

COMMITTEE ON ONE HEALTH

Co-chair: Liz Wagstrom, IA

Co-chair: Joni Scheffel, MN

Gary Anderson, KS; Chris Ashworth, AR; Kay Backues, OK; Sarah Bailey, ND; Deanna Baldwin, MD; Erin Beasley, NC; Karen Beck, NC; Peter Belinsky, RI; Yvonne Bellay, WI; Scott Bender, AZ; Van Brass, AZ; Richard Breitmeyer, CA; Paul Brennan, IN; Susan Bright-Ponte, MD; Charles Brown, WI; Roselle Busch, CA; Maria Cooper, IN; Michael Costin, IL; Stephen Crawford, NH; Tarrie Crnic, KS; Ignacio dela Cruz, MP; Thomas DeLiberto, CO; Barbara Determan, IA; Leah Dorman, OH; Brandon Doss, AR; Stéphanie-Anne Dulièpre, NY; Tracy DuVernoy, MD; Anita Edmondson, CA; Brigid Elchos, MS; François Elvinger, NY; Jessica Emerson, FL; William Fales, IA; John Fischer, GA; Allison Flinn, DC; Katie Flynn, CA; Patricia Foley, IA; Larry Forgey, MO; Heather Fowler, IA; Tony Frazier, AL; Tam Garland, TX; Robert Gerlach, AK; Eric Gingerich, IN; K. Fred Gingrich II, OH; Gail Golab, IL; Alicia Gorczyca-Southerland, OK; Michael Greenlee, WA; Keith Haffer, SD; Rod Hall, OK; Steven Halstead, MI; Karyn Havas, NY; Bill Hawks, DC; Kate Hayes, AL; Fidelis Hegngi, MD; Julie Helm, SC; Janemarie Hennebelle, GA; Warren Hess, IL; Heather Hirst, DE; Donald Hoenig, ME; Kristin Holt, GA; Jarra Jagne, NY; Eric Jensen, AL; Annette Jones, CA; Brian Joseph, WA; Melissa Justice, IN; Anne Justice-Allen, AZ; Subhashinie Kariyawasam, PA; Donna Kelly, PA; Patrice Klein, DC; Michael Kopp, IN; Charlotte Krugler, SC; Todd Landt, IA; Dale Lauer, MN; Elizabeth Lautner, IA; Brad LeaMaster, OR; Jonathan Lebovitz, MD; Molly Jean Lee, IA; Donald Lein, NY; Rick Linscott, ME; Mary Jane Lis, CT; Lindsey Long, WI; Karen Lopez, DE; Margie Lyness, GA; Joanne Maki, GA; David Marshall, NC; Scott Marshall, RI; Beatriz Martinez Lopez, CA; James Maxwell, WV; Patrick McDonough, NY; Shirley McKenzie, NC; Caitlin McKenzie, WI; Katherine McNamara, VT; Scott McVey, KS; David Meeker, VA; Shelley Mehlenbacher, VT; Gay Miller, IL; Eric Mohlman, NE; Susan Moore, KS; Brenda Morningstar-Shaw, IA; Lee Myers, GA; Cheryl Nelson, KY; Dustin Oedekoven, SD; Skip Oertli, TX; Steve Olson, MN; Kenneth Olson, IL; Kristy Pabilonia, CO; Roger Parker, TX; Elizabeth Parker, TX; Steve Parker, GA; Boyd Parr, SC; Elisabeth Patton, WI; Kristin Patton, KS; Janet Payeur, IA; Allison Phibbs, DC; William Pittenger, MO; Dave Pyburn, IA; Lisa Quiroz, CA; Valerie Ragan, VA; Shelley Rankin, PA; G. Donald Ritter, DE; Susan Rollo, TX; Jane Rooney, MD; Mark Ruder, GA; Margaret Rush, MD; Sherri Russell, MO; Larry Samples, PA; John Sanders, WV; Yuko Sato, IA; Travis Schaal, IA; Joni Scheffel, MN; David Schmitt, IA; Krysten Schuler, NY; Stacey Schwabenlander, MN; Sheikh Selim, CA; Michael Short, FL; Richard Sibbel, IA; Tom Sidwa, TX; Kathryn Simmons, DC; Shri Singh, KY; Allison Siu, AL; David Smith, NY; Susan Stehman, PA; Patricia Stonger Lonsdale, WI; Kelly Straka, MI; Nick Striegel, CO; Tahnee Szymanski, MT; Manoel Tamassia, NJ; Todd Tedrow, SD; Jane Teichner, FL; Belinda Thompson, NY; Beth Thompson, MN; Alberto Torres, AR; Alex Turner, CO; Shauna Voss, MN; Bruce Wagner, CO; Liz Wagstrom, DC; Michele Walsh, ME; Doug Waltman, GA; Emily Walz, MN; Courtney Wheeler, MN; Patricia White, CA; Ben Wileman, MN; Michelle Willette, MN; Sharon Williams, AR; Ross Wilson, TX; Dennis Wilson, CA; Nora Wineland, MI; Melissa Yates, MD; Alan Young, SD; Muhammad Usman Zaheer, CO; Marty Zaluski, MT; Bereket Zekarias, KS; Ernest Zirkle, NJ.

The Committee met on October 30 at the Rhode Island Convention Center in Providence, Rhode Island, from 8:00 am to 12:00 pm. There were 65 members. A 2018 funding resolution was reviewed and it was noted that there was no response to that resolution.

Presentations & Reports

Dr. Melissa Rojas-Downing:

Global demand for livestock products is expected to double by 2050, mainly due to improvement in the worldwide standard of living. Meanwhile, climate change is a threat to livestock production because of the impact on quality of feed crop and forage, water availability, animal and milk production, livestock diseases, animal reproduction, and biodiversity. This presentation reviewed the global impacts of climate change on livestock production, the contribution of livestock production to climate change, and specific climate change adaptation and mitigation strategies in the livestock sector.

Dr. Jenna Bjork:

Ticks and mosquitoes aren't just annoying pests. They can also spread disease, to both humans and animals. Vectorborne diseases are becoming more and more of a threat throughout the world due to factors such as land use changes, globalization, human migration, and climate change. Since these vectors are highly susceptible to environmental conditions, like temperature and humidity, disease risk is often focal and varies significantly across time and space. While it is difficult to accurately predict when and where vectorborne disease risk will occur in the future, lessons may be learned from many of the endemic and emerging vectorborne diseases we're dealing with today.

Dr. Sherri Kasper:

Dr. Kasper discussed Harmful Algal Blooms (HABs), which are caused by phytoplankton found in both freshwater and marine waters. Phytoplankton, including cyanobacteria, diatoms, and dinoflagellates, are natural to our environment, but in large numbers they can cause illness and death in all animals that come in contact with them. In her presentation, Dr. Kasper covered the many factors associated with climate change that may affect the types and frequency of HABs.

