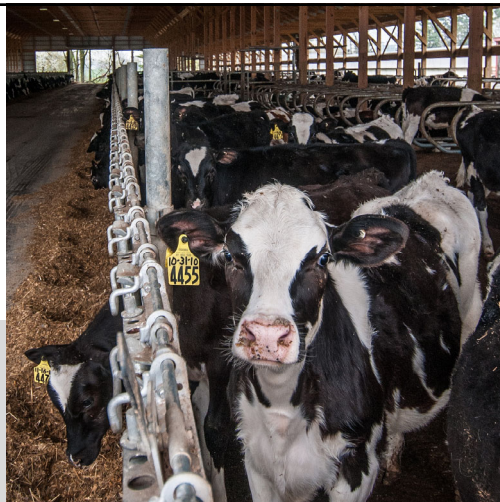




Antimicrobial Stewardship



Dr. Hayley Springer DVM, MS

Extension Veterinarian
Assistant Clinical Professor
Veterinary & Biomedical Sciences
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extension.psu.edu

Agenda

Introduction to antimicrobial resistance (AMR)

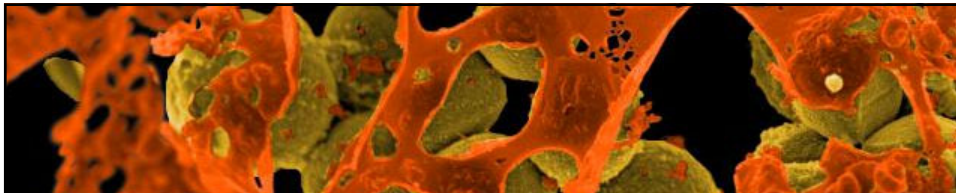
Why addressing AMR on farms is important

Antimicrobial stewardship & how can it save money



Photo: Dave Young (flickr)
Title Page: USDA – L. Cheung

 PennState Extension



Antibiotic Resistance

A brief introduction to antibiotic resistance (ABR).

1

Photo: NIAID

 PennState Extension

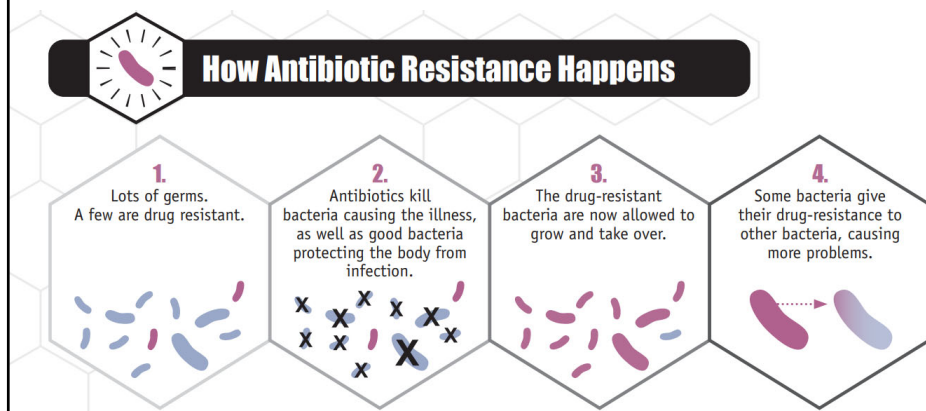
What is Antimicrobial Resistance?

The ability of a bacteria to resist the effects of an antibiotic that would otherwise kill it or stop its growth.

CDC

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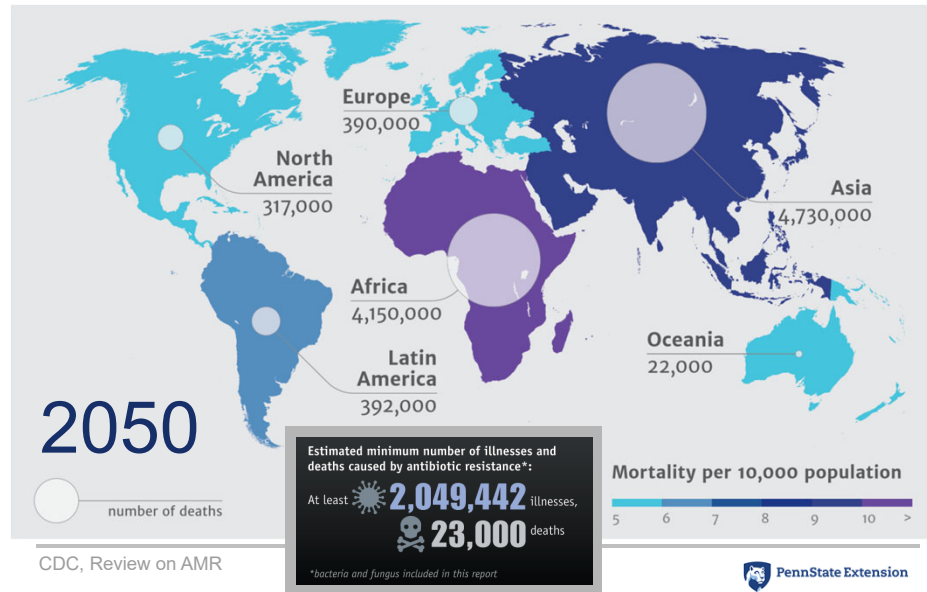
What is Antibiotic Resistance?



