ISESSAH-InnovSur 2018 Conference



14 & **18** May 2018



[·] SupAgro Montpellier - France [·]

ABSTRACT BOOK

Program - List of participants



International Society for Economics and Social Sciences of Animal Health

MONDAY 14 & TUESDAY 15 MAY 2018



	y for Economics of Animal Health
ISESSAH	International Society and Social Sciences (

PLANNING AT A GLANCE



FRIDAY 18 MAY		Welcome coffee	Feedback from	brainstorming	Keynote presentation	Coffee break	Expert panel. from	research to policy action in surveillance	InnovSur closure		Brown bag Lunch		Hall d'Honneur (Bât. 9)	Espace Platanes (Bât. 9)	ISESSAH program Amphi. Lamour (Bât. 9)	ERIAH Workshop Amphi. 206 (Bât. 9)	InnovSur program Amphi. 206 (Båt. 9)	InnovSur program Amphi. Lamour (Bât. 9)	
THURSDAY 17 MAY	Registration Welcome coffee	00:60	SESSION 3 SESSION 4	Keynote 3 Keynote 4	10:30	Coffee break		Brain- Brain- storming storming	sessions 3 sessions 4 12:45	13:00	Lunch	14:00		Field trip to	Camargue's	недіопаі Natural Park			Official Gala Dinner InnovSur (Camargue)
WEDNESDAY 16 MAY	Registration 08:00 Welcome coffee	Official Welcome 09:00	Keynote presentation	SESSION 1	Keynote 1			SESSION 2	Keynote 2	13:00	Lunch	14:00	Brainstorming sessions 1 & 2	Coffee break		Day 1 closure			
07.46	08:30	08:45	09:15			11:15	11:40			13:30		14:30		16:00	16:30		17:00		
TUESDAY 15 MAY	Registration		SESSION 5	Keynote 4		Coffee break		SESSION 6	Conclusions		Lunch		ERIAH Workshop*: 'From economic assessment to policv making'	Coffee break		ERIAH Workshop*		* Montpellier city tour will be available on Tuesday	joining ERIAH workshop.
	08:30	00:60			0 1	11:00	3	ļ	C4:21	13:00		14:00		16:00	16:30		18:00	~	
SUNDAY 13 MAY	Welcome desk opening for registration	MONDAY 14 MAY	18:45 Registration	Opening ceremonie	0:30 Press meeting	SESSION 1	1:00	1:15 Coffee break	SESSION 2 Keynote 2	2:45	Lunch	3:45	SESSION 3 Keynote 3	0.9	6:30 Coffee break	SESSION 4	6.0	AGM ISESSAH	0:00 Welcome cocktail Official Dinner ISESSAH

WELCOME MESSAGE

A Jelcome to ISESSAH-InnovSur 2018

V On behalf of the Scientific and Organizing committees, it is a great pleasure to welcome you to Montpellier for the **ISESSAH-InnovSur 2018** event, merging a high-level scientific conference on the contribution of economics and social sciences to animal health (**ISESSAH**); an international forum to discuss gaps and needs for innovation in health surveillance (**InnovSur**) and a workshop (**ERIAH**) toward a better uptake of economic research outputs into health decision-making. This entire week aims to improve health decision-making by taking into account socio-economic dimensions, to stimulate innovative and integrated health surveillance approaches, and to promote inter-sectorial and North-South collaborations.

Efficient decision-making in animal health especially surveillance, is essential to anticipate and prevent epidemics and zoonotic risks. Livelihoods and food security of the world's poorest communities are threatened by economic consequences of animal diseases. Most animal health programmes rely on data generated by national surveillance systems, the effectiveness of which may vary from one country and one disease to another. Many socio-cultural, economical and political factors can affect their performance and costs, as recently demonstrated by the Ebola crisis. To ensure the quality of the data generated, these systems must be regularly evaluated and optimized. An integrated approach and optimisation of animal health systems are needed in a constantly changing world, with threats such as antimicrobial resistance, population growth, environmental and political challenges affecting the well-being of populations.

The objective of the 2nd Conference of the International Society for Economics and Social Sciences in Animal Health (ISESSAH, 14-15 may 2018) is to encourage researchers and policy makers to better integrate socio-economic issues into health decision-making and to promote interdisciplinary approaches. This will be done by adressing 4 main themes: i) the role played by animal health professionals; ii) sociology applied to animal health; iii) decision-making and ecology of animal diseases - surveillance; iv) governance and human behaviour.

The objective of **InnovSur** International Forum **(InnovSur, 16-18 may 2018)** is to examine and discuss the gaps and needs of the next generation in health surveillance: innovations in animal, human and environmental health surveillance but also at the interface (integrated surveillance). **InnovSur** will focus on practical applications and needs for methods and tools to facilitate decision-making, including translational needs to ensure uptake of the research innovations by policy makers and strengthening of public private partnerships. Brainstorming will focus during the Forum on 4 main themes: innovation in integrated surveillance; ii) innovation in research and surveillance policy; iii) innovation in surveillance design and big data; iv) innovation in surveillance of vectors and vector-borne diseases.

The combination of **ISESSAH 2018** and the **InnovSur** forum will provide a specific opportunity to strenghthen North-South interactions and emphasize on environmental and agricultural health economic issues. Animal health economics is a growing field both in North and South countries, given the political and economic uncertainties and the needs to optimise limited resources **ERIAH** (rational in economics to improve animal health) is a network of researchers in health and economy, aiming to promote applied animal health economics to improve inter-sectorial collaborations between scientists, private sector, producers associations and policy makers. Back to back with **ISESSAH**, **ERIAH workshop** will focus on how to translate economic assessments outputs into practical decision-making.

These events bring together around 200 participants from 30 countries. **ISESSAH-InnovSur 2018** owes much to the scientific committees and local organizing committee and particularly Catherine Richard and Marie Cabane for all the logistics and the rest of our Alpha Visa support team whom we thank warmly for their help.

We wish everyone a lively, successful, inspiring and enjoyable **ISESSAH-InnovSur 2018** event and we look forward to fruitful discussions, enhanced networking and the production of relevant results to improve global health surveillance and reduce the burden of animal and zoonotic diseases.

Let's make good health decisions again!

Marisa Peyre, Thierry Baldet, Didier Raboisson

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SESSION 5 - Qualitative approaches for practical solutions
Keynote 4
SESSION 6 - Policies of animal health prevention and control
Oral presentations
Posters

List of participants	94
List of posters	98

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SUNDAY 13 MAY

17.00-10.00	Welcome desk opening for registration	Hall d'Honneur (Bât. 9)							
17.00-19.00	welcome desk opening for registration	<u>nan a nonnear (but. 5)</u>							
	PROGRAM - MONDAY 14	ΜΑΥ							
08:00-08:45	Registration	<u>Hall d'Honneur (Bât. 9)</u>							
08:45-09:30	Opening ceremonie	<u>Amphi. Lamour (Bât. 9)</u>							
09:30-10:30	Press meeting	<u>Hall d'Honneur (Bât. 9)</u>							
09:30-11:00	SESSION 1 - The role played by animal health professionals	<u>Amphi. Lamour (Bât. 9)</u>							
	Chair: Didier Raboisson (ENVT-INRA, France)								
09:30-10:15	• Keynote 1 - State of the US Veterinary Profession Michael Dicks (American Veterinary Medical Association, USA)								
10:15-10:45	 Selected oral presentations S1-OC1 - A field trial on the effect of veterinary peer study groups on t antimicrobials - Valerie-Beau Pucken (Vetsuisse Faculty - University of Be S1-OC2 - Brexit and the International Migration of Veterinary Surgeons 	he prescription of intramammary ern, Switzerland) s to and from the UK							
	Gareth Enticott (Cardiff University, UK)								
10:45-11:00	Selected short oral presentations S1-SO1 - How the income of French veterinarians is composed? An economic analysis Jean-Joseph Minviel (INRA-ENVT, France) 								
	 S1-SO2 - How do French veterinarians face the new antimicrobial resistance policy regarding the use of critically important antibiotics? - Clémence Boireau (ANSES, France) 								
	 S1-SO3 - Vertical coordination and health control measures in the French young bull sector: a transaction cost analysis - Florence Beaugrand (Oniris - Inra, France) 								
	• S1-SO4 - Role of upstream packers, processors, and retailers in producer biosecurity effort Glynn Tonsor (Kansas State University, USA)								
	• S1-SO5 - The dilemma of controlling BVDV in Thuringia, Germany: Outcome of an agent based model Jörn Gethmann (Friedrich-Loeffler-Institut, Germany)								
11:00-11:15	Coffee break - Visit of exhibition - Poster session	<u>Hall d'Honneur (Bât. 9)</u>							
11:15-12:45	SESSION 2 - Sociology applied to animal health	<u>Amphi. Lamour (Bât. 9)</u>							
	Chair: Gareth Enticott (Cardiff University, UK)								
11:15-12:00	• Keynote 2 Future challenges of the sociology of animal health. Examples from antir Nicolas Fortané (Inra - IRISSO, France)	nicrobials use in livestock production							
12:00-12:45	Selected oral presentations								
	• S2-OC3 - Anthropological comparison of occupational practices, risk and biosecurity along the poultry commodity chains in Bangladesh and Vietnam - Erling Høg (London School of Hygiene & Tropical Medicine, UK)								
	 S2-OC4 - Animal health management on organic farm: influence of extension services and animal health professionals - Claire Manoli (Goupe ESA. France) 								
	• S2-OC5 - An ethnography of medicine use on UK dairy farms - Gwen Re	ees (University of Bristol, UK)							
12:45-13:45	Lunch	<u>Espace Platanes (Bât. 9)</u>							
	Visit of exhibition - Poster session	<u>Hall d'Honneur (Bât. 9)</u>							

13:45-16:00	SESSION 3 - Decision making and ecology of animal diseases - Surveillance	<u>Amphi. Lamour (Bât. 9)</u>								
	Chair: Pablo Alarcon (Royal Veterinary College, UK)									
13:45-14:30	 Keynote 3 - How much is nature worth? Challenges and controversies around the economic valuation of plant and animal life - Eric Gómez-Baggethun (Norwegian University of Life Sciences, Norway) 									
14:30-15:45	Selected oral presentations									
	• S3-OC6 - Effects of disease risk, information certainty, and messaging on biosecurity compliance on lives- tock facilities: evidence from experimental simulations - Susan Moegenburg (University of Vermont, USA)									
	 S3-OC7 - At the interface of Animal health and Environmental management, a case study driven by in Thailand - Aurélie Binot (Cirad, France) 									
	 S3-OC8 - Avian influenza in Bangladesh: ethnography, behavioural economics and experimental behavioural epidemiology in One health - A proof of concept - Tony Barnett (LSHTM, UK) 									
	 S3-OC9 - Selecting an optimal surveillance option during an outbreak: a comparison of Cost-effectiveness for highly pathogenic Avian influenza - Kaming Johnson (JISDA - APHIS, JISA) 									
	S3-OC10 - Unbiased assessment of disease surveillance utilities: a prospect theory application Victor L del Rio Vilas (University of Surrey, UK)									
15:45-16:00	Selected short oral presentations									
	• S3-SO6 - Levers and barriers to the implementation of the One Health surveillance strategy for antibiotic resistance in Vietnam - Marion Bordier (Cirad, Vietnam)									
	• S3-SO7 - Economic evaluation of swine health surveillance and control system in Vietnam Marisa Peyre (Cirad, France)									
	• S3-SO8 - One Health evaluation of the University of Copenhagen Research Centre for Control of Antibiotic Resistance (UC-CARE) - Angis Léger (SAEOSO AG, Switzerland)									
	 S3-SO9 - Economic evaluation of antimicrobial resistance surveillance system in Duna Vu (OUCRU Hanoi, Vietnam) 	Vietnam								
	• S3-SO10 - How local socio-economic and cultural factors shape animal health surve Marisa Peyre (Cirad, France)	illance and control programs								
16:00-16:30	Coffee break - Visit of exhibition - Poster session	<u>Hall d'Honneur (Bât. 9)</u>								
16:30-18:00	SESSION 4 - Governance and human behaviours	<u>Amphi. Lamour (Bât. 9)</u>								
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PROGRAM - TUESDAY 15 MAY

08:30-09:00	Registration	<u>Hall d'Honneur (Bât. 9)</u>
09:00-11:00	SESSION 5 - Qualitative approaches for practical solutions	<u>Amphi. Lamour (Bât. 9)</u>
	Chair: Bouda Vosough Ahmadi (SRUC, UK)	
09:00-09:45	• Keynote 4 - Qualitative methods in Animal Health Research Rob Christley (University of Liverpool, UK)	
09:45-10:45	 Selected oral presentations S5-OC16 - Evaluation of One Health-ness: insights into interdisciplinary Simon Rüegg (University of Zurich, Switzerland) S5-OC17 - Making shared responsibilities work? Contested biosecurity s Brian Furze (Charles Sturt University, Australia) S5-OC18 - Increasing the local relevance of epidemiological research: si amongst Basongora pastoralists in Uganda - Erika Chenais (National Vet S5-OC19 - Participatory evaluation of vaccination services for Newcastl in Democratic Republic of Congo - Francis Lwapa (University of Liège, Bet 	and cross-sectoral integration spaces in the Australian egg industry tuated knowledge of cattle disease terinary Institute, Sweden) e disease control in village poultry elgium)
10:45-11:00	 Selected short oral presentations S5-S016 - Walking at the edge of social and biomedical sciences: a fasc N. Antoine-Moussiaux (University of Liège, Belgium) S5-S017 - Scoping review on farmer's attitude and personality as possi health, welfare, productivity and farm management Friedeman Adler (University of Veterinary Medicine Hannover, Germany) S5-S018 - Big-five personality traits of farmers evaluated by self- and o implementation of animal hygiene measures Marcus Mergenthaler (Southwestfalia University of Applied Science, Gerri S5-S019 - Stakeholder perceptions of colostrum management for dairy Laura Palczynski (Harper Adams University, UK) S5-S020 - Adoption of secure pork supply plan biosecurity by U.S. Swin Christopher Pudenz (Iowa State University, USA) 	inating yet tricky trek! ble risk factors for dairy cattle ther-rating in relation to many) calves in England he Producers
11:00-11:30	Coffee break - Visit of exhibition - Poster session	Hall d'Honneur (Bât. 9)
11:30-12:45	SESSION 6 - Policies of animal health prevention and control	Amphi. Lamour (Bât. 9)
12:45-13:00	 Chair: Dannele Peck (USDA-ARS - PA - RRSRU, USA) Selected oral presentations S6-OC20 - Evaluation of measures to control emerging parasitic disease Leishmaniasis) in Veneto region, North-Eastern Italy - Massimo Canali (S6-OC21 - Using a food-chain risk analysis to model the cost-effectivene diagnosis and treatment in western Kenya - Lian Thomas (University of S6-OC22 - Rethinking caprine brucellosis control: lessons from a Mexica David Oseguera Montiel (Universidad Autónoma de Yucatán, Mexico) S6-OC23 - Impact of indemnity expectations on producer biosecurity efformation of glynn Tonsor (Kansas State University, USA) S6-OC24 - An overview of prevention and control policies of infectious farms in Iran - Mohammad Abdoshah (Razi Vaccine and Serum Research Conclusions - Jonathan Rushton (University of Liverpool, UK) 	es (Cystic Echinococcosis and University of Bologna, Italy) ess of porcine cysticercosis Liverpool, UK) an study fort diseases in commercial poultry Institute, Iran)
	Group photo	
13:00-14:00	Lunch Visit of exhibition - Poster session	<u>Espace Platanes (Bât. 9)</u> Hall d'Honneur (Bât. 9)

PROGRAM - TUESDAY 15 MAY

ERIAH Workshop 'From economic assessment to policy making'

14:00-14:15	Welcome	<u>Amphi. 206 (Bât. 9)</u>
14:15-14:30	Introduction Didier Raboisson (ENVT-INRA, France) and Arnaud Rault (INRA, France) • Reminder of ERIAH objectives and of last workshop themes • Programme of the afternoon	ce)
14:30-15:00	Disease control and practices along the value chain Karl Rich (ILRI, Vietnam)	
15:00-15:30	Modelling risk attitudes: concepts and empirical applications Nicolas Treich (INRA-TSE, France)	
15:30-16:00	Trade, markets, shocks and biosecurity: lessons for the future Dustin Pendell (Kansas State University, USA)	
16:00-16:30	Coffee break	<u>Hall d'Honneur (Bât. 9)</u>
16:30-17:50	Round table discussion A facilitated discussion between the invited speakers and the audio Facilitators: Didier Raboisson and Arnaud Rault	<u>Amphi. 206 (Bât. 9)</u> ence
17:50-18:00	Conclusion & end	

ABSTRACTS

(MICHAEL DICKS)

Dr. Michael Dicks is currently the Director of Veterinary Economics with the American Veterinary Medical Association. The Veterinary Economics Division has been tasked with improving the efficiency of veterinary markets and the financial performance of veterinary practices.

