AAVMC / APLU National Action Plan to Address Antibiotic Resistance

Antimicrobial Resistance Core Competencies Working Group

»» AMR LEARNING OUTCOMES

Association of Public & Land-grant Universities

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The Association of American Veterinary Medical Colleges (AAVMC) is a nonprofit membership organization working to protect and improve the health and welfare of animals, people and the environment around the world by advancing academic veterinary medicine. Members include 49 accredited veterinary medical colleges in the United States, Canada, the Caribbean Basin, Europe, Australia and Mexico.

ASSOCIATION OF PUBLIC & LAND-GRANT UNIVERSITIES

Association of Public and Land-grant Universities

The Association of Public and Land-grant Universities (APLU) is a research, policy, and advocacy organization representing 237 public research universities, land-grant institutions, state university systems, and affiliated organizations. Founded in 1887, APLU is North America's oldest higher education association with member institutions in all 50 U.S. states, the District of Columbia, four U.S. territories, Canada, and Mexico. Annually, member campuses enroll 4.7 million undergraduates and 1.3 million graduate students, award 1.1 million degrees, employ 1.3 million faculty and staff, and conduct $41 billion in university-based research.

Food & Agriculture Organization of the United Nations

This publication was developed with support from the FAO Liaison Office for North America in Washington, D.C., in the context of a strategic collaboration between the AAVMC and FAO, with the objective to raise public awareness, provide education and facilitate collaboration on antimicrobial resistance.

»» EDUCATION: A POWERFUL TOOL FOR ADDRESSING AN OMINOUS THREAT

Responding to the global public health threat posed by antimicrobial resistance, the Association of Public and Land Grant Universities (APLU) and the Association of American Veterinary Medical Colleges (AAVMC) joined forces to create the Joint APLU | AAVMC Task Force on Antibiotic Resistance in Production Agriculture. The task force, comprised of 14 leaders (please see inside rear cover) from U.S. agriculture colleges/land grant universities, veterinary colleges and key representatives from the production animal agriculture community and the pharmaceutical industry, developed a comprehensive national strategy for diminishing the role antibiotics used in food animal production systems play in the broader antimicrobial resistance (AMR) problem. Their final report, which articulated a research and educational agenda for addressing the overall strategy, was released in October 2015.

Crucial to the success of the AMR mitigation effort is the need to educate a wide variety of stakeholders about the proper stewardship and the judicious use of antibiotics in production agriculture. To address this substantial task, the Antimicrobial Resistance Core Competencies Working Group, which includes scientists and professors from a group of major universities and the CDC, was established. Recognizing the opportunity to help mitigate a global public health problem, the Food & Agriculture Organization of the United Nations (FAO) agreed to provide support for the project. The development of these learning outcomes is a critical step forward in the process of constructing formal curricula.

LEARNING OUTCOMES: A BLUEPRINT FOR CURRICULUM DEVELOPMENT

As part of the AAVMC/APLU National Action Plan to Address Antibiotic Resistance, Education and Outreach Recommendations were made, including (1) design and implement a model curriculum to improve awareness, understanding and help in the implementation of effective actions to combat antibiotic resistance, and (2) develop and implement educational and informational strategies, tools and programs that focus on different groups extending across our education spectrum. The Antimicrobial Resistance Core Competencies Working Group was formed to further those two Recommendations. The Working Group included expertise in teaching and in antibiotic resistance.

Adapting a curriculum design model,[1] the Working Group created a series of interrelated learning outcomes that are relevant to 3 different educational levels and are meant to be implemented at a program level. The educational levels were youth (focusing on youth involved in 4H, FFA, and the like), animal science undergraduate and graduate levels, and veterinary graduates. Learning outcomes are designed to define what learners will know and what skills they will have at the end of a program that incorporates various kinds of learning activities or courses.

