AVTRW
The Association for Veterinary Teaching and Research Work

CONFERENCE 2020

14-15th September
University of Glasgow,
School of Veterinary Medicine

74th Annual AVTRW Conference 2020

The Association for Veterinary Teaching and Research Work
University of Glasgow, School of Veterinary Medicine

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Welcome

Welcome to the 74th AVTRW Annual Conference, the first virtual conference of the society, broadcasted from the University of Glasgow, School of Veterinary Medicine. I know everyone says it, but it has been and still is, a challenging year. However, I feel we should all focus on the many opportunities that periods of great changes bring, like the flexibility allowed by working remotely, the idea of re-prioritising our time and goals and to value the important things in life more.

For our society, the changes have meant that, for the first year, the AVTRW conference is held virtually. Although a lot it's lost from not being able to socialise directly, as many connections are made at the social night on Monday as well as during breaks, it also means more people have been able to join us and costs for the delegates have obviously been much lower.

The program that our speakers have all contributed to shape is truly engaging and diverse and we hope that you will enjoy these two days.

All the best,

Valentina Busin

AVTRW President

Meeting Programme

Monday 14th September

09:30 - 09.45 Welcome addresses (Valentina Busin, AVTRW President; Ewan Cameron, Head of School)

09:45 - 10.00 Virtual tour of the University of Glasgow, School of Veterinary Medicine

Session 1. Bringing research to the end-users (impact) and diagnostics.

Chair: McNeilly Tom

10.00 - 10:45 Keynote 1. Eckersall David: Veterinary Ventures in Technology Transfer: Biochemical Biomarkers to Developing Diagnostics for End Users.

10:45 - 11:00 O1. Ayala Carlos: Impact and engagement: communicating research in a multi-cultural and multi-disciplinary environment.

11:00 - 11.15 O2. Maughan Jones Charlotte: 'X-ray vision' – Advanced x-ray imaging, the future of medical diagnostics?

11.15 - 11.30 O3. Morgan Genever: A Dog's Dinner: A survey investigating diet choices among UK dog owners.

11:30 - 11:45 Coffee break

11:45 - 12:00 O4. Linardopoulou Konstantina: Lameness detection in dairy cows: Evaluation of the agreement and repeatability of mobility scoring.

12:00 - 12:15 O5. Donlon John Denis: Agreement between Thoracic Ultrasound and a Clinical scoring system in preweaned Irish dairy calves.

12:15 - 12:30 O6. Montout Axel: Accurate and interpretable prediction of poor health in small ruminants with accelerometers and machine learning.

12:30 - 12:45 O7. Macdonald Bethany: The effect of immediate post-birth analgesia provision on the expression of social behaviours in neonatal Holstein dairy calves.

12:45 - 13:00 O8. Kilgour Ashleigh J: Physiological and behavioural impacts of summer rugging on horses in a temperature climate.

13:00 - 14:00 Lunch break

Session 2. Teaching the new generation of professionals.

Chair: Gladden Nicola

14:00 - 14:45 Keynote 2. Hammond Jennifer. Training for uncertainty in Veterinary Education

14:45 - 15:00 O9. Debenham John: eClinic – A gamified case simulator.

15:00 - 15:15 O10. Driver Emma: Development of an Undergraduate Veterinary Leadership Framework.

15:15 - 15:30 Coffee break

15:30 - 15:45 O11. Watson Fraje: Evolving EMS – adapting learning to suit an ever-changing world. A case study of the "UCL 2020 Veterinary Research Undergraduate Programme".

15:45 - 16:00 O12. Tasker Alex: The 21st Century Vet: Non-clinical EMS for building cross-disciplinary research engagement in veterinary undergraduates.

16:00 - 16:15 O13. Wood Sarah: Directly Observed Procedural Skill (DOPS) assessment of clinical examination skills in cattle: student perceptions.

16:15 - 16:30 O14. Woollatt Sarah: Teaching at arm's length: a farm clinician's view.

16:30 - 16:45 O15. Borkowski Emma: Playing with parasites in a pandemic: A new teaching tool.

17:00 Flash poster presentation

Tuesday 15th September

09:45 - 10:00 Welcoming back to the second day. Professor the Lord Trees.

Session 3. Surveillance.

Chair: Martineau Henny

10.00 - 10:45 Keynote 3: Carty Helen. Surveillance shouldn't sit in a silo.

10:45 - 11:00 O16. Clarke AnneMarie: Prioritisation of Animal Health Surveillance Activities in Ireland.

11:00 - 11.15 O17. Havercroft Charlotte Letitia: Demographics and diagnoses of neonatal lamb carcass submissions to APHA for post mortem examination over a ten-year period.

11.15 - 11.30 O18. Macrelli Michele: First report of fatal tick pyaemia caused by heavy infestation with the red sheep tick, Haemaphysalis punctata and co-infection with Babesia and Theileria spp.

11:30 - 11:45 Coffee break

11:45 - 12:00 O19. Geddes Eilidh: Exploiting scanning surveillance data to assess the impact of disease control initiatives and inform future strategies to control endemic diseases. The example of sheep scab.

12:00 - 12:15 O20. Kiernan Kelsey: The occurrence and distribution of antimicrobial resistant bacteria in companion animals at a small animal veterinary hospital.

12:15 - 12:30 O21. McGlennon Abigail. Investigating laboratory diagnoses of equine strangles in the UK and internationally to enhance understanding of disease prevalence and veterinary approaches to diagnosing strangles.

12:30 - 12:45 O22. Kelly Nicholas: A retrospective analysis of dog, cat and rabbit forensic post-mortem examinations, performed at Royal veterinary college 2003-2020, with emphasis upon starvation-based neglect and non-accidental injury.

12:45 - 13:00 O23. Rhodes Victoria: Diagnosis of respiratory disease in Irish dairy calves using thoracic ultrasonography - temporal transitions and association with growth rates.

13:00 - 13:15 O24. O'Neill Lorcan: Antimicrobial resistance in Escherichia coli isolates in pigs from farms with differing levels of antimicrobial use: a longitudinal study.

13:15 - 14:00 Lunch break

Session 4. Parasitology.

Chair: McAloon Conor

14:00 - 14:45 Keynote 4: Denwood Matt. Diagnostics and parasitology: the problem of mapping diagnostic test results to disease status.

14:45 - 15:00 O25. Gummery Lauren: Clinical features of T. brucei ssp. infection in working equids in The Gambia: a prospective clinical case series.

15:00 - 15:15 O26. McGregor Cassandra: Investigating the role of animal movement in the dissemination of roundworm infection and anthelmintic resistance in livestock.

15:15 - 15:30 Coffee break

15:30 - 15:45 O27. Apaa Ternenge: Seroprevalence and risk factors associated with canine vector-borne diseases in Nigeria.

15:45 - 16:00 O28. Chen Wan: RNA interference in the poultry red mite Dermanyssus gallinae.

16:00 - 16:15 O29. Evangelista Francisco Miguel Dias: In silico identification of vaccination targets from Ascaris lumbricoides and Ascaris suum proteomes.

16:30 - 16:45 Conference closure

17:00 - 18:00 AVTRW annual general meeting, open to all conference attendees

AVTRW membership

Do I have to be a vet to join?

No. Members may be either veterinarians or other graduates who have a major interest in either Veterinary Research or Teaching. Currently, members range through:

- Academic staff in many veterinary and non-veterinary faculties
- Research workers in both universities and research institutions
- Medical researchers with particular interests in the veterinary field
- Veterinary investigation officers
- Individuals in commerce and diagnostic laboratories

How do I join?

Please download and complete the application forms either from our website at:

http://www.avtrw.co.uk/membership/

or from the following direct download link (full instructions and an overview of the procedure are provided on the first page of the document) at:

http://www.avtrw.co.uk/index.php/download_file/view/45/125/

Once your membership application is received and processed, you will begin to receive Association correspondence and notice of future meetings and will be eligible for all benefits and discounts that are available to AVTRW members. Your membership will be classified as provisional until it is either ratified or declined at the next Annual General Meeting of the full Association following your application. Should your application be declined, your membership joining fee will be refunded.

How much does it cost?

- Annual membership is currently £25 sterling when paid by standing order from a UK bank, or £26 when paid by PayPal.
- Applicants that are registered as a student (undergraduate or postgraduate) at the time of application will receive three years membership for the price of the membership joining fee. Thereafter the annual fee is as above.
- Note that conference costs are kept low to encourage attendance, and participation from students is actively encouraged.

Keynote Speaker Biographies

Professor David Eckersall

Professor David Eckersall graduated from the University of Liverpool with a BSc in Biochemistry (1973) and a PhD in Biochemistry from University of Edinburgh (1977) whilst working at the Animal Breeding Research Organisation (Roslin Institute). Prof Eckersall is the Professor of Veterinary Biochemistry at the School of Veterinary Medicine, University of Glasgow. His research has been focused on the diagnostic applications of protein analysis in veterinary medicine and in particular on the development and applications of acute phase proteins such as haptoglobin, C-reactive protein and serum amyloid A in diagnosis of disease in animals. He has published over 200 peer reviewed papers, holds 4 patents and co-edited the first and second books on animal proteomics (Methods in Animal Proteomics, Wiley, Proteomics in Domestic Animals: from Farm to Systems Biology, Springer). He was the Chair of the COST Action for Farm Animal Proteomics (2011-14) and ERA Chair at the Proteomics laboratory University of Zagreb, Croatia. He was awarded the Heiner Sommer Prize of the International Society for Animal Clinical Pathology for Lifetime Contribution to Animal Clinical Biochemistry in 2008, the Siemens Prize of the Division of Animal Clinical Chemistry of the American Association of Clinical Chemistry for Contributions to Animal Clinical Chemistry in 2010 and the Lifetime Achievement Award of the Comparative Clinical Pathology Association in May 2016. His university spinout company ReactivLab Ltd was acquired by Avacta Group Ltd in 2010. He is a Fellow of the Royal College of Pathologists, a Fellow of the Royal Society of Biology and a Member of the Academia Europaea.