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Why should we worry about AMR?



Who worries about AMR & ag?



Photos: USAID EMAS, USAF (J. Bainter), U.S. DOD (J. Lebron)

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What do they know?

2017 Could Be A Terrible Tipping Point for Antibiotic Resistance

FOOD REVOLUTION NETWORK

We're now at the brink of a post-antibiotic era

In December 2016, Ohio State University researchers published the results of a frightening study — which they fear could signal “the end of the antibiotic age” — bacteria with a gene resistant to a class of drugs used when all other antibiotics have failed — found on a Midwestern hog farm.

“Nightmare” Bacteria Resistant to Last-Resort Antibiotics Discovered on Farm

CIVIL EATS

Last week, a team of Ohio State University researchers published the results of a **frightening scientific study**. The group found bacteria possessing a gene resistant to carbapenems — a class of drugs used as a last resort when all other antibiotics have failed — on a Midwestern hog farm. The scientists fear their discovery could signal “the end of the antibiotic age” — a time when drugs no longer work against deadly diseases.

Carbapenemase-Producing *Enterobacteriaceae* Recovered from the Environment of a Swine Farrow-to-Finish Operation in the United States



Antimicrobial Agents and Chemotherapy®

Dixie F. Mollenkopf,* Jason W. Stull,* Dimitria A. Mathys,* Andrew S. Bowman,*
Sydney M. Feicht,* Susan V. Grooters,* Joshua B. Daniels,* Thomas E. Wittum*

Department of Veterinary Preventive Medicine, The Ohio State University College of Veterinary Medicine, Columbus, Ohio, USA*; Department of Veterinary Clinical Sciences, The Ohio State University College of Veterinary Medicine, Columbus, Ohio, USA*

Photos: USAID EMAS, USAF (J. Bainter), U.S. DOD (J. Lebron)

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What do we know?

Carbapenemase-Producing *Enterobacteriaceae* Recovered from the Environment of a Swine Farrow-to-Finish Operation in the United States



Antimicrobial Agents and Chemotherapy®

One 1500 sow farrow-to-finish operation
Ceftiofur metaphylaxis in piglets

Visit/Sampling	No. CRE Isolates
Visit 1	3 CRE phenotype (from 2 nursery samples)
- 30 Env. gauze samples from animal-contact surfaces	
- 10 Env. samples from human-contact surfaces	

Mollenkopf et al., 2017

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What do we know?

Carbapenemase-Producing *Enterobacteriaceae* Recovered from the Environment of a Swine Farrow-to-Finish Operation in the United States



Antimicrobial Agents
and Chemotherapy®

One 1500 sow farrow-to-finish operation
Ceftiofur metaphylaxis
in piglets

Visit/Sampling	No. CRE Isolates
Visit 1 - 30 Env. gauze samples from animal-contact surfaces - 10 Env. samples from human-contact surfaces	3 CRE phenotype (from 2 nursery samples)
Visit 2 - 15 Animal-contact surfaces (positive nursery barn) - 4 Human-contact surfaces (positive nursery barn) - 54 fecal samples (across the farm)	NONE
Visit 3 - 12 Environmental samples - 100 rectal swabs	NONE (some carried carbapenemase, but none carried conj. plasmid)
Visit 4 - 36 Environmental samples - 72 fresh fecal samples	NONE

Mollenkopf et al., 2017



What do we know?

“the end of the antibiotic age”



Antimicrobial Agents
and Chemotherapy®

EPIDEMIOLOGY AND SURVEILLANCE



Carbapenemase-Producing *Enterobacteriaceae* Recovered from the Environment of a Swine Farrow-to-Finish Operation in the United States

Dixie F. Mollenkopf,* Jason W. Stull,* Dimitria A. Mathys,* Andrew S. Bowman,*
Sydney M. Faicht,* Susan V. Grooters,* Joshua B. Daniels,* Thomas E. Wittum*
Department of Veterinary Preventive Medicine, The Ohio State University College of Veterinary Medicine,
Columbus, Ohio, USA; Department of
Veterinary Medicine, Columbus, Ohio

ABSTRACT Carbapenem-resistant to public health. While use producing animals, other β -lactams may provide selection pressure but this relationship has not livestock, plasmid-mediated C. Asia. In this study, environment sow, U.S. farrow-to-finish operation. Samples were screened using sulitting carbapenemase-producing

Acrobat Reader



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OK

Find

antibiotic age

Previous Next

Mollenkopf et al., 2017



What do we know?

Carbapenemase-Producing *Enterobacteriaceae* Recovered from the Environment of a Swine Farrow-to-Finish Operation in the United States



Antimicrobial Agents
and Chemotherapy®

“The implication of our finding is that there is a real risk that CRE may disseminate in food animal populations and eventually contaminate fresh retail meat products. Foodborne transmission may then produce a reservoir of mobile carbapenemase genes in the enteric flora of consumers.”

Mollenkopf et al., 2017



Where should the public go for info?



