Centre for VETERINARY EPIDEMIOLOGICAL RESEARCH



BIENNIAL REPORT

2020-2022



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Message from the Director



It is a pleasure to provide a summary of the activities related to the Centre for Veterinary Epidemiological Research (CVER) at the University of Prince Edward Island during 2020–2022. CVER continues to make important headlines at regional, national, and international arenas. In the following sections,

I will summarize the main activities carried out by our members during this period. More information about other events and activities can also be found in our CVER website (*cver.upei.ca*).

A major highlight during this period was the successful organization of the 16th International Symposium in Veterinary Epidemiology and Economics (ISVEE) in Halifax, Nova Scotia, in August 2022. The prestigious conference brought more than 700 delegates from countries around the world for five days of intense discussion about different topics in population health. More details are described in this report.

In other important highlights, Dr. Krishna Thakur, assistant professor of infectious disease epidemiology, was awarded the UPEI Faculty Association Merit Award for Scholarly Achievement in 2022; and Dr. Dennis Makau, a former UPEI PhD student, was presented with the prestigious Wayne Martin ISVEE Emerging Scientist Award at the 2022 ISVEE conference. CVER's Epi on the Island courses, "Bias in Observational Studies" and "Online Course in Quantitative Risk Modelling" in 2021 and the "Measurement of Scale Workshop" in 2022, provided exciting opportunities to engage international audiences in our successful training program in veterinary epidemiology.

We congratulated CVER graduate students who completed their degrees as well as those who received awards for their research and knowledge translation efforts, both near and far. We welcomed several new CVER faculty members and graduate students, and we sent our best wishes to all our members who started a new professional path.

I would like to thank all our members for their talents and efforts to keep CVER such a strong brand within the veterinary epidemiology world. It is because of everyone's commitment to research excellence and dedication to training and mentoring that we continue to be among the most successful veterinary epidemiology programs worldwide. With such an extraordinary CVER team, we will continue to grow and flourish. I hope you will enjoy reading some details of our activities and accomplishments.

Sincerely, Dr. Javier Sanchez, Director

2. CVER Hosts ISVEE

In August of 2022, Halifax, Nova Scotia, welcomed over 700 delegates from 54 countries to the 16th International Symposium of Veterinary Epidemiology and Economics (ISVEE). Co-chaired by Drs. Javier Sanchez, director of CVER, and John VanLeeuwen, interim dean and professor, Department of Health Management, Atlantic Veterinary College (AVC), the conference's theme was "Connecting animals, people, and their shared environments."



The conference is a global forum for graduate students, postdoctoral fellows, junior and

senior investigators, health policymakers, and those working in and researching veterinary medicine to exchange information that can advance the fields of veterinary epidemiology and economics, and related disciplines in the health and social sciences. ISVEE traditionally takes place every three years, but due to COVID-19, it has not been hosted since it was held in Chiang Mai, Thailand, in 2018.

During the symposium, delegates participated in and discussed over 400 oral and 350 poster presentations. In addition, five pre-conference workshops were offered in Halifax and one post-conference workshop at AVC. Six faculty members from AVC sat on the organizing committee. CVER was well represented with more than 30 members at the conference (see photo below).



CVER delegates at ISVEE itn Halifax 2022

As is the tradition, ISVEE 2022 concluded with a memorable social event— a traditional Eastern Canadian kitchen party in one of Canada's historic landmarks, the Halifax Citadel National Historic Site. The party featured a live band that played traditional Eastern Canadian music and much more. We are looking forward to the next international symposium in Sydney, Australia, in 2024.

3. Partners

3.1. Ocean Frontiers Institute (OFI) by Drs. Krishna Thakur and Sonja Saksida

Research on new models of salmon health management and on One Ocean Health continues to be carried out by the CERC/ CVER group as part of the Ocean Frontiers Institute Phase-I and Phase-II research programs, respectively. Phase-I research activities, which are completed now, included agent-based models on sea lice treatment strategies and development of resistance (Dr. Jaewoon Jeong), infectious viral disease spread models between salmon farms on the east and west coast of Canada (Dr. Joao Romero), and state-space modelling of sea lice outbreaks in salmon farms around Grand Manan Island, New Brunswick (Dr. Adel Elghafghuf). The assessment of transmission patterns of sea lice among salmon farms in the Bay of Fundy, New Brunswick (PhD student Marianne Parent), is ongoing research activity under OFI Phase-I project. Drs. Sonja Saksida and Krishna Thakur are leading CVER-related research activities under the OFI Phase-II project. One of the Phase-II research projects is on epidemiological and genomic determinants of epizootic shell disease in lobsters in Canada (PhD student Svenja Köpper) and aims to forecast the risk of the disease in key lobster fishery areas under varying climate projections. Another activity aims to evaluate the effectiveness of current antibiotic treatment practices on Atlantic salmon farms and will develop novel intervention strategies to avoid the need for commonly used therapeutants (Dr. Kristin Reynolds).

