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Evaluation of an Interactive workshop designed to teach practical welfare techniques to beef cattle caretakers and decision makers

R. Dewell[1, 2], C. Hanthorn[1], J. Danielson[3], R. Burzette[4], J. Coetzee[1], A. Ramirez[1], G. Dewell[1]
[1]Veterinary Diagnostic and Production Animal Medicine, College of Veterinary Medicine, Iowa State University;[2]Center for Food Security and Public Health, College of Veterinary Medicine, Iowa State University;[3]Veterinary Pathology, College of Veterinary Medicine, Iowa State University; [4]Administration, College of Veterinary Medicine, Iowa State University

New Method for Extension Needs Assessment and Use in STEC Extension Programming

D.A. Moore[1] and D.R. Smith[2]
[1]Washington State University and [2]Mississippi State University

Occupational Safety Survey of Corporate Cattle Feeding Operations in the Western United States

Jeff Sarchet, DVM, MPH, DABVP (beef)
Zoetis, Decatur, Texas

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D.J. Wilson[1], K.A. Rood[1], G.M. Goodell[2], T.M. Byrem[3]
[1]Department of Animal, Dairy and Veterinary Sciences, School of Veterinary Medicine, Utah State University, Logan, UT, [2]The Dairy Authority, Greeley, CO, [3]Antel BioSystems, Lansing, MI

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C.A. Cull[1], D.G. Renter[1], N.M. Bello[2], A.H. Babcock[3], and T.G. Nagaraja[1]
[1] Department of Diagnostic Medicine/Pathobiology, Kansas State University, Manhattan, KS 66506;
[2] Department of Statistics, College of Arts and Sciences, Kansas State University, Manhattan, Kansas, 66506; [3] Adam's Land and Cattle Company, Broken Bow, Nebraska, 68822

Using Serology to Investigate Reproductive Failure Due to Neospora in Beef Herds

Russ Daly, DVM, MS, DACVPM
South Dakota State University

Impact of Foot and Mouth Disease Indirect Transmission Probability and Vaccination on Outbreak Duration, Herds Depopulated and Economic Costs

S.W. McReynolds[1], M.W. Sanderson[1] T. Schroeder[2], D. Pendell[3]
[1]Department of Diagnostic Medicine and Pathobiology and [2]Agricultural Economics, Kansas State University, USA, [3]Department of Agricultural Economics, Colorado State University

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S.C. Trock and J. A. Zingeser
Centers for Disease Control and Prevention, Atlanta, GA

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[1]Department of Veterinary Diagnostic and Production Animal Medicine, Iowa State University, Ames, IA, [2]Seaboard Farms, Inc., Guymon, OK, [3]Tetracore®, Inc., Rockville, MD

Evaluation of an Interactive workshop designed to teach practical welfare techniques to beef cattle caretakers and decision makers

R. Dewell[1, 2], C. Hanthorn[1], J. Danielson[3], R. Burzette[4], J. Coetzee[1], A. Ramirez[1], G. Dewell[1]
[1]Veterinary Diagnostic and Production Animal Medicine, College of Veterinary Medicine, Iowa State University;[2]Center for Food Security and Public Health, College of Veterinary Medicine, Iowa State University;[3]Veterinary Pathology, College of Veterinary Medicine, Iowa State University; [4]Administration, College of Veterinary Medicine, Iowa State University

An interactive workshop was organized in July 2014 to teach techniques to enhance beef cattle welfare. Participants received instruction on topics related to (1) local anesthesia techniques for dehorning and castration;(2) the use of non-steroidal anti-inflammatory drugs for pain management; (3) low stress cattle handling techniques; (4) decision making for compromised cattle and (5)lameness evaluation and treatment. Instructional objectives were completed using a combination of didactic classroom-based instruction and hands-on instruction using cadavers, live animals, and demonstrations using a mobile video camera. Participants were asked to complete a pre and post-workshop questionnaire to 1) measure attitude changes towards welfare techniques as a result of participation and 2) compare perceived ability to perform or incorporate certain procedures as a result of workshop participation. Participants used a five point scale to rate the likelihood that they would use or recommend the use of certain techniques/ procedures both prior to and following the workshop. Paired t-tests were used to compare pre and post- questionnaire data with significance set at $p<0.05$. Following training, respondents were more likely to use or recommend use of local anesthesia for dehorning, and castration. Participants were more inclined to utilize meloxicam for pain management. Respondents also reported being “somewhat better” to “much better” at performing all skills taught in the workshop after completing the workshop than before. These results suggest instructional techniques used to teach practical concepts/ techniques relevant to beef cattle welfare led to improvements in both perceived competency and estimated likelihood that the material will be utilized.