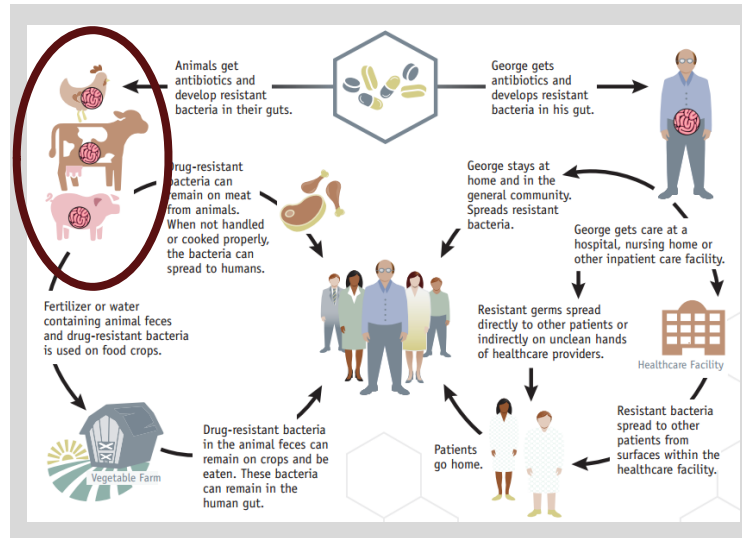
**World Health
Organization**



**CENTERS FOR DISEASE
CONTROL AND PREVENTION**



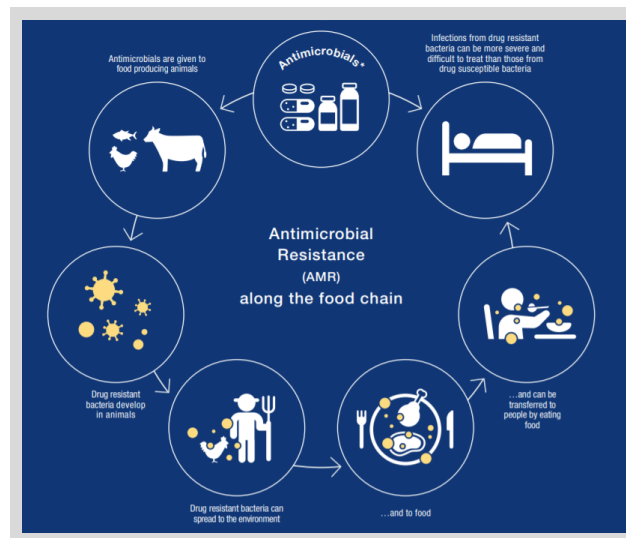
Where should the public go for info?



CDC

PennState Extension

Where should the public go for info?



WHO, 2016

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Antimicrobial Resistance & Ag

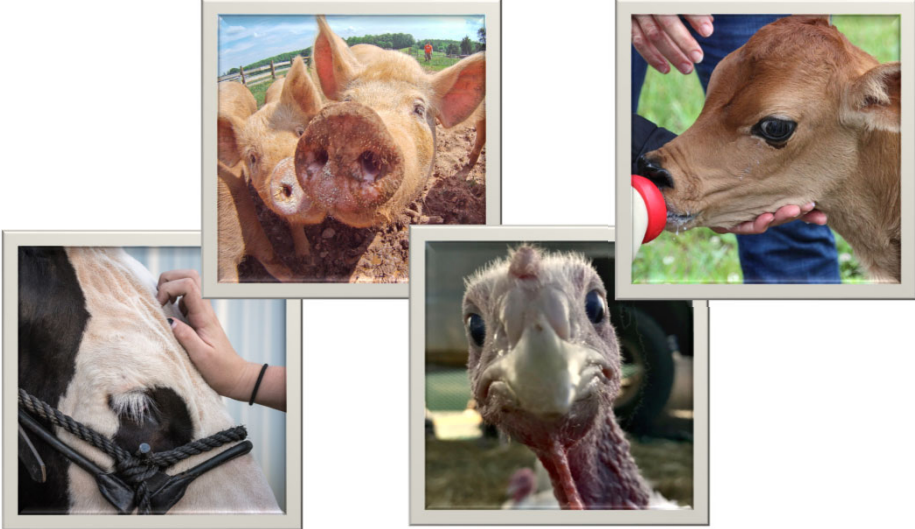
Why addressing antibiotic resistance on farms is important.

2


Photo: Jereme Rauckman (flickr)



Do we really have AMR in Ag?



Photos: scott1346 (flickr), USDA L. Cheung (3 photos)



AMR in Dairy Calves

% Calves Carrying Resistant E. coli
(by antibiotic)



We know that AMR is found on farms,
even in young dairy calves.

What can be done about it?

