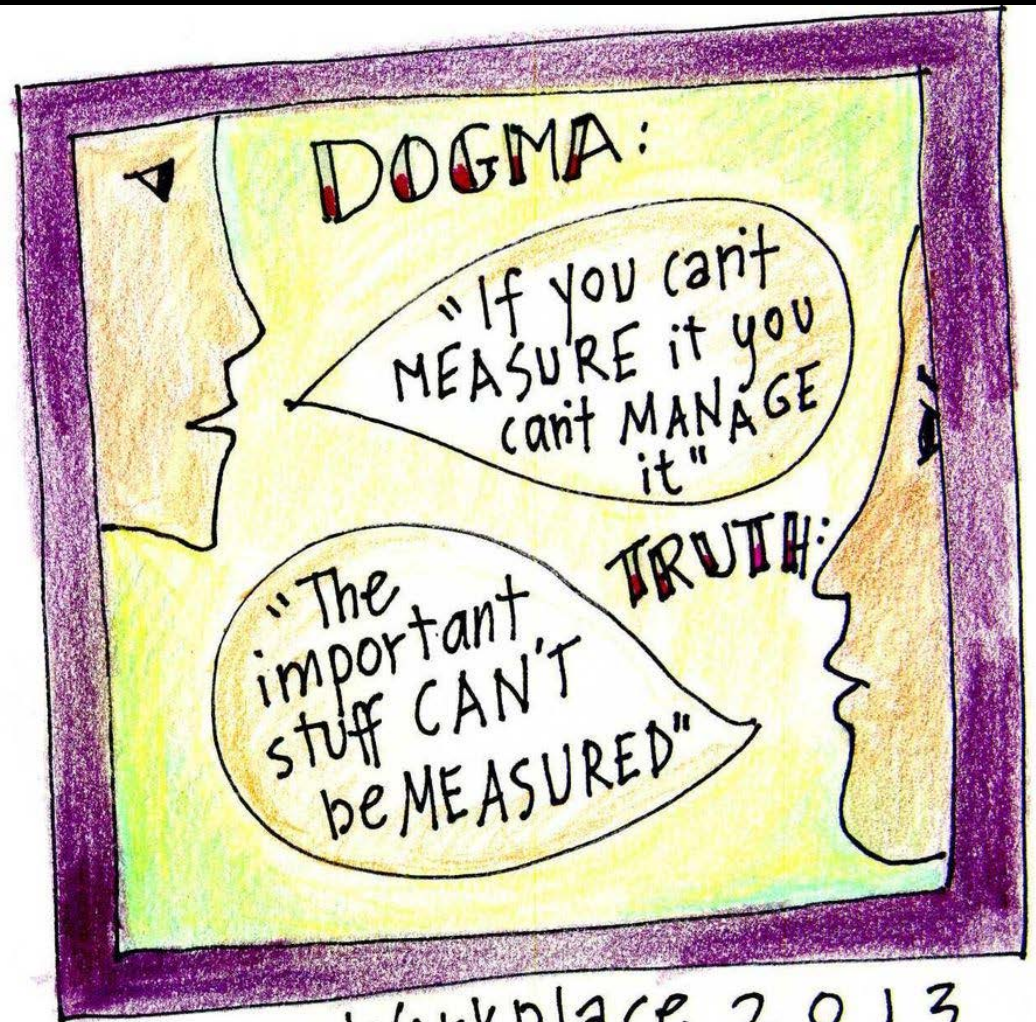
Hog and Pig Farms by Type of Owner

	% of Operations	% of Sales
Family/Individual	83	41
Corporation	8	34
Partnership	7	23
Other	2	2
All	100	100

