

## Multistate Research Project NC1206: Annual Report 2020

**Project/Activity Number:** NC1206

**Project/Activity Title:** Antimicrobial Resistance

**Period Covered:** Dec 10, 2020 – Aug 4, 2021

**Date of Report:** Oct 2, 2021

**Annual Meeting Dates:** Aug 4, 2021

### Participants:

Advisor, NIFA representatives, and external speakers

Kathe Bjork ([kathe.e.bjork@usda.gov](mailto:kathe.e.bjork@usda.gov)) – NIFA Representative

Christina Hamilton ([chamilton@wisc.edu](mailto:chamilton@wisc.edu)) – NCRA Assistant Director and NIMSS Admin

### NC 1206 members

Bing Wang ([bing.wang@unl.edu](mailto:bing.wang@unl.edu)) - University of Nebraska; Outgoing President

Erika Ganda ([ganda@psu.edu](mailto:ganda@psu.edu)) - Pennsylvania State University; Secretary, Incoming President

Emmanuel Okello ([eokello@ucdavis.edu](mailto:eokello@ucdavis.edu)) - University of California, Davis; Incoming Secretary Elect

Sharif Aly ([saly@ucdavis.edu](mailto:saly@ucdavis.edu)) - Member – University of California, Davis

Paul Plummer ([pplummer@iastate.edu](mailto:pplummer@iastate.edu)) - Member - Iowa State University

Tim Johnson ([john2185@purdue.edu](mailto:john2185@purdue.edu)) - Member – Purdue University

Stephanie Lansing ([slansing@umd.edu](mailto:slansing@umd.edu)) - Member – University of Maryland

Sung Woo Kim ([skim22@ncsu.edu](mailto:skim22@ncsu.edu)) - Member – North Carolina State University

Renata Ivanek Miojevic ([ri25@cornell.edu](mailto:ri25@cornell.edu)) - Member – Cornell University

Yrjo Grohn ([ytg1@cornell.edu](mailto:ytg1@cornell.edu)) - Member – Cornell University

### **Brief Summary of Minutes of Annual Meeting**

- Opening: The meeting started with a welcome note by Dr. Bing Wang, who passed the Chair position to Dr. Erika Ganda. Drs. Ganda and Wang co-moderated the meeting.
- Project renewal: Dr. Christina Hamilton, NCRA assistant director, discussed the upcoming project renewal and reiterated the emphasis on multistate collaborative efforts as the main mission of the project. The renewal proposal should emphasize progress made to date and outline the future direction of this project.
- Funding: Dr. Kathe Bjork, NIFA representative, provided updates on AFRI funding programs and personnel changes at NIFA USDA, with a focus on the Divisions of Animal Systems and Food Safety which cover programs supporting research on antimicrobial resistance.
- Project objectives review: Objectives for the project renewal application was discussed and it was decided that the original 5 objectives will be reformulated into 3 main objectives in the renewal proposal. Members elected to lead the writing of each objective.
  - Objective 1: Develop knowledge and tools to improve antimicrobial stewardship. The objective will focus on surveillance and monitoring of antibiotic resistance, developing improved diagnostic tests, and determining the ecology and mechanisms involved in resistance and transmission of resistance. Lead: Tim Johnson.
  - Objective 2: Develop and evaluate antimicrobial use, resistance transmission, mitigation strategies, and stewardship programs in food systems from a One-Health perspective. The objective focus on animal health, public health, social, economic, and environmental impacts of antimicrobial interventions in food production systems. Lead: Bing Wang, with Renata Ivanek.
  - Objective 3: Create and deliver programs on antibiotic stewardship in food production systems through education and outreach. Lead: Paul Plummer and Stephanie Lansing.
- Project objectives review timelines: Oct. 1<sup>st</sup> – Draft outline; Nov. 15<sup>th</sup> – Group review; Dec 1<sup>st</sup> – Submission due date.
- New leadership: Dr. Emmanuel Okello will serve as the project Secretary for next year cycle, which was supported and confirmed by the group.
- Annual meeting schedule, 2022: Proposed date: Late January / early February or October 1-31 with option for zoom. Proposed location: California (UC Davis) or Iowa State would serve as host institutions, final selection subject to vote.
- Funding landscape: Group members shared the opinion that funding mechanisms to study antimicrobial resistance are scarce. The concept of One Health was agreed to be of great importance in the context of

antimicrobial resistance, however all members agreed that an actual funding mechanism supporting studies designed with a One Health perspective is critically needed.