Dr. Kevin Harriger:

Climate (weather, temperature, wind patterns, severe events, etc.) has always played a pivotal role with insect and disease populations, including survival and spread. Although the direct impact of climatic variations on spread and/or transmission of insect/disease populations may be hard to quantify, it is widely believed to be a contributing factor. Several examples were provided that illustrated the impacts of changes in distribution of insects and diseases, some endemic and some invasive, that are attributed to climatic flux.

Dr. Gericke Cook:

Veterinary Services monitors four major areas for indicators of emerging animal disease: new pathogens, new pathways, new geographic distributions, and unusual epidemiology. Changes in climate patterns affect disease emergence across all four areas. Drs. Gericke Cook and Dana Cole presented examples of climate effects on patterns of disease emergence and the importance of these diseases to the U.S.

Committee Business:

The following resolution that originated in the Rabies Subcommittee was discussed and passed on to the Resolutions Committee: The United States Animal Health Association requests the 120th Congress to appropriate a minimum of \$33 million for the United States Department of Agriculture, Animal Plant Inspection Service, Wildlife Services, National Rabies Management Program.

Reports from the Rabies, Pharmaceutical Issues and *Salmonella* Subcommittees were given orally by the subcommittee chairs and a written report was received as information.

OTHER NOTES:**Subcommittees:**

- **Rabies – Tarrie Crnic, KS and Skip Oertli, TX**
- **Pharmaceutical Issues – Steve Crawford, NH and Heather Fowler, IA**
- ***Salmonella* – Donna Kelly, PA and Shelly Rankin, PA**

Subcommittee reports:**REPORT OF THE SUBCOMMITTEE ON RABIES**

Chair: Tarrie Crnic, KS

Vice Chair: Ernest Oertli, TX

No committee roster required on subcommittee reports!

The Subcommittee met on Tuesday, October 29, 2019 at the Rhode Island Convention Center in Providence, Rhode Island, from 8:00 AM to 12:00 PM EST. There were 24 members and 7 guests

present. The chair reviewed the subcommittee mission statement and the status of the 2018 resolution approved by the committee in Kansas City, Missouri. The resolution is still in pending status with no action over the last year. The chair reminded attendees that only approved members could vote, but everyone was welcome to participate in discussion and ask questions. After opening remarks were completed, the first presenter of the day was introduced.

Presentations & Reports

Vampire Bats: Preparing for Range Expansion into the US

Michael J. Bodenchuk

State Director

Texas Cooperative Wildlife Services Program

The common vampire bat (*Desmodus rotundus*) are apparently expanding their range northwards in Mexico and appear poised to enter the US. Climate models predict suitable habitat in the US in South Texas and parts of Southern Arizona. While range expansion isn't unexpected, vampire bats host a specific strain of rabies which impacts livestock and people. Annual economic damages have been modeled between \$7M and \$9M and are largely associated with rabies deaths of livestock. Post-exposure prophylaxis is estimated to cost between \$135,000 and \$173,000 annually. To prepare for the emerging rabies issue, the Cooperative Texas Wildlife Services program has begun training employees to recognize symptoms and respond to bat presence, initiated surveillance of livestock at sale barns and on ranches and has conducted outreach on the issue, via one-on-one training and a DVD handout to landowners along both sides of the border. The DVD has been placed in over 1200 households in the US and Mexico.

Overview of the National Rabies Management Program

Dr. Thomas Deliberto

USDA, APHIS, Wildlife Services

NWRC

The USDA's Wildlife Services (WS), National Rabies Management Program (NRMP) works cooperatively with local, state, and federal partners to manage rabies across large landscapes to prevent the spread and ultimately eliminate specific terrestrial rabies virus variants in carnivores. Wildlife rabies control in the U.S. is primarily achieved through distribution of oral rabies vaccine baits, in combination with enhanced rabies surveillance, population monitoring activities, and applied research. During 2018, approximately 8.9 million vaccine baits were distributed in 16 eastern states to prevent the westward spread of raccoon rabies. In addition, >1 million ORV baits were distributed along the Texas-Mexico border to prevent reemergence of canine rabies variant into the U.S. Current management focus for oral rabies vaccination (ORV) campaigns in the U.S. primarily occur in rural habitats. However, as the NRMP makes a programmatic shift towards the strategic goal of raccoon rabies elimination, it will be critical to address the unique challenges associated with controlling rabies in urban-suburban areas. Rabies management in developed habitats is complex as a result of increased population densities in target species, knowledge gaps in understanding their ecology, patchy distribution, anthropogenic food sources and non-target species bait competition. Lower seroconversion rates and persistence of rabies cases typically are observed in urban-suburban habitats compared to more rural environments. Additionally, it is more difficult logistically to adequately distribute vaccine baits in urban areas and typically there are more reports of bait contacts from the public.

Approximately 85% of all ORV baits distributed during 2018 were in rural areas by fixed wing aircraft, followed by 8% of baits distributed by helicopter in suburban areas, 6% by ground (vehicle) methods, and 1% by bait stations in urban-suburban environments where aerial operations in fragmented and highly developed habitats is often not feasible. However, refining and improving ORV bait distribution in these strategically important habitats targeting raccoon (*Procyon lotor*) and striped skunk (*Mephitis mephitis*) populations is essential for working towards the goal of raccoon rabies elimination in the eastern U.S. Innovative approaches to improve vaccination effectiveness and efficiency in areas traditionally ground baited are required to achieve success. Recent innovations include using Point-of-Interest (POI) GPS spatial technology to refine ground baiting approaches; a comprehensive, multi-year research project

documenting home range, movement and habitat use by raccoons, striped skunks and Virginia opossums (*Didelphis virginiana*) in Burlington, Vermont relative to ORV; and evaluation of bait station methods compared to ground methods. Based on preliminary evaluation of POI data collected from defined ground baited areas during 2017 in New England, Ohio and West Virginia, ground baiting grids were reconfigured for 2018 operations into standard, 1-kilometer squared cells within grid boundaries with a goal to better disperse baits along roadsides more evenly throughout each grid.

Because Pittsburgh, Pennsylvania represents more than 50% of all ground baited areas in current ORV zones and is the largest, most complex city presently baited, grids were reconfigured into standard, 9-kilometer squared cells. Evaluation of bait distribution patterns and evidence of increased bait uptake (based on presence of rabies virus neutralizing antibodies) is underway to assess whether the reconfigured grid designs improved bait coverage overall.

The use of bait stations for distribution of oral rabies vaccine baits in urban-suburban habitats has historically been limited to experimental work conducted in Pinellas County, Florida from 2009-2014 and an innovative but small-scale operational program currently established in Cape Cod, Massachusetts. In order to better evaluate the scale, scope and logistics required to implement a comprehensive operational bait station program in larger urban-suburban landscapes, a bait station study was initiated in October 2018 in Birmingham, Alabama.

The two primary program metrics used to evaluate and monitor wildlife rabies management are serology (i.e., virus neutralizing antibodies as an index to population immunity) and enhanced rabies surveillance (i.e., virus antigen detection; absence of cases as a mark of success). The NRMP collects an average of 5,600 blood sera samples and 7,200 brainstem samples each year. From 2005-2017, >110,000 enhanced rabies surveillance (ERS) samples were collected by USDA WS and cooperators in addition to standard public health surveillance. Approximately 82% of ERS samples were tested using the direct, rapid immunohistochemistry test (DRIT), and >1,600 rabies were confirmed by the DRIT that likely would not otherwise have been detected through public health testing. Beginning in 2015, the NRMP developed a new ERS initiative to better standardize practices and approaches associated with sample collection, and to re-energize and expand the cooperative coalition. The key components of the initiative included development and maintenance of an ERS network of cooperators, sample prioritization, laboratory support and improved data management practices. By establishing and refining a series of best management practices, the NRMP developed a sample categorization system and stratified point values to place emphasis on the highest priority specimens. Samples were classified into the following categories, from highest to lowest priority: 1 = strange-acting; 2=found dead (not road kill); 3=road kill; 4=surveillance trapped; 5=NWCO/other; and 6=unknown. After 2 full years of implementation of the ERS Initiative and associated categorical point system during 2016-2017, the NRMP observed a 25% increase in samples collected overall, and a 30% increase in the proportion of highest priority samples collected relative to all sample categories.

Contingency action risk assessments are initiated after rabies is documented in areas that threaten the integrity of oral rabies vaccination zones. Subsequent management activities may include intensifying and expanding ERS, trap-vaccinate-release, or expanding ORV zones. During 2017 and 2018, the NRMP implemented contingency responses to rabies cases that occurred west of the ORV barrier in Stark (5 miles) and Tuscarawas (17 miles) Counties, OH, respectively. During both contingency actions, the ORV zone was expanded and the experimental use of the oral rabies vaccine ONRAB was assessed in real time emergency response efforts. Also in 2017, a contingency baiting area was established in Wise County, VA in response to rabies cases that were detected 9 miles west of the historic RABORAL V-RG® zone. Contingency ORV zones in both states will be heavily monitored and maintained for a minimum of 3 years.

Applied research has focused on a series of ONRAB field trials conducted from 2011-2017 in 5 states (NY, NH, OH, VT and WV). Formal field trials addressed questions regarding vaccine effectiveness at multiple bait densities, in rural and urban-suburban habitats, and targeting both raccoons and skunks.

A number of the initial field trials were concluded during 2017 and analysis of study results is currently underway for publication. At present, field evaluation of ONRAB continues to further assess trends in vaccine effectiveness relative to various bait distribution strategies and as part of contingency actions.

The NRMP has also worked with several USDA WS state programs to develop a vampire bat surveillance project. Ecological niche modeling suggests that vampire bats may recolonize in south Texas or Florida over the next 10 years or less. Rabies transmitted by vampire bats could pose a considerable rabies risk to livestock in recolonized areas. In TX, AZ, NM and FL, USDA began conducting cattle sales barn, dairy farm and feedlot surveys during 2016 to examine livestock for evidence of vampire bat bites. Additionally, an informational DVD was developed and distributed to ranchers and other livestock owners and cooperating agency officials. Since 2016, >740 cattle surveys have been conducted involving almost 195,000 cattle and >1,000 DVDs have been distributed. No vampire bat bites have been identified to date.

USDA WS has been cooperating with the Puerto Rico Departments of Health and Natural and Environmental Resources since 1999 on rabies issues related to the small Indian mongoose (*Herpestes auropunctatus*). Formal research led by the USDA National Wildlife Research Center (NWRC) has been ongoing since 2011, including basic ecologic studies to evaluate population density and ORV bait flavor preferences. Four oral rabies vaccine placebo bait field trials have been conducted since October 2016. Placebo baits were distributed at 200 baits/km² and 100 baits/km². The NRMP is working with NWRC, the Alabama WS Program, the vaccine manufacturer, and key cooperators in Puerto Rico in pursuit of a live vaccine trial targeted for the spring of 2020.

Several key rabies management accomplishments have been achieved in the U.S. through the implementation of ORV cooperative programs, including declaration of the U.S. as canine rabies free in 2007 (with the last reported case of canine rabies in 2004). Near elimination of the Texas Gray Fox variant of rabies has been achieved, with the last reported case in 2013. There has been no appreciable spread of raccoon rabies to the west of its current extent, and the NRMP has completed broad scale ONRAB field trials in 5 states. Wildlife rabies management programs in the U.S. represent the largest coordinated wildlife disease management program undertaken in North America.

Rabies Detection in Canine Imported from Egypt

Sara McReynolds DVM MPH PhD
Assistant Animal Health Commissioner
Kansas Department of Agriculture, Division of Animal Health

In January of 2019, 26 dogs were imported to Kansas by a licensed shelter from Egypt. All dogs presented with international health certificates and documentation of rabies vaccination. Upon arrival the shelter disbursed the dogs to foster homes in Kansas and Missouri. On February 21, 2019 a three-year-old mixed breed female, that had been imported from Egypt in January, bit a technician at a Missouri veterinary hospital and developed neurological signs. The dog was euthanized and confirmed positive for rabies as Kansas State Veterinary Diagnostic Laboratory. Following the confirmation, all dogs on the shipment and those with known exposure to the rabid dog had to be located for quarantine. In total, 27 dogs were quarantined at a licensed shelter for up to six months. Over 20 people received Rabies Postexposure Prophylaxis (PEP). An investigation was done on the documentation of the international import of the dogs and it concluded that the rabies vaccination certificates and rabies titers were all falsified documents. Titters indicated only 7 of the 26 dogs had previously been vaccinated. According to the CDC regarding the number of dogs imported into the U.S., an estimated 1.06 million dogs are entering the U.S. each year and 107,100 from a country with canine rabies virus variant. The CDC also published the cost of these investigations as it relates to past imported rabid dogs. They estimate the cost per each imported rabid dog is around \$213,000.

Update from Rabies in the Americas

Dr. Joanne Maki
Boehringer-Ingelheim, Athens, GA

Dr. Maki gave a brief update on presentations and hot topics from the Rabies in the Americas (RITA) conference that was concurrently being held in Kansas City, Missouri. Numerous topics were highlighted including bat rabies, bat rabies vaccine developments, wildlife rabies, and epidemiology & surveillance updates.