3.2. AVC Centre for Aquatic Health Sciences (CAHS) by Dr. Larry Hammell

The AVC Centre for Aquatic Health Sciences (AVC-CAHS) is a long-standing academic centre of expertise for applied fish health research, operated entirely on external funding. The Centre continues to work with various groups in Atlantic Canada on a range of research projects, while also leading the activities of a World Organization for Animal Health (WOAH, formerly OIE) Collaborating Centre on Epidemiology and Risk Assessment of Aquatic Animal Diseases (ERAAAD).

3.2.1. Fish-iTrends (FiT) Database Management

This ongoing sea lice data management project, with three industry associations (ACFFA, NAIA, AANS) and involving Matt Sanford (programmer) and Holly Burnley (project manager), continues to adjust to developments in the salmon aquaculture industry. All sites in NB, NS, and NL are part of the FiT database which includes records on sea lice counts and audits, and non-chemical and chemical controls for lice removal. After upgrading the software used on the fishitrends.com website, we have continued upgrading many related web pages and reports to ensure compatibility and improved user experience. The system continues to provide the basis for OFI research on sea lice infestation on the East Coast (PhD student Marianne Parent).

3.2.2. Infectious Salmon Anaemia Virus (ISAv) Research

A few ISAv research projects have been undertaken in collaboration with the Aquatic Animal Health Division of the NL Department of Fisheries, Forestry and Agriculture (NL FFA). One project compared the fish level apparent prevalence of ISAv among four marine cage sites considered to be infected with two different genotypes of the virus. We compiled an extensive collection of retrospective ISAv diagnostic test (PCR, IFAT, and cell culture) data available for 2020, with completion of further genotyping on selected samples. Apparent prevalence and molecular differences among the detected genotypes were compared.

A second study, which began in late 2022, examines the prevalence of ISAv (based on RT-PCR results) between freshly dead, moribund, and apparently healthy fish from an ISAv-infected marine site and fish from neighbouring sites. ISAv outbreaks result in substantial financial losses to the industry due to fish mortality, depopulation, and potential pathogen spread. With the emergence of new strains of ISAv in recent years and the changing dynamics of the spread of the virus between cages within an infected site and between sites, the objective is to explore pathogen-spread dynamics at the fish level. Fish-level prevalence of ISAv will also be compared for apparently healthy fish samples collected from infected sites with different within-site exposure histories. This study will inform the province's pathogen-specific surveillance program and increase system sensitivity and earlier detection of the virus.

The third ISAv study compiled all historic test results of ISAv from 2012 onward, estimated

the annual incidence of ISAv in NL, and identified factors associated with time-todetection of the virus in marine sites and timeto-depopulation.

3.2.3. Understanding Winter Mortality Patterns in Atlantic Salmon

This research project will use molecular genetic tests on archived samples from Newfoundland marine farms for bacterial and parasitic agents previously known to be associated with winter mortality events in farmed Atlantic salmon in Norway and other regions and conduct an exploratory analysis of retrospective data along with diagnostic test results to identify likely infectious and non-infectious factors associated with winter mortality events in marine sites of farmed Atlantic salmon in NL.

3.2.4. Student Externship and VetSRA Placements

The primary focus in recent years in this collaboration with NL FFA has been on fourthyear DVM students who undertake a twoto-three week clinical externship as part of their rotation schedule to experience clinical veterinary practice in aquaculture. We were able to send one student to NL for an external rotation in 2022 and have secured funding for both a Veterinary Summer Research Award placement and an externship in the coming year.

3.2.5. International Efforts

• WOAH (formerly OIE) Collaborating Centre (ERAAAD): Dr. Larry Hammell has been involved in several activities related to ERAAD. He will be contributing to the implementation plans for WOAH's global aquatic animal health strategy starting in 2023. partnered with IDH and two Indonesian companies to work on expanding their capacity to utilize health and productivity data collected on shrimp and fish farms for predictive models. Dr. Krishna Thakur and three postdoctoral fellows have now finalized publications related to this research.

3.3. Shellfish Research Group by Dr. J Davidson

Projects in 2021–22 included the effect of land use practices, in particular the construction of buildings near the water's edge, on shellfish aquaculture farms; the effect and mitigation of invasive species on oyster growing gear; assessing the effect of Hurricane Fiona on the shellfish aquaculture industry; conducting clinical trials to mitigate the presence of invasive species on mussel socks and collectors; and assessing the effect of oyster seed enhancement on public fishing grounds on PEI.

Final year veterinary rotation student exchanges between AVC and two veterinary colleges in Thailand, which had been cancelled the past two years due to COVID concerns, are expected to be reinstituted in 2023. AVC students will attend a fish health rotation at Kasetsart University and an ecohealth rotation at Mahidol University. Thai students will attend similar rotations at AVC.

3.4. Smallholder Dairy Research Group (SDRG) by Dr. John VanLeeuwen

The Smallholder Dairy Research Group (SDRG) has a dairy research, teaching, and service program involving faculty members, graduate students, veterinarians, veterinary students, and other animal health professionals, along with smallholder dairy farmers. The SDRG collaborates with researchers and students in family science and human nutrition due to the spin-off benefits to farm families from better livestock productivity. The program has been a result



of partnerships among UPEI and other universities (University of Nairobi and Kenyatta University in Kenya, Kasetsart University in Thailand), the Canadian non-governmental organizations Farmers Helping Farmers (FHF) and Veterinarians without Borders Canada (VWB), and dairy farmer groups. Research topics have included methods of enhancing milk productivity through infectious disease control and dairy health management, and how dairy farming and higher milk production have improved sustainable livelihoods, human nutrition, and quality of life.



In 2021 and 2022, Phase 2 of the Queen Elizabeth II Diamond Jubilee Scholarships (QES) interdisciplinary program continued. This project started as a four-year project with \$750,000 in funding for research, teaching, and service in central Kenya, but due to COVID-19, no UPEI students went to Kenya during the past two years, requiring an extension to the project. Six UPEI students are planning to go to Kenya in the summer of 2023 for three-month internships. During the

past two years, the three Kenyan graduate students funded by the project were able to continue to work on their research and theses. Research topics included mastitis control through cow comfort and mastitis prevention efforts (MSc student Edward Kariuki), bovine viral diarrhea virus control through diagnostics and vaccination (PhD student Daniel Muasya), and enhanced nutrition of farm families and school-aged children through training programs (MSc student Julie Oyoo). COVID-19 did interrupt their research projects for several months and complicated the field supervision processes, but Julie defended her thesis in 2021, Daniel defended his thesis in early 2023, and Edward will defend by April 2023. A former QES graduate student, Dr. Dennis Makau, was honoured with the prestigious Wayne Martin ISVEE Emerging Scientist Award at the 16th ISVEE international symposium in Halifax.

The partnerships with the two Canadian NGOs have provided helpful additional human resources for the Kenyan activities of the SDRG, and the partnerships have also been good for these NGOs. VWB has resumed its seven-year \$9M project funded by Global Affairs Canada (GAC) in six countries: Kenya, Ghana, and Senegal in Africa, and Laos, Vietnam, and Cambodia in SE Asia. In partnership with UPEI, FHF is finishing its four-year \$1.7M project in Kenya, also funded by GAC, and has applied for \$2M for a food security project and \$7.1M for a One Health project, both through GAC. It is encouraging to see the many direct and indirect benefits of the SDRG to the partners involved, and we look forward to the continued fruits of these partnerships in the future.