- Station reports and updates: Seven (7) states updated the group on progress made in antimicrobial resistance related activities in research, extension, and education.

**Impact:**

Antimicrobial resistance is a quintessential One Health problem that must be addressed by multidisciplinary and collaborative efforts across the animal, human and environmental health spheres. The multistate project NC1206 research group has accomplished key studies and extension education activities that advance the knowledge and mitigation efforts on antimicrobial resistance in animals, humans, and the environment. Key areas of research accomplished include developing manure treatment strategies to mitigate dissemination resistant bacteria and genes in the environment, developing mathematical models to help understand the dynamics of antimicrobial resistance transmission in livestock, and surveys to understand perceptions and antimicrobial drug use practices by farmers and veterinarians. In addition, the multistate research group NC1206 has been very active in extension education and outreach by organizing workshops and conferences, creating several extension materials that are available online and disseminated through various social media platforms to educate the public, and creation and delivery of a new graduate course focused on antimicrobial resistance and one-health. These efforts are vital in advancing our knowledge on the problem of antimicrobial resistance, increases awareness among the different stakeholders and contribute to the general goal of mitigating resistance.

**Accomplishments:**Objective 1. Enhance surveillance and monitoring of antibiotic resistance and develop improved diagnostic tests.

- Effect of high temperature digestion and composting temperature on AMR in dairy and beef systems. University of Maryland led project, in collaboration with Cornell University and University of Nebraska, as well as partners at USDA-ARS, is assessing effect of high temperature treatment in dairy manure and modeling antibiotic residual transformations in dairy and beef manure with high temperature and grass strip treatments, respectively on antibiotic residuals, antimicrobial genes (ARG), and bacteria (ARB). This research is on-going, so impact of the results is still to be determined. The antibiotic detection method paper is expected to be submitted for publication in December 2020. [MD, NY, NE]

Objective 2. Determine the ecology and mechanisms involved in resistance and transmission of resistance.

No multistate project to report.

Objective 3. Develop and evaluate interventions (including alternatives to antibiotics) that reduce antimicrobial resistance in food production systems.

- Mitigating the dissemination of antimicrobial resistant bacteria and genes from livestock production to environment. Scientists in Nebraska and Hawaii collaborated on a project investigated practical solutions for mitigating the dissemination of antimicrobial resistant bacteria and genes from livestock production system to environment through effective control strategies implemented at the collection, storage, management, and application of beef manure. The project generates knowledge on the effectiveness of lime treatment, solarization, and conservation tillage on mitigating antibiotic resistance during manure management. A novel, heat-based technology has been developed to treat cattle manure during stockpiling to inactivate antimicrobial resistant bacteria and genes.

Objective 4. Quantify animal health, public health, social, economic, and environmental impacts of antimicrobial interventions in food production systems.

- Stakeholders' perceptions of antimicrobial resistance prevalence and conveyance in the environment. University of Maryland, in collaboration with Cornell University and University of Nebraska, as well as partners at USDA-ARS and University of Maryland-Baltimore County, are assessing the perceptions of farmers and veterinarians to develop communication materials that are more tailored to the biases, current level of understanding, and perception. The project is also investigating stakeholder perceptions (and misconceptions) of AMR prevalence and conveyance in the environment of farmers, veterinarians, and

other stakeholders using interviews, focus groups, surveys, and Q-sort analyses. This research is on-going. [MD, NY, NE].

- Workshop on Human Dimensions of AMR in Agriculture. University of Maryland organized a workshop with the leaders in AMR social science research and AMR communication (objective #5) to identify research to date, identify holes in the literature, write articles that addressed these limitations of social science-based AMR information in agriculture. The workshop consisted of 37 participants including researchers, graduate students, post-docs, and industry experts in this arena. Participants were divided into working groups to facilitate discussion, coordinate research efforts, cultivate long-term collaborations, and offer mentoring opportunities between students and professionals outside of their home institutions. Workshop website and participant information can be found here: <https://enst.umd.edu/research/antimicrobial-resistance-workshop>. Two publications from this group were published, two more publications are under review. [MD, NE]
- Antibiotic use and resistance in dairy farming. Cornell University in collaboration with Purdue University, and USDA ARS in KY and NE conducted a survey of dairy farmers in the northeastern US about dairy farmers' perceptions and habits regarding antibiotic use in dairy cattle completed. Draft manuscript on mathematical modeling study of the dynamics of tetracycline-resistant *Escherichia coli* in a feedlot written. The team developed preliminary mathematical model of antibiotic resistant *Salmonella* Dublin on a heifer raising operation [NY, KY, IN, NE]

Objective 5. Create and deliver programs on antibiotic stewardship in food production systems through education and outreach.