Panel Discussion: Rabies Education and Outreach

Rabies Education and Outreach in Texas

Tom J. Sidwa, DVM, MPH
State Public Health Veterinarian

Texas is a rabies-endemic state with both terrestrial and bat variants. The Texas Department of State Health Services (DSHS), Zoonosis Control Branch and the Zoonosis Control Programs serving each of the eight DSHS Public Health Regions are tasked with administering the Rabies Control Act. The DSHS partners with local health departments and other stakeholders to mitigate the risk posed to Texans and their animals by rabies. Inherent in the DSHS goal of reducing infectious disease burden is the need to educate the population concerning infectious diseases, including disease avoidance. Many tools and modes of communication are employed by the DSHS to educate people about rabies, an infectious disease with a case fatality rate approaching 100%. This presentation will provide information on the DSHS' educational outreach to heighten awareness of rabies.

Rabies Outreach: 2019 Delaware State Fair

Karen Lopez, DVM, MPH, Dipl. ACVPM
Deputy State Veterinarian
Delaware Department of Agriculture

In 2018, Delaware reported its first confirmed human rabies case since 1941. Subjectively, state agency personnel with regular direct communications with constituents regarding rabies issues also noted deficiencies in the public's knowledge about the risk of rabies. To address this issue, a multi-agency committee including representation from the Delaware Departments of Agriculture, Natural Resources and Environmental Conservation/Division of Fish & Wildlife, Health and Social Services/Division of Public Health and Public Health Laboratory was formed to provide educational outreach. The Delaware State Fair was selected as the outreach venue due to the large number of lay constituents that could be targeted in only a few days, and the dates of the fair, which allowed for adequate time to prepare educational activities and materials.

An exhibition booth was set up for five days (half the duration of the fair) in the Agricultural Commodities building, which houses a variety of displays and demonstrations for the public. The objective of the outreach was to communicate two key messages to constituents: "vaccinate your pets against rabies" and "enjoy wildlife from a distance." The booth was manned 8 hours a day by two agency volunteers per 4-hour shift. Constituents were invited to play two games to win prizes. In the first game, they could spin a colored game wheel to answer an age-appropriate rabies-related question corresponding to the image that they landed on. They could also play a mock rabies test game where an individual would select and read a scenario about a domestic or wild animal, and then secretly be directed to a "positive" or "negative" test by staff depending on whether the animal was likely to test positive or negative for rabies based on the scenario. The mock rabies test consisted of the constituent pipetting vinegar into a test tube prefilled with either a small amount of plain baking soda (negative) or baking soda colored pink with powdered iced tea mix (positive). A variety of rabies awareness-themed prizes printed with contact information for rabies exposure reporting were available for constituents: temporary tattoos; animal silhouette pens; activity books and crayons; fox, brain, and pawprint stress relief squeeze balls. Informational pamphlets were also available. Materials were paid for with funding from the Centers for Disease Control and Prevention's Epidemiology and Laboratory Capacity (ELC) for Prevention and Control of Emerging Infectious Diseases cooperative agreement.

Lessons learned from this outreach project included the following:

- Recruiting additional volunteers would allow staff to be relieved for breaks, especially on very busy shifts during Kids Day at the fair, and potentially run the educational booth for the entire

- 10 days of the fair. Staff also need to be better educated on rabies to handle questions from the public (some volunteers hold non-technical roles within the agencies).
- The colored game wheel was very popular and easy to run, but the mock rabies test game was time-consuming and held up the line of people wanting to visit the booth. The committee plans on replacing the latter with a different simple game next year.
 - The committee would like to explore the ability to project an educational video for constituents visiting the booth.
 - Applying temporary tattoos at the booth assured that parents of tattooed children had to look at the rabies messages for days. Several children requested bat tattoos, which were not one of the available designs, so the committee plans on acquiring some for next year. Stress balls and animal silhouette pens were very popular giveaways. The committee also think that dog toys with rabies messaging printed on them would be popular and effective educational tools.

Members of the public visiting the rabies booth were prone to trying to take giveaways without participating in the educational activities. Persistent volunteers are needed to limit access to prizes to those constituents that receive education while visiting the booth.

Rabies Education in Maine

Don Hoenig, VMD
One Health Veterinary Consulting
Animal Agriculture, Public Health, & Animal Welfare

Dr. Hoenig started with a brief presentation on the history of rabies in Maine. Maine has maintained records on rabies cases since the 1930's. Dr. Hoenig provided a background on the introduction of raccoon variant rabies into Maine and how this affected rabies education efforts. Partnerships between the state agencies for agriculture, public health, and wildlife were formed to increase rabies education and outreach to the public. These partnerships have continued and are essential to the ongoing education efforts.

Rabies Education and Outreach in Minnesota

Joni Scheftel DVM, MPH, DACVPM
State Public Health Veterinarian
Supervisor, Zoonotic Diseases Unit

Reaching the public and other audiences with rabies messaging is universally difficult. Dr. Joni Scheftel presented a variety of Minnesota Department of Health rabies outreach projects and materials. These included their "How to catch a bat" video, "Rabies for Law Enforcement" and other specialized training, and rabies business cards with directions for handling animal bites.

Subcommittee Business:

The business meeting was opened by Dr. Crnic at 9:40 AM EST and the presence of a quorum was established.

One resolution was brought forward for consideration. The resolution considered was a request for the 120th Congress to appropriate a minimum of \$33 million for the United States Department of Agriculture, Animal Plant Health Inspection Service, Wildlife Services, National Rabies Management Program. The committee approved this resolution to be moved forward for consideration by the One Health Committee. An important issue moving forward for the committee includes continued work with USDA, APHIS, Wildlife Services to push forward the rabies free by 2053 effort to eliminate raccoon variant rabies from the east coast. This will involve close collaboration to understand the resource needs for each phase of the project and what assistance the committee can provide to help ensure these needs are met. Another important issue moving forward appears to be the risk of rabies in animals imported into the US from high risk countries.

At the close of the meeting the chair brought forward the possibility of one or two conference calls to discuss resolutions for consideration at the 2020 committee meeting in Nashville, TN relating to the issues identified at the 2019 meeting. The business portion of the meeting was concluded at 10:00 AM EST.

REPORT OF THE SUBCOMMITTEE ON PHARMACEUTICAL ISSUES

Chair: Steve Crawford
Vice-Chair: Heather Fowler

The Subcommittee met on Tuesday, October 29, 2019 at the Rhode Island Convention Center in Providence, RI from 1:00 PM until 5:00 PM. There were 16 members and 14 guests who signed the attendance sheets; there were 38 attendees in the session for the final panel. Full attendance will be reconciled with mobile check in data at a later date. No old business or resolutions were discussed from the previous year.

The Subcommittee agenda (attached) was built to provide a number brief updates on existing federal programs and experiences from state-level legislation, and introductions to various industry and research initiatives. Q&A panels followed each section. In a rapidly evolving area of animal health, this offered interested subcommittee members a primer on a number subjects where they believe policy should be developed, improved, or advanced. Interested subcommittee members were encouraged to subsequently communicate directly with the speaker to look more deeply into areas of interest or concern to them or their constituents.

Attendees and speakers participated in wide ranging Q&A sessions after each section.

