FARM FOUNDATION® FORUM

ANTIMICROBIAL STEWARDSHIP IN AGRICULTURE: HOW FAR HAVE WE COME AND WHAT'S NEXT?

SEPTEMBER 27, 2022

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MARTHA KING

Vice President, Programs and Projects
Farm Foundation

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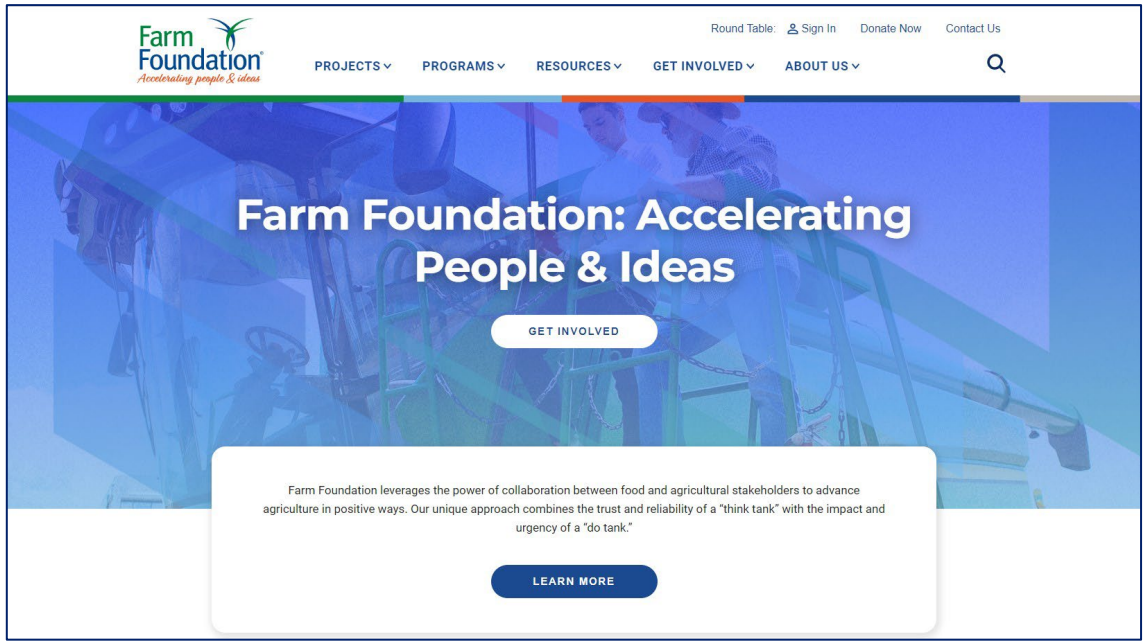

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IMPORTANT NOTES

- Submit questions by clicking on the **Q&A Button** at the bottom of your screen.
- Please **include your name and company** so questions may be contextually understood.
- Due to **time limits**, we may not be able to ask all questions submitted.
- This Forum is being recorded and will be posted on our website at **farmfoundation.org** as well as the Farm Foundation **YouTube** channel.
- Please take the **short survey** at the conclusion of the Forum.

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DR. PAUL PLUMMER

Moderator
Director, National Institute of Antimicrobial Resistance Research and Education
Associate Dean of Research and Graduate Studies, College of Veterinary Medicine, Iowa State University

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NIAMRRE

Coordinating action to combat the global threat of antimicrobial resistance.

ONE HEALTH APPROACH

HUMANS + ANIMALS + ENVIRONMENT

VISION

NIAMRRE will be the trusted leader in coordinating One Health efforts that preserve the ability to prevent and treat infectious diseases for generations to come.

MISSION

NIAMRRE drives cross-sector engagement and coordinated action to combat the global threat of Antimicrobial Resistance across humans, animals, and the environment.

Current NIAMRRE Members

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DR. WILLIAM FLYNN

Deputy Director for Science Policy,
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Updates on AMR Activities
FDA, Center for Veterinary Medicine

Farm Foundation Forum: Antimicrobial Stewardship in Agriculture

September 27, 2022

William T. Flynn, DVM, MS

Deputy Director for Science Policy

FDA Center for Veterinary Medicine

Supporting Antimicrobial Stewardship in Animals

FDA/CVM's Key Areas of Focus (Goals of CVM's 5-year stewardship plan)

- Evaluating use conditions of approved animal antimicrobial products
- Promoting antimicrobial stewardship at the user level
- Collecting data to monitor antimicrobial use and antimicrobial resistance in animals

CVM's Approach for Implementing Change

- Focusing actions or mitigations on drugs of greatest concern: drugs that are important human therapies ("medically important antimicrobials")
- Emphasizing collaboration and seeking cooperation from industry to take action voluntarily

Important Milestones

2013 — Initiated plan to eliminate production use; bring under vet oversight (GFI #213/VFD rule)

2016 — Funded cooperative agreements to develop methodologies for collecting data on antimicrobial use in food-producing animals

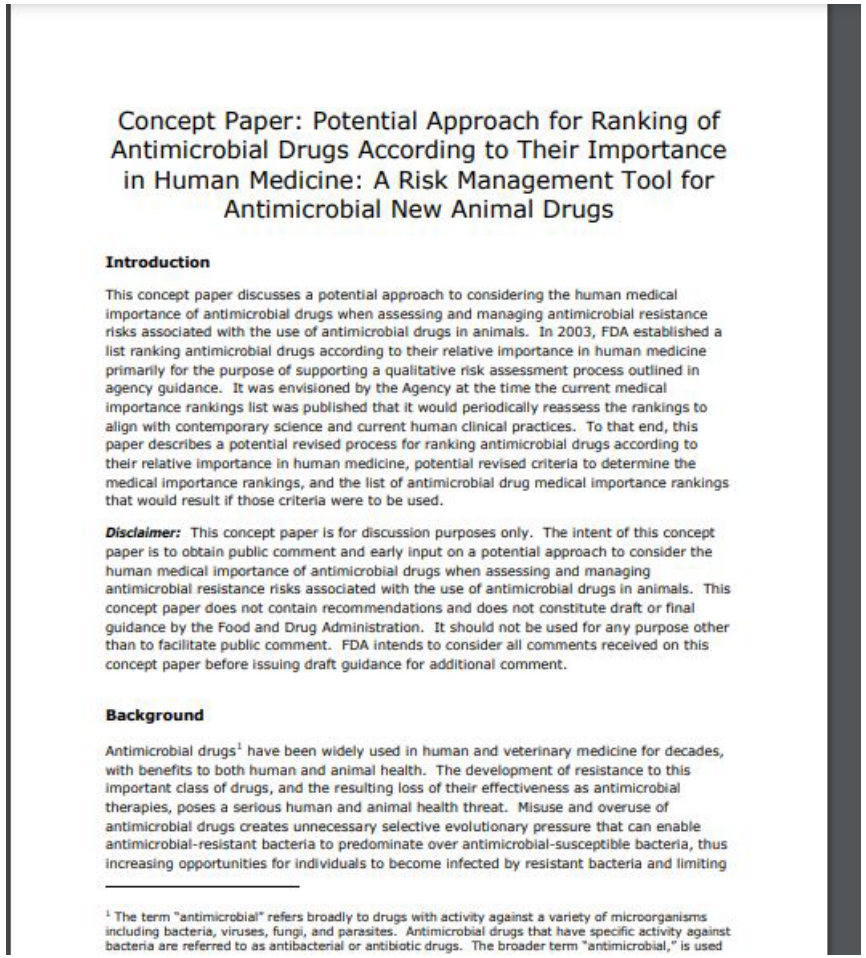
2017 — Implemented GFI #213 and the VFD Final Rule

2018 — Published CVM's 5-year plan for Supporting Stewardship in Veterinary Settings

2020 — 2020-2025 NARMS Strategic Plan; enhanced focus on One Health approach

2021 — Finalized a process to bring all remaining medically important antimicrobials under vet oversight (GFI #263)

Supporting Antimicrobial Stewardship



Concept Paper: Potential Approach for Ranking of Antimicrobial Drugs According to Their Importance in Human Medicine: A Risk Management Tool for Antimicrobial New Animal Drugs

Introduction

This concept paper discusses a potential approach to considering the human medical importance of antimicrobial drugs when assessing and managing antimicrobial resistance risks associated with the use of antimicrobial drugs in animals. In 2003, FDA established a list ranking antimicrobial drugs according to their relative importance in human medicine primarily for the purpose of supporting a qualitative risk assessment process outlined in agency guidance. It was envisioned by the Agency at the time the current medical importance rankings list was published that it would periodically reassess the rankings to align with contemporary science and current human clinical practices. To that end, this paper describes a potential revised process for ranking antimicrobial drugs according to their relative importance in human medicine, potential revised criteria to determine the medical importance rankings, and the list of antimicrobial drug medical importance rankings that would result if those criteria were to be used.

Disclaimer: This concept paper is for discussion purposes only. The intent of this concept paper is to obtain public comment and early input on a potential approach to consider the human medical importance of antimicrobial drugs when assessing and managing antimicrobial resistance risks associated with the use of antimicrobial drugs in animals. This concept paper does not contain recommendations and does not constitute draft or final guidance by the Food and Drug Administration. It should not be used for any purpose other than to facilitate public comment. FDA intends to consider all comments received on this concept paper before issuing draft guidance for additional comment.

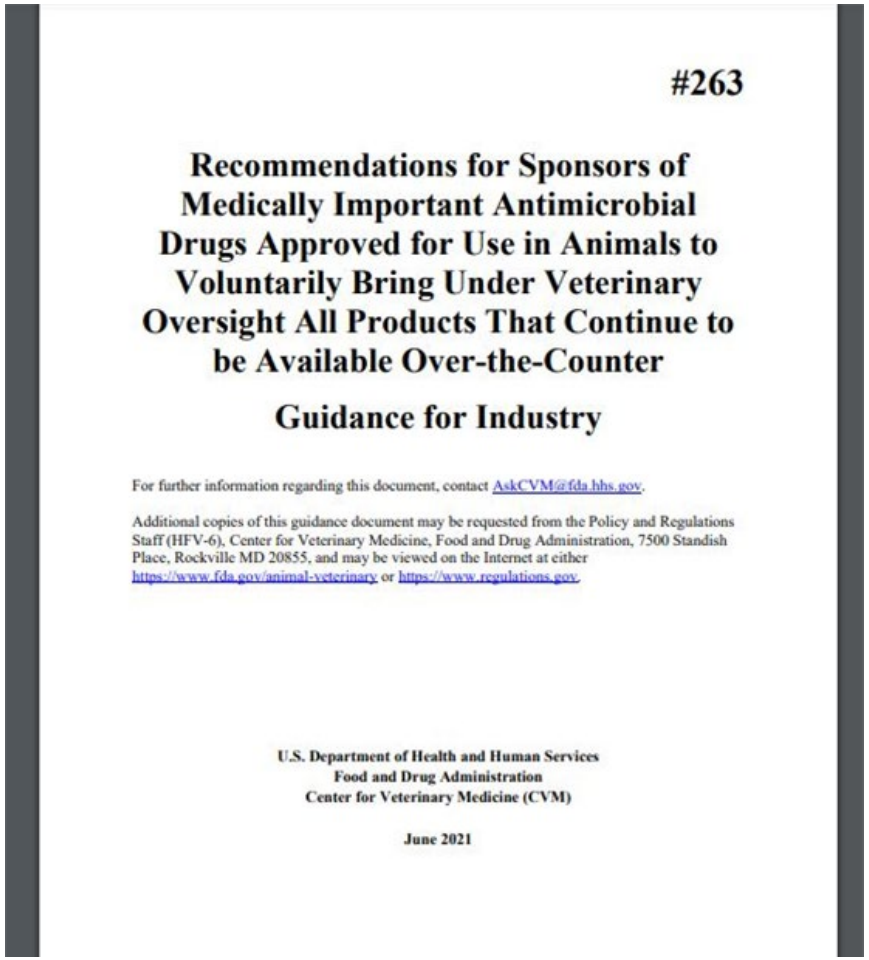
Background

Antimicrobial drugs[1] have been widely used in human and veterinary medicine for decades, with benefits to both human and animal health. The development of resistance to this important class of drugs, and the resulting loss of their effectiveness as antimicrobial therapies, poses a serious human and animal health threat. Misuse and overuse of antimicrobial drugs creates unnecessary selective evolutionary pressure that can enable antimicrobial-resistant bacteria to predominate over antimicrobial-susceptible bacteria, thus increasing opportunities for individuals to become infected by resistant bacteria and limiting

[1] The term "antimicrobial" refers broadly to drugs with activity against a variety of microorganisms including bacteria, viruses, fungi, and parasites. Antimicrobial drugs that have specific activity against bacteria are referred to as antibacterial or antibiotic drugs. The broader term "antimicrobial," is used

Assessing AMR risks for new products

- **Guidance #152 -** finalized in 2003, outlines a risk assessment (RA) approach for evaluating AMR risks as part of new animal drug approval process.
- One input to this RA process is the human medical importance of drug in question
  - In **Oct 2020** CVM issued a concept paper outlining a potential approach for updating the current list of antimicrobial drugs ranked by their importance in human medicine (commonly referred to as “Appendix A” GFI #152)



#263

Recommendations for Sponsors of Medically Important Antimicrobial Drugs Approved for Use in Animals to Voluntarily Bring Under Veterinary Oversight All Products That Continue to be Available Over-the-Counter

Guidance for Industry

For further information regarding this document, contact AskCVM@fda.hhs.gov.

Additional copies of this guidance document may be requested from the Policy and Regulations Staff (HFV-6), Center for Veterinary Medicine, Food and Drug Administration, 7500 Standish Place, Rockville MD 20855, and may be viewed on the Internet at either https://www.fda.gov/animal-veterinary or https://www.regulations.gov.