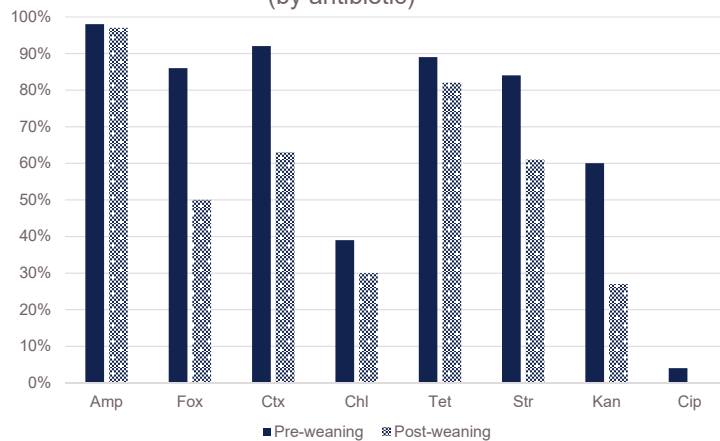


Springer, et al., unpublished

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AMR in Dairy Calves

% Calves Carrying Resistant E. coli
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Springer, et al., unpublished

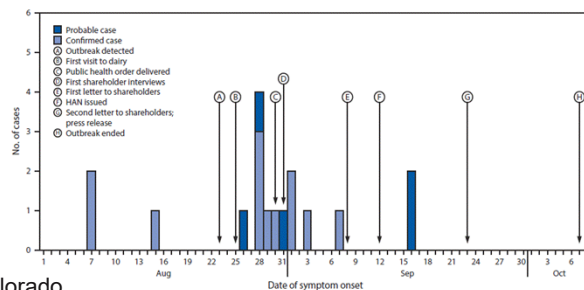
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Human Risks: Foodborne Disease

AUGUST – OCTOBER 2016

- 12 People infected
 - 5 additional probable cases
 - 1 Hospitalization
 - 5 Colorado counties
- *Campylobacter jejuni*
 - Multi-drug resistant
 - Ciprofloxacin
 - Tetracycline
 - Nalidixic acid
- Source: Raw Milk
 - Herdshare dairy in Colorado



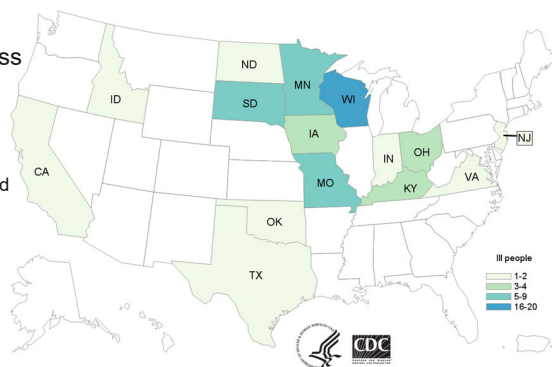
Burakoff, et al., 2018. MMWR



Human Risks: Animal Contact

JANUARY 2015 – NOVEMBER 2017

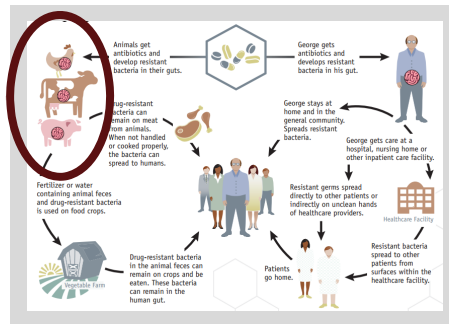
- 56 People infected
 - 15 States reported illness
 - 17 Hospitalizations
- *Salmonella* Heidelberg
 - Multi-drug resistant
 - Amoxicillin-clavulanic acid
 - Ampicillin
 - Cefoxitin
 - Ceftriaxone
 - Streptomycin
 - Sulfisoxazole
 - Tetracycline
- Source: Dairy Calves
 - 63% of cases had direct contact with livestock



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What to do about AMR...