Presentations & Reports – Slide decks will be made available on the Subcommittee link on the USAHA website, <https://www.usaha.org/pharmaceuticals>.

FSIS Residue Updates

Dr. Kis Robertson-Hale, USDA, Food Safety Inspection Service

Dr. Hale covered the establishment, objectives, and operations of the FSIS National Residue Program. Residue classes included in surveillance have expanded greatly in recent years, from 51 in 2012 to 108 in 2019. Residue findings per 100 samples has remained relatively level from FY16 through FY19.

Antimicrobial Use & Stewardship Activities at Veterinary Services

Dr. Chelsey Shively, USDA, APHIS, Veterinary Services

Dr. Shively covered the basis for antimicrobial use studies, development of the 2020-2025 National Action Plan, the history of NAHMS, and overviews of recent and ongoing use studies in various livestock sectors. Swine and feedlot sector studies are set to begin in 2020.

Supporting Antimicrobial Stewardship – FDA's 5-Year Plan

Dr. Susan Bright-Ponte, FDA Center for Veterinary Medicine

Dr. Bright-Ponte reviewed the current status and impacts of FDA Guidances 209 and 213, notably that sales have decreased. FDA's 5-year plan, *Supporting Antimicrobial Stewardship in Veterinary Settings* is currently in phase 1, 2019-2021. Among others, key projects include transition all OTC antimicrobial products to Rx, defining durations of use, updating list and ranking of medically important antimicrobials, and antimicrobial use data collection pilot projects. Hemp and CBD are developing areas of FDA involvement. FDA has received more than 4,000 comments following a May 2019 public meeting.

California's Antibiotic Program: 2 years of progress

Dr. Marissa Silva, California Department of Food and Agriculture

Dr. Silva reviewed program history, including the legislative background and development of regulations. The program gathers a large volume of information and is able to produce reports that are beneficial to veterinarians, producers, legislators, and the public. The program goal is to use antimicrobials appropriately to optimize livestock health and minimize selection for

antimicrobial resistance while reducing the need for antimicrobial drugs through infectious disease prevention.

Maryland Senate Bill 471

Dr. Jo Chapman, Maryland Department of Agriculture

Dr. Chapman reviewed the legislative background and development of regulations, including the issue of how to address prohibitions on prophylactic uses such as intramammary dry cow therapies. A working group was convened to work on this specific issue. Updates from that group's deliberations are included in the slide deck. Lessons learned from this process include, increase outreach to veterinarians and stakeholders on general antimicrobial use issues, consider mandatory veterinary continuing education regarding antimicrobial use, establish advisory groups sooner rather than later, funding is important to expand support of regulatory compliance to industry.

New Molecular Approaches to AMR Testing

Dr. Laura Goodman, Cornell University

Dr. Goodman reviewed various data relative to AMR patterns and prevalence in domestic animal and wildlife species. This data and advances in molecular diagnostics may offer future guidance on stewardship decisions.

FFAR Update on ICASA Research

Dr. Tim Kurt, Foundation for Food and Agriculture Research

Dr. Kurt provided updates on the work of FFAR and ongoing research projects. FFAR has been able to develop public-private partnerships to support over \$700M of research. The International Consortium for Antimicrobial Stewardship in Animal Agriculture is early in its various research initiatives and more updates will be forthcoming.

Antibiotic Stewardship in Animal Agriculture

Dr. Karin Hoelzer, Pew Charitable Trusts

Dr. Hoelzer discussed alternatives to antimicrobial use and how human behavior affects stewardship decisions. Vaccine improvement considerations include safety, efficacy, ease of administration, and cost of the vaccine. Pew is involved in research studying how to positively affect human behavior to advance judicious use decisions.

Pipestone Antibiotic Resistance Tracker (PART)

Drs. Gordon Spronk and Scott Dee

Drs. Spronk and Dee discussed Pipestone's efforts to address antibiotic use concerns and deliver useful information for producers to use in daily management decisions. PART encourages behavior change among producers by using a system of benchmarks for its producers.

One Health Certified Program Review

Dr. Don Ritter, Mountaire Farms, Inc.

Dr. Ritter discussed work to gauge public acceptance of a product label to offer an alternative to zero-use labels. Research shows public acceptance of the use of antibiotics in a judicious manner. One Health Certified labels have received FSIS approval and producers will be audited by USDA Agricultural Marketing Service for compliance with program standards.

The AVMA's definitions of antimicrobial prevention, control, and treatment

Dr. David Smith, Mississippi State University College of Veterinary Medicine

Dr. Smith discussed AVMA's efforts to provide clarity for veterinarians regarding stewardship and judicious use. AVMA has defined prevention, control, and treatment within the framework of judicious use.

Subcommittee Business:

No resolutions

New business: Members suggested that the subcommittee monitor FDA Guidance 152 through the course of the year. The subcommittee may coordinate comments as appropriate before the next Annual Meeting.

Meeting adjourned at 4:55 PM.

REPORT OF THE SUBCOMMITTEE ON SALMONELLA

Chair: Donna Kelly, PA

Vice Chair: Shelley Rankin, PA

The Subcommittee met on October 28, 2019 at the Rhode Island Convention Center in Providence, Rhode Island, from 1:00 PM to 4:45 PM. There were [25] members and [30] guests present. Chair Donna Kelly presided and welcomed the Subcommittee. There were no Resolutions from the 2018 meeting to review.

Dr. Donna Kelly summarized the National Poultry Improvement Plan (NPIP) Salmonella Update Report for Dr. Elena Benke, USDA-APHIS-VS, National Poultry Improvement Plan (NPIP), Conyers, GA. Dr. Benke's report is included in these proceedings.

Dr. Megin Nichols, CDC presented Salmonella Outbreak Attributed to Pig Ear Investigations. Her presentation is included in these proceedings.

Dr. Laura Gieraltowski, CDC and Dr. Sheryl Shaw, USDA/FSIS presented Multi-State Salmonella Outbreak Investigations. Their presentation is included in these proceedings.

Dr. Sheryl Shaw, USDA/FSIS presented Salmonella Outbreak Lessons Learned. Her presentation is included in these proceedings.

Dr. Kristina Lantz, USDA-APHIS-VS-NVSL, Ames, IA, presented the NVSL Salmonella Update. Her report is included in these proceedings.

Dr. Renate Reimschuessel, FDA/Vet-LIRN, presented Vet-LIRN Salmonella Vet-Investigations for 2019. Her presentation is included in these proceedings.

Dr. Nikki Shariat, Department of Population Health, College of Veterinary Medicine, University of Georgia, Athens, GA, presented Deciphering Salmonella Serovar Diversity in Food Animals. Her presentation is included in these proceedings.