U.S. Department of Health and Human Services
Food and Drug Administration
Center for Veterinary Medicine (CVM)

June 2021

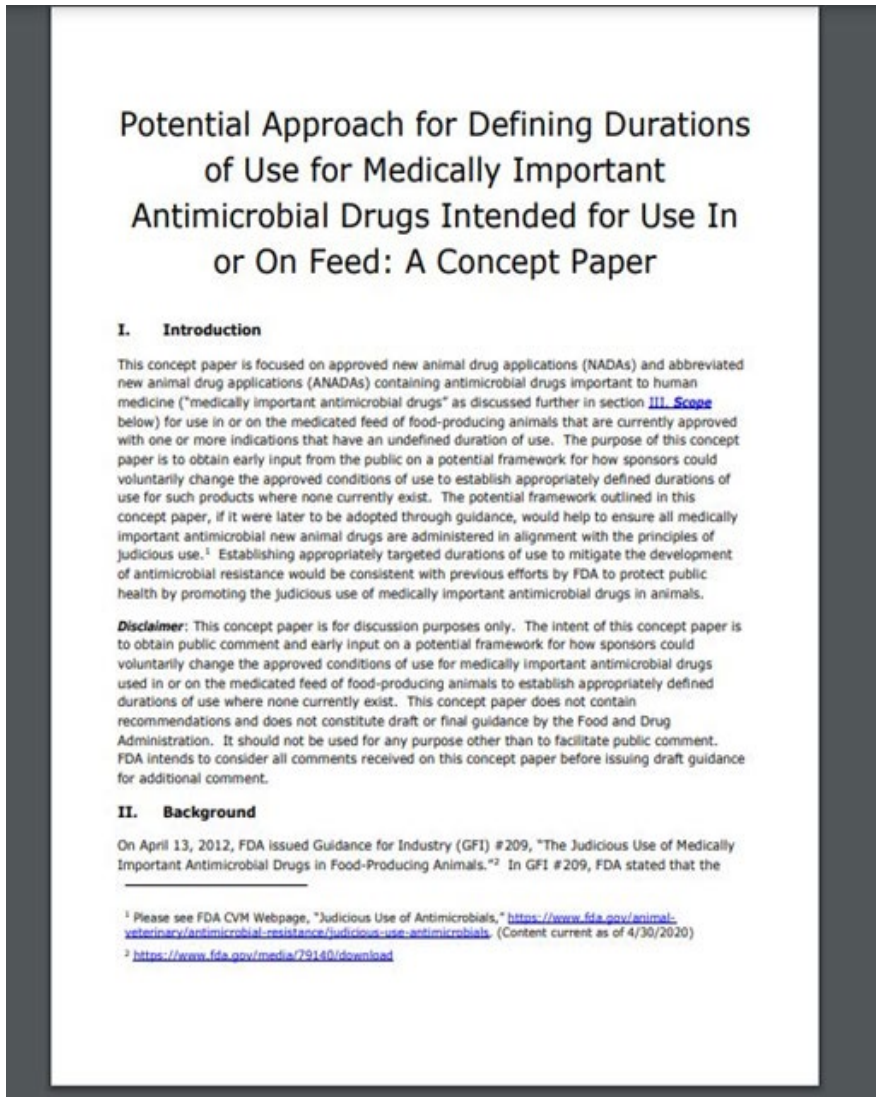
Supporting Antimicrobial Stewardship

Veterinary oversight

Guidance #263 - published June 2021, outlines a 2-year plan for drug sponsors to voluntarily transition to veterinary oversight all medically important antimicrobials that are still available OTC

- Target for completion June 2023
- Approx. 90 approved drug applications impacted
- Ongoing outreach efforts being targeted to most impacted animal production sectors
- When complete, all medically important antimicrobials will be under the oversight of veterinarians.

Supporting Antimicrobial Stewardship



Potential Approach for Defining Durations of Use for Medically Important Antimicrobial Drugs Intended for Use In or On Feed: A Concept Paper

I. Introduction

This concept paper is focused on approved new animal drug applications (NADAs) and abbreviated new animal drug applications (ANADAs) containing antimicrobial drugs important to human medicine ("medically important antimicrobial drugs" as discussed further in section III. Scope below) for use in or on the medicated feed of food-producing animals that are currently approved with one or more indications that have an undefined duration of use. The purpose of this concept paper is to obtain early input from the public on a potential framework for how sponsors could voluntarily change the approved conditions of use to establish appropriately defined durations of use for such products where none currently exist. The potential framework outlined in this concept paper, if it were later to be adopted through guidance, would help to ensure all medically important antimicrobial new animal drugs are administered in alignment with the principles of judicious use.[1] Establishing appropriately targeted durations of use to mitigate the development of antimicrobial resistance would be consistent with previous efforts by FDA to protect public health by promoting the judicious use of medically important antimicrobial drugs in animals.

Disclaimer: This concept paper is for discussion purposes only. The intent of this concept paper is to obtain public comment and early input on a potential framework for how sponsors could voluntarily change the approved conditions of use for medically important antimicrobial drugs used in or on the medicated feed of food-producing animals to establish appropriately defined durations of use where none currently exist. This concept paper does not contain recommendations and does not constitute draft or final guidance by the Food and Drug Administration. It should not be used for any purpose other than to facilitate public comment. FDA intends to consider all comments received on this concept paper before issuing draft guidance for additional comment.

II. Background

On April 13, 2012, FDA issued Guidance for Industry (GFI) #209, "The Judicious Use of Medically Important Antimicrobial Drugs in Food-Producing Animals."[2] In GFI #209, FDA stated that the

[1] Please see FDA CVM Webpage, "Judicious Use of Antimicrobials," https://www.fda.gov/animal-veterinary/antimicrobial-resistance/judicious-use-antimicrobials. (Content current as of 4/30/2020)

[2] https://www.fda.gov/media/79140/download

Defining duration of use

- **Concept paper -** In Jan 2021 CVM published concept paper outlining potential framework for how drug sponsors could voluntarily establish defined durations of use for those medically important antimicrobials that currently lack a defined duration of use.
  - affects certain approved feed-use medically important antimicrobial products
  - objective is to optimize use (to better define when and for how long to administer) so that effectiveness is maintained, but extent of exposure is minimized
  - Comment period closed June 2021; over 31,000 received
  - Next steps include developing and seeking input on draft guidance

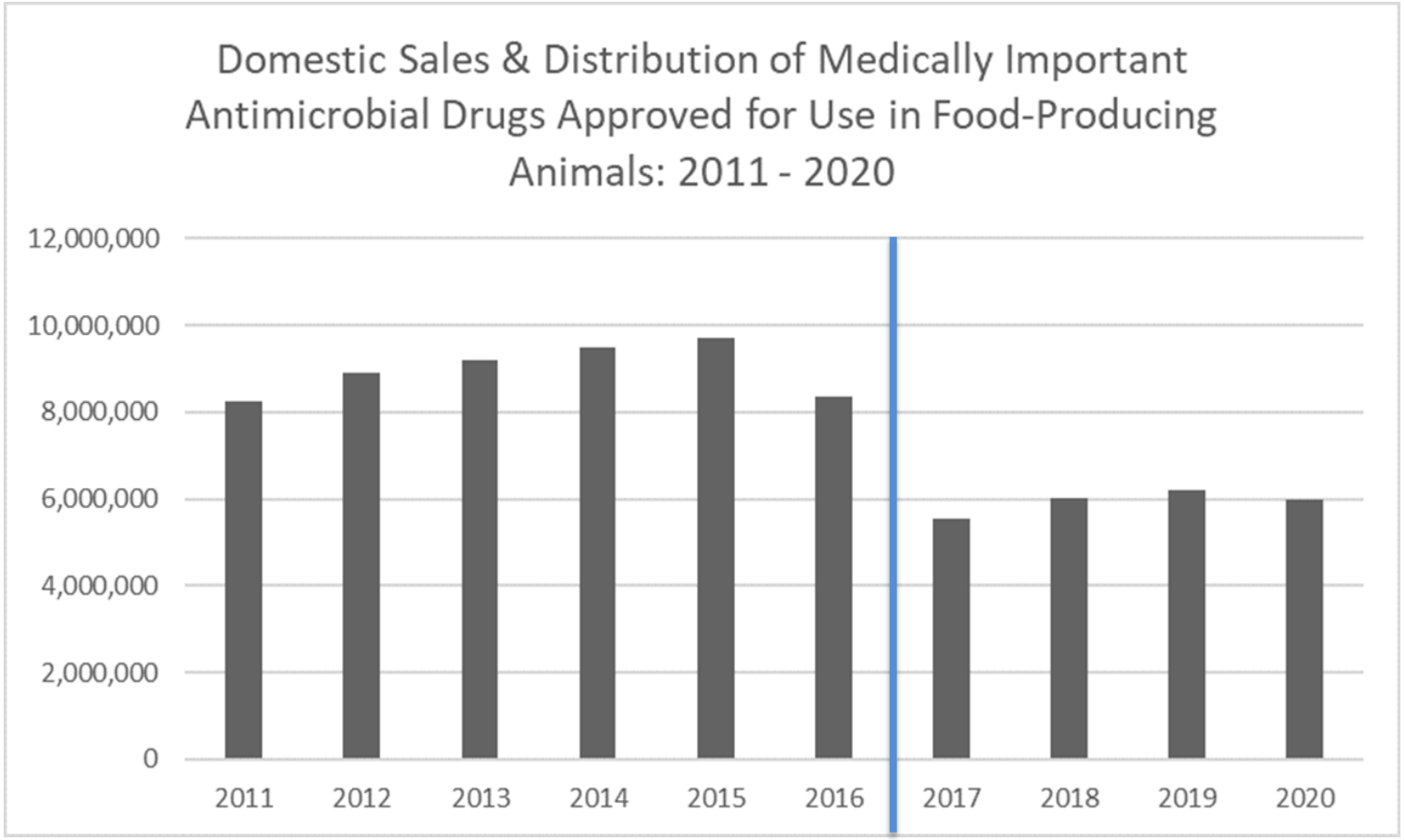
Assessing the Impact of AMR Activities

- Need for data and appropriate metrics to assess impacts of actions taken and monitor progress of stewardship initiatives
- Ongoing work to enhance collection of data on –
  - antimicrobial resistance
  - volume of antimicrobial drug sales/distribution
  - volume of antimicrobial drug use in animals

Changes in Sale and Distribution Data

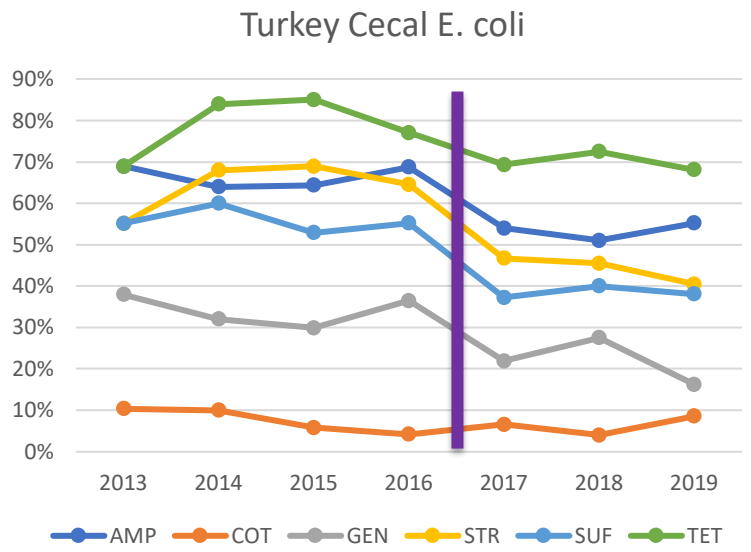
The 2020 Sales and Distribution report show:

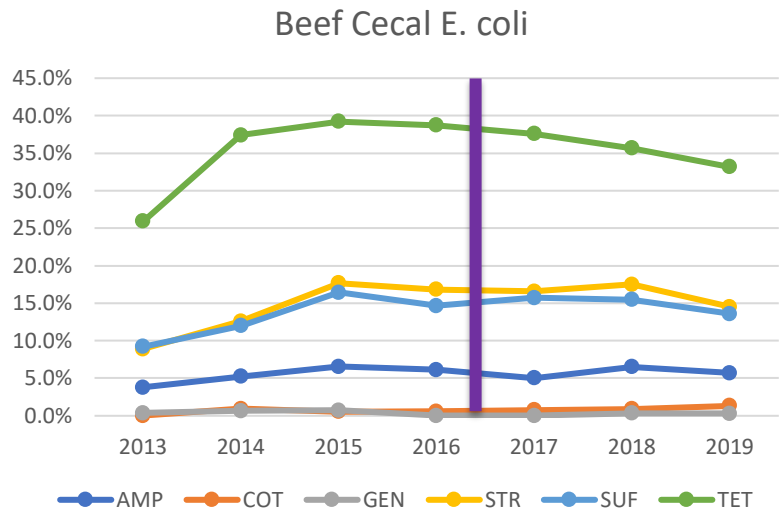
- Domestic sales decreased by three percent between 2019 and 2020.
- Decreased 33% between years 2016 and 2017
- That is a 38% decrease since 2015, which was the peak year of sales