These learning outcomes were grouped according to categories developed by the Working Group in an iterative manner: Healthy Animals, Global Impact, Antimicrobial Stewardship, Antimicrobial Drugs and Resistance, Roles and Relationships, and Critical Analysis. Healthy Animals learning outcomes focus on raising healthy animals and keeping animals healthy. Global Impact learning outcomes demonstrate the importance of understanding that antibiotic resistance is a global public health issue. Antimicrobial Stewardship learning outcomes lead to an understanding of how the usefulness of antibiotics can be preserved. Antimicrobial Drugs and Resistance learning outcomes center on the science of antibiotic drugs, how they work, and what antibiotic resistance is at the level of bacteria. Roles and Relationships learning outcomes relate to understanding who is responsible for the various aspects of antibiotic use and antibiotic resistance. Critical Analysis learning outcomes underline the importance that critical thinking plays in evidence, communications, and publications about antibiotic resistance.

In the curriculum design model, the next steps would include designing rubrics with performance criteria to define progress for each learning outcome, and mapping a curriculum to identify where the learning outcomes are introduced, reinforced, or demonstrated/mastered. Curricular materials can be developed at this stage, in order to guide instructors and teachers and to aid them in addressing the learning outcomes associated with their course(s). Implementation across a curriculum would be designed, as would an assessment plan. These steps in curricular design were beyond the scope of this Working Group, but they are outlined to encourage teachers and instructors to consider how the learning outcomes proposed here might be implemented in courses and programs.

[1] http://cte.tamu.edu/CTE/media/Images/Final-v4-Fowler-PRD-Model-for-Curriculum-20160906-sm_1.pdf; http://cte.tamu.edu/getattachment/Faculty-Teaching-Resource/Program-ReDesign/Program-%28Re%29design-Booklet_TAMU_CTE-%282%29.pdf.aspx

AAVMC | APLU AMR Core Competencies Working Group

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Learning Outcomes for Antimicrobial Resistance for Youth, Animal Science Undergraduate or Graduate, and Veterinary Medical Students