- Communication strategies and tools to best convey AMR knowledge. University of Maryland in collaboration with Cornell University and University of Nebraska, as well as partners at USDA-ARS, University of Maryland-Baltimore County, and Ithaca College, are creating video, web, and print information on antimicrobial resistance prevalence, treatment, stewardship, and perceptions. Ref: <https://water.unl.edu/article/animal-manure-management/iamresponsible-nationwide-antimicrobial-resistance-amr-education>. The team have hosted workshops, lectures, and produced over 150 pieces of graphical content were created for distribution on social media and print in the past year. The infographics are intended to help illustrate AMR related scientific research, spread awareness of the basic concepts of AMR, describe current public health concerns, and provide information around best practices the intended audience can take to minimize potential AMR-related risks. The team has hosted workshops, lectures, and produced hundreds of social media graphics and content items to facilitate connection between researchers, agricultural personnel, and policy makers. [NY, NE].
- AMR Food Safety Outreach Project. University of Nebraska, in collaboration with Oregon State University, Oklahoma State University, North Carolina State University, and University of Maryland are facilitating optimal distribution and utilization of AMR-related food safety information and resources at the state, regional and national levels via on-demand access to science-based information, educational resources, and decision-support tools using the iAMResponsible created resources and network. Two on-line social media outlets for dissemination of AMR related materials are managed with weekly or multi-weekly outputs. Content includes videos, summaries of published research, and press articles curated by the team to build on and expand audience understanding of AMR. As we generate a greater understanding of stakeholder's perspectives on AMR and further quantify the effect of advanced manure technologies on reducing AMR, more informed decisions and policies can be implemented by informed farmers, consumers, and stakeholders [NE, MD, OR, OK].
- One Health Graduate Online Course. A graduate-level course on the fundamentals of AMR development, transmission, and risks to humans, animals and the environment is delivered by experts in the One Health concept (interconnection between people, animals, plants, and their shared environment). Review and development of research-based resources and methods for communicating scientific information to non-academic audiences. Multi-institution collaboration with online engagement during class meetings. Twenty (24) graduate students enrolled in the course in Spring 2021 and learned from academic, industry and government leaders about multiple elements of the AMR crisis and developed their own scientific communication skills and contributed new materials to the iAMR team's outreach database and/or website. There were six institutions participating in the Spring 2021 course (University of Nebraska – Lincoln,

North Carolina State University, University of Minnesota, Washington State University, Oklahoma State University, and University of Maryland) [MD, NE, MN, OK, WA, NC].

- NIAMRRE hosted the Annual conference with attendees from over 30 states and 60 Organizations for discussions include antibiotic stewardship in food production systems

### Funding

- A. Iowa and New York received joint funding to investigate AMR in manures and new manure management strategies [IA, NY]
- B. Emerging multidrug resistance mechanisms in *Campylobacter* [IA, OH]
- C. Secured funding from ICASA to determine assay targets and to develop assays for antibiotic resistance genes in BRD pathogens [IN]