Dr. Dicks received his undergraduate degrees in biochemistry and animal science from California Polytechnic State University, MS and PhD in Agricultural Economics from University of Missouri.

Before joining the AVMA is 2013, Dr. Dicks was a professor of Agricultural Economics for 24 years and directed the Great Plains Agricultural Policy Center and the Center for International Trade and Development at Oklahoma State University. Dr. Dicks has over 500 publications and currently

produces the AVMA Veterinary Markets Report Series, a monthly column, 'Eye on Economics' in DVM360.com and speaks frequently at veterinary conferences to provide economics expertise to the veterinary profession.

State of the US Veterinary Profession

Michael Dicks*

**Corresponding author: aecnslt@gmail.com (Michael Dicks)*

For the last five years, the American Veterinary Medical Association has engaged in a rigorous and systematic data collection and analysis program to understand the veterinary markets with the goal of improving market efficiency and the financial performance of veterinary practices. While not yet complete, the effort has provided valuable insights into problems in the markets such as a high student debt to starting salary ratio, declining percent of the profession as practice owners, declining value of the DVM degree, and a five-fold difference between health care needs and veterinary services provided. This presentation provides the current situation and future outlook of the performance of the US veterinary markets.

S1-0C1

A field trial on the effect of veterinary peer study groups on the prescription of intramammary antimicrobials

Valerie-Beau Pucken^{a*}, Michèle Bodmer^b, Esther Schelling^c, Gertraud Schüpbach-Regula^d

^aVetsuisse Faculty, University of Bern, Bern, Switzerland; ^bClinic for Ruminants, Vetsuisse Faculty, University of Bern, Bern, Switzerland; ^cSwiss Tropical Institute, Basel, Switzerland; ^dVeterinary Public Health Institute, Vetsuisse Faculty, University of Bern, Bern, Switzerland

**Corresponding author: valerie.pucken@vetsuisse.unibe.ch (Valerie-Beau Pucken)*

Within the dairy industry, most antimicrobials are used for dry-cow therapy or mastitis treatment. In previous studies participating in peer study groups supported knowledge transfer between farmers and helped them to maintain a good udder health with reduced use of antimicrobials (1,2). The objective of our project is to evaluate the effect of peer-group education on prescription practices of veterinarians. This study especially focuses on the qualitative analysis of the peer study groups.

Twenty-one participating Swiss cattle practitioners were divided into three groups. Each peer study group met every two to three months, together with an expert and a moderator. The peers determined the topics of the meetings. Minutes of the meetings were analyzed with the software MAXQDA. Intramammary antimicrobial prescriptions were recorded during the 18 months of study period.

The topics discussed in the peer study groups can be divided into mastitis-related topics (73.3%) (e.g., drying off, therapy or diagnostics) and non-mastitis-related topics (26.7%) (e.g., communication, herd health management or complementary medicine). Within the peer study groups active participation in discussion improved over time, also depending on the discussed topic. In meetings on mastitis-related topics, more speaking contributions were recorded. For the mastitis-related topics, veterinarians stated that they liked the comparison with their peers (34%), the change of perspective (30%) and that they gained new knowledge (22%). For other topics gaining new knowledge was clearly the most important aspect (83% of the answers).

Our study shows that this type of continuing education is positively perceived by veterinarians. This is confirmed by their improved active participation over time. The next step is to analyze the data on antimicrobial prescriptions of the participating veterinarians to show whether peer-group education is an efficient method for reducing antimicrobial usage.

Research impact highlights: With the need for antimicrobial reduction, peer-group education might be a promising approach for veterinarian's continuing education. Our project evaluates the efficiency of peer-group education of veterinarians with regard to their prescription practice for mastitis treatment. This study focuses on the qualitative evaluation of the peer-groups. Our results show that active participation in discussion and speaking contribution increased over time but also varied between different topics. This knowledge could help to improve peer study groups for veterinarians and may then contribute to the reduction of antimicrobials usage.

Keywords: antimicrobial reduction - veterinarian - continuous education - peer study group - prescription practice

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S1-0C1

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S1-0C2

Brexit and the International Migration of Veterinary Surgeons to and from the UK

Gareth Enticott^{*}

Geography and Planning, Cardiff University, Cardiff, Wales

^{*}Corresponding author: enticottg@cardiff.ac.uk (Gareth Enticott)

The decision to leave the European Union has highlighted the United Kingdom's reliance on overseas veterinary labour: in 2017, 33% of all registered veterinary surgeons qualified outside of the UK. The veterinary workforce is also affected by UK veterinary graduates leaving the UK. Despite the significance of the migration of veterinary labour, there is little research examining the factors influencing the migration of vets. This paper addresses this lacuna by examining the migration of vets to the UK, and those that have left the UK. Migration is conceptualised as a response to disruptions to narratives of professional subjectivity that are set within a 'disease ecology' - the inter-woven social, economic, biological, environmental and institutional relations that shape the practice of animal disease management. Using the Biographical Narrative Interpretive Method, the paper draws on 86 interviews life-history interviews with vets. The paper outlines five narratives of migration that capture the relationships between the personal, professional and biological and inform vets' decisions to migrate to and from the UK. These include: (i) the 'first job' narrative which highlights the tensions between becoming a vet and the challenges of being a vet; (ii) the narrative of the 'anti-vet' describes the rejection of dominant veterinary subjectivities and the search for alternatives; (iii) the narrative of 'poverty farming' describes the effects of incremental changes and disruptions to farming and veterinary identities; (iv) the narrative of luck and chance which highlights the unplanned nature of migration and the importance of support from fellow migrants; and (v) a narrative of recovery and therapy in which a return to traditional veterinary values provide ontologically secure veterinary subjectivities. In conclusion, the paper discusses the differences in migration between vets arriving and leaving the UK, and calls for further research on the international migration of vets.

Research impact highlights: Vets are required to conduct animal disease surveillance in public and private organisations. In the UK, the delivery of these veterinary services may be compromised by Brexit and other workforce issues. This paper provides the first analysis of the causes of veterinary migration and its consequences for the delivery of veterinary services. The paper focuses on vets delivering disease control functions for farm animals, and relates to the conference themes of governing human behaviours and the role played by animal health professionals in the management of animal disease.

Keywords: Veterinary Surgeons - Migration - Labour

How the income of French veterinarians is composed? An economic analysis

Jean Joseph Minviel^{a*}, Ahmed Ferchiou^a, Didier Raboisson^{a, b}

^aIHAP, Ecole nationale vétérinaire de Toulouse, Toulouse, France; ^bSanté Animale, Inra, Toulouse, France

**Corresponding author: j.minviel@envt.fr (Jean Joseph Minviel)*

French veterinarians are authorized to both prescribe and deliver drugs, leading to a situation of conflict of interest. Risks of over-prescription to increase profit from drug prescriptions are often underlined by some stakeholders. The concern is particularly delicate for antimicrobials. There exits little evidence on potential over-prescription in the case of prescription and drug delivery by the same actor, on the share of drug delivery in veterinarians' income, and on how regulatory changes may affect veterinarians' interest in food animal sector. The present work aims to describe how the income of French veterinarians is composed, focusing on farm and small animal sectors, and to analyze solutions to guarantee veterinarians' revenue in cases of reduction or end of drug delivery.

Structural and accounting data from 20 French vet offices with various sectors (farm animals, horses, small animals...) were selected for 3 years. The net hourly income was composed by direct and indirect hourly incomes. The direct one was defined as income from services (consultations, acts and advice, including prescription and surgery), and the indirect one as income from selling of drugs or other products. The net hourly income was then regressed to identify influencing factors.

The results showed that the net hourly income associated with a given sector highly varied between offices. The net income and the share of services in the net income were higher, on average, for food animal sector compared to small animal ones. To maintain the veterinarians' income without drug delivery, the prices of services should on average be increased by more than 35% in food animal sector and by about 10% in small animal sector. The results highlighted a high risk for vets to neglect the farm animal sector in cases of high restrictions on drug delivery by vets, unless incentives were given

Research impact highlights: Because French veterinarians are authorized to both prescribe and deliver drugs, a risk of over-prescription is often underlined. Defining how the veterinarians' income is composed is of interest to define veterinarians' dependence on drug selling and to predict their behavior in cases of reduction or end of drug delivery. Because the share of drug selling in final income is higher for food animal production compared to other sectors, restrictions in drug delivery by veterinarians may lead them to neglect the farm animal sector, suggesting public policy to adopt incentives. Quantifications of these incentives are needed.

Keywords: Economic analysis - Healthcare professionals - Antimicrobial use - French veterinary office - Business economics

How do French veterinarians face the new antimicrobial resistance policy regarding the use of critically important antibiotics?

Clémence Boireau^{a, b, c*}, Nicolas Fortané^d, Didier Calavas^a, Agnès Leblond^b, Emilie Gay^a

^aUnité Épidémiologie, ANSES, Lyon, France; ^bUMR EpiA, Inra, Marcy-l'Étoile, France; ^cENSV, Marcy-l'Étoile, France; ^dIRISSO, CNRS-Inra, Paris, France

**Corresponding author: clemence.boireau@anses.fr (Clémence Boireau)*

In March 2016, the French animal health authorities have enacted a decree requiring an antibiogram before using critically important antibiotics in veterinary medicine in order to fight antimicrobial resistance. The aim of this study was to provide a better understanding of veterinarians' motivations and role-players' influence concerning the choice of whether to ask for an antibiogram in the bovine, porcine, poultry and equine sectors. We concurrently evaluated the impact of this decree.

Semi-structured interviews with veterinarians were conducted in France. Thematic analysis was used to analyse transcripts.

We surveyed 66 French veterinarians. Recourse to an antibiogram in veterinary medicine was multifactorial (46 factors gathered into 11 categories were identified) and varied between animal sectors: it was quasi-systematic in poultry, frequent in porcine but rare in both bovine and equine sectors. The decision making to use this test was largely influenced by interactions between stakeholders. Surprisingly, even though the new decree implied a restriction on prescriptions, it has been well accepted, mainly because veterinarians considered it to be relevant and fair. Up to now, the decree has not increased the use of antibiograms but it has induced a change in prescriptions; respondents see it as an aid for promoting responsible and prudent use of antibiotics, fostering the use of alternatives. From a cultural and social point of view, it introduced a paradigm shift reorienting veterinary practices towards a more global and preventive approach of animal health.

Our findings shed light on the basis of veterinarians' position regarding antibiogram use and antimicrobial resistance and highlight key factors for a successful change in regulations. Thus, our results will be useful in guiding representative veterinary bodies and regulatory authorities in their communication and policy-making decisions.

Research impact highlights: Published in 2016, a French decree restrains the prescription of critically important antibiotics to the use of antibiogram in animal health. Our study focused on the impacts of this public policy on practices of veterinarians. Surprisingly, the decree was well received and perceived by veterinarians as a regulatory support to change prescription habits and redefine their role. Exploring underpinning drivers and reasons behind the use of antibiogram in veterinary medicine, we found that antibiogram is still an underestimated tool for resistance containment and identified levers to facilitate its use. These findings will be useful to design new measures or regulations.

Keywords: antimicrobial resistance - regulation - antibiogram - animal health - sociological survey

Vertical coordination and health control measures in the French young bull sector: a transaction cost analysis

Axelle Poizat^{a*}, Sabine Duvaleix-Tréguer^b, Florence Bonnet-Beaugrand^a

^aOniris/Inra, Nantes, France; ^bInra, Rennes, France

**Corresponding author: axelle.poizat@oniris-nantes.fr (Axelle Poizat)*

The French young beef bulls sector presents very diverse vertical coordination patterns. This mixed system of vertical coordination has animal health issues. The more animals are mixed and subjected to long transports, the more likely they will be to develop bovine respiratory disease (BRD) at the beginning of the fattening period. Two major challenges exist, both based on economic and public health issues.

We aimed to understand how and why the vertical coordination patterns in the young bulls sector are shaped this way and how these different vertical coordination patterns influence public health issues (BRD and antibiotic use). We collected informations through 54 qualitative semi-structured interviews and 6 field observations.

Our analysis show that cow-calf producers and fatteners face different transaction costs, which explain the choice of low vertical coordination for cow-calf producers and more diverse forms of vertical integration, ranging from spot market to perfect vertical integration, for fatteners. We also show that the level of vertical organisation has a direct influence on BRD risks and antibiotic use at the beginning of the fattening period. The "health issues" parameter is involved in different categories of transaction costs (risk, uncertainty, quality). When vertical coordination is strong (weak), the risk of BRD is low (high). This article explains further ways to implement incentives to reduce systematic, preventive antibiotic use in this sector. From a technical point of view, to diminish the risk of BRD and at the same time, the systematic and preventive use of antibiotics; one should implement early vaccination (Figure 3), reduce animal mixing, and reduce the length of transfers. From an economic point of view, this improvement will be linked to fewer transaction costs and a more vertically coordinated governance. This tends to confirm the positive correlation between good information exchange and performance.

Research impact highlights: The French young beef bulls sector presents a complex organisation. The more animals are mixed and subjected to long transports, the more likely they will be to develop bovine respiratory disease (BRD). We aimed to understand the vertical coordination patterns in the young bulls sector and how they influence public health issues (BRD and antibiotic use). Transaction costs analyses revealed a diversity of vertical coordination patterns, from spot market to vertical integration. The "health issues" parameter is involved in different categories of transaction costs (risk, uncertainty, quality,...). When vertical coordination is strong (weak), the risk of BRD is low (high), which thus have an indirect effect on antibiotic use.

Keywords: Transaction costs - vertical coordination - Young bulls sector - Animal health control measures - Reduction of antibiotics use

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Role of Upstream Packers, Processors, and Retailers in Producer Biosecurity Effort

James Mitchell^{a*}, Glynn Tonsor^a, Lee Schulz^b

^aAgricultural Economics, Kansas State University, Manhattan, KS, United States; ^bAgricultural Economics, Iowa State University, Ames, IA, United States

**Corresponding author: jlmitch19@ksu.edu (James Mitchell)*

While multiple biosecurity strategies have been developed, few are fully adopted by livestock producers. This in part reflects the limited monetary signaling from livestock buyers (packers and processors) that biosecurity investments are valued. However, reductions in business interruption that may follow fewer (or shorter) disease events hold economic value to packers, processors, and retailers who maintain more regularly business flows following producer investments. Given the significant fixed costs of upstream businesses, this economic impact if substantial yet often overlooked. When one considers recent major disease events such as PEDv, PRRS, or HPAI or possible future cases of FMD and other Tier 1 diseases, the disruption that follows reduced aggregate animal flows becomes apparent.

This study uses an equilibrium displacement model of the U.S. meat-livestock industry to identify the economic impact to U.S. livestock producers who elect to adopt higher biosecurity practices. The model maps out the changes in prices and quantities of vertically connected industries enabling economic welfare impacts of changes (e.g. adoption of additional biosecurity) to be quantified. The specific retailer and packer cost reductions that are needed to encourage producer adoption of additional biosecurity are quantified. Stated differently, the upstream cost savings that lead to sufficiently higher livestock prices (following increased derived demand for livestock) making producers indifferent (where benefits from higher output prices and elevated costs equate once volume adjustments are endogenously controlled for) are estimated. This approach has been applied successfully in food safety research but not yet in animal disease, biosecurity settings.