HEALTHY ANIMALS

	Developmental Level		
	Novice (4H/FFA/Youth)	**Developing (animal science undergraduate or graduate)**	**Advanced (veterinary medical students)**
Define healthy	Understand that health is different from the absence of detectable disease. Recognize health as a holistic state of wellbeing, including the presence of good general welfare, stress-limiting environment and optimal productivity	Understand that health is different from the absence of detectable disease, that it is a holistic state of wellbeing, including the presence of good general welfare, stress-limiting environment with opportunities for mental enrichment, limitations of disease presence, and optimal productivity	Explain why health is different from the absence of detectable disease, that it is a holistic state of wellbeing, including the presence of good general welfare, stress-limiting environment with opportunities for mental enrichment, limitations of disease presence, and optimal productivity
Animal production	Demonstrate an understanding of good production practices and animal record keeping (e.g., poultry, dairy, swine, or beef)	Demonstrate an understanding of good production practices, record keeping, exposure risk, and prevention practices (e.g., poultry, dairy, swine, beef, etc.)	Explain good production practices in various animal industries (e.g., poultry, dairy, swine, or beef) including record keeping, exposure risk, prevention, and biosecurity measures
Programs	Recognize general signs of infectious disease in their animals (healthy vs. not healthy)	Explain in general how good production practices, record-keeping, exposure risk, and infection prevention practices can lead to prevention of infectious or zoonotic diseases	Develop prevention and biosecurity programs to prevent infectious or zoonotic diseases that include an understanding of good production practices, record keeping, exposure risk, and infection prevention practices
Health promotion	Understand the benefits of good nutrition and husbandry and optimal housing	Understand the benefits of good nutrition and husbandry, optimal housing, in addition to, physiological basis of animal health. Apply precautions to prevent infection spread (keeping animals separate, quarantine new animals, hand hygiene, biosecurity)	Apply the knowledge of good nutrition and husbandry, optimal housing, in addition to, physiological basis of animal health in analyzing animal programs (e.g., vaccination, herd health, ration formulation, husbandry standards)
Production type	Describe common production systems in different animal species	Describe common production systems in different animal species and health risks related to each system. (e.g., conventional, antibiotic free, organic, free range)	Explain the difference between modes of transmission and routes of infection in various animal species/different production systems (conventional, antibiotic free, organic, free range)
Records	Explain the use of animal production records to evaluate animal health and productivity in individuals and populations, and identify basic production measures	Explain common production measures and use animal production records to evaluate health status and productivity in individuals and populations	Design methods to collect production measurements and health information, and utilize resulting animal health records to evaluate health status and productivity in individuals and populations and be able to make recommendations to enhance health when appropriate
Disease transmission	Explain in general how bacterial diseases can spread between animals and from animals to people/people to animals	Demonstrate knowledge about spread of bacterial diseases between animals and from animals to people/people to animals and common practices to limit the spread of disease	Apply knowledge of bacterial disease transmission between animals and from animals to people/people to animals to formulate preventative programs
Disease	Apply practices to prevent infection spread that benefit productivity and reduce the need for antimicrobials (keeping animals separate, quarantine new animals, hand hygiene, biosecurity)	Describe basic principles of ecology related to the environment, host-pathogen interactions, and commensal and pathogenic organism interactions, and recognize that maintaining or disrupting the balance can affect productivity, disease occurrence, and the need for antimicrobials to treat sick animals	Apply knowledge of ecology to prevent and reduce exposure risk, and recommend appropriate treatments and prevention in different animal species (poultry, dairy, swine, beef, etc.) that can result in welfare and productivity benefits and reduced need for antimicrobials
Zoonosis	Demonstrate an understanding that pathogens can be passed between people and animals	Explain what a zoonosis is, and give examples of human/animal interfaces including wildlife in which zoonotic disease is a risk	Evaluate the risk of zoonoses in clinical settings, including risk associated with interaction with wildlife, and evaluate and recommend effective means of prevention of zoonotic disease

GLOBAL IMPACT

	Developmental Level		
	Novice (4H/FFA/Youth)	**Developing (animal science undergraduate or graduate)**	**Advanced (veterinary medical students)**
Global reach	Recognize that bacteria that are resistant to antimicrobial drugs can move across borders	Recognize that bacteria that are resistant to antimicrobial drugs can move across borders and discuss what impact this may have on people and animals	Explain how bacteria that are resistant to antimicrobial drugs can move across borders
Demand for food	Identify global populations that are growing and developing, and the resulting increase in demand for food such as meat and milk	Discuss the impact an increase in global population will have in increased demand for food such as meat and milk	Discuss the impact an increase in global population will have in increased demand for food such as meat and milk
International trade	Identify one way that countries communicate with each other regarding international trade	Discuss the importance of communication between countries for international trade	Discuss the importance of communication between countries for international trade
International trade	Identify an important role food plays in international trade	Discuss the important role food plays in international trade	Recommend clinical practices, educational programs, and surveillance policies for international trade
International trade	Identify rules/policies related to food in international trade	Identify and discuss the importance of rules/policies related to food in international trade	Implement local rules/policies for international trade, including those implied in ethics and welfare
Differences among countries	Identify an antimicrobial drug that is used in more than one country, but the regulation governing its use is not the same in all countries	Identify an antimicrobial drug that is used in more than one country, but the regulations governing its use is not the same in all countries and discuss the impact on food these regulations may have	Describe potential trade implications of differences in antimicrobial drug uses and antimicrobial regulations among major trade partners, including market restrictions and antimicrobial drug withdrawal times
Production practices	Identify a story about food production practices used in one country that impacts how food is used in another country	Identify the key factors of a story about food production practices used in one country that impacts how food is used in another country	Identify the key factors of a story about food production practices used in one country that impacts how food is used in another country and propose appropriate "risk communication" messages to educate producers and veterinarians in both countries
Production practices	Identify a food production practice that requires an environmental resource such as water	Describe environmental resources required in food production	Describe environmental resources required in food production
Food supply	Describe how antimicrobial drug use might impact global food supplies and food quality	Describe how antimicrobial drug use might impact global food supplies and food quality	Describe how antimicrobial drug use might impact global food supplies and food quality
Education	Identify antimicrobial use policies that people should be educated on	Identify and discuss the importance of education about antimicrobial use policies and the effects this education may have on the global food supply	Identify and discuss the importance of education about antimicrobial use policies and the effects this education may have on the global food supply