### Appendix I: Publications

- Abraham ME, Weimer SL, Scoles K, Vargas JI, Johnson TA, Robison CL, Hoverman L, Rocheford E, Rocheford T, Ortiz D, Karcher DM. (2021). Orange corn diets associated with lower severity of footpad dermatitis in broilers. *Poultry Science*, 100(5), 101054. <http://doi.org/10.1016/j.psj.2021.101054>
- Adiguzel, M. C., D. B. Goulart, Z. Wu, J. Pang, S. Cengiz, Q. Zhang and O. Sahin 2021. Distribution of CRISPR Types in Fluoroquinolone-Resistant *Campylobacter jejuni* Isolates. *Pathogens* 10(3). 345. <https://doi.org/10.3390/pathogens10030345>
- Alt, L., A. Iverson, M.L. Soupir, T.B. Moorman, A.C. Howe. 2021. Antibiotic resistance gene dissipation in soil microcosms amended with antibiotics and swine manure. *Journal of Environmental Quality*. DOI: <http://doi.org/10.1002/jeq2.20240>
- Barrios, R.E., Bartelt-Hunt, S.L., Li, Y. and Li, X., 2021. Modeling the vertical transport of antibiotic resistance genes in agricultural soils following manure application. *Environmental Pollution*, p.117480.
- Bulut, E., A. Stout, M. Wemette, S. Llanos-Soto, R.C. Schell, A. Greiner Safi, M.A. Shapiro, P. Moroni, R. Ivanek. How does public perception of antibiotic use on dairy farms contribute to self-reported purchasing of organic? *Journal of Food Science*, 2021, May 6. doi: 10.1111/1750-3841.15720 [CA, NY, Italy]
- Cantu-Jungles TM, Bulut N, Chambry E, Ruthes A, Iacomini M, Keshavarzian A, Johnson TA, Hamaker BR. (2021). Dietary fiber hierarchical specificity: the missing link for predictable and strong shifts in gut bacterial communities. *mBio*, e0102821. <http://doi.org/10.1128/mBio.01028-21>
- Dutta, E., Loy, J.D., Deal, C.A., Wynn, E.L., Clawson, M.L., Clarke, J. and Wang, B., 2021. Development of a multiplex real-time PCR assay for predicting macrolide and tetracycline resistance associated with bacterial pathogens of bovine respiratory disease. *Pathogens*, 10(1), p.64.
- Duttlinger AW, Centeno Martinez RE, McConn BR, Kpodo KR, Lay DC, Richert BT, Johnson TA, Johnson JS (2021). Replacing dietary antibiotics with 0.20% L-glutamine in swine nursery diets: impact on intestinal physiology and the microbiome following weaning and transport. *Journal of Animal Science*. [in press] <http://doi.org/10.1093/jas/skab091>
- Hall, M.C., Duerschner, J., Gilley, J.E., Schmidt, A.M., Bartelt-Hunt, S.L., Snow, D.D., Eskridge, K.M. and Li, X., 2021. Antibiotic resistance genes in swine manure slurry as affected by pit additives and facility disinfectants. *Science of the Total Environment*, 761, p.143287.
- Kaniyamattam, K., L. Tauer, and Y. Grohn (2021). System economic costs of antibiotic use elimination in the US beef supply chain. *Front. Vet. Sci.*, 26 April 2021 <https://doi.org/10.3389/fvets.2021.606810> [NY]
- L. J. Verteramo Chiu, L.W. Tauer, and Y. T. Grohn. (Accepted for 2022) Pricing efficiency and market power in livestock auction markets: a two-tier frontier approach. *Agricultural Economics*. [NY]
- Li, B., Li, X. and Yan, T., 2021. A Quantitative Metagenomic Sequencing Approach for High Throughput Gene Quantification and Demonstration with Environmental Antibiotic Resistance Genes. *Applied and Environmental Microbiology*, pp.AEM-00871.
- Llanos-Soto, S., N. Vezeau, M. Wemette, E. Bulut, A. Greiner Safi, P. Moroni, M.A. Shapiro, R. Ivanek. Survey of perceptions and attitudes of an international group of veterinarians regarding antibiotic use and resistance on dairy cattle farms. *Preventive Veterinary Medicine*. 2021, Volume 188. 105253. <https://doi.org/10.1016/j.prevetmed.2020.105253> [IL, NY, Italy]
- Mohan S, Pascual-Garrigos A, Brouwer H, Pillai D, Koziol JH, Ault A, Schoonmaker J, Johnson TA, Verma MS. (2021). Loop-mediated isothermal amplification for the detection of *Pasteurella multocida*, *Mannheimia haemolytica*, and *Histophilus somni* in bovine nasal samples. *ACS Agricultural Science and Technology*. [in press] <http://doi.org/10.1021/acsagscitech.0c000722020>.