3.5. Sir James Dunn Animal Welfare Centre (SJDAWC) by Dr. Kathryn Proudfoot

The SJDAWC promotes animal welfare through research, service, and education. Over the past two years, research and integrated grants were awarded for the following projects:

2021

• Identifying optimal experimenter handling and familiarization protocols that can be universally implemented to improve lab animal welfare (P Bernard, J Spears, L Bigelow)

• Effects of veterinary handling on canine behaviour and physiology: Must we scare dogs? (K Overall, W Montelpare, K Proudfoot, C Squair)

• Assessment and improvement of horse welfare on Prince Edward Island through benchmarking and a better understanding of horse caretakers' decision-making (C Ritter, K Proudfoot, K MacMillan, I Elsohaby, S McKenna)

2022

• The impact of volunteering with a wildlife service on empathy in veterinary students (LCusack, K Proudfoot, C VanLeeuwen)

• Effects of early life experiences on later problematic behaviours in homeless, rescue shelter kittens (K Overall, K Proudfoot, W Montelpare, C Martin)

• The effect of rearing in a shelved environment on behavioural and physiological markers of welfare (P Bernard, J Spears) Several graduate students and veterinary summer research students were funded through these projects.

Funding was also awarded to two service projects through which investigators work with community groups to provide direct services to animals:

 Improving animal health and welfare of pets in remote northern Canadian communities 2021 (J VanLeeuwen, M Hopson, C Gilroy, M Tuma, S Kutz)

• Medical and surgical care of homeless animals (H Gunn McQuillan, P Foley, R MacDonald, R MacLean, M MacLean)

The following graduate student funded through the SJDAWC (in whole or in part) defended their degree in 2021: Madeline Stein (MSc).

The SJDAWC's annual Animal Welfare in Practice Symposium focused on animal abuse



Hamilton and Dr. Karen Overall

and neglect in 2021 and on the welfare of reptiles and amphibians in 2022. The SJDAWC's 2021 fall webinar series was presented by Dr.

Karen Overall who covered three important topics in veterinary behavioural medicine. The 2022 webinar series was on animal welfare concerns with dog breeding featuring Drs. Brenda Bonnett, Candace Croney, and Rowena Packer. In collaboration with the AVC Animal Welfare Club, the SJDAWC awarded two grants in 2021 and three grants in 2022 to support students who were pursuing external rotations related to animal welfare. It also assisted five students in 2021 and eleven students in 2022 to participate in the annual Intercollegiate Animal Welfare Assessment Contest. To prepare for the contest, students were provided guest lectures in relevant species, including cats in research, psittacine as pets (e.g., parrots), and boar studs in 2021, and octopus in aquaria, dairy-beef calves, show chickens, and shelter cats and dogs in 2022.

More details about all activities, including graduate students, publications, and presentations, can be found in the SJDAWC 2021 Report.



AVC's 2021 Animal Welfare Assessment Contest team (left to right): Alyssa McGee, Lilly Mitchell, Devyn Enwright, Brianna Forbes, and Amy Stoyles

3.6. Antimicrobial Resistance and Risk Analysis Groups by Dr. Javier Sanchez

The Antimicrobial Resistance (AMR) group continues to collaborate with Canada's four other veterinary colleges within the Canadian Dairy Network for Antimicrobial Stewardship and Resistance (CaDNetASR). The fiveyear project is ending in March 2023, and a new proposal have been submitted to Diary Farmers of Canada to continue with this program. The program has been very successful and has trained six PhD, two MSc, and ten undergraduate students working on different projects related to surveillance and stewardship of antimicrobial usage and resistance. One major output of this program is the development of an automated system to capture veterinary clinic antimicrobial sales records to benchmark dairy farms across Canada. As it has done during the last five years, the Public Health Agency of Canada (PHAC) will continue to be a key partner of the new proposal. In addition to continuing with the surveillance component of the program, the new proposal will emphasize the communication, education, and knowledge translation of the research outputs. We have received positive feedback about the proposal, and a final decision about funding will occur in the spring of 2023.

The Risk Analysis group is engaged in diverse fields. First, the group became involved in COVID-19 related activities at the local and national levels, supporting Health PEI and the PHAC modelling group. In addition, it collaborated with a government from Colombia in modelling COVID-19 and obtained funding from three NSERC network proposals related to emerging infectious disease modelling using a One Health approach. Currently, the group is working with two postdoctoral fellows on the transmission of antimicrobial resistance in food animals, humans, and the environment. The supervision is done jointly with Dr. Jane Parmley from the Ontario Veterinary College.

The group is collaborating with research groups from Africa and Europe. It is providing advice for an exposure assessment of health risks associated with the consumption of aflatoxin M1 through milk in dairy farms in Burkina Faso. In addition, the group is collaborating with the Danish Technical University through Dr. Tine Hald to develop an exchange program on the risk of antimicrobial transmission in populations. A PhD student from Denmark will visit CVER during the fall of 2023.