Regulation

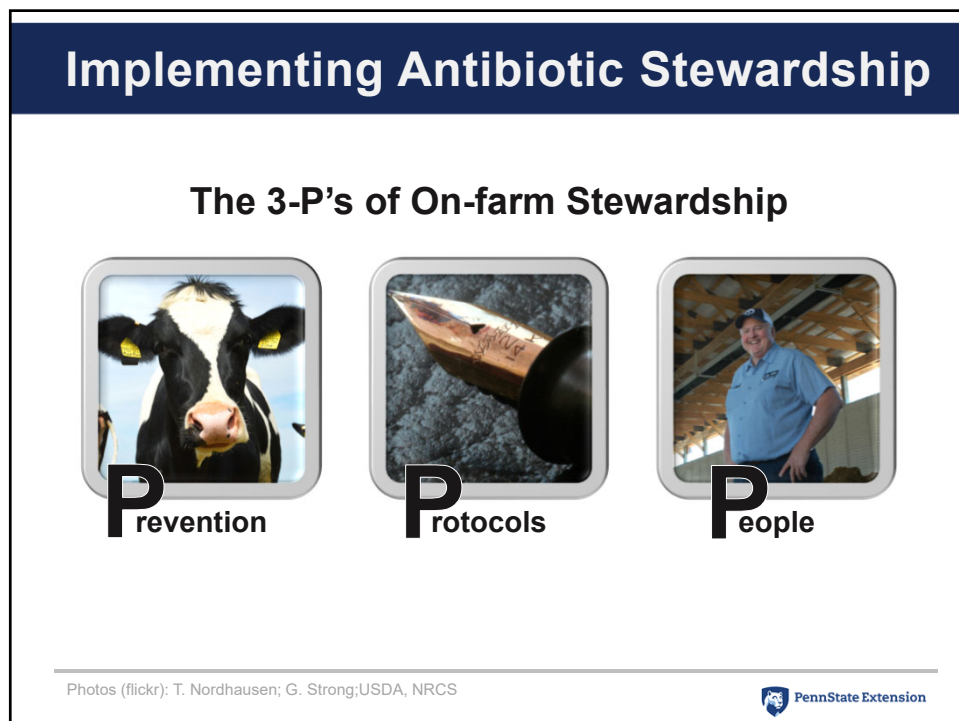
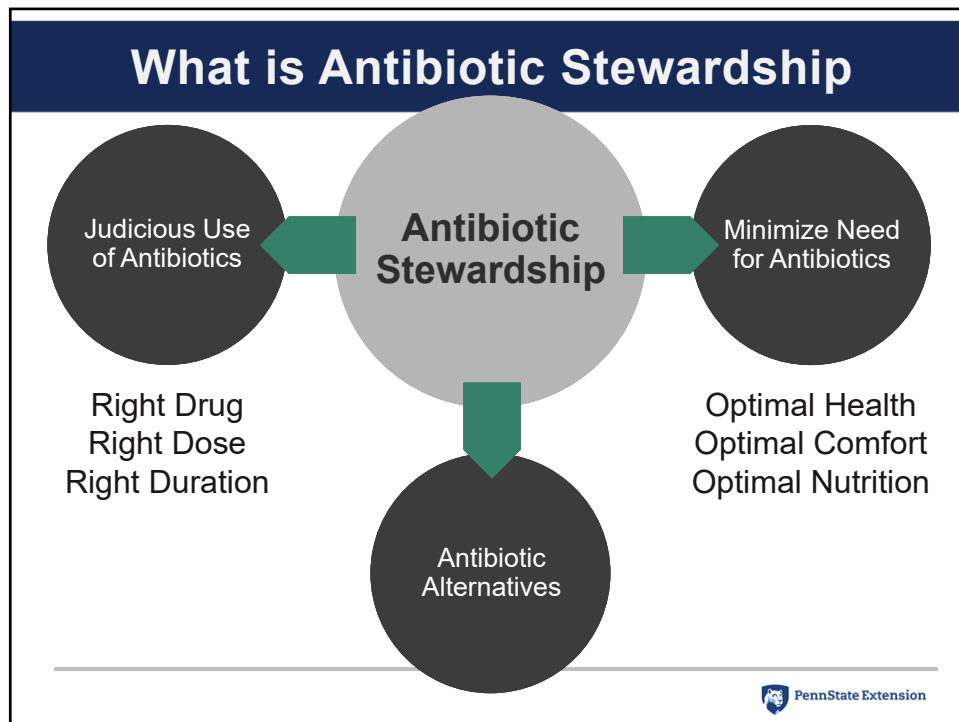
Antimicrobial Stewardship



Antibiotic Stewardship

Protecting antibiotic effectiveness while saving money.

3



Making Antibiotic Stewardship Pay



Prevention

**Minimize
Need for
Antibiotics**

Optimal Health

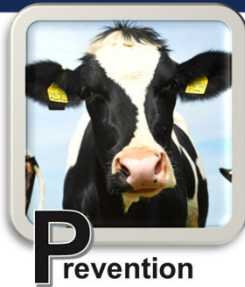
Optimal Comfort

Optimal Nutrition

Hulbert & Moisa, 2016; Photo: T. Nordhausen (flickr)

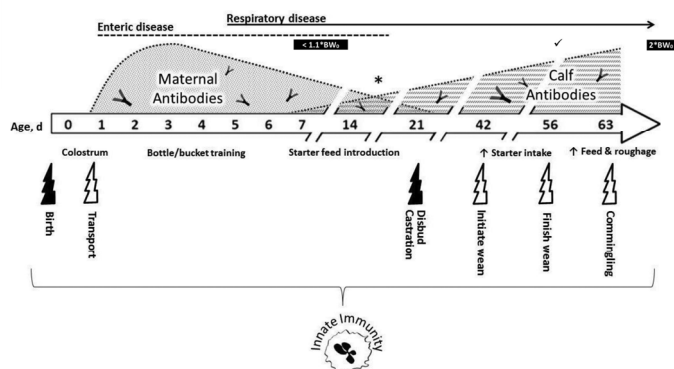


Making Antibiotic Stewardship Pay



Prevention

Colostrum & Calves



Hulbert & Moisa, 2016; Photo: T. Nordhausen (flickr)



Making Antibiotic Stewardship Pay

Colostrum & Calves The 5 Q's of Colostrum

Quality



Quickness



Quantity



sQueaky clean



Failure of Passive Transfer (FPT)

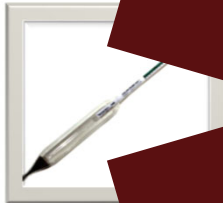
Images: www.colostrometer.com, www.enasco.com, K-State Research & Extension (flickr)
5Q's credit: S. Godden, U. Minnesota