Source: USDA NASS, 2012 Census of Agriculture.
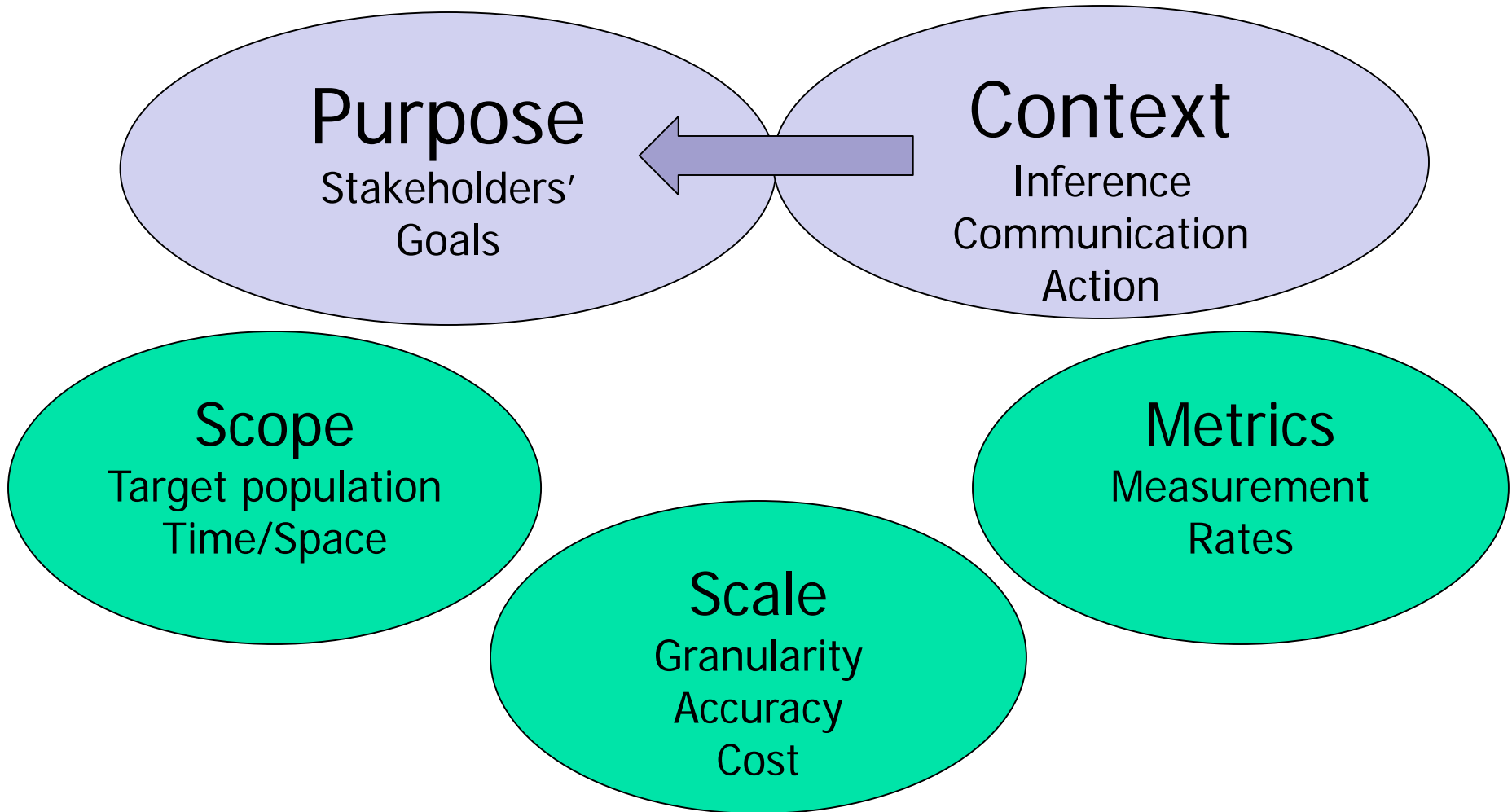
Increasingly concentrated industry

2014: Operations >5000 head
~ 5% of operations
~ 68% of inventory

DOGMA:

"If you can't MEASURE it you can't MANAGE it"

TRUTH:

"The important stuff CAN'T be MEASURED"

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Towards meaningful measurement

Purpose
Stakeholders'
Goals

Context
Inference
Communication
Action

Scope
Target population
Time/Space

Scale
Granularity
Accuracy
Cost

Metrics
Measurement
Rates

What is the primary goal?

- Reduce the impact of ABU in animals on clinical resistance in human medicine
- Reduce ABU in veterinary medicine
  - Independent of AMR and stewardship outcomes
  - Arbitrary targets?
- Optimize ABU (use more effectively)
  - Inform and motivate antibiotic stewardship
  - Reduce 'inappropriate' antibiotic use
  - Preserve efficacy of antibiotics in veterinary medicine

NPB Sabattical project NPB 2015-2016

- Review AMU systems used in EU
  - Visits to DK, NL, BE, DE (2013, 2016)
- White paper to NPB (April 2016) on options for measurement in US industry
  - Assessment of existing data sources
  - Comparison of metrics
  - Form industry task force
- Design pilot project for AMU measurement
- May 2016 - FDA RFP (funded Sep 2016)

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Develop and implement an antibiotic use data collection program in U.S. swine production

- FDA cooperative agreement
  - 5 year time frame
- Evaluate existing data on antibiotic use in the swine industry
  - 2016 data forward
- Develop a platform for data collection that minimizes producer disruption
- Guidance of NPB task force

