

Overview of USDA-APHIS Veterinary Services Historical and Current Antimicrobial Use Data Collection and Analysis

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Veterinary Services
Science, Technology, and Analysis Services
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Overview

- Historical Data Collection Efforts
 - NAHMS Commodity Surveys
 - CAHFSE Pilot Study
 - Special Studies to Augment NAHMS Data
- Current Data Collection Efforts

Historical and Current APHIS Activity Related to AMR Surveillance

- National Animal Health Monitoring System (NAHMS) Surveys
 - Periodic
 - National in scope
 - Questionnaires and biological sample collection
 - Animal health and management
 - Participation is voluntary
 - Responses are confidential
 - Statistically based for population estimation



National Study Rotation Plan

Year	Commodity
1990, 1995, 2000, 2006, 2012	Swine
1992, 1996, 2002, 2007, 2011, 2014	Dairy
1993, 1997, 2007-08	Beef cow/calf
1998, 2005, 2015	Equine
1994, 1999, 2011	Beef feedlot
1995, 2001, 2011	Sheep
1997, 2003, 2010	Aquaculture
1996, 2004, 2010, 2013	Poultry
2009	Goats
2014	Cervids, Bison
2017	Stocker cattle



Resource Materials

- Reports posted at:

<http://www.aphis.usda.gov/nahms>

- Hard copies available by request or to join mailing list:

NAHMS

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Commodity	Dairy		Swine		Feedlot		Dairy	Beef Cow/calf	Dairy	Swine
	2014		2012		2011		2011	2007-08	2007	2008
Year	2014		2012		2011		2011	2007-08	2007	2008
Population	30+ Milking cows	<30 Milking cows	100+ pigs	<100 pigs	≥1,000 head	<1,000 head	Heifer rearing	Beef cows	Milking cows	100+ pigs
States	17	17	13	31	12	13	21	24	17	17
Questionnaires	2	1	2	1	3	1	1	3	3	3
Sampling	Y	N	Y	N	Y	N	N	Y	Y	Y
<i>Salmonella</i>	X		X		X			X	X	X
<i>E coli</i>	X		X		X			X	X	X
<i>Campylobacter</i>	X				X			X	X	X
<i>Enterococcus</i>			X		X			X	X	X
MRSA									X	
<i>C. difficile</i>								X	X	X
<i>Listeria</i>	X									

Changes in NAHMS Data and Sample Collections

- Antimicrobial use in feed/water
 - Qualitative global use (y/n) to
 - use of named products/classes
 - quantitative use (numbers of animals) and duration of use
 - Indication/reason for use

Changes in NAHMS Data and Sample Collections (cont'd)

- Antimicrobial use by injection
 - Primary product used to
 - use of named products/classes
 - quantitative use (numbers of animals) and disease condition
 - outcomes of treatment
 - subsequent products used

Changes in NAHMS Data and Sample Collections (cont'd)

- Context for antimicrobial use
 - Influencers and importance for product selection
 - Ancillary treatments

Changes in NAHMS Data and Sample Collections (cont'd)

- Sample collection and evaluation
 - Individual animal sampling to composite sampling
 - Individual sampling to environmental sampling
 - *Salmonella* culture to inclusion of other organisms
 - *E. coli*
 - *Campylobacter*
 - *Enterococcus*
 - MRSA
 - *Clostridium difficile*
 - *Listeria*
 - Culture only to further characterization
 - Resistance
 - Speciation
 - Molecular typing (PFGE, others)
 - Followup studies of subgroups of isolates

AMR Data Example – *Salmonella* Isolates from Feedlot Cattle

1994

- Prevalence
 - Sample = 5.5%
 - Pen = 38.0%

Most Common Serotypes

Serotype	Number of isolates	Percent isolates
Anatum	78	27.9
Montevideo	36	12.9
Muenster	33	11.8
Kentucky	23	8.2
Others	110	39.2

2011

- Prevalence
 - Sample = 9.1%
 - Pen = 35.6%

Most Common Serotypes

Serotype	Number of isolates	Percent isolates
Anatum	103	18.0
Montevideo	98	17.2
Kentucky	87	15.2
Others	283	49.6

AMR Data Example – *Salmonella* Isolates from Feedlot Cattle

1994

- 74.9% pan-susceptible
- 23.2% resistant to tetracycline
- 5.7% resistant to sulfamethoxazole
- 6.8% resistant to two or more antimicrobials

2011

- 74.4% pan-susceptible
- 21.7% resistant to tetracycline
- 12.4% resistant to sulfamethoxazole
- 9.3% resistant to two or more antimicrobials

Desired Additional Data

- Quantitative antimicrobial use
 - Dosing level, inclusion rates in feed, duration or use
 - Use of combination products
- Study Intervals
 - Data collection on a more regular basis, such as annually
 - Collection of data over time on operations to assess changes

CAHFSE Pilot Study

- Prospective monitoring of antimicrobial use and resistance
- July 2003 – June 2005
- Swine operations (n=54 in 5 States)
- Quarterly data/sample collections

Tables

Figure 6. Sample-level prevalence for enteric organisms

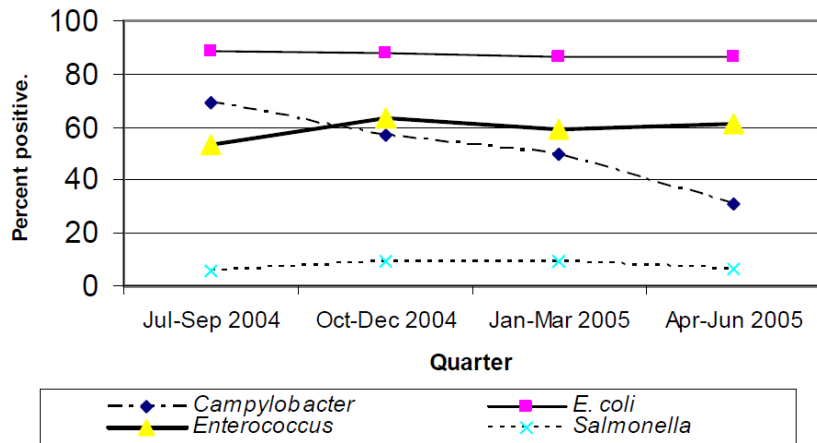


Table 6. Frequency of *Salmonella* serotypes cultured

<i>Salmonella</i> serotype	Number isolates	Number pens	Number sites
Derby	161	71	18
Typhimurium (Copenhagen)	53	29	11
Typhimurium	43	14	3
Heidelberg	42	18	5
Mbandaka	27	15	5
Worthington	14	9	4
Untypeable	6	5	3
Anatum	4	2	1
Infantis	3	2	1
Meleagridis	2	2	1
Newport	2	2	2
Saintpaul	1	1	1
Senftenberg	1	1	1
Total	359	171	56

Table 7. Number and percent of *Salmonella* isolates resistant to each antimicrobial tested

Antimicrobial	Number isolates resistant	Percent isolates resistant
Tetracycline	322	89.7%
Streptomycin	246	68.5%
Sulfamethoxazole	225	62.7%
Ampicillin	166	46.2%
Kanamycin	138	38.4%
Choramphenicol	114	31.8%
Cephalothin	90	25.1%
Trimethoprim/sulfa	85	23.7%
Cefoxitin	77	21.4%
Amoxicillin/clavulanic acid	76	21.2%
Ceftiofur	76	21.2%
Gentamicin	4	1.1%
Nalidixic acid	1	0.3%
Ceftriaxone	0	0.0%
Amikacin	0	0.0%
Ciprofloxacin	0	0.0%

Total number of isolates was 359.

Table 8. Top 10 antimicrobial resistance patterns

Antimicrobial resistance pattern	Number of isolates resistant	Percent of resistant isolates (n=336)
Tet	51	15.18%
Strep/Sulfa/Tet	51	15.18%
Amox/Amp/Cefox/Cefti/Ceph/Chlor/Kan/Strep/Sulfa/Tet/Trisul	49	14.58%
Amp/Chlor/Strep/Sulfa/Tet	36	10.71%
Kan/Strep/Tet	19	5.65%
Sulfa/Tet/Trisul	17	5.06%
Amp/Kan/Strep/Tet	17	5.06%
Amp/Kan/Strep/Sulfa/Tet	13	3.87%
Amox/Amp/Cefox/Cefti/Ceph/Chlor/Strep/Sulfa/Tet/Trisul	10	2.98%
Amp/Ceph/Kan/Strep/Sulfa/Tet	10	2.98%

*23 of the 359 isolates were susceptible to all antimicrobials tested.

Special Studies to Augment NAHMS Data

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Original Article

Use Estimates of In-Feed Antimicrobials in Swine Production in the United States

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Abstract

When considering the development of antimicrobial resistance in food animals, comparing gross use estimates of different antimicrobials is of little value due to differences in potencies, duration of activity, relative effect on target and commensal bacteria, and mechanisms of resistance. However, it may be valuable to understand quantities of different antimicrobials used in different ages of swine and for what applications. Therefore, the objective of this project was to construct an estimate of antimicrobial use through the feed in swine production in the United States. Estimates were based on data from the National Animal Health Monitoring System (NAHMS) Swine 2006 Study and from a 2009 survey of swine-exclusive practitioners. Inputs consisted of number of pigs in a production phase, feed intake per day, dose of the antimicrobial in the feed, and duration of administration. Calculations were performed for a total of 102 combinations of antimicrobials ($n=17$), production phases ($n=2$), and reasons for use ($n=3$). Calculations were first conducted on farm-level data, and then extrapolated to the U.S. swine population. Among the nursery phase estimates, chlortetracycline had the largest estimate of use, followed by oxytetracycline and tilmicosin. In the grower/finisher phase, chlortetracycline also had the largest use estimate, followed by tylosin and oxytetracycline. As an annual industry estimate for all phases, chlortetracycline had the highest estimated use at 533,973 kg. The second and third highest estimates were tylosin and oxytetracycline with estimated annual uses of 165,803 kg and 154,956 kg, respectively. The estimates presented here were constructed to accurately reflect available data related to production practices, and to provide an example of a scientific approach to estimating use of compounds in production animals.

Current Data Collection Efforts

Commodity	Swine	Dairy	Equine	Beef
Year	2012	2014	2015	2017
Population	100+ pigs	Milking cows		?
States	13	17	17	
Questionnaires	3	3	3	
Sampling	Y	Y	Y	
<i>Salmonella</i>	X	X	X	
<i>E coli</i>	X	X	X	
<i>Campylobacter</i>		X		
<i>Enterococcus</i>	X			
<i>Listeria</i>		X		
Status	Analysis	Collection	Planning	Info Needs

Summary/Conclusions

- USDA NAHMS program has been collecting and reporting on antimicrobial data (use and resistance) since the early 1990s
- Nature of the information reported has changed
 - Increase specifics on antimicrobial use
 - Expansion of organisms evaluated

Summary/Conclusions

- USDA continues to respond to stakeholder input on the nature of the information related to AMR that is needed
- USDA has an AMR action plan
 - Components under discussion with stakeholders
 - Awaiting resources to initiate highest priority items



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