"AMR is a formidable public health threat, but it's encouraging to see a number of promising initiatives underway. Veterinarians will play a critical role in the success of these efforts because of their expertise in both animal and public health. One of the most important things we can do is help educate core stakeholders about the proper stewardship and the judicious use of antibiotics in production agriculture."

Dr. Andrew T. Maccabe, Chief Executive Officer, AAVMC

ANTIMICROBIAL STEWARDSHIP

	Developmental Level		
	Novice (4H/FFA/Youth)	**Developing (animal science undergraduate or graduate)**	**Advanced (veterinary medical students)**
Definition	Define antimicrobial drug stewardship	Define antimicrobial drug stewardship	Define antimicrobial drug stewardship
Societal resource	Recognize that there is increasing societal concern about bacterial resistance to antimicrobials and potential reduction or loss of effectiveness	Recognize that there is increasing societal concern about bacterial resistance to antimicrobials and potential reduction or loss of effectiveness. Cite examples of antimicrobial stewardship that might be helpful	Describe specific examples of resistance in pathogenic and non-pathogenic bacteria that are commonly found in a specific animal species and in important human pathogens
Common uses of antimicrobial drugs	Identify common situations in which antimicrobials are needed to address animal health and welfare and minimize suffering	Recognize that there are common situations in which antimicrobials are needed to address animal health and welfare and minimize suffering and those in which antimicrobial drugs will not make a difference	Distinguish common or important situations in which antimicrobials are needed to address animal health and welfare and minimize suffering, and those in which antimicrobial drugs will not make a difference
Complexity of bacterial infections	Recognize that infectious diseases can be caused by a variety of microorganisms, and that disease risks can vary among different animals	Recognize that infectious diseases can be caused by a variety of microorganisms, and describe how disease risks can vary among different animals	Describe the epidemiology and pathogenesis of the most common and the most significant bacterial disease challenges in major domestic species of animals; describe the organism or patient factors that may impact treatment options
Need for antimicrobial drugs	Recognize that there may be a need to use antimicrobial drugs in cases of infectious disease where subsequent health and life or lives of animals are threatened	Recognize that there is a need to use antimicrobial drugs in cases of infectious disease where subsequent health and life or lives of animals are threatened, and understand that antimicrobial drugs may not be required	Explain to animal owner or manager why an antimicrobial drug is or isn't recommended based upon the perceived need and benefit to the animal, including differentiating an infection requiring treatment and a contaminant not requiring treatment
Antimicrobial alternatives	List questions that should be asked whenever the efficacy of antimicrobial alternatives are being considered	List questions that should be asked whenever the efficacy of antimicrobial alternatives are being considered	Give examples of and interpret information about efficacy of alternative therapies for important bacterial diseases
Empirical antimicrobial decision-making	Understand that some bacterial diseases can be successfully treated without culture and susceptibility information, but treatment with critically important antimicrobial drugs is inappropriate in most of these situations	Understand that some bacterial diseases can be successfully treated without culture and susceptibility information, but treatment with critically important antimicrobial drugs is inappropriate in most of these situations	Describe and explain the rationale for the steps for choosing an antimicrobial drug and regimen empirically in the absence of case-based antimicrobial susceptibility data
Susceptibility-based antimicrobial decision-making	Understand that culture and susceptibility data are often the best source of information about treatment with antimicrobial drugs	Understand that culture and sensitivity data are often the best source of information about treatment with antimicrobial drugs	Describe and explain the rationale for the steps for choosing an antimicrobial drug and regimen when case-based antimicrobial susceptibility data are available
Interpreting test results			Collect appropriate clinical samples and interpret diagnostic results of antimicrobial susceptibility testing and other clinical tests that impact antimicrobial drug selection
Complexity of antimicrobial decision-making			Select and apply an antimicrobial drug and regimen for simple and complicated infections and in patient with and without co-morbidities
Resistance and treatment outcomes	Recognize that antimicrobial resistance can result in an adverse health outcome	Summarize the outcomes to therapy when antimicrobial resistance is present	Predict the various outcomes to antimicrobial drug therapy when antimicrobial resistance is present
Non-drug-related treatment failure	Recognize that antimicrobial drug failure may result from multiple factors	Describe general factors that might contribute to antimicrobial drug failure	Describe factors that might contribute to antimicrobial drug failure, and differentiate their likelihood in a clinical setting

ANTIMICROBIAL STEWARDSHIP

	Developmental Level		
	Novice (4H/FFA/Youth)	**Developing (animal science undergraduate or graduate)**	**Advanced (veterinary medical students)**
Following treatment outcomes			Evaluate patient outcomes following antimicrobial drug treatment
Evolution of antibiotic resistance	Explain in general how the use of antimicrobial drugs can select for resistant bacteria	Explain in general how the use of antimicrobial drugs can select for resistant bacteria	Explain the difference between the general perspective that all antimicrobial drug use causes resistance in bacterial populations and the specific application of that principle to predict whether this use selects for resistance in this bacterial species
Impacts of antimicrobial drug use	Describe some of the effects of antimicrobial use on the environment	Explain some of the effects of antimicrobial use on the environment	Predict and explain the effects of antimicrobial drug use on the environment
Impacts of antimicrobial drug use	Describe the connection among antimicrobial drug use, antimicrobial resistance, and health outcomes	Analyze current scientific knowledge and existing gaps in understanding about antimicrobial drug use, selection pressure, resistance, and health consequences related to use in animals and humans	Critically appraise scientific knowledge about antimicrobial drug use, selection pressure, antimicrobial resistance, and health consequences related to antimicrobial drug use in animals and humans
Legal use of antimicrobial drugs	Understand that local, state, and federal regulations may impact antimicrobial drug availability and use	Name the local, state, and federal regulations that regulate antimicrobial drug availability and use	Describe the local, state, and federal regulations that regulate antimicrobial drug availability and use
Communicate	List questions you might ask when prescribed an antimicrobial drug for yourself or an animal	List questions you might ask when prescribed an antimicrobial drug for yourself or an animal	Explain to an animal owner the proper administration of the antimicrobial drug regimen
Communicate			Explain to an animal owner how antimicrobial drug use can lead to the risk of transmission of resistant bacteria to susceptible humans and animals
Communicate			Describe effective methods of maintaining scientific expertise about the clinical use of antimicrobial drugs in animals and risk factors for antimicrobial resistance

"Solving problems through the production and application of knowledge is a key role of colleges and universities in society. This is a big challenge with global implications, but it is one our land-grant and public universities are well-qualified to address. Our universities can conduct the research that must be undertaken and transmit the information that must be shared."

Dr. Peter McPherson, President, APLU

ANTIMICROBIAL DRUGS AND ANTIMICROBIAL RESISTANCE

	Developmental Level		
	Novice (4H/FFA/Youth)	**Developing (animal science undergraduate or graduate)**	**Advanced (veterinary medical students)**
Definitions	Define what a drug is, and define what an antimicrobial drug is	Define what a drug is, and define and differentiate the following related terms: antibiotic, antimicrobial compound, antimicrobial drug, anti-infective, anthelmintic, antiparasitic, antifungal, and biocide	Define what a drug is, and define and differentiate the following related terms: antibiotic, antimicrobial compound, antimicrobial drug, anti-infective, anthelmintic, antiparasitic, antifungal, and biocide
Antimicrobial Drugs	Explain why antimicrobial drugs are used, how they are administered, and describe in general how they are distributed in the body, and how they are removed from the body. Demonstrate understanding by describing knowledge that different antimicrobials act in different ways and act against different bacteria	Explain why antimicrobial drugs are used, how they are administered, and describe in general how they are distributed in the body, and how they are removed from the body. Describe the different mechanisms of action for antimicrobial drugs, and associate these mechanisms with the common classes of antimicrobial drugs	Explain why antimicrobial drugs are used, how they are administered, and describe specifically how they are distributed in the body, and how they are removed from the body. Describe the different mechanisms of action for antimicrobial drugs, and associate these mechanisms with the common classes of antimicrobial drugs
General mechanisms of resistance	Describe in general the concept of antimicrobial resistance and the impact of diseases caused by bacteria in animals	Define antimicrobial resistance and explain different mechanisms of resistance	Define antimicrobial resistance and identify the different mechanisms of resistance. Differentiate intrinsic resistance from acquired resistance, and give an example of each in a specific type of bacteria
Genetics of mechanisms of resistance	Understand some microbes can resist or survive the effects of antimicrobial drugs	Understand some microbes can resist or survive the effects of antimicrobial drugs	Using an example, describe how different genetic elements can cause resistance that appears the same phenotypically
Need for antimicrobial drug	Understand that each antimicrobial drug may require different doses and length of time to be effective against bacteria	Understand why each antimicrobial drugs may require different amounts of antimicrobial drug and length of time to be effective against bacteria	Explain pharmacodynamic and pharmacokinetic factors that affect dose and duration of treatment needed to provide effective therapy for bacterial infections
Resistance in populations	Understand that resistance can be different among different populations of bacteria	Describe how antimicrobial resistant bacteria can become common in populations of animals	Describe factors that could affect the prevalence of resistant bacteria in populations, including exposure to antimicrobial drugs
Resistance in organisms that don't cause disease	Recognize that resistance in non-pathogenic bacteria is problematic	Explain why resistance in non-pathogenic (e.g., commensal) bacteria is problematic	Explain why resistance in non-pathogenic (e.g., commensal) bacteria is problematic
Withdrawal times	Define the phrase "withdrawal time"	Explain why and how withdrawal times should be observed, and demonstrate how to calculate the date on which an animal or its products can be sold for consumption	Demonstrate how to create a record of antimicrobial drug use and plan for the appropriate withdrawal times
Withdrawal times	Recognize that withdrawal times for antimicrobial drugs is not related to the ability of the drug to select for antimicrobial resistance	Recognize that withdrawal times for antimicrobial drugs is not related to the ability of the drug to select for antimicrobial resistance	Explain how the concept of withdrawal times differs as it relates to drug toxicity as compared to selection for antimicrobial resistance