National Poultry Improvement Plan (NPIP) Salmonella Update Report

Elena Benke, USDA-APHIS-VS, National Poultry Improvement Plan (NPIP), Conyers, GA

Pullorum-Typhoid Status: There were no isolations of *Salmonella* pullorum in commercial poultry in FY2015, FY2016, FY2017, FY2018 or FY2019. There were no isolations of *Salmonella* pullorum in

backyard birds in FY2016, FY2017, FY2018 or FY2019. There have been no isolations of *Salmonella gallinarum* since 1987 in any type poultry in the US.

Hatchery Participation in the National Poultry Improvement Plan Testing Year FY2019	
Egg and Meat-Type Chickens: Participating	268
Turkeys: Participating	66
Waterfowl, Exhibition Poultry and Game Birds: Participating	779

Egg-Type Chicken Breeding Flocks in the National Poultry Improvement Plan Participation and Testing Summary Testing Year FY2019	
U.S. Pullorum-Typhoid Clean Flocks	230
Birds in Flocks	6,004,447
Birds Tested	252,059

Meat-Type Chicken Breeding Flocks in the National Poultry Improvement Plan Participation and Testing Summary Testing Year FY2019	
U.S. Pullorum-Typhoid Clean Flocks	6,385
Birds in Flocks	114,368,511
Birds Tested	38,577,875

Turkey Breeding Flocks in the National Poultry Improvement Plan Participation and Testing Summary Testing Year FY2019	
U.S. Pullorum-Typhoid Clean Flocks:	381
Birds in Flocks	3,674,096
Birds Tested	21,034

Waterfowl, Exhibition Poultry, and Game Birds Breeding Flocks in the National Poultry Improvement Plan Participation and Testing Summary Testing Year FY2019	
U. S. Pullorum-Typhoid Clean Flocks	7,170
Birds in Flocks	2,554,380
Birds Tested	392,431

Meat Type Waterfowl Breeding Flocks in the National Poultry Improvement Plan Participation and Testing Summary Testing Year FY2019	
U. S. Pullorum-Typhoid Clean Flocks	130
Birds in Flocks	350,564
Birds Tested	10,731

**U.S. *Salmonella enteritidis* Clean Egg-Type Breeding Chickens
No. of flocks and birds in flocks by State with *Salmonella enteritidis* isolates, 1990-2019**

	Arkansas	Environmental	Dead Germ	Birds
Flocks		1		2
Birds in Flocks		6,000		15,000
Georgia				
Flocks		7	2	1
Birds in Flocks		110,400	46000	10,000
Illinois				
Flocks		3	2	1
Birds in Flocks		3,900	3700	1200
Indiana				
Flocks		15	2	1
Birds in Flocks		158,345	27,479	15,092
Kentucky				
Flocks		1		
Birds in Flocks		6,625		
Ohio				
Flocks		17		9
Birds in Flocks		192,700		91,600
Oregon				
Flocks		2		
Birds in Flocks		19,516		
Pennsylvania				
Flocks		16		6
Birds in Flocks		166,385		78,450
Texas				
Flocks		1		
Birds in Flocks		10,000		

Phage Type 13	Environmental	Dead Germ
Flocks	11	2
Birds in Flocks	152,000	3,700
Phage type 13A		
Flocks	5	2
Birds in Flocks	54,321	27,479
Phage type 2		
Flocks	2	
Birds in Flocks	28,900	
Phage type 23		
Flocks	21	
Birds in Flocks	16,000	
Phage type 28		
Flocks	2	2
Birds in Flocks	15,000	46,000
Phage type 34		
Flocks	2	
Birds in Flocks	12,500	
Phage type RNDC		
Flocks	1	
Birds in Flocks	7,000	
Phage type-Untypable		
Flocks	2	
Birds in Flocks	24,000	
Phage type 8		
Flocks	21	
Birds in Flocks	237,701	

Egg-type Chicken breeding flocks with isolates of <i>Salmonella Enteritidis</i> by phage type and by year 1989-2019		
Year	No. Flocks	Phage Type
1989	1	13A
1990	11	13A, 13, 8, 28
1991	12	13A, 13, 8
1992	10	Untypable, 13A, 8, 28, 34
1993	5	Untypable, 8, 2
1994	3	13A, 8
1995	2	13A, 28
1996	5	Untypable, RNDC, 13A, 8, 2
1997	2	8
1998	2	8
1999	1	13
2000	4	13, 8
2001	1	13
2002	0	
2003	0	
2004	0	
2005	1	13
2006	1	34
2007	4	13, 8
2008	3	8
2009	0	
2010	3	8(2), 13
2011	0	
2012	0	
2013	0	
2014	1	NA
2015	0	
2016	0	
2017	0	
2018	3	NA
2019	1	NA

**U.S. *Salmonella enteritidis* Clean Egg-Type Breeding Chickens
No. of flocks and birds in the flocks with *Salmonella enteritidis* isolates, 1990-2019**

	Environmental	Dead Germ	Bird
Flocks	75	6	20
Birds in flocks	786871	77,179	211,342

Outbreak of Multidrug-Resistant *Salmonella* Infections Linked to Contact with Pig Ear Dog Treats
Megin Nichols, CDC, Atlanta, GA

- Investigation findings linked the illnesses in this outbreak to contact with pig ear dog treats.
 - 154 people infected with the outbreak strains of *Salmonella* were from 34 states.
 - Of 133 ill people with available information, 35 (26%) were hospitalized. No deaths were reported.
 - 27 illnesses (19%) were among children younger than 5 years.
 - Epidemiologic, laboratory, and traceback evidence indicated that contact with pig ear dog treats from many different suppliers was the likely source of this outbreak.

- Testing of pig ears identified the outbreak strains of *Salmonella* in 135 samples. Some of the pig ears were imported from Argentina, Brazil, and Colombia. Some product labels indicated that the pig ears were irradiated and this process should kill any *Salmonella* present on the pig ears. *Salmonella* identified in products labeled as irradiated indicate they may not have been irradiated or there was another issue that led to *Salmonella* contamination. FDA is continuing to investigate the manufacturing process and has posted information for manufacturers regarding the control of *Salmonella* in these products. Several firms recalled pig ears during the investigation because they were contaminated with *Salmonella*. No single supplier, distributor, or common brand of pig ear treats was identified.

Multi-State Salmonella Outbreak Investigations

Laura Gieraltowski, CDC, Atlanta, GA and Sheryl Shaw, USDA/FSIS, Washington, D.C.

During 2018 and 2019 CDC, FSIS and state public health partners investigated persistent or recurring foodborne illness outbreaks due to three different *Salmonella* found in poultry.

Illnesses due to *Salmonella* Reading and linked to turkey exposure included 358 cases from 42 states. A variety of exposures to turkeys and turkey products were included, and no single brand or single establishment was identified as the cause of all illnesses. Two recalls of turkey and two pet food recalls resulted from the outbreak. Illnesses due to Multi Drug Resistant *Salmonella* Infantis and linked to chicken exposure included 129 cases from 32 states. A variety of exposures to chicken products were included, and no single brand or single establishment was identified as the cause of all illnesses. Illnesses due to *Salmonella* Blockley and linked to chicken exposure included 51 cases from 10 states in 2018 and 94 cases from 6 states in 2019. A variety of exposures to chicken products were included, and no single brand or single establishment was identified as the cause of all illnesses.