- Muurinen J<sup>‡</sup>, Richert J, Wickware CL<sup>†</sup>, Richert B, Johnson TA. (2021) Swine growth promotion with antibiotics or alternatives can increase antibiotic resistance gene mobility potential. *Scientific Reports*, 11(1), 5485-13. <http://doi.org/10.1038/s41598-021-84759-9>
- Neher, T., L. Ma, T.B. Moorman, A.C. Howe, M.L. Soupier. 2020. Catchment-scale export of antibiotic resistance genes and bacteria from an agricultural watershed in central Iowa. *PLoS one*. 15(1): e0227136. DOI: <https://doi.org/10.1371/journal.pone.0227136>
- Neher, T., L. Ma, T.B. Moorman, A.C. Howe, M.L. Soupier. 2020. Seasonal variations in export of antibiotic resistance genes and bacteria in runoff from a small-scale agricultural watershed in central Iowa. *Science of the Total Environment*. 140224 DOI: <https://doi.org/10.1016/j.scitotenv.2020.140224>
- Padda, H., Wemette, M., Safi, A. G., Beauvais, W., Shapiro, M. A., Moroni, P., & Ivanek, R. (2021). New York State dairy veterinarians' perceptions of antibiotic use and resistance: A qualitative interview study. *Preventive Veterinary Medicine*, 194. <https://doi.org/https://doi.org/10.1016/j.prevetmed.2021.105428> [IN, NY, Italy]
- Qian, X.; Gunturu, S.; Sun, W.; Cole, J.R.; Norby, B.; Gu, J.; Tiedje, J.M. (2021) Long-read sequencing revealed cooccurrence, host range, and potential mobility of antibiotic resistance in cow feces. *Proc Natl Acad Sci USA* June 22, 2021 118(25) e2024464118; <https://doi.org/10.1073/pnas.2024464118>
- Ruddell, B., A. Hassall, O. Sahin, Q. Zhang, P. Plummer, and A. Kreuder. 2020. Role of metAB in methionine metabolism and optimal chicken colonization in *Campylobacter jejuni*. *Infect. Immun.* *Infect Immun* 89:e00542-20. <https://doi.org/10.1128/IAI.00542-20>.
- Schueler, J., Lansing, S., Crossette, E., Naas, K., Hurst, J., Raskin, L., Wigginton, K., Aga, D.S., 2021. Tetracycline, sulfadimethoxine, and antibiotic resistance gene dynamics during anaerobic digestion of dairy manure. *Journal of Environmental Quality* 50(3): 694-705. doi: 10.1002/jeq2.20211
- Schueler, J., Lansing, S., Naas, K., Hurst, J., Aga, D.D., Lansing, S., 2021. Effects of on-farm dairy manure composting on tetracycline content and nutrient composition. *Journal of Antibiotics* 10 (4): 443. doi: 10.3390/antibiotics10040443
- Staley, Z.R., Tuan, C.Y., Eskridge, K.M. and Li, X., 2021. Using the heat generated from electrically conductive concrete slabs to reduce antibiotic resistance in beef cattle manure. *Science of The Total Environment*, 768, p.144220.
- Staley, Z.R., Woodbury, B.L., Stromer, B.S., Schmidt, A.M., Snow, D.D., Bartelt-Hunt, S., Wang, B. and Li, X., 2021. Comparison of Stockpiling and Composting on Reducing Antibiotic Resistant Bacteria and Resistance Genes in Beef Cattle Manure. *Applied and Environmental Microbiology*, pp.AEM-00750.
- Sun, Y., Clarke, B., Clarke, J. and Li, X., 2021. Predicting antibiotic resistance gene abundance in activated sludge using shotgun metagenomics and machine learning. *Water Research*, p.117384.
- Sylte, M. J., S. K. Sivasankaran, J. Trachsel, Y. Sato, Z. Wu, T. A. Johnson, L. C. Chandra, Q. Zhang and T. Looft. 2021. The Acute Host-Response of Turkeys Colonized With *Campylobacter coli*. *Front Vet Sci* 8: 613203. doi: 10.3389/fvets.2021.613203
- Venkateswarlu Y, Medina R, Johnson TA, Koteva K, Cox G, Thaker M, Wright G. (2020). Resistance-Guided Discovery of Elfamycin Antibiotic Producers with Antigonococcal Activity. *ACS Infectious Diseases*, acsinfecdis.0c00467. <http://doi.org/10.1021/acsinfecdis.0c00467>
- Wemette, M., Greiner Safi, A., Wolverson, A.K., Beauvais, W., Shapiro, M., Moroni, P., Welcome, F., Ivanek, R. Public Perceptions of Antibiotic Use on Dairy Farms in the United States. *Journal of Dairy Science*. 2021, Volume 104 (3). 2807-2821. DOI: <https://doi.org/10.3168/jds.2019-17673> [IN, NY, Italy]
- Wind, L., Briganti, J.S., Brown, A.M., Neher, T.P., Davis, M.F., Durso, L.M., Spicer, T., Lansing, S., 2021. Finding what is inaccessible: Antimicrobial resistance language use among the One Health domains. *Journal of Antibiotics* 10 (4): 385. doi: 10.3390/antibiotics10040385
- Wu, Z., O. Sahin, and Q. Zhang. 2021. Complete genome sequence of *Campylobacter hepaticus* USA52 associated with chicken spotty liver disease. *Microbiology Resource Announcement*. Vol 10: e01266-20
- Wu, Z.; M.J. Yaeger, O. Sahin, C. Xu, A.F. Beyi, P.J. Plummer, M. Meral Ocal, and Q. Zhang. 2021. A homologous bacterin protects sheep against abortion induced by a hypervirulent *Campylobacter jejuni* clone. *Vaccines*. 8:662. <https://doi.org/10.3390/vaccines804066>
- Zhang, Y., Schmidt, J.W., Arthur, T.M., Wheeler, T.L. and Wang, B., 2021. A Comparative Quantitative Assessment of Human Exposure to Various Antimicrobial-Resistant Bacteria among US Ground Beef Consumers. *Journal of Food Protection*, 84(5), pp.736-759.

**Appendix II: Scientific and Outreach Presentations**

- Adiguzel, M., Goulart, D. B., Dai L., Wu, Z., Pang, J., Cengiz, S., Sahin, O., Zhang, Q. 2020. Distribution of CRISPR in fluoroquinolone resistant *Campylobacter jejuni* isolates. ASM Microbe Online, June 18-22, 2020.
- Beyi, A.F., T. Hawbecker, A. Hassall, R. Dewell, G. Dewell, O. Sahin, Q. Zhang, P. J. Plummer. A single injection of enrofloxacin alters gut microbial diversities irrespective of its dose in beef calves. Conference of Research Workers in Animal Diseases (virtual), December 5-8, 2020.
- Beyi, A.F., T. Hawbecker, C. Slagel, B. Ruddell, A. Hassall, R. Dewell, G. Dewell, O. Sahin, Q. Zhang, P. J Plummer. 2020. Treatment of bovine respiratory disease with danofloxacin altered diversities and resistome profiles of gut microbiota and prevalence of *Campylobacter* in beef calves. BIOF 089 | Microbiome Bioinformatics with QIIME2 at NIH, Jan. 8 - 10, 2020; Bethesda, Maryland, USA.
- Bing Wang. A comparative quantitative assessment of human exposure to various antimicrobial resistant bacteria among U.S. ground beef consumers. Presented at the National Institute of Antimicrobial Resistance Research and Education (NIAMRRE) Annual Conference. Virtual event. April 20, 2021.
- Bulut, E., Stout, A., Wemette, M., Llanos-Soto, S., Schell, R., Greiner Safi, A., Shapiro, M., Moroni, P., Ivanek, R. How does public perception of antibiotic use on dairy farms contribute to purchasing organic? 2020 Conference for Research Workers in Animal Agriculture (CRWAD) Virtual Conference, December 5-8, 2020. Oral presentation.
- Centeno RE, Glidden N, Mohan S, Davidson J, Verma M, Johnson TA. (2021) Identifying Bovine Respiratory Disease (BRD) through the nasal microbiome. World Microbe Forum (virtual), June 2021.
- Centeno RE, Glidden N, Mohan S, Davidson J, Verma M, Johnson TA. (2021) Identifying Bovine Respiratory Disease (BRD) through the nasal microbiome. Indiana Branch of the American Society for Microbiology Annual Meeting (virtual), April 2021.
- Cheng JJ, Centeno RE, McConn B, Johnson J, Johnson TA. (2021) The Impact of Transportation Stress on the Swine Gut Microbiome. World Microbe Forum (virtual), June 2021.
- Cheng JJ, Centeno RE, McConn B, Johnson J, Johnson TA. (2021) The Impact of Transportation Stress on the Swine Gut Microbiome. Indiana Branch of the American Society for Microbiology Annual Meeting (virtual), April 2021.
- Goulart, D. B., Beyi, A. F., Wilson, S., Schroeder, A., Ocal, M., Adiguzel, M., Wu, Z., Singh, K., Dewell, R., Dewell, G., Plummer, P., Sahin, O., Zhang, Q. 2020. Effect of different fluoroquinolone treatments on the dynamics of fluoroquinolone resistance in *Campylobacter jejuni* in calves. ASM Microbe Online, June 18-22, 2020
- Goulart, D. B., Beyi, A., Wilson, S., Schroeder, A., Ocal, M., Adiguzel, M., Wu, Z., Singh, K., Dewell, R., Dewell, G., Plummer, P., Zhang, Q., Sahin, O. 2020. The influence of enrofloxacin and danofloxacin on fluoroquinolone resistance in *Campylobacter jejuni* in calves. Conference of Research Workers in Animal Diseases (virtual), December 5-8, 2020.
- Lansing, S., 2021. Quantifying cattle manure-AMR perceptions and treatment system variabilities to develop a novel communication framework for conveying AMR science and mitigation opportunities: A4171 Food Safety Challenge Area Mitigating Antimicrobial Resistance. USDA-AFRI Project Directors Meeting. Virtual Meeting. May 3-5, 2021.
- Llanos-Soto S., N. Vezeau, M. Wemette, E. Bulut, A. Greiner Safi, P. Moroni, M. Shapiro, R. Ivanek. Antibiotic use and resistance on dairy cattle farms: perceptions of an international group of veterinarians. 5th International Conference on Responsible Use of Antibiotics in Animals. Amsterdam, the Netherlands. (Virtual due to COVID-19). 7-9 June, 2021. Poster presentation.
- Llanos-Soto, S., Vezeau, N., Wemette, M., Bulut, E., Greiner Safi, A., Moroni, P., Shapiro, M.A., Ivanek, R. International survey of veterinarians' perceptions about antibiotic use and resistance on dairy cattle farms. 2020 Conference for Research Workers in Animal Agriculture (CRWAD) Virtual Conference, December 5-8, 2020. Oral presentation.
- Oladele PO, Trachsel J, Looft TP, Johnson TA. In-feed Antibiotic Reduces Bacterial Functional Diversity While Increasing Antibiotic Resistance Gene Abundance in Turkeys. World Microbe Forum (virtual), June 2021.
- Pang J, Q. Zhang, and O. Sahin. 2020. Evaluation of microbiota-based interventions as a preharvest control strategy for *Campylobacter* in poultry. ASM Microbe Online (virtual), June 18-22, 2020.
- Pang, J., Q. Zhang, O. Sahin. 2020. Protection against *Campylobacter* by Fecal Microbiota Transplantation in Newly Hatched Broiler Chickens. Conference of Research Workers in Animal Diseases (virtual), December 5-8. 2020.