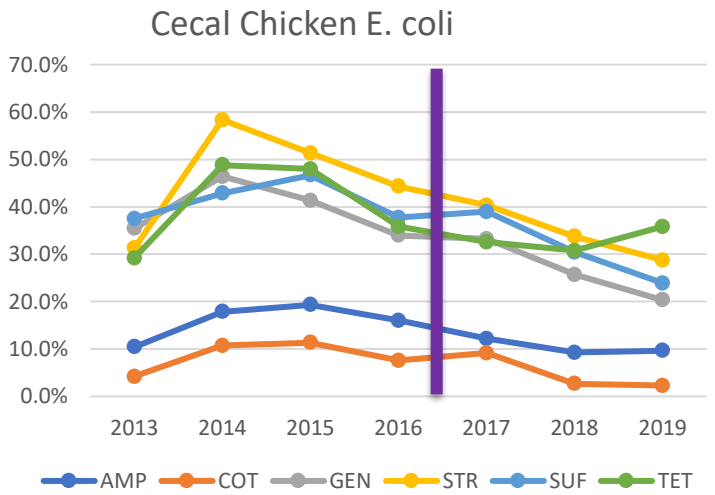


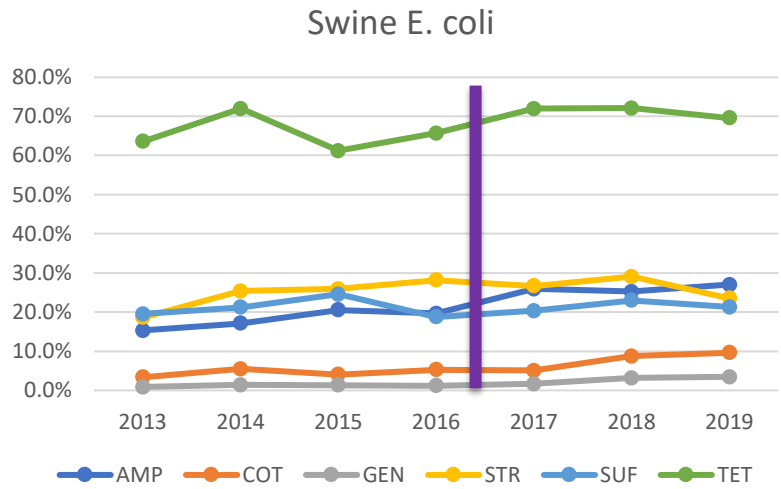
AMR Trends from the 2019 NARMS Report

Data sources for 2019 NARMS Integrated Summary









Data Collection: Antimicrobial Use (AMU)

FDA Cooperative Agreements

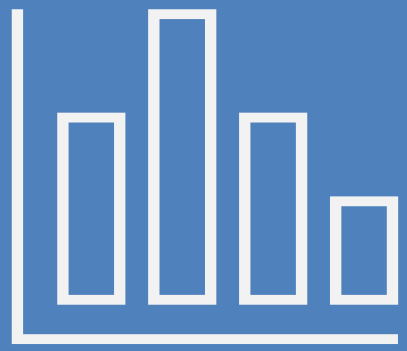
FDA issued a two Funding Opportunity Announcements

- March 2016 - focused on 4 major food-producing species (cattle, swine, turkeys, chickens)
- Feb 2020 - focused on dogs and cats

Requested proposals that would:

- Provide detailed data that reflect actual use
- Pilot methodologies for collecting, summarizing, and reporting AMU data
- Foster public-private partnerships/ collaboration
- Leverage existing data systems and minimize burden to collect data
- Incorporate strategies for protecting confidential information

Challenge: Need for Better Data and Metrics



- Sales data limitations
- Need data that better reflect actual use
- Lack of existing infrastructure

Exploring strategies for collection of antimicrobial use data

- Initiated project with Reagan-Udall Foundation for FDA
- Exploring feasibility of public private partnership model
- Benefits include:
  - Enable monitoring of trends; help understand AMR drivers
  - Foster antimicrobial stewardship
  - Inform regulatory and policy decision making
  - Enhance transparency regarding antimicrobial use

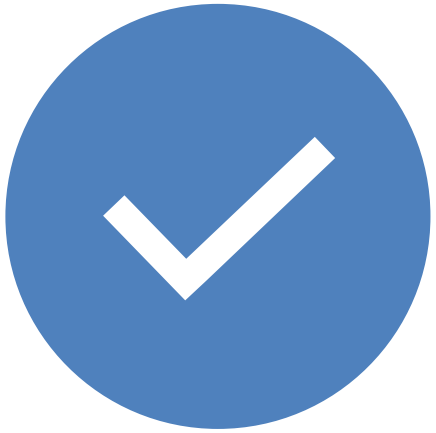
What's Next for CVM?

Advance ongoing initiatives in 5-year (2019-2023) AMR plan

- Transition OTC products to Rx (June 2023)
- Update process for ranking importance for human medicine
- Better define duration of use for certain feed use products
- Consider needed measures in companion animal sector
- Building an approach for collecting antimicrobial use information from animals

Have initiated new strategic planning process

- Examining need for additional actions as current AMR plan ends in September 2023



IMPORTANT CHANGES HAVE BEEN MADE REGARDING ANTIMICROBIAL USE

FOCUS ON ANTIMICROBIAL STEWARDSHIP AND OPTIMIZING THE USE OF ANTIMICROBIALS IN VETERINARY SECTOR

EMPHASIS ON STAKEHOLDER ENGAGEMENT IN DEVELOPING COLLABORATIVE STRATEGIES FOR IMPLEMENTING CHANGE

In Conclusion


FDA
U.S. FOOD & DRUG
ADMINISTRATION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DR. CHELSEY SHIVLEY

Antimicrobial Resistance Coordinator,
Office of Interagency Coordination for USDA
APHIS Veterinary Services

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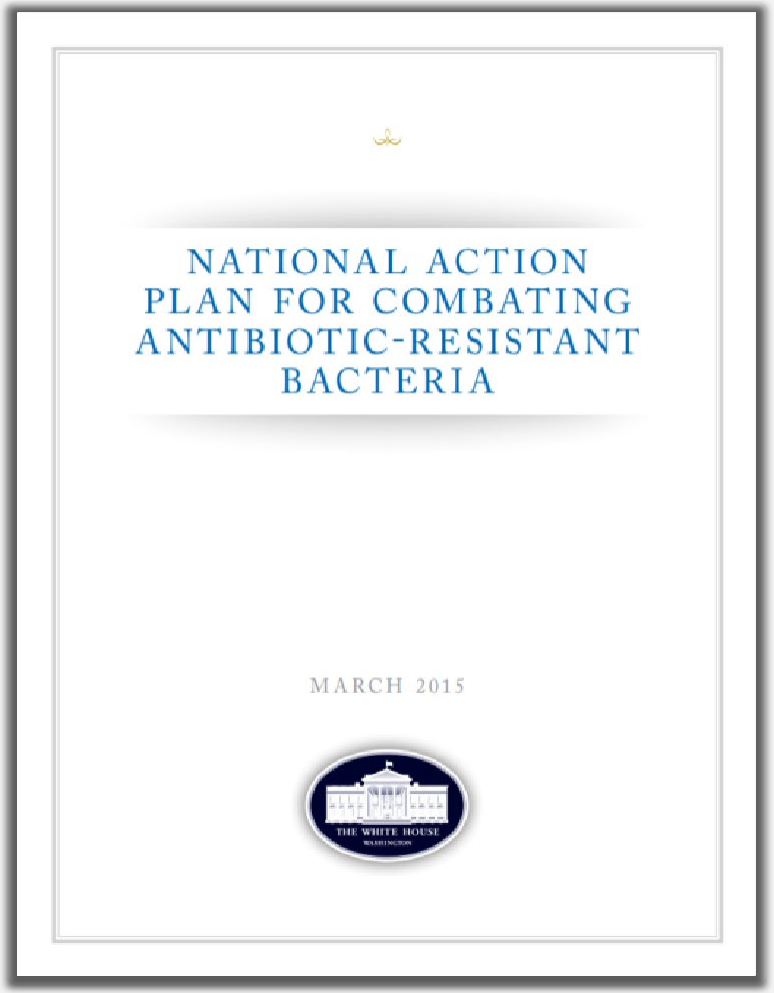
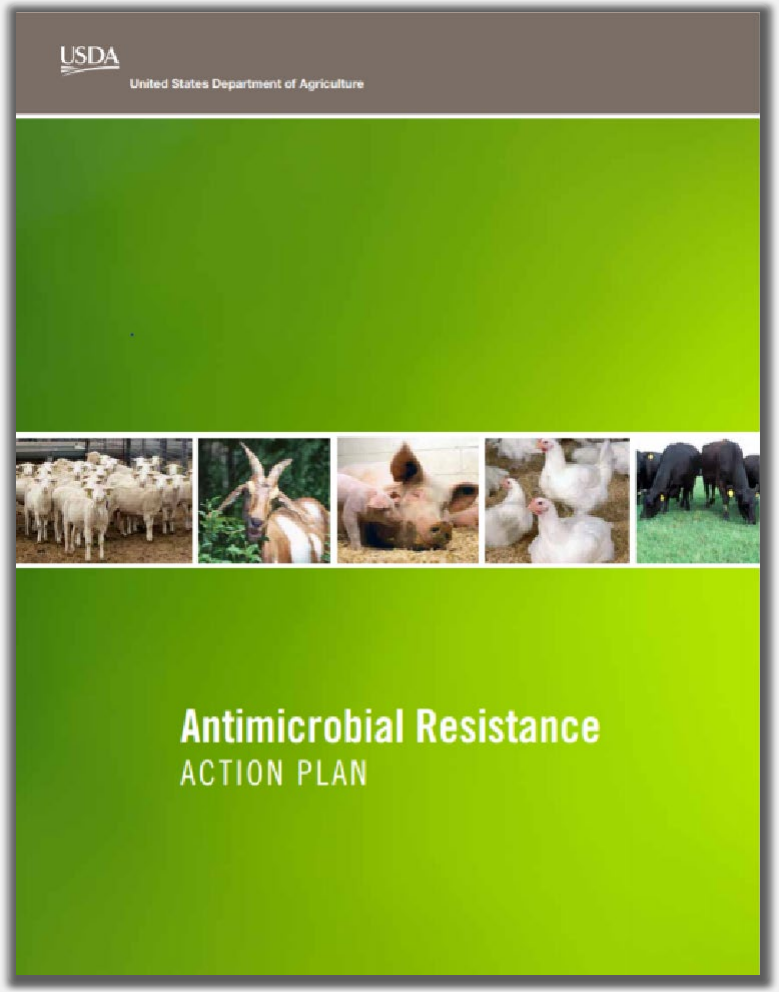
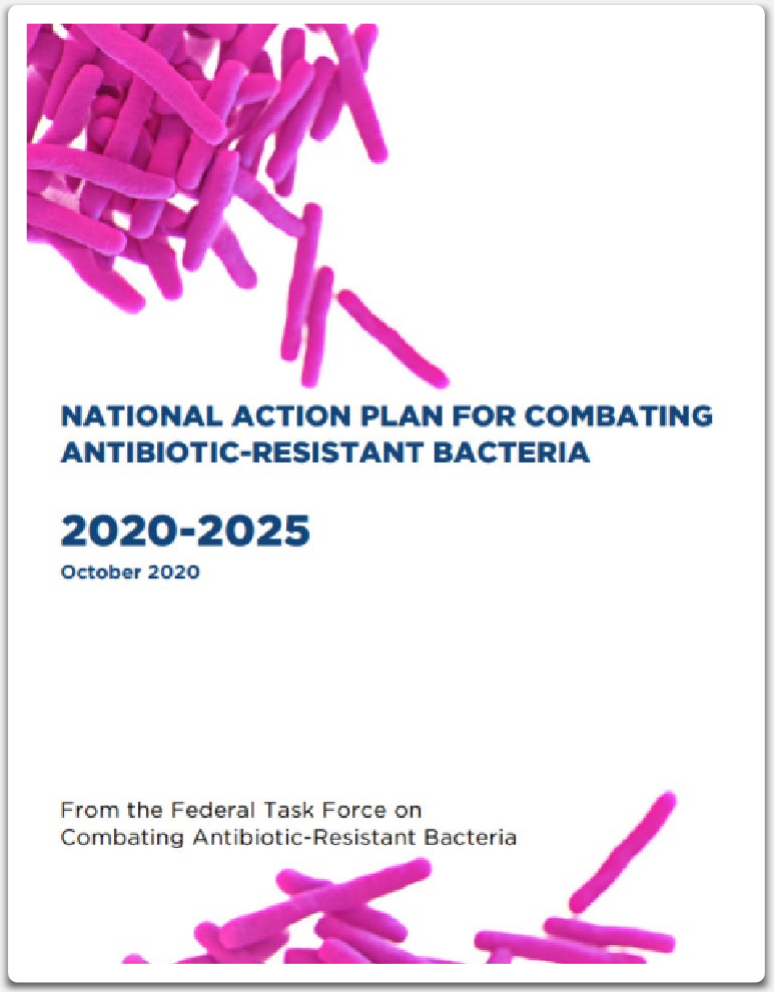
Antimicrobial Stewardship in Agriculture: USDA APHIS Perspective

Chelsey Shivley, DVM, PhD, DACAW
Veterinary Epidemiologist
Farm Foundation Forum
September 27, 2022

