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CALIFORNIA LIVESTOCK ANTIBIOGRAMS: A USER GUIDE

California Department of Food and Agriculture
Antimicrobial Use and Stewardship

UC Davis
California Animal Health and Food Safety Laboratory

cdfa
CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

AUS
ANTIMICROBIAL USE AND STEWARDSHIP

UC DAVIS
VETERINARY MEDICINE
California Animal Health & Food Safety Laboratory System

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Introduction

Antibiograms represent cumulative antimicrobial susceptibility data for a particular bacterial organism and host species combination. They provide information about the proportion of bacterial isolates that are susceptible to the drugs tested. Antibiograms can be used by veterinarians as a clinical tool to target antibiotic therapy and assess trends in antibiotic resistance. Although widely used in human health systems, antibiograms are not often available in veterinary medicine, particularly for livestock species. The California Department of Food and Agriculture Antimicrobial Use and Stewardship program (CDFA AUS) and the UC Davis California Animal Health and Food Safety Laboratory (CAHFS) created this document to promote the use of antibiograms in large animal veterinary medicine.

Antibiograms are often specific to a certain region or populace, such as a human hospital. This allows for a more precise evaluation of antibiotic resistance profiles among the target population.

Antimicrobial resistance patterns can change over time and are influenced by factors such as geographic region, production type, and management practices. Therefore, antibiograms are most useful when they are up to date and specific to the population of interest.

CDFA AUS and CAHFS aim to educate veterinary clinicians on the use of antibiograms so they can be effectively used to direct empiric antibiotic selection, improve treatment outcomes, and assess antibiotic resistance prevalence and trends in California.

All client information is kept confidential at CAHFS.
For more information on how CAHFS analyzes antibiotic susceptibility, please see:
https://www.cdfa.ca.gov/AHFSS/aus/docs/AntibiogramDevelopment.pdf

It is vital for the creation of antibiograms that clinical samples continue to be submitted to CAHFS for susceptibility testing. Antibiograms are useful to guide initial empiric therapy but should not replace case-specific testing to determine a more definitive diagnosis for appropriate therapy. More targeted antibiograms require detailed information on submission forms that **include the age of the animal, production class, location, and previous treatments**. For questions regarding sample submission, please contact CAHFS at (530) 752-8700.

Veterinarian's Name _____ Owner Name _____
Clinic Name _____ Ranch _____
Address _____ Address _____
City _____ State ____ Zip _____ City _____ State ____ Zip _____
Phone _____ Phone _____ Fax _____
Email _____ Email _____
Bill to: ☐ Vet ☐ Clinic ☐ Owner ☐ Other _____ Report to: ☐ Clinic ☐ Owner
☐ If UC Recharge Acct # (required) _____ ☐ Add'l Copy to: _____
Bill to address if different than above: _____ Preferred reporting method: ☐ fax, ☐ email, and/or ☐ mail
_____ Email notification of sample receipt? Yes ☐

Sample Reference _____ Date sample(s) collected _____ Date sample(s) shipped _____

☐ Cattle ☐ Turkey
☐ Horse ☐ Other
☐ Swine ☐ Vaccine
☐ Sheep ☐ Goat
☐ Rabbit ☐ Plant or Feed
☐ Other _____

If testing for animal movement please specify:
☐ Domestic ☐ Export out of U.S.
Animal being shipped to: _____
(Specify test methods below) Destination / Date of Shipment

#in herd/flk	
#in group/hse	
#sick	
#died	

Current Location of Animal(s) _____
Production Class _____

History (clinical signs, nutrition, housing, vaccination, treatment, production level, etc. Use next page if more space is needed.):
Duration of Illness: _____ Date of death: _____ Euthanized? Yes ☐ Method/Agent used: _____ Insured? Yes ☐ No ☐

(continue on next page if necessary)

Treatments/Medications (type & when given) _____

Disease(s) or condition(s) suspected: _____

Animal/Specimen Information *(continue on back)*

Lab Use	Animal Name/Specimen ID	Breed	Sex (F/M)	Age in Units (days, weeks, months, years)	Qty	Specimen Type	Test(s) Requested

To sign up for antibiograms from CAHFS, please scan the QR code (pictured left) or use this link: http://tinyurl.com/AntibiogramSignup

Using Antibiograms in Veterinary Practice

What is an antibiogram?

An antibiogram represents a summary of cumulative antimicrobial susceptibility test data for a given drug-bug-host combination over a specified time-period (e.g. one year) and population subset (e.g. region, farm, production-type, etc.).

How can I use an antibiogram?

DO use antibiograms to:

- Guide empiric therapy
- Assess local susceptibilities
- Monitor resistance trends

DO NOT use antibiograms to:

- Replace culture & sensitivity
- Extrapolate results to other regions
- Make decisions if the antibiogram is outdated

What data is used in CAHFS antibiograms?

Unless otherwise specified, CAHFS antibiograms will:

- Contain **only isolates from animals with clinical disease associated with the bacterial organism tested**.
- Be based on a **minimum of 30 isolates**.
- Be **updated annually**. If fewer than 30 isolates are available, the time between updates will be extended as needed.

*According to the **Clinical & Laboratory Standards Institute (CLSI)**, estimates of percent susceptibility have less statistical validity when there are fewer than 30 isolates. If needed, CAHFS will extend the timeframe of the antibiogram until there are 30 or more isolates available for inclusion.*

What do these terms mean?

Clinical breakpoint – The minimum inhibitory concentration (MIC) used to categorize an organism as susceptible (S), intermediate (I), or resistant (R). The S/I/R categorization is derived from microbiological characteristics, pharmacokinetic/pharmacodynamic (PK/PD) parameters, and/or clinical outcome data. CAHFS utilizes breakpoints established by CLSI.

Susceptible (S) – The bacterial isolate is inhibited by a concentration of drug that is usually achievable at the site of infection.

Intermediate (I) – The bacterial isolate has an MIC that falls between the breakpoints for susceptible and resistant. Clinical efficacy might be achieved in body sites where the drug concentrates (e.g. urine).

Resistant (R) – The bacterial isolate is not inhibited by the concentrations of drug that are usually achievable at the site of infection.

Non-susceptible – The isolate is either resistant or not completely susceptible to one or more antibiotics.

NA – No interpretive criteria are available.

For many veterinary species, clinical breakpoints have not been established. In these instances, ***clinical breakpoints are used from other host species (such as human) or other closely-related bacterial organisms.***

Where can I find more information?

Clinical & Laboratory Standards Institute (CLSI) publications:

CLSI M39:
Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data

CLSI VET09:
Understanding Susceptibility Test Data as a Component of Antimicrobial Stewardship in Veterinary Settings

CLSI VET01/VET01S:
Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for Bacteria Isolated From Animals

CLSI VET08:
Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for Bacteria Isolated From Animals

Link to MIC/Antibiogram Process Visual:
https://www.cdfa.ca.gov/AHFSS/aus/docs/AntibiogramDevelopment.pdf

Anatomy of a Simple Antibiogram

Antimicrobial agents tested: this is usually determined based on the animal host and microbial organism (drug names removed for this example)

Title: identifies the host species, organism profile and timeframe for the antibiogram

This example displays three **different microbial organisms**, labeled X, Y, and Z, with the total number of microbial isolates in parentheses next to the name of each organism

	CAHFS Bovine Respiratory Pathogens Antibiogram July 2019 - June 2020		
	Organism X (n=83)	*Organism Y* (n=90)	*Organism Z* (n=45)
Antimicrobial[a]	% S	% S	% S
Class 1			
Drug 1a	See below[b]	See below[b]	See below[b]
Drug 1b	49%	94%	96%
Class 2			
Drug 2a[c]	99%	100%	100%
Class 3			
Drug 3a[c]	41%	47%	98%
Drug 3b	41%	49%	98%

[a] S (Susceptible) based on the Clinical Laboratory Standards Institute (CLSI) cattle-specific breakpoints for each drug/bug combination.
[b] New criteria indicates this isolate is susceptible to Drug 1a (if MIC less than 0.06) which current methods cannot evaluate.
[c] No CLSI breakpoint for *Organism Z* in cattle, extrapolated from *Organism X* CLSI breakpoints.

Important notes and disclaimers about the data presented; may include disclaimer if breakpoints from other host species or organisms are used or notes about extra-label drug use

Percentage of total **isolates susceptible** to the drug

Anatomy of a Detailed Antibiogram

Antimicrobial agents tested: this is usually determined by the animal host and microbial organism tested (drug names removed for this example)

Title: identifies the bacterial organism, animal host and timeframe for the antibiogram (drug names removed for this example)

Number of **microbial isolates included** in analysis

Breakpoints: minimum inhibitory concentrations of the drug at which the microbial organism is classified as susceptible, intermediate, or resistant

Shaded areas in table indicate the **range of concentrations tested** for each drug

***Organism X* Respiratory Sites Cattle CAHFS Clinical Isolates July 1, 2019 - June 30, 2020**

Antimicrobial	Breakpoints[a] Susceptible	Intermediate	Resistant	Percentage of isolates with MIC for each concentration of antimicrobial (ug/mL) 0.12	0.25	0.5	1	2	4	8	16	32	64	128	N=83 % Susceptible
Class 1	-		-												
Drug 1a	≤0.03	0.06-0.12	≥0.25		66%	18%	1%	1%		1%	1%	11%			See below[b]
Drug 1b	≤0.25	0.5	≥1	14%	35%	28%	7%	1%			14%				49%
Class 2															
Drug 2a	≤2	4	≥8		96%	2%					1%				99%
Class 3															
Drug 3a	≤0.25	0.5	≥1	37%	4%	8%	5%	46%							41%
Drug 3b	≤0.25	0.5-1.0	≥2	37%	4%	12%	7%		40%						41%
Class 4															
Drug 4a	≤8	16	≥32					1%	20%	19%	10%	49%			41%
Drug 4b	≤4	8	≥16				39%	11%	2%	6%	1%	41%			52%

The numbers of susceptible (yellow), intermediate (gold) and resistant (brown) isolates are shown for each antimicrobial.

Solid bold line marks breakpoint for resistance.

Numbers in bold to the right of shaded area have an MIC > than highest concetration tested.

[a] CLSI Cattle *Organism X* breakpoints for respiratory sites.

[b] New criteria indicates this isolate is susceptible to Drug 1a (if MIC less than 0.06) which current methods cannot evaluate.

Percentage of total **microbial isolates classified as susceptible** to the drug

Important notes and disclaimers about the data presented; may include disclaimer if breakpoints from a different host species or organism are used, explanation of color shading and notes about extra-label drug use

Key:

- Susceptible (S)
- Intermediate (I)
- Resistant (R)
- % — MIC greater than highest concentration tested (R)

How to Read a Simple Antibiogram

CAHFS Bovine Respiratory Pathogens Antibiogram July 2019 - June 2020			
	Organism X (n=83)	*Organism Y* (n=90)	*Organism Z* (n=45)
Antimicrobial[a]	% S	% S	% S
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Drug 1a	**See below[b]**	**See below[b]**	**See below[b]**
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Class 2			
Drug 2a[c]	**99%**	**100%**	**100%**
Class 3			
Drug 3a[c]	41%	47%	98%
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[a] S (Susceptible) based on the Clinical Laboratory Standards Institute (CLSI) cattle-specific breakpoints for each drug/bug combination.
[b] New criteria indicates this isolate is susceptible to Drug 1a (if MIC less than 0.06) which current methods cannot evaluate.
[c] No CLSI breakpoint for *Organism Z* in cattle, extrapolated from Organism X CLSI breakpoints.

The higher the percentage susceptible, the greater the chance of treatment success

If you are unsure which organism is causing the disease, you should pick an antibiotic with a high percentage of susceptible isolates for all possible organisms. In this example, Drug 2a should be chosen over Drug 3a.

Percentage of microbial isolates tested of each **organism that were susceptible** to this antibiotic

How to Read a Detailed Antibiogram

***Organism X* Respiratory Sites Cattle CAHFS Clinical Isolates July 1, 2019 - June 30, 2020**

	Breakpoints[a]			Percentage of isolates with MIC for each concentration of antimicrobial (ug/mL)											N=83
Antimicrobial	**Susceptible**	**Intermediate**	**Resistant**	**0.12**	**0.25**	**0.5**	**1**	**2**	**4**	**8**	**16**	**32**	**64**	**128**	**% Susceptible**
Class 1	-		-												
Drug 1a	≤0.03	0.06-0.12	≥0.25		66%	18%	1%	1%		1%	1%	11%			See below[b]
Drug 1b	≤0.25	0.5	≥1	14%	35%	28%	7%	1%			**14%**				**49%**
Class 2															
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Class 4															
Drug 4a	≤8	16	≥32					1%	20%	19%	10%	49%			**41%**
Drug 4b	≤4	8	≥16				39%	11%	2%	6%	1%	41%			**52%**

The numbers of susceptible (yellow), intermediate (gold) and resistant (brown) isolates are shown for each antimicrobial.

Solid bold line marks breakpoint for resistance.

Numbers in bold to the right of shaded area have an MIC > than highest concetration tested.

[a] CLSI Cattle *Organism X* breakpoints for respiratory sites.

[b] New criteria indicates this isolate is susceptible to Drug 1a (IF MIC less than 0.06) which current methods cannot evaluate.

Percentage of isolates classified as **intermediate (I)**

Clinical efficacy might be achieved in body sites where the drug concentrates

Percentage of isolates with an **MIC greater than the highest concentration tested** (also classified as resistant)

Percentage of isolates classified as **susceptible (S)**

Percentage of isolates classified as **resistant (R)**

Percentage of **isolates classified as susceptible** to this antibiotic

Breakpoint for classification of resistance

The higher percentage susceptible, the greater the chance of treatment success using the specified drug

Get Involved

Californian veterinarians have options to expand their knowledge:

- Request additional information on antibiograms
- Plan a continuing education seminar for your local veterinary medical association or practice
- Provide feedback or request a particular species, production type or pathogen-focused antibiogram

Please **continue to submit samples with complete submission forms** for culture and antibiotic susceptibility testing so CAHFS can create robust livestock antibiograms!

To **sign up for antibiograms** from CAHFS, please scan the QR code *(pictured left)* or use this link: **http://tinyurl.com/AntibiogramSignup**

For **requests or questions** regarding California-focused livestock antibiograms, please contact CDFA AUS at: **CDFA_AUS@CDFA.CA.GOV**