Making Antibiotic Stewardship Pay

Colostrum & Calves The Keys to Colostrum Management

Quality



Timing



Quantity



sQueaky clean



Failure of Passive Transfer (FPT)

Images: www.colostrometer.com, www.enasco.com, K-State Research & Extension (flickr)
5Q's credit: S. Godden, U. Minnesota



Making Antibiotic Stewardship Pay

Failure of Passive Transfer (FPT)

Reduced Disease = Reduced Antibiotic Use

Increased calf mortality	\$ 10.86
Increased risk of pneumonia	\$ 10.86
Increased risk of diarrhea	\$ 9.95
Decreased daily weight gain	\$ 37.44
	\$ 69.11

Raboisson, Trillat, and Chachuzac, 2016

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Making Antibiotic Stewardship Pay

Failure of Passive Transfer (FPT)

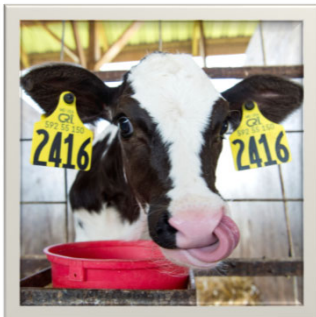
Average: 19%

250 cow dairy

~125 heifer calves/year
19% FPT = 24 calves

Cost: \$1659

\$ 69.11



Raboisson, Trillat, and Chachuzac, 2016

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Making Antibiotic Stewardship Pay

Failure of Passive Transfer (FPT)

Cost: \$1659

Make sure all colostrum supplies are CLEAN

Test colostrum for quality

Feed 4 quarts within 4 hours of birth

Raboisson, Trillat, and Chachuzac, 2016



Making Antibiotic Stewardship Pay



**Judicious Use
of Antibiotics**

Right Drug

Right Dose

Right Duration



Making Antibiotic Stewardship Pay



Veterinarian Developed Treatment Protocols

Development of these protocols does come with an expense

Improves animal care & reduces wasteful treatments

Promotes antibiotic stewardship

Making Antibiotic Stewardship Pay

Calf Scours Protocols

Most vets agree:

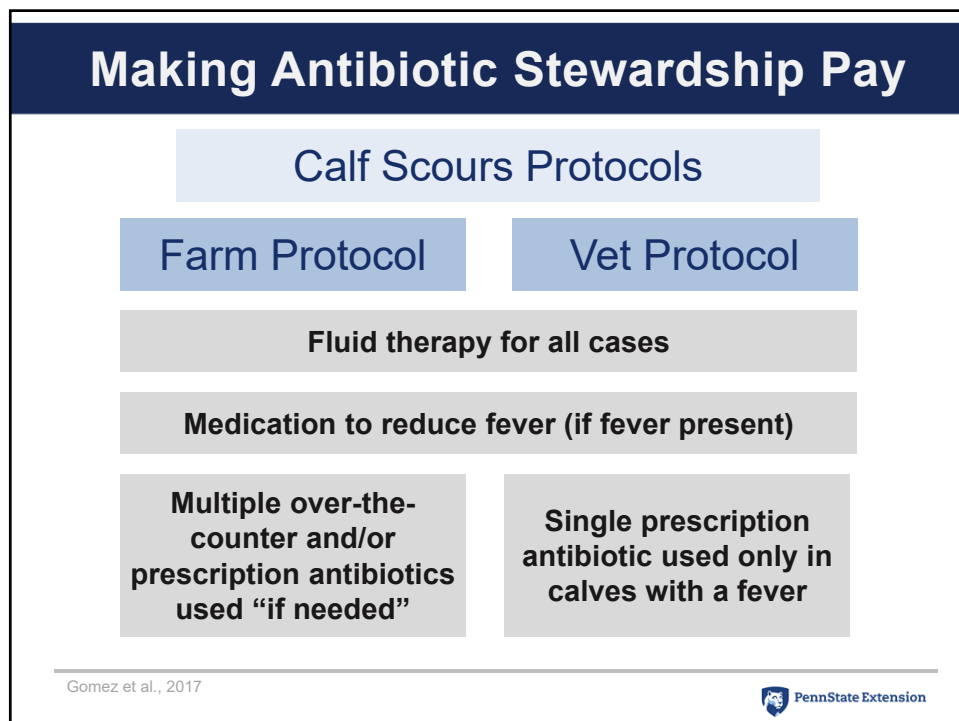
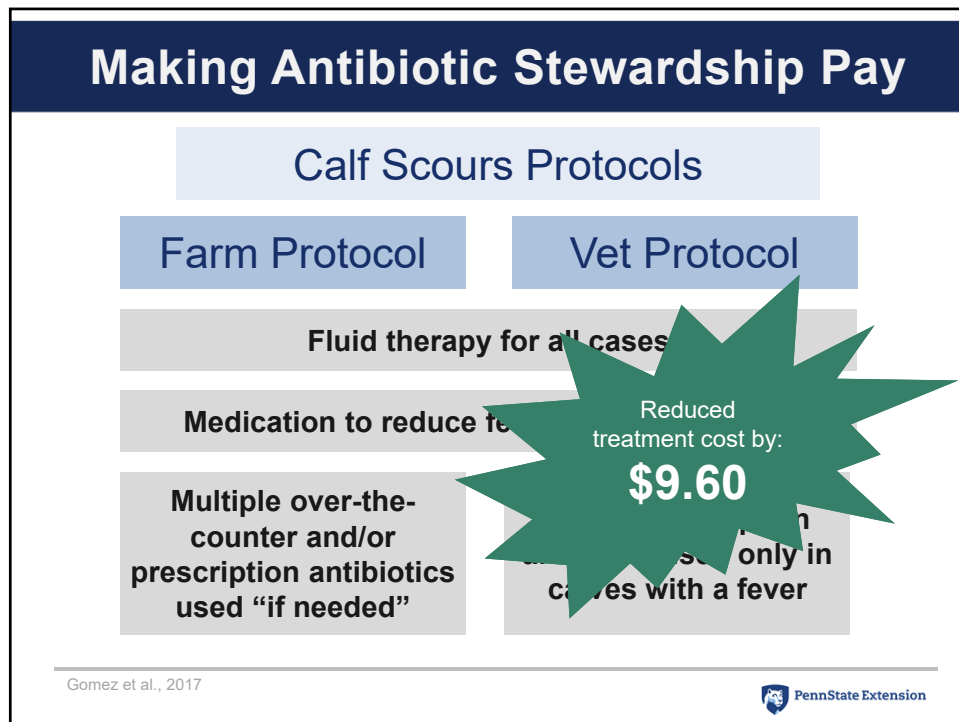
- ✓ Hydration (fluids) are ESSENTIAL
- ✓ Antibiotics are not always needed

Mild calf scours:

13% of conventional producers would treat with antibiotics

Moderate calf scours:

>50% of conv. producers would treat with antibiotics



Making Antibiotic Stewardship Pay

Calf Scours Treatment

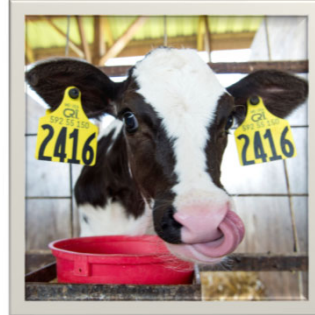
**Save
\$9.60**

Avg. Scours: 19%

250 cow dairy

~125 heifer calves/year
19% Scours = 24 calves

Savings: \$230



Urie et al., 2018 (NAHMS 2014)

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Making Antibiotic Stewardship Pay

Selective Dry Cow Therapy

High SCC Cows:

**Antibiotics
± Teat Sealant**

Low SCC Cows:

**Teat Sealant
or nothing**

**Reduced costs at
dry-off**

**Increased cost of
fresh cow mastitis**

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Making Antibiotic Stewardship Pay

Selective Dry Cow Therapy

Economic return varies depending on protocol and mastitis history

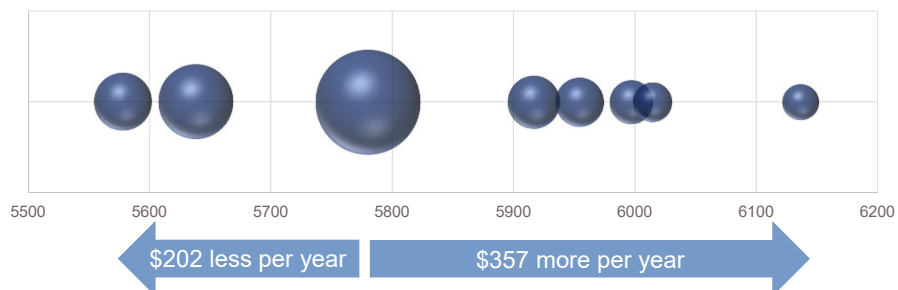
Adapted from: Schrepenzeel et al., 2016 (JDS)



Making Antibiotic Stewardship Pay

Selective Dry Cow Therapy

Several different SDCT strategies modeled in an “average” 100 cow milking herd



Adapted from: Schrepenzeel et al., 2016 (JDS)





P
People

**Protocols don't work
if employees don't
understand them**

**Comprehensive calving
assistance training**



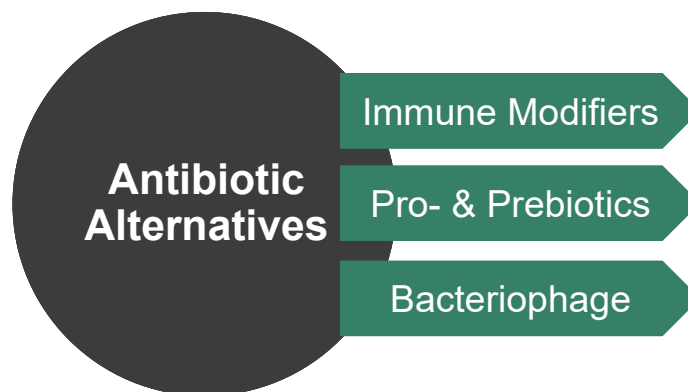
Data: A. Barragan, PSU, unpublished. Photos (flickr): USDA, NRCS

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The Future of Antibiotic Stewardship



Is Here Today



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The Future of Antibiotic Stewardship