Dr Jennifer Hammond

Jennifer Hammond is a veterinary surgeon with a background in small animal primary care practice and expertise in veterinary education including small group clinical teaching, competency assessment and curriculum design. Her current role is as a Senior Lecturer in Veterinary Education at the University of Glasgow, where she is responsible for the Bachelor of Veterinary Medicine and Surgery (BVMS) Programme. Her research interests include understanding how students learn to cope with uncertainty in veterinary professional practice (the topic of my professional doctorate) and the impact of ambiguity tolerance on learning. She is particularly interested in how students are prepared to learn in the clinical workplace and how we can optimise learning in these rich and complex environments.

Helen Carty

Helen Carty qualified from Edinburgh in 2003 and following four years in mixed practice in Renfrewshire moved to SRUC Veterinary Services, based in Ayr in southwest Scotland in 2007. She holds a As Veterinary Centre Manager her work includes farm animal pathology, disease investigation, reporting on surveillance in addition to Premium Cattle Health Scheme technical support. She completed her Certificate in Advanced Veterinary Practice (Cattle) in 2015.

Dr Matthew Denwood

Matt graduated from Glasgow vet school in 2006 with a keen interest in production animal medicine. Shortly afterwards he decided a brief return to the University environment was essential in order to get to grips with the epidemiology that is fundamental to preventive medicine, but after almost 15 years he is still working on fully understanding what turned out to be a bigger field than he anticipated. His PhD covered epidemiology and data analysis relating to cyathostomins in horses and nematodirus battus in sheep, along with methodological developments relating to the faecal egg count reduction test. His post-doctoral training and experience developed interests in applied statistics and programming, ultimately leading him to a move to the University of Copenhagen in 2014 where he is currently employed as Associate Professor in Quantitative Veterinary Epidemiology and Biostatistics.

Oral Presentations

Session 1. Bringing research to the end-users (impact) and diagnostics.

Keynote 1. David Eckersall: Veterinary Ventures in Technology Transfer: Biochemical Biomarkers to Developing Diagnostics for End Users.

Institute of Biodiversity, Animal Health and Comparative Medicine & School of Veterinary Medicine, University of Glasgow, UK

Over recent years an objective of our research has been to enable the impact of research in veterinary biochemistry by transferring the technology to end-users in diagnostic laboratories and for point of care and on-farm utilisation. Examples of these ventures, including successful outcomes as well as pitfalls encountered, will illustrate how basic scientific investigations can initiate technology transfer for enhancing diagnostics in both companion and farm animal health care. Investigations of acute phase proteins (APP) in animals has been the backbone of research, for example with patents generated in the analysis of serum haptoglobin in all species, while immunoassays have been developed for biomarkers such as canine C-reactive protein and feline a1 acid glycoprotein. Assay of haptoglobin and mammary associated serum amyloid A in bovine milk has also been pioneered as biomarkers for mastitis and are available often by collaboration with kit manufacturers.

To have viable impact, is vital that research outputs can be transferred to end-users in sufficient volume and high quality to allow widespread use. A variety of means has been used to achieve this technology transfer, from close collaboration with industry, through protection of intellectual property by patenting and subcontracting manufacturing and distribution, to the full extent of establishing a spin-out company. While progress has been made in transferring research into routine diagnostic testing, there is still plenty of scope for novel approaches to the sector. Identification of novel biomarkers for instance where proteomic and metabolomic investigations have yielded promising discoveries of protein and metabolites that will underpin the diagnostics of the future. There are new means of delivery especially in the area of point-of-care diagnostics with methodology gaining traction for rapid delivery of testing and there are new uses for established tests such as with algorithm based multiplexing of biomarkers. These make for promising areas with plentiful opportunities to bring the impact of research to end-users.

O1. Impact and engagement: communicating research in a multi-cultural and multi-disciplinary environment.

Carlos Ayala, Cristina Ballesteros, Kristen Reyher

Bristol Veterinary School - University of Bristol

It has been reported that research projects often consider communication and engagement as abstract measures marginally linked to their activities. In some cases, research activities may result in lack of defined objectives and target audiences (EIPRD, 2018). Communication, however, contributes to promotion of both research actively being carried out as well as completed achievements. The international and multi-disciplinary 'Futureproofing Antibacterial resistance Risk Management – Surveillance and Stewardship in the Argentinian Farming Environment' project, using a participatory approach involving research teams in the UK and Argentina, has developed a Communication, Impact and Engagement Strategy focusing on project branding in order to strengthen local engagement, raise awareness about antibacterial medicine use, and resistance in Argentina. The Strategy, which seeks to establish objectives, identify target audiences and monitor progress, was designed following review of a number of government and non-governmental organisational reports, research project plans and academic journal articles, and makes use of evidence-based planning tools adapted from the Danida Fellowship Centre guide to planning a communication strategy (DFC, 2016). These tools aim to secure the appraisal of impact indicators during implementation and assist with designing tailored communication and engagement activities for specific audiences. It is envisioned that the Strategy will help to increase the processes of interaction and participation between and within both Argentina and the UK through stakeholder engagement. The Strategy will also act as an instrument for strengthening project sustainability in the short and mid-term, bringing value for funders, partners, researchers, educators, policy makers and the wider public.

O2. Maughan Jones Charlotte: 'X-ray vision' – Advanced x-ray imaging, the future of medical diagnostics?

Charlotte J Maughan Jones[1], Jayesh Dudhia[2], Roger K Smith[2], Alessandro Olivo[1]

[1]Department of Medical Physics and Biomedical Engineering, UCL, Malet Place Engineering Building, Gower Street, London. WC1E6BT

[2]RVC, Department of Clinical Sciences and Services, Hawkshead Lane, North Mymms AL9 7TA UK

X-ray imaging is widely utilised in clinical practice for disease diagnosis and monitoring. It is a vital diagnostic tool, and therefore the technology has widespread dissemination within first opinion and referral practice. However the principal behind image formation has remained unchanged since the first x-ray image was obtained over 100 years ago, with contrast produced solely by the variation in absorption of x-rays by different biological tissues. The advanced imaging technique known as 'X-ray phase contrast imaging' (XPCi) utilises the refraction properties of x-rays as they traverse a sample, and the images obtained provide significantly improved image contrast, especially within soft tissues. The 'Edge-Illumination' (EI) method of XPCi developed at UCL produces such contrast enhanced images using a standard laboratory x-ray source, and has been used successfully in a variety of applications such as mammography, materials science, security scanning, tissue engineering and nondestructive '3D histology' of ex vivo tissues. This technique, clinically, could lead to earlier diagnosis of disease and therefore better patient outcome. Preclinically it has the ability to aid in the greater understanding of physiology and anatomy of disease via nondestructive, laboratory based 3D imaging of biological research samples. Within veterinary medicine, equine tendinopathy remains a commonly observed disease state where this approach would support improving the evidence base for treatment. With the enhanced soft tissue contrast obtained from XPCi, we aim to clearly visualise not only the extent of fulminant disease, but also identify areas of subclinical damage enabling clinical disease prevention, and better clinical outcomes.

O3. Morgan Genever: A Dog's Dinner: A survey investigating diet choices among UK dog owners.

Genever Morgan, Nicola Williams, Vanessa Schmidt, Gina Pinchbeck

University of Liverpool

Objectives

- Identify owner factors which may influence diet choice for UK dogs.
- Identify sources of pet diet information sought by UK dog owners.
- Determine the reasons and beliefs behind food choices.

Methods

An online survey was conducted from February-March 2020. All dog owners living in the UK were eligible to participate, regardless of dog food preference. Statistical analysis included chi square and logistical regression methods.

Results

1831 dog owners (915 feeding raw meat diets (RMD), 916 cooked meat diets (CMD)) completed the survey, providing information for 3212 (n=1754 RMD, n= 1458 CMD fed) dogs.

Owners aged 41-74 years were more likely to feed RMD. Owner gender did not have an effect on diet choice.

Dogs obtained from breeders were more likely to be fed RMD, whereas those obtained from a friend/colleague were least likely. Dogs used for breeding, show or working purposes were more likely to be fed RMD compared to pet dogs.

Owners who chose RMD were more likely to seek diet information from social media, friends/family, dog breeders and trainers, and least likely to consult veterinary sources. RMDs were most commonly chosen due to a lack of trust of certain foods and the belief that it is more natural.

Significance of results

There were differences in the diet information source and reasons for diet selection between dog owners who fed RMD and those who did not. Information regarding food safety and hygiene should be directed to these owners via appropriate channels in order to reach the desired population.

O4. Linardopoulou Konstantina: Lameness detection in dairy cows: Evaluation of the agreement and repeatability of mobility scoring.

Linardopoulou Konstantina, Viora Lorenzo, Abbasi Qammer H., Fioranelli Francesco, Le Kernec Julien, Jonsson Nicholas

University of Glasgow

Lameness is often detected by trained experts using visual scoring systems. To develop an artificial intelligence (AI) system for lameness detection, this study aimed to evaluate the performance of the commonly used 4-point mobility scoring system (AHDB Dairy) and determine whether its utility for training AI could be improved if it were transformed to a binary system. Locomotion scoring of 49 cows was conducted using the AHDB 4-scale system. Two experienced veterinarians and three veterinary students simultaneously and independently assessed mobility of the cows on-farm twice, 3 weeks apart, and videos were obtained of all the animals. Videos were evaluated by five experienced veterinarians, including the two who conducted on-farm evaluations. They recorded a score, the number of times they viewed the video, certainty about the score, and a secondary score if they were not certain, as well as comments about the video. A binary scoring system (0=not lame, 1=lame) was constructed from the 4-level system (0, 1, 2, 3) by grouping 0 and 1 as not lame, and 2 and 3 as lame. The intra-rater reliability of the two veterinarians on-farm was 0.249 and 0.349 and transposed to 0.445 and 0.283 after the binary transformation, respectively. Inter-rater reliability ranged from -0.007 to 0.33 for the 5 raters and the original scores, and -0.08 to 0.55 for the binary transformed set. The reliability and agreement of the method were poor to moderate but all measures were improved by the binary transformation, which is significant for future AI study.