Finally, the group continued to provide advice to the PHAC's Risk and Capability Assessment Unit about risk prioritization approaches for health-related threats. A working group was established with members from three academic institutions from Canada, a government organization from the UK, and different PHAC offices. A paper was published with this work (Zhao, J., et al. *A Rapid Literature Review of Multi-Criteria Decision Support Methods in the Context of One Health for All-Hazards Threat Prioritization*), and a second paper is being finalized.

3.7. Veterinary Epidemiology and Social Science for Animals (VESSA) Group by Dr. Caroline Ritter

The VESSA group was initiated in June 2020 when Dr. Ritter started her position as Canada Research Chair and assistant professor within CVER. Funding received from the John R. Evans Leaders Fund (JELF) allowed for renovations of a lab space and acquisition of necessary equipment. Research by the VESSA group links epidemiology and social sciences using quantitative and qualitative methods. In 2021–2022, Dr. Ritter was an author on nine peer-reviewed articles covering topics such as dairy farmer attitudes and behaviours, public perceptions of dairy farm management practices, and veterinary-client communication.

Two graduate students started in 2021 as part of the VESSA group. Megan Ross, an MSc student supervised by Dr. Ritter and Dr. Proudfoot, focusses on the "human factor" of horse care. Funding for this project has been secured from the Canadian Agricultural Partnership and the Sir James Dunn Animal Welfare Centre. Furthermore, Megan received a Canada Graduate SSHRC scholarship. Emily Morabito, a PhD student supervised by Dr. Ritter and Dr. Andria Jones-Bitton of OVC, investigates veterinarian mental health especially during the transition period from veterinary school to working as a veterinary practitioner. Funding for this project has been secured from Zoetis, Mitacs, VetStrategy, and all five Canadian veterinary colleges.

4.New CVER Team Members



Dr. Beibei Jia joined the AVC Department of Health Management as assistant professor of aquatic epidemiology. In addition to a veterinary degree, she holds a MPVM from the Chinese Academy of Agricultural Sciences, a MVPH from Germany Freie Universität Berlin–Thailand Chiang Mai University, and a PhD in epidemiology from UPEI AVC. Her doctoral and postdoctoral training focused on aquatic epidemiology between 2011 and 2022 at CVER. Her working experience with international animal health organizations gains her the perspective of transboundary animal diseases and emergency preparedness. She now researches the risk factor of complex gill diseases in farmed Atlantic salmon in British

Columbia, Canada. Her career goal is to improve health at the animal-human-environment interface. Her research interests include knowledge synthesis, field investigation, biosecurity, spatial-temporal analysis, and modelling of risk factors.

5. Guests

5.1 Visiting Graduate Students

- Tipsarp Kittisam, Kasetsart University, Thailand, January to June 2021
- Sitang Arkanit, Kasetsart University, September 2022 to February 2023
- Tran Khang, University of Science and Technology of Hanoi, Vietnam, September 2022 to February 2023

6. Awards and Recognition



Dr. Krishna Thakur was honoured with the UPEI Faculty Association Merit Award for Scholarly Achievement in 2022. The award is given to faculty members who possess clear evidence of significant scholarly achievements in their field of study in the last five years. Krishna had published 29 peer-reviewed articles, 16 abstracts in conference proceedings, and six invited talks in the last five years. He also obtained more than \$1.2 million (CAD) in research grants and contracts as principal investigator or co-principal investigator and has been involved in training five post-doctoral trainees and eight graduate students as a primary or co-supervisor in the last three years.



Dr. Dennis Makau (PhD'19) was honoured with the prestigious Wayne Martin ISVEE Emerging Scientist Award at the 16th International Symposium for Veterinary Epidemiology and Economics in Halifax, Nova Scotia, in 2022. The award is given to an individual who is early in their career and demonstrates evidence for high potential based on achievements so far in veterinary epidemiology and economics.

7. Graduate Program Highlights

• **Megan Ross** started an MSc degree on May 1, 2021, under the supervision of Drs. Caroline Ritter and Katy Proudfoot. Her project is titled "Investigation of horse caretakers' perceptions and experiences regarding horse management."