- Soupir, M.L. 2020. AMR detection and mitigation in the agricultural environment. Presentation and Panel Discussion. National Institute of Animal Agriculture 10th Antibiotic Symposium, Humans, Animals and the Planet. Vital to Our Future. Virtual Conference, 11/2/20 – 11/4/20.
- Soupir, M.L. 2020. AMR World Antimicrobial Resistance Congress Americas 2020. One Health Panel Discussion. Virtual Conference, 10/8/20.
- Soupir, M.L. 2021. AMR detection and mitigation in the agricultural environment. Presentation and Panel Discussion. NIAMRRE Webinar. Member Spotlight, 03/02/2021.
- Vasco, K., S. Carbonell, R. Mosci, B. Bowcutt, R. Erskine, L. Sordillo-Gandy, B. Norby, P. Ruegg, L. Zhang, S.D. Manning. Variation in intestinal antibiotic-resistant bacterial populations in dairy cattle following a third-generation cephalosporin treatment. 2020.
- Wickware C, Chastain C, Radcliffe JS, Schinkel AP, Richert B, Johnson TA. (2021) Effects of Pre- and Post-weaning Soluble Fiber (Dextrin) Supplementation in Pigs on Intestinal Microbial Community Composition. World Microbe Forum (virtual), June 2021.
- Xu Li. Mitigating antimicrobial resistance in agricultural and urban environments. Presented at the NIAMRRE Member Spotlight. Virtual event, July 6, 2021.
- Yifan Wu. John W. Schmidt, Terrance M. Arthur, and Bing Wang. Antimicrobial-resistant non-typhoidal Salmonella in various foods at retail in the United States: A rapid systematic review and meta-analysis. Poster presentation at IAFP 2021 Annual Meeting, Phoenix, Arizona. July 18 - 21, 2021.