This study's provision of new insights into the role of upstream stakeholders adds to the broader understanding of livestock producer, disease mitigation effort and more efficient market and policy systems. Coupling this with specific estimates of economic welfare provides several more general implications worthy of discussion at the ISESSAH meeting.

Research impact highlights: Most assessments of producer decision making involves examining their response to costs of changing production practices (e.g. out-of-pocket expense of new equipment). However, the net effect once adjustments from customers are considered is truly what drives realized economic outcomes for producers. In the case of livestock disease efforts, it is important to examine the role of the upstream, meat industry segment (packers, processors, and retailers) in encouraging livestock producer biosecurity efforts. This study estimates the economic "carrot" needed, in the form of higher market hog prices, to encourage producers to adopt biosecurity practices they otherwise may avoid.

Keywords: biosecurity - upstream signaling - packer - processor - equilibrium displacement model

The dilemma of controlling BVDV in Thuringia, Germany: Outcome of an agent based model

Jörn Gethmann^{a*}, Carolina Probst^a, Hartmut Lentz^a, Pascal Blunk^b, Jason Bassett^b, Martin Beer^c, Philipp Hövel^b, Franz J. Conraths^a

^aInstitute of Epidemiology, Friedrich-Loeffler-Institut, Greifswald - Insel Riems, Germany; ^bInstitute of Theoretical Physics, Technische Universität Berlin, Berlin, Germany; ^cInstitute of Diagnostic Virology, Friedrich-Loeffler-Institut, Greifswald - Insel Riems, Germany

^{*}Corresponding author: joern.gethmann@fli.de (Jörn Gethmann)

Introduction: Bovine viral diarrhea (BVD) is an economically important disease in cattle. Therefore, a nationwide compulsory BVD control program was started in Germany on 01 January 2011. Its central elements are testing all newborn calves before the age of six months for BVD virus genome using ear-tag samples. Persistently infected (PI) animals must be swiftly removed from the population. It is also mandatory to test animals prior to movement, if they have not been previously assigned a BVD status.

Materials and methods: To prepare a scientific basis for the decision on the future control strategy, we developed an agent-based disease-spread model on animal basis that includes trade between farms and allows to study the effects of thirteen different control strategies. The results of the model were used in a cost-benefit analysis to estimate costs and benefits of the strategies.

Results and discussion: The total costs of the different control strategies (2011 - 2030) range between 40 and 180 million \in . The results showed that not starting a control program would have been the cheapest option, followed by the current strategy (net present value 0.73). Terminating control now would lead to an increase of the PI prevalence to the level before the program.

Only scenarios that include compulsory vaccination and additional antibody-detection in young animals (9-18 months, so-called 'Jungtierfenster') may eventually lead to freedom from disease. The more intensive the monitoring, the faster freedom can be achieved.

The current strategy will reduce the number of PI animals, but is unlikely to lead to a free population due to the risk of re-introduction.

Current EU legislation does not allow member states to use the BVDV status of cattle for general movement restrictions. Hence, a control program can only be successful, if each farmer takes responsibility and buys only BVD-free animals.

Research impact highlights: A compulsory BVD control program was started in 2011 in Germany. To decide on the future of the control program, we developed an agent-based model to simulate different control strategies and their costs. The results showed that none of the control strategies will lead to a permanently disease-free population, caused by the fact that the import of persistently infected (PI) animals might be possible. The current strategy reduces the PI prevalence and is the cheapest option. Other strategies, e.g. vaccination, can eliminate all PI animals, but they are very expensive and a reintroduction is possible.

Keywords: Bovine Viral diarrhoea - cost-benefit analysis - agent-based disease-spread model - control strategy

S1-P1

One Health practitioners must master interdisciplinary knowledge, methods and skills

Simon Rüegg^{a, b*}, Barbara Häsler^c, Martin Hitziger^a

^aSection of Veterinary Epidemiology, University of Zürich, Zürich, Switzerland; ^bon behalf of the NEOH consortium, London, United Kingdom; ^cRoyal Veterinary College, University of London, London, United Kingdom

**Corresponding author: srueegg@vetclinics.uzh.ch* (Simon Rüegg)

Introduction: The One Health (OH) approach has been promoted for many current health challenges, particularly those arising from the complex and intertwined spheres of humans, animals and the ecosystems constituting their environment. In an iterative consultation process, the EU COST funded "Network for Evaluation of One Health (NEOH)" has identified specific aspects, which are characteristic for OH initiatives addressing such wicked problems. In a consecutive study, we formulated how these characteristics can be operationalized through knowledge integration (KI).

Methods: In this study we illustrate that the OH characteristics and KI in OH initiatives demand specific knowledge, methods and skills to implement this theoretical concept.

Results: OH initiatives rely on systems thinking, flexible planning to respond to unexpected outcomes, and working in a transdisciplinary way. Consequently, they must provide opportunities for learning at individual, team and organisational level, which in turn requires sharing of data, information and experiences. The approach promotes the negotiation among stakeholders throughout the policy cycle to integrate tacit knowledge and objective data during agenda setting, implementation and evaluation. This includes two processes requiring special skills: 1) the diversity of knowledge must be ordered and put into relation to become meaningful for the collective decisions, and 2) the diversity of values, epistemologies and cultural practices between disciplines, sectors and demographic strata leads to contradictions that must be brought to a compromise. Both processes require a thorough understanding of methods from social and natural sciences, and demand a high ability to moderate between different view-points that may be associated with emotionally laden conventions and moral values. Discussion: The identified skills are interdisciplinary and rarely taught or trained in current health education. For future leaders in OH it is essential to acquire systems thinking, epistemology, mixed method approaches, moderation and adaptive leadership skills to enable practical applications of integrated health.

Research impact highlights: The One Health (OH) approach is being promoted for complex health challenges at the interfaces of humans, animals and the ecosystems constituting their environment. In an iterative consultation process, the EU COST Action 'Network for Evaluation of One Health (NEOH)' has identified the characteristic aspects of this approach and illustrated the linkages to the policy cycle. OH practitioners therefore must connect the meanings of tacit knowledge and diverse other data, and conciliate diverse values, cultural practices and epistemologies. This requires systems thinking, epistemology, mixed method approaches, moderation and adaptive leadership skills to translate effectively OH into practical applications.

Keywords: One Health - Education - Interdisciplinarity - Skills

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S1-P1

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S1-P2

Policy options to reduce antibiotic prescribing in veal calf production in Switzerland

Anaïs Léger^{a*}, Julie Pont^b, Isabel Lechner^a, Maren Feldmann^b, Martin Kaske^b, Katharina D.C. Stärk^a

^aSAFOSO, Liebefeld, Suisse; ^bVetsuisse-Faculty Zurich, Zurich, Suisse

**Corresponding author: anais.leger@safoso.ch (Anaïs Léger)*

Introduction: Veal calf production in many European countries, including Switzerland is competitive and economically viable partly due to the use of antibiotics. Yet for public health reasons, increasing attention is drawn towards a more prudent and restrictive use of antimicrobials. The Swiss national strategy StAR for antimicrobial reduction triggers actions to decrease their usage. The objective of this study was to identify alternative policy options such as the use of incentives and leverage points among veterinarians to enhance practice changes.

Materials and methods: The first part of this study included the description of the veal calf value chain in Switzerland based on literature from the scientific community, national statistics and input from industry experts. Second, a workshop was organised with selected European experts to create an inventory of alternative policy actions implemented that could be adopted to reduce prescription intensity.

Results: The veal calf value chain is a complex production system with numerous actors and economic drivers. It involves actors at agricultural, veterinary, food and public-sector level. Antimicrobial usage is impacted by decisions at all levels. In Switzerland, veterinarians are selling antibiotics and make a financial profit. Based on the experience in other countries, the following possible scenarios were discussed during the workshop: (i) reward system for veterinarians for low antibiotic use; (ii) taxes on antibiotics, (iii) subsidies for a veal calf meat label with "minimal antimicrobial usage"; (iv) change the role of the veterinarians towards as a farm consultant.

Discussion/conclusion: The results will need to be discussed among veterinarians, industry partners and policy makers. Acceptable and realistic options will then be developed further, including economic analysis to assess their feasibility and impact on the different actors along the value chain.

Research impact highlights: The Swiss national strategy for reducing the use of antibiotics for production animals encourages actions to identify incentives for veterinarians to prescribe less antimicrobials. In this project, we focus on the veal calf production. First, a description of the value chain was developed and specified for Switzerland, identifying all actors and their role and influence in the system. Second, based on European experts' knowledge, we identified possible economic scenarios for sharing costs along the value chain with the aim of reducing the prescription of antibiotics. Results can be used to inform industry and government actions.

NICOLAS FORTANÉ

Nicolas Fortané is an INRA research fellow in sociology at IRISSO (Paris-Dauphine University) and works on animal health policy and the veterinary profession, especially on the regulation of veterinary drugs. His research focuses on the construction of the Antimicrobial Resistance (AMR) public problem in France and the UK, the transformations of rural veterinary medicine and the role of the livestock industry in antimicrobial use regulation.

Amongst his recent publications:

Cécile Adam, Christian Ducrot, Mathilde Paul, Nicolas Fortané, "Autonomy under contract: the case of traditional free-range poultry farmers", Review of Agriculture, Food and Environment studies, 98 (1-2), 2017, p. 55-74.

Nicolas Fortané, Frédéric Keck, "How biosecurity reframes animal surveillance", Revue d'Anthropologie des Connaissances, 9 (2), 2015, p. A-L.

Future challenges of the sociology of animal health. Examples from antimicrobial use in livestock production

Nicolas Fortané^{*}

Inra, Paris, France

^{*}Corresponding author: nicolas.fortane@inra.fr (Nicolas Fortané)

The sociology of animal health is developing for about 15 years but still has several challenges to tackle. Research has been produced on 21st century animal health crisis, such as avian Influenza, foot-and-mouth disease, bovine tuberculosis or, more recently, antimicrobial resistance. These works have also benefit from interactions with interdisciplinary qualitative research in veterinary sciences. Most of the knowledge that has been produced so far on concerns either public policies and regulatory issues, or farmers' practices and knowledge towards animal health management. Future challenges of the sociology of animal health would be to build bridges with other areas of social sciences, such as sociology of labour and professions, or sociology of markets and economics, to be able to focus and develop studies on other relevant dimensions of animal health issues.

I will use examples drawn from research on antimicrobial use (AMU) in livestock production to illustrate these challenges. Indeed, most of the studies that have been produced on this topic so far concerns farmers' behaviours and perceptions of antibiotics. Although more works are still required on this issue, it is time to develop research on other actors and institutions, which also play an important role in the regulation of AMU in livestock production. I will in particular insist on the veterinarians and the recent evolution of their professional and business models, as well as the producers' organizations (*i.e.* cooperatives) which have a strong impact on the development of reduced-AMU standards. In conclusion, I will also briefly underline the need of doing research on the marketing strategies of pharmaceutical industries and retailers companies, and show how the sociology of animal heath could draw inspiration from other research topics where social sciences have already started to tackle with these challenges.

Research impact highlights: AMR AMU Animal disease management Animal health policy Veterinary drug regulation.

S2-0C3

Anthropological Comparison of Occupational Practices, Risk and Biosecurity along the Poultry Commodity Chains in Bangladesh and Vietnam

Erling Høg^{a*}, Tony Barnett^a, Md. Ahasanul Hoque^b, Rashed Mahmud^b, Marisa Peyre^c, Mai Hoang Ngoc^d, Dirk Pfeiffer^e, Guillaume Fournié^f

^aDepartment of Global Health and Development, London School of Hygiene & Tropical Medicine, London, United Kingdom; ^bDepartment of Medicine & Surgery, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh; ^cASTRE Research Unit, French Agricultural Research Centre for International Development, Montpellier, France; ^dCentre for Interdisciplinary Research on Rural Development, Vietnam National University of Agriculture, Hanoi, Vietnam; ^eDepartment of Infectious Diseases and Public Health, City University of Hong Kong, Hong Kong, Hong Kong SAR China; ^fDepartment of Pathobiology and Population Sciences, Royal Veterinary College, London, United Kingdom

**Corresponding author: Erling.Hoeg@lshtm.ac.uk (Erling Høg)*

Using innovative methodology, engaging anthropology as a following science,¹ enables us to follow practices that involve humans, animals and pathogens across a poultry commodity chain.

Multi-site ethnographic fieldwork was conducted in Bangladesh during 2015-2017 (375 interviews) and in Vietnam in 2017 (142 interviews). We interviewed farmers, feed dealers, traders, middlemen, and managers and workers in hatcheries, live bird markets, slaughterhouses and retail markets. We identified the poultry trading patterns, investigated risk and biosecurity knowledge, assumptions and practices and how they prevent the transmission and spread of avian influenza viruses, identifying human behaviours and structural roles of potential epidemiological significance.

Key findings: 1) low risk perception, 2) varying biosecurity comparing actors and sites, 3) deficient knowledge about biosecurity, 4) financial inability to invest in biosecurity, 5) attention to the past and present, not the future, 6) contradictions between policy and practice and 7) significant differences in governance, practices, policy and disease traceability comparing Bangladesh and Vietnam.

We argue that 'normalized' disease risk, calculated retrospectively,³ will unlikely lead to investment in biosecurity. This may lead to unpredictable outlier events.

Seeing poultry as 'commodities on the move' focuses not only on the processes and flows within and between networks of human relationships, but also on the meanings and rationales of these relationships and transactions. Why do people in a given context handle and transact birds in the ways they do? What are the consequences for avian influenza disease surveillance and control of a heterogeneous poultry trading network?

Socio-economic and cultural factors have significant or potential implications for network connectedness and rates of transmission of birds through those networks. They may be relevant social variables for calibration of epidemiological models of infectious disease transmission. 'Following birds and people' to understand the rationales behind behaviours and practices has been central towards this aim.^{4,5}

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Research impact highlights: Using innovative methodology, engaging anthropology as a following science,1 enables us to follow practices that involve humans, animals and pathogens across a poultry commodity chain. The use of qualitative methods and analytical tools complement and may extend epidemiological studies by describing and interpreting the detail of context and experience based on close observation. This supports interdisciplinary disease research and may open the way to novel hypotheses.2.

Keywords: commodity chains - avian influenza - risk - biosecurity - comparative ethnography

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S2-0C4

Animal health management on organic farm: influence of extension services and animal health professionals

Claire Manoli^{a*}, Florence Hellec^b, Claire Ruault^c, Tiphaine Le Bris^d, Claire Douine^e

^aAnimal Production, Groupe ESA, Angers, France; ^bUMR ASTER, Inra, Mirecourt, France; ^cGERDAL, Le Verger, France; ^dUMR EPia, Inra, Clermont-Ferrand-Theix, France; ^eAgroSup Dijon, Dijon, France

**Corresponding author: c.manoli@groupe-esa.com (Claire Manoli)*

Introduction: Organic Agriculture Standards limit antibiotic treatments and recommend a preventive approach to herd health. Accordingly, health management on organic farms should be based on farming practices that aim to prevent diseases, and on alternative treatments (e.g. homeopathy or phytotherapy). Thus, organic farming, and perhaps especially conversion to organic farming, require specific technical advice. Yet, recent studies showed that most rural veterinarians, traditionally called upon emergencies, fail to provide appropriate advice and to fulfil organic farmers' expectations. As a result, organic farmers go to other sources of advice, which are not yet well known. To bridge this gap, we carried out individual analyses of farmers' health management on one hand, and a comprehensive study of the role of a diversity of animal health professionals and stakeholders on farmers' health management on the other hand.

Materials and methods: We collected qualitative data through semi-structured surveys and participatory observations with organic farmers, veterinary practitioners, salespersons and technical advisors. 47 research interviews were conducted in several ruminant production systems and in different regions of France : dairy cattle systems in Franche-Comté (6 interviews), and dairy sheep systems in Pays-Basque (18 interviews) and in Aveyron (23 interviews). The fully-transcribed interviews were reviewed according to content-analysis methods.

Results and discussion: Our results confirm that in most cases, local veterinary practitioners do not meet organic farmers' expectations regarding alternative therapies or global health management. However, we point out that these changes in farmers' sanitary practices and approach are addressed and supported by other advisors. Moreover, we emphasise the existence of a variety of forms of intervention other than the common face-to-face consultancy. Finally, our results highlight the major parts played by consulting veterinarians, a new way of work practice in the veterinary profession, and collective trainings, where consulting veterinarians and farmers' group facilitators work together.

