CALIFORNIA LIVESTOCK OWNERS: AN ASSESSMENT OF FAMILIARITY WITH NEW ANTIMICROBIAL RULES AND ACCESS TO EDUCATIONAL OUTREACH

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ABSTRACT

California Livestock Owners: An Assessment of Familiarity with New Antimicrobial Rules and Access to Educational Outreach

Philip Theodor Paulson

The purpose of this research is to support the California Department of Food & Agriculture (CDFA) with education and outreach about recent changes regarding antimicrobial use in livestock, and to enhance their emergency communications network. This was done by characterizing a population of small-scale livestock owners underserved with regards to educational outreach about animal health issues, such as antimicrobial use rules. The project also seeks to enhance public understanding of the importance of responsible antimicrobial use in animal and human health.

To accomplish this, the study used a survey administered in person at local farm supply stores and online to investigate the level of understanding of antimicrobial rules among livestock owners in San Luis Obispo county. The survey gathered information about the livestock owners' practices, connection to livestock groups, and access to information pertaining to animal health among other things.

The results of the survey showed that respondents were largely unaware of new rules pertaining to use of antimicrobials in livestock. Familiarity with California rules of this kind was used as an indicator of access to information about animal health and was found to correlate positively with knowledge about antimicrobial resistance and familiarity with federal rules concerning antimicrobial use in livestock. As predicted, respondents with a connection to 4-H and FFA had greater familiarity with both federal and state rules concerning antimicrobial use in livestock.

Keywords: SB 27, antibiotics, antimicrobials, antimicrobial use in livestock, antimicrobial resistance, antimicrobial regulatory compliance, antimicrobial stewardship.

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Chapter 1
INTRODUCTION

Since the discovery of the first antimicrobials in the 1940s, they have become an essential part of the treatment of infectious diseases. Use of these drugs has greatly reduced illness and death in both humans and animals, but has created selection pressures that have resulted in the development of resistance in some bacteria and an accompanying loss of efficacy of some antimicrobials. The possibility that the use of antimicrobials in livestock contributes to antimicrobial resistance has led lawmakers to pass legislation at state and federal levels that affect how antimicrobials can be given to animals and poultry that are raised, kept, or used for profit (CDFA, 2019a).

In 2015, Governor Brown signed Senate Bill 27 into law (SB 27), which affects how antimicrobials can be given to livestock (Food and Agriculture Code, 2015; Senate Bill No 27., 2015). As of January 1, 2018, over the counter injectables and all other medically important antimicrobials must be administered with a prescription or veterinary feed directive (VFD) ordered by a California licensed veterinarian under a valid veterinarian-client-patient relationship (VCPR). This law is in addition to the federal Veterinary Feed Directive regulations that were implemented on January 1, 2017 (United States Food and Drug Administration, 2012; 2013a; 2013b; 2015).

SB 27 impacts the use of medically important antimicrobial drugs in all species raised or used for profit in California. It also makes the CDFA responsible for assessment, education, and enforcement of antimicrobial use in livestock, and specifically requires them to gather data on the sale and usage of medically important antimicrobials, antimicrobial resistant bacteria in livestock operations, and livestock management practices. In order to meet these challenges, the CDFA established the Antimicrobial Use and Stewardship (AUS) Program. The AUS is collaboratively partnering with the California livestock industry and stakeholders, including universities, to fully implement SB 27.

While the new requirements are manageable hurdles for most large-scale producers, the time and expense associated with establishing a VCPR and the availability of local veterinarians may be prohibitive for small-scale producers, causing them to opt out of certain antimicrobial

treatments or prophylaxes. Many small-scale livestock producers may also have limited access to information about animal health and management practices and limited awareness of rules regarding how antimicrobials and other medications can be used in food animals. It is important to educate this population of livestock owners in order to enhance the safety of their animal husbandry practices, to ensure compliance with changing legislation, and promote public appreciation of responsible antimicrobial use practices in livestock production. Furthermore, characterization of the communication networks used by this subset of backyard livestock owners is important for future regulatory and disease outbreak communications.

Much of the CDFA's educational outreach efforts have been through organizations such as a state industry association (e.g. The California Pork Producers), FFA or 4-H. One of the challenges identified by the CDFA AUS Program is providing educational outreach to backyard livestock owners that are not part of an organized agriculture group. Little information is known about this subset of livestock owners, including demographics, communication networks, access to veterinary care and animal health knowledge. In some cases, this group may have very little knowledge regarding fundamental concepts of antimicrobial use and resistance, the veterinary-client-patient relationship, legal uses of antimicrobials, and changes in antimicrobial use legislation.

1.1 Statement of Problem

The California Department of Food and Agriculture is concerned that there is a population of California livestock owners that are unfamiliar with new California State rules concerning how antimicrobials can be given to livestock. It is not known how this population can best be reached with educational materials.

1.2 Hypothesis

An analysis of surveys administered to a subsection of livestock owners in San Luis Obispo County will reveal a population of small-scale livestock owners underserved with regards to veterinary care and educational outreach about animal health issues, such as antimicrobial use

rules. Results of the survey will characterize this population and provide information about the best routes by which to provide educational outreach to this population.

1.3 Stakeholders

There are a number of stakeholders in the project. The California Department of Food and Agriculture's (CDFA) Antimicrobial Use and Stewardship (AUS) program was first to identify this problem and solicit assistance from Dr. Wishnie and Philip Paulson with assessing the population of interest. The mission of the AUS program is to combat the development of antimicrobial resistance in bacteria, and "provides the education and tools for veterinarians and producers to make decisions regarding disease prevention and judicious use of antimicrobials in livestock" (CDFA, 2019b). They are responsible to the public and to California taxpayers to help ensure the continued efficacy of antimicrobials in use today. Specifically, the project was initiated in response to the passage of Bill SB 27 and a desire to increase the AUS program's ability to communicate with small-scale livestock producers.

Another important group of stakeholders is livestock producers. SB 27 affects how antimicrobials can be used in the production of livestock and has changed the way that many livestock operations must tend to their animals' health and welfare. The new legislation changes the availability of some antimicrobials, which may cause a significant change in practices and the cost of running some operations. It is possible that small-scale operations are affected disproportionately, as they often have fewer resources to cope with the necessary changes and may have limited access to information about the law.

The public are stakeholders in that they rely on a safe, healthy, secure food supply and the continued efficacy of antimicrobials for their health and wellbeing. They are generally represented by consumer and environmental interest groups. Taxpayers fund the CDFA and its AUS program.

The veterinary and medical communities rely on these drugs to prevent, control and treat disease in their patients, and to perform certain procedures like invasive surgeries.

Universities, including California Polytechnic State University, are partnering with the

AUS program to conduct research that is essential for assessing the impacts of the current legislation.

This project focuses on small-scale livestock producers for the reason that they are a group that is difficult for the CDFA to reach with information about laws, practices, and antimicrobial resistance outreach, all of which are important to the decisions they make concerning their operations.

Future work may investigate characteristics of other stakeholder groups such as the medical community or the public at large in terms of their understanding of antimicrobial use and resistance.

1.4 List of Terms

"Antimicrobial Agent": Any substance of natural, semi-natural, or synthetic origin that, at concentrations within the treated human or animal, kills or inhibits the growth of microorganisms by interacting with a specific target. The term antimicrobial is a collective for antiviral, antibacterial, antifungal, antiparasitic, and antiprotozoal agents. For the purposes of this thesis, the term antimicrobial is used exclusively as it relates to antibacterial (acting against bacteria) properties (CDFA, 2019a).

"Medically Important Antimicrobial Drug": Antimicrobial agents for therapeutic use in humans. This does not include ionophores or other antimicrobial agents not important for human therapeutic use (CDFA, 2019a).

"Veterinary Feed Directive" (VFD): A written (nonverbal) statement issued by a licensed veterinarian that authorizes the use of a VFD drug or combination VFD drug in or on an animal feed. This written statement authorizes the client (the owner of the animal or animals or other caretaker) to obtain and use animal feed bearing or containing a VFD drug or combination VFD drug to treat the client's animals only in accordance with the conditions for use approved, conditionally approved, or indexed by the FDA. A VFD is also referred to as a VFD order (CDFA, 2019a).

"VFD Drug": A drug intended for use in or on animal feed, which is limited to use under the professional supervision of a licensed veterinarian (CDFA, 2019a).

Combination VFD Drug: An approved combination of new animal drugs intended for use in or on animal feed under the professional supervision of a licensed veterinarian, and at least one of the new animal drugs in the combination is a VFD drug (CDFA, 2019a).

Veterinarian-Client-Patient Relationship: A veterinarian-client-patient relationship shall be established by the following:

(1) The client has authorized the veterinarian to assume responsibility for making medical judgments regarding the health of the animal, including the need for medical treatment,

(2) The veterinarian has sufficient knowledge of the animal(s) to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s). This means that the veterinarian is personally acquainted with the care of the animal(s) by virtue of an examination of the animal or by medically appropriate and timely visits to the premises where the animals are kept, and

(3) The veterinarian has assumed responsibility for making medical judgments regarding the health of the animal and has communicated with the client a course of treatment appropriate to the circumstance (CDFA, 2019c).

"Backyard Livestock Owner": For the purpose of this thesis, small-scale livestock owner, small-scale producer, or backyard producer refers to people who own livestock but for whom livestock is not a primary source of income.

"Underserved Population": For the purposes of this thesis, and unless otherwise specified, underserved population herein refers to a population of small-scale livestock owners that is underserved with regards to veterinary care and educational outreach about animal health issues, such as antimicrobial use rules.

"Federal and California rules": Unless otherwise stated, rules refers to any and all FDA and California specific laws, regulations, and rules that affect the how antimicrobials can be given to livestock

1.5 Approach

In order to address the problem, a survey was designed (see Appendix B) to identify small-scale livestock owners that are underserved in terms veterinary care and educational outreach about animal health issues, such as antimicrobial use rules. The responses were analyzed to characterize this population in terms of demographics, information networks and knowledge about antimicrobial use in livestock.

Participants were recruited at the entrance to select feed supply stores in San Luis Obispo County that are frequented by local livestock owners.

Educational materials were designed to help livestock owners understand and comply with new antimicrobial rules (see Appendix C) and were given to survey participants after their responses were collected.

Chapter 2 of this thesis reviews previous studies done on related topics, Chapter 3 describes in detail the methodology and procedure used in this study, Chapter 4 describes how data was collected and analyzed, Chapter 5 states the results of the study and discusses the implications of those results, and Chapter 6 summarizes the study's findings and conclusions.

Chapter 2
LITERATURE REVIEW

2.1 Antimicrobial Use and Stewardship

Since the discovery of penicillin in 1928, antimicrobial drugs have become a regular part of modern life (Lobanovska and Pilla, 2017). They are used to treat a wide variety of diseases in humans and animals and are responsible for saving millions of lives (Gould and Bal, 2013; CDFA, 2019a). In addition to their use in the treatment of infectious disease in humans, they are also used prophylactically in certain medical procedures such as invasive surgeries (Boucher et al., 2011). Without them, many medical procedures would not be possible, and many people would die of infectious diseases which are now considered trivial.

Antimicrobial drugs are also used in animal health to prevent, control and treat disease in individual or groups of animals. The American Veterinary Medical Association (AVMA) defines preventative use as the administration of an antimicrobial to mitigate the risk for acquiring disease or infection that is anticipated based on history, clinical judgement, or epidemiological knowledge. Control of disease is the use of antimicrobials to reduce the incidence of infectious disease in a group of animals that already has some individuals with evidence of infectious disease or evidence of infection. Treatment is the administration of an antimicrobial as a remedy for an animals with evidence of infectious disease (AVMA, 2019).

While antimicrobials have become an essential part of human and animal medicine, the potential development of antimicrobial resistance is a threat to their efficacy in animal and human health. One of the defining characteristics of antimicrobials is their action on specific biological targets, which means that any use of them to kill bacteria creates a selective pressure in the bacterial population for alleles that give cells protection of some kind against the drug (CDFA, 2019). Over time this can result in the development of antimicrobial resistant strains of bacteria, which can cause serious problems in healthcare (CDC, 2013).

It is not clear how much the use of antimicrobials in livestock contributes to antimicrobial resistance that affects human health. There are some that place much of the blame for antimicrobial resistance on the livestock industry, often citing the fact that 80% of antimicrobials

used in this country are used in animal agriculture (Landers, 2012). On the other hand, many argue that quantity of antimicrobials used does not reflect the dangers posed in terms of the development of antimicrobial resistance. There is certainly a need for more thorough investigation on this topic, but in the meantime there is also a need to adopt a policy of antimicrobial stewardship, actions taken individually and as a group to preserve the effectiveness and availability of antimicrobial drugs through conscientious oversight and responsible medical decision-making while safeguarding animal, public, and environmental health (AVMA, 2019).

2.2 The Law

In response to concerns about the loss of efficacy of medically important antimicrobial drugs, The FDA produced a series of Guidance for Industry (GFI) including GFI #209 (general guidance on the use of medically important antimicrobial drugs in livestock), GFI #213 (guidance for drug producers) and the Veterinary Feed Directive (guidance for veterinarians). These documents formed the basis of a conversation between veterinarians, livestock producers, and consumer and environmental interest groups and lawmakers to determine what regulations would be necessary feasible, and enforceable.

In 2015, Governor Brown signed Senate Bill 27 (Hill) into law (SB 27), which resulted in additions to California Food and Agricultural Code (FAC), Division 7, Chapter 4.5, Sections 14400-14408 (Food and Agriculture Code, 2015; Senate Bill No 27., 2015). FAC 14400-14408 address the development of antimicrobial stewardship guidelines and best management practices; surveillance of antimicrobial use as well as antimicrobial resistance patterns in bacteria; and mandates the California Department of Food & Agriculture (CDFA) to ensure that livestock producers in rural areas with limited veterinary care continue to have timely access to antimicrobials (California Department of Food and Agriculture, 2017). As of January 1, 2018, over the counter injectables and all other medically important antimicrobials must be administered with a prescription or veterinary feed directive (VFD) ordered by a California licensed veterinarian under a valid veterinarian-client-patient relationship (VCPR). This law is additional to the federal

Veterinary Feed Directive regulations that were implemented on January 1, 2017 (United States Food and Drug Administration, 2012; 2013a; 2013b; 2015).

2.3 Backyard Livestock Owners

In the United States, small-scale or backyard farming is growing in popularity along side organic and local food movements (Hoey and Sponseller, 2018). Products of backyard livestock are frequently used for personal consumption, bartering, gifting or sales. For many purposes, this group of livestock owners must be considered separately from large scale commercial producers because they often have more limited access to information and resources needed to manage their animals' health. Few backyard livestock producers make use of veterinarian services for example and most use vaccines and antimicrobials at much lower levels than those used by commercial producers (USDA, 2005).

The nature of small-scale livestock producers makes it difficult to gather information on them. Various methods have been employed to estimate the number of these producers and to understand their methods and knowledge concerning their animals' health. When proximity to commercial operations is considered of particularly high importance, researchers have canvassed door-to-door within a given radius of the operations of interest (Garber et al., 2007). Other studies have used web-based surveys and a chain referral technique to access this hard-to-reach population across the United States (McClintock et al., 2014). Another strategy used to examine the effects of backyard poultry production on animal health and antimicrobial resistance included recreating the conditions commonly seen in backyard production to compare it to conditions commonly seen in larger operations (Braykov et al., 2016).

A common motivation to study small-scale livestock operations is related to the containment of livestock disease epidemics. Research in this area has focused largely on chickens. For example, backyard chickens were found to have played a significant role in Exotic Newcastle Disease outbreaks in California in 1998 (Crespo et al., 1999), and in Italy in 2000 (Capua et al., 2002). Smith and Dunipace (2011) argue that even if backyard flocks are less susceptible to disease than are commercial flocks, that their impact on avian influenza epidemics

are significant. Overall, livestock owners use and knowledge of antimicrobials has not been well studied.

Chapter 3
METHODOLOGY AND PROCEDURES

This chapter describes the materials and methods used in this study, including the rationale behind the survey design, participant selection, specific methods and procedures, materials used, and ethical considerations.

3.1 Research Methodology

The primary objective of the study was to identify a population of small-scale livestock owners underserved with regards to veterinary care and educational outreach about animal health issues, such as antimicrobial use rules. The survey was, therefore, designed to characterize respondents based on the nature of their livestock, their information networks and their knowledge of antimicrobials and rules pertaining to them.

Survey questions were written in consultation with the CFDA's AUS Program staff. Several questions about veterinarian use, antimicrobial use, antimicrobial resistance attitudes, and information access (Questions #9, 10, 14, 16, and 19) were taken from a survey used in a previous study conducted by the CDFA. Faculty at California Polytechnic State University (hereinafter Cal Poly) who had significant experience with surveys were also consulted. The survey produced was largely quantitative.

Most of the questions were written to allow respondents to "check all [answers] that apply" as it provided the best opportunity to collect all relevant information. This design allowed respondents to record all of the ways in which they accessed information, used their animal products, and used veterinary services.

3.2 Participant Selection

In this pilot study, small-scale livestock owners in San Luis Obispo County were used as a sample of the California small-scale livestock owners population. The nature of small-scale livestock owners makes them difficult to access with educational materials.

The primary method of collecting survey responses was in person at the entrance of feed supply stores in San Luis Obispo County. This was deemed appropriate because it appeared to be one of the few physical places that a large percentage of the target population would come to. Online solicitation for surveys was also used as it allowed us to obtain responses from a wider reaching selection of the population.

Criteria for participant selection in either of these venues was ownership of livestock. In cases where two or more potential participants shared ownership of livestock, only one was surveyed and represented the caretaking of those animals for all people responsible for them. In order to be used in the analyses, the respondent also had to live in SLO County. This was asked in the survey so the responses could be separated out during analysis.

3.3 Specific Methods and Procedures

The primary method used to collect survey responses was in person at three Farm Supply Company locations in San Luis Obispo, Paso Robles, and Arroyo Grande:

224 Tank Farm Road, San Luis Obispo, CA 93401

2450 Ramada Drive, Paso Robles, CA 93446

1079 El Camino Real, Arroyo Grande, CA 93420

These stores were chosen because they represented the source of supplies for a large proportion of small-scale livestock owners in the county and Farm Supply Company gave their permission to collect surveys at those locations. Customers entering and exiting the store were asked if they owned or cared for any livestock. If they did, they were asked if they would participate in the study and were told that it would take about 10 minutes. Depending on the participant's desire, they took the survey in one of three different ways: 1) they filled out a paper version of the survey, which was collected and the information later input into Survey Monkey by

the researcher; 2) they completed the survey directly on Survey Monkey using a computer provided by the researcher; or 3) the survey was read aloud to the participant by the researcher and the response to each question was recorded by the researcher as they were verbally selected by the participant. The third option was used in situations where the participant was uncomfortable using the computer, reading the survey themselves, or simply at their request.

Data collection took place between 9:30 am and 5:00 pm on 10 different days in July and August of 2018. During the first few days of collection, Cal Poly branded pencils were offered to participants as an incentive to take the survey, but this was discontinued as interest in the pencils was low.

Other survey responses were collected online using Facebook. A message was posted on pages of livestock husbandry, sales and interest groups that were associated with San Luis Obispo County or California as a whole. The message posted was as follows:

> "Hi! I'm Philip Paulson, an animal science graduate student at Cal Poly San Luis Obispo. My thesis project includes surveying people who keep livestock, including horses and chickens. The purpose is to gather demographic data and improve livestock owners' access to information about animal health and antibiotic resistance. The survey is anonymous and takes 10 minutes or less. I would greatly appreciate your participation!
> Just click the link:
> https://www.surveymonkey.com/r/B9XGHD5
> Thank you!
> Phil"

The link to the survey that was included could be used only once by any given IP address. This was to prevent individuals with ill-intentions from being able to significantly affect the survey results. The separate link also allowed results obtained online to be distinguished from those collected in person.

3.4 Materials

The materials used in this study include the survey described above as well as educational materials designed by Cal Poly Animal Science student Bailey Munday as part of her senior project (see Appendix C). These educational materials concisely explain important

components of the new California antimicrobial rules and were intended to help livestock owners comply with them. The educational materials were given to participants after they had completed the survey. Survey Monkey was used for survey design and all data collection. The data was collected on a computer borrowed from the Cal Poly Media Resource Center.

3.5 Ethical Considerations

An application was submitted for this project to the Cal Poly Institutional Review Board (IRB) Committee. Before answering any survey questions, all participants (both in-person and online) agreed to the following informed consent:

> "A research project on backyard livestock producers is being conducted by Philip Paulson, a graduate student in the Department of Animal Science at Cal Poly, San Luis Obispo, under the supervision of Dr. Jennifer Wishnie. The purpose of the study is to gather demographic information about backyard livestock producers and assess their access to veterinary care and animal husbandry information.
>
> You are being asked to take part in this study by completing the following questionnaire. Your participation will take approximately 10 minutes. Please be aware that you are not required to participate in this research, you may omit any items that you prefer not to answer, and you may discontinue your participation at any time without penalty.
>
> Your responses will be provided anonymously to protect your privacy. Potential benefits associated with the study include understanding how regulatory changes can affect medicines used in backyard animals and better understanding of key communication channels to provide backyard livestock producers with important animal health, public health, and regulatory topics now and in the future.
>
> If you have questions regarding this study or would like to be informed of the results when the study is completed, please feel free to contact Philip Paulson (ptpaulso@calpolu.edu) or Dr. Jennifer Wishnie (jwishnie@calpoly.edu). If you have concerns regarding the manner in which the study is conducted, you may contact Dr. Michael Black, Chair of the Cal Poly Institutional Review Board, at (805) 756-2894, mblack@calpoly.edu, or Ms. Debbie Hart, Compliance Officer, at (805) 756-1508, dahart@calpoly.edu.

> If you agree to voluntarily participate in this research project as described, please indicate your agreement by completing and submitting the following questionnaire. Please print a copy of this consent form now for your reference, and thank you for your participation in this research."

Without agreeing to the informed consent statement, it was not possible for the participants to continue taking the survey. Participation in the survey was anonymous. The names of participants were not recorded nor were any other personal identifying information.

3.6 Data Collection and Analysis

Whether directly or indirectly, all survey responses were collected in Survey Monkey. The survey data was then downloaded in several forms for use in various analyses. For the creation of bar charts representing single survey questions, the data was downloaded into Microsoft Excel 2016. For comparisons between survey questions, the data were downloaded in the form of comma separated values (CSV) and were analyzed using JMP Pro 13. Most of the relationships were determined using contingency tables and Chi-Square tests. Statistical significance was determined using an alpha level of .05.

In order to run some of the analyses and produce certain graphs, it was necessary to manually alter the Excel and CSV files. In some cases, empty cells were replaced with a placeholder number. The placeholder number used was "-99", because it is number which would not be present in any cells otherwise. In other cases, additional columns were created to interpret columns or summarize several existing columns that were to be grouped together. For example, a column was created to indicate whether a respondent used *any* of their animals for meat, and another which indicated whether the respondent had greater than 10 animals total or not.

In particular, data was analyzed to identify characteristics of people who had the lowest level of familiarity with the recent Federal and California antimicrobial rules. Of greatest importance were the ways in which this population accesses information about animal care as this provides insight into the best means of reaching this population with the information they need to understand and comply with the rules.

Chapter 4
RESULTS AND DISCUSSION

The only question that respondents were required to answer before moving on to the others was the informed consent page. Answering “No, I don’t consent (Exit survey)” ended the session without allowing the respondent to answer any other questions. Respondents were able to skip any of the other questions as they took the survey. Thus, each question was not answered by all of the respondents.

A total of 172 people opened the survey, and 158 of those consented to participate. Of those 158 who actually took the survey, 105 answered that they lived in SLO county. Only the respondents living in San Luis Obispo County met the criteria, so only these 105 were used in the following analyses.

4.1 Respondents’ Familiarity with Antimicrobial Rules

The population of interest to this study is that of small-scale livestock owners underserved with regards to veterinary care and educational outreach about animal health issues, such as antimicrobial use rules. The survey contained questions that assessed the respondents’ familiarity with FDA and California rules concerning how antimicrobials can be given to livestock (Table 1). In order to characterize this population, the respondents that indicated they had low familiarity with changes made to California state law in January 2018 concerning how antimicrobials can be given to livestock were compared to the group of respondents with high familiarity with those rules.

Table 1. Familiarity with rules affecting how antimicrobials can be given to livestock. Responses to Question #12, "How familiar are you with the National Food and Drug Administration (FDA) regulations that were implemented in January 2017 concerning how antibiotics can be given to livestock?" and Question #13, "How familiar are you with the changes made to California state law in January 2018 concerning how antibiotics can be given to livestock?"

Level of familiarity	Federal rules, Question #12 (n=105)	California rules, Question #13 (n=105)
Not at all familiar	44%	50%
Not familiar	18%	19%
Somewhat familiar	23%	19%
Very familiar	12%	10%
Extremely familiar	3%	3%

4.2 Comparison of Respondents Familiar and Unfamiliar with Antimicrobial Rules

Familiarity with California rules was used to identify an underserved population because the new California rules are the primary focus of this study. Respondents that answered "not at all familiar" or "not familiar" to Question #13 about California rules were grouped and will be referred to as "unfamiliar with California rules" and those that answered "somewhat familiar," "very familiar," or "extremely familiar" were grouped and will be referred to as "familiar with California rules". The following tables compare responses of those unfamiliar to those with familiar with new California antimicrobial rules. Of the respondents from SLO County, 69% fell into the "unfamiliar" group and 31% fell into the "familiar" group. For both Federal and California rules, familiarity was lower than expected. Familiarity with California rules was even lower than familiarity with federal rules.

Question #3 asked how many of each type of livestock the respondent owned. This information was used to calculate the percentage of respondents that owned each type of

livestock and the total amount of animals owned by each respondent. On average, respondents familiar with California rules had a greater number of animals (Tables 2 and 3).

Table 2. Types of Livestock. The percentage of respondents in each group that had at least one of the given type of animal, from responses to Question #3, “How many of each type of livestock do you have?”

Livestock type	Respondents familiar with California rules (n=33)	Respondents unfamiliar with California rules (n=72)
Alpaca	9%	1%
Cattle	33%	26%
Chickens	45%	53%
Donkeys	3%	6%
Ducks	12%	3%
Goats	27%	17%
Geese	3%	7%
Guineafowl	0%	1%
Horses	39%	51%
Llamas	3%	1%
Mules	3%	0%
Pigs	24%	11%
Rabbits	12%	6%
Sheep	21%	14%
Turkeys	6%	6%
Quail	3%	1%

Table 3. Total number of Animals. Statistics for total number of animals owned by respondents, from responses to Question #3, “How many of each type of livestock do you have?”

Number of animals	Respondents familiar with California rules (n=31)	Respondents unfamiliar with California rules (n=72)
Mean	63	40
Median	13	10

Question #4 asked about the purpose for which livestock were raised and whether their animals were associated with 4-H or FFA (Table 4). A greater percentage of respondents familiar with California rules kept animals for milk and for show than did respondents unfamiliar with California rules. They were also significantly more likely to have an animal associated with 4-H or FFA (p=.0040, see page 34).

Table 4. Purpose of Livestock. The percentage of respondents who kept at least one type of animal for the purpose of meat, eggs, milk, or show. Responses to Question #4, “For what purpose do you raise each type of livestock? Are these animals associated with 4H or FFA?”

Purpose of livestock	Respondents familiar with California rules (n=31)	Respondents unfamiliar with California rules (n=72)
Meat	52%	46%
Eggs	52%	51%
Milk	10%	4%
Show	32%	11%

Table 5. Association with 4-H or FFA. Respondents that did or did not have at least one animal associated with 4-H or FFA, from responses to Question #4, “For what purpose do you raise each type of livestock? Are these animals associated with 4H or FFA?”

	Respondents familiar with California rules (n=31)	Respondents unfamiliar with California rules (n=72)
Had at least one animal associated with 4-H or FFA	35%	11%
Did not have any animals associated with 4-H or FFA	65%	89%

Question #5 of the survey asked in what way the products of the livestock were used (Table 6). Respondents unfamiliar with California rules were more likely to consume their animal products on site and give them away, but less likely to barter or sell them. It is possible that livestock owners who barter and sell their products are more active in seeking information about rules they need to abide for these transactions than those giving away products or consuming them themselves.

Table 6. Usage of Animal Products. Responses to Question #5, “How are the products of your livestock used? (check all that apply)”

Usage of animal products	Respondents familiar with California rules (n=33)	Respondents unfamiliar with California rules (n=72)
Consumed on site	52%	61%
Given away	30%	35%
Bartered	30%	15%
Sold	55%	41%

Question #6 of the survey asked how good respondents felt their access to information about animal care was (Table 7). A majority (81%) of people who are unfamiliar with California rules feel that they have very good access or better to information about animal care. It is possible that many livestock owners believe they are well informed even though important pieces of information such as those about antimicrobial rules never reach them. The distribution for respondents familiar with California rules was similar.

Table 7. Perceived quality of access to information about animal care. Responses of to Question #6, "Do you feel that you have good access to the information you need to care for your animals?"

Quality of access	Respondents familiar with California rules (n= 32)	Respondents unfamiliar with California rules (n=71)
Bad	0%	1%
Not very good	3%	3%
Good	16%	14%
Very good	31%	42%
Extremely good	50%	39%

Question #7 asked respondents where they got information about animal husbandry and animal care practices (Table 8). The most used sources of information for both groups were other livestock owners, websites, and veterinarians. Respondents unfamiliar with California rules were more likely to use farm supply stores and social media, and less likely to use blogs/online forums, organizations livestock journals and books.

Table 8. Source of information about animal health and husbandry practices. Responses to Question #7, "Where do you get information about animal health and animal husbandry/animal care practices? (check all that apply)"

Source	Respondents familiar with California rules (n=33)	Respondents unfamiliar with California rules (n=72)
Veterinarian	64%	72%
Farm supply store	36%	61%
Other livestock owners	60%	81%
Co-operative extensions	6%	7%
Websites	57%	79%
Blogs/online forums	21%	14%
Social media	12%	22%
Organizations	42%	28%
Livestock journals	33%	15%
Books	48%	40%
Pet/feed store	27%	31%
I don't have good access to this information	0%	0%
I don't want or need this information	0%	0%

Question #8 asked whether anyone in the respondent's household worked for a commercial livestock operation (Table 9). These results are notable because a slightly greater percent of the population unfamiliar with California rules had a household member work for a commercial livestock operation than that of respondents familiar with California rules. This suggests that contact with commercial livestock operations did not increase the likelihood of being familiar with rules about antimicrobial use in livestock.

Table 9. Connection to commercial operation. Responses to Question #8, “Do you or anyone in your household work for a commercial livestock operation?”

	Respondents familiar with California rules (n=33)	Respondents unfamiliar with California rules (n=71)
Yes	12%	14%
No	88%	86%

Question 9 asked respondents how they used veterinarians in 2017 (Table 10). This question was predicted to show a significant difference between populations familiar and unfamiliar with antimicrobial rules, but no difference was seen except for phone and email consultations, which respondents familiar with California rules used more.

Table 10. Use of veterinarians in 2017. Responses to Question #9, “How did you use veterinarians in 2017?”

	Respondents familiar with California rules (n=32)	Respondents unfamiliar with California rules (n=72)
Veterinarian made regular or routine visits	44%	43%
Veterinarian was called out only for emergencies	44%	42%
Veterinarian was consulted over the phone or by email	41%	22%
Veterinarian was only used for feed VFDs and water prescriptions	0%	0%
I am a veterinarian and provided veterinary services for my livestock	0%	2%

Did not use a veterinarian in 2017	22%	28%

For respondents that did not use a veterinarian in 2017, Question 10 asked why they did not (Table 11). No difference was seen between familiar and unfamiliar populations. A large number of respondents said that a veterinarian was not needed and a few said that they were too expensive. In the “other” category, one respondent wrote “I worked as a vet tech in the past so I already have some knowledge of medicine” and another said “There aren't many trusted vets out here.”

Table 11. Reason for not using veterinarians in 2017. Responses to Question #10, “If you did NOT use a veterinarian in 2017, which of the following reasons did you have for not using a veterinarian? (Check all that apply)”

	Respondents familiar with California rules (n=29)	Respondents unfamiliar with California rules (n=70)
Veterinarian was not available in the local area	0%	1%
Veterinarian was available but not knowledgeable about the kinds of livestock I own	3%	1%
Too expensive	3%	7%
Not available at times needed (for emergencies)	0%	0%
Not needed for my livestock	31%	23%
I did use a veterinarian in 2017	66%	70%

Question #11 asked about factors that may limit the ability of the respondent to care for their animals (Table 12). Many respondents said that none of the above were limitations, but many also cited cost of medications as a limitation. Respondents familiar with California rules were more likely to say that access to medications and information were limitations. Like the results of Question #6 (Table 7), this suggests that people with limited access to information are unaware that there is information they are not aware of.

Table 12. Limitations on the respondents' ability to care for their livestock. Responses to Question #11, "Which of these (if any) do you consider a limitation on your animals' health and welfare? (check all that apply)"

Limitation	Respondents familiar with California rules (n=32)	Respondents unfamiliar with California rules(n=69)
Cost of medications	31%	35%
Access to medications	34%	20%
Access to information	13%	7%
Amount of space to keep them	9%	12%
None of the above	34%	45%

Question #14 asked how the respondents' antibiotic use practices were affected by the January 2018 California rules (Table 13). As was expected, a major difference was seen between familiar and unfamiliar groups. The majority of respondents unfamiliar with California rules did not change their practices because they were unaware of the legal changes, whereas the majority of the other group said that their practices were not affected by the law. Respondents familiar with California rules were also more likely to change their husbandry practices and use fewer antibiotics, different antibiotics, and alternative treatments other than antibiotics.

Table 13. Effect of California rules on antimicrobial use. Responses to Question #14, "How did the January 2018 California state legal changes affect your antibiotic use practices? (check all that apply)"

	Respondents familiar with California rules (n=33)	Respondents unfamiliar with California rules(n=72)
I use fewer antibiotics	15%	3%
I use different antibiotics	18%	1%
I use more additional or alternative treatments other than antibiotics	21%	4%
I have made changes to my husbandry/management practices	12%	3%
I have not changed my practices because they were not affected by the legal changes	55%	18%
I have not changed my practices because I was unaware of the legal changes	3%	79%

Question #15 asked respondents how knowledgeable they were about the impacts of antimicrobial use in livestock (Table 14). Respondents unfamiliar with California rules rated their knowledge significantly lower (p= .0002, see page 32).

Table 14. Respondents' self-assessed knowledge of the effects of antimicrobial use in livestock. Responses to Question #15, "How knowledgeable are you about the impacts of antibiotic use in livestock?"

	Respondents familiar with California rules (n=33)	Respondents unfamiliar with California rules(n=72)
Not at all knowledgeable	3%	10%
Not knowledgeable	3%	29%
Somewhat knowledgeable	48%	43%
Very knowledgeable	30%	17%
Extremely knowledgeable	15%	1%

Question #16 assessed respondents' opinions and knowledge of antimicrobial resistance by asking the extent to which they agree with a series of statements (figure 1).

- Statement #1, "Current antibiotic use practices in animal agriculture will make it harder to treat livestock infections in the future."
- Statement #2, "Antibiotic use in livestock does not cause problems in humans."
- Statement #3, "Antibiotic use in livestock leads to bacterial infections in people that are more difficult to treat."
- Statement #4, "Any use of antibiotics may result in infections that are more difficult to treat in the future."
- Statement #5, "I would be willing to treat my animals with alternatives to antibiotics if they are equally effective".

The distributions were similar, though respondents unfamiliar with California rules were less likely to agree with Statement #2 and more likely to remain neutral in general.

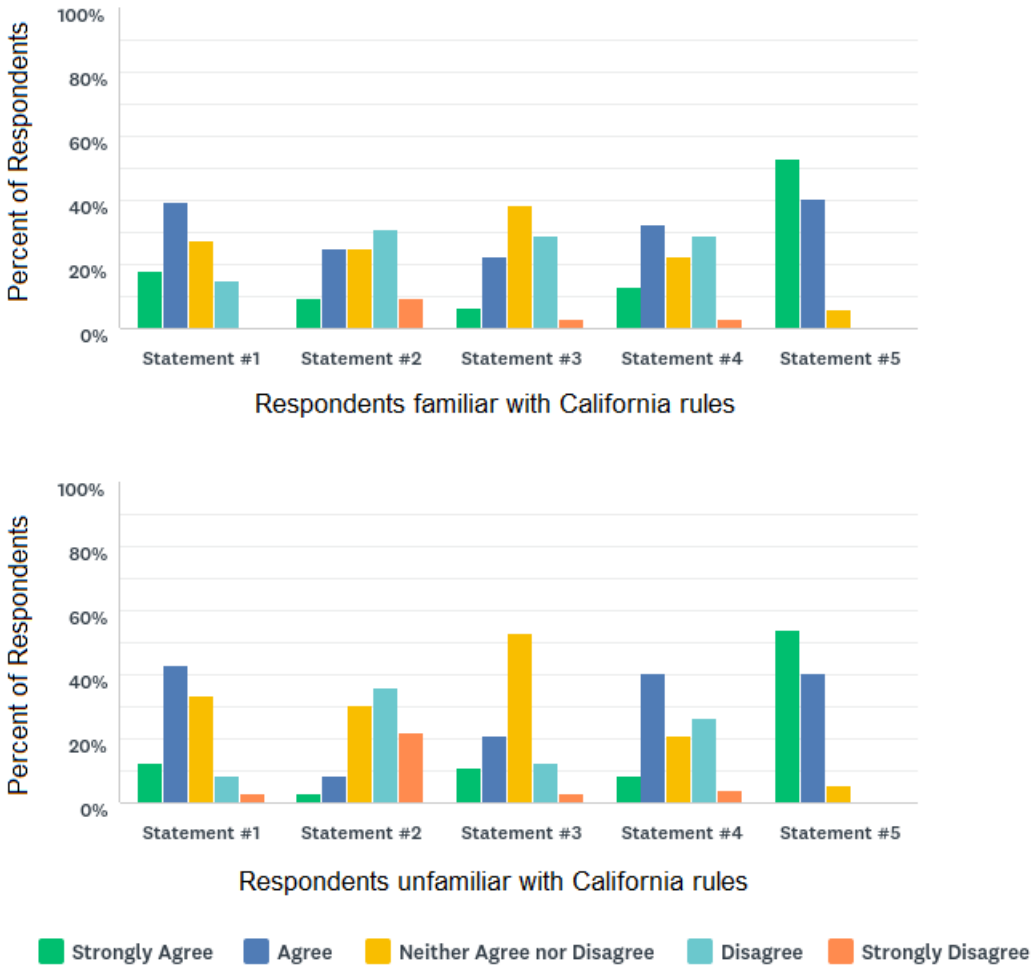


Figure 1. Agreement with statements related to antimicrobial use in livestock. Responses to Question #15, “To what extent do you agree with the following statements relating to antibiotic resistance?” Statement #1, “Current antibiotic use practices in animal agriculture will make it harder to treat livestock infections in the future.” Statement #2, “Antibiotic use in livestock does not cause problems in humans.” Statement #3, “Antibiotic use in livestock leads to bacterial infections in people that are more difficult to treat.” Statement #4, “Any use of antibiotics may result in infections that are more difficult to treat in the future.” Statement #5, “I would be willing to treat my animals with alternatives to antibiotics if they are equally effective” (n=33 for familiar and n=72 for unfamiliar).

Question #17 assessed the respondents' opinion of the amount of regulation affecting small-scale livestock operations (Table 15). The majority of respondents unfamiliar with California rules did not know enough to form an opinion and a plurality of respondents familiar with California rules wanted less regulation.

Table 15. Respondents' opinion on the amount of regulation of small-scale livestock operations. Responses to Question #17, "What is your opinion regarding current federal and state regulations pertaining to small-scale non-commercial livestock owners?"

	Respondents familiar with California rules (n=33)	Respondents unfamiliar with California rules(n=72)
The current amount of regulation is reasonable	15%	10%
There should be more regulation	6%	3%
There should be less regulation	42%	18%
I don't know enough about current regulations to say	36%	69%

Question #18 asked what topics respondents were interested in learning more about (Table 16). The distribution was similar between familiar and unfamiliar respondents and was fairly even across the topics offered as answer choices.

Table 16. Respondents' interest in obtaining information on antimicrobial and animal care topics. Responses of underserved population to Question #18, "Would you be interested in obtaining information on the following topics? (check all that apply)"

	Respondents familiar with California rules (n=31)	Respondents unfamiliar with California rules(n=69)
Antibiotic resistance patterns	42%	48%
Antibiotic usage guidelines	55%	48%
Best management practices	58%	64%
None of the above	32%	28%

Question 19 asked by what means respondents would prefer to obtain information on antimicrobial and animal care topics (Table 17). The majority of both groups preferred a website. Several respondents from both groups selected "other" and wrote they wanted to get info from a veterinarian.

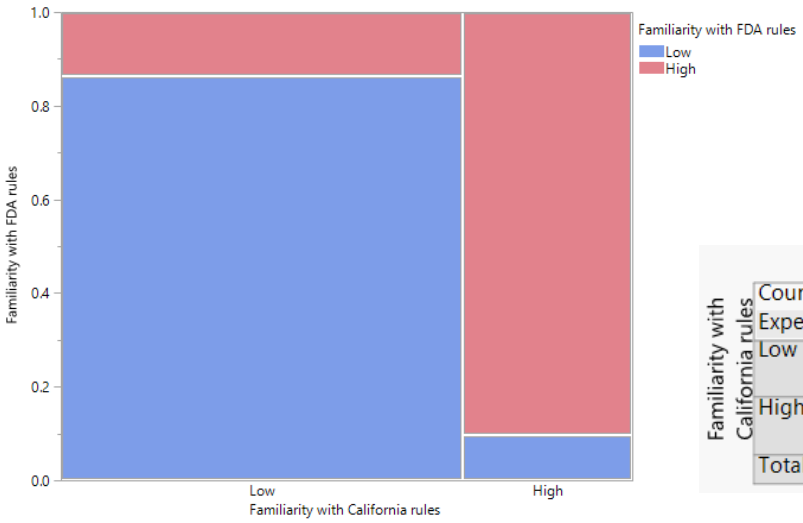
Table 17. Respondents' preferred method of obtaining information on antimicrobial and animal care topics. Responses of underserved population to Question #19, "How would you prefer to obtain information on relevant antibiotic resistance patterns, antibiotic usage guidelines, and best management practices? (check all that apply)"

	Respondents familiar with California rules (n=32)	Respondents unfamiliar with California rules (n=70)
Website	75%	63%
Electronic newsletter	31%	41%
Paper newsletter	19%	29%
Videos or webinars	9%	19%
Printed handbooks	31%	31%
Electronic/digital handbooks	13%	6%
Workshops, presentations, or talks	25%	24%
Mobile phone app	25%	10%