	2 raters visit 1 & visit 2 (average +/- SD)	Intra-rater Farm-farm (average +/- SD)	5 raters video (average +/- SD)	Intra-rater Farm-video (average +/- SD)
Cohen's Kappa (4 point)	0.44 (+/-0.026)	0.299 (+/-0.05)	0.054676 (+/-0.124200649)	0.166 (+/-0.034)
Agreement (4 point)	63 (+/-0)	53.25 (+/-3.25)	37.17 (+/-9.492212598)	47.95 (+/- 1.05)
Cohen's Kappa (binary)	0.675 (+/-0.086)	0.364 (+/-0.081)	0.26647 (+/-0.2200037)	0.395 (+/- 0.162)
Agreement (binary)	88.05 (+/-5.45)	77.15 (+/-3.25)	68.57 (+/-11.84795763)	79.6 (+/- 10.2)

Table 1:Inter-rater reliability and percentage agreement for 2 raters (farm), for 5 raters (video) and intra-rater reliability and percentage agreement for 2 raters(farm/farm & farm/video) before and after the binary transformation of the scores.

O5. Donlon John Denis: Agreement between Thoracic Ultrasound and a Clinical scoring system in preweaned Irish dairy calves.

John Donlon[1], Conor McAloon[1], John Mee[2]

[1]University College Dublin, Belfield, Dublin 4, Ireland D04V1W8

[2]Teagasc, Dairy Production Research Department, Dairy Production Research Centre, Moorepark, Fermoy, Co. Cork, Ireland P61C996

Objectives; The objective of this study was to assess the agreement between Thoracic ultrasound (TUS) and the Wisconsin clinical score (WS) in pre-weaned Irish dairy calves, and to estimate the sensitivity and specificity of each method using non-gold standard Bayesian latent class methods.

Materials and Methods; Spring calving dairy farms (n = 29), were randomly recruited throughout the Republic of Ireland, 20 calves were selected on each farm for examination and ultrasound, the study aimed to sample calves between 4 and 6 weeks of age.

The Wisconsin clinical scoring system was used, a score between 0 and 3 was assigned to nasal discharge, ear position, presence of a cough and temperature, a score of ≥5 was considered a case.

TUS was performed on each of the calves using an linear ultrasound probe (Easy Scan Go, IMV). Each calf was assigned a thoracic ultrasound score between 0 and 5, using a scale previously described in literature. Any calf that had a score ≥3 was considered a case of BRD.

We performed Cohen's Kappa to test agreement between results, we also performed a latent class analysis.

Results; There was 87.2% agreement between the tests, a Cohen's kappa of 0.142 was found, this was not found to be statistically significant ($p > 0.05$).

Conclusions; These results suggest that neither method effectively evaluates the entire respiratory tract of a calf resulting in the lack of agreement, further research into alteration of the weighting of certain parameters in clinical scoring systems may improve this agreement.

O6. Montout Axel: Accurate and interpretable prediction of poor health in small ruminants with accelerometers and machine learning.

Axel X. Montout[1,2], Ranjeet S. Bamber[1,2], Debbie S. Lange[3], Doreen Z. Ndlovu[4], Eric R. Morgan[5], Christos C. Ioannou[6], Thomas H. Terrill[7], Jan A. van Wyk[8], Tilo Burghardt[9], Andrew W. Dowsey[1,2]

[1]Bristol Veterinary School, University of Bristol, Bristol, UK

[2]Department of Population Health Sciences, Bristol Medical School, University of Bristol, UK

[3]13 Spey St., Extension 3, North Mead, Benoni 1501, Gauteng Province, South Africa

[4]KZN Department of Agriculture and Rural Affairs, P/B X9059, Pietermaritzburg, 3200, KwaZulu-Natal Province, South Africa

[5]School of Biological Sciences, Queen's University Belfast, Belfast, UK

[6]School of Biological Sciences, University of Bristol, Bristol, UK

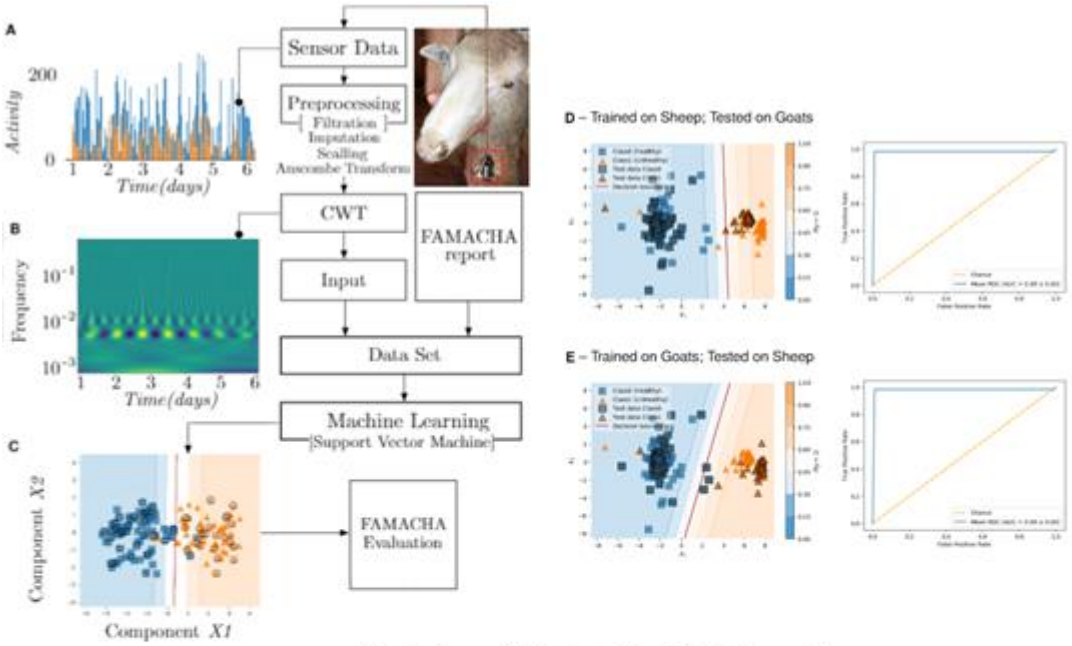
[7]Department of Agricultural Sciences, Fort Valley State University, Fort Valley, Georgia, USA

[8]Department of Veterinary Tropical Diseases, Faculty of Veterinary Science, University of Pretoria, South Africa

[9]Department of Computer Science, University of Bristol, Bristol, UK

Accurate assessment of the health status of individual animals is a key step in timely and targeted treatment of infections, which is critical in the fight against anthelmintic and antimicrobial resistance. The FAMACHA scoring system has been used successfully to detect levels of anaemia caused by infection with the parasitic nematode Haemonchus contortus in small ruminants. However, assessing FAMACHA is labour-intensive and costly as individuals must be manually examined at frequent intervals over the Haemonchus season. In Montout et al. (bioRxiv 2020), we show that accelerometers can measure individual activity in extensively grazing small ruminants subject to natural infection in southern Africa overlong time-scales, and when combined with machine learning (Figure A-C), can predict the smallest pre-clinical increases in FAMACHA score and respond to treatment with high precision (>95%). These classifiers remain robust over time, and remarkably, generalise without retraining across goats and sheep in different regions and types of farming enterprise (Figure D-E). Interpretation of the trained classifiers reveal that as the effect of haemonchosis increases, both sheep and goats exhibit a similar reduction in the fine-grained variation of their activity levels. Our study thus reveals common behavioural patterns across small ruminant species, which low cost biologgers can exploit to

detect subtle changes in animal health and enable timely and targeted intervention. This has real potential to improve economic outcomes and animal welfare as well as limit the use of anthelmintic drugs and hence diminish pressures on anthelmintic resistance under conditions of both commercial and resource-poor communal farming.



Schematic of our machine learning pipeline. (A) The biologger outputs accelerometry data as a count of the instances the acceleration exceeded 2g over a short interval. Here we show derived activity time series for two animals (blue/orange) over a 5 days period with a bin size of 10 minutes. As can be seen, there are significant differences in signal magnitude which we account for through preprocessing. **(B)** After normalisation and variance stabilisation, we transform the data with a Continuous Wavelet Transform (CWT), which separates the activity levels into longitudinal dynamics (*x* axis) at a range of temporal scales (Frequency, *y* axis). Higher frequencies represent transient bursts of activity, while lower frequencies represent more consistent levels. For example, the day/night cycle can now clearly be seen. **(C)** The high-dimensional CWT data is then combined with the FAMACHA report for supervised machine learning. The scatter plot shows clustering of the animals in this space (blue and orange points represent healthy and unhealthy animals respectively; those not used for training are circled, and are used to test classification performance). A Support Vector Machine with 10-fold cross-validation repeated 100 times is then used to derive the classification boundary (red) and to derive predicted probabilities that each animal is healthy or unhealthy (shading from blue to orange).

External validation across farm, region and species. (D) Scatter plot and ROC curve for the classifier trained on the sheep at Delmas and tested on the goats at Cedara. (E) Scatter plot and ROC curve for the reciprocal.

O7. Macdonald Bethany: The effect of immediate post-birth analgesia provision on the expression of social behaviours in neonatal Holstein dairy calves.

Bethany Macdonald[1], Nicola Gladden[2], Dorothy McKeegan[1], Kathryn Ellis[2] and Davina Hill[1]

[1]Institute of Biodiversity, Animal Health and Comparative Medicine, College of Medical, Veterinary and Life Sciences, University of Glasgow, Glasgow, G12 8QQ, UK.

[2]Scottish Centre for Production Animal Health and Food Safety, School of Veterinary Medicine, University of Glasgow, Glasgow, G61 1QH.

Although group housing from birth improves welfare, social behaviour has only been studied in calves of several weeks old. It has also been found that the provision of analgesia immediately post-birth improves the welfare of dairy calves. This project aimed to (1) investigate the prevalence of social behaviours in neonatal calves, (2) assess whether social behaviour is affected by the provision of analgesics immediately post-birth and (3) to assess whether group size affects the expression of social behaviours. Of 32 dairy calves housed on a commercial dairy farm in Scotland, half were randomly assigned either an analgesia treatment (ketoprofen), and the other half, a placebo (saline). The calves were housed in group pens, and social behaviours exhibited over four one-hour sampling periods (8am, 12pm, 4pm, and 8pm) on the calves' first full day in the pen were recorded. This study demonstrates that neonatal calves exhibit social behaviours which, to our knowledge, has not previously been reported. Calves that received the analgesic treatment, showed a greater number of social behaviours than those given the placebo (Figure 1). The number of individuals in a pen had no effect on the number of social behaviours exhibited, indicating that calves were able to avoid social contact. As the provision of analgesia reduces pain and inflammation, these results suggest that social behaviour may be an indicator of welfare. In addition, as calves showed social behaviours hours after birth, it may also improve welfare to group house dairy calves once removed from the dam.

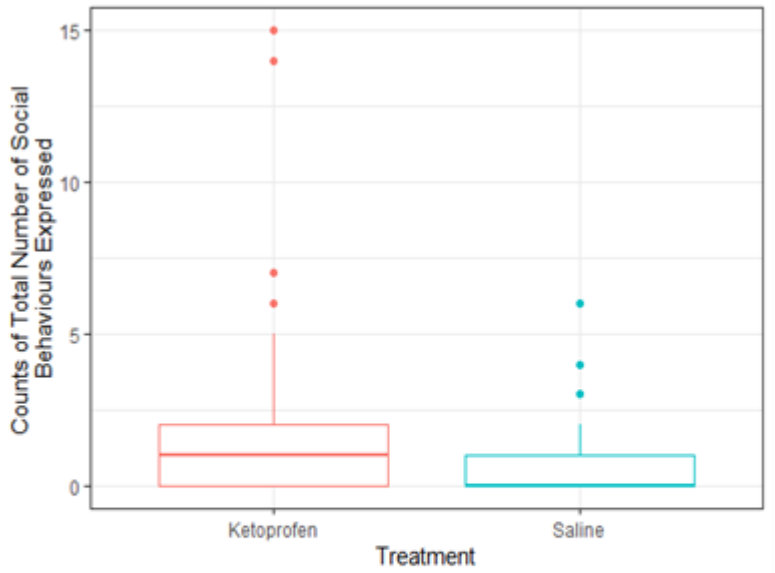


Figure 1 Total number of social behaviours exhibited by neonatal Holstein dairy calves recorded in a 1-hour sampling period for each treatment group (n=16 for each group) (χ^2=5.67, df=1, p=0.017).

O8. Kilgour Ashleigh J: Physiological and behavioural impacts of summer rugging on horses in a temperature climate.

Ashleigh J Kilgour, Davina L Hill

Institute of Biodiversity, Animal Health and Comparative Medicine, College of Medical, Veterinary and Life Sciences, University of Glasgow, Glasgow G12 8QQ, UK.

Routine rugging is a common management practice for horse owners and keepers that can allow horses to live outside even during challenging conditions. Lightweight turnout rugs are often used throughout summer to shield horses from rain and flies and to keep them clean, but little research has so far been conducted on the impact of this type of rug use on horse thermoregulation. This study looked into both the physiological and behavioural impact of rug use in a temperature climate, with the aim of identifying whether the addition of a lightweight turnout rug could add a significant additional thermal load to the extent of inducing thermal stress, and to identify influencing external factors, such as weather, that impact the physiological and behavioural response to the addition of a rug. A significant rise surface temperature was observed with the addition of a rug, along with an increase in self-care behaviours, such as turning the head around to itch the body and head shaking. Increased ambient temperature and relative humidity correlated with an increase in stress related behaviours, while increased wind velocity resulted in a reduction of such behaviours. Additionally, a significant interaction was commonly found between rug use and he presence of flies, suggesting the decision about when to rug a horse may be more complex than previously understood. These results could help to educate owners and keepers on the factors affecting their horse's thermoregulation in relation to rug use, leading to more informed management decision and overall improvement of welfare.

Session 2. Teaching the new generation of professionals.

Keynote 2. Hammond Jennifer. Training for uncertainty in Veterinary Education.

School of Veterinary Medicine, University of Glasgow, Glasgow, United Kingdom

This presentation explores the question of how veterinary students learn to cope with uncertainty in professional practice. Although there is widespread recognition that managing uncertainty is central to practice in the health professions (reflected in the fact that the ability to cope with uncertainty is considered a "day one competency" for veterinary surgeons) there has been a lack of clarity in discussion of what constitutes effective coping with uncertainty in veterinary practice and indeed how this might be taught or assessed as part of the veterinary education process.

Drawing on experience and research from veterinary education and across other health professions, this presentation will reflect on the challenges of addressing training for uncertainty in the veterinary curriculum and consider how insights from educational theory can help us prepare the new generation of professionals to navigate uncertainty in their professional practice.

O9. Debenham John: eClinic – A gamified case simulator.

John James Debenham

Norwegian University of Life Sciences

Racecourse Road Veterinary Hospital

The use of case simulators in medical training has many potential benefits as they provide the ability to interact with complex, life-like scenarios without incurring the costs and risks associated with live patients. This is particularly relevant for teaching clinical reasoning, given the inherent risks involved in allowing students to make decisions and then observe their consequences on real patients. Additionally, by using scenario-based learning and creating non-linear journeys, medical case simulators are able to stimulate a higher learning experience.

Unfortunately, their uptake within veterinary education has been limited, in part due to the IT expertise and substantial time commitment required to develop them. However, new web-based platforms are reducing this hurdle and global events like COVID-19 are highlighting the importance of digital teaching alternatives.

Veterinary eClinic is a web-based veterinary case simulator that utilizes gamification to create an enjoyable, interactive case simulator. It entwines elements of reality such as time pressure, patient's health and the owner's budget to mirror the challenges of clinical medicine. The platform architecture, software and infrastructure tools have all been purposely designed to facilitate case development and minimize the time input required by academics to develop a case. It is built as a community learning environment, involving universities and their students from around the world.

O10. Driver Emma: Development of an Undergraduate Veterinary Leadership Framework.

Emma Driver, Dr Kate Cobb, Dr Erica Gummery

University of Nottingham

From day one, graduate vets are required to demonstrate leadership. The Vet Futures Project has highlighted leadership as a key area for development in the aim for a more sustainable profession (Vet Futures Project, 2015). Though leadership elements are developed throughout a UK veterinary degree, there is currently no veterinary specific leadership framework for undergraduates. However, in the medical field, the NHS have published the Medical Leadership Competency Framework (MLCF), which can be applied to medical undergraduate students.

This research aims to use the MLCF to define leadership elements and develop a veterinary leadership framework for the undergraduate curriculum.

Thirty-two veterinary leaders in varied multidisciplinary roles throughout the profession were contacted via email and requested to participate in a two-round Delphi study. Each round was developed as an online survey, composed of Likert scales and free-text boxes. The first round (65% response rate) looked at how appropriate the leadership elements of the MLCF were for veterinary medicine, along with the importance of the leadership elements at a veterinary undergraduate level.

Analysis of these responses involved simple quantitative and thematic analysis. Following this feedback, the MLCF was adapted with appropriate veterinary terminology and the leadership competency expectation altered to an undergraduate level.

The second survey is currently open and aims to gauge the panels opinion on the proposed undergraduate veterinary version.

O11. Watson Fraje: Evolving EMS – adapting learning to suit an ever-changing world. A case study of the "UCL 2020 Veterinary Research Undergraduate Programme".

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Veterinary medicine and nursing students must complete extramural studies (EMS) before registration to the profession. EMS provides students varied insights into the profession and enables them to hone 'day one competencies'. Areas of competency include professionalism, self-awareness/reflection, collaboration and communication and One Health/public health knowledge. The Covid19 pandemic led to the cancellation of many EMS; responding to this complex situation RCVS-registered academics, led by a team based at University College London collaborated to deliver an intensive three week 'research EMS' remote-learning placement to meaningfully address key competencies outside the practice setting. In April 2020 the course was run online, with 21 participants from UK vet schools. The course consisted of online lectures, small group work and self-directed sessions on performing literature reviews, experimental design, analysis and planning, across a diverse set of diciplines including anthropology, developmental biology, orthopaedics, medical physics, experimental pathology and epidemiology. Student feedback and personal reflections, emulating the 1CPD model, were gathered weekly and used to adapt course delivery. Students assessed the course on completion by scoring outcome statements (5 maximum score, 12 respondents). The statement, "The placement has provided me with experiences that are applicable to the workplace", was scored 4.8 (range 4-5), reinforcing its relevance to veterinary training, and the overall course score was 4.7 (4-5). Written student reflections evidenced growth in student thinking, career aspirations, and evidence-based decision making. This programme provides

a potential framework for future online EMS, which is suited to the global veterinary community and provides essential day one competencies.

O12. Tasker Alex: The 21st Century Vet: Non-clinical EMS for building cross-disciplinary research engagement in veterinary undergraduates.

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21st century veterinary professionals operate in complex interconnected webs of disciplinary relationships. The development of cross-disciplinary approaches such as One Health require veterinarians to work within often unfamiliar dynamic and emerging research landscapes.

This study draws together research on cross-disciplinary working and wider pedagogical theory around veterinary Extra-Mural Studies (EMS) to create an integrated theoretical framework to explore an EMS Case Study, focussing on a cross-disciplinary research summer school. This study collected and analysed qualitative data to identify:

1. How do current veterinary undergraduates understand cross-disciplinary research?

2. In what ways can non-clinical research EMS create engagement and understanding of cross-disciplinary research?

3. How can these programmes be best designed to promote cross-disciplinary engagement in the next generation of veterinary surgeons?

Aim 1 was explored using pre-course qualitative data, aim 2 triangulated results between pre-, mid-, and post-programme reviews, summative research proposal exercises, and follow-up interviews. Aim 3 drew on data from feedback-led reflective focus groups with staff and students.

Our results suggest that engagement with cross-disciplinary, non-clinical EMS can promote and develop engagement with the wider research landscape. The study found that prior exposure, professional identity, and barrier

navigation were key themes. A reflective case review then identifies areas of excellence and for development.

The study concludes that non-clinical EMS is an effective way to build cross-disciplinary engagement in veterinary undergraduates. The study links these findings to existing pedagogic and theoretical literatures to suggest research as a vital, yet undervalued part of veterinary EMS.

O13. Wood Sarah: Directly Observed Procedural Skill (DOPS) assessment of clinical examination skills in cattle: student perceptions.

Sarah Wood, Sarah Baillie, Sheena Warman

Bristol Veterinary School

Veterinary students at the University of Bristol learn to perform a clinical examination of cattle through practical classes in years 3 and 4, cases experienced during clinical rotations and extra-mural studies (EMS), with supporting resources such as an online video. Part of the assessment for final year students is a series of Directly Observed Procedural Skills (DOPS), these allow valid assessment of key practical skills, feasible in the clinical environment (Hurst and Prescott-Clements, 2018).

Focus groups were used to explore students' perceptions of DOPS for assessing their ability to perform a clinical examination of a cow and the impact on their learning of this key competency.

The results of thematic analysis identified three key areas: the students' experience of prior learning; their experiences of the DOPS assessment; and the perceived impact of the DOPS assessment on their learning. Overall, students perceived DOPS assessments to be beneficial to their learning of this skill.

Consideration of student perceptions may be useful in guiding those using these workplace-based assessments across the health sciences.

HURST, Y. K. & PRESCOTT-CLEMENTS, L. 2018. Optimising workplace-based assessment. Clin Teach, 15, 7-12.

O14. Woollatt Sarah: Teaching at arm's length: a farm clinician's view.

Sarah Woollatt, Sarah Wood

Langford Veterinary Services, University of Bristol

The 2020 Covid-19 (C-19) pandemic has applied new and unexpected pressures on the provision of veterinary teaching across the world. Suddenly, prioritising human health over animal health has created a challenging environment not only for clinical practice, but also for continuing to fulfil "day one competences" and maintaining high graduate standards. The aim of this project was to explore the obstacles in teaching clinical skills whilst adhering to necessary C-19 safety measures, based on the experiences of staff and students in a UK-based university farm animal practice. Barriers to regular teaching methods, particularly of practical skills, included social distancing for travel in ambulatory practice vehicles, restraint of patients and assistance in finding landmarks or administering medications. Solutions to these obstacles were trialled with a small number of students completing extra-mural studies placements within the practice from July to September 2020.

Adapting procedures to facilitate on-farm learning focused on strategical selection of clinical cases suitable for teaching, increased personal protective equipment, modified restraint techniques and increased use of technology. These methods were largely successful, and yielded useful feedback from both staff, students and farmers in refining our approach to suit evolving pandemic conditions. This was an important step in preparation for larger-scale return of students to the clinic, and protecting both safety of personnel and quality of teaching.

O15. Borkowski Emma: Playing with parasites in a pandemic: A new teaching tool.

Emma Borkowski, Martha Betson

University of Surrey School of Veterinary Medicine

The ability to correctly identify common parasites of domestic animals is a core competency for veterinarians, and many veterinary programmes use hands-on laboratory sessions to teach this skill. These sessions usually rely on a combination of preserved and glass-mounted specimens for gross and microscopic examination. However, social distancing requirements in the era of COVID-19 have necessitated most veterinary schools to adopt a remote or 'hybrid learning' curriculum for the coming academic year, including laboratory sessions where possible. We discuss our experiences converting two parasite identification laboratories for internal and external parasites into interactive virtual tutorials at the University of Surrey School of Veterinary Medicine. Methods to support these virtual tutorials include generation of a library of high-resolution photographs of gross specimens and digital scans of glass-mounted specimens. The goal of this presentation is to share useful tools, tips, and lessons learned, and to stimulate discussion of strategies to deliver high-quality virtual training in veterinary parasitology.

Session 3. Surveillance.

Keynote 3: Carty Helen. Surveillance shouldn't sit in a silo.

Ayr Veterinary Surveillance Hub, J F Niven Building, Auchincruive Estate, Auchincruive, Ayr, KA6 5HW

Surveillance shouldn't sit in a silo: For surveillance to be effective, everyone needs to play their part. Effective surveillance should both gather data for researchers and inform future research initiatives. By exposing both undergraduate and postgraduate students as well as vets in practice to surveillance in action, they will become more aware of their role in surveillance, how the surveillance system works and be better equipped to actively engage as their careers progress. This will be demonstrated through real case examples and set the scene for the presentations that follow.

O16. Clarke AnneMarie: Prioritisation of Animal Health Surveillance Activities in Ireland.

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The objectives of this study were to seek opinion from experts about diseases/conditions and animal health surveillance activities in the Irish livestock industries, and in doing so, develop a tool for the prioritisation of surveillance activities. A survey of stakeholders on which diseases/conditions required prioritisation was first carried out. Then experts used the developed prioritisation tool to identify the most important surveillance objectives and to allocate resources to the activities that best meet the surveillance objectives for each disease/condition. A process and accompanying user-friendly practical tool for animal disease surveillance prioritisation was developed in this study. Antimicrobial resistance (AMR) and bovine Tuberculosis (bTB) were ranked top of the endemic diseases/conditions while African swine fever (ASF) and Foot & Mouth Disease (FMD) were ranked top of the exotic diseases/conditions by the stakeholders. The study showed that most of the diseases/conditions examined in the prioritisation exercise require a combination of active and passive surveillance activities. Experts believed that an even split between active and passive surveillance activities were required for AMR and ASF. For bTB, active measures were considered to better meet the objectives of the bTB programme. In contrast, passive surveillance activities were considered better for FMD.

This study facilitated a process to be put in place that will inform recommendations for the optimum delivery of future animal health surveillance programmes and in doing so, to maximise the effective use of resources.

O17. Havercroft Charlotte Letitia: Demographics and diagnoses of neonatal lamb carcass submissions to APHA for post mortem examination over a ten-year period.

Charlotte Letitia Havercroft, Sonja Jeckel

Royal Veterinary College

APHA provides postmortem services for veterinarians in England and Wales to aid investigations into the cause of mortality and disease in farmed animal species for individual outbreaks and herd health planning. Information collected from these post mortem investigations provide data for National Veterinary Disease Surveillance. APHA data for 865 neonatal lamb carcass submissions received over 10 years from 2010 to 2019 was analysed and revealed that in 81% of all submissions at least one diagnosis was reached. Hypogammaglobulinemia (HGG) was the most frequent diagnosis in neonatal lambs and in over 76% of cases diagnosed in combination with diseases like colisepticaemia or cryptosporidiosis. This finding reinforces the need for good colostrum protocols on farm underpinning lamb immunity and health. Other potentially preventable diagnoses made recurrently such as clostridial diseases, navel ill and hypothermia/starvation highlight that management improvements are still relevant to farms wanting to decrease neonatal lamb mortality. Interestingly, though hypothermia/ starvation is more frequently diagnosed amongst outdoor lambs there is no statistically significant difference. In contrast, trauma/ fractures were found to be significantly more likely in housed animals. Though it is unlikely that the analysed data reliably represents the majority of causes of individual lamb deaths in England and Wales, it provides a good understanding of common causes for disease outbreaks amongst neonatal lambs and highlights opportunities for prevention.

O18. Macrelli Michele: First report of fatal tick pyaemia caused by heavy infestation with the red sheep tick, Haemaphysalis punctata and co-infection with Babesia and Theileria spp.

Michele Macrelli[1], Liz McGinley[2] Kayleigh Hansford[2], Jolyon Medlock[2], Paul Phipps[3], Nicholas Johnson[3]

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Tick pyaemia is a disease of sheep characterised by the development of internal abscesses caused by Staphylococcus aureus. The disease cause significant economic loss through debilitation and death in lambs. The disease is normally triggered by infestation with Ixodes ricinus (the sheep tick) and can be exacerbated by co-infection with Anaplasma phagocytophilum. In Great Britain Ixodes ricinus is the most common and widely distributed tick species. However, in recent years the numbers of detections of Haemaphysalis punctata (the red sheep tick) and its geographical distribution have significantly increased. Here we report the finding of tick pyaemia in a sheep flock suffering from high mortality caused by severe infestation with H. punctata. Tick pyaemia was confirmed by gross identification of internal abscesses in two lambs and isolation of S. aureus from these lesions, with concurrent identification of H. punctata ticks on the carcases. Additionally, Babesia motasi and Theileria luwenshuni were detected by pan-piroplasm PCR in the blood of infested animals including the two sent for post-mortem examination. A. phagocytophilum was not detected. These findings suggest that infestation with H. punctata is capable of inducing tick pyaemia in lambs and that this may be exacerbated by coinfection with piroplasms.

O19. Geddes Eilidh: Exploiting scanning surveillance data to assess the impact of disease control initiatives and inform future strategies to control endemic diseases. The example of sheep scab.

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Scanning surveillance allows us to monitor the occurrence of many endemic diseases in Great Britain (GB), including sheep scab, an ectoparasitic disease of major economic and welfare burden. The Veterinary Investigation Diagnosis Analysis (VIDA) database records diagnoses made by disease surveillance centres in GB and contributes to the scanning surveillance of sheep scab. This study aimed to investigate the use of the VIDA database to assess the impact of disease control initiatives to inform control strategies using a temporal alarm detection algorithm (TADA).

A total of 2,401 positive skin scrapes were recorded from 2003-2018. Significant clustering was observed in Wales, with a maximum of 47 positive scrapes in Ceredigion in 2007. Across the study period 11 national disease control initiatives, organised by stakeholders, industry and government occurred: 4 in Wales, 3 in England and 4 in Scotland. The majority (8) offered free diagnostic testing, and the remaining offered knowledge transfer and free testing, skills training and knowledge transfer, and the introduction of the Sheep Scab (Scotland) Order. The TADA raised 20 alarms, of which 11 occurred within a period of free testing in Wales, and 1 at the introduction of the sheep scab order. In summary, this study shows that further use of the VIDA database enhances our knowledge of sheep scab by identifying areas for targeted action and offers a framework to measure the impact of future disease control initiatives. Additionally, this framework could be applied to inform cost-effective and sustainable strategies for the control of other endemic diseases.

O20. Kiernan Kelsey: The occurrence and distribution of antimicrobial resistant bacteria in companion animals at a small animal veterinary hospital.

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The distribution and occurrence of antimicrobial resistant (AMR) nosocomial pathogens in human medicine has been increasingly documented in recent decades. However, this kind of knowledge in veterinary medicine is more limited, particularly in the context of small animal veterinary hospitals. Most veterinary hospitals rely on private laboratories to provide diagnostic information and consequently lack the laboratory information management systems (LIMS) that facilitate a formal surveillance system. As a case study, we here describe a University-based small animal hospital, which benefits from an integrated clinical pathology service with a dedicated LIMS that handles all diagnostic bacterial samples. We have undertaken descriptive analysis of the clinical bacteriology dataset contained in this LIMS from July 2000 to November 2019. Over this time, there were a total of 53,206 isolations collected, of which 68% (n=36,168) were canine-derived and 32% (n=17,038) were feline-derived, representing a total of 337 unique bacterial species. The majority of isolates originated from faecal samples (43.5%), followed by urine (10.7%), oropharyngeal (8.7%), nasal (6.2%) and ear samples (5.7%). We have mined this database and been able to identify AMR-related trends among the pathogens detected. Our analysis will inform the design of a structured surveillance system for the early detection and control of outbreaks of AMR and nosocomial pathogens in this small animal veterinary hospital. Additionally, it will provide background data for evidence-based infection control interventions within companion animal practice.

O21. McGlennon Abigail. Investigating laboratory diagnoses of equine strangles in the UK and internationally to enhance understanding of disease prevalence and veterinary approaches to diagnosing strangles.

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Transmission of Streptococcus equi (S. equi), the causative agent of strangles amongst horses remains poorly investigated. The Surveillance of Equine Strangles (SES) project aims to understand the occurrence of strangles in the UK and internationally through surveillance networks comprised of diagnostic laboratories, where laboratory confirmation of S. equi infections from practitioner-submitted samples is reported. Objectives include providing regular summaries to the industry, through epidemiological data reported with samples, and whole genome sequencing of bacterial isolates enabling phylogenetic and network analysis to be undertaken.

Between 01/01/2018 and 31/12/2019 SES collated 516 positive diagnoses of S. equi from samples submitted by 189 UK veterinary practices. Of the samples, 53% (n=313) were swabs and 42% (n=248) guttural pouch lavages. Diagnoses were based on qPCR and culture (44%, n=230), qPCR only (49%, n=257), or culture only (5%, n=28). Where stated (n=272), 60% (n=164) of samples originated from clinically ill horses and 36% (n=98) from asymptomatic horses.

Diagnoses were widespread across the UK (figure 1). Mapping diagnoses increases knowledge of where positive diagnoses are broadly located, permitting the optimisation of biosecurity and pre-movement testing which can decrease the prevalence of strangles.

SES provides important data enhancing epidemiological analysis on the occurrence and diagnosis of strangles within the UK and has recently expanded to include the collection of international data and isolates. Gathering international data will provide invaluable information across the industry helping to further research and raise awareness of strangles, with the ultimate aim of reducing national and international spread of disease.

O22. Kelly Nicholas: A retrospective analysis of dog, cat and rabbit forensic post-mortem examinations, performed at Royal veterinary college 2003-2020, with emphasis upon starvation-based neglect and non-accidental injury.

Nicholas Kelly, Dr. Jonathan Williams, Dr. Henny Martineau

Royal Veterinary College

This study focused upon dog, cat and rabbit forensic post-mortems at Royal Veterinary College, investigating numbers of forensic cases seen, causes of death given and compared signalment, gross and histological features of starvation-based neglect and non-accidental injury (NAI).

Forensic necropsies were found performed increasingly frequently, most often upon dogs. Across the three species, starvation-based neglect was found the most frequent cause of death, with low body condition in deceased animals found resulting from deliberate withholding of food (exogenous starvation) more frequently than due to internal diseases (endogenous starvation). Animals starved by either origin were most often found with depletion of fat, liver and/or skeletal muscle tissues.

NAI in dogs and cats was found primarily affecting the skull and ribs, with traumatic injuries significantly more likely resulting from blunt force origins, compared to sharp force or ballistic trauma. NAI in cats was found most often causing death by traumatic brain injury, compared to dogs, where hypovolemic shock was the most frequent mechanism of death. Rabbits were found infreqently suffering from NAI from any origin.

Across the species, animals found maliciously starved were most frequently, entire, significantly more commonly purebred than crossbred and exceeding two years of age for dogs and cats, and six months for rabbits. These trends were the same for dogs and cats receiving NAI.

Such results provide much needed data regarding pathological aspects of animal abuse and will aid veterinary pathologists in recognising patterns of findings they can expect to see when faced with such cases.

O23. Rhodes Victoria: Diagnosis of respiratory disease in Irish dairy calves using thoracic ultrasonography - temporal transitions and association with growth rates.

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Objectives - characterise the temporal transitions in (TUS) scores in pre-weaned Irish dairy calves over the course of a rearing season and to investigate the relationship between the presence of Bovine Respiratory Disease (BRD) diagnosed by TUS and growth rate.

Data was collected from calves across seven farm in Ireland during the spring calving season. Calves were examined three times at 21 day intervals. The examination included calf respiratory scoring (CRS) using the University of Wisconsin Calf Respiratory Score Chart, thoracic ultrasound scoring (TUS) and determination of live weight.

The final data set consisted of 955 thoracic ultrasounds scores and 951 clinical respiratory scores, collected from 319 calves. The average CRS in calves on individual farms ranged from 1.69 to 3.45. The average farm TUS score ranged from 0.19 to 1.33. The percentage of calves with a TUS great than or equal to 2 (lung consolidation present) ranged from 4% to 45%. The percentage of calves with a CRS score >5 ranged from 1% to 29%. Unaffected calves were predicted to grow to 85kg within 63days. Calves that were affected early and recovered, or affected late and recovered were approximately 2kg lighter. Calves that were affected in later were 2.5kg lighter. Calves that were chronically affected had the highest weight loss.

Calves unaffected by BRD throughout the study on both assessment systems had higher average daily weight gains (ADG) than those affected at any stage with the disease; however, calf lung pathology can recover from BRD positive scores over time.

O24. O'Neill Lorcan: Antimicrobial resistance in Escherichia coli isolates in pigs from farms with differing levels of antimicrobial use: a longitudinal study.

Lorcan O'Neill[1,2], Maria Rodrigues da Costa[1,2], Rachel Grimes[3], James Gibbons[4], Edgar Garcia Manzanilla[1,2,] Finola Leonard[1]

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Antimicrobial resistance (AMR) in bacteria of animal origin present a threat to public health. In Ireland, prophylactic antimicrobial use (AMU) in medicated feed is routinely administered to post weaned piglets. While AMU in pig production has been associated with AMR in Escherichia coli, longitudinal studies are lacking.

This study aimed to investigate the effect of AMU in medicated feed on the evolution of AMR in E. coli isolates during the pig production cycle.

Twelve farms were selected based on their in-feed AMU practices (none, mid, high). Ten litters of piglets were selected from each farm; pooled faecal samples were collected during each production stage (piglet, 1st stage weaner, 2nd stage weaner and finisher). Twenty E. coli isolates from each sample were tested against a panel of 14 antimicrobials. Logistic regression models of resistance to each antimicrobial were constructed using AMU practice and stage of production as explanatory variables.

The highest frequencies of resistance were to doxycycline, ampicillin, trimethoprim/sulfamethoxazole, gentamicin and the fluoroquinolones. Resistance to these agents was highest in 1st stage weaners except for fluoroquinolones where resistance was highest in piglets. Resistance to amikacin or imipenem was not observed and resistance to the cephalosporins was low. For most models, increased AMU predicted increased resistance; the fluoroquinolones were notable exceptions.

Stage of production and in-feed AMU practices influence the occurrence of AMR in pig production. Although further analysis is required, these findings have implications for strategies to control AMR at farm level.

Session 4. Parasitology.

Keynote 4: Denwood Matt. Diagnostics and parasitology: the problem of mapping diagnostic test results to disease status.

Department of Veterinary and Animal Sciences, University of Copenhagen
Grønnegårdsvej 15, 1870 Frederiksberg

Almost all work on animal disease systems depends on our ability to diagnose both disease and the efficacy of treatment. This is a particular challenge within parasitology because parasites tend to be associated with multiple stages of infection with varying clinical signs, treatment/control possibilities, and potential for detection via different diagnostic tests. I will give a brief overview of some different work that attempts to overcome these challenges within different host/parasite systems, with a particular emphasis on the steps that need to be considered to be able to deal with imperfect diagnostic test information. I will also highlight some challenges and potential solutions to the problems surrounding diagnosis of anthelmnintic resistance.

O25. Gummery Lauren: Clinical features of T. brucei ssp. infection in working equids in The Gambia: a prospective clinical case series.