Research impact highlights: In this study, we examine the effects of extension services on animal health management in organic agriculture. We focus on the role played by health professionals in animal disease management. Organic Agriculture Standards limit antibiotic use and promote a preventive approach to herd health. Taking into account current European policies on antibiotic restriction on farms, organic farmers' health practices can serve as an example that may be transferred to conventional farming. Therefore, while studying how health professionals impact organic farmers' practices, we also discuss the factors that contribute to curb antibiotic use on farms.

Keywords: animal health management - health professionnals - organic farming - farmer's practices - ruminant

An ethnography of medicine use on UK dairy farms

Gwen Rees^{a*}, Kristen Reyher^a, David Barrett^a, Henry Buller^b

^aBristol Veterinary School, University of Bristol, Langford, United Kingdom; ^bUniversity of Exeter, Exeter, United Kingdom

**Corresponding author: gwen.rees@bristol.ac.uk (Gwen Rees)*

Introduction: Veterinary medicine use on UK dairy farms is an important yet little understood research area. The context, on-farm culture and agency of the actors involved are of equal importance to quantitative surveillance of medicine use, and studies in human medicine show that a variety of social and cultural influences and beliefs can affect physician compliance when prescribing medicines (Martin et al., 2005).

Materials & Methods: Three dairy farms were recruited for a year-long participant observation study. These farms were purposively sampled in order to be heterogeneous and reflect different types of dairy farms present in the United Kingdom. Alongside extensive ethnographic work on these three core farms, qualitative in-depth interviews with a further 20 dairy farmers have been conducted in order to investigate the attitudes, beliefs and values of UK dairy farmers in relation to the storage, recording and actual use of medicines.

Results: Several important themes have emerged from the data, falling broadly into the categories of trust (in the farm staff, the veterinarian and the medicine), risk (of using versus not using a particular medicine), past experience and the concept of medicine effectiveness being specific to "this farm". Additionally, ethnographic work identified social conflict and a struggle for power and agency between key decision makers on-farm. These tensions were observed to drive both coercive and subversive medicine use behaviours.

Conclusions: The key factors influencing decisions about medicines were: advice from the farm's veterinary surgeon, advice from peers and personal anecdotal experience from perceived past successes or failures. Availability, cost and withdrawal periods of medicines also influenced the choice of medicines used in different situations. There was strong awareness amongst farmers that their access to certain antimicrobials may soon be limited, although there was varying understanding of the antimicrobials involved and the full reasons for this.

Research impact highlights: Inappropriate use of antimicrobials in agriculture is a focus of behaviour change policy worldwide, and in order to inform interventions in this area, data on current practice are urgently needed. Values, perceptions and behaviours surrounding veterinary medicine use by farmers are areas with an overwhelming need for further research (Morris et al., 2016). This research seeks to understand veterinary medicine use by UK dairy farmers using ethnographies and semi-structured in-depth interviews, providing a vital insight into decision-making on farm.

Keywords: Ethnography - Antimicrobial - Medicine - Dairy - Veterinary

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ERIK GÓMEZ-BAGGETHUN

Erik Gómez-Baggethun is a Professor of Environmental Governance at the Norwegian University of Life Sciences (NMBU), Senior Scientific Advisor at the Norwegian Institute for Nature Research (NINA), and Senior Visiting Research Associate at the University of Oxford. His research focuses on ecological economics and environmental policy, themes in which he has published over 100 articles and book chapters for international journals and edited volumes. He is vice president of the European Society for Ecological Economics, was a lead author of the report 'The Economics of Ecosystems and Biodiversity' (TEEB), and has served as an expert for the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).

Overview on publications: https://scholar.google.no/citations?user=vNALUmoAAAAJ&hl=en

How much is nature worth? Challenges and controversies around the economic valuation of plant and animal life

Erik Gomez-Baggethun*

International Environment and Development Studies, Norwegian University of Life Sciences, Ås, Norway

**Corresponding author: erik.gomez@nmbu.no (Erik Gomez-Baggethun)*

The reach of markets and money into aspects of life traditionally governed by nonmarket values and norms is one of the most significant developments of our time. The notion of commodification describes this phenomenon and can be defined as the symbolic and institutional changes through which a good or service that was not previously meant for sale enters the sphere of money and market exchange. Commodification has been often criticized on the grounds that some things ought neither to be for sale nor governed through the market logic. One of the domains where commodification tends to be controversial is plant and animal life, as well as the benefits they provide to humans, often referred to as environmental services. Much of the controversy stems from ethical considerations around the pricing of living beings and from the historically grounded observation that commodification transforms the values that govern the relationships between people and the things being commodified. A critical ethical question is thus where to draw the line defining what domains of life ought to be valued through money and which not, a dilemma hinted at by German philosopher Emanuel Kant in his famous statement "In the kingdom of ends everything has either a price or a dignity." In this talk, we review the challenges and controversies around the economic valuation of plant and animal life, we contrasts the arguments of advocates and critics regarding the opportunities and risks involved, and provide tentative criteria for informing the debate on when and under which circumstances valuing living beings in money terms is more or less ethically problematic.

Research impact highlights: Relevant for economics of biodiversity

Effects of disease risk, information certainty, and messaging on biosecurity compliance on livestock facilities: evidence from experimental simulations

Susan Moegenburg^{a*}, Scott Merrill^a, Christopher Koliba^b, Asim Zia^b, Luke Trinity^a, Eric Clark^c, Gabriela Bucini^a, Serge Wiltshire^d, Julia Smith^e

^aPlant and Soil Science, and Social Ecological Gaming and Simulation Lab, University of Vermont, Burlington, Vermont, USA; ^bCommunity Development and Applied Economics and Social Ecological Gaming and Simulation Lab, University of Vermont, Burlington, Vermont, USA; ^cMathematics and Computer Science, and Social Ecological Gaming and Simulation Lab, University of Vermont, Burlington, Vermont, USA; ^dFood Systems, and Social Ecological Gaming and Simulation Lab, University of Vermont, Burlington, Vermont, Burlington, Vermont, Burlington, Vermont, Burlington, Vermont, USA; ^eAnimal and Veterinary Sciences, and Social Ecological Gaming and Simulation Lab, University of Vermont, Burlington, Vermont, USA; ^eAnimal and Simulation Lab, University of Vermont, Burlington, Vermont, USA; ^eAnimal and Veterinary Sciences, and Social Ecological Gaming and Simulation Lab, University of Vermont, Burlington, Vermont, USA; ^eAnimal Applied Ecological Gaming and Simulation Lab, University of Vermont, Burlington, Vermont, USA; ^eAnimal Applied Ecological Gaming and Simulation Lab, University of Vermont, Burlington, Vermont, USA; ^eAnimal Applied Ecological Gaming and Simulation Lab, University of Vermont, Burlington, Vermont, USA; ^eAnimal Applied Ecological Gaming Applied Ecological Cological Gaming Applied Ecological Cological Co

*Corresponding author: susan.moegenburg@uvm.edu (Susan Moegenburg)

Human decision-making in the context of economic trade-offs plays a key role in the adoption of and compliance with biosecurity but it is a challenging factor to capture and measure. A novel and effective method to study human behavior is through the use of experimental video games. Compared to surveys, this approach has one major advantage: the user is actively engaged within the environment where opportunities for decision-making arise. With Cloud and online technology, experimental games can reach a wide audience, generating significant data.

This presentation shows the application of experimental games in the context of biosecurity compliance under different scenarios of risk perception. Research has shown that animal production systems become vulnerable to animal and economic losses when facility workers do not comply with biosecurity measures. Understanding factors that influence individual decisions to comply or not is important in designing policies and procedures that nudge behavior towards greater compliance. Based on socio-economic theories we hypothesized that compliance with biosecurity protocols is affected by perceived disease risk, perceived certainty of risk information, and the type of disease risk message. We designed an experimental video game that simulates a hog facility with a worker performing tasks that require decisions about complying with biosecurity protocols under different scenarios of disease risk, risk certainty, and risk messaging. To encourage realistic behavior from the players they were paid in actual cash based on how well they kept disease out of their facility. Our data show that compliance in influenced by message delivery methodology with numeric, verbal, and graphical messages showing increasing efficacy, respectively. Moreover, increased uncertainty and increased risk are correlated with increased compliance. These results can inform the design of messages that policy makers and owner/operators give to facility workers to nudge their behavior towards greater compliance and more disease resilient systems.

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Research impact highlights: Novel research methods in the field of experimental games reveal new insights about behavioral economics. Animal production industries concerned with disease can benefit greatly from new information about how to improve biosecurity at facilities. We designed experimental video games that allow the capture of data on decisionmaking under different scenarios of disease risk, risk certainty, and risk messaging. Results show a range of behaviors in response to risk suggesting ways in which behavior might be nudged toward improved biosecurity management. Our findings have application to all levels of production chains from management of individual facilities to design of national policies.

Keywords: Behavioral economics - Livestock biosecurity - Disease risk - Serious games - Complex systems

At the interface of Animal health and Environmental management, a case study driven by in Thailand

Aurélie Binot^{a*}, Waraphon Primpapai^b, Suporn Thongyuan^b, Phitsanu Thuyalakul^b, Panomsak Promburom^c

^aASTRE, Cirad, Montpellier, France; ^bFaculty of Veterinary Science, Kasetsart University, Bangkok, Thailand; ^cFaculty of Agriculture, Chiang Mai University, Bangkok, Thailand

**Corresponding author: binot@cirad.fr (Aurélie Binot)*

Increasing urbanization, intensification of trade and farming systems and drastic land use change are affecting the drivers of health risks emergence, notably in Southeast Asia. It calls for a better integration between animal health and public health sectors, social and environmental sciences, and agriculture (including livestock production) to address associated health issues. To foster such cross-sectorial and interdisciplinary collaboration, in the framework of the ComAcross project (EuropeAid One health in Asia program), we have implemented a case study in Ayutthaya province (Thailand) aiming at building capacities in systems thinking to address complex health issues at animal/human/environment interface involving the veterinary services and local authorities in community based action.

Implementing collaborative modeling process that involved social scientists and veterinarians, we have achieved some key results, acknowledging the local stakeholders' risk perception through participatory process and enabling One health field interventions. First, the organization of stakeholders' workshops aimed at highlighting the gaps in coordination across agriculture, environment and health sectors at municipality and provincial levels. Local stakeholders' risk perception was highlighted through participatory process. Then the project provided scientific based evidences relying on epidemiological studies, participatory appraisal, risk analysis and risk mapping, contributing to empower the local stakeholders for animal and human waste management issues, and for rabies management. These inputs have allowed modifying and implementing local policy (municipality and provincial level) improving rabies management: health volunteers training for dogs' vaccination, stray dogs' surveillance; local waste management and recycling facilities have been setup.

Research impact highlights: Communities empowerment in rabies management Policy implementation Cross-sector collaboration for health management within a One Health framework Participatory epidemiology Pollution assessment and waste management.

Keywords: One health - Socio-ecosystem - Rabies - Waste management - Cross-sector coordination

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Avian influenza in bangladesh: ethnography, behavioural economics and experimental behavioural epidemiology in one health – a proof of concept

Tony Barnett^{a,b*}, Erling HØg^a, Mohamed Ahsanul Hoque^c, Gargie Ahmad^a, Rashed Mahmud Sizer^c, Dirk Pfeiffer^{d, e}, Guillaume Fournié^e

^aGlobal Health and Development, LSHTM, London, United Kingdom; ^bHumanitarian and Conflict Response Institute, University of Manchester, Manchester, United Kingdom; ^cDepartment of Medicine & Surgery, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh; ^dCollege of Veterinary Medicine and Life Sciences, City University of Hong Kong, Hong Kong, Hong Kong SAR China; ^ePathobiology and Population Sciences, Royal Veterinary College, London, United Kingdom

*Corresponding author: tony.barnett@lshtm.ac.uk (Tony Barnett)

Introduction: Human behaviours of *potential epidemiological significance* are not solely *individual* behaviours around poultry or personal hygiene practises; they include *structural roles*. We examined how medium size farmers made *decisions* about biosecurity in relation to a *transaction chain* from hatchery to retail sale and slaughter.

Methods and Materials: A multi-site ethnography produced 375 interviews from 346 informants at 33 sites. These were supplemented by focus groups. Ethnographic investigation indicated concentration on a limited number of *roles*, some structural. To investigate *proof of concept*, we focused on decision making in one role, medium-size farmers. We designed a *game-experiment* to explore the impact of various epidemiological and socio-economic conditions on farmers' biosecurity investments. 150 farmers were recruited. Each attended an individual scenario session facilitated by a Bangla speaking team led by an anthropologist. Participants also answered questions about socio-economic position, attitudes to risk, and about how they had made their decisions in the game-experiment

Results: We identified *nodes* [GF4] on the *transaction chain* [GF5] where decisions are made which likely influence transmission, recombination and reassortment of avian influenza (AI). We identified *roles*, e.g. feed dealers, transporters, credit providers and market makers, whose choices and decisions are *epidemiologically significant*. Game-experiments revealed the influence of social norms, farmers' socioeconomic status and past disease outbreaks on their decisions. This evidence was used to inform mathematical models of disease transmission, thus suggesting how ethnographic evidence can be used alongside epidemiological modelling. **Conclusions:** The combined method (a) is practically feasible; (b) produces meaningful results; (c) produces results which may in principle enable combination of ethnographic and epidemiological techniques to inform interventions. The results will be used to develop further *game-experiments* examining *epidemiologically significant behaviours* at other places in the *transaction chain*.

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Research impact highlights: Using an innovative combination of ethnography, epidemiology and adapted behavioural economics we examined the poultry transaction chain (a concept broader than value chain) identifying human behaviours and structural roles of potential epidemiological significance. Using a "game experiment" we sought to understand epidemiologically significant decisions by poultry keepers. We recognise that such decisions and choices are not "rational" in a simple sense but reflect evolved psychological processes and socio-economic and cultural conditions. This approach will be used to develop a method to transform "rich" ethnographic evidence into a form which can be used to inform epidemiological models and thus enrich approaches to design of interventions.

Keywords: epidemiology - ethnography - avian influenza - interventions - Bangldesh

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Selecting an Optimal Surveillance Option During an Outbreak: A Comparison of Cost-Effectiveness for Highly Pathogenic Avian Influenza

Kamina Johnson^{*}, Amy Hagerman, Columb Rigney, Amy Delgado, Marta Remmenga, Marian Talbert, Rebecca Jones, Lori Gustafson

Department of Agriculture, United States Government, Fort Collins, CO, USA

*Corresponding author: Kamina.K.Johnson@aphis.usda.gov (Kamina Johnson)

The balance between gathering disease status information and resource availability is at the forefront of disease manager's minds when an outbreak occurs.

This research examines the epidemiologic and response cost consequences of 15 highly pathogenic avian influenza (HPAI) surveillance scenarios with varying combinations of testing frequency (e.g. daily, every other day, no active surveillance) and amount of information available on tracing of indirect contact infections. Interspread Plus was used to estimate the epidemiologic spread using parameters chosen for these scenarios. Preliminary results reveal extremely skewed distributions in outbreak durations and number of infected birds with most outbreaks being very limited in spread and duration but with some outbreaks affecting 400 times the number of birds as others. Tracing indirect contacts was more effective at limiting the size of the largest epidemics than testing within the control area. The greatest epidemic size reduction occurred when tracing every indirect contact and testing daily within the control area were used in combination, but resource intensity may be relatively high. Comparing the resource needs to trace indirect contacts and control area testing to current emergency surveillance plans will provide actionable information on optimal resource allocation.

The statistical software, R, was used to cluster the epidemiologic model output to find alternative surveillance strategies with similar required testing levels. Using information from the 2014-2015 HPAI outbreak in the United States, previous literature, and other sources an economic analysis estimated the costs of the different clusters. The results from the cost analysis will be used to calculate the cost effectiveness ratio for each cluster, allowing for comparison across clusters. The results from this research will be presented as actionable information that will allow HPAI disease outbreak managers to weigh the costs of emergency surveillance design decisions with the potential changes in the risk of disease spread.