• **Emily Morabito** started a PhD in September 2021, under the supervision of Drs. Caroline Ritter and Andria Jones-Bitton (OVC, University of Guelph). Her project is titled "Supporting positive well-being in early career veterinarians."

Chaya Seale started a doctor of psychology (PsyD) degree in September 2022, under

the supervision of Drs. Caroline Ritter and Yoshi Takano. Her project is titled "Supporting positive well-being in early career veterinarians."

• **Gemma Postill** began a research assistant position in 2021 under the supervision of by Dr. Caroline Ritter. Her project is titled "Experiences of young adults living in PEI during the pandemic."

• **Kaitlin Fitzpatrick** started an MSc degree in January 2021, under the supervision of Drs. Sona Saksida and Krishna Thakur. His project is "An assessment of risk factors associated with ISAv in farmed salmon in Atlantic Canada and Maine."

• **Mark Moore** started an MSc degree in September 2021, under the supervision of Drs. Larry Hammell and Krishna Thakur. His project is titled "Risk factors for poor treatment outcomes after sea lice treatment."

• **Paul Tonita** started an MSc degree in September 2022, under the supervision of Drs. Krishna Thakur and Larry Hammell. His project is titled "Molecular epidemiology of infectious salmon anemia virus."

• **Ahsan Raquib** started a PhD in September 2022, under the supervision of Drs. Krishna Thakur and Larry Hammell. His project is "Within and between farm epidemiology of infectious salmon anemia virus."

• **Sumit Jyoti** started an MSc degree in September 2022, under the supervision of Drs. Krishna Thakur and Beibei Jia. His project is "Spatio-temporal description of patterns of health and mortality events of farmed salmon in British Columbia."

• **Lauren MacNeil** started an MSc degree in January 2022, under the supervison of Drs. Luke Heider and Javier Sanchez. Her project is titled "Phenotypic and genotypic characterization of Campylobacter spp from food production animals in Canada."

• **Murray Gilles** started an MSc degree in September 2022, under the supervision of Drs. Luke Heider and J McClure. His project is titled "Antimicrobial use in dairy farms in Canada."

• **Joao Romero**, PhD, successfully defended his thesis in July 2022.

• **Rasaq Ojasanya**, MSc, successfully defended his thesis in September 2022.

• Julie Oyoo, MSc in Applied Human Sciences, successfully defended her thesis in December 2021.

8. Outreach

This section describes some examples of outreach initiatives.

8.1. Epi on the Island

CVER hosted its annual Epi on the Island summer courses in 2021:

• Drs. Ian Dohoo and Simon Dufour (U. of Montreal) taught a one-week course on "Bias in Observational Studies."

• Dr. Javier Sanchez taught a twoweek online course in "Food Safety Risk Assessment." Three students were from the United States (one is missing in the picture) and two from Canada.



8.2. CVER Research Seminars

 "Integrating different sources of evidence for healthier animals and humans. An example of pathogenic *Leptospira spp.* Infection."
 Dr. Gustavo Monti, associate professor in quantitative veterinary epidemiology,
 Wageningen University, The Netherlands, visited our centre on August 15 and 16, after the ISVEE conference in Halifax.

8.3. International Teaching

• During 2019–2020, Dr. Ian Dohoo was engaged in several teaching and consultation activities outside UPEI:

• He co-taught a one-week course on questionnaire design and measurement scales with Marika Wenemark in Uppsala, Sweden, and as a post-ISVEE course held at AVC.

• He taught a course," Introduction to Multilevel Modelling," three times in 2021, twice for ILRI (once online for graduate students and once for staff) and once in person in Uppsala, Sweden.

• He continued to work with ILRI in Nairobi, Kenya. from 2015–2021, consulting on a variety of research projects each year.

• He contributed to a project run by Health Security Partners, developing and implementing a KAP (knowledge, attitude, practices) survey for the dairy sector in Pakistan.



Questionnaire design and measurement scales course in Sweden

9. Peer-Reviewed Journal Publications

The list includes publications accepted in 2022, even if published in 2023 (or later). The list is not exhaustive and might not include some publications.

1. Cockram M. 2021. Invited Review: The welfare of cull dairy cows. *Applied Animal Science*, 37: 334-352. doi.org/10.15232/ aas.2021-02145

2. Cockram M. and Velarde A. 2022. Sheep. In: *Preslaughter Handling and Slaughter of Meat Animals*. Edited by L. Faucitano. Wageningen Academic Publishers, Wageningen, The Netherlands. 267-310.