Leverage existing data

- 'Pork powerhouses'
  - 30 producers >50% of production
  - Record/analyze AMU for cost accounting reasons
  - Some benchmarking on costs of AMU
    - Agristats, Metafarms
  - Variability in granularity of data recorded
  - Some publishing AMU (mg/lb)
- Private benchmarking initiatives (PART)

General approach

- **Initial focus on large systems and existing data collection systems**
  - Scope and granularity of data
  - Approaches to achieve confidentiality
  - Benchmarking and understanding practices
  - Development of metrics
- **Phased development**
  - Initial pilot project for feasibility
  - Grow-finish

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Voluntary participation

- Need for AMU data and analysis
- Potential for sharing data already collected
- Must give value to participants
  - Benchmarking
  - Broader industry benefit
- Confidentiality
- Benefits of USG involvement
  - Credibility and analytical resources
- Metric(s)

Leverage existing data

- Accounting based – no standard method
  - Invoicing not administration
- Level at which use is attributed and analyzed
  - System
  - Flow
  - Site
  - Barn
  - Lot (group)
  - Pigs (injection only)

What is a year?

- Tracked by lot
  - Groups closed out in calendar year
  - ABU by weight; pigs/wt by closed lots
  - Variation in ABU among lots within systems
- Not tracked by lot
  - ABU in calendar year across all growing sites
  - Pigs/wt sold across all sites in calendar year
  - Assumes 'steady state' production
- Hybrid – feed by system, Water/Inj by lot

Pig Flow complexity

- Wean-to-Finish vs. Nursery and Finishing
- Variability in site capacity and barns
- 'Double stocking'
- Commingling
- Traceability and allocation of ABU through flow

Attribution issues

- Data mostly based on orders/dispensing
- Amounts allocated to lots or sites (or not)
  - Assume all used for respective lots
  - OK for feed (correct distribution, wastage)
  - Carryover for injectables and water
- Significance of carryover amounts
  - Level of analysis
  - Lot vs. site vs. flow vs. system

Population denominator issues

- Numbers vs. weight vs. both
- Numbers
  - Pigs marketed in 2016 vs. pigs placed
  - Mortality, culls
  - Retained for breeding
  - Primary and secondary markets
- Weight and age of pigs marketed
  - Varies with market conditions
  - Live weight vs. carcass weight

Scope vs. granularity of data

	Purpose	Scope	Metric
Level 1	Descriptive	System level	Weight
		Retrospective	
Level 2	Benchmarking	Farm level	ADD?
		Retrospective	
Level 3	Stewardship	Administration	'Used' DD
		Group/animal level Prospective	

Surveillance ≠ Stewardship

- Reduction in antibiotic use is an intervention, not an outcome
- Assessing appropriate use?
  - Definition?
  - Who is qualified to decide?
  - What are the criteria?
- Outcomes
  - Real or projected benefits to human health
  - Demonstrable?

Metric pondering?

- Aggregate weight measures meaningless
  - Needs to be explained/articulated in all reports
- Does a magic metric exist?
- Can one exist when we don't understand the relationships between "use" and "resistance"
- Importance of time of administration in relation to market?

Measurement and Stewardship
Ways forward

Market Driven

Niche: RWA, ABF, ...

Differentiated
Commercial
Customer oriented

Industry Driven

Transparency

Data driven
Stewardship
Getting better

Government driven

Availability
Oversight
Enforcement
Reduction

Pipestone Antibiotic Resistance Tracker

http://www.pipestonepart.com

The urge to compare?

- Comparison of use among countries
- Comparison of use among species/industries
- Academic interest and curiosity
    - Conversation starter ⟶ 'public shaming'
    - Fodder for misinformation and mischief
- Scientifically meaningless?
    - Ignores geographic and climatic factors
    - Ignores species biology and life span
    - Ignores differences in disease risk profiles

ABU in the Netherlands
Comparison by species

Table 14. Annual defined daily doses animal (DDDA$_{VET}$) for veterinarians active in the broiler, turkey, pig, dairy cattle, veal and non-dairy cattle farming sectors, for 2016. Provided parameters are the mean, 50th percentile (median), 75th percentile (P75) and 90th percentile (P90)

Livestock sector	n	Median	P90
Broiler farming sector	90	5.12	20.00
Turkey farming sector	9	8.59	38.79
Pig farming sector	268	4.94	10.58
Dairy cattle farming sector	739	2.21	2.84
Veal farming sector	141	10.48	28.45
Non-dairy cattle farming sector	682	0.73	1.89

Summary

- Measuring antibiotic use in food animals
  - What vs. how vs. why
- Potential for voluntary collection of use data
- Representativeness
- More detailed and granular data needed to inform stewardship in veterinary medicine
- Clarity of purpose for data collection