FSIS continues to monitor isolates collected from poultry products and shares this information with CDC, USDA APHIS and representatives of the poultry industry to better inform hypotheses regarding detection of potential sources and for prevention of future outbreaks. CDC, FSIS and APHIS met with the National Turkey Federation, National Chicken Council, National Poultry Improvement Plan general council and industry representatives to share findings of the outbreaks.

These investigations required close collaboration between states, CDC, USDA (FSIS and APHIS), and FDA CVM. Evidence indicates that the outbreak strains are present in multiple locations and not limited to a single establishment. These strains appear to have spread within the poultry industry and may be persisting in chicken or turkey populations, their environments, or feed. Further investigations and interventions may lead to the mitigation of these strains prior to presentation at slaughter facilities, thus preventing further outbreaks in humans.

Salmonella Outbreak Lessons Learned

Sheryl Shaw, USDA-FSIS, Washington, D.C.

The Food Safety and Inspection Service (FSIS) is the public health regulatory agency in the United States Department of Agriculture responsible for ensuring that meat, poultry, and processed egg products are safe, wholesome, and accurately labeled. Through a series of Acts, Congress empowers FSIS to inspect all meat, poultry, and processed egg products in interstate commerce. These include the Federal Meat Inspection Act (FMIA) in 1906; the Agricultural Marketing Act (AMA) in 1946; the Poultry Products Inspection Act (PPIA) in 1957; the Humane Methods of Slaughter Act (HMSA) in 1958; and the Egg Products Inspection Act (EPIA) in 1970. The Office of Public Health Science is located under the Office of the Deputy Administrator for Food Safety and includes the Applied Epidemiology Staff (AES).

The Applied Epidemiology Staff uses data from public health partners and throughout FSIS to inform decision making when investigating foodborne illness outbreaks potentially attributed to FSIS regulated products. AES uses epidemiological information, traceback of food consumed, laboratory evidence, and environmental health assessments to investigate potential sources of illness. Early

communication and collaboration within FSIS and with partners are essential in determining potential sources of illness. Understanding consumer behaviors, interpreting laboratory results such as whole genome sequencing, and use of routine and investigative sampling all contribute to the success of outbreak investigations.

FSIS AES conducts After Action Reviews to identify what went well and opportunities for improvement in future investigations. Examples discussed include investigations of *Salmonella* Typhimurium in chicken salad which led to a recall; investigation into *Salmonella* in not-ready-to-eat stuffed chicken which led to improved labeling; and an investigation into Multi Drug Resistant *Salmonella* Infantis in chicken which led to increased industry engagement to identify upstream sources of *Salmonella* in chicken. An investigation into illnesses caused by *Salmonella* Newport in ground beef led to a large recall. Shopper cards proved useful in identifying the source of ground beef purchased by consumers.

While some outbreaks lead to recalls, public communication, and policy changes, others, such as *Salmonella* Reading and Infantis led to increased communication with industry to identify potential preharvest mitigations for *Salmonella*. FSIS recognizes that communication and collaboration with industry are essential to protect and improve public health

***Salmonella* Serotypes Isolated from Animals and Related Sources, January 1-December 31, 2018**

B. Morningstar-Shaw, T. Mackie, A. Ludvik, D. Ludwick, E. Palmer

Diagnostic Bacteriology and Pathobiology Laboratory, National Veterinary Services Laboratories, USDA
Ames, IA

The Bacterial Identification section within the Diagnostic Bacteriology and Pathobiology Laboratory of the National Veterinary Services Laboratories (NVSL) routinely performs serotyping of *Salmonella* isolates submitted by private, state, and federal laboratories as well as veterinarians, researchers and other animal health officials. This report summarizes *Salmonella* serotyping submissions received at the NVSL from January 1 through December 31, 2018.

In 2018, 13,037 submissions were received for *Salmonella* serotyping. There were 258 serotypes identified from 48 states, Belize and Barbados. *Salmonella* isolates were divided by clinical isolates (5,334), non-clinical isolates (5,511), and research (2,192). Isolates were identified as clinical samples based on clinical or sub-clinical signs of salmonellosis from primary or secondary infection or as non-clinical samples when derived from herd and flock monitoring programs, environmental sources, food or other testing. Serotyping data from samples submitted for research purposes are not included in this summary. Table 1 provides information on the source of submissions to the NVSL.

Isolates were divided into the following animal source categories for analysis based on information provided by the submitter: bovine, chicken, equine, swine, turkey and all other. Table 1 lists the source of submissions for both clinical and non-clinical isolates for calendar year 2018. The 10 most commonly identified serotypes from clinical and non-clinical isolates from all animal sources are shown in Table 2. These 10 serotypes account for 58% of the total isolates submitted from clinical and 64% of non-clinical sources in 2018. The most common serotypes observed in chicken, turkey, bovine, equine and swine isolates are listed in Tables 3-7.

Salmonella serotyping at the NVSL is an ISO 17025 accredited test. Salmonellae are typed via classical serotyping using polyvalent and single factor antisera to determine the O and H antigens and/or via molecular typing using the xMAP *Salmonella* serotyping assay. Approximately 60% of the sera used at the NVSL is produced in-house as previously described (Ewing, 1986). The remaining antisera are purchased from commercial vendors. All sera are subject to extensive quality control testing prior to use. *Salmonella* antigenic formulae are determined as previously described (Ewing) and interpreted via the White-Kauffmann-Le Minor scheme (Grimont, 2007). The subspecies designation precedes the antigenic formula for those serotypes other than subspecies I.

The NVSL provided a *Salmonella* Group D proficiency test to 98 individuals from 85 different laboratories. The purpose of the PT was to assess the ability of laboratories to detect or isolate *Salmonella* Group D and/or *Salmonella* Enteritidis from simulated environmental samples. The test consisted of 10 lyophilized cultures containing various combinations of *Salmonella* and common contaminants typically found in environmental swabs. The 2018 test included *Salmonella* serotypes Enteritidis, Heidelberg, Javiana, and Oranienburg. Contaminant bacteria included *Citrobacter sedlakii* or

rodentium, *Citrobacter freundii*, *Enterobacter cloacae*, *Klebsiellae pneumoniae* and *Pseudomonas aeruginosa*. Laboratories were instructed to test the samples according to the procedures used in their laboratories. The NVSL randomly retained approximately 10% of the test kits for QA purposes. All were tested blindly with no discrepancies. The results of the proficiency test are shown in Table 8.