Research impact highlights: Deciding where and when to do disease surveillance can result in the overuse of resources or higher than acceptable disease spread risk if the right information is not available at the right time. One challenge is designing and evaluating costeffective surveillance strategies that provide information to help control the outbreak and prevent disease spread. These results can serve as an example of how economic information can support and directly inform public and private policies, specifically related to how animal health surveillance decisions can influence the risks, costs, and tradeoffs of disease control.

Keywords: Surveillance - highly-pathogenic avian influenza - disease outbreak - modeling - economics

Unbiased assessment of disease surveillance utilities: a prospect theory application

Victor j del rio vilas^{a*}, Arthur Attema^b, Lisheng He^c

^aUniversity of Surrey, Guildford, United Kingdom; ^bUniversity of Rotterdam, Rotterdam, Netherlands; ^cUniversity of Warwick, Coventry, United Kingdom

**Corresponding author: vdelriovilas@yahoo.co.uk* (Victor j del rio vilas)

We contribute a new methodological framework to the ongoing efforts towards the evaluation of disease surveillance. Specifically, we apply a descriptive framework, grounded in prospect theory (PT), for the evaluation of decisions on disease surveillance implementation. We focus on two attributes of any surveillance system: timeliness, and false positive rate (FPR).

In a sample of 69 health professionals from a number of health related networks polled online, we elicited PT preferences, specifically respondents' attitudes towards gains, losses and probabilities (i.e., if they overweight or underweight extreme probabilities) by means of a series of lotteries for either timeliness or FPR. Moreover, we estimated willingness to pay (WTP) for improvements in the two surveillance attributes. We apply our framework to an example of One Health Surveillance (OHS) implementation: rabies surveillance. Specifically, we assessed time improvements in suspect rabid bite identification, and the rate at which false positives would lead to the unnecessary, and very costly, administration of post-exposure prophylaxis to suspect rabid patients.

For choices pertaining to timeliness and FPR, our data reveal considerable probability weighting, both for gains and losses. In particular, respondents underestimate (overestimate) their chances of getting a good (bad) outcome in uncertain situations, i.e. they were pessimistic. Moreover, there is convex utility for losses and significant loss aversion, that is, losses loom larger than gains of the same absolute magnitude. We find no differences between the estimated parameters for timeliness and FPR. The median WTP is \$7,250 per day gained in detection time and \$30 per 1/10,000 reduction in FPR.

Our results indicate that the biases described by PT are present among health professionals, which highlights the need to incorporate a PT framework when eliciting their preferences for surveillance systems. This has significant implications for cost-effectiveness analyses, traditionally assuming risk neutrality, to compare surveillance alternatives.

Research impact highlights: This is the first application of PT to surveillance outcomes. Ongoing research into the operationalization of One Health Surveillance (OHS) is mainly aimed at addressing the analytical complexities, for example towards the integration of data from different domains to exhaustively inform zoonotic risks. These approaches, however, fail to acknowledge the relevance of organizational complexities that may prevent the deployment of OHS due to perceived barriers, and risk related attitudes. The need for an understanding of the underlying motivations for investing in OHS, as addressed by our work, is clear.
Levers and barriers to the implementation of the One Health surveillance strategy for antibiotic resistance in Vietnam

Marion Bordier^{a, b*}, Quentin Pauchard^b, Dien Thi Nguyen^c, Nicolas Fortané^d, Flavie Goutard^{a, e}, Aurelie Binot^a

^aASTRE, Univ Montpellier, Cirad, Inra, Montpellier, France; ^bASTRE, Cirad, National Institute of Veterinary Research, Hanoi, Vietnam; ^cFaculty of Political and Social Sciences, Vietnam University of Agriculture, Hanoi, Vietnam; ^dInra, Ivry-sur-Seine, France; ^eKasetsart University, Bangkok, Thailand

**Corresponding author: marion.bordier@cirad.fr (Marion Bordier)*

Antibiotic resistance (ABR) is a global health threat calling for the implementation of interdisciplinary and inter-sectoral surveillance system, in line with the One Health (OH) concept. The Vietnamese authorities have recently developed an inter-ministerial strategy for the surveillance of ABR. However, actors assigned to surveillance tasks face difficulties in implementing the inter-sectoral and inter-disciplinary collaborations promoted by policymakers. In order to understand factors influencing those collaborations, we conducted a structural and social analysis of actors' position regarding the multi-ministerial surveillance strategy for ABR in Vietnam.

The study has been conducted in three steps: (1) a description of the structure of the national surveillance strategy (literature review, key informant interviews); (2) an analysis of the key actors' position regarding the strategy (in-depth interviews); (3) the identification of factors influencing the operationalisation of the collaborative surveillance strategy.

The first step allowed us to map the system and to characterize actors regarding organizational and functional attributes. Cross sectoral and cross disciplinary surveillance initiatives are actually happening but the organisation of the national surveillance system remains highly silo-oriented.

The second step led to the characterization of actors' perception based on their statements and using social attributes (legitimacy, knowledge, capacities, resources, commitment, attitude towards collaboration, flexibility, confidence, trust, and power). The results show that attributes' value are highly homogeneous within each category of actors and that correlation exist among some attributes.

Finally, the last step allowed the identification of factors influencing the implementation of the collaborative approach for ABR surveillance: governance modalities, institutional culture, level of knowledge, technical capacities, resources, conflict of commercial interests, international partners' influence.

A new model for governance of the ABR surveillance should be considered in Vietnam. Actions should be taken to improve mutual understanding and trust among actors and to provide an appropriate framework to operationalise relevant collaborations.

Research impact highlights: The study led to the identification of factors influencing intersectoral and inter-disciplinary collaborations for the implementation of the One Healh surveillance policy for antibiotic resistance in Vietnam. The success of this inter-ministerial policy will rely on the commitment of all the stakeholders, that can only be achieved through (i) development of mutual understanding and trust among actors and (ii) provision of an appropriate governance and operational framework to support collaborations.

Stakeholders mapping and analysis helps in decrypting the context into which a One Health policy is to be implemented and supports development of tailored interventions to ease its operationalization.

Keywords: surveillance - antibiotic resistance - collaborations - One Health - policy

Economic evaluation of swine health surveillance and control system in Vietnam

Hoa Pham^{a*}, Marc Choisy^{b, c}, Peyre Marisa^d

^aASTRE, Cirad, Hanoi, Vietnam; ^bIRD, Hanoi, Vietnam; ^cOxford University Clinical Research Unit, Hanoi, Vietnam; ^dASTRE, Cirad, Montpellier, France

*Corresponding author: thithanhhoapham@ymail.com (Hoa Pham)

Most emerging zoonotic diseases come from or "transit" through pigs. Surveillance systems in South East Asian countries are not sufficiently developed to provide precise information on the evolution of pathogens circulating in pigs. There is a real need to improve disease surveillance in swine were ressources are limited. The objective of this study was to evaluation the economic performances of swine disease surveillance and control system in Vietnam. The evaluation protocol was defined using the RISKSUR EVA tool to consider multiple functional attributes, which affect the performance of the system along with economic aspects (1). A cost-benefit analysis was performed comparing the costs and benefits of different disease control scenario outputs simulated using a susceptible-infectiousrecovered (SIR) model. The control scenarios were defined based on results from a discrete choice experiment study previously described (2). Culling all pigs in infected households with 70% compensation (scenario 1, current strategy in place) was not effective due to the unacceptance of pig producers (less than 4% sensitivity). Scenario 2 which restricted the culling to unrecovered pigs only with same compensation level as per scenario 1 (70%) got the highest acceptability but scenario 3 with a lower compensation rate (50% of the market value) for un-recovered pigs had the highest cost benefit ratio. This study highlight two important facts which were not a priori intuitive: i) the culling of apparently healthy pigs (total culling scenario) has a dramatic effect on farmer's willingness to report and an important impact on control program benefits; ii) the level of compensation is less important to farmers compared to the culling aspect and impact less the control program benefits. This study also highlight the importance of an integrated evaluation approach to identify meaningful recommendation for improvement of swine disease surveillance and control system in Vietnam.

Research impact highlights: This study represent an original case study combining classic economic evaluation approaches and experimental economics to provide insights on the influence of farmers behaviors on the outcomes of disease control programs. This integrated evaluation approach is a novel methodological approach which could benefit the international community in social and economic sciences in animal health.

Keywords: economic evaluation - experimental economics - integrated evaluation - swine disease - Vietnam

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One Health evaluation of the University of Copenhagen Research Centre for Control of Antibiotic Resistance (UC-CARE)

Anaïs Léger^{a*}, Katharina D.C. Stärk^a, Jonathan Rushton^b, Liza Rosenbaum Nielsen^c

^aSAFOSO, Liebefeld, Switzerland; ^bUniversity of Liverpool, Liverpool, United Kingdom; ^cUniversity of Copenhagen, Copenhagen, Denmark

**Corresponding author: anais.leger@safoso.ch* (Anaïs Léger)

Introduction: The EU COST Action "Network of Evaluation of One Health" (NEOH) developed an evaluation tool for One Health (OH) initiatives. A recent four-year research project entitled 'University of Copenhagen Research Centre for Control of Antibiotic Resistance' (UC-Care) gathered participants from four faculties and stakeholders from industry and health authorities aiming to produce new knowledge and methods to reduce the development of antimicrobial resistance. In the present study, we performed an evaluation of essential elements in UC-Care to assess beneficial and counter-productive characteristics that may affect the outcomes and impact of this initiative.

Materials and methods: Some information to inform evaluation of UC-Care could be extracted from publications including the original research proposal and a midterm evaluation report. Other assessment methods included knowledge and opinion elicitation from project participants and stakeholders. We adapted the NEOH tools to conduct semi-open, 1-hour-long interviews with key consortium members. An online survey for external participants and stakeholders was also used.

Results: All senior UC-Care members showed great interest and willingness to be interviewed. Young scientists were more difficult to engage, and 25% of stakeholders/external partners answered the online survey. Interviewees mentioned that their main benefit of the project was an increased awareness and understanding of the antimicrobial resistance issues. Some partners debated the applicability, and identified that potentially counter-productive short-comings in the information sharing and OH working methods were generated across the consortium. Participants mentioned that a dedicated OH coordinator and a more integrative project organization would have allowed for more knowledge exchange with potentially higher societal impact.

Discussion/conclusion: All partners mentioned a new interest in the work of other disciplines, an expanded network and the new interest in future joint proposals and acknowledged the necessity and the benefit in working cross-disciplinary. This study also provided feedback to NEOH on the tool development.

Research impact highlights: This study demonstrates a new approach to evaluation of One Health initiatives based on systems thinking and participatory evaluation. We used the tools developed by the EU COST Action "Network of Evaluation of One Health" to evaluate a large research project 'University of Copenhagen Research Centre for Control of Antibiotic Resistance'. This also served to provide feedback on the tools shared within the NEOH consortium for their improvement. The long-term aim of developing these tools is to improve the societal impact of One Health initiatives. The tools provide feedback regarding the beneficial and counter-productive characteristic that may affect the outcomes.

Economic evaluation of antimicrobial resistance surveillance system in Vietnam

Dung Vu^{a, b, c*}, Marc Choisy^{b, d}, Kinh Nguyen^e, Trung Nguyen^e, H Rogier van Doorn^b, Marisa Peyre^a

^aASTRE research unit, French Research Center for Agricultural Dev, Montpellier, France; ^bHa Noi, Oxford University Clinical Research Unit, Ha Noi, Vietnam; ^cUniversity of Monpellier, Montpellier, France; ^dInstitute of Research for Development, Marseille, France; ^eNational Hospital for Tropical Diseases, Ha Noi, Vietnam

**Corresponding author: dungvtv@oucru.org (Dung Vu)*

Introduction: Antimicrobial resistance (AMR) prevalence in Vietnam has been among the highest the world. AMR surveillance initiatives have been in place for twenty years through research programs but these had significant limitations and their cost and effectiveness had never been evaluated. This study aimed to evaluate the cost-effectiveness of different AMR surveillance initiatives in Vietnam to draw recommendations for development of an efficient surveillance system.

Methods: This analysis was based on data available from three studies (GARP situation analysis, VINARES 2012-13 and 2016-17), each considered as a component of Vietnam AMR surveillance system. The system and its components were described using RISKSUR tool (<u>https://webtools.fp7-risksur.eu</u>), a decision support tool for design and evaluation of cost-effective risk-based surveillance systems. Each component was characterized by its target sector, geographical area covered, data collection point, study type, and type of sample collected. The evaluation question was about assessing the costs of surveillance components that achieve a defined effectiveness target, using least cost analysis method. Surveillance costs included field operation consumables, laboratory analysis, training, and communication. A discount rate was applied to account for differential timing between the components. We assessed sensitivity and bias by stochastic modeling, and coverage and representativeness by spatial analysis.

Results: System-level coverage and representativeness were high when the three components were considered together. Over time, the components allowed the system to have a comprehensive overview of important resistance patterns. However, these could only be implemented at a small scale because of operational, human and budget constraints. Each component had a low sensitivity and high level of bias mainly linked to the surveillance design and sampling protocols. The results of this study provided information on how to reduce bias, and increase representativeness, coverage and sensitivity at minimum cost. These elements are critical to design an efficient AMR surveillance system in Vietnam.

Research impact highlights: AMR is a major threat to public health and involves both human and animal health, food safety and the environment. Surveillance of AMR is essential to understand its spread, evolution and impact. Strengthening of global surveillance is critical to inform global strategies, monitor the effectiveness of interventions, and detect new trends and threats. This study represents the first attempt to implement a systematic economic evaluation approach to improve AMR surveillance design in Vietnam and the methodology used and its outcomes could highly benefit the international community.

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Keywords: antimicrobial resistance - economic evaluation - decision tools - Vietnam

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How local socio-economic and cultural factors shape animal health surveillance and control programs

Marisa Peyre^{a*}, Nicolas Antoine-Moussiaux^b, Flavie Routard^c, François Roger^d

^aASTRE, Cirad, Montpellier, France; ^bUniversité de Liège, Liège, Belgium; ^cASTRE, CIRAD, Bangkok, Thailand; ^dASTRE, Cirad, Saint-Denis, La Réunion

**Corresponding author: marisa.peyre@cirad.fr (Marisa Peyre)*

Efficient animal disease surveillance systems are essential to prevent disease epidemics and the emergence of zoonotic threats. Many socio-cultural, economical and political drivers can affect their performance and their costs. Within the past ten years CIRAD and his partners have developed and applied innovative evaluation tools activities in South East Asia and Europe to better understand local constraints impairing animal health surveillance performances. The studies looked at the perceived costs and benefits of avian influenza passive surveillance in Vietnam and in Thailand (1); novel methodology for economic evaluation of swine influenza surveillance in Vietnam integrating functional and socioeconomic factors (2); participatory tools to evaluate African Swine Fever surveillance system in Corsica (France) (3) and the acceptability of the bovine tuberculosis surveillance in Belgium and of Classical Swine Fever surveillance in wild boar in Germany (4, 5). This paper presents a comparative analysis of the constraints observed by these studies, both in developed and developing countries and its implication for animal health surveillance improvement. North and South countries share common constraints on local actors' reporting decision. However, the origin and the responses to these constraints differ from one setting to the other, linked to specific socio-cultural practices rather than the level of economic development of the country. Similarities and differences were linked to the type and level of structuration of the breeding sector concerned. All the studies used common evaluation tools mainly based on participatory approaches, although the object of evaluation varied. This highlights the flexibility of the approach, which could be used under different socio-economic contexts but also across different disciplinary fields. This comparative analysis highlights similarities and key differences in local constraints impacting disease reporting in North and South settings. Such information is critical to ensure acceptability and sustainability of the surveillance systems and ensure proper resources management.

Research impact highlights: This study present a first attempt to compare socio and economic factors affecting the performances of animal health surveillance in low, middle and high income countries. This comparative analysis highlights the importance of considering local social, economic and cultural elements to improve disease surveillance at the global level.