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Equine trypanosomiasis is endemic in The Gambia. Progression of naturally occurring infection with T. brucei ssp. (TBr) is poorly documented and frequently causes chronic, fatal neurological disease. This prospective case series followed TBr cases over 9-12 months. Hypotheses were: a) Molecular diagnostics would be necessary to discriminate between TBr +ve/-ve animals due to co-endemicity of other Trypanosoma spp; b) Animals with haemolymphatic TBr infection would develop fatal neurological disease.

All equids in 11 villages in Central River District, The Gambia were examined and blood sampled for trypanosomiasis. Treatment (isometamidium 0.5mg/kg i.v.) was given if animals fulfilled validated criteria. Animals were included (T0) if TBr positive (LAMP/TBR-PCR). Animals were classified as specifically 'symptomatic' for TBr if they fulfilled ≥ 1 clinical criterion (oedema, abortion, neurological disease, BCS□1.5, pyrexia, PCV□25%). CSF was tested if neurological abnormalities existed. Animals were re-examined at 9-12 months (T1).

315/510 animals were treated and tested for TBr, 79 (15%) TBr positive were included (54 donkeys, 25 horses). Low body condition score was associated with positive TBr status (p=0.033).

At T0, 67/79 (84.8%) were 'symptomatic' including 9/79 (11.4%) with neurological abnormalities. CSF samples (n=5) were TBr positive. At T1 (n=38/79), 20/26 (76.9%) of live animals were 'symptomatic', 12/38 were dead (31%) including 8/9 animals with neurological signs at T0 and 2 animals that had developed neurological disease.

Diagnosis on clinical criteria was not reliable. Mortality in neurological animals was high despite treatment. TBr positive animals can remain asymptomatic. Future studies should incorporate control groups and disease staging (CNS/non-CNS).

O26. McGregor Cassandra: Investigating the role of animal movement in the dissemination of roundworm infection and anthelmintic resistance in livestock.

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Gastro-intestinal nematode (GIN) infections are costly to the livestock industry, affecting the overall health, welfare and productivity of ruminants. Infections are becoming more difficult to control with the increasing prevalence of anthelmintic resistance in the UK and worldwide. This study aimed to explore the potential risk of dissemination of GIN and anthelmintic resistance posed by animal movements, particularly livestock trade. This study also aimed to explore transportation data in relation to animal movement and the livestock trade. To quantify the prevalence and composition of GIN infections in animals being moved between farms, faecal samples were collected from sheep and cattle being sold at auction. A total of 496 sheep populations and 383 cattle populations were opportunistically collected from 13 breeding and store animal sales at livestock markets across Great Britain over a 5-month period. Differential faecal egg counts were conducted on all samples. Strongyle eggs were observed in 90% of sheep populations (mean±SEM 217 ±127 eggs per gram (epg), range 0-11,268) and 64% of the cattle populations (20±3, range 0-747 epg). *Nematodirus* eggs were observed in 37% of sheep populations (9±1, range 0-216 epg), and 3% of cattle populations (<1 epg, 0-21). The high prevalence of GIN observed in the populations tested highlights the importance of effective quarantine treatment for bought-in stock. Quantitative knowledge of the potential GIN dissemination risk associated with animal trade is important in raising awareness of the risk of importing anthelmintic resistance onto farms and could improve development and uptake of best-practice recommendations, safeguarding the sustainability of livestock production, both now and in the future.

O27. Apaa Ternenge: Seroprevalence and risk factors associated with canine vector-borne diseases in Nigeria.

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Canine vector-borne diseases (CVBDs) have a large impact on the health status of dogs, they are also known to be potential zoonotic across the globe. In Nigeria, there are limited data on the prevalence, distribution of CVBDs however; no data on risk factors associated with canine vector borne diseases of dogs is available. The aim of this study was to provide current data on the seroprevalence of *Ehrlichia* spp., *Anaplasma* spp., *Borrelia burgdorferi* (sensu lato), and *Dirofilaria* spp. in Nigerian dogs. Blood samples were collected from 259 dogs presented at Nigerian veterinary clinics. Serological testing for CVBDs from the samples were carry out using the SNAP 4Dx kit®. In addition, questionnaires were design to obtain demographic data on the dogs, and likely risk factors for CVBDs were determined utilizing binary logistic regression models.

In general, 32.8% of the samples tested were seropositive for one of the canine vector borne pathogens tested. *Ehrlichia* spp., recorded the highest seroprevalence (29.7%), followed by Anaplasma spp., (10.8%) and *Dirofilaria* spp., (0.4%). All dogs examined were seronegative to *Borrelia burgdorferi* (sensu lato). Following assessment of risk factors, dogs ≥6 months old (p=0.002) infested with ticks (p=0.054) were more likely to be seropositive to CVBDs. In addition, male dogs were more likely to be infested with ticks (p=0.041).

This study demonstrates that dogs ≥ 6 months infested with ticks are highly susceptible to CVBDs, and male dogs are at an increased risk of tick infestation.

O28. Chen Wan: RNA interference in the poultry red mite Dermanyssus gallinae.

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The avian haematophagous ectoparasite, Dermanyssus gallinae or the poultry red mite (PRM), causes significant economic losses to the egg laying industry worldwide and also represents a significant welfare threat. Current acaricide-based controls are unsustainable due to the mite's ability to rapidly develop resistance, thus developing a novel sustainable means of control for PRM is a priority. RNA interference (RNAi) represents a powerful method of pest control and works by selectively knocking-down genes, which are crucial to the mite's survival and has been employed in pest management for decades. Here we describe the interrogation of the PRM genome, and subsequent identification of the key components of the small interfering RNA (si-RNA) and micro-RNA (miRNA) pathways, which indicate the likely presence of these mechanisms in PRM. In addition, we noted the absence of Aub and P-element induced wimpy testis (Piwi) genes indicating the absence of the Piwi-interacting RNA (piRNA) pathway in PRM. The function of the exo-siRNA pathway was confirmed by selective knock-down of the vATPase gene in PRM, using dsRNAs targeting two regions of the vATPase-subunit A. Successful gene knock-down was observed with a significant reduction in vATPase expression being observed. Gene knockdown was achieved within 24 hours, and persisted for at least 120 hours. The significance of gene knock-down in PRM has shown the potential of RNAi as a control measure for the poultry industry.

O29. Evangelista Francisco Miguel Dias: In silico identification of vaccination targets from Ascaris lumbricoides and Ascaris suum proteomes.

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Ascariasis is the most prevalent of the soil-transmitted helminth (STH) diseases in the world, estimated to affect up to 1.5 billion people. This disease is a zoonosis caused by the roundworm parasites Ascaris lumbricoides and A. suum, infecting both humans and pigs. Currently, there is no vaccine available that has been approved to be used in humans or in pigs, and mass drug administration continues as the most common control method, leading to concerns of anthelminthic resistance. In this work we focus on the identification of potential vaccine antigen targets.

For this, we have used a "Reverse Vaccinology" approach to identify targets that could be further tested in a laboratory environment. The three genomes available for Ascaris spp., one for A. lumbricoides and two for A. suum, are annotated into three proteomes that contained over 100,000 protein sequences. These proteins were analyzed using bioinformatic tools (e.g. Vacceed, VaxiJen, and AllergenFP) which tested for: sub-cellular location, presence of signal peptides, transmembrane location, MHC class II molecular binding, antigenicity and, at last, allergenicity. To date, six proteins are predicted as "good" candidates for new in vitro assays and further testing as vaccination targets. These six candidates will be further investigated for their usability as either recombinant vaccines or the development of epitope-based vaccines.

Poster Abstracts

P1. O'Hagan Maria: Do European badgers (Meles meles) cross major roads?

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As part of the Test and Vaccinate or Remove (TVR) badger intervention research study in Northern Ireland, a project was launched in order to answer the following question: Do badgers cross major roads such as the A1 dual carriageway, which runs from Belfast to Newry? This road acted as a western boundary for the TVR study area with the aim of discouraging movements of badgers in and out of the study area.

A total of five badgers were trapped in the TVR study zone close to the A1 and were fitted with a Global Positioning System (GPS) collar in October 2017. The collars were scheduled to record 24 locations per night.

Only one of the five badgers crossed the A1, which was on one occasion only and for a short time period. Based on the 4313 location points recorded in total for the five collared badgers, only 2 location points were recorded on the western side of the A1.

Although the number of badgers involved in this study is small, it can be concluded that in general badgers rarely cross major roads which would suggest that roads like the A1 provided a good barrier for badger movements. This finding is supported by evidence from other studies. This finding is important for the development of future badger intervention areas where major roads can be considered as hard borders to discourage migrations of badgers in and out of the intervention zone.

P2. Garrett Declan: Simultaneous Quantification of Metals, Metalloids and Non-Metals in Animal Blood by Inductively Coupled Plasma - Mass Spectroscopy.

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In veterinary clinical chemistry and toxicology, the development of multi-element methods assists in the diagnosis of deficiencies and toxicities and in the elemental profiling of animals, which in turn is essential in promoting and safeguarding public health, animal health, and animal welfare. Limited methods are available for multi-element analysis of blood; they are often restricted to human blood. They often require a digestion step and have low throughput or a limited range of elements. A high-throughput multi-element method, using an alkaline dilution approach, has been developed for the quantification of 12 elements (aluminium, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, and tin) in avian, bovine, caprine, cervine, equine, ovine, and porcine blood. Samples and calibration standards are prepared in an aqueous solution of n-butanol, NH_4OH, EDTA, and Triton-X 100 and analysed for a range of isotopes by inductively coupled plasma – mass spectroscopy (ICP-MS) in combination with an integrated sample introduction system – discrete sampler (ISIS-DS) and a high matrix interface (HMI) attachment. Internal standards rhodium, tellurium and thulium have been selected as appropriate and preliminary results to-date, using whole blood Seronorm™, indicate this method is suitable for multi-element analysis of blood. Linearity, stability, limit of detection, limit of quantification, precision, recovery, ruggedness, and uncertainty of measurement will be determined, and the method will be validated in accordance with ISO 17025. Project research will provide new knowledge and tests to support investigative and surveillance services for animal disease and food safety incidents.