U.S. Department of Agriculture





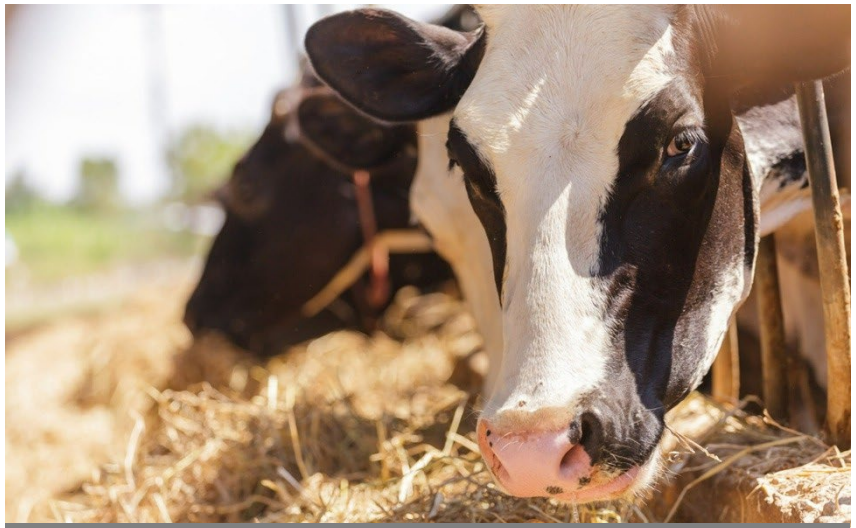


USDA **U.S. Department of Agriculture**

Veterinary Services AMR Activities

Antimicrobial Use & Stewardship Monitoring

Antimicrobial Resistance Monitoring



Education & Outreach

Collaboration with Industry & University Partners

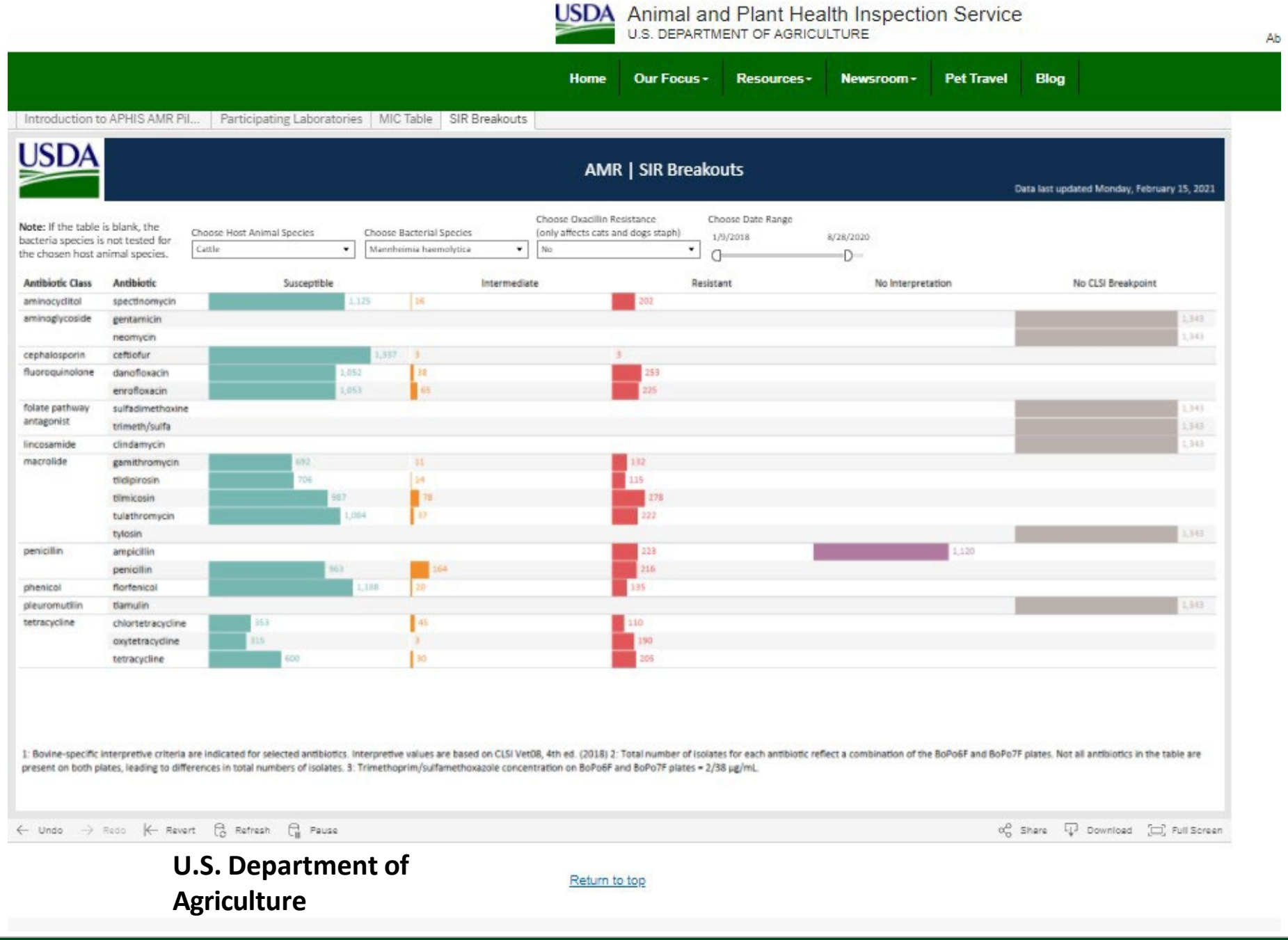
U.S. Department of Agriculture

National Animal Health Monitoring System (NAHMS)

USDA U.S. Department of Agriculture

Recent NAHMS Studies

USDA U.S. Department of Agriculture



U.S. Department of Agriculture

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National Animal Health Laboratory Network AMR Pilot Project

National Veterinary Accreditation Program

Swine Industry Collaboration

Dairy Industry Collaboration

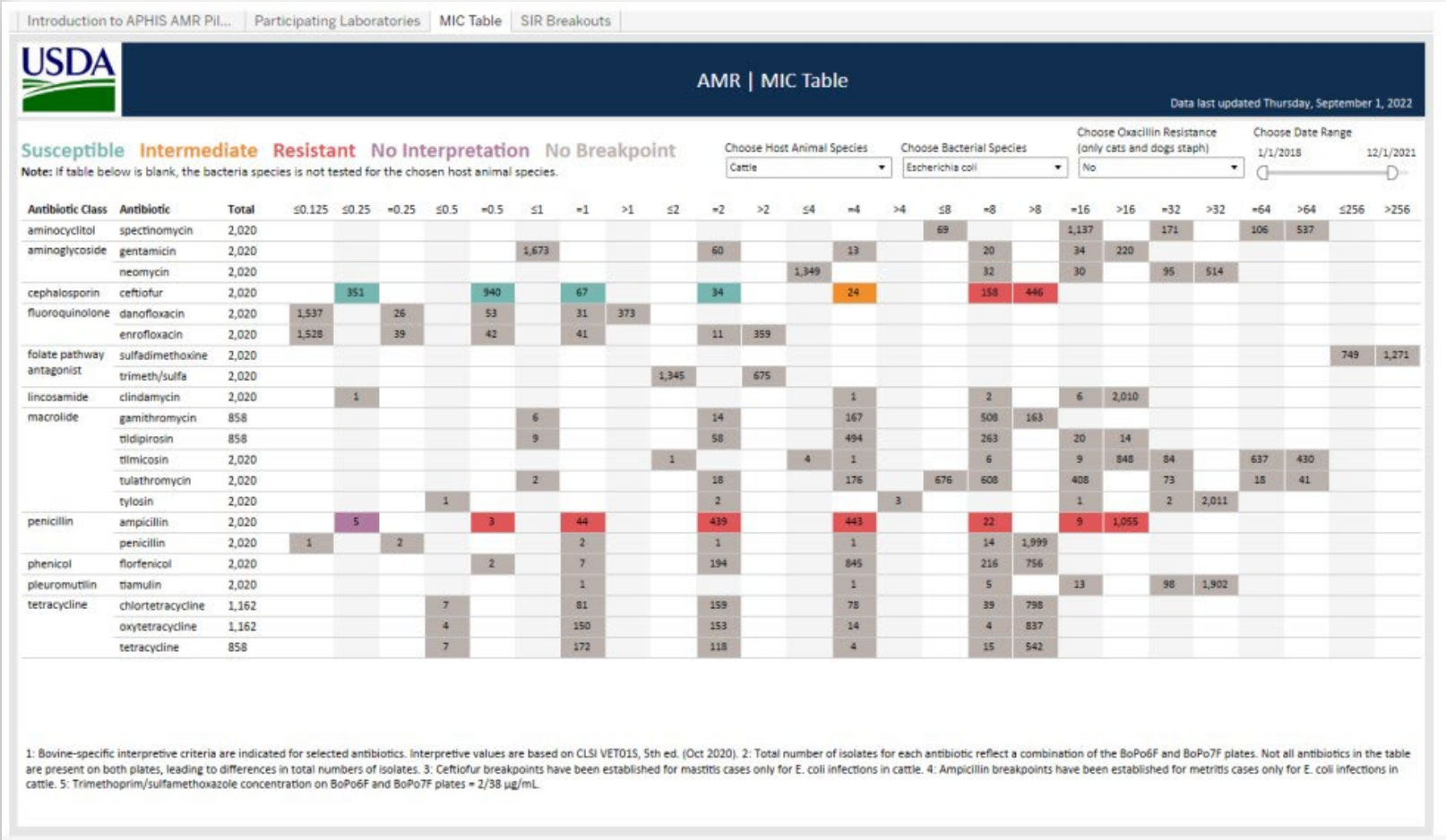
Collaboration

Producers

Veterinarians

Diagnostic Laboratories

Communication

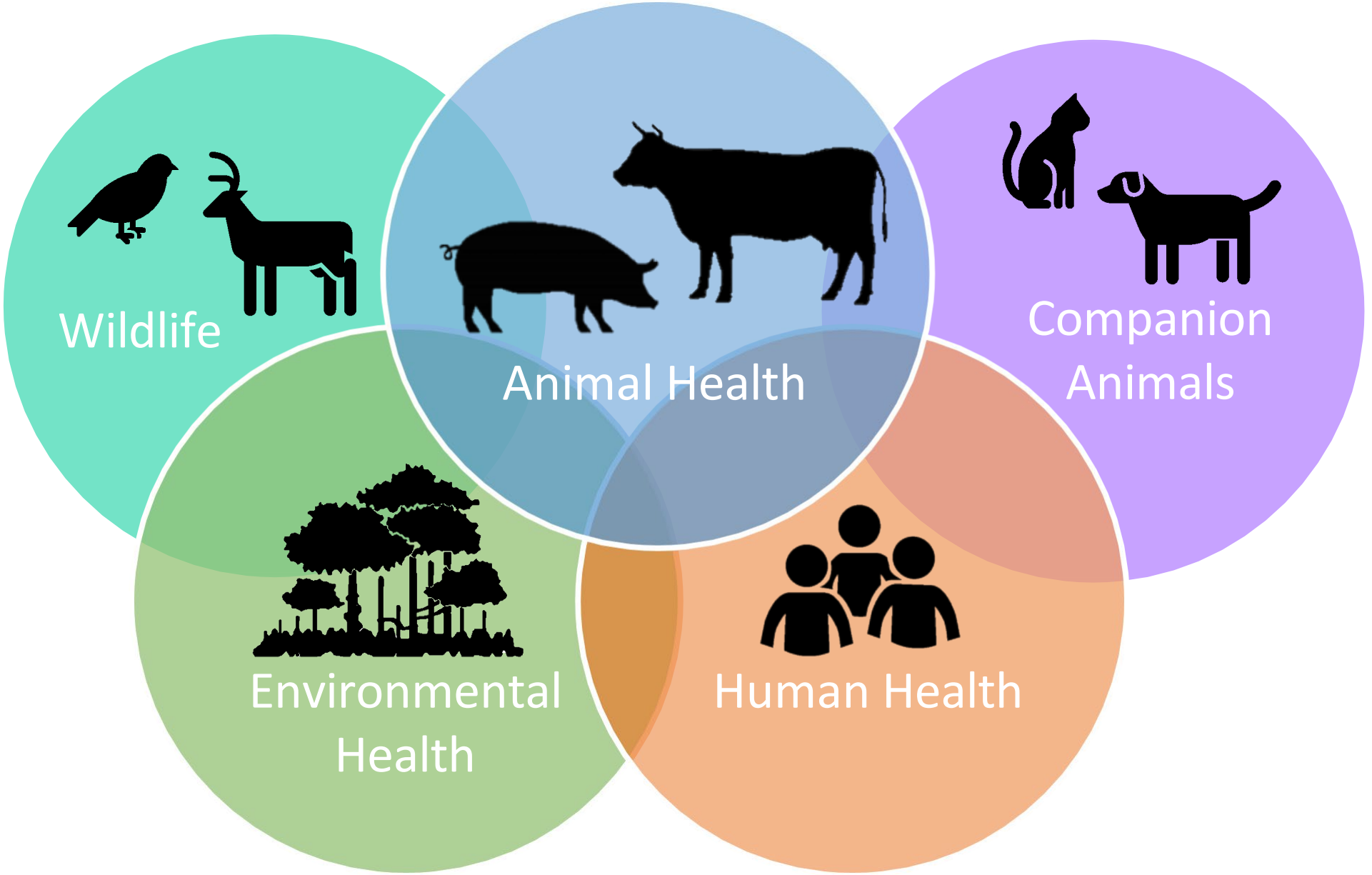


Antibiotic Class	Antibiotic	Total	≤0.125	≤0.25	=0.25	≤0.5	=0.5	≤1	=1	>1	≤2	=2	>2	≤4	=4	>4	≤8	=8	>8	=16	>16	=32	>32	=64	>64	≤256	>256
aminocyclitol	spectinomycin	2,020															69			1,137		171		106	537		
aminoglycoside	gentamicin	2,020						1,673				60			13			20		34	220						
	neomycin	2,020												1,349				32		30		95	514				
cephalosporin	ceftiofur	2,020		351			940		67			34			24			158	446								
fluoroquinolone	danofloxacin	2,020	1,537		26		53		31	373																	
	enrofloxacin	2,020	1,528		39		42		41			11	359														
folate pathway antagonist	sulfadimethoxine	2,020																								749	1,271
	trimeth/sulfa	2,020									1,345		675														
lincosamide	clindamycin	2,020		1											1			2		6	2,010						
macrolide	gamithromycin	858						6				14			167			508	163								
	tildipirosin	858						9				58			494			263		20	14						
	tilmicosin	2,020									1			4	1			6		9	848	84		637	430		
	tulathromycin	2,020						2				18			176		676	608		408		73		18	41		
	tylosin	2,020				1						2				3				1		2	2,011				
penicillin	ampicillin	2,020		5			3		44			439			443			22		9	1,055						
	penicillin	2,020	1		2				2			1			1			14	1,999								
phenicol	florfenicol	2,020					2		7			194			845			216	756								
pleuromutilin	tiamulin	2,020							1						1			5		13		98	1,902				
tetracycline	chlortetracycline	1,162				7			81			159			78			39	798								
	oxytetracycline	1,162				4			150			153			14			4	837								
	tetracycline	858				7			172			118			4			15	542								

1: Bovine-specific interpretive criteria are indicated for selected antibiotics. Interpretive values are based on CLSI VET01S, 5th ed. (Oct 2020). 2: Total number of isolates for each antibiotic reflect a combination of the BoPo6F and BoPo7F plates. Not all antibiotics in the table are present on both plates, leading to differences in total numbers of isolates. 3: Ceftiofur breakpoints have been established for mastitis cases only for E. coli infections in cattle. 4: Ampicillin breakpoints have been established for metritis cases only for E. coli infections in cattle. 5: Trimethoprim/sulfamethoxazole concentration on BoPo6F and BoPo7F plates = 2/38 µg/mL.