Keywords: economic evaluation - integrated evaluation - participatory approaches - social factors - disease surveillance

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Assessing the economic impact of infectious-nature lameness: zooming into aetiology

Joao Afonso^{a*}, Georgios Oikonomou^{a, b}, Stuart Carter^c, Jonathan Rusthon^a

^aEpidemiology and Population Health, University of Liverpool, Liverpool, United Kingdom; ^bLivestock Health and Welfare, University of Liverpool, Liverpool, United Kingdom; ^cInfection Biology, University of Liverpool, Liverpool, United Kingdom

**Corresponding author: jafonso@liverpool.ac.uk (Joao Afonso)*

Lameness is presently one of the main concerns in the livestock sector, reflecting both the high incidence and significant animal welfare and production impact. Research has provided figures on its impact, but through different methodologies making it difficult to compare results and hindering decision making.

Lameness can be the result of many causes, some of them infectious. To build-up reliable epidemiological information on infectious lameness issues it is necessary to determine the causes of the problem, if possible at pathogenic agent level. This will translate into accurate data to estimate the impact of specific pathogens in animal production, to highlight the main problems of the sector, assisting decision-makers on proportionate interventions. In addition, aetiology can influence the control and prevention strategy, as well as determine the treatment of choice, which has relevance to anti-microbial resistance concerns.

The core objective of this work is to define an internationally reliable and replicable method of estimating the impact of lameness, establishing a common platform that will allow results' comparison and facilitate decision-making. And to drill down the analysis to aetiology, defining how much of the lameness-related impact is due to any given pathogen – leading to research prioritization and resource allocation to the infectious lameness with strongest impact, as well as establishing the most effective strategy in controlling and/or preventing this condition.

Data has been recorded on a cohort of approximately 500 animals from different farms. Additionally serum samples and foot skin swab samples have been taken and preserved up-todate, being available for laboratorial tests. Identifying the pathogens present in the lesions will allow us to understand the weight of each pathogen in the syndrome and infer associated costs, narrowing down the broader approach of estimating the impact of lameness from a syndrome, to a disease and ultimately to a specific pathogenic agent.

Research impact highlights: Lameness is a worldwide cross-species prevalent syndrome with strong impact in animal welfare and production. While studies have estimated the impact of lameness, the different methodologies taken hinder the ability to compare results and prioritise health issues, hampering the decision making process. Additionally most studies approach lameness as a syndrome and do not explore the need to attribute the impact to specific diseases or pathogens. The core objective of this work is to define an internationally accepted, reliable and replicable method of estimating impact of lameness-causing agents, establishing a common platform enabling comparative data analysis comparison and facilitating decision-making.

Keywords: Lameness - Impact - Decision-making - Infectious - Estimate

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Modelling economics of prevention of tail biting in fattening pigs

Jarkko Niemi*

Natural Resources Institute (Luke), Seinäjoki, Finland

^{*}Corresponding author: jarkko.niemi@luke.fi (Jarkko Niemi)

Tail biting in pigs is a multifactorial disorder and an animal welfare issue. Tail biting can arise due to factors such as inadequate provision of enrichment and rooting materials to the pigs, inappropriate housing conditions, along with other emerging health problems in the pigs or. changes occurring in the rearing environment.

The aim of this study was investigate the rationale of measures to control tail biting in fattening pigs. Data collected from pigs farms was applied in a dynamic optimization model to assess the value of these measures.

The results illustrate that tail biting outbreak can behave like an epidemic disease outbreak in a pen. Therefore, rapid response to the first observations of tail biting in a pen pays off. The results also illustrate that the profitability of preventive measures is sensitive to the costs incurred when adopting these measures and the risk faced by the farm. For continuous prevention measures to be applied, it is critical that their impacts on the risk of tail biting can be validated.

Research impact highlights: The results illustrate the importance of rapid response to health problems which can escalate quickly. The results also show differences in incentives of problem-farms versus non-problem-farms to adopt preventive measures. Finally, the results quantify the net benefits that are expected to be obtained by preventive measures.

Keywords: Tail biting - Pig - Prevention - Dynamic optimisation

Is failure of passive transfer of immunity in calves linked to bad management, insufficient knowledge or other farm(er) characteristics?

Erwin Wauters^{a*}, Frank Coopman^b, Lore Van Raemdonck^b, Cristina Rojo Gimeno^a, Jozefien Callens^c, Charlotte Brossé^c

^aSocial Sciences Unit, Institute for Agricultural and Fisheries Res, Merelbeke, Belgium; ^bDepartment of Applied Biosciences, Ghent University, Ghent, Belgium; ^cAnimal Health Flanders, Torhout, Belgium

**Corresponding author: erwin.wauters@ilvo.vlaanderen.be (Erwin Wauters)*

Failure of passive transfer (FPT) of immunity in calves is linked to increased mortality and morbidity and long-term decreases in productivity. Previous studies have identified several management practices that can greatly reduce the risk of FPT, predominantly regarding the timing, quality and quantity of first colostrum intake of the newborn calf and the timing of colostrum collection, along with several management practices related to hygiene, housing and feeding. These findings have been translated into recommendations for cattle farmers, and several public and private consultancies advice farmers on good practices. Yet, between-farm differences in the quality of passive transfer of immunity remain high, and veterinarians and advisors lack insight into the deeper causes for this. More particularly, advisors remain in the dark whether known management practices fail to adequately prevent against FPT, whether farmers have sufficient knowledge about good management practices, or whether this differences in visible management practices, or difference in knowledge about good management practices, less tangible characteristics related to farmers' perspectives on health, welfare ann management can explain differences in the risk of FPT between farms.

This study reports on a study on the risk of FPT on 50 dairy farms and 50 beef farms in Belgium, whereby first a survey was conducted collecting farm and farmer characteristics, management characteristics relevant to FPT and information on farmers' knowledge and perspectives on health management, and, second, serum samples were collected from 6 random calves on each farm, along with a collostrum samples.

The preliminary results indicate that the risk of FPT is in general quite high and that, indeed, large farm differences exist. At the time of writing this abstract, further analyses are ongoing, but will be finalized at the time of the conference.

Research impact highlights: FPT is an important condition with potentially long-lasting impacts on animal health and productivity. It is an example of an animal health problem for which it is largely known how to prevent it, yet, large differences between farms remain and advisors lack insight how to further improve health management in this area. This study could provide insights into the role of management practices versus knowledge versus other farm(er) characteristics. This better understanding of the nature of the problem is crucial for developing effective advisory services that improve decision making, and hence improve our understanding of animal health.

Keywords: FPT - Health advice - Dairy calves - Beef calves

Hard Work or Making it Easy? Good Farming and Triggering Change in the Management of Cattle Pneumonia.

Gareth Enticott^{*}

Geography and Planning, Cardiff University, Cardiff, Wales

**Corresponding author: enticottg@cardiff.ac.uk (Gareth Enticott)*

This paper explores cattle farmers' approaches to managing respiratory conditions in their stock in the United Kingdom and Ireland. Respiratory disease is estimated to cost the UK cattle industry approximately £60million per year. Outbreaks can be treated using antibiotics and anti-inflammatory drugs, or prevented using vaccines or other management techniques. In seeking to understand farmers' behaviour, the concept of 'good farming' has also been developed to explain how farming subjectivities and other socio-technical aspects of farming culture lock-in path-dependent solutions to the management of animal health. Transition theory suggests that these forms of path-dependency may be broken though different triggers which challenge existing socio-technical lock-ins, leading to experimentation with new practices before they are fully adopted. Drawing on 24 interviews with cattle farmers using the Biographical Narrative Interpretive Method, this paper identifies the socio-technical barriers to animal health practices, and the triggers that lead to new practices. Barriers to the adoption of new practices include: (i) gendered subjectivities of 'good farming' that relegate the importance of caring for calves; (ii) the importance of 'hard work' and productivity; and (iii) the inflexibility of farming infrastructure. However, competing farming subjectivities relating to 'making life easy' rather than working hard were associated with triggers such as generational change, starting a family, and mobility. The paper therefore describes 'making life easy' leads to innovation with housing and feeding management practices. Biographical interviews also reveal how changes in farm ownership and family circumstances, rather than outbreaks of disease, trigger innovation in animal disease management.

Research impact highlights: This paper examines cattle farmers' behaviour in relation to the management of respiratory. Farmers' management plans may face different socio-technical dependencies, but various triggers may lead to these routines being challenged. In analyzing how farmers change their approaches to respiratory disease, the paper therefore provides an understanding of decision making within socio-technical ecologies.

Keywords: Farmer behaviour - farming subjectivity - Respiratory Disease - Innovation - Transition

Evaluation of integrated economic policies to control Crimean Congo Hemorrhagic Fever - An emerging but neglected tick-borne illness in Bangladesh

Muhammad Asaduzzaman^{a, b*}, Shovon Chakma^b, Nurul Islam^b, Sultan Mahmood^b, Sithar Dorjee^b, Masako Wada^b, Roger Morris^c

^aOne Health Research group, icddr,b, Dhaka, Bangladesh; ^bInstitute of Veterinary Animal and Biomedical Sciences, Massey University, Palmerstone North, New Zealand; ^cMorVet Ltd, Masterton, New Zealand

**Corresponding author: asaduzzaman@icddrb.org (Muhammad Asaduzzaman)*

Introduction: Crimean Congo Hemorrhagic Fever (CCHF) is a highly fatal neglected tickborne zoonosis, largely undiagnosed in humans in Bangladesh due to lack of awareness of zoonoses amongst health care providers as well as lack of diagnostic facilities. The northwestern part of Bangladesh (a sub-tropical hot and humid country), known as 'Barind tract' is very favourable for Ixodid (hard) *Hyalomma* ticks, which act as both reservoir and vector for the CCHF virus.

Materials and methods: An economic analysis was done using a comprehensive disease control policy options model named HandEcon (Human and Animal Disease Economics) where different parameters from data available at national departments, literatures and experts' views were evaluated. Main aim of this economic model based evaluation performing a cost effective analysis (CEA) was to evaluate the three alternative control options of CCHF for the duration of ten years with 5% discount rate and recommend the cost effective policy option to decision makers in Bangladesh. The options included different combinations of integrated surveillance, awareness campaign and vector Control.

Results: Based on the Cost Effective Analysis, Awareness Campaign only is found to be the best option.Both the Net cost per human case avoided (CU per case) and Net cost per DALY avoided (CU per DALY) are lowest in this option. As this disease is asymptomatic in animals, the final incidence in humans will be considered here. Moreover, the Cumulative discounted control costs (CU) is also lowest in Awareness only option. Economic analysis outcomes were strongly influenced by costs of control options, population sizes in control areas, cost of human treatment due to CCHF, effectiveness of control in humans and animals.

Conclusion: Economic policy evaluation as well as continuing collaboration between animal health and human health agencies on CCHF at all levels is crucial to its overall detection, prevention and control.

Research impact highlights: Crimean Congo Hemorrhagic Fever (CCHF) is a highly fatal but neglected tick-borne zoonosis. It is also not included in current health policy in most developing countries for which rigorous motivation of policy makers is required. An economic analysis using a comprehensive disease control policy options model named HandEcon (Human and Animal Disease Economics) was executed where different parameters were evaluated. Main aim of this economic model based evaluation (a cost effective analysis) was to evaluate control options of CCHF for the duration of ten years with 5% discount rate and recommend the cost effective policy option to decision makers.

Keywords: CCHF - Cost effective analysis - Economic policy evaluation - One Healh - Tickborne disease

A Tale of Two Diseases: Chronic Wasting Disease Complicates Brucellosis at the Wildlife-Livestock Interface

Matt Maloney^{a*}, David Aadland^a, Jerod Merkle^b, Dannele Peck^c, Brant Schumaker^d

^aDepartment of Economics, University of Wyoming, Laramie, Wyoming, USA; ^bDepartment of Zoology & Physiology, University of Wyoming, Laramie, Wyoming, USA; ^cNorthern Plains Climate Hub, USDA Agricultural Research Service, Fort Collins, Colorado, USA; ^dDepartment of Veterinary Sciences, University of Wyoming, Laramie, Wyoming, USA

**Corresponding author: mmalone8@uwyo.edu (Matt Maloney)*

Introduction: In northwest Wyoming, USA, wild elk (*Cervus elaphus*) receive supplemental winter forage at 23 official feedgrounds to reduce the transmission risk of bovine brucellosis (*Brucella abortus*) to nearby cattle. Recently, chronic wasting disease (CWD) has arrived at the feedgrounds' doorstep, carried by infectious migratory mule deer (*Odocoileus hemionus*). The potential biological and economic consequences of CWD reaching highly concentrated elk on winter feedground management, in an effort to minimize CWD prevalence in elk, have triggered concerns about potential increases in the risk of brucellosis transmission to cattle as unfed elk disperse. These two epidemiologically distinct but economically intertwined diseases will fundamentally alter the costs and benefits of current elk management strategies. An objective model is needed to quantify the economic tradeoffs of alternative management approaches.

Methods: We develop a bio-epi-nomic model to determine economically optimal elk management (feeding and hunting) policies. We use elk telemetry and landscape data to predict migratory behavior and population densities with and without supplementary feeding. This approach reduces reliance on arbitrary assumptions about how feeding affects elk population densities and influences elk-cattle interactions. We focus on 4,800 km² around four (of 23) feedgrounds as a case study, and use simulations to generate welfare estimates under various management strategies.

Results & Conclusions: Initial results suggest that, upon introduction of CWD to the four case-study feedgrounds, the combined social welfare of elk hunters and cattle producers would be reduced if the current elk feeding strategy is continued. Over a 100-year horizon, continued feeding could result in welfare losses of up to \$23.2 million for the case study region. If CWD prevalence is lowered enough through reduced elk feeding, the option to resume feeding has value and should therefore be retained.

Research impact highlights: In northwest Wyoming, USA, stakeholders interested in wildlife healh are calling for reduced winter feeding of wild elk to minimize the prevalence of chronic wasting disease, which is rapidly approaching the region. These calls have triggered concerns among agricultural stakeholders about increased risk of bovine brucellosis transmission to cattle when unfed elk disperse. Our bio-epi-nomic model simulates social welfare under alternative elk feeding and hunting strategies at four (of 23) official feedgrounds. Results provide objective insights for policymakers about the complex economic tradeoffs encountered when management strategies for two interdependent diseases are not necessarily complementary.

Keywords: Rocky Mountain Elk - Cattle - Bovine Brucellosis - Chronic Wasting Disease - Economics

Adoption of sensors for improving health and reproduction of dairy cows is influenced by uncertainty about future performance of the sensors

Wilma Steeneveld^{a*}, Niels Rutten^a, Henk Hogeveen^b, Alfons Oude Lansink^b

^aDepartment of Farm Animal Health, Utrecht University, Utrecht, Netherlands; ^bChair group Business Economics, Wageningen University, Wageningen, Netherlands

**Corresponding author: w.steeneveld@uu.nl (Wilma Steeneveld)*

There is a large difference in the adoption of sensors for improving health and reproduction of dairy cows on dairy farms. Where some sensors are hardly adopted, others are adopted by many farmers. A potential, rational, explanation for the difference in adoption may be the expected future technological progress in the sensor technology and expected future improved decision support possibilities. The adoption of sensors may thus be partly explained by uncertainty about the investment decision, in which uncertainty lays in the future performance of the sensors and uncertainty about whether improved informed decision support will become available. The overall aim was to offer a plausible example of why a sensor may not be adopted now. To explain this, the role of uncertainty about technological progress in the investment decision was illustrated for highly adopted sensors (automated estrus detection) and hardly adopted sensors (automated BCS). This illustration uses the real options theory, which accounts for the role of uncertainty in the timing of investment decisions. A discrete event model, simulating a farm of 100 dairy cows, was developed to estimate the Net Present Value (NPV) of investing now and investing in 5 years in both sensor systems. The results show that investing now in automated estrus detection resulted in a higher NPV than investing in 5 years from now, while for the automated BCS postponing the investment resulted in a higher NPV compared to investing now. These results are in line with the observation that farmers postpone investments in sensors for which there is no clear decision support on how to improve health of the cows. The results confirm that uncertainty about future sensor performance and uncertainty about whether improved decision support will become available, play a role in investment decisions.