3. Creutzinger K, Broadfoot K, Goetz H, Proudfoot K, Costa J, Meagher R, and Renaud D. 2022. Assessing dairy calf response to long-distance transportation using conditioned place aversion. *JDS Communications*. 3:275-279.

4. Creutzinger K, Dann H, Krawczel P, Habing G, Proudfoot K. 2021. The impact of stocking density and a blind on the behavior of Holstein dairy cattle in group maternity pens. Part I: Calving location, locomotion, and separation behavior. *Journal of Dairy Science*, 104:7109-7121. doi.org/10.3168/jds.2020-19744

5. Creutzinger K, Dann H, Krawczel P, Moraes L, Pairis-Garcia M, Proudfoot K. 2021. The impact of stocking density and a blind on the behavior of Holstein dairy cows in group maternity pens. Part II: Labor length, lying behavior, and social behavior. *Journal of Dairy Science*, 104: 7122-7134. doi.org/10.3168/ jds.2020-19745 6. Creutzinger K, Dann H, Moraes L, Krawczel P, Proudfoot K. 2021. Effects of prepartum stocking density and a blind on physiological biomarkers, health, and hygiene of transition Holstein dairy cows. *Journal of Dairy Science*, 104:886-898. doi.org/10.3168/ jds.2020-18718

 Creutzinger K, Pempek J, Habing G, Proudfoot K, Locke S, Wilson D, Renaud D.
 2021. Perspectives on the management of surplus dairy calves in the United States and Canada. *Frontiers in Veterinary Science*, 8:661453. doi.org/10.3389/fvets.2021.661453

Deka RP, Shome R, Dohoo I,
 Magnusson U, Randolph DG, Lindahl JF.
 2021. Seroprevalence and Risk Factors of
 Brucella Infection in Dairy Animals in Urban
 and Rural Areas of Bihar and Assam, India.
 Microorganisms 9.

9. Delphino M, Laurin E, Patanasatienkul T, Rahardjo R, Hakim L, Zulfikar W, Burnley H, Hammell L, Thakur K. 2022. Description of biosecurity practices on shrimp farms in Java, Lampung, and Banyuwangi, Indonesia. doi. org/10.1016/j.aquaculture.2022.738277

10. Delphino M, O'Brien N, Laurin E, Whelan D, Burnley H, Hammell L, Thakur K. 2022. Bayesian analysis of diagnostic sensitivity and specificity for detecting infectious salmon anemia virus (ISAV) using IFAT versus qRT-PCR testing from three different laboratories in Atlantic Canada. (Accepted for publication in *Aquaculture*).

 Diana N, Hoet A, Van Balen Rubio J, Stull JW. 2021. Longitudinal environmental *Staphylococcus* contamination in a new small animal veterinary hospital and utility of cleaning checklists. Zoonoses Public Health.

12. Dohoo I., Emanuelson U. 2021. The use of item response theory models to evaluate scales designed to measure knowledge of, and attitudes toward, antibiotic use and resistance in Swedish dairy producers. *Prev Vet Med* 195, 105465.

13. Ellis J, Stryhn H, Cockram M. 2021. Effects of the provision of a hiding box or shelf on the behaviour and faecal glucocorticoid metabolites of bold and shy cats housed in single cages. *Applied Animal Behaviour Science*, 236:105221. doi.org/10.1016/j. applanim.2021.105221

14. Evason M, McGrath M, Stull JW. Companion animal preventive care at a veterinary teaching hospital—Knowledge, attitudes, and practices of clients. Can *Vet J* 2021; 62:484-490.

15. Evason M, Stein M, Stull JW. Impact of a spectrum of care elective course on third year veterinary students' self-reported knowledge, attitudes, and competencies. *J Vet Med Educ* 2022.

16. Ferreira GCM, Canozzi MEA, Peripolli V, Moura G de P, Sanchez J, Martins, CEN. 2022. Prevalence of bovine Babesia spp., Anaplasma marginale, and their co-infections in Latin America: Systematic review-meta-analysis. Ticks and *Tick-borne Diseases* 13, 101967. doi. org/10.1016/j.ttbdis.2022.101967

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