New Method for Extension Needs Assessment and Use in STEC Extension Programming

D.A. Moore[1] and D.R. Smith[2]
[1]Washington State University and [2]Mississippi State University

Background: Extension program planning includes several basic steps: (1) Assessing the problem, (2) Analyzing the audience, (3) Reaching the audience, (4) Delivering the program, and (5) Evaluation. Assessment of the problem and discovering audience learning needs has traditionally been done in several ways: (1) mail and online surveys; (2) focus groups; (3) key informants; or (4) the community forum approach. Another method, environmental scanning, appears intuitive and it seems as if Extension specialists are doing it every day when talking with clients, reading journals, or perusing the lay literature. An environmental scan is a 'process of studying and analyzing the current and emerging forces' that could impact an organization or your clientele (Guion, 2010). It is a way of looking at outside factors. The technique of environmental scanning is not new and has been adapted to public health needs assessment (Rowel et al., 2005). With the expansion of the Internet, information, whether accurate or not, can be spread widely, and misinformation can permeate public knowledge and affect policy-making, particularly when it comes to food safety.

Objectives: The purpose of this project was to evaluate the national "conversation" on pre-harvest STEC control in cattle in an effort to identify educational needs.

Material and Methods: An environmental scan using "Google Alerts" (http://www.google.com/alerts) was conducted using the search term: *E. coli* cattle. The system is a search query one that continuously monitors internet traffic on a topic and forwards traffic summaries as a daily email update and included press-releases, news items, blog entries, etc. with the search term from February, 2010, to November, 2010. The items were categorized by theme and evaluated for accuracy based on the current literature and science about pre-harvest control and production practices for cattle.

Results: There were 144 "Google Alerts" that focused on pre-harvest STEC and cattle over the scanning period. Four major news stories were revealed by the scan that occurred during this time: (1) A press release about efficacy of cattle vaccination from a vaccine manufacturer, (2) A large European outbreak of a non-O157 STEC, (3) An outbreak of STEC O157 at the North Carolina State Fair, and (4) A press release on studies linking feeding of wet distillers grains to cattle resulting in higher STEC O157 shedding. The Internet news stories and blogs that surfaced primarily focused on these news stories and included stories on the "other" STECs (N=27) and the subsequent labeling of them by the USDA as adulterants requiring additional testing (N=6), on cattle vaccination as a way to reduce STEC O157 shedding (N=18), and animals in public settings as sources of STEC O157 (N=10). Water contamination by cattle and wildlife (N=14) was also discussed. The pre-harvest control themes included cattle diet influences on STEC O157 (N=11), cattle production practices' influence on shedding (N=16), and antibiotic use influence on shedding (N=7). Misinformation or 'myths' were identified with the most significant and common ones being: "grass-fed beef is safer", "industrial farming results in more STEC O157 ", "antibiotic use in cattle leads to STEC O157 shedding", and "local or organic food is safer with regards to STEC O157".

Conclusions: Without having to read every email alert, lay publication, or newspaper, a daily, targeted internet environmental scan can provide data on the national conversation on a specific topic. Knowing what people are talking about and what information might be inaccurate or not supported by evidence can help identify learning needs for Extension programming.

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Occupational Safety Survey of Corporate Cattle Feeding Operations in the Western United States

Jeff Sarchet, DVM, MPH, DABVP (beef)
Decatur, Texas

Information from data obtained from a survey on occupational safety of eleven corporate cattle feeding operations in the western United States measuring the type of safety culture in these feedlots was obtained. Data is categorized by feed mill workers, cattle handling workers, maintenance workers, pen riders, and management or office workers as well as general information and demographics. The survey was voluntary, anonymous, written in English and Spanish and the data was analyzed by each feed lot and as a whole. Differences in perceived safety culture and survey data were measured but must be interpreted with caution because of inherent biases in the design and implementation of the survey however the data adds to the limited information on occupational safety in the beef industry.