Research impact highlights: Adoption of sensors for improving dairy health is high for some sensors (automatic estrus detection), while it is very low for other sensors (automated body condition scoring). Results of this study show that uncertainty about future technical performance of the sensors is a key driver in the decision of farmers to adopt sensors. The concepts and considerations presented in this study can be used for further development of strategies to enhance adoption by farmers.

Keywords: decision support - dairy - health - sensors - economics

Bio-economic modelling of antibiotic use and health management in dairy French production

Ahmed Ferchiou^{a*}, Jean Joseph Minviel^a, Didier Raboisson^{a, b}

^aIHAP, Ecole nationale vétérinaire de Toulouse, Toulouse, France; ^bSanté Animale, Inra, Toulouse, France

**Corresponding author: ferchiouahmed@gmail.com (Ahmed Ferchiou)*

Disease prevention and curative alternatives are key levers to fight against antimicrobial use (AMU) in food animal production. Field observations highlight that AMU reduction can be cost-effective, for example, when obtaining more outputs by using less or same levels of inputs (such as preventive tools and antimicrobials). There is yet no clear overview today on virtuous situations associated with lower AMU and same or higher farmer's incomes.

The present work aims at identifying the trade-offs between AMU and farm income in dairy cow production, using a bio-economic stochastic dynamic sequential optimizing model. It focuses on optimizing the farm income, the farmer utility (risk adjusted income) or the AMU under constraint (mainly working time). Mastitis was used as a case study since it represents the first reason for AMU in dairy production. A two-step model was developed: (i) a biologic model with the cow-week as unit and weekly probabilities of events, productions and diseases (implemented using R statistical software), combined with (ii) an economic optimizing model (using General Algebric Modeling System software) including farmer's decisions, farmer's constraints and market conditions. The two-step model was calibrated based on literature review and leaders' opinions. The model was run over 10 years and includes sequentially the most common potential decision and management strategies by the farmer.

The results identified management strategies that optimize a low AMU without lowering farmer's utility. For instance, dry-off selective AM treatment was identified as an optimal strategy, combining low AMU and stabilized incomes. Such a strategy yet failed to increase the income compared to the conventional approach (systematic AM at dry-off). For in milk cow mastitis treatment, low AMU can be reached without decreasing incomes up to a threshold in AMU that depends on the structural characteristics of the farm. Other case studies included lame and reproductive issues.

Research impact highlights: This model dynamically represents input allocation decisions by the farmer while maximizing his utility under constraints including antimicrobial use (AMU). It clearly helps decision by enhancing strategies and areas associated with win-win strategies: lower AMU and same or higher revenues with same level of labour. The methods improve common approaches observed in economics applied to animal health, by combining precise biologic modelling and famer's behaviour in sequential optimisation approach. It can also be used as a tool to test incentives helping farmers adopting virtuous strategies and practices.

Keywords: animal health - bioeconomic modelling - economics - mathematical programing - antimicrobial use

Interactive model-based tool for animal disease simulation and intervention strategies

Gabriela Bucini^{a*}, Serge Wiltshire^b, Eric Clark^c, Scott Merrill^a, Christopher Koliba^d, Asim Zia^d, Luke Trinity^e, Susan Moegenburg^e, Julia Smith^f

^aDepartment of Plant and Soil Science, University of Vermont, Burlington, United States; ^bDepartment of Food Systems, University of Vermont, Burlington, United States; ^cDepartment of Mathematics and Statistics, University of Vermont, Burlington, United States; ^dDepartment of Community Development and Applied Economics, University of Vermont, Burlington, United States; ^eSocial-Ecological Gaming and Simulation (SEGS) Lab, University of Vermont, Burlington, United States; ^fDepartment of Animal and Veterinary Sciences, University of Vermont, Burlington, United States

**Corresponding author: gbucini@uvm.edu (Gabriela Bucini)*

Innovations inspired by interactive online modeling tools can enhance our understanding of animal disease and intervention strategies. Agent-Based Models (ABMs) can integrate epidemiology, human behaviors, biosecurity and economics paradigms and provide both scientists and stakeholders with a platform to test theories and hypotheses regarding controlling disease incursions. Here we show how model-based interactive tools transform how we collaborate and gather data to improve management strategy and potentially reduce the impact of disease on the health of livestock. We created an ABM that incorporates epidemiological, structural and human-behavioral components involved in the spread of Porcine Epidemic Diarrhea virus within a spatially-explicit hog-production system. Our ABM links risk attitude, contagion factors and the level of biosecurity adopted by the model agents (hog producers, feed mills, auction houses and slaughter plants) and simulates the spread of disease across a geographic region via the interaction networks in the hog supply chain. The model also includes a supply-and-demand market to track economic losses and sales price changes due to infection. Calibration data were derived from sources such as the United States Department of Agriculture and through active participation by stakeholders in the hog industry. Our work has resulted in an operational online interactive tool that allows for scenario testing and data gathering. The tool offers a dynamic graphical interface and easy-to-interpret outputs (e.g., infected farms and market losses). Users such as livestock producers, veterinarians or policy makers can engage in two ways: 1. as attackers by starting outbreaks and locating vulnerable points in the system or; 2. as decision makers (defenders) by investing in biosecurity protection and controlling critical points of disease transmission. The output data can be used directly to examine policy and/or management strategies. This presentation promotes the use of interactive model-based tools in reducing impacts of animal disease on our livestock industries.

Research impact highlights: Innovative ideas anchored in science are key to approaching complex challenges in animal disease control. Collaboration among producers, state agencies, the industry and scientists is crucial to find solutions but is hindered by ineffective communication. We present an interactive model-based tool with online capacity that can be brought to the discussion table and used by stakeholders for theory and intervention scenario testing. It simulates biosecurity adaptation strategy and notes effects on disease spread within a regional-scale animal-production system. This tool represents an operational and intuitive way for stakeholders with varied knowledge backgrounds to interact, while generating data for management strategy.

Keywords: Biosecurity - Agent-Based Modeling - Human behavior - Interactive simulation tools - Decision making

A time series approach for measuring the indirect costs of animal disease outbreaks

Alyson Barratt^{a*}, Karl Rich^b, Jude Eze^c, Alistair Stott^d, Thibaud Porphyre^e, George Gunn^c

^aLand Economy, Environment, and Society Research Group, Scotland's Rural College, Edinburgh, United Kingdom; ^bEast and Southeast Asia Regional Office, International Livestock Research Institute, Hanoi, Vietnam; ^cFuture Farming Systems Research Group, Scotland's Rural College, Inverness, United Kingdom; ^dFuture Farming Systems Research Group, Scotland's Rural College, Edinburgh, United Kingdom; ^eThe University of Edinburgh, Roslin Institute, Edinburgh, United Kingdom

**Corresponding author: alyson.barratt@sruc.ac.uk (Alyson Barratt)*

Traditionally, cost-benefit analyses (CBAs) focus on the direct costs of animal disease, including animal mortality, morbidity, and associated response costs. However, such approaches often fail to capture the wider, dynamic market impacts that could arise. The duration of these market dislocations could last well after an initial disease outbreak, with financial ramifications to both public and private sectors.

Vector Error Correction model (VECM) is an econometric time series method for analysing statistical relationships between data series over time, thus allowing insights on how market dynamics may change from a disease outbreak. The aim of this work was to develop a methodological framework using VECM techniques to estimate the indirect costs of animal disease control strategies, using a foot and mouth disease (FMD) outbreak in Scotland as a case study.

An epidemiological model was first used to simulate FMD disease dynamics based on alternative control strategies. Output from the epidemiological model was used to quantify direct costs and applied in a multivariate vector error correction model, to quantify the indirect costs of alternative culling control strategies as a result of FMD. Indirect costs, i.e. revenue foregone, associated with an outbreak were defined as those which occurred as a result of changes in the unit prices and quantities in Scottish domestic markets of beef, pork, chicken, lamb, milk, and feed wheat.

Our results suggest that indirect costs often exceed direct costs depending on specific assumptions; size of outbreak; incursion location; and control strategy. This research not only provides a framework for estimating indirect costs, but also one that is suitably applicable to both exotic and endemic diseases. CBAs only capture activities in isolation, ignore linkages across sectors, and do not consider price effects. However, our framework incorporates wider knock-on price effects between sectors, which are often omitted from CBAs.

Research impact highlights: Better estimates of the indirect costs of animal diseases are necessary to support decision-making in animal disease prevention and control strategies. Producers and policymakers need to be aware of the broader disease impacts on trade and foregone revenue in commodity markets. These may be significant and enduring as negative publicity and/or trade restrictions will continue to affect stakeholders even if outbreaks are quickly contained. In the context of changing trade relationships with global trading partners under Brexit, understanding these costs will become even more important.

Keywords: Animal health - Indirect costs - Time series analysis - Prevention and control strategies - Foot and mouth disease

From dairy farm to consumer: analysis of the impacts of policies mitigating antimicrobial use in dairy production

Guillaume Lhermie^{a*}, Loren Tauer^b, Yrjo Grohn^a

^aPopulation Medicine and Diagnostic Sciences, College of Veterinary Medicine, Cornell University, Ithaca, United States; ^bDyson School of Applied Economics and Management, Cornell SC Johnson College of Business, Cornell University, Ithaca, United States

**Corresponding author: gl467@cornell.edu (Guillaume Lhermie)*

Introduction: Antimicrobial use (AMU) fulfills therapeutic and economic objectives, but generates a negative externality: antimicrobial resistance (AMR). The consideration of socioeconomic and behavioral determinants of AMU is necessary to frame adequate public policies addressing AMR. Our aim was to assess the impacts of potential public policies mitigating AMU, at the farm and food system levels, in the dairy production sector.

Material and Methods: First, we modelled a representative dairy herd with average prevalences for the most frequent western countries diseases. We calculated the farm net costs of current AMU practice, of AMU prohibition, an increase in antimicrobial prices, and an increase in the withdrawal period for AMU, representing possible policy scenarios. Second, we used an economic model to determine equilibrium U.S. demand and supply of milk quantity and prices under the policy scenarios. This permitted an estimation of producer and consumer economic welfare measures. We also assessed the impact on AMR, and the need to compensate farmers for any hypothetical losses associated with a decrease in AMU.

Results: The average yearly additional cost of AMU prohibition was \$60 per cow, compared to current modeled AMU. A fivefold increase in antimicrobial prices was necessary to encourage profit maximizing farmers to switch to alternative disease control methods. We demonstrated that the choice of policies needed to pursue a pattern of decline in AMU was highly dependent on the prices of inputs and outputs. Regarding regulations prohibiting AMU, our results suggest that dairy production and profits may be marginally affected, while some of the increase in production costs will be transferred to consumers. However, implementing taxes without a thorough evaluation of the potential adjustments made by the farmers could lead to a suboptimal situation.

Conclusions: Our projections provide estimates to frame the components of sustainable AMU in a holistic approach considering various stakeholders.

Research impact highlights: Antimicrobial resistance, unavoidably generated by antimicrobial use, constitutes a negative externality threatening public health and antimicrobial use in livestock production. This issue has lead policymakers to implement regulations aiming to curb antimicrobial use in animal agriculture. However, antimicrobials are also used in agriculture for animal welfare and economic reasons, so any policies will impact more than public health. Our research constitutes a step further to establish the tradeoff that compromises neither animal farming viability, and animal welfare on the one hand, nor therapeutic effects in humans on the other hand: i.e., sustainable antimicrobial use.

Keywords: antimicrobial use - economics - dairy cattle - public policies - consumer welfare

Decentralized zoonotic disease control by livestock producers: a game theoretic model applied to avian influenza in Southeast Asia

Alexis Delabouglise^{a*}, Timothy Reluga^b, Anup Malani^c, Maciej Boni^a

^aBiology, Pennsylvania State University, University Park, United States; ^bMathematics, Pennsylvania State University, University Park, United States; ^cSchool of Law, University of Chicago, Chicago, United States

**Corresponding author: aud334@psu.edu (Alexis Delabouglise)*

Highly Pathogenic Avian Influenza (HPAI) is still endemic in the domestic bird population of several countries of Asia and Africa. In several of them the control of the disease seems to be hindered by the trade of infected birds¹, poultry farmers being able to sell their infected bird flocks at a reduced price². This theoretical study is an attempt to predict the behavioral response of farmers to varying investments of the state in HPAI detection and cost of prevention technologies.

A Susceptible-Infected-Susceptible (SIS) model was used. Two disease propagation mechanisms were considered: inter-farm transmission through virus excretion in the environment and contamination by contacts with poultry traders purchasing birds in infected farms. Farmers were assumed to exert control over three variables: the number of birds they keep, the level of prevention applied to protect them from HPAI and the timing of the sale of birds. The concept of Evolutionary Stability ³, from the field of game theory, was used to identify stable strategies.

According to the study's findings, stable farmers' strategies are strongly influenced by the dominant disease transmission mechanism. In case of contamination through the environment, a bistable state is predicted, farmers either keeping their infected flocks until fully grown or selling it immediately, this second strategy preventing the propagation of the disease in the population. In this case, increasing the disease detection risk can incentivize the eradication of the disease by farmers. In case of transmission through trade, an endemic disease state with farmers having a mixed strategy of immediate and delayed sale of infected flocks is possible. Increasing the risk of disease detection further motivates the early sale of infected flocks and can increase the disease incidence. This adverse effect is offset if an affordable prevention technology is made available to farmers.

Research impact highlights: The behavioral responses of livestock producers to sanitary issues may play a key role in disease control but they are still poorly understood and not integrated in epidemiological models. The principles of game theory, which are widely used in economics, were applied to predict how poultry producers may adapt their farm management to the risk of Highly pathogenic Avian Influenza. Incentivizing the control of the disease by farmers through surveillance is possible when the disease is mainly transmitted through the environment but it faces a limit when the disease is, at least partly, transmitted through the trade of infected birds.

Keywords: Avian Influenza - Game theory - Evolutionary stability - Poultry production - Theoretical modeling

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Cost-benefits analysis of pig feed Salmonella control programme in Finland

Jarkko Niemi^{a*}, Katriina Heinola^b

^aNatural Resources Institute Finland (Luke), Seinäjoki, Finland; ^bNatural Resources Institute Finland (Luke), Helsinki, Finland

**Corresponding author: jarkko.niemi@luke.fi (Jarkko Niemi)*

Feed can be an important route for introduction of pathogens, such as Salmonella, into pigs. Hygienic management of feed is therefore important for animal health and food safety. Finland has adopted a stringent control policy for salmonella in feeds. Our aim was to investigate the cost and benefits of pig feed Salmonella control programme in Finland. Two options were compared: current pig feed salmonella control and an alternative where fewer preventive measures and interventions upon detection of Salmonella in feed were applied than in the currently.

A Monte Carlo simulation model was developed to determine the costs incurred due to preventive measures and due to measures taken to eradicate Salmonella. The data were collected through surveys conducted among feed and livestock sector operators. The model was parametrised to represent current situation and an alternative scenario.

At present, the costs for prevention of Salmonella contaminations in pig feeds were estimated at $\in 1.8 - \in 3.0$ million per year. The costs due to feed contamination and the resulting Salmonella infections in pigs and humans were estimated on average at three (0.7-8.7) million euros annually. Thus, the total costs of the current control programme were close to $\in 6$ million per year.

According to a reduced control scenario, considerable increase in Salmonella prevalence in the Finnish pig feed could increase Salmonella contaminations in fattening pigs and human infections to 55-fold. When measures to eliminate Salmonella from feed were not carried out, the costs due to preventive actions against Salmonella were estimated at $\in 1.1-\in 1.8$ million per year. Additionally, the costs due to eradication of feed-borne Salmonella on pig farms, consequential measures at slaughterhouses and the health costs to humans could rose to approximately $\in 32.5$ million. The results suggest that the present Salmonella controls, including the preventive actions, are cost-effective and generate benefits to the society.

Research impact highlights: This study looks at tradeoffs between disease prevention and 'cure'. The results suggest that the present Salmonella control, including the preventive actions, is cost-effective and generates benefits to the society. The results indicate that stakeholders who benefit from the programme are different from those who take actions to prevent salmonella contamination in pig feed. This suggest potential conflicting interests among the stakeholders.