Bacteriophage Technology

Infection

10-14 DIM

- S. Aureus (bovine mastitis origin)
- 2 contralateral glands infected (L4/R4)



Treatment

4h post-infection

- Phage cocktail
- PBS (neg. control)
- Cefalonium (pos. control)

Breyne et al., Front. Microbiol. 2017



The Future of Antibiotic Stewardship

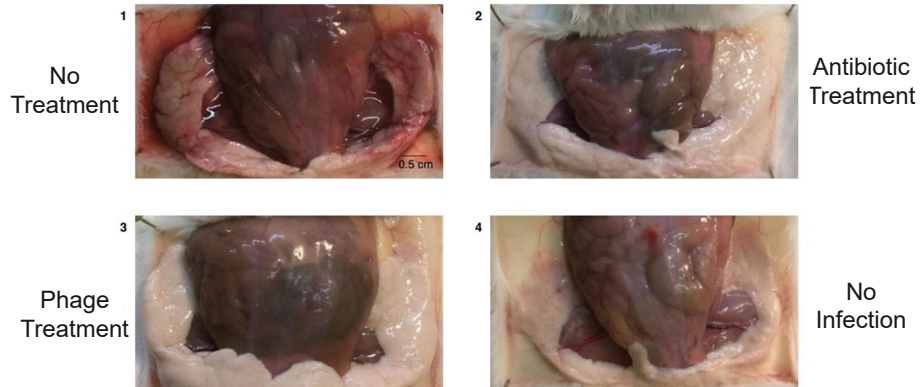
Bacteriophage Technology

Breyne et al., Front. Microbiol. 2017



The Future of Antibiotic Stewardship

Bacteriophage Technology



Breyne et al., Front. Microbiol. 2017

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Summary

ABR is a concern in animal agriculture & we can help!

Preventing disease reduces antibiotic use & costs less!

Treatment protocols assure proper antibiotic use.

Not all antibiotic stewardship options work on every farm.

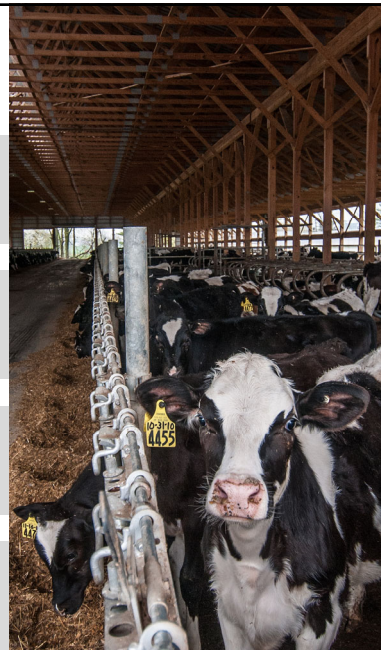
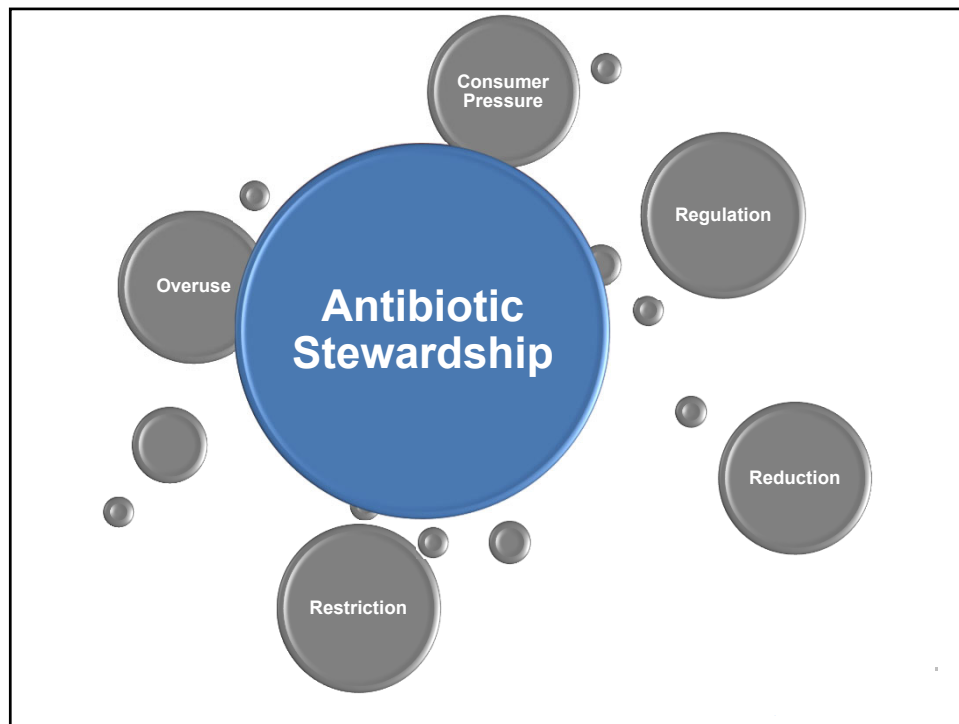


Photo: Dave Young (flickr)
Title Page: USDA – L. Cheung

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Questions?

Thank you!

Photo: Johan (flickr)