Science-Based Approach

Future Antimicrobial Use & Resistance Activities


Wildlife
Animal Health
Companion Animals
Environmental Health
Human Health

Thank You!

Chelsey Shivley, DVM, PhD, DACAW
Veterinary Epidemiologist
Antimicrobial Resistance Coordinator
Office of Interagency Coordination
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DR. MEGIN NICHOLS

Veterinary Epidemiologist,
Division of Foodborne, Waterborne, and Environmental Diseases, Centers for Disease Control and Prevention

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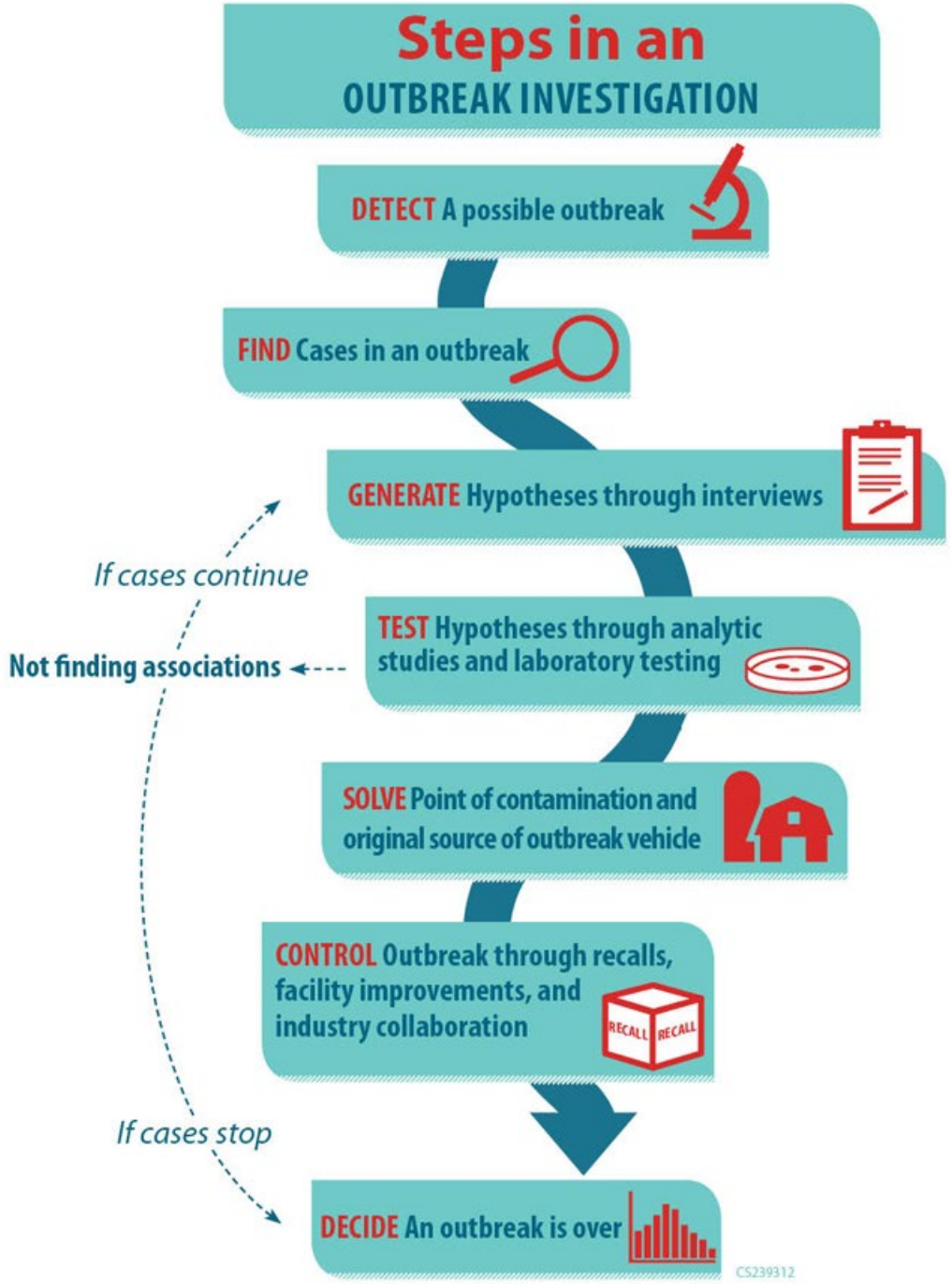
Antimicrobial Stewardship in Agriculture: How Far Have We Come and What's Next?

Lessons learned from human illness outbreaks linked to animal contact

Megin Nichols, DVM, MPH, DACVPM
Division of Foodborne, Waterborne, and Environmental Diseases
Centers for Disease Control and Prevention

September 27, 2022

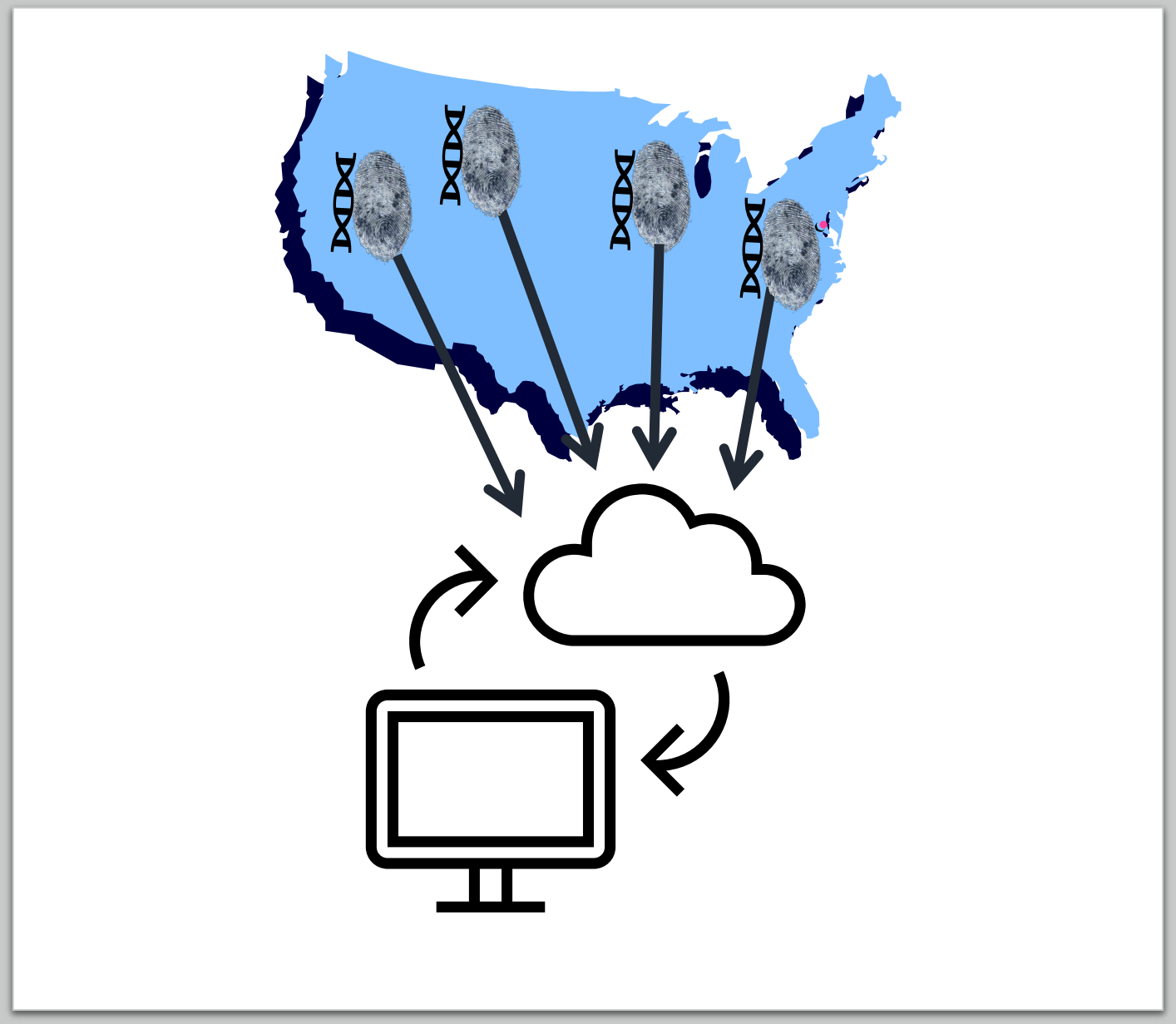


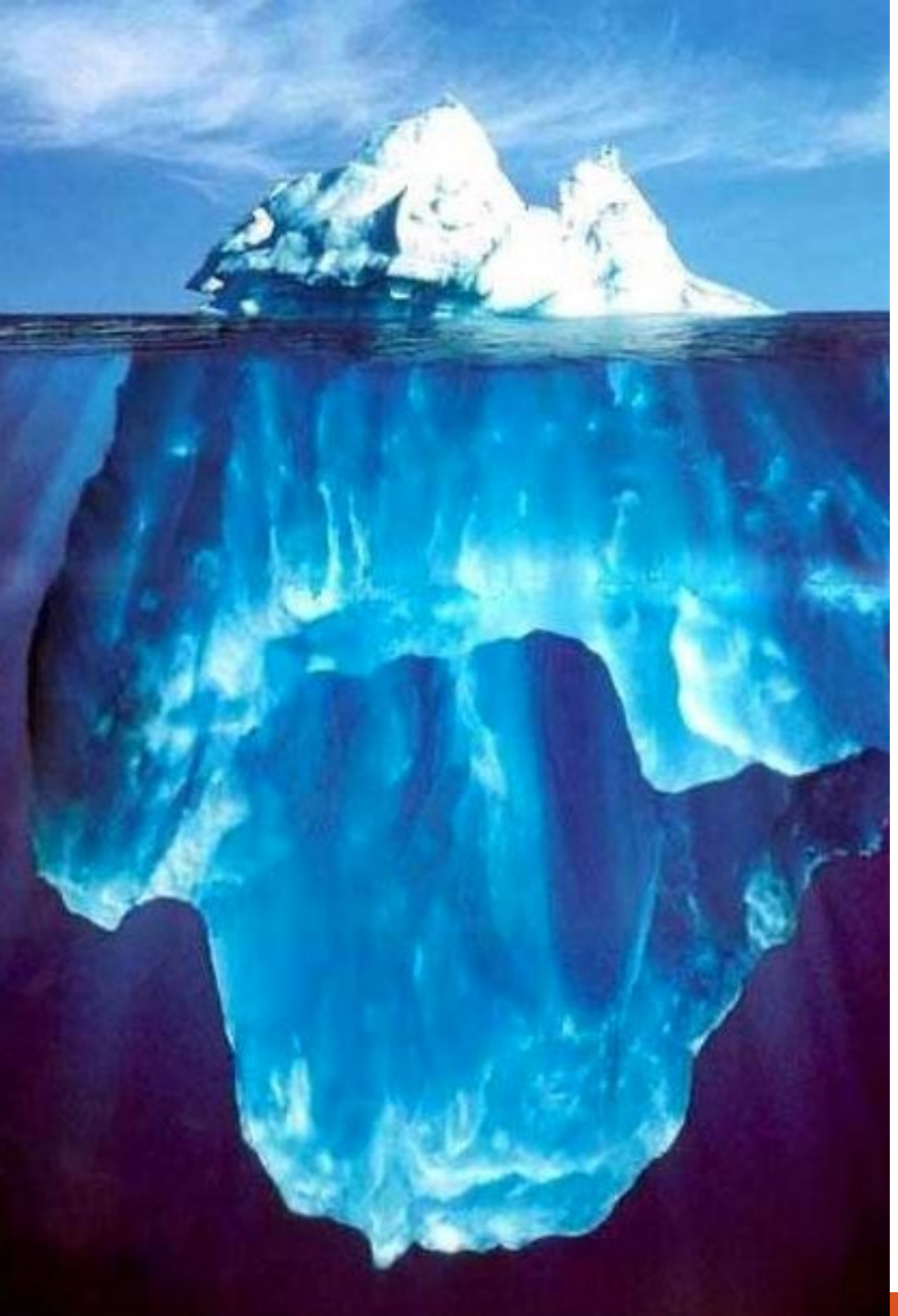
What is an outbreak?