Keywords: Prevention - Salmonella - Cost-benefit analysis - Simulation

S4-S012

The Value of Information for Livestock Production: Concept, Analytical and Methodological Approaches and Challenges

Erwin Wauters*, Cristina Rojo Gimeno

Social Sciences Unit, Institute for Agricultural and Fisheries Res, Merelbeke, Belgium

**Corresponding author: erwin.wauters@ilvo.vlaanderen.be (Erwin Wauters)*

Researchers and technolog providers are continuously seeking new ways to improve animal production and health. One area that thas sparked huge anticipation is that of precision livestock system, the combination of rapid and often automated monitoring of indicators for production and health with ICT developments for the quick and easy processing and exchange of this data. These developments are anticipated to improve aniaml production adn health, because they allow for better decision making. Yet, the value of such systems, and how they improve decision making has not often been investigated. Nonetheless, progress in the assessment of the value of information is timely and needed. Many monitoring and information processing technologies are being developed and marketed and stakeholders should be informed on the value of these technologies and on its determinants. Especially exante assessments of the potential value of such systems are useful and needed as they allow R&D investments to be made where the provide the greatest benefit. Such analyses could direct developers and researchers to adapt their systems so that the eventual value that will be produced from these systems is the highest. However, ex-ante analyses of the value of information systems are almost non-existent. The main identified reason for this is the complex research designs needed, the - paradoxically - lack of data and the large amount of assumptions that analysts need to make regarding how these systems will change decision making and how the create value. This paper present a conceptual framework for the value of information systems, composed of the different elements that influence this value. It presents a literature review on what is known yet regarding each of these elements and which questions remain. Further, the papers discusses methodological challenges and offers approach how to operationalize this conceptual framework.

Research impact highlights: Precision livestock systems are emerging and large anticipation and expectation are made regarding their potential to improve animal production and health by improving and finetuning decision making. Yet, there is almost no evidence backing-up these anticipations and expectations. Especially ex-ante studies would be useful since they can still inform researchers and developers about how to design these systems such they provide the highest value. This paper will present a useful framework about how to assess the potential value of information system and its influencing factors.

S4-S013

Big impacts, little science? A critical review of animal health impact assessments

Camille Bellet^{*}, Jonathan Rushton

Institute of Infection and Global Health, Liverpool, United Kingdom

**Corresponding author: camille.bellet@liverpool.ac.uk (Camille Bellet)*

Livestock infectious diseases pose major threats to global health and their control is crucial for animal and social welfare, productivity, and food security. How 'problems' are framed by those people responsible for conducting animal health impact assessments has implications for how impacts are identified and defined, what are the outcomes, as well as for how resource is allocated for animal disease control. Sociologists have explored how research design is shaped by researchers' values and concerns and how this, is turn, shapes their own practice and objects of study. Based on a systematic and critical analysis of the literature, this study investigates the research landscape of impact assessments in relation to bovine and porcine respiratory and poultry enteric disease complexes in Europe. For each disease complex, we explore the socio-economic and political contexts in which scientists are working; the values and assumptions deployed; how uncertainties and data limitations are addressed; and the policy conclusions supported. Our findings show a landscape of heterogeneous research that is in transformation but incomplete, especially in some geographical areas. Despite a growing support for interdisciplinary and integrative approaches that address human, animal and ecosystem dimensions together, impact assessments remain limited to a sub-set of disease problems and narrow policy advice. Addressing the complexity of health impacts on livestock due to infectious diseases requires mobilisation of a wider range of expertise, disciplines and data sources and our hypothesis is that more robust impact assessments would add value through improved disease management and resource allocation.

Research impact highlights: The way scientists frame animal disease problems has implications for how impacts are defined and evaluated, and subsequently how health decisions are made. This paper investigates the social and economic research landscape of animal health impact assessments in relation to three livestock disease complexes in Europe. Our results stimulate reflection on the value of scientific animal health research and how this can be optimised for the benefit of society.

Feedlot Willingness to Pay for Disposal Capacity to Address Foreign Animal Disease Risk

Jada Thompson^{a*}, Dustin Pendell^b

^aAgricultural and Resource Economics, University of Tennessee Institute of Agriculture, Knoxville, TN, United States; ^bAgricultural Economics, Kansas State University, Manhattan, KS, United States

*Corresponding author: jthom207@utk.edu (Jada Thompson)

Foreign animal disease (FAD) outbreaks can create severe and lasting effects through productivity losses and mortality, zoonosis, control costs, and demand impacts. Commercial livestock industries are vulnerable to FAD outbreaks due to concentrated production and largescale animal movements. Biosecurity practices can mitigate some of the risks associated with disease spread but can be costly to implement given the perceived risk and longevity of a disease outbreak. This study estimates feedlot decision makers' willingness to pay (WTP) to implement proactive biosecurity measures through increased on-site disposal capacity addressing potential limited off-farm mobility during an FAD outbreak which can inform FAD policy. U.S. feedlots were surveyed for their biosecurity practices, emphasizing disposal methods employed on- and off-site. The WTP for disposal capacity was elicited using one-and-onehalf-bound dichotomous choice framework^{1,2}. An interval censored regression was estimated to determine feedlot WTP for increased disposal capacity and the factors that contribute WTP. A feedlot's willingness to proactively invest in measures to mitigate potential losses depend on many factors including death loss rate and the number of animals annually on feed which indicates the size of the operation and influences the cash flow, or the amount available to invest in proactive measures. The estimated willingness to invest in on-site disposal capacity for the average feedlot respondent was \$14,310 with WTP as high as \$29,500 for the largest operations. Additionally, biosecurity decision making is influenced by the perceived likelihood of a disease event. As globalization continues to increase the movement of people and goods worldwide, the potential risk of disease spread will continue to grow, leading to the need for increased biosecurity and alternative management plans. Determining the willingness of decision makers to invest in biosecurity can generate understanding of their perceived value and inform future outreach efforts and policies.

Research impact highlights: Livestock producers make decisions regarding the level of biosecurity to adopt given perceived likelihood of a disease event, access to capital, and size and value of their operation. This work estimates the willingness for feedlot decision makers to invest in proactive disposal capacity preemptively to address disposal constraints during a disease event. The results provide a quantitative foundation for policy development in encouraging biosecurity adoption and preplanning. Determining the factors that contribute to biosecurity investment helps in understanding the heterogeneity between operations and how policy can achieve greater adoption.

Keywords: Biosecurity Adoption - Feedlots - Willingness to Pay - Carcass Disposal

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S4-S015

An economic model of the meat paradox

Nicolas Treich^{a*}, Nina Hestermann^b, Yves Le Yaouanq^c

^aToulouse School of Economics, Inra, Toulouse, France; ^bTSE, Toulouse, France; ^cLMU, Munich, Germany

**Corresponding author: ntreich@toulouse.inra.fr (Nicolas Treich)*

How can individuals care about animals and, at the same time, eat meat? We design a survey study to explore this "meat paradox". Survey participants (N = 3,054) underestimate farm animal suffering, and underestimate it more (i.e., are less realistic) when they eat more meat. Building on the literature on cognitive dissonance, we develop a model in which individuals form self-serving beliefs in order to reduce their moral guilt associated with meat consumption. The model characterizes how individuals' beliefs about animal welfare and their attitude towards information are affected by the economic environment (e.g., price of meat, salience of animal welfare), and by individuals' preferences (e.g., taste for meat, moral cost of guilt). Several empirical observations are consistent with our model.

Research impact highlights: The paper studies empirically and theoretically the attitude of consumers toward animal welfare.

Farmer and Veterinarian Attitudes towards the Bovine Tuberculosis Eradication Programme in Spain: A Quantitative analysis

Giovanna Ciaravino^{a*}, Josep Espluga^b, Jordi Casal^{a, c}, Alberto Allepuz^{a, c}

^aDepartament de Sanitat i Anatomia Animals, Universitat Autònoma de Barcelona (UAB), Bellaterra (Barcelona), Spain; ^bDepartament de Sociologia / IGOP - GEPS - ARAG-UAB, Universitat Autònoma de Barcelona (UAB), Bellaterra (Barcelona), Spain; ^cCentre de Recerca en Sanitat Animal (CReSA), Institut de Recerca i Tecnologia Agroalimentàries (IRTA), Bellaterra (Barcelona), Spain

**Corresponding author: giovanna.ciaravino@uab.cat (Giovanna Ciaravino)*

In a previous study, Ciaravino et al. (2017) identified social factors that may hinder the success of the bovine tuberculosis (bTB) eradication program in Spain using a qualitative approach. Here, we assessed the importance of those factors by quantifying how many people shared the same "arguments". A telephone survey of 706 farmers and 180 veterinarians was conducted using a structured questionnaire. The single intradermal test was considered reliable for 40% of farmers and 60% of veterinarians. Official veterinarians trust the test slightly more than the private ones and farmers from low prevalence areas more than those from high prevalence areas. Uncertainties on test results were mainly due to the absence of visible lesions in slaughtered animals, especially among farmers that would like to be allowed to verify positive results in independent laboratories. More than 70% of farmers and private vets agreed that wildlife reservoirs play a main role in the maintenance of bTB, whilst official vets attributed to them a secondary role. The existence of 'client-relationships' between farmers and private vets was considered negative by official vets (73%) that believe it generates pressure during bTB testing, and positive by private vets (67%) and the vast majority of farmers (81%), since it facilitates the bTB testing activities. During the last year, 68% of farmers have not attended any course on bTB and the 86% considered that it would be useful to organize regular meetings with vets. Scepticism about the achievement of bTB eradication arose; in high prevalence areas, the eradication programme raised mistrust among farmers that conceived it as an excuse to reduce the cattle population in Southern European countries (54%). The improvement of communication strategies should be considered a priority in order to increase the motivation of farmers and veterinarians and the acceptability of the bTB eradication programme.

Research impact highlights: We assessed the importance of different social factors in relation to the Spanish bTB eradication program, conducting a survey of 706 farmers and 180 veterinarians. The single intradermal test was considered reliable for 40% of farmers and 60% of veterinarians. Most of farmers have not attended courses on bTB during the last year and considered that organize regular meetings would be useful. 56% veterinarians and 40% of farmers were sceptic about the achievement of bTB eradication. Develop communication strategies to strengthen the motivation of farmers and veterinarians and the acceptability of the bTB eradication programme should be considered a priority.

Keywords: Bovine Tuberculosis - Sociological Factors - Quantitative Survey - Eradication Programme

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S4-P11

Factors influence the antibiotic usage in aquaculture production in Nam Dinh province, Northern Vietnam

Dien Nguyen Thi*

Sociology, Vietnam National University of Agriculture, Hanoi, Vietnam

**Corresponding author: namdien@gmail.com (Dien Nguyen Thi)*

Aquaculture is fastest-growing food sector in the world and it is developed with high speed and large scale in Vietnam. The aquaculture production of the country is facing the high level of infectious diseases and the over consumption of antibiotics at farm level is alarming. Considering as the major challenge to public health, the great attempts in technological aspects have been made to tackle to the antibiotics overuse but little attention has been paid on the macroeconomic and social behaviour drivers of this human action. This research aims to identify the factors influencing the antibiotics usage of aquaculture producers in Nam Dinh province. A survey on antibiotic consumption of 90 households involving in fish and shrimp production and the participatory epistemological tools with individual interviews and group discussions are conducted in two coastal communities of Nam Dinh province, Northern Vietnam. The research results show that although the aquaculture producers share the common interests of using veterinary antibiotics in maintaining the animal health and improving the productivity there are the differences in antibiotics usage between fish and shrimp producers in terms of quantity and application time. The high risks of diseases, the absence of professional veterinary services, the scale and intensification of farm as well as the looseness of regulations on selling and using antibiotics are the main factors causing the over consumption of antibiotics. The aquaculture producers have been recognizing the benefits of reducing the antibiotic usage firstly for gaining the trustfulness of the consumers in order to sustain their long term aquaculture production. The research provides the sociological analysis on farmer's practices and decisions related to antibiotics usage in its interactions to the local and national context.

Research impact highlights: Antibiotic usage in aquaculture production related closely to the driven forces from local conditions and the technological solutions are insufficient to dealing with the over consumption of antibiotics. Beside the tight regulations, the policy interventions on reducing antibiotic usage in aquaculture production need to take into account the raising awareness of producers and their interlinked benefits to the consumers.

Keywords: Antibiotics usage - aquaculture production - animal health - socioeconomical factors - participatory epistemology

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S4-P12

The private contribution of animal epidemic prevention and control investment from farmers--a public goods game

Zeng Heng*, Baoxu Huang, Youming Wang, Xiangdong Sun

China Animal Health and Epidemiology Center, Qingdao, China

**Corresponding author: zengheng@cahec.cn* (*Zeng Heng*)

Introduction: As a public product, animal epidemic prevention is non-competitive and nonexclusive. These attributes can easily lead to free-riding phenomenon, making product supply a problem. In China, the prevention and control of animal epidemics is dominated by the government, with low efficiency and low adaptability. How to coordinate the relationship between government supply and private supply is an important prerequisite for the prevention and treatment of animal diseases.

Method: This paper explores the willingness and influence factors of the farmers' contribution on animal epidemic prevention and control in natural field experiments, using decisions from a sample of 188 farmers form five provinces in western and southern China. There are four different types of experiments, the basic game, the open public goods game, the game with authoritative information and the game with punishment.

Result: Most of the farmers have just a primary school education and some are illiterate. But the average contribution rate is 76% in the basic game. The open public goods game has 81% on average contribution rate. And the rate of the game with authoritative information and the game with punishment are 99% and 97%.

Conclusion: The overall contribution rate of farmers is high, and it is easy to be influenced by measures such as publicity and policies. Animal epidemic prevention and control should strengthen the guidance of farmers and improve their enthusiasm for independent epidemic prevention.

Research impact highlights: In China, animal epidemic prevention and control, as a public product, has been dominated by the government, with low efficiency and poor adaptability. The public goods game is an economic experiment method to study human behavior, which may provide a new way to solve the problem of animal epidemic prevention and control.

S4-P13

A qualitative study investigating the feasibility of surveillance for beef cattle and sheep diseases in England: Farmer opinions and behaviour

Hanne H Nijs^{a*}, Liz Genever^b, Laura E Green^a

^aSchool of Life Sciences, University of Warwick, Coventry, United Kingdom; ^bAHDB Beef & Lamb, Stoneleigh, United Kingdom

*Corresponding author: h.nijs@warwick.ac.uk (Hanne H Nijs)

Introduction: Qualitative research methods provide more insight into the opinions and thoughts of participants. Focus group discussions were conducted with English beef cattle and sheep farmers as part of the study to investigate the feasibility and value of a new surveillance system that benefits both the producer and the industry.

Methods: A total of six separate meetings were held for sheep and beef farmers in the Midlands, North and South of England. Semi-structured guidelines aided the facilitator and ensured all relevant topics were covered. The participants consented to the focus group discussions being audio-recorded. After manual transcription, NVivo software was used for coding. Thematic analysis was applied to create a narrative that is evidenced by quotes from the participants.

Results: Farmers record what they consider important for their business type, management policies or decision-making. However, the participants expressed the need for more diagnostic feedback and to raise awareness amongst livestock producers. Beef farmers are particularly concerned about buying in diseased animals through livestock markets or diseases being introduced by infected cattle from nearby farms. Similar to beef producers, biosecurity is of interest to sheep farmers although their primary interest in surveillance would be to develop a diagnostic tool to use on-farm. Receiving diagnostic reports or seeing a financial return (e.g. international certification) will incentivise farmers to take part in a monitoring scheme.

Discussion: The value of surveillance depends on the farm type (e.g. pedigree vs commercial flocks, suckler vs finisher herds). Participants indicated that diagnostic results are useful rather than the recording of non-specific health indicators. However, sheep farmers prefer a diagnostic tool since a consult from the veterinarian is too expensive. Farmers want a system where they can access historic information and the health status of individual animals to aid when buying in stock.

Research impact highlights: Endemic livestock diseases cause significant economic losses and impact on animal health. The value of a surveillance system for endemic beef cattle and sheep diseases was assessed by conducting focus group discussions with farmers. The objectives of the qualitative study were (i) to identify the purpose of a surveillance system, (ii) to investigate the feