

Animal Agriculture Updates and Impacts June 2018

STATE OF THE SCHOOL ADDRESS 2018

In his annual State of the School address, Dean Michael Lairmore congratulated the school's community for achieving the top spot among veterinary schools in the world by QS World University Rankings for the fourth year running. He credits that honor to the school's ability to attract the best and brightest students, and a community of faculty and staff dedicated to compassionate care, clinical innovation, and ground-breaking research.

The Class of 2022, a group of 150 with 48 percent from underrepresented minority groups, will begin in August. The school's \$85 million high-impact transdisciplinary research budget funds a research enterprise larger than any other veterinary schools by more than \$30 million. The veterinary hospital provided outstanding patient care with the most advanced clinical techniques to more than 50,000 patients. Over the past year, success stories include a complete hip replacement



on a champion show dog, a laceration repair surgery that saved a horse's athletic career, identifying genetic causes of glaucoma in cocker spaniels, and the development of immunotherapy in dogs that will lead to human clinical trials.

School stories made national and international headlines. One of the highlights was Dr. Jamie Peyton's innovative use of tilapia fish skin to treat burn wounds of two bears and a mountain lion that were injured in the California wildfires in the fall of 2017. Her expertise was called upon recently to assist a seriously burned pony in the U.K.

Dean Lairmore highlighted other activities and accomplishments during the past academic year including:

- Election of Drs. Patricia Conrad, Jonna Mazet, and Stephen McSorley to the American Association for the Advancement of Science.
- Dr. John Madigan recognized with a special Congressional certificate for his help in saving animals in the aftermath of fires in Napa and Sonoma counties
- Launch of the Global Virome Project—a 10-year effort to identify most viruses with potential to cause disease in humans
- Reducing pandemic risk globally through PREDICT training of more than 4,000 professionals world-wide
- Establishing the Planetary Health Center of Expertise through the UC Global Health Institute with Dr. Woutrina Smith serving as co-director
- Extending leadership in clinical education with new fellowships in nephrology and extracorporeal therapies
- Public launch of the Veterinary Medical Center Campaign in the fall of 2017
- Philanthropic gifts totaling more than \$35 million since July of 2017

The full presentation can be viewed at: <u>www.vetmed.ucdavis.edu/local_resources/pdfs/State-of-School-Address-</u> 2018.pdf

CADMS BECOMES AN FAO REFERENCE CENTER FOR VETERINARY EPIDEMIOLOGY

The Center for Animal Disease Modeling and Surveillance (CADMS) led by Dr. Beatriz Martínez López was formally recognized by the Food and Agriculture Organization (FAO) of the United Nations as an FAO Reference Center for



Veterinary Epidemiology in May 2018. As a designated FAO Reference Center, CADMS will continue to provide independent technical/scientific advice on notable issues of relevance to FAO and join in the large range of scientific, technical and economic expertise upon which FAO draws for collaboration. CADMS will inform FAO of changes in epidemiologic situations of animal diseases and to any risks that are identified to be associated with animal diseases using state-of-the-art risk mapping technologies such as those developed within the Disease BioPortal (http://bioportal.ucdavis.edu). Center team members will support risk assessment research and training activities and provide advice on appropriate disease surveillance methods, as well as

contribute to support capacity building programs in FAO member developing countries.

"Recognition of CADMS and our team as an FAO Reference Center is both gratifying and significant to our mission," said Director Martínez López. "As an FAO Center, our team will make even greater impacts on global health, expand our animal health training and capacity building activities and provide collaborators with essential information to inform disease control strategies."



FEEDING WASTE MILK TO CALVES: REDUCING ANTIMICROBIAL RESISTANCE

An undesired consequence of the use of antimicrobial drugs in cattle is the presence of drug residues and/or metabolites in feces and urine, or in the milk of lactating animals. To avoid discarding this valuable product, many dairies feed waste milk to pre-weaned calves. A collaborative project was conducted with Richard Pereira, Paolo Tempini and Sharif Aly, at the School of Veterinary Medicine and Betsey Karle, from UC Cooperative Extension to study the drug residues present in waste milk fed to dairy calves, while also collecting herd management data that could provide information to better understand the current scenario and direct future research efforts.