DAIRY FARM MANAGEMENT PRACTICES AND CHARACTERISTICS OF HERDS POSITIVE FOR JOHNE'S DISEASE AND/OR BOVINE VIRAL DIARRHEA IN THE INTERMOUNTAIN WEST

D.J. Wilson[1], K.A. Rood[1], G.M. Goodell[2], T.M. Byrem[3]
[1]Department of Animal, Dairy and Veterinary Sciences, School of Veterinary Medicine, Utah State University, Logan, UT
[2]The Dairy Authority, Greeley, CO
[3]Antel BioSystems, Lansing, MI

The objective of the study was to record herd characteristics and management practices on dairy farms positive for either Johne's disease (JD) and/or Bovine Viral Diarrhea (BVD) virus in bulk tank milk. Positive status for JD or BVD was defined by finding at least one positive test result (JD by PCR or ELISA, BVD by PCR) from 5 milk samples collected at 3-4 day intervals from all bulk tanks on 151 participating dairy farms. The farms were located in Utah and southern Idaho. There were 67 herds detected with JD and/or BVD in bulk milk, and 22 farms participated in a follow up visit project. The 22 farms were visited and evaluated using a questionnaire and standardized observations. An owner and usually other key personnel were interviewed and farms were observed.

20 herds were JD+ only, one was BVD+ only, one was + for JD and BVD. For all 22 herds, means and medians respectively were: no. milking cows, 778, 420; 305d milk production, 20,052 lbs (9240 kg), 20,311 lbs (9221 kg); SCC in bulk milk, 175,545/ml, 178,000/ml. Holsteins were the main breed on 21 farms (95%), Jerseys the main breed on one farm (5%), but 15/22 farms (68%) had a mixture of Holsteins, Jerseys or other breeds. 15 farms (68%) milked in herringbone parlors, 6 (27%) milked in parallel parlors, and one (5%) milked in a rotary parlor. No. of milking units ranged from 6 to 160, with a mean of 28 units.

Main type of lactating cow housing was: 16 farms (73%) outdoor freestalls with small roofs, 4 (18%) freestalls in covered barns, 2 (9%) dry lot. Main type of dry cow housing was: 12 farms (55%) dry lot, 7 (32%) freestalls, with some loose housing or pasture. Visibly soiled % of stalls: mean 37%, median 32%, range 5% to 90%. Freestall bedding used was: 16 (80%) straw, 3 (15%) sand, one (5%) sawdust.

13 farms (59%) including the farm positive only for BVD, had been closed for $\geq$ 1 year to purchased animals, for a median of 5 years. Within the previous year, 9 farms (41%) had purchased: 6 farms (27%) springing heifers, 4 farms (18%) bulls, 3 farms (14%) cows, 2 farms (9%) calves. Whenever they had most recently purchased herd additions, 14 farms (64%) used no biosecurity practices. 8 farms (36%) had used the following biosecurity practices: 6 farms (27%) administered IBR-BVD-PI3-BRSV and Leptospirosis vaccine to replacements on arrival, 3 farms (14%) segregated replacements, 2 farms (9%) provided plastic boots for visitors, 2 farms (9%) tested replacements using BVD ELISA, one farm (5%) cleaned their livestock trailers after unloading replacements, one farm (5%) tested replacements using tuberculosis caudal fold tests, and one farm (5%) tested replacements using mycoplasma culture. 11 farms (50%) (5 closed, 6 open) had previously tested for JD, primarily testing cows with clinical signs of the disease; 9/11 had had a previous animal test JD+, but none had tested the whole herd for JD. 11 farms (50%) (8 closed, 3 open) had performed no previous testing for JD. No farms had tested regularly for BVD; some had tested periodically for Persistently Infected BVD animals. The 2 farms with BVD had never tested previously for either BVD or JD.

12/21 (57%) of JD+ farms stated that they would allow known JD+ cows to calve again, 3 (14%) were not sure; in addition, none of the 15 farms allowing JD+ cows to calve again would require a separate calving area for those cows. Both farms detected with BVD would allow BVD+ cows to calve again. All farms administered BVD vaccine at least once per year. 14 farms (64%) fed pooled colostrum; 12 of those also fed unpasteurized discard milk to calves. 6 farms (29%) fed only individual-cow colostrum and pasteurized milk to calves. 19 farms (86%) did not wash machinery if it contacted manure and then handled feed. 17 (81%) JD+ farms had observed cows losing weight but continuing to eat; 11 (52%) had seen cows with diarrhea that died. Both BVD+ farms had observed abortions. One farm with BVD had sheep of all ages mixed with dairy animals. The results demonstrate that most recommended control measures for JD or BVD were not widely adopted on farms positive for one or both diseases.

Efficacy of a vaccine and a direct-fed microbial against fecal shedding of *Escherichia coli* O157:H7 and corresponding impacts on cattle performance in a commercial feedlot

C.A. Cull[1], D.G. Renter[1], N.M. Bello[2], A.H. Babcock[3], and T.G. Nagaraja[1]

[1] Department of Diagnostic Medicine/Pathobiology, Kansas State University, Manhattan, KS 66506; [2] Department of Statistics, College of Arts and Sciences, Kansas State University, Manhattan, Kansas, 66506; [3] Adam's Land and Cattle Company, Broken Bow, Nebraska, 68822

Our primary objective was to determine the efficacy of a siderophore receptor and porin proteins-based vaccine (VAC) and a *Lactobacillus acidophilus*-based direct-fed microbial (DFM) against fecal shedding of *Escherichia coli* O157:H7 in commercial feedlot cattle. Our secondary objective was to quantify performance and carcass characteristics associated with these treatments. Cattle (n=17,148) fed a finishing diet during the summer were randomly allocated into 40 pens grouped by processing dates into 10 complete blocks; pens within block were randomly allocated to control, VAC, DFM, or VAC+DFM treatment groups. The DFM groups were fed a product with 10^6 CFU/animal/day of *Lactobacillus acidophilus* and 10^9 CFU/animal/day of *Propionibacterium freudenreichii.* The VAC cattle were vaccinated on days 0 and 21 whereas unvaccinated cattle were not given a placebo and were not re-handled on day 21. Pen floor fecal samples (30/pen) were collected weekly for four total weeks with a total of 4,800 samples. Two concurrent culture procedures were used to estimate the *E. coli* O157:H7 prevalence for shedding and for high shedders; the cumulative prevalence for these were 31.7% and 3.5%, respectively. Data were analyzed using linear mixed models that accounted for the study design. For analyses of *E. coli* O157:H7 shedding and high shedding, there were no significant treatment and time of sampling interactions. However, vaccinated pens had significantly lower prevalence estimates for *E. coli* O157:H7 shedding ($P < 0.01$) and for high shedding ($P < 0.01$) compared to unvaccinated pens. There was no evidence of a DFM effect on either measure of *E. coli* O157:H7 prevalence. For performance and carcass characteristics, the main effects of DFM and VAC during the intervention period are reported as there were no significant interactions among treatments. Vaccinated cattle had significantly ($P < 0.05$) lower total weight gain, average daily gain (ADG) and cumulative dry matter intake (DMI) while the DFM increased total weight gain and the ratio of cattle weight gain to weight of feed delivered (G:F). Daily DMI was significantly lower for vaccinated pens as compared to unvaccinated pens for five days following revaccination. After the intervention period, cattle were followed until harvest where days on feed, yield dressing %, hot carcass weight and ADG differed among treatment groups. We conclude that the application of these two treatments differentially impacted both fecal shedding of *E. coli* O157:H7 and cattle performance outcomes. Thus, our results demonstrate the need to consider potential food safety impacts as well as cattle and carcass performance, when evaluating potential costs and benefits of interventions.

Using Serology to Investigate Reproductive Failure Due to Neospora in Beef Herds

Russ Daly, DVM, MS, DACVPM
Extension Veterinarian
South Dakota State University

In late November, 2013, a diagnosis of abortion due to *Neospora caninum* was made in a fetus aborted from a coming second-calf cow in a north central South Dakota beef herd. The cow was one of 81 bred cows purchased at a sale earlier that month. Following the abortion, the purchased group was re-examined for pregnancy and 21/81 cows previously confirmed pregnant were found open.

Nine other South Dakota ranchers were identified to have purchased bred cows from the same sale. All 9 herds then had their purchased bred cows re-examined for pregnancy during December 2013 or January 2014. The size of the purchased groups ranged from 12-376 (average = 87). All 9 herds found cows that were now open. The open rates in the 10 groups of previously-confirmed-pregnant cows ranged from 8 to 31 percent (average = 22%). In all, 205 out of 866 cows (24%) were diagnosed "not pregnant" by their herd veterinarians.

The cows were purchased at auction on November 19, 2013, at a north central South Dakota auction market from a single North Dakota ranch. The heifers were bred to calve in May 2014 and were ultrasounded to confirm pregnancy by a veterinarian on October 17, 2013.

Because of the diagnosis of *Neospora caninum* in 1 of the affected groups, The 10 herds tested cows for the presence of *N. caninum* antibody. All herds were sampled from January 14-31, 2014. Eight herds tested all purchased animals, while 2 herds tested some of the purchased animals. All serology was performed at the SDSU ADRDL, utilizing the ELISA test. A percent inhibition of 30 or above was considered positive for *N. caninum* antibodies. Information regarding cow pregnancy status was provided with the submissions.

The overall seropositive rate for purchased animals was 17.6%. However, there were marked differences in seropositive rates between open and bred animals. Open cows sampled had an overall seropositivity rate of 78% (group range = 50-100%), while cows still pregnant had an overall rate of 7% (group range = 3-18%). In these animals, the odds of an open cow being *N. caninum*-positive were 46.7 times that of pregnant cows being seropositive (95% confidence interval = 26.8-81.6).

Pathologic diagnosis of *N. caninum* was not obtained in 8 subsequent abortion submissions to SDSU from these groups, nor was a point source of infection identified for these animals. Evidence pointing to *N. caninum* as a cause of reproductive loss in these animals includes: extremely high levels of association between seropositivity and non-pregnancy, a higher overall seropositivity rate in these groups compared to expected background levels in the Northern Plains, and the lack of other infectious agents consistently identified in serology or pathology submissions. Evidence supporting a cause of reproductive loss in these animals prior to sale includes the consistent open rates found across the 10 groups.

Impact of Foot and Mouth Disease Indirect Transmission Probability and Vaccination on Outbreak Duration, Herds Depopulated and Economic Costs

S.W. McReynolds[1], M.W. Sanderson[1] T. Schroeder[2], D. Pendell[3]
[1]Department of Diagnostic Medicine and Pathobiology and [2]Agricultural Economics, Kansas State University, USA, [3]Department of Agricultural Economics, Colorado State University

Introduction:

The central United States (U.S.) has a large livestock population including cattle, swine, sheep and goats that are susceptible to Foot and Mouth Disease (FMD). Because FMD is a highly infective foreign animal disease, the only method to assess the impact of an introduction and effectiveness of control is through modeling. We developed simulation scenarios to assess the impact of an FMD introduction in the central U.S. and the effect of vaccination strategies and variation in biosecurity on FMD outbreaks using the North American Animal Disease Spread Model (NAADSM), a spatially explicit, stochastic infectious disease model.

Materials and Methods:

Based on data from the U.S. Department of Agriculture National Agricultural Statistic Service, a simulated population of livestock operations was generated. The population included 151,620 herds defined by latitude and longitude, production type, and herd size. For the simulations, a single 17,000 head feedlot in Northeast Colorado was selected as the initial latently infected herd in an otherwise susceptible population.

Direct and indirect contact rates between herds were based on survey data of livestock producers in Kansas and Colorado or estimated from expert opinion. Scenarios were simulated for different vaccination protocols compared to depopulation only. Ring vaccination of herds was triggered around infected herds. Large feedlots ($\geq$3,000 head) had the highest vaccination priority. Simulated vaccination protocols included low and high vaccine capacity based on results from a livestock producer survey and expert opinion, vaccination zones of 10 km vs. 50 km, and vaccination trigger of 10 or 100 infected herds. The effect of biosecurity methods was modeled by varying the probability of indirect transmission following an indirect contact between an infected as susceptible herd as 15%, 20% and 25%.

The economic model was a multi-market, multi-commodity quarterly partial equilibrium model of the United States agricultural sector. The model incorporates horizontal and vertical linkages from livestock production to the final consumer, including international trade. Grain markets are also incorporated in the model as a major input into livestock production.

Results:

Increasing probability of transmission following an indirect contact between an infected and susceptible herd increased the number of herds depopulated and the outbreak duration. In scenarios with a probability of transmission following indirect contact between an infected and susceptible herd of 15% no vaccination strategy altered the median number of herds depopulated or outbreak duration compared to the no vaccination baseline, but the 90th percentile for each was decreased particularly when the vaccination zone was set at 50 km. When the probability of transmission following indirect contact was set at 20%, all vaccination scenarios decreased the median and 90th percentile number of herds depopulated compared to baseline but outbreak duration was only decreased when the vaccination zone was 50 km. When the probability of transmission following indirect contact was set at 25%, only the vaccination scenario with high capacity and a 50 km zone was effective at decreasing the number of herds depopulated compared to baseline.

The no vaccination baseline scenario had the largest total median loss of any scenario ($187 billion), and the longest median disease duration. Scenarios with a vaccination zone size of 50 km were most effective at decreasing outbreak duration as well as median producer and consumer loss ($56-75 billion).

Significance:

The probability of transmission following indirect contact between an infected and susceptible herd is a measure of the biosecurity practices applied to traffic and people on and off the farm. Important aspects include truck washing, boot washing and control of visitor contact with animals. The level of biosecurity required to achieve a given probability of transmission is not known. The results of these scenarios were compared to assess the impact of the probability of transmission following an indirect contact, an indicator of biosecurity controls, on the number of herds depopulated and the duration of the FMD outbreak. Outbreak size and number of herds depopulated was sensitive to transmission probability/biosecurity.

Increased size of the vaccination zone during an outbreak may lead to decreased length of the outbreak and number of herds destroyed even in an outbreak with high probability of indirect transmission. A better understanding of the biosecurity practices necessary to control transmission probability would allow more focused planning of optimal control efforts. Economic outcomes indicate that large vaccination zones are most effective at controlling producer and consumer loss in the face of an outbreak.

Live Bird Markets, Disease Surveillance and e-Learning

S.C. Trock and J. A. Zingeser
Centers for Disease Control and Prevention, Atlanta, GA

In 2013 low pathogenic avian influenza H7N9 emerged in China as a pathogen for humans while causing little to no illness/mortality among infected poultry. Based upon epidemiologic data linking human cases with exposure to poultry in live birds markets, several jurisdictions in China summarily closed live bird markets and witnessed a drop in human cases. Subsequent to these closures, markets have been allowed to re-open and continue to operate.

The live bird markets provide a unique setting, often in urban environments, where the public interfaces directly and indirectly with live birds from a variety of sources. Depending upon the country or local setting, the markets themselves present a variety of hygienic standards. Because birds are often carried over from day to day and new birds are mixed with the carry over birds, these settings are sometimes viewed as points in the marketing chain where avian influenza virus can continue to circulate and provide a unique opportunities for bird to human transmission.

Because these markets provide a culturally, socially and traditionally accepted marketing system for customers, there is continued demand for them and the products they provide. Therefore it is necessary to create recommendations and protocols for avian disease surveillance – using avian influenza as the model – in live bird market systems. In March 2014 the Food and Agricultural Organization of the UN (FAO) held an *ad hoc* external consultation of subject matter experts on developing such systems in various settings. The 14 external subject matter experts represented ten countries and five continents. The challenge to the group was to provide practical guidelines for surveillance in live bird market settings, particularly ones that could be used in resource poor settings.

Discussions included sampling protocols, swab types, sample type, transport media, laboratory quality assurance/quality control and reporting. General consensus agreed that pooling samples of similar type was most cost effective and would enhance surveillance efforts. It was agreed that sampling frequency and number of sample sites was dependent upon resource availability and the goal of surveillance. It was also agreed that surveillance design must take into consideration the market chain associated with live bird markets.

Proposed surveillance programs in live bird markets were qualified based upon status of the country. Three situations were considered and guidance was drafted for each situation. In the first situation, a country was categorized as ‘endemic’ for avian influenza (ex: Indonesia, Egypt). In the second scenario, a country was conducting surveillance for AI in their live bird markets to detect early incursion of AI (ex: Viet Nam, Hong Kong SAR). The final scenario developed was for countries considered ‘free’ of AI, where surveillance in live bird markets would be necessary to establish such freedom from infection (ex: US, Australia).

One of the proposed meeting products is the creation of web-based/CD-ROM training materials that could also be used in person-to-person outreach and education. This would be in addition to the meeting resultant surveillance document that could be used by countries or locales to conduct surveillance for avian influenza in live bird market systems.

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Influenza A virus (IAV) surveillance using pre-weaning oral fluid samples

Y Panyasing[1], C Goodell[1], A Kittawornrat[1], C Wang[1], I Levis[2], L Defresne[2], R Rauh[3], P Gauger[1], J Zhang[1], K Lin[1], S Nezami[1], S Azeem[1], K-J Yoon[1], J Zimmerman[1]

[1]Department of Veterinary Diagnostic and Production Animal Medicine, Iowa State University, Ames, IA, [2]Seaboard Farms, Inc., Guymon, OK, [3]Tetracore®, Inc., Rockville, MD

IAV is a major respiratory pathogen in contemporary production systems. IAV circulates endemically in all age groups, including suckling pigs. That is, IAV transmission and infection occurs in piglets despite the presence of maternally-derived antibodies. The feasibility of conducting influenza A virus (IAV) surveillance using pre-weaning oral fluid samples from litters of piglets was evaluated in four ~12,500 sow, IAV-vaccinated, breeding herds. Oral fluid samples were collected from 600 litters 24 hours prior to weaning. Serum samples from their dams were included for comparison. Litter oral fluid samples were tested for IAV by virus isolation, quantitative reverse-transcriptase polymerase chain reaction (qRT-PCR), RT-PCR subtyping, and sequencing. Commercial nucleoprotein (NP) ELISA kits and NP isotype specific assays (IgM, IgA, and IgG) were used to characterize NP antibody in litter oral fluid and sow serum. All litter oral fluid specimens (n = 600) were negative by virus isolation. Twenty-five oral fluid samples were positive by qRT-PCR, based on screening (Laboratory 1) and confirmatory testing (Laboratory 2). No hemagglutinin (HA) and neuraminidase (NA) gene sequences were obtained, but matrix (M) gene sequences were obtained for all qRT-PCR-positive samples submitted for sequencing (n = 18). Genetic analysis revealed that all M genes sequences were identical (GenBank accession no. KF487544) and belonged to the triple reassortant influenza A virus M gene (TRIG M) previously identified in swine. The proportion of IgM- and IgA-positive samples was significantly higher in sow serum and litter oral fluid samples, respectively ($p < 0.01$). Consistent with the extensive use of IAV vaccine, no difference was detected in the proportion of IgG- and blocking ELISA-positive sow serum and litter oral fluids. The circulation of IAV in vaccinated sow herds was detected in oral fluid samples collected from litters of pigs prior to weaning. This study supported the use of oral fluid sampling as a means to conduct IAV surveillance in pig populations and demonstrated the inapparent circulation of IAV in piglets. Future work on IAV oral fluid diagnostics should focus on improved procedures for virus isolation, subtyping, and sequencing of HA and NA genes. The role of antibody in IAV surveillance remains to be elucidated, but longitudinal assessment of specific antibody has the potential to provide information regarding patterns of infection, vaccination status, and herd immunity.