P3. Setyo Laura Christina: Abortion in a Hereford X (*Bos taurus*) associated with *Bacillus licheniformis.*

Laura Christina Setyo

University of Surrey

Bacillus licheniformis is a ubiquitous organism commonly associated with sporadic bovine abortion in the UK. This report describes a case of placental-fetal infection and abortion in a bovine associated with B. licheniformis infection. Stomach contents and lung tissue from the aborted fetus were collected for identification of the causative agent. Histopathology demonstrated a necrosuppurative placentitis and multifocal suppurative pneumonia. Bacterial isolation and histopathology were used to confirm the etiology, B. licheniformis, in fetal tissues. Extensive testing was performed to rule out other causes of bovine abortion (see Table 1).

Table 1. Laboratory test results.

Test	**Result**
Aerobic culture (foetal stomach contents)	Mixed flora containing a moderate growth of *Bacillus spp.* Predominant spp.
Aerobic culture (lung)	Mixed flora containing a moderate growth of *Bacillus licheniformis*
Real-time PCR for *Leptospira spp.* (kidney tissue)	No pathogenic Leptospira DNA detected
Real-time PCR for *Neospora spp.* (brain tissue)	Neospora DNA not detected
Campylobacter spp. enrichment culture (foetal stomach contents)	No *Campylobacter spp.* isolated
Fungal culture (foetal stomach contents)	No fungi recovered
Modified Ziehl-Neelsen smear (foetal stomach contents)	No organisms resembling *Brucella spp., Chlamydia spp.* or *Coxiella spp.* seen.

P4. Varghese Anitha: Developing an ELISA based serology diagnostic for detecting antibodies against louping ill virus (LIV).

Anitha Varghese[1,2], Janet Daly[1], Kevin Gough[1], Mara Rocchi[2]

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Louping ill virus is a UK endemic flavivirus vectored by *Ixodes ricinus* ticks. LIV mainly affects sheep and red grouse usually with a fatal outcome in the latter. The disease in sheep was controlled by a vaccine that has become unavailable. This is likely to lead to a rise in new cases and economical loss, especially in lambs who would have been protected by maternal antibodies. There is a need for a rapid diagnostic test as current serology diagnostics take over a day to complete.

Phage display is an in-vitro selection technique in which peptides of interest can be identified through iterative rounds of biopanning against a phage library. The main advantage of phage display is the linking of the phenotype (peptide binding properties) with genotype (the peptide gene displayed by the phagemid). Serum antibodies can be used to select specifically binding phages.

Output phage clones from the biopanning experiment were tested in an ELISA against LIV positive sera to test their ability in detecting LIV IgG.

P5. Sanchez-Arsuaga Gonzalo: Novel vaccine candidates related to the endogenous development in *Eimeria:* a characterization approach.

Gonzalo Sanchez-Arsuaga, Damer Blake, Fiona Tomley and Virginia Marugan-Hernandez

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Poultry coccidiosis caused by *Eimeria* spp. is a severe intestinal disease that has a significant economic impact on the farming sector. Treatment and prevention principally rely on the use of coccidiostat in feed; however, this could led to drug-resistant *Eimeria* strains. The second most effective prevention strategy is the use of live vaccines, but high cost and complications of production have led to limited use. Research in new generation vaccines has emerge as a suitable alternative, but the identification and validation of protective antigens has shown to be complex. Dense granules (DG) are a major storage organelle for parasitophorous vacuole proteins in *Eimeria* close related parasites such as *Toxoplasma gondii*. Nevertheless, their presence has not been proved in *Eimeria* and limited information is available regarding DG proteins (EtGRAs).

Low number of DG gene orthologues found in *Eimeria* genome together with the lack of microscopic visual evidence, make the points of DG existence and EtGRAs description worth considering. Additionally, over-expression found in some EtGRAs during invasion and early development, the association with MCH class I and positive outcome of certain DG proteins as vaccines in *Toxoplasma* leads to hypothesize EtGRAs as possible vaccine candidates.

Herein, three EtGRAs were selected. Firstly, an in-silico characterization was carried out. Secondly, a genetic approach was performed, looking for possible SNP's among worldwide field samples and, therefore, elucidating preexisting genetic diversity and function significance. Further work will be performed to identify intracellular localization, demonstrate the existence of DG-like structures and evaluate their potential as vaccine antigens.

P6. Widdicombe Jo: Evaluating spatial and temporal Cystic Echinococcosis risk in Argentina.

Jo Widdicombe, Joaquin Prada and Daniel Jackson

University of Surrey

Objectives

To integrate human and canine surveillance data on cystic echinococcosis (CE) incidence at small spatial scales, using a spatiotemporal statistical model. This will allow the generation of fine-scale risk maps of CE in Rio Negro, Argentina. Outputs will be used to inform the regional action plan for CE control coordinated by Pan American Health Organisation (PAHO).

Introduction

Cystic Echinococcosis is a neglected tropical disease causing significant public health problems worldwide. It is endemic in South America, with up to 5000 human cases reported annually. In Argentina, the epidemiological situation varies considerably by region, as do the level of control measures in place.

Methods

Using 15 years of recent human data from the control and surveillance programme in Rio Negro (2003-2018) and three cross-sectional surveys in dogs during that time period in the region, we developed a statistical spatio-temporal model in a Bayesian framework to estimate risk of CE at the implementation unit level.

Expected outcomes

Our model results provide additional insights into the epidemiology of CE in the region and will allow for a rigorous evaluation of current control efforts and optimised deployment of interventions with the most suitable and economically viable strategies.

P7. Burrell Alison: Use of antimicrobials in animal health on the island of Ireland: knowledge, attitudes and behaviour.

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Antimicrobial resistance (AMR) is a global health risk which affects humans and animals resulting in a significant loss of effectiveness of vital medication used to treat illness.

The food-producing animal industry is an area in which antibiotics need to be used more prudently, with antimicrobials, including those deemed to be critically important to human health, being used as a prophylaxis or metaphylaxis instead of improving herd health management practices.

Objectives: analyse primary and secondary mixed-methods data to identify psychosocial factors which influence antimicrobial use on the island of Ireland.

Results: Vet's prescribing behaviours are influenced by moral obligation, a shift in perceived role, profit, experience, pressure from clients, uncertainty and peers. Farmers' use of antimicrobials is affected by awareness, farm practices, emotions, perceived risk, habit and social influences. There is a lack of validated measures to monitor amounts of antimicrobials used per sector and behavioural patterns of antimicrobial use on farms in Ireland.

The risk of AMR could be greatly reduced with behavioural changes to farm practices, e.g. biosecurity and herd health management. There is a lack of literature on taking a behavioural science approach to antimicrobial use, however addressing individual (motivation, self-efficacy) and interpersonal factors show more positive, long-term changes than restrictive measures alone. Findings show that improving vet-farmer communication through motivational interviewing and evidence-based behaviour change techniques will elicit positive behaviour change in the field of AMR in animals.

P8: Collins PJ: Retrospective study of porcine circovirus type 2 (PCV2) genotypes in Northern Ireland from 1996-2006 and 2011-2015: Genotypic shift from PCV2a to PCV2b.

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Porcine circovirus type 2 (PCV2), is the causative agent of postweaning multisystemic wasting syndrome (PMWS) in pigs. PCV2 was first identified in 1998 and according to the most recent global analysis, eight PCV2 genotypes have been identified, namely, PCV2 a-h. To date, there has been no phylogenetic study published about circulating PCV2 strains in Northern Ireland. To address this issue and to explore the current situation, the open reading frame 2 (ORF2) of 22 PCV2 isolates dated 2011 - 2015 were analysed in the present study. Comparison of current strains to 28 archival strains dated 1997 - 2006 was performed. Eighteen percent of the current strains belong to PCV2a and 82% to PCV2b genotypes, compared to 36% of PCV2a and 64% of PCV2b for archived strains. PCV2c, PCV2d, PCV2e, PCV2f, PCV2g or PCV2h were not identified in the present study. These results indicate the ongoing genotype shift in the prevalence of PCV2a to PCV2b in Northern Ireland pig farms which occurred before the widespread vaccination against PCV2, whereas the recent genotype shift from PCV2b to PCV2d has occurred in other countries since the introduction of PCV2 vaccination. Given the observed high evolutionary substitution rate of PCV2, the emergence of new genotypes (PCV2d, PCV2e, PCV2f, PCV2g and PCV2h), which may be as a result of factors such as vaccination pressure and natural selection and emphasises the importance of continued monitoring of PCV2.

P9. Larkin Andrew: A novel approach to analytical mineral analysis in the diagnosis of animal health.

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Minerals are nutrients essential for maintaining biological life. In animals they perform structural, physiological, catalytic and regulatory functions. However, when mineral deficiencies or toxicities occur this can greatly impact animal health. Therefore, it is important that these occurrences are diagnosed quickly in order to safeguard not only animal health but human health as well. Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) is an analytical technique that can determine the elemental make-up of samples, however, its application in veterinary diagnosis is limited. It is this application of ICP-OES in combination with a 'Dilute & Shoot' approach which highlights the novelty of this research.

The overall aim of this project is to enhance the analytical capability of the laboratory to provide diagnostic support in animal clinical investigations. The key objectives in achieving this are to: A) develop and optimise two robust multi-element methods for the analysis of trace (Zn, Fe) and macro minerals (Mg, Ca, K, P, Na) in animal serum and vitreous humour and B) validate the developed analytical methods according to ISO-17025.

The 'Dilute & Shoot' method uses a 1% nitric acid solution with 0.01% Triton-X 100 along with an external standard calibration curve approach. The samples are diluted with a known volume of diluent and run directly on the instrument. Currently the devised analytical ranges for the standard curves are being investigated to ensure suitability. Once validated to ISO 17025, the methods will be implemented for use within the laboratory to support veterinary diagnosis and monitoring of animal health.