A total of 25 dairies were sampled, of which 15 had drug residues above the limit of detection in the waste milk sampled. The most common drug residues detected were in the cephalosporin class, namely ceftiofur and cephapirin. Ceftiofur is present commercially in intramammary treatments (e.g. Spectramast LC, Spectramast DC), as well as in injectable drugs (e.g. Excenel, Excede, and Naxcel). Most injectable ceftiofur drugs, if used at the dose indicated in the label, do not result in drug residues in the milk above the tolerance level established by the Food and Drug Administration (FDA). Based on answers from our questionnaire, ceftiofur was the most common drug used to treat mastitis, reproductive diseases, pneumonia, and lameness that warranted systemic antimicrobial treatment. Cephapirin is also a drug that can be found in drugs used commercially for treatment of cows with mastitis. Mastitis treatment is the most common use of antibiotics on dairy farms; therefore it is not surprising that most drug residues in waste milk are probably a consequence of treating cows with mastitis. This finding highlights even further the importance of management efforts to reduce the cases of mastitis in the herd, including proper milking procedures, having mechanisms for identification and accurate treatment of cows with mastitis, and reducing environmental challenges such as proper bedding and overall practices that result in cleaner udders.

Future research by the team will evaluate interventions that could reduce unwanted consequences of feeding waste milk, such as increasing resistance of disease causing bacteria. Currently, there is very limited information on how pasteurization and/or other procedures may break down drug residues present in waste milk, extinguishing their unwanted properties.

UC DAVIS PARTICIPATES IN SIMULATION EXERCISE FOR FOOT-AND-MOUTH DISEASE (FMD)

The 2001 FMD outbreak in the UK led to the culling of more than six million sheep, cattle and pigs, and the loss of billions in British pounds. To prevent a similar situation from happening in this country, the U.S. Department of Agriculture (USDA) in conjunction with several state departments of agriculture and the National Animal Health Laboratory Network (NAHLN) led a 3-day FMD simulation exercise in May to advance the nation's capability to respond to a FMD emergency. As a critical partner with the California Department of Food and Agriculture in protecting animal and human health in the state, the California Animal Health and Food Safety Laboratory System (CAHFS) played a crucial role in this exercise.



The simulation exercise objectives were to:

- Demonstrate effective communication among the federal, state, local, and industry entities, and among federal and state emergency operations centers;
- Define the critical information requirements and prioritization strategies to support requests for and manage scarce or critical resources;
- Refine policies and procedures for engaging/requesting support during an FMD response;
- Demonstrate procedures for the integration of state and federal information management systems;
- Validate FMD response plans; and
- Identify gaps in available resources and policies that would be needed to effectively respond to an FMD outbreak.

The complete training comprised a 3-day functional exercise for six states (California, Colorado, Montana, Minnesota, South Dakota and Wisconsin) and a table-top exercise of shorter duration for six additional states (Iowa, Kentucky, Michigan, Nebraska, Oklahoma, and Texas). While FMD doesn't pose a human health threat, it is highly infectious and can be spread through contact with contaminated farming equipment, vehicles, clothing, feed and by domestic and wild predators. Its containment demands considerable efforts in vaccination, strict monitoring, trade restrictions, quarantines and the culling of animals.

If and when suspected cases of various animal diseases are identified, samples can be sent to any of the four CAHFS facilities in the state (Davis, Turlock, Tulare, and San Bernardino). Early detection, rapid response and vaccination would play a major part in helping to minimize the impacts of an outbreak to the California economy and all impacted livestock industries.

One of the biggest concerns is the potential impact of an FMD outbreak on the dairy industry. The state is now the 5th largest agricultural economy in the world, with a dairy industry valued at approximately seven billion dollars annually. A delay in the detection of an FMD outbreak could cost up to \$565 million per hour.

"Our long-standing partnership with CDFA enables CAHFS to provide routine diagnostic support and service to the commercial livestock industries in California," said Pam Hullinger, CAHFS Director. "This relationship with industry is key to establishing the surveillance that enables early detection and a rapid response by CDFA."

THIS SCARY NEW REPORT SHOWS HOW UNPREPARED WE ARE TO FIGHT TICK- AND MOSQUITO-BORNE DISEASES

The Centers for Disease Control and Prevention (CDC) reported recently that cases of vector-borne diseases tripled from 2004 to 2016. And over that time period, as global travel has increased, eight new diseases have emerged here, including Zika and chikungunya. Although some of the spike is probably due to increased disease surveillance, the threat, the report's authors note, is becoming increasingly urgent—even as funding to fight vector-borne diseases remains dangerously inadequate. According to the report, four-fifths of control agencies lack critical prevention and control capacities.

William K. Reisen, an emeritus medical entomology professor in the school, points out that because insect control efforts are often funded by property taxes, sparsely populated areas are particularly hard hit.

Chris Barker, an epidemiologist in the school, who directs the Pacific Southwest Regional Center of Excellence in Vector-Borne Diseases, indicates that funding ebbs and flows with outbreaks. When West Nile first hit the U.S. in 1999 there was an influx of support, but it dried up after a few years. When West Nile cases spiked again in 2012 a lot of the places that had the highest number of cases had let their programs erode because there hadn't been an outbreak for a while. West Nile hospitalizations have cost nearly \$800 million since 1999. The budget for the CDC's vector-borne disease division is less than \$50 million.



In 2016, Congress authorized the CDC to use an additional \$350 million to fight the mosquito-borne Zika virus—the agency used some of that money the following year to launch five new research centers to study vector-borne diseases. Congress also established the Tick-Borne Disease Working Group in 2017. Yet in 2018, the budget for CDC's Division of Vector-Borne Diseases is less than \$50 million, with \$10.6 million of that dedicated to Lyme disease.

That's a paltry sum, points out Maria Gomes-Solecki, a University of Tennessee immunologist who has worked on a Lyme vaccine, for a disease with an estimated 300,000 cases a year. By comparison, she notes, in 2017 the CDC spent \$789 million on HIV, of which there were less than 40,000 new diagnoses. The contrast is even starker at NIH, whose estimated 2018 budget allocates \$2.5 billion for HIV and just \$22 million to Lyme. Kirby Stafford, Connecticut's chief entomologist and Barker's institutional counterpart in the Northeast, reports that funding for Lyme disease and other tick-borne diseases has lagged for years compared to other diseases, given the number of people impacted.

Congress' working group is expected to issue its first report in December, which will inform future spending decisions. "Ultimately, progress will depend on the support of our legislators and Congressional appropriations," Stafford says. "These diseases are prone to cycles and the expertise needs to remain in between the outbreaks."

FIGHTING THE SPREAD OF INFECTIONS AT DAIRIES

Rob Atwill, Director of the Western Institute of Food Safety and Security (WIFSS) and Professor of Medical Ecology and Epidemiology, recently presented on Preventative Interventions to Reduce Dairy Worker Infection as part of a series of monthly seminars hosted by the Western Center for Agricultural Health and Safety (WCAHS).

Atwill addressed a combination of veterinary and medical school students and faculty, as well as industry professionals, on the potential risks and remedies associated with Cryptosporidium on dairies.

Cryptosporidium parvum is a parasite commonly found in the feces of young dairy calves and other mammalian species like rodents. While it typically causes symptoms such as diarrhea and dehydration in more severe cases, it is also zoonotic, meaning it can infect humans. Atwill's talk detailed the methods of transmission, best practices for preventing infection in cattle and humans, and the health risks associated with Cryptosporidium for both dairy producers and their workers.



Atwill's seminar was part of a larger ongoing research project that focuses on dairy worker heath. The project, titled "Reducing Occupational Exposure to Zoonotic Pathogens in California Dairy Farm Workers" is being led by a PhD student and laboratory manager of the Atwill Water and Foodborne Zoonotic Disease Laboratory, Jennifer Chase. This four-year project aims to fill the gaps in occupational health and safety for zoonotic disease in California dairy farms, by quantifying microbial risk and evaluating worker behavior and employer controls.

Cryptosporidium isn't the only pathogen under study. The project plans on quantifying four more significant pathogens: Campylobacter spp., Escherichia coli O157, Listeria monocytogenes, and Salmonella. These pathogens are known causative agents of foodborne outbreaks in human and can be endemic in dairy cattle populations. Chase also plans on surveying the specific roles and responsibilities of dairy workers, to estimate the frequency of contact and areas of interaction with cattle that may be infected with zoonotic pathogens.



"We will be quantifying their contact patterns," Chase, notes. "From there, based on the level of pathogen concentration in the cattle, we can identify job categories or specific behaviors that pose the highest risk for zoonotic infection."

The last year of the study aims to use the results to create outreach materials in the form of voluntary training manuals and recommendations that dairy producers can incorporate into their onfarm safety programs. Awareness of these zoonotic pathogens has the potential to reduce negative health impacts resulting from exposure.

The results of this study could help create a safer dairy environment with less sick days being used by a healthier, more efficient workforce. In turn these positive effects would be systemic, creating an overall awareness for science-based practices that would put both dairy producers and consumers at ease.

The multidisciplinary approach to this study involves researchers from the UC Davis Veterinary Medicine Extension, WCAHS, as well as WIFSS.

HOW SALAD BECAME A MAJOR SOURCE OF FOOD POISONING IN THE US

Since March, the countrywide romaine E. coli outbreak grew into the largest multi-state E. coli scare since 2006. As of May 15th, 172 people in 32 states have fallen ill, including one person who died in California. Of these cases, 75 have been hospitalized, including 20 who developed kidney failure.



Although officials at the CDC have said that the greens from the Yuma growing region — the source of this outbreak — are no longer being sold and past their shelf life of 21 days, consumers should probably be a little wary of lettuce all the time. As sales of precut and bagged greens have boomed, one thing is becoming increasingly clear: They're now one of the most common sources of food poisoning in the US.

The map shows the people infected with the outbreak of E. coli-contaminated lettuce, by state of residence, as of May 15. CDC

According to a 2015 estimate from the CDC, nearly half of all food-borne illnesses (48 million/year) are caused by produce. Meanwhile, dairy and eggs cause 20 percent, meat and poultry are the culprits in only 22 percent of cases, and fish and shellfish just 6 percent.



Michele Jay-Russell, a food safety researcher at the school who has investigated salad-related poisoning outbreaks in the past, said the raw vegetables that are the most common culprits are basically all salad greens, but especially the chopped and bagged kind.

People are simply eating more fresh produce these days than they did just a few years ago, and we tend to eat most produce raw. That means "there's no kill step for the consumer to cook off the bacteria that might be lurking in our food," said Jay-Russell.

While there are extensive procedures to

prevent this kind of food poisoning from happening, and regulations on farms have gotten stricter, some contamination can still slip through. Some of the processes farms have in place to clean salads actually trap bacteria in the plants, making them impossible to wash away. But contamination can happen "all along the spectrum of growing plants," Jay-Russell added. "There can be animal intrusions or inputs like contaminated water sources that bring the bacteria into the field."

There are also types of bacteria that you simply can't wash off, or the contamination happens in places you typically don't splash with water, like inside the core of a lettuce head. Americans' love of convenience for mass-produced chopped, bagged lettuce amplifies the risk of poisoning. Instead of shipping heads of lettuce or large carrot sticks that people wash, we chop them and mix them up in processing, then package them in plastic bags. In that process the bacteria has a chance to grow, which makes a lot of people get sick.

UC DAVIS STUDY EXAMINING WILDFIRE EFFECT ON CHICKEN EGGS

Researchers at UC Davis are now asking if eggs from backyard chickens could be contaminated after the devastating wildfires in Northern California last year. At this point, it's unknown what the effects of potentially contaminated eggs can have on human consumption. Maurice Pitesky, UC Cooperative Extension poultry specialist at the school, and lead researcher of the study, is concerned about the vaporization of plastic and all those chemicals in people's

garages that can become ash and then end up in the environment. "Chickens spend a lot of time pecking off the ground," Pitesky says.



So far, Pitesky and his team have collected eggs from about 200 locations across the state, where wildfires hit last year. A toxicologist will then sample the eggs by testing the yolk for chemicals, particularly heavy metals and fire retardants. Pitesky is also trying to study how long these chemicals can live inside the eggs, and whether the amount dissipates over time.

To find out if harmful substances on the ground that are eaten by hens get passed along in the eggs they lay, Pitesky, is providing free egg testing. "We're trying to understand the connection between the environment that backyard poultry are raised in and the eggs

they are producing," Pitesky said.

Pitesky's colleague veterinary toxicologist Birgit Puschner is testing eggs for different types of contaminants, depending on the county the eggs are from. Eggs from counties recently affected by wildfires will be tested for chemicals, building materials and heavy metals that may have been carried in the smoke and ash. Pitesky and Puschner are also looking for lead and PCBs in eggs from certain regions of the state.

The individual egg test results will be shared with each poultry owner. At the end of the study, all of the results will be summarized and made available to the general public.

CAHFS NEW BROCHURE

In this new California Animal Health and Food Safety Laboratory System (CAHFS) brochure, the cutting edge diagnostics brought to animal agriculture to protect animal health, human health and the economy are outlined. The new laboratory facility in Tulare demonstrates the lab's commitment to the heart of California agriculture in the Central Valley; an investment in the future of one of the most productive agricultural regions in the world.

The new brochure can be viewed at: www.vetmed.ucdavis.edu/cahfs/news_disease_info/cahfs-report.cfm

VIRULENT NEWCASTLE DISEASE IN CALIFORNIA



Leading diagnostics nationally, protecting California locally

Following the initial detection of virulent Newcastle disease (vND) through a routine submission to the CAHFS which was confirmed by the U.S. Department of Agriculture (USDA) on May 16, 2018, CAHFS continues working with the California Department of Food and Agriculture (CDFA), USDA and poultry owners to contain and eradicate this foreign



animal disease. As of May 25, 2018, cases have been confirmed on six premises in Los Angeles and San Bernardino counties.

Virulent Newcastle disease is a very contagious and often fatal disease of many avian species. Infected birds might show a variety of clinical signs including sudden death, respiratory signs such as sneezing and nasal discharge, depression, paralysis and diarrhea. Biosecurity remains the key step to prevent spread of this disease. This includes washing hands and scrubbing boots before and after entering a poultry area, cleaning and disinfecting tires and equipment

before moving them on or off the property, and isolating any birds returning from shows for 30 days before placing them with the rest of the flock. In addition to practicing good biosecurity, all bird owners should report sick birds or unusual bird deaths through California's Sick Bird Hotline, 866-922-BIRD (2473).

CAHFS offers diagnostic services for all avian species. Oropharyngeal swabs and/or sick/dead birds are the preferred samples for diagnosis of Newcastle disease. The CAHFS San Bernardino lab is the closest to the current outbreak location, but the Davis, Turlock and Tulare labs are all receiving samples and carcasses for testing.

PLANNING THE FUTURE OF GLOBAL FOOD SAFETY RESEARCH

Universities from around the world came together on April 5th this year in Wageningen, Netherlands to plot a course for food safety at the "2018 Global One Health Research, The Future" international symposium. Western Institute for Food Safety and Security (WIFSS) faculty researchers joined other UC Davis faculty in a consortium of prestigious institutions including Wageningen University, China's Nanjing Agricultural University, and New Zealand's Massey University with the goal of confronting food safety issues in an increasingly globalized world. Taking a One Health approach, this conference explored innovations being made to improve the future health of humans, animals, and the environment. It also stressed the importance of cooperation between researchers, industry, and various stakeholders worldwide.

Dr. Bennie Osburn sees WIFSS as a driving force behind this collaborative interest in food safety, saying, "Now that more and more food travels all over the world, this consortium is a way to focus on research and education to build a workforce that will take on this holistic approach to food safety."

Taking an all-inclusive One Health perspective, the conference covered a wide variety of topics ranging from plant health to climate change. Dr. Rob Atwill, Director of WIFSS, was a keynote speaker and delivered a lecture entitled, "Climate



perturbations on the risk of microbial contamination of fresh produce in the western US agricultural system." Osburn also gave a talk on global one health research and education.

Professionals from diverse schools of knowledge presented their research and shared ideas and innovations on food safety and One Health. Further representing UC Davis, PhD graduate student in the soils and biogeochemistry program, Rachel Danielson, presented her research on microbes and pasture-converted Amazon soils, and PhD graduate student, Dr. Kyuyoung Lee, spoke about the wild-domestic-human interface of Influenza viruses. Nanjing Agricultural University graduate student, currently participating in the 3+X One Health program at UC Davis, Yitong Huang, also contributed insights on African swine fever.

The myriad of lectures ended with a lively discussion during which participants were able to exchange opinions and plan strategies to address these global health issues. The successful conference ended with a clear message: *the only way to ensure safe food on a global scale is to approach it with a global perspective*.

The next steps suggested by WIFSS are to establish small working groups that will address three pertinent topics:

- Infectious disease
- Food safety, quality, nutrition, sustainability
- Environment and society

The next conference is being planned to be held at Massey University in New Zealand.

ONE HEALTH CURRICULUM PROVIDES POWERFUL MODEL

Davis Warriors was the name of the team. They were one of four collaborative student learning groups at the WIFSS student conference on One Health for food safety and security. Seven teammates worked together on a learning activity called, "Good Guys vs. Bad Bugs," in which they explored the importance of sanitary practices on a dairy farm to protect animals from the disease-causing bacteria *E. coli*. In the activity, half of the team represented the dairy manager and staff, referred to as the "good guys," and the other half of the team represented the *E.coli*, also known as the "bad bugs."



The bad bugs on the team were to identify ways *E. coli* can enter a dairy farm and cause mastitis in the dairy cattle. The good guys were to identify biosecurity measures that should be implemented on the dairy farm at critical points to protect the dairy cows from the harmful bacteria. A lively exchange between the bad bugs and the good guys ensued during the 15 minute presentation.

The Good Guys vs. Bad Bugs learning exercise was part of the 3-week NAU-UC Davis Education Conference on One Health for Food Safety and Security, held at UC Davis, January 22 – February 9, 2018. Twenty-nine undergraduate students from Nanjing Agricultural University (NAU) attended the conference sponsored by NAU, and hosted by WIFSS.



VETERINARY MEDICAL TEACHING AND RESEARCH CENTER (VMTRC) - High School Career Days and Internship

For students contemplating college, VMTRC post-graduate residents participate in high school career days. An annual high school internship program with the center's Milk Quality Lab and Clinical Program provides students the opportunity to work in the laboratory, which processes more than 50,000 samples each year, and learn basic skills. For students that are specifically interested in becoming a veterinarian, they have the opportunity to observe clinical veterinary services provided on-farm to local dairy herds with the Dairy Production Medicine Clinicians. The internship has been very successful with several of the students going on to veterinary school and becoming practicing veterinarians.

INTERNATIONAL IMPACTS: FISH-SKIN DRESSINGS USED ON ACID-ATTACK PONY IN PIONEERING SURGERY



A pony which was left with extensive facial burns in a suspected acid attack has undergone pioneering surgery at a Yorkshire horse hospital. The eightmonth-old cob filly, which has been named Cinders, was found dumped in Clowne, Derbyshire, Now, in a world first on a horse, vets have applied dressings made from the skin of tilapia fish to the wounds.

Tilapia dressings were first used on human patients last year by doctors in Brazil looking for cost-effective methods of treating burns. Veterinary emergency and critical care specialist Jamie Peyton, a faculty member at the school, has adapted the process for animals. The UK case veterinarian contacted Peyton about the technique and she ended up flying to the UK to take part in the pioneering surgery.

Peyton and her veterinary nurse Krisie Vine, with the support of the UC Davis Veterinary Medical Teaching Hospital, took the tilapia dressings with them. Once Cinders was anesthetized, her previous dressings were removed and cold laser therapy and focused pulsed electromagnetic field therapy was applied to decrease pain and inflammation, kill bacteria and improve blood flow. The entire surgery took approximately three hours. Cinders recovered from anesthesia within 30 minutes and was back in her stable eating within an hour.

FACULTY PUBLICATIONS

AN ADVECTION-DEPOSITION-SURVIVAL MODEL TO ASSESS THE RISK OF INTRODUCTION OF VECTOR-BORNE DISEASES THROUGH THE WIND: APPLICATION TO BLUETONGUE OUTBREAKS IN SPAIN. Fernández-Carrión E¹, Ivorra B², Ramos ÁM², Martínez-López B³, Aguilar-Vega C¹, Sánchez-Vizcaíno JM¹. https://www.ncbi.nlm.nih.gov/pubmed/29566088

MOTION-BASED VIDEO MONITORING FOR EARLY DETECTION OF LIVESTOCK DISEASES: THE CASE OF AFRICAN SWINE FEVER.

Fernández-Carrión E¹, Martínez-Avilés M¹, Ivorra B², Martínez-López B³, Ramos ÁM², Sánchez-Vizcaíno JM¹. https://www.ncbi.nlm.nih.gov/pubmed/28877181

ADENOVIRAL HEMORRHAGIC DISEASE IN CALIFORNIA MULE DEER, 1990–2014

L. Woods, B. Schumaker, P. Pesavento, B. Crossley, P. Swift <u>https://ucdavis.pure.elsevier.com/en/publications/adenoviral-hemorrhagic-disease-in-california-mule-deer-19902014</u>

AUTOMATION AND APPLICATIONS OF THE TOLERANCE LIMIT METHOD IN ESTIMATING MEAT WITHDRAWAL PERIODS FOR VETERINARY DRUGS

O. Udiani, S. Mason, G. Smith, D. Mzyk, R. Gehring, L. Tell, J. E. Riviere, R. E. Baynes <u>https://ucdavis.pure.elsevier.com/en/publications/automation-and-applications-of-the-tolerance-limit-method-in-esti</u>

BIOSECURITY ASSESSMENT AND SEROPREVALENCE OF RESPIRATORY DISEASES IN BACKYARD POULTRY FLOCKS LOCATED CLOSE TO AND FAR FROM COMMERCIAL PREMISES

T. Derksen, R. Lampron, R. Hauck, M. Pitesky, R. A. Gallardo <u>https://ucdavis.pure.elsevier.com/en/publications/biosecurity-assessment-and-seroprevalence-of-respiratory-diseases</u>