4.3 Inferences About Backyard Livestock Owners in SLO County

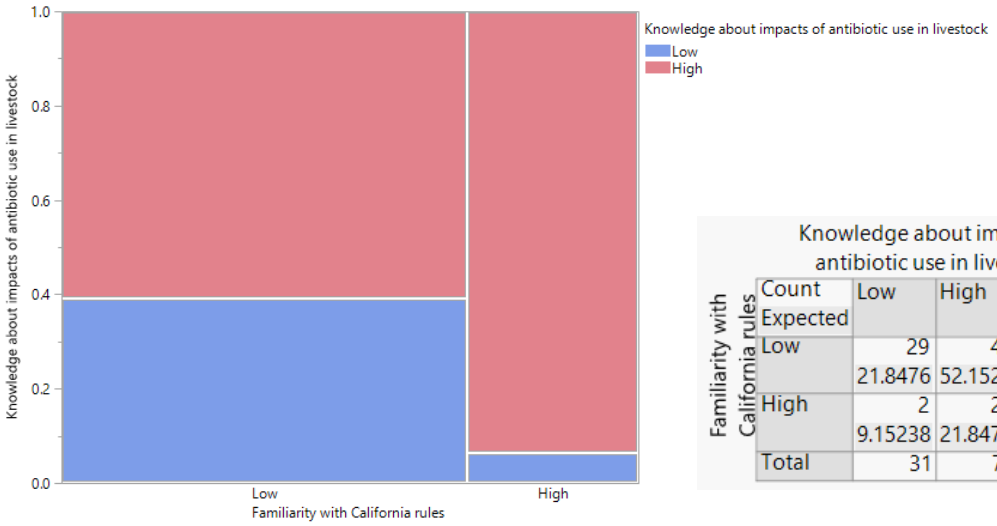
In this section, we use survey results to make inferences about livestock owners in San Luis Obispo County. Familiarity with California rules about how antimicrobials can be used in livestock has been used extensively in this study as an indicator of the respondents' access to information. Here, the soundness of using that indicator was investigated in a few ways. One measure of its appropriateness is the extent to which familiarity with California rules is correlated with familiarity with other rules, like those of the FDA. Another measure chosen by this study is the extent to which it correlates with the knowledge about the impacts of antimicrobial use in livestock.

A Chi Square test was used to determine that respondents familiar with California rules had statistically significantly greater familiarity with FDA rules about how antimicrobials can be given to livestock (Chi Square=59.121, $p<.0001$, df=1, n=105, figure 2). Another Chi Square test was used to determine that respondents familiar with California rules had statistically significantly greater self-assessed knowledge about the impacts of antimicrobial use in livestock (Chi Square=13.493, $p=.0002$, df=1, n=105 , figure 3).



Familiarity with California rules	Familiarity with FDA rules: Low	High	Total
Low (Count)	64	10	74
Low (Expected)	47.219	26.781	
High (Count)	3	28	31
High (Expected)	19.781	11.219	
Total	67	38	105

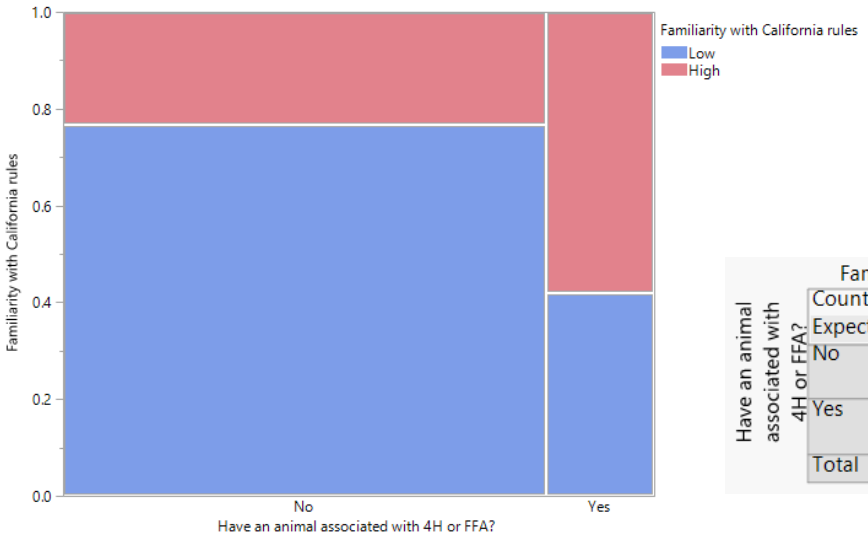
Figure 2. Mosaic plot and contingency table for familiarity with California rules vs familiarity with FDA rules. A Chi-Square test was used to determine that respondents that had high familiarity with California rules had statistically significantly greater familiarity with FDA rules about how antimicrobials can be given to livestock (Chi Square=59.121, p<.0001, df=1, n=105).



Familiarity with California rules	Knowledge about impacts of antibiotic use in livestock: Low	High	Total
Low (Count)	29	45	74
Low (Expected)	21.8476	52.1524	
High (Count)	2	29	31
High (Expected)	9.15238	21.8476	
Total	31	74	105

Figure 3. Mosaic plot and contingency table for familiarity with California rules vs knowledge of about impacts of antimicrobial use in livestock. A Chi-Square test was used to determine that respondents that had high familiarity with California rules had statistically significantly greater self-assessed knowledge of about impacts of antimicrobial use in livestock (Chi Square=13.493, p=.0002, df=1, n=105).

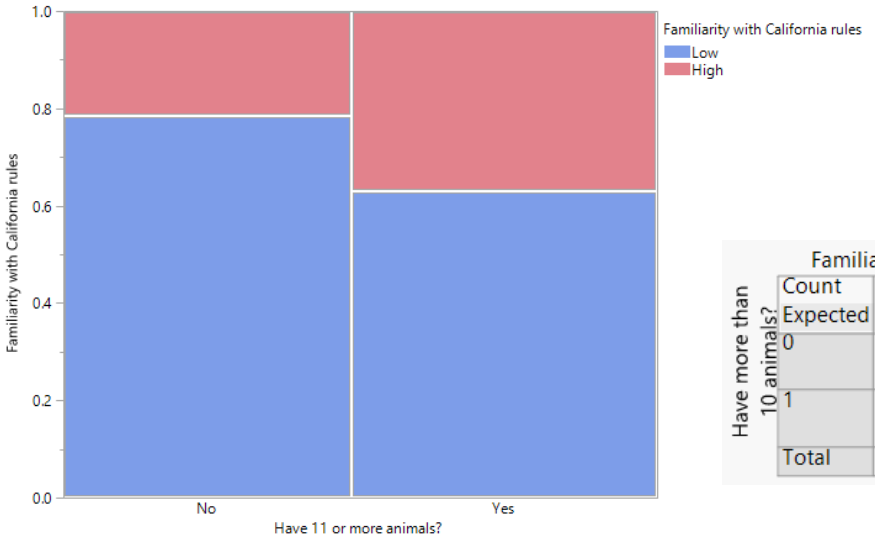
In approaching the underserved population, one of the principles that we are working on is that people with animals associated with livestock organizations like 4-H and FFA have greater access to information about livestock care. Testing this concept using survey data, familiarity with California rules (Question #13) was compared to whether the respondent owned any animals associated with 4-H or FFA (from Question #4). The method used above to define whether a respondent was a part of the underserved population was again applied to California antimicrobial rules familiarity: Respondents who were “not familiar” or “not at all familiar” were grouped into “low familiarity” and respondents who were “somewhat familiar”, “very familiar” or “extremely familiar” were grouped into “high familiarity.” A Chi-Square test was used to determine that livestock owners with at least one animal associated with 4-H or FFA had statistically significantly greater familiarity with changes made to California state law in January 2018 concerning how antimicrobials can be given to livestock than livestock owners that did not have any animals associated with 4-H or FFA (Chi Square=8.275, p=.0040, df=1, figure 4)



Have an animal associated with 4H or FFA?	Count / Expected	Familiarity with California rules: Low	High	Total
	No	66	20	86
		60.6095	25.3905	
	Yes	8	11	19
		13.3905	5.60952	
	Total	74	31	105

Figure 4. Mosaic plot and contingency table for having an animal associated with 4-H or FFA vs familiarity with California rules. A Chi-Square test was used to determine that livestock owners with at least one animal associated with 4-H or FFA had statistically significantly greater familiarity with changes made to California state law in January 2018 concerning how antimicrobials can be given to livestock than livestock owners that did not have any animals associated with 4-H or FFA (Chi Square=8.275, p=.0040, df=1, n=105).

A major characteristic that distinguishes livestock operations is their size. It was hypothesized that smaller livestock operations would generally be more underserved than large operations. To test this hypothesis, respondents were grouped into livestock owners with fewer than 11 total animals and those with 11 or more total animals (from Question #3). This division was chosen because the median number of animals among SLO county respondents was 11. This was compared to familiarity with California rules as explained above. A Chi-Square test was run to determine that livestock owners with 11 animals or more had greater familiarity with changes made to California state law in January 2018 concerning how antimicrobials can be given to livestock than livestock owners that had fewer than 11 animals. While there was a trend suggesting that the hypothesis was true, the correlation was not statistically significant (figure 5).



Have more than 10 animals?	Familiarity with California rules		
Count / Expected	Low	High	Total
0	40 35.9429	11 15.0571	51
1	34 38.0571	20 15.9429	54
Total	74	31	105

Figure 5. Mosaic plot and contingency table for having 11 or more animals vs familiarity with California rules. A Chi-Square test was used to determine if livestock owners with 11 or more animals had greater familiarity with changes made to California state law in January 2018 concerning how antimicrobials can be given to livestock than livestock owners with fewer than 11 animals. The correlation is not statistically significant.

Chapter 5
SUMMARY AND CONCLUSIONS

An analysis of the surveys administered to livestock owners in San Luis Obispo County revealed characteristics of a subset of that population that are underserved with regards to veterinary care and educational outreach about animal health issues, such as antimicrobial use rules.

5.1 Summary of Survey Results

Survey results showed that respondents were largely unaware of new rules pertaining to use of antimicrobials in livestock, 69% or respondents being either “not familiar” or “not at all familiar” with California rules and 62% being either “not familiar” or “not at all familiar” with Federal rules. Chickens and horses were the most common livestock owned, each being owned by more than half of respondents. The average number of animals owned by respondents unfamiliar with California rules was less than that of SLO County respondents in general, though the correlation was not statistically significant. The majority of respondents consumed the products of their livestock on site.

Of the respondents that were “not familiar” or “not at all familiar” with California rules affecting how antimicrobials can be given to livestock, 81% that they had “very good” or “extremely good” access to the information they needed to care for their animals. This suggest the possibility that many livestock owners believe they are well informed even though important pieces of information such as those about antimicrobial rules never reach them.

It was hypothesized that respondents unfamiliar with California rules would use veterinarians less than the rest of the population, but no major differences were seen in this respect. The most common reason for using veterinarians was that they were not needed, and expense was the second most common reason.

Unexpectedly, a slightly greater percent of the population unfamiliar with California rules had a household member work for a commercial livestock operation than that of respondents

from SLO County in general, suggesting that contact with commercial livestock operations did not increase the likelihood of being familiar with rules about antimicrobial use in livestock.

The most used sources of information about animal health and husbandry practices for both groups were other livestock owners, websites, and veterinarians. The most commonly preferred means of obtaining information on antimicrobial and animal care topics was by website. Newsletters, printed handbooks and workshops were also popular choices.

Cost of medications was a limitation on more respondents' ability to care for their livestock than was access to medication or access to information. The California rules concerning antimicrobial use in livestock did not change the majority of respondents' practices because they were unaware of the legal changes. The majority of respondents did not know enough about regulation of small-scale livestock owners to form an opinion as to whether there should be more or less regulation.

Familiarity with California rules affecting how antimicrobials can be given to livestock was found to correlate positively with knowledge about antimicrobial resistance and familiarity with federal rules concerning antimicrobial use in livestock. Respondents with a connection to 4-H and FFA also had greater familiarity with both federal and state rules concerning antimicrobial use in livestock.

5.2 Limitations

After analyzing the results of the study, different survey strategies seem like they might have yielded more useful information. Most of the questions in the survey were written to allow respondents to "check all [answers] that apply" as it provided the best opportunity to collect all relevant information. This design allowed respondents to record all of the ways in which they accessed information, used their animal products, and used veterinary services, for example.

In retrospect, however, questions in which respondents can choose only one answer may be more useful in some situations. This would force respondents to choose the most important, most common, or best answer, which might allow for a clearer separation between groups of interest and have less overlap. For example, most people got information both from veterinarians

and websites, but making respondents chose their most used source of information may have identified distinct groups that get information primarily from one of these sources or the other.

Another limitation of this study was the sampling. Responses were gathered at three store locations of the same supply company. Though the products at the stores were wide-ranging, there is still likely a particular cross-section of the population that frequents these sites. A future study gathering data across a greater area may be able to collect surveys from a wider variety of locations to somewhat decrease sampling bias.

In terms of this study's application to characterizing small-scale livestock owners in California, it is difficult to determine the extent to which the residents of San Luis Obispo county reflect the residents of California. Likely, a state-wide survey is needed to understand the impacts of the new California rules.

Future studies may choose to use a similar approach to the one used here. As stated above, it may be advantageous to use less "select all that apply" style questions and to collect surveys at a variety of different locations. It may also be useful to ask some questions that were not asked in this study, including questions that uncover more detailed ways in which antimicrobials and other medications are used on respondents' farms. It would also be useful to gather more detail about respondents' sources of information, such as what kind of veterinarian (large or small animal), which social media platforms, and what kind of websites or blogs.

5.3 Contribution of Study

This project both informs the CDFA about this underserved population and serves as a pilot study for future research across a larger area. The results of this research will support CDFA's efforts to ensure compliance with SB 27, enhance understanding of the needs of this underserved population (including regarding educational outreach and veterinary care), and establish communication networks through which this subset of livestock producers can be reached. This research will enhance understanding of the importance of responsible antimicrobial use in animal and human health, and support animal health and welfare among small-scale livestock producers.

REFERENCES

AVMA. 2019. AVMA Definitions of Antimicrobial Use for Treatment , Control and Prevention. Available from: https://www.avma.org/KB/Policies/Pages/AVMA-Definitions-of-Antimicrobial-Use-for-Treatment-Control-and-Prevention.aspx?PF=1

Boucher, H. W., J. S. Bradley, B. I. Eisenstein, D. Gerding, R. Lynfield, L. B. Reller, J. Rex, D. Schwartz, E. Septimus, and F. C. Tenover. 2011. Combating Antimicrobial Resistance : Policy Recommendations to Save Lives. 52:397–428. doi:10.1093/cid/cir153.

Braykov, N. P., J. N. S. Eisenberg, M. Grossman, L. Zhang, K. Vasco, W. Cevallos, D. Muñoz, A. Acevedo, K. A. Moser, C. F. Marrs, B. Foxman, J. Trostle, G. Trueba, and K. Levy. 2016. Antibiotic Resistance in Animal and Environmental Samples Associated with Small-Scale Poultry Farming in Northwestern Ecuador. mSphere. 1:e00021-15. doi:10.1128/mSphere.00021-15. Available from: http://msphere.asm.org/lookup/doi/10.1128/mSphere.00021-15

Capua, I., M. Dalla Pozza, F. Mutinelli, S. Marangon, and C. Terregino. 2002. Newcastle disease outbreaks in Italy during 2000. Vet. Rec. 150:565–568. doi:10.1136/vr.150.18.565.

CDC. 2013. Antibiotic resistance threats in the United States, 2013. Current. 114. doi:CS239559-B. Available from: http://www.cdc.gov/drugresistance/threat-report-2013/index.html

CDFA. 2019a. Antimicrobial Use and Stewardship (AUS) Program Report to the Legislature. Available from: https://www.cdfa.ca.gov/ahfss/aus/docs/CDFA_AUS_Report_2019.pdf

CDFA. 2019b. CDFA AUS Website. Available from: https://www.cdfa.ca.gov/ahfss/aus/

CDFA. 2019c. Veterinarian-Client-Patient Relationship. 2032. Available from: https://www.cdfa.ca.gov/ahfss/aus/docs/Antimicrobial_Availability_Vet.pdf

Crespo, R., H. L. Shivaprasad, P. R. Woolcock, R. P. Chin, D. Davidson-York, and R. Tarbell. 1999. Exotic Newcastle disease in a game chicken flock. Avian Dis. 43:349–355. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10396652

Garber, L., G. Hill, J. Rodriguez, G. Gregory, and L. Voelker. 2007. Non-commercial poultry industries: Surveys of backyard and gamefowl breeder flocks in the United States. Prev. Vet. Med. 80:120–128. doi:10.1016/j.prevetmed.2007.01.012.

Gould, I. M., and A. M. Bal. 2013. New antibiotic agents in the pipeline and how they can help overcome microbial resistance. 185–191.

Hoey, L., and A. Sponseller. 2018. “ It ’ s hard to be strategic when your hair is on fire ”: alternative food movement leaders ’ motivation and capacity to act. Agric. Human Values. 35:595–609. doi:10.1007/s10460-018-9850-z. Available from: http://dx.doi.org/10.1007/s10460-018-9850-z

Landers, T. F. 2012. A Review of Antibiotic Use in Food Animals : Perspective , Policy , and Potential. 127.

Lobanovska, M., and G. Pilla. 2017. Penicillin ’ s Discovery and Antibiotic Resistance : Lessons for the Future ? 90:135–145.

McClintock, N., E. Pallana, and H. Wooten. 2014. Urban livestock ownership, management, and regulation in the United States: An exploratory survey and research agenda. Land use policy. 38:426–440. doi:10.1016/j.landusepol.2013.12.006.

Smith, G., and S. Dunipace. 2011. How backyard poultry flocks influence the effort required to curtail avian influenza epidemics in commercial poultry flocks. Epidemics. 3:71–75.

doi:10.1016/j.epidem.2011.01.003.

USDA. 2005. Part I: Reference of Health and Management of Backyard/Small Production Flocks in the United States, 2004.

California Department of Food and Agriculture. Antimicrobial Use and Stewardship. CDFA. Available from: https://www.cdfa.ca.gov/ahfss/aus/

APPENDICES:

Appendix A: Senate Bill 27

Senate Bill No. 27

CHAPTER 758

An act to add Chapter 4.5 (commencing with Section 14400) to Division 7 of the Food and Agricultural Code, relating to livestock.

[Approved by Governor October 10, 2015. Filed with Secretary of State October 10, 2015.]

LEGISLATIVE COUNSEL'S DIGEST

SB 27, Hill. Livestock: use of antimicrobial drugs.

(1) Existing law regulates the distribution and use of livestock drugs, as defined, by the Secretary of Food and Agriculture. Existing law also requires a person to obtain a license from the secretary to manufacture, sell, distribute, or store commercial feed, including commercial feed containing drugs.

This bill would, beginning January 1, 2018, prohibit the administration of medically important antimicrobial drugs, as defined, to livestock unless ordered by a licensed veterinarian through a prescription or veterinary feed directive pursuant to a veterinarian-client-patient relationship, as specified, and would prohibit the administration of a medically important antimicrobial drug to livestock solely for purposes of promoting weight gain or improving feed efficiency. The bill would require the Department of Food and Agriculture, in consultation with the Veterinary Medical Board, the State Department of Public Health, universities, and cooperative extensions, to develop antimicrobial stewardship guidelines and best management practices on the proper use of medically important antimicrobial drugs and would require the department to gather information on medically important antimicrobial drug sales and usage, antimicrobial resistant bacteria, and livestock management practice data. The bill would require information provided pursuant to those provisions to be held confidential, as specified. The bill would authorize the department to request and receive copies of veterinary feed directives from certain persons to implement the bill's provisions. The bill would make a first violation of the bill's provisions subject to a civil penalty of up to $250 for each day a violation occurs, and would make second and subsequent violations subject to an administrative fine of $500 for each day a violation occurs, except as specified.

(2) Existing constitutional provisions require that a statute that limits the right of access to the meetings of public bodies or the writings of public officials and agencies be adopted with findings demonstrating the interest protected by the limitation and the need for protecting that interest.

This bill would make legislative findings to that effect.

The people of the State of California do enact as follows:

SECTION 1. Chapter 4.5 (commencing with Section 14400) is added to Division 7 of the Food and Agricultural Code, to read:

CHAPTER 4.5. LIVESTOCK: USE OF ANTIMICROBIAL DRUGS

14400. For purposes of this chapter, the following definitions apply:

(a) "Medically important antimicrobial drug" means an antimicrobial drug listed in Appendix A of the federal Food and Drug Administration's Guidance for Industry #152, including critically important, highly important, and important antimicrobial drugs, as that appendix may be amended.

(b) "Livestock" means all animals and poultry, including aquatic and amphibian species, that are raised, kept, or used for profit. Livestock does not include bees or those species that are usually kept as pets, such as dogs, cats, and pet birds.

(c) "Veterinary feed directive" has the same definition as in Section 558.3 of Title 21 of the Code of Federal Regulations.

14401. Beginning January 1, 2018, a medically important antimicrobial drug shall not be administered to livestock unless ordered by a licensed veterinarian through a prescription or veterinary feed directive, pursuant to a veterinarian-client-patient relationship that meets the requirements of Section 2032.1 of Title 16 of the California Code of Regulations.

14402. (a) Beginning January 1, 2018, a medically important antimicrobial drug may be used when, in the professional judgment of a licensed veterinarian, the medically important antimicrobial drug is any of the following:

(1) Necessary to treat a disease or infection.

(2) Necessary to control the spread of a disease or infection.

(3) Necessary in relation to surgery or a medical procedure.

(b) A medically important antimicrobial drug may also be used when, in the professional judgment of a licensed veterinarian, it is needed for prophylaxis to address an elevated risk of contraction of a particular disease or infection.

(c) A person shall not administer a medically important antimicrobial drug to livestock solely for purposes of promoting weight gain or improving feed efficiency.

(d) Unless the administration is consistent with subdivision (a), a person shall not administer a medically important antimicrobial drug in a regular pattern.

14403. (a) Notwithstanding Sections 14401 and 14402 of this code and Article 15 (commencing with Section 4196) of Chapter 9 of Division 2 of the Business and Professions Code, medically important antimicrobial drugs may be sold by retailers licensed pursuant to Article 5 (commencing with Section 14321) of Chapter 4 of Division 7 with a prescription or veterinary feed directive from a licensed veterinarian.

(b) This section shall not be construed to invalidate the requirement to obtain a prescription or veterinary feed directive to administer a medically important antimicrobial drug as required by Section 14401.

(c) The department may promulgate regulations to implement this section.

14404. (a) The department, in consultation with the Veterinary Medical Board, the State Department of Public Health, universities, and cooperative extensions, shall develop antimicrobial stewardship guidelines and best management practices for veterinarians, as well as livestock owners and their employees who are involved with administering medically important antimicrobial drugs, on the proper use of medically important antimicrobial drugs for disease treatment, control, and prevention. The guidelines shall include scientifically validated practical alternatives to the use of medically important antimicrobial drugs, including, but not limited to, the introduction of effective vaccines and good hygiene and management practices.

(b) The department shall consult with livestock producers, licensed veterinarians, and any other relevant stakeholders on ensuring livestock timely access to treatment for producers in rural areas with limited access to veterinary care.

(c) For purposes of this section, "antimicrobial stewardship" is a commitment to do all of the following:

(1) To use medically important antimicrobial drugs only when necessary to treat, control, and, in some cases, prevent, disease.

(2) To select the appropriate medically important antimicrobial drug and the appropriate dose, duration, and route of administration.

(3) To use medically important antimicrobial drugs for the shortest duration necessary and to administer them to the fewest animals necessary.

14405. (a) It is the intent of the Legislature that the department coordinate with the United States Department of Agriculture, the federal Food and Drug Administration, and the federal Centers for Disease Control and Prevention to implement the expanded antimicrobial resistance surveillance efforts included in the National Action Plan for Combating Antibiotic-Resistant Bacteria, and that the information gathered through this effort will help lead to a better understanding of the links between antimicrobial use patterns in livestock and the development of antimicrobial resistant bacterial infections.

(b) (1) The department shall gather information on medically important antimicrobial drug sales and usage, as well as antimicrobial resistant bacteria and livestock management practice data. Monitoring efforts shall not be duplicative of the National Animal Health Monitoring System and the National Antimicrobial Resistance Monitoring System, and, to the extent feasible, the department shall coordinate with the United States Department of Agriculture, the federal Centers for Disease Control and Prevention, and the federal Food and Drug Administration in the development of these efforts.

(2) In coordinating with the National Animal Health Monitoring System and the National Antimicrobial Resistant Monitoring System, the department shall gather representative samples from all of the following:

(A) California's major livestock segments.
(B) Regions with considerable livestock production.
(C) Representative segments of the food production chain.

(c) The department shall work with willing participants to gather samples and shall consult with, and conduct outreach to, livestock producers, licensed veterinarians, and any other relevant stakeholders on the implementation of the monitoring efforts. Participation in this effort shall be done in a manner that does not breach veterinary-client-patient confidentiality laws.

(d) (1) The department shall report to the Legislature by January 1, 2019, the results of its outreach activities and monitoring efforts. The department shall advise the Legislature as to whether or not participation is sufficient to provide statistically relevant data. The report shall be submitted in compliance with Section 9795 of the Government Code.

(2) This subdivision is inoperative on January 1, 2023, pursuant to Section 10231.5 of the Government Code.

(e) The department shall seek funds from federal, state, and other sources to implement this section.

(f) The department may promulgate regulations to implement this section.

14406. The department has the authority to request and receive copies of veterinary feed directives from the livestock owner, veterinarian, or distributor to fully implement the provisions of this chapter.

14407. Notwithstanding the California Public Records Act (Chapter 3.5 (commencing with Section 6250) of Division 7 of Title 1 of the Government Code), any information provided pursuant to this chapter and Section 14902.5, if that section is added by Senate Bill 770 of the 2015–16 Regular Session of the Legislature, shall be held confidential, and shall not be disclosed to any person or governmental agency, other than the department or the Veterinary Medical Board, for the purposes of enforcing the Veterinary Medicine Practice Act (Chapter 11 (commencing with Section 4800) of Division 2 of the Business and Professions Code), unless the data is aggregated to prevent the identification of an individual farm or business. Information may be shared with federal agencies so long as it is protected by the federal Confidential Information Protection and Statistical Efficiency Act of 2002 (Public Law 107-347).

14408. (a) A person who violates this chapter shall be liable for a civil penalty of not more than two hundred and fifty dollars ($250) for each day a violation occurs.

(b) (1) For a second or subsequent violation, a person who violates this chapter shall be punishable by an administrative fine, levied by the secretary, in the amount of five hundred dollars ($500) for each day a violation occurs.

(2) In addition to the administrative fine, the violator shall attend an educational program on the judicious use of medically important antimicrobial drugs that has been approved by the secretary. The violator shall successfully complete the program and provide proof to the secretary within 90 days from the occurrence of the violation.

(c) Subdivisions (a) and (b) do not apply to licensed veterinarians. If the Veterinary Medical Board determines that a veterinarian is in violation of

the Veterinary Medicine Practice Act (Chapter 11 (commencing with Section 4800) of Division 2 of the Business and Professions Code), the veterinarian may be subject to disciplinary sanctions pursuant to the act.

(d) The moneys collected pursuant to this article shall be deposited into the Department of Food and Agriculture Fund and shall be available for expenditure upon appropriation by the Legislature.

SEC. 2. The Legislature finds and declares that Section 1 of this act, which adds Section 14407 to the Food and Agricultural Code, imposes a limitation on the public's right of access to the meetings of public bodies or the writings of public officials and agencies within the meaning of Section 3 of Article I of the California Constitution. Pursuant to that constitutional provision, the Legislature makes the following findings to demonstrate the interest protected by this limitation and the need for protecting that interest:

In order to ensure the confidentiality of the information collected pursuant to this act and the integrity of that information for regulatory and enforcement purposes, it is necessary that this act take effect.

O

Appendix B: Survey Questions

1.

Thank you for taking our survey! I'm Philip Paulson, a Cal Poly San Luis Obispo graduate student working on the thesis project for my master's degree. I am gathering demographic information about livestock owners in San Luis Obispo County to determine where they get information pertaining to their animals' health, and the extent of their access to veterinary care. I would also like to find out how livestock owners use antibiotics and how they are impacted by new antibiotic regulations.

1. INFORMED CONSENT TO PARTICIPATE IN A BACKYARD LIVESTOCK PRODUCER SURVEY

A research project on backyard livestock producers is being conducted by Philip Paulson, a graduate student in the Department of Animal Science at Cal Poly, San Luis Obispo, under the supervision of Dr. Jennifer Wishnie. The purpose of the study is to gather demographic information about backyard livestock producers and assess their access to veterinary care and animal husbandry information.

You are being asked to take part in this study by completing the following questionnaire. Your participation will take approximately 10 minutes. Please be aware that you are not required to participate in this research, you may omit any items that you prefer not to answer, and you may discontinue your participation at any time without penalty.

Your responses will be provided anonymously to protect your privacy. Potential benefits associated with the study include understanding how regulatory changes can affect medicines used in backyard animals and better understanding of key communication channels to provide backyard livestock producers with important animal health, public health, and regulatory topics now and in the future.

If you have questions regarding this study or would like to be informed of the results when the study is completed, please feel free to contact Philip Paulson (ptpaulso@calpolu.edu) or Dr. Jennifer Wishnie (jwishnie@calpoly.edu). If you have concerns regarding the manner in which the study is conducted, you may contact Dr. Michael Black, Chair of the Cal Poly Institutional Review Board, at (805) 756-2894, mblack@calpoly.edu, or Ms. Debbie Hart, Compliance Officer, at (805) 756-1508, dahart@calpoly.edu.

If you agree to voluntarily participate in this research project as described, please indicate your agreement by completing and submitting the following questionnaire. Please print a copy of this consent form now for your reference, and thank you for your participation in this research.

- ◯ Yes, I consent (Continue to survey)
- ◯ No, I don't consent (Exit survey)

2.

2. Do you live in San Luis Obispo County?

- ◯ Yes
- ◯ No

3. How many of each type of livestock do you have?

Alpaca	
Cattle	
Chicken	
Donkey	
Duck	
Goat	
Goose	
Horse	
Llama	
Pig	
Rabbit	
Sheep	
Turkey	
Other	

4. For what purpose do you raise each type of livestock? Are these animals associated with 4H or FFA?

	Meat	Eggs	Milk	Pet	Show	Other Purpose	4H or FFA?
Alpaca	☐	☐	☐	☐	☐	☐	☐
Cattle	☐	☐	☐	☐	☐	☐	☐
Chicken	☐	☐	☐	☐	☐	☐	☐
Donkey	☐	☐	☐	☐	☐	☐	☐
Duck	☐	☐	☐	☐	☐	☐	☐
Goat	☐	☐	☐	☐	☐	☐	☐
Goose	☐	☐	☐	☐	☐	☐	☐
Horse	☐	☐	☐	☐	☐	☐	☐
Llama	☐	☐	☐	☐	☐	☐	☐
Pig	☐	☐	☐	☐	☐	☐	☐
Rabbit	☐	☐	☐	☐	☐	☐	☐
Sheep	☐	☐	☐	☐	☐	☐	☐
Turkey	☐	☐	☐	☐	☐	☐	☐
Other Animal	☐	☐	☐	☐	☐	☐	☐

Other Animal (please specify)

5. How are the products of your livestock used? (check all that apply)

- ☐ Consumed on site
- ☐ Given away
- ☐ Bartered
- ☐ Sold
- ☐ Not Applicable
- ☐ Other (please specify)

6. Do you feel that you have good access to the information you need to care for your animals?

Extremely Good	Very Good	Good	Not Very Good	Bad
○	○	○	○	○

7. Where do you get information about animal health and animal husbandry/animal care practices? (check all that apply)

- [ ] Veterinarian
- [ ] Farm supply store
- [ ] Other livestock owners
- [ ] Co-operative extentions
- [ ] Websites
- [ ] Blogs/online Forums
- [ ] Social media
- [ ] Organizations (FFA, 4H, CA Cattleman's, wool growers, farm bureau, pork producers, etc.)
- [ ] Livestock journals
- [ ] Books
- [ ] Pet/feed store
- [ ] I dont have good access to this information
- [ ] I don't want or need this information
- [ ] Other (please specify)

8. Do you or anyone in your household work for a commercial livestock operation?

- ( ) Yes
- ( ) No

9. How did you use veterinarians during 2017? (check all that apply)

- [ ] Veterinarian made regular or routine visits
- [ ] Veterinarian was called out only for emergencies
- [ ] Veterinarian was consulted over the phone or by email
- [ ] Veterinarian was only used for feed VFDs and water prescriptions
- [ ] I am a veterinarian and provided veterinary services for my livestock
- [ ] Did not use a veterinarian in 2017

Other (please specify)

10. If you did NOT use a veterinarian in 2017, which of the following reasons did you have for not using a veterinarian? (Check all that apply)

- [ ] Veterinarian was not available in the local area
- [ ] Veterinarian was available but not knowledgeable about the kinds of livestock I own
- [ ] Too expensive
- [ ] Other (please specify)
- [ ] Not available at times needed (for emergencies)
- [ ] Not needed for my livestock
- [ ] I did use a veterinarian in 2017

11. Which of these (if any) do you consider a limitation on your animals' health and welfare? (check all that apply)

- [ ] Cost of medications
- [ ] Access to medications
- [ ] Access to information
- [ ] Amount of space to keep them
- [ ] None of the above
- [ ] Other (please specify)

12. How familiar are you with the National Food and Drug Administration (FDA) regulations that were implemented in January 2017 concerning how antibiotics can be given to livestock?

Extremely familiar	Very familiar	Somewhat familiar	Not familiar	Not at all familiar
○	○	○	○	○

13. How familiar are you with the changes made to California state law in January 2018 concerning how antibiotics can be given to livestock?

Extremely familiar	Very familiar	Somewhat familiar	Not familiar	Not at all familiar
○	○	○	○	○

14. How did the January 2018 California state legal changes affect your antibiotic use practices? (check all that apply)

- ☐ I use fewer antibiotics
- ☐ I use different antibiotics
- ☐ I use more additional or alternative treatments other than antibiotics
- ☐ I have made changes to my husbandry/management practices
- ☐ I have not changed my practices because they were not affected by the legal changes
- ☐ I have not changed my practices because I was unaware of the legal changes

15. How knowledgeable are you about the impacts of antibiotic use in livestock?

Extremely knowledgeable	Very knowledgeable	Somewhat knowledgeable	Not knowledgeable	Not at all knowledgeable
○	○	○	○	○

16. To what extent do you agree with the following statements relating to antibiotic resistance?

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Current antibiotic use practices in animal agriculture will make it harder to treat livestock infections in the future.	○	○	○	○	○
Antibiotic use in livestock does not cause problems in humans.	○	○	○	○	○
Antibiotic use in livestock leads to bacterial infections in people that are more difficult to treat.	○	○	○	○	○
Any use of antibiotics may result in infections that are more difficult to treat in the future.	○	○	○	○	○
I would be willing to treat my animals with alternatives to antibiotics if they are equally effective.	○	○	○	○	○

17. What is your opinion regarding current federal and state regulations pertaining to small-scale non-commercial livestock owners?

- ○ The current amount of regulation is reasonable
- ○ There should be more regulation
- ○ There should be less regulation
- ○ I don't know enough about current regulations to say

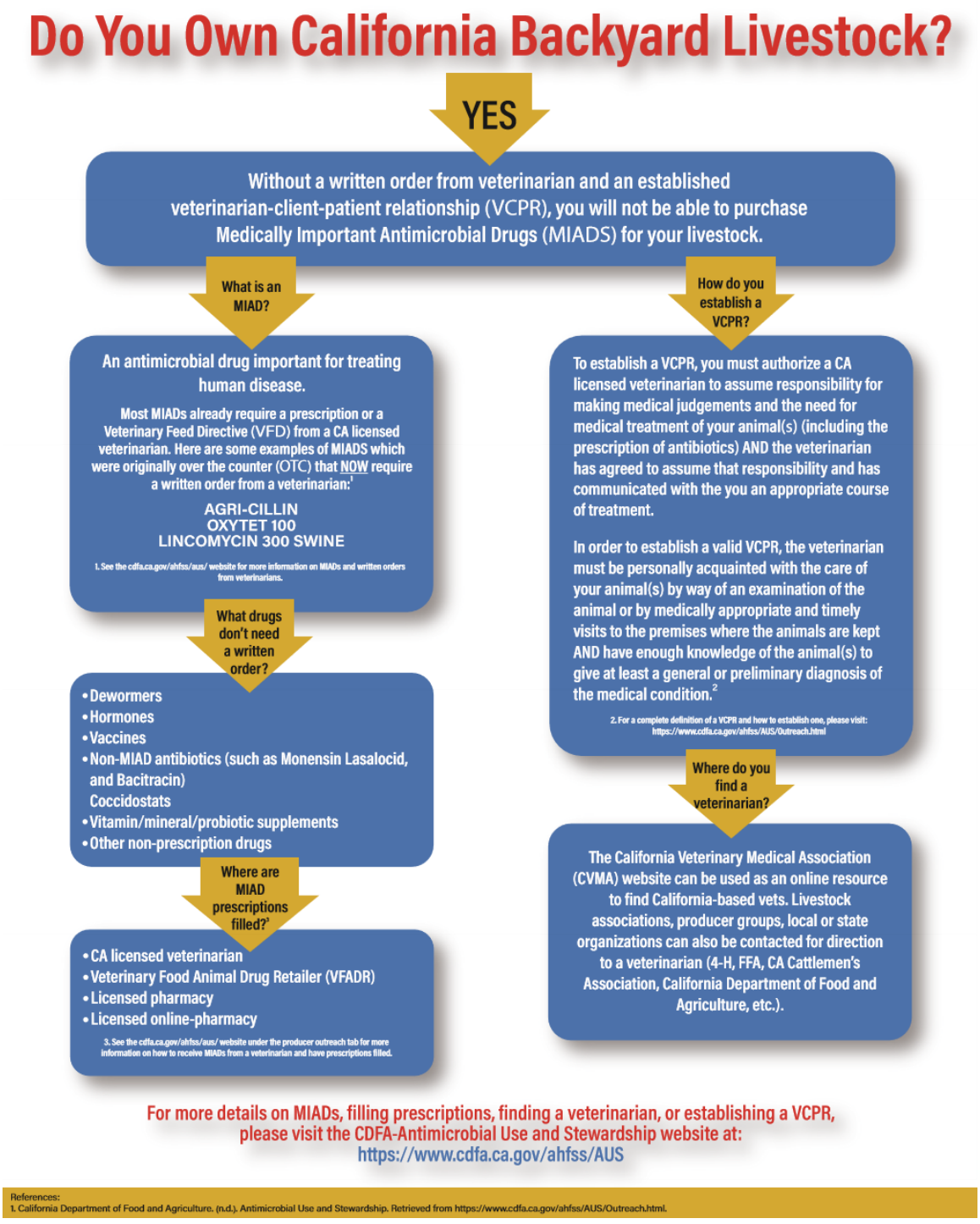
18. Would you be interested in obtaining information on the following topics? (check all that apply)

- ☐ Antibiotic resistance patterns
- ☐ Antibiotic useage guidelines
- ☐ Best management practices
- ☐ None of the above
- ☐ Other (please specify)

19. How would you prefer to obtain information on relevant antibiotic resistance patterns, antibiotic usage guidelines, and best management practices? (check all that apply)

- ☐ Website
- ☐ Electronic newsletter
- ☐ Paper newsletter
- ☐ Videos or Webinars
- ☐ Printed handbooks
- ☐ Electronic/digital handbooks
- ☐ Workshops, presentations, or talks
- ☐ Mobile phone app
- ☐ Other (please specify)

Appendix C: Educational Materials



References:
1. California Department of Food and Agriculture. (n.d.). Antimicrobial Use and Stewardship. Retrieved from https://www.cdfa.ca.gov/ahfss/AUS/Outreach.html.

Drugs Affected by the Antimicrobial Use & Stewardship Law

Effective January 1, 2018, all medically important antimicrobial drugs (MIADs) require a prescription or VFD for sale and use. Many MIADs have always required a prescription (Nuflor, Excede, Baytril, Draxxin, etc) and there are other livestock drugs currently sold at feed stores that did not change with the new law. The following is a **list of MIADs that changed from over-the-counter to prescription status** and are thus only available for sale at California Board of Pharmacy licensed facilities. BRAND NAMES OF PRODUCTS are separated into groups based on ***ROUTE OF ADMINISTRATION***, **MEDICALLY IMPORTANT CLASS OF ANTIBIOTIC**, and *drug compound and concentration*.

INJECTABLE

LINCOSAMIDES
lincomycin 300 mg/mL
- LINCOMYCIN 300 SWINE

MACROLIDES
tylosin 50 mg/mL
- TYLAN 50

tylosin 200 mg/mL
- TYLAN 200
- TYLOVED

PENICILLINS
penicillin G procaine 300,000 Units/mL
- AGRI-CILLIN
- BACTRACILLIN G
- NOROCILLIN STERILE USP
- PEN- AQUEOUS
- PENICILLIN G PROCAINE
- PENICILLIN INJECTABLE
- PRO-PEN-G INJECTION
- VET ONE PENONE PRO

penicillin G benzathine and penicillin G procaine 300,000 Units/mL
- BACTRACILLIN G BENZATHINE
- COMBI-PEN-48
- DURA-PEN

TETRACYCLINES
oxytetracycline 100 mg/mL
- AGRIMYCIN 100
- OXYTET 100
- TERRA-VET 100
- VET ONE VETRIMYCIN 100

oxytetracycline 200 mg/mL
- AGRIMYCIN 200
- BIO-MYCIN 200
- LIQUAMYCIN LA-200
- OXYTETRACYCLINE INJECTION 200
- TERRA-VET 200
- TETROXY-LA
- VETRIMYCIN 200

oxytetracycline 300 mg/mL
- NOROMYCIN 300 LA

SULFONAMIDES (SULFAS)
sulfadimethoxine 40%
- DI-METHOX INJECTION - 40%
- SULFAMED INJECTION 40%
- SULFAMED 40% INJECTION

ORAL – BOLUS

TETRACYCLINES
oxytetracycline hydrochloride 500 mg
- 5-WAY CALF SCOUR BOLUS
- CALF SCOUR BOLUS ANTIBIOTIC
- OXY 500 CALF BOLUS

oxytetracycline hydrochloride 250 mg
- TERRAMYCIN SCOURS TABLETS

SULFONAMIDES (SULFAS)
sulfadimethoxine 5 g
- ALBON 5 g BOLUS

sulfadimethoxine 15 g
- ALBON 15 g BOLUS

sulfamethazine 8.02 g
- SUSTAIN III SUSTAINED RELEASE CALF BOLUS
- SUSTAIN III SUSTAINED RELEASE CALF BOLUS

sulfamethazine 32.1 g
- SUPRA SULFA III BOLUS
- SUSTAIN III SUSTAINED RELEASE BOLUS
- SUSTAIN III SUSTAINED RELEASE BOLUS (72 HOURS)

ORAL – DRENCH

AMINOGLYCOSIDES
spectinomycin 50 mg/mL
- LIQUID SPECTOGARD SCOUR-CHEK

TOPICAL - OPHTHALMIC

TETRACYCLINES
oxytetracycline hydrochloride
- TERRAMYCIN OPHTHALMIC OINTMENT

INTRAMAMMARY

CEPHALOSPORINS
cephapirin sodium 200 mg
- TODAY LACTATING COWS

cephapirin benzathine 300 mg
- TOMORROW DRY COW

PENICILLINS
penicillin G procaine 200,000 Units
- ALBADRY PLUS SUSPENSION DRY COW

penicillin G procaine 100,000 Units
- HANFORD'S US VET GO-DRY
- HANFORD'S US VET MASTI-CLEAR

California Department of Food and Agriculture, Revised 12/2017