ROLES AND RELATIONSHIPS

	Developmental Level		
	Novice (4H/FFA/Youth)	**Developing (animal science undergraduate or graduate)**	**Advanced (veterinary medical students)**
Legal relationships	List the characteristics included in legal and ethical definitions of the veterinarian-client-patient relationship	List the characteristics included in legal and ethical definitions of the veterinarian-client-patient relationship	List the characteristics included in legal and ethical definitions of the veterinarian-client-patient relationship
Global	Describe in general terms the flow of companion and food animals and food animal products around the world	Describe in general terms the flow of companion and food animals and food animal products around the world	Describe in general terms the flow of companion and food animals and food animal products around the world
Government Relationships	Name the federal agencies responsible for approving and monitoring antimicrobial use	Describe the roles of federal agencies in approving and monitoring antimicrobial use	Differentiate drugs approved by a federal agency (e.g., FDA) from compounded drugs, and describe the roles of federal agencies in approving and monitoring antimicrobial use
Personal Relationships	Explain the role of the animal owner in providing complete information to the veterinarian at the time of disease diagnosis, treatment, and prevention	Explain the role of the animal owner in providing complete information to the veterinarian at the time of disease diagnosis, treatment, and prevention	Explain the role of the veterinarian in gathering complete information from the animal owner at the time of disease diagnosis, treatment, and prevention
Communication	Follow directions for use of antimicrobials and management of treated animals from a veterinarian	Follow directions for use of antimicrobials and management of treated animals from a veterinarian or from an over-the-counter label	Revise directions for use of antimicrobials and management of treated animals so they are comprehensible for a particular client
Evaluating Relationships	Choose a veterinarian based on their ability and willingness to develop good working relationship	Choose a veterinarian based on their ability and willingness to develop good working relationship	Evaluate your own ability to create positive relationships with animal owners

CRITICAL ANALYSIS

	Developmental Level		
	Novice (4H/FFA/Youth)	**Developing (animal science undergraduate or graduate)**	**Advanced (veterinary medical students)**
Differentiate	Explain the differences between peer-reviewed scientific literature, non-peer-reviewed scientific sources, and general interest publications	Identify whether information about antimicrobial drugs and antimicrobial resistance is from peer-reviewed scientific journals, non-peer-reviewed scientific sources, and general interest publications	Critically appraise information in peer-reviewed scientific literature, non-peer-reviewed scientific information, and general interest publications in order to differentiate accurate and inaccurate information about antimicrobial drugs and antimicrobial resistance
Non-scientific information	Extract information from producer magazines and popular press articles, and industry publications	Differentiate accurate and inaccurate information about antimicrobial drugs and antimicrobial resistance from producer magazines, and popular press articles	Differentiate accurate and inaccurate information about antimicrobial drugs and antimicrobial resistance from producer magazines and popular press articles, and explain the information to animal owners and to the general public
Scientific information	Identify sources of scientific information that would be most valuable in learning about health, disease, and antimicrobial resistance	Explain laboratory and scientific data or information related to antimicrobial resistance and antimicrobial drug use in animals	Interpret laboratory and scientific data or information, including published clinical trials, related to antimicrobial resistance and antimicrobial drug use in animals
Animal records	Explain how to record and store animal production and health records, data	Analyze and interpret animal production and health records, data	Analyze and interpret animal health/ production records, data

CRITICAL ANALYSIS

	Developmental Level		
	Novice (4H/FFA/Youth)	**Developing (animal science undergraduate or graduate)**	**Advanced (veterinary medical students)**
Laboratory information	Explain why a laboratory is needed to establish or confirm a diagnosis	Understand and explain the application of the information to specific animals	Describe how laboratory data may be an important part of decision making about antimicrobial drugs, and differentiate relevant and irrelevant laboratory data
Drug labels	Describe what can be found on an antimicrobial drug label, and describe how you would obtain reliable information about how to use antimicrobial drugs in animals	Describe what can be found on an antimicrobial drug label, and describe how you would obtain reliable information about how to use antimicrobial drugs in animals	Describe what can be found on an antimicrobial drug label, and explain how each section can be applied to treatment of animals

"We know that antibiotic resistance is biologically complex and poorly understood. We also know that the scope and scale of the problem threatens human, animal and environmental health, nationally and globally. The committee has accomplished some important work, but now we need to take action. Solving this problem is going to require focus, resources, collaboration and sustained effort."

Dr. Lonnie King, Co-Chair, Joint APLU / AAVMC Task Force on Antibiotic Resistance in Production Agriculture, Vice-Chair, Presidential Advisory Council on Combating Antibiotic Resistant Bacteria

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