Table 1: Sources of submissions to the NVSL for *Salmonella* serotyping in 2018

Source	No. Clinical Submissions	No. Non-Clinical Submissions
Bovine	1,672	184
Chicken	317	4,425
Equine	674	60
Swine	1,710	23
Turkey	340	534
All others	621	285
Total	5,334	5,511

Table 2: Most common serotypes in 2018: All sources

Clinical		Non-Clinical	
Serotype	No. Isolates	Serotype	No. Isolates
Typhimurium	690	Kentucky	916
I 4,[5],12:i:-	664	Senftenberg	564
Dublin	484	Montevideo	461
Cerro	233	Mbandaka	387
Montevideo	184	Enteritidis	331
Newport	172	Typhimurium	195
Anatum	171	Worthington	183
Derby	168	Agona	178
Infantis	166	Cerro	161
Agona	151	Newport	157
All others	2,251	All others	1,978
Total	5,334	Total	5,511

Table 3: Most common serotypes in 2018: Chicken

Clinical		Non-Clinical	
Serotype	No. Isolates	Serotype	No. Isolates
Enteritidis	109	Kentucky	881
Typhimurium	58	Senftenberg	444
Kentucky	33	Montevideo	428
Infantis	29	Mbandaka	347
Braenderup	14	Enteritidis	309
All others	74	All others	2,061
Total	317	Total	4,425

Table 4: Most common serotypes in 2018: Turkey

Clinical		Non-Clinical	
Serotype	No. Isolates	Serotype	No. Isolates
Albany	41	Senftenberg	100
Reading	39	London	96
Senftenberg	33	Bredeney	74
Uganda	31	Schwarzengrund	43
Anatum	28	Agona	29
All others	168	All others	192
Total	340	Total	534

Table 5: Most common serotypes in 2018: Bovine

Clinical		Non-Clinical	
Serotype	No. Isolates	Serotype	No. Isolates
Dublin	467	Typhimurium	38
Cerro	211	Dublin	35
Montevideo	151	Montevideo	12
Typhimurium	140	Cerro	11
Heidelberg	78		
All others	625	All others	88
Total	1,672	Total	184

Table 6: Most common serotypes in 2018: Equine

Clinical		Non-Clinical	
Serotype	No. Isolates	Serotype	No. Isolates
Typhimurium	156	Newport	26
Newport	76	Mbandaka	16
Anatum	41	Typhimurium	8
Mbandaka	36	Javiana	3
Muenchen	29	Infantis	2
All others	336	All others	5
Total	674	Total	60

Table 7: Most common serotypes in 2018: Swine

Clinical	
Serotype	No. Isolates
4,[5],12:i:-	528
Typhimurium	242
Derby	153
Agona	90
Choleraesuis v. Kunzendorf	83
All others	614
Total	1,710

Table 8: Summary of NVSL *Salmonella* Group D proficiency test

	2013	2014	2015	2016	2017	2018
Participants	61	80	94	98	101	98
Mean Score	94%	98%	98%	97%	95%	98%
Below Passing	4	0	1	0	1	3

Ewing, WH. 1986. Edward and Ewing's Identification of Enterobacteriaceae. 4th edition. Elsevier Science Publishing Co., Inc., New York, U.S.

Grimont, PAD, Weill, FX. 2007. Antigenic Formulae of the *Salmonella* Serovars. 9th edition. WHO Collaborating Centre for Reference and Research on *Salmonella*. Paris, France.

Vet-LIRN *Salmonella* Investigations for 2019

Renate Reimschuessel, Veterinary Laboratory Investigation and Response Network, Center of Veterinary Medicine, US Food and Drug Administration, Laurel, MD

During 2019, FDA's Veterinary Laboratory Investigation and Response Network (Vet-LIRN) investigated multiple consumer reports related to pig ear treats and raw pet food products. *Salmonella* was isolated from animal diagnostic samples (feces) and from products samples. Whole genome sequence analysis

showed relatedness of some of the bacterial isolates from products to those isolated from the animals, and in one case to a human isolate in the NCBI database. Sequencing of case related material is proving a valuable tool for investigating consumer complaints regarding animal food. Vet-LIRN is also continuing its Antimicrobial Resistance Monitoring Program, which was initiated in 2017. Our 2017 dataset will be incorporated into the online National Antimicrobial Monitoring System (NARMS) integrated report. The 2018 dataset from Vet-LIRN's program and the 2018 data collected by USDA's NAHLN network will be combined and also reported via the NARMS reporting website. These data will facilitate tracking veterinary pathogen susceptibility and provide a way to identify emerging issues.

Deciphering Salmonella Serovar Diversity in Food Animals

Nikki Shariat, Department of Population Health, College of Veterinary Medicine, University of Georgia, Athens, GA

Salmonella is a leading bacterial cause of foodborne illness in the United States. It is a remarkably diverse species that can be separated into over 2500 serovars, many which exhibit different phenotypes, including virulence, antimicrobial resistance, host restriction, and association with human illness. Food animals such as poultry and cattle are major *Salmonella* reservoirs, and current culture-based detection methodology limits the ability to assess the extent of mixed-serovar populations in these reservoirs.

The CRISPR arrays in *Salmonella* are highly conserved, and CRISPR spacer content and organization are well correlated with serovar identity. CRISPR-SeroSeq is an amplicon-based next-generation sequencing tool that exploits this characteristic to map frequencies of *Salmonella* serovars within a single population. This allows direct assessment of dynamic serovar changes in mixed populations and has been successfully used in poultry and cattle samples. CRISPR-SeroSeq detected serovars comprising as low as 0.003% of the total *Salmonella* population. CRISPR-SeroSeq can also distinguish between polyphyletic lineages of individual serovars, such as ser. Kentucky and Newport. In poultry and cattle, mixed serovar populations occurred in the majority of cases: in broiler house environments (98% of samples consisted of at least two serovars), in processing plants, pre-chiller (67%), and in feedlot cattle (59%).

In a study examining the effect of antibiotic treatment on *Salmonella* populations we identified low populations of a serovar associated with antibiotic resistance in untreated cattle fecal samples, and high levels in treated cattle with cognate reduction in serovar diversity. CRISPR-SeroSeq was also used to investigate the effect of different *Salmonella* selective enrichment broths (tetrathionate and Rappaport-Vassiliadis) on serovar populations in broiler carcasses at processing. Broth-specific trends were identified, including a bias for ser. Enteritidis selection in tetrathionate and ser. Schwarzengrund in Rappaport Vassiliadis).

Improvements to the CRISPR-SeroSeq technology include amplification and sequencing of additional targets to reveal differences between distinct clades of a serovar. Amplicon-based next-generation sequencing approaches allow development of high resolution diagnostics and investigation of *Salmonella* population dynamics in different agricultural systems. An ability to assess serovar diversity at the population level improves surveillance, and allows prioritization of serovar-specific mitigation strategies in food animals

There were no Recommendations nor Resolutions for the Subcommittee to consider.

The Subcommittee meeting adjourned at 4:45 PM on October 28, 2019.