- When two or more people get the same illness and investigation shows it came from the same contaminated food or drink, or contact with the same species of animal, the event is called a disease outbreak

Detecting Outbreaks with PulseNet

- WGS data from illness-causing bacteria uploaded to the PulseNet USA database
- Monitored for temporal and geographic clustering
- When a cluster is identified, PulseNet notifies epidemiologists





PulseNet-confirmed cases represent the tip of the iceberg

Salmonella (non-typhoidal)

- Under-reporting/under-diagnosis multiplier: 29.3

Foodborne Illness Acquired in the United States – Major Pathogens. Scallan, et al. EID 2011

Groups at higher risk from enteric zoonoses

- Higher risk for infection
  - Young children (<5 years)
- Higher risk for adverse outcomes
  - Older adults (>65 years)
  - Young children (< 5 years)
  - People with weakened immune systems

Occupational

- Ranchers
- Dairy workers
- Veterinarians
- Slaughterhouse workers
- Postal workers
- Pet store workers
- Zookeepers

What have we learned through investigation of outbreaks linked to livestock?

One Health Response to a Multidrug-Resistant (MDR) *Salmonella* Heidelberg Outbreak

ZOONOTIC OUTBREAK

A new strain of *Salmonella* caused outbreaks of severe illness in dairy calves and people, mostly children.

LABORATORY INVESTIGATION

Laboratory testing detected infections across multiple states from the same strain and identified a new antibiotic resistance gene.

OUTBREAK RESPONSE

Public health, animal health, environmental, and agricultural experts worked together to track the spread of this strain and teach about infection prevention.

cdc.gov/amd/whats-new/

CS 317622-A

Salmonella Contamination

AND DAIRY CALF PRODUCTION

Outbreaks of multidrug-resistant *Salmonella* in humans have been linked to dairy calves. CDC supported The Ohio State University and University of Wisconsin-Madison to study contamination in dairy calf production. **Percentages** of environmental samples with *Salmonella*. Many were resistant to antibiotics.

97% IN LIVESTOCK MARKET

22% IN BARNS

74% IN TRAILERS

93% IN HOLDING PENS

Improving infection control throughout calf production will reduce the spread of antibiotic-resistant *Salmonella* in people, animals, and the environment.

Stewardship Defined

- Antimicrobial stewardship refers to the actions veterinarians take individually and as a profession to preserve the effectiveness and availability of antimicrobial drugs through conscientious oversight and responsible medical decision-making while safeguarding animal, public, and environmental health.

https://www.avma.org/sites/default/files/resources/AntimicrobStewardshipDef_CorePrinciplesFlyer_052318.pdf

Survey of production animal veterinarians' prescription practices, factors influencing antimicrobial drug use, and perceptions of and attitudes toward antimicrobial resistance

Daniel D. Taylor DVM, MPH
Jennifer N. Martin PhD
Paul S. Morley DVM, PhD
Keith E. Belk PhD
Alice E. White MS
Elaine J. Scallan Walter PhD

From the Colorado Integrated Food Safety Center of Excellence, Colorado School of Public Health, Aurora, CO 80045 (Taylor, White, Scallan Walter); and Department of Animal Sciences, College of Agricultural Sciences (Martin, Belk), and Department of Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences (Morley), Colorado State University, Fort Collins, CO 80523. Dr. Morley's present address is the Veterinary Education, Research, and Outreach Center, West Texas A&M University, Canyon, TX 79016.

Address correspondence to Dr. Taylor (daniel.d.taylor@ucdenver.edu).

OBJECTIVE
To assess production animal medicine veterinarians' prescription practices and identify factors influencing their use of antimicrobial drugs (AMDs) and their perceptions of and attitudes toward antimicrobial resistance (AMR).

SAMPLE
157 production animal veterinarians in the United States.

PROCEDURES
An online cross-sectional survey and digital diary were used to gather information regarding perceptions on AMD use and AMR and on treatment recommendations for production setting–specific disease scenarios. Results were compared across respondents grouped by their selected production setting scenarios and reported years as veterinarians.

RESULTS
The most commonly selected production setting disease scenarios were dairy cattle (96/157 [61.1%]), backgrounding cattle (32/157 [20.4%]), and feedlot cattle (20/157 [12.7%]). Because few respondents selected swine (5/157 [3.2%]) or poultry (4/157 [2.5%]) scenarios, those responses were excluded from statistical analysis of AMD prescription practices. Most remaining respondents (147/148 [99.3%]) reported that they would recommend AMD treatment for an individual ill animal; however, responses differed for respondents grouped by their selected production setting scenarios and reported years as veterinarians when asked about AMD treatment of an exposed group or high-risk disease-free group. Most respondents reported that government regulations influenced their AMD prescribing, that owner and producer compliance was a veterinary-related factor that contributed to AMR, and that environmental modifications to prevent disease could be effective to mitigate AMR.

CONCLUSIONS AND CLINICAL RELEVANCE
Results of the present study helped fill important knowledge gaps pertaining to prescription practices and influencing factors for AMD use in production animal medicine and provided baseline information for future assessments. This information could be used to inform future interventions and training tools to mitigate the public health threat of AMR. (*J Am Vet Med Assoc* 2020;257:87–96)

https://avmajournals.avma.org/view/journals/javma/257/1/javma.257.1.87.xml?tab_body=pdf

Actions For Veterinarians

Veterinarians can slow antibiotic resistance by implementing disease prevention strategies and improving the use of antibiotics while also guaranteeing high-quality medical care for animal patients.

Prevent Disease

Maintain Accurate Records of Treatment & Outcomes

Stay Current

Clean Your Hands & Equipment

Select & Use Antibiotics Appropriately

Prevent Environmental Contamination

Commit to Antibiotic Stewardship

Antibiotic Stewardship Education

FOR CALF PRODUCERS

CDC supported The Ohio State University todevelop and test antibiotic use decision-making tools and a training program for calf producers.

Dairy calf producers often need to decide whether antibiotics are needed using veterinary protocols. Giving antibiotics when they are not needed contributes to antibiotic resistance.

Antibiotic use knowledge test scores improved by about 20% after introduction of tools and training.

Farms receiving tools and training used fewer antibiotics than control farms. More data is needed to confirm the impacts of these interventions over time.

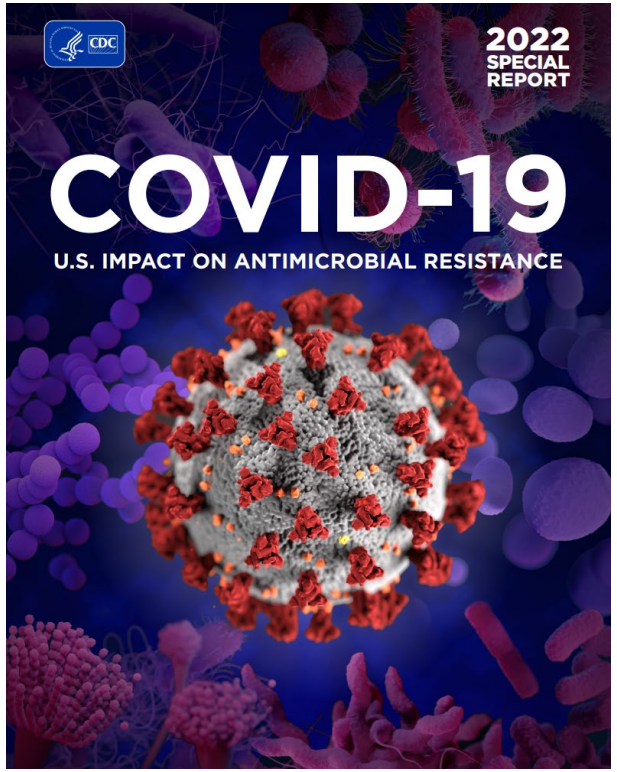
Educating calf producers on antibiotic stewardship can help reduce unnecessary antibiotic use.

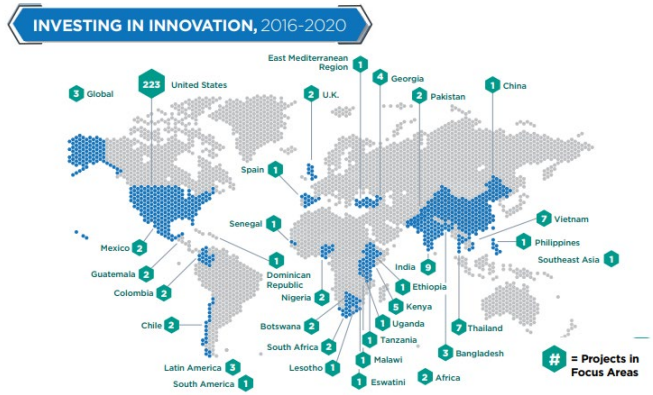
https://youtu.be/tr5EgQBc770

ANTIBIOTIC RESISTANCE THREATS
IN THE UNITED STATES

2019

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention





What's Next: CDC is exploring investments in the U.S. public health infrastructure to better respond to the challenges of antimicrobial resistance and emerging threats simultaneously.

- Supporting more innovation and research on therapeutics, vaccines, and diagnostics.
- Enhancing interagency collaborations to accelerate research for developing new antibiotics, antifungals, therapeutics, and vaccines, including working with FDA to identify ways to support decolonization products.
- Working to undo negative impacts the COVID-19 pandemic may have had on essential vaccine conversations.
- Supporting the widespread use of vaccines to prevent infections, slow the spread of resistance, and reduce antibiotic use.
- Building a vaccine data platform to inform and accelerate the development of new vaccines, stopping infections before they start, as part of the CARB National Action Plan.

AVMA/Committee on Antimicrobials

ANTIMICROBIAL RESISTANT PATHOGENS AFFECTING ANIMAL HEALTH IN THE UNITED STATES

AVMA
American Veterinary Medical Association

	Aminoglycosides	Amphenicols	Carbapenemes	Cephalosporins	Fluoroquinolones	Lincosamides	Macrolides	Penicillins	Pleuromutilins	Sulfonamides	Tetracyclines	Trimethoprim
Aeromonas spp		●									●	●
Campylobacter Jejuni	●				●	●	●				● ●	
Edwardsiella spp		●									●	●
Enterobacteriaceae	● ● ●	●		● ● ●	●			*		● ●	● ● ●	●
Enterococcus spp					*		●	●				
Flavobacterium Psychrophilum		●									●	●
Moraxella spp							●				●	
Ornithobacterium Rhinotracheale								●		●	●	
Pasteurellaceae					● ●		●	● ●	●	●	● ● ●	
Psuedomonas Aeruginosa	●		● ●		● ●							
Salmonella	●	●		●	●		●	●	●	●	●	
Staphyloccocus spp	●			●	●	●	● ● ●	* ● ●			* ● ●	●
Streptococcus				●	●			●				
Vibrio	●	●		●	●		●	●		●	●	●

● Fish & Shrimp ● Cattle ● Dogs & Cats ● Equine ● Chickens & Turkeys ● Sheep & Goats ● Swine

*Note: Some of the resistance noted for these organisms has been long-established and there available therapeutic options which may be successfully used for treatment.

Available at:
https://www.avma.org/resources-tools/one-health/antimicrobial-use-and-antimicrobial-resistance

Antibiotic Resistance (AR)

- Bacteria can develop the ability to defeat the drugs designed to kill them.
  - These bacteria can spread between people, animals and the environment
- Antibiotics save lives, but anytime they are used, they can lead to antibiotic resistance.
- AR affect the health of both people and animals.

Want to learn more about enteric zoonotic outbreaks and antimicrobial resistance?

https://www.cdc.gov/healthypets/outbreaks.html

https://www.cdc.gov/healthypets/keeping-pets-and-people-healthy/pets-and-antibiotic-resistance.html

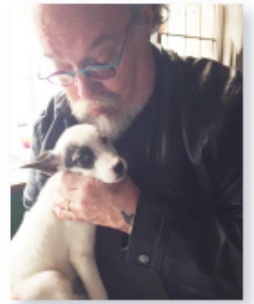
For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

ANTIBIOTIC RESISTANCE THREATS
IN THE UNITED STATES

2019

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

PUPPIES MADE PEOPLE SICK



How could an adorable puppy cause her owner to have a month-long hospital stay, including multiple stays in the intensive care unit? That is what happened to Mike, a 67-year-old retired professor with an existing chronic disease. Within a week of bringing home puppy Mabel from a pet store, Mike experienced diarrhea, fatigue, and lower back pain. The pain became excruciating and he was hospitalized with failing kidneys.

Mike was one of 113 people across 17 states identified as part of an outbreak of multidrug-resistant *Campylobacter* infections linked to pet store puppies. Only one type of antibiotic was able to treat his resistant infection. Due to complications from this infection and his chronic disease, he needed surgery to remove a dead section of stomach. Three months later, Mike finally felt well enough to return to post-retirement work at a bookstore. He still enjoys his pup, but is careful to wash his hands when cleaning up after her.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DR. ALISON ROBERTSON

Professor and Extension Field Crops Pathologist,
Department of Plant Pathology and Microbiology,
Iowa State University

Stewardship of antifungals in crop production

Alison Robertson
Professor and extension field crops pathologist
Iowa State University
alisonr@iastate.edu @alisonrISU

IOWA STATE UNIVERSITY
Extension and Outreach

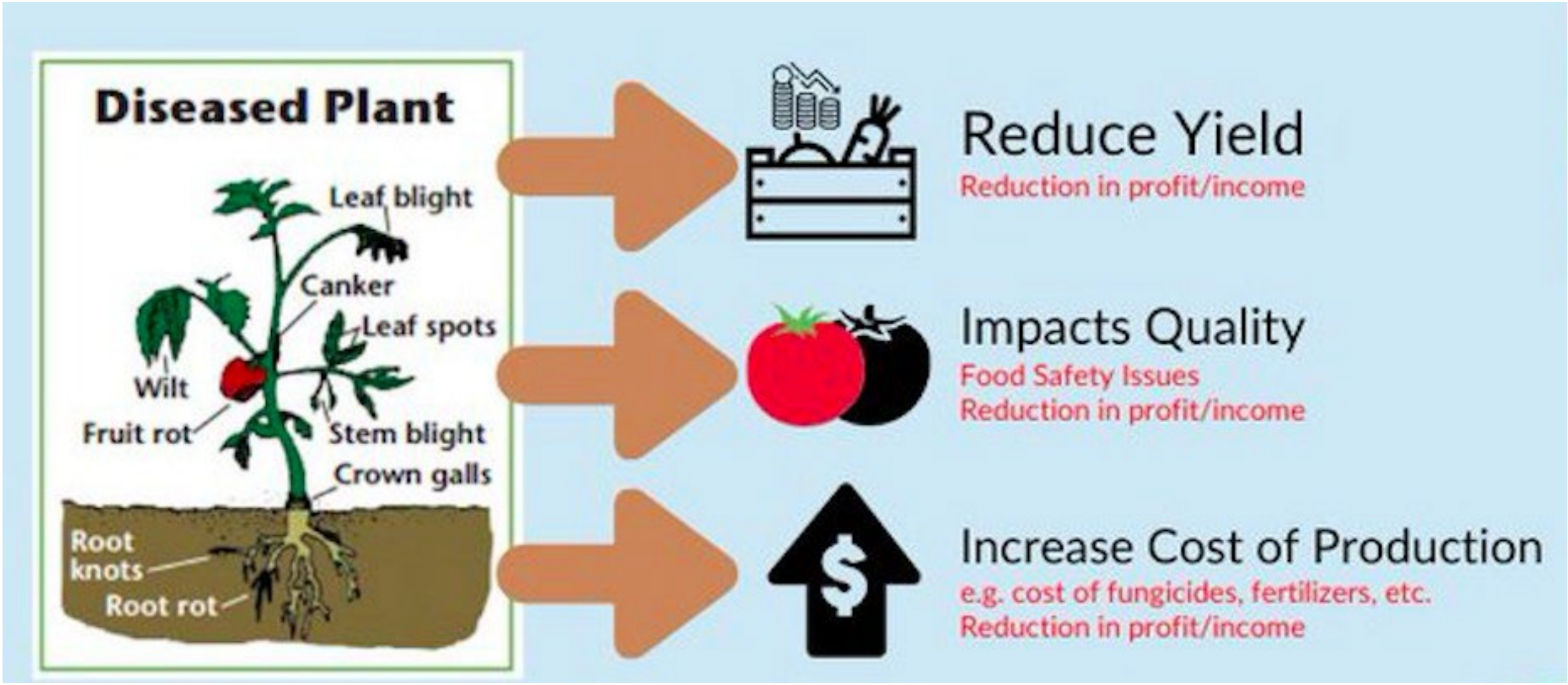
Plants get sick too!



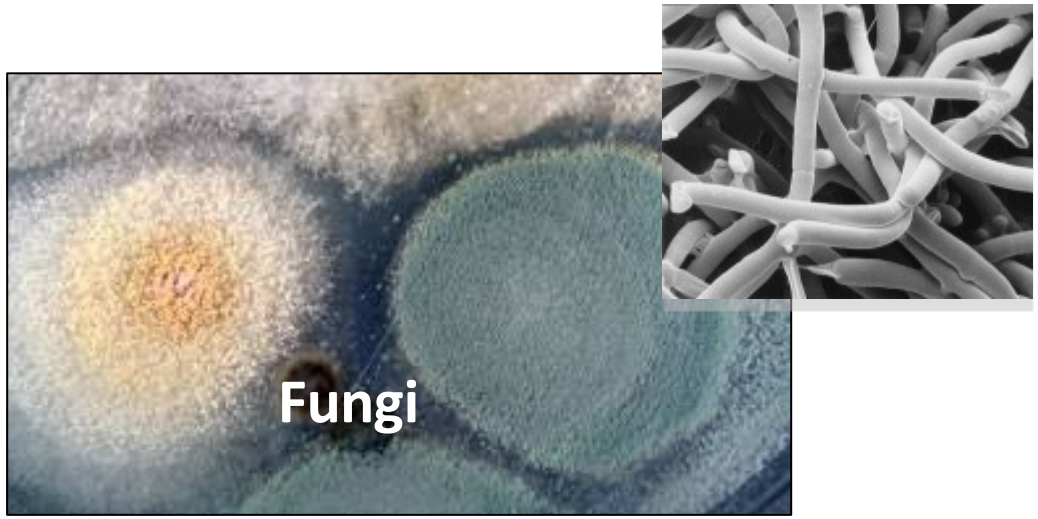


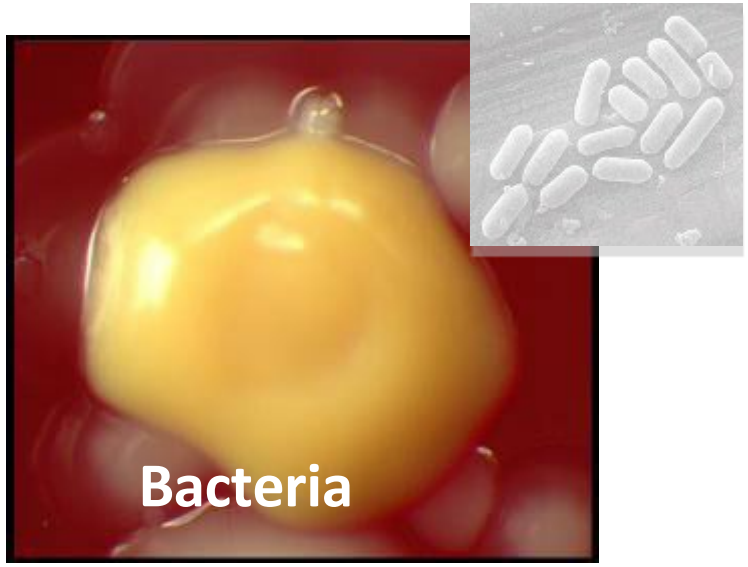


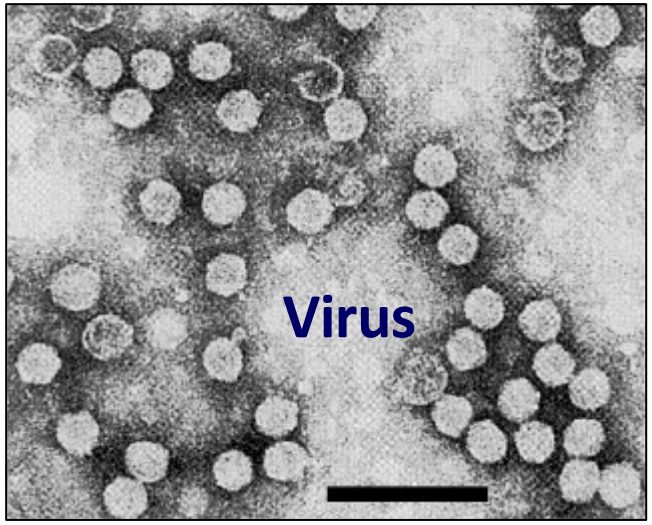
Why are plant diseases important?

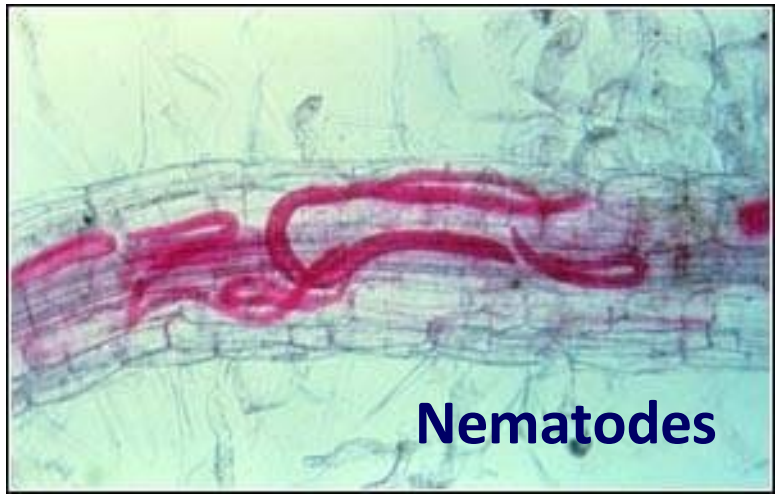


What causes disease in plants?









How do we treat plant disease?

How do we treat plant disease?

1. Plant disease resistant cultivars
2. Fungicide applications (seed and foliar)
3. Cultural methods (crop rotation, planting date, manage crop residue, etc.)

How do we treat plant disease?

1. Plant resistant cultivars
2. Fungicide applications (seed and foliar) = Antifungals
3. Cultural methods (crop rotation, planting date, manage crop residue)

Antifungals used to treat field crop disease

45 FRAC (mode of action) groups

Fungicide **R**esistance **A**ction Committee
**********.frac.info

3-7 FRAC groups primarily used on field crops

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Extension and Outreach

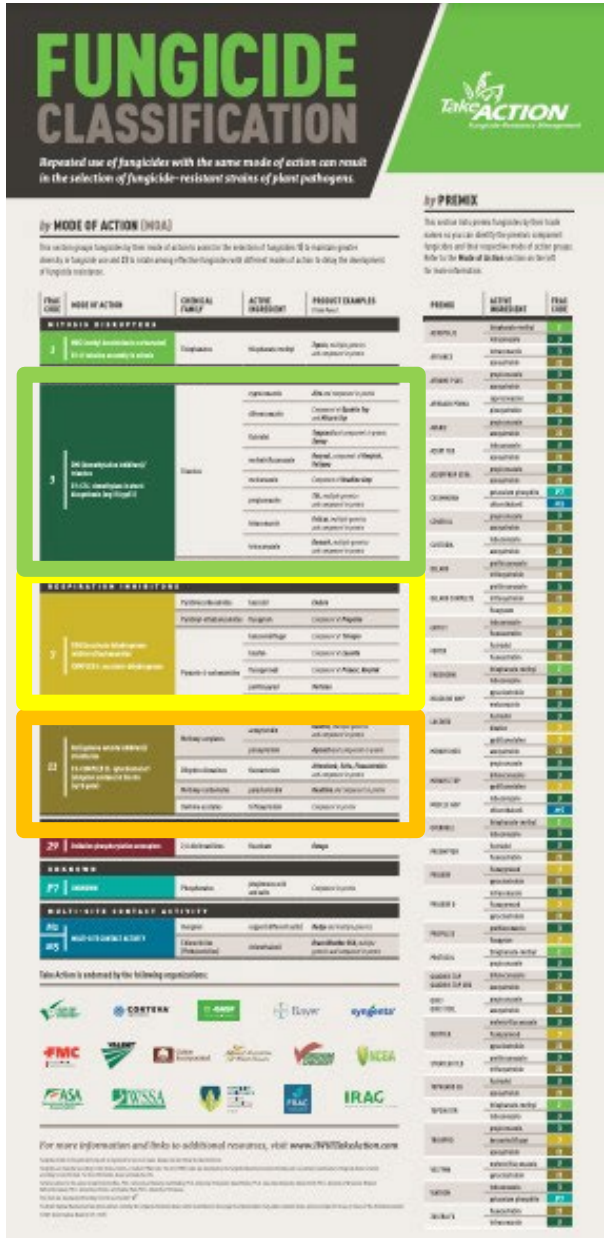
********iwilltakeaction.com/resources/fungicide-classification-chart

Antifungals used to field crop disease

FRAC Group 3 Demethylation Inhibitors (DMI)

FRAC Group 7 Succinate dehydrogenase inhibitors (SDHI)

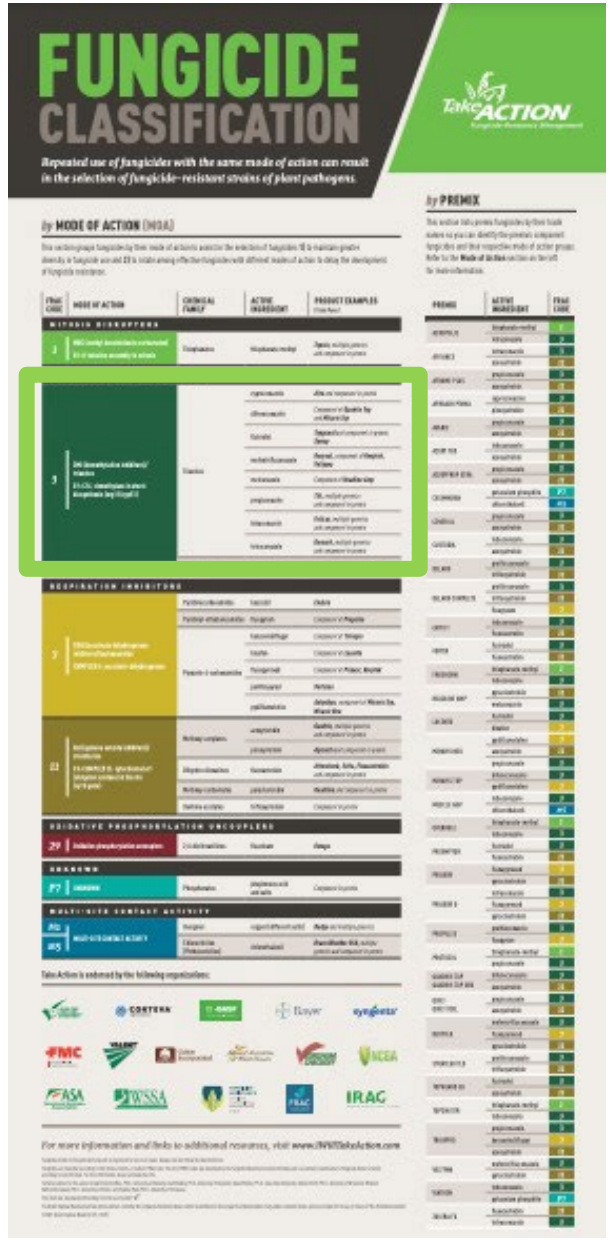
FRAC Group 11 Quinone outside inhibitors (QOI)



********iwilltakeaction.com/resources/fungicide-classification-chart

Antifungals used to treat field crop disease

Azoles ⇦ FRAC Group 3 Demethylation Inhibitors (DMI)



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Is use of DMIs to treat plant disease resulting in azole resistance in human health?

Commentary

A Section 508–conformant HTML version of this article is available at https://doi.org/10.1289/EHP7484.

Trends in Agricultural Triazole Fungicide Use in the United States, 1992–2016 and Possible Implications for Antifungal-Resistant Fungi in Human Disease

Mitsuru Toda,[1] Karlyn D. Beer,[1] Kathryn M. Kuivila,[2] Tom M. Chiller,[1] and Brendan R. Jackson[1]

PLOS PATHOGENS

REVIEW

Fungicide effects on human fungal pathogens: Cross-resistance to medical drugs and beyond

Rafael W. Bastos[1], Luana Rossato[2], Gustavo H. Goldman[1¤a]*, Daniel A. Santos[3¤b]*

Perspective

SCI

Received: 18 January 2017 Revised: 2 May 2017 Accepted article published: 8 May 2017 Published online in Wiley Online Library: 24 July 2017

(wileyonlinelibrary.com) DOI 10.1002/ps.4607

Does agricultural use of azole fungicides contribute to resistance in the human pathogen *Aspergillus fumigatus*?

Derek Hollomon*

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Fungicides are More Than a Plant Disease Management Tool

Published: 10/11/2021
DOI: doi.org/10.31274/cpn-20211011-000
CPN-4009

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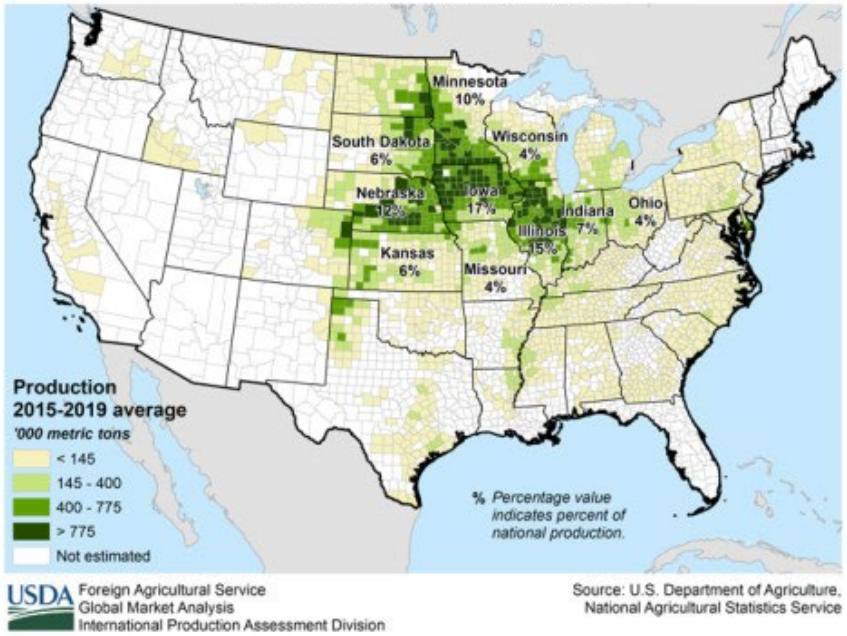
Field crop production in the U.S.

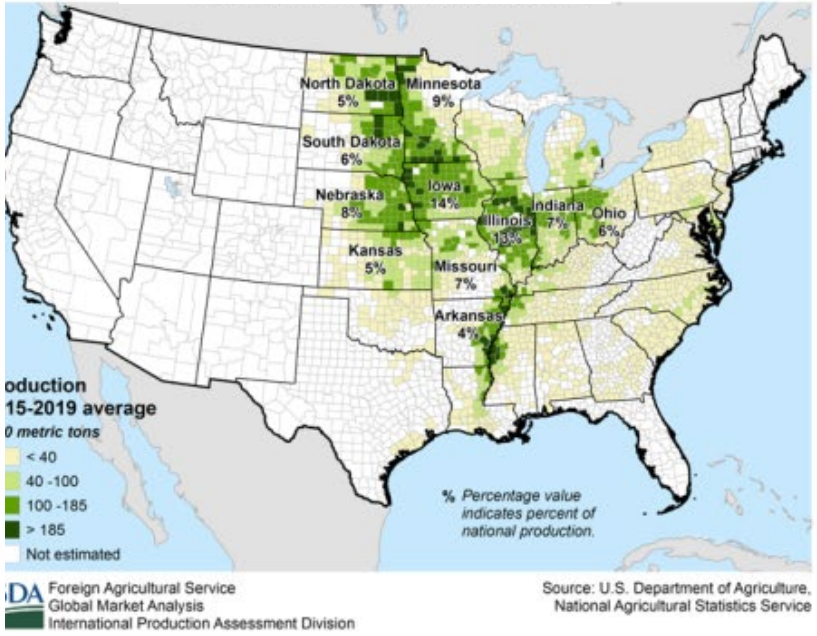
Corn



92.0 million acres in 2020

$61 billion

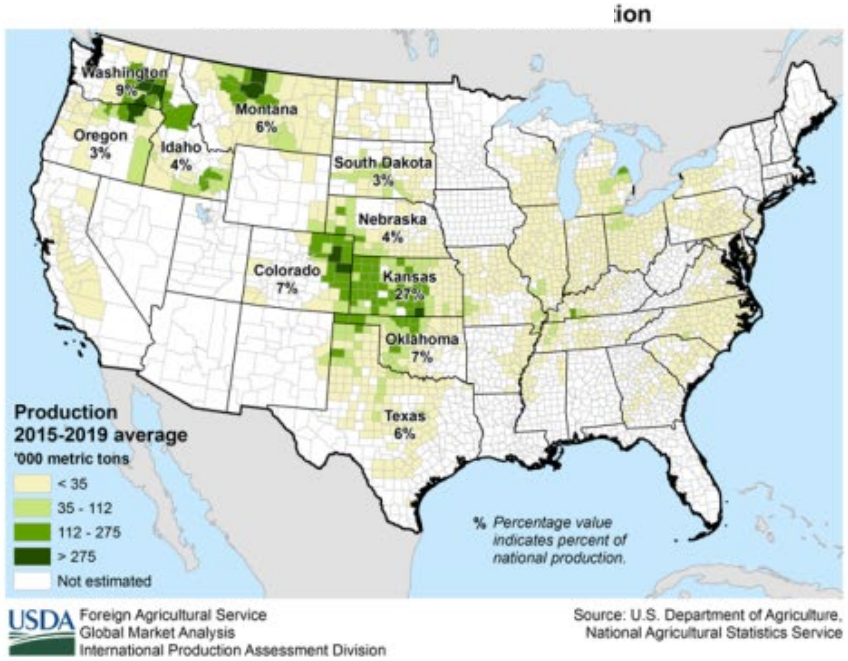
Soybean



83.8 million acres in 2020

$46.1 billion

Wheat



44.3 million acres in 2020

$9.6 billion

USDA; Statistica.com

Losses due to diseases of corn

2012 - 2021

2018 - 2021

Tar spot

Gray leaf spot

Northern corn leaf blight

Southern rust

45.4 – 231.3 mill. bu
=
$0.64 - $13.69/ac

80.4 - 482.4 mill. bu
=
$4.17 - $19.89/ac

38.2 – 539.6 mill. bu
=
$1.58 - $22.98/ac

3.1 – 158.6 mill. bu
=
$0.13 - $6.08/ac

Losses due to diseases of corn

2018 - 2021

2012 - 2021

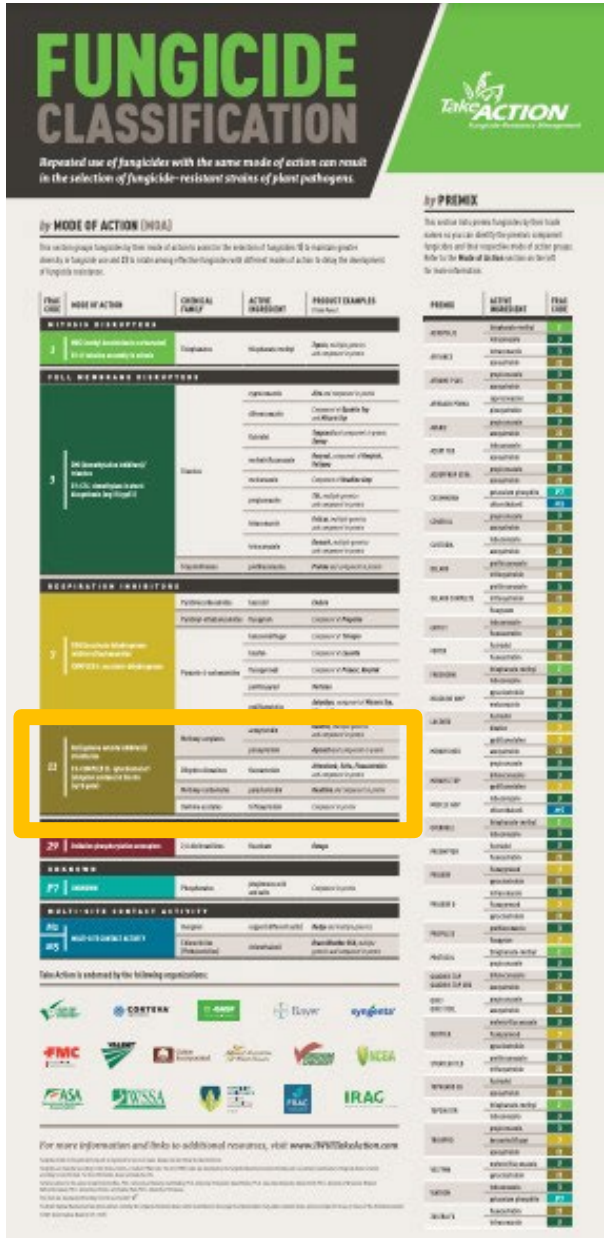
Tar spot	Gray leaf spot	Northern corn leaf blight	Southern rust
			
45.4 – 231.3 mill. bu = $0.64 - $13.69/acre	80.4 - 482.4 mill. bu = $4.17 - $19.89/acre	38.2 – 539.6 mill. bu = $1.58 - $22.98/acre	3.1 – 158.6 mill. bu = $0.13 - $6.08/acre

Treatment with antifungals mitigates losses

Plant pathogens also develop resistance

FRAC Group 11 Quinone outside inhibitors (QOI)

Field resistance in ~40 plant pathogens



Plant pathogens also develop resistance

Frogeye leaf spot

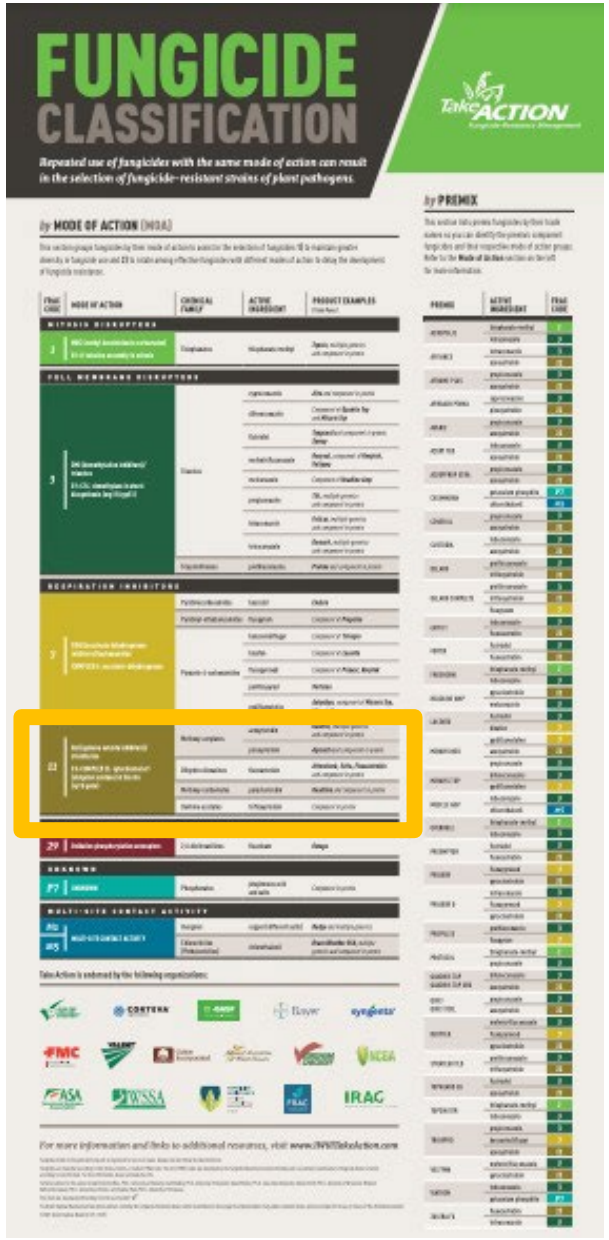
3.8– 53.4 mill. bu

=

$0.56 - $5.34/acre

FRAC Group 11 Quinone outside inhibitors (QOI)

Field resistance in ~40 plant pathogens



How far have we come and what's next?

Communication and education

How far have we come ….

Communication and education

Fungicides are More Than a Plant Disease Management Tool

Published: 10/11/2021
DOI: doi.org/10.31274/cpn-20211011-000
CPN-4009

…. and what's next?

Fusarium Head Blight Prediction Center for Wheat

**********.wheatscab.psu.edu/

National Prediction Modeling Tool Initiative

NPMTI

********agpmt.org/

Thanks for your attention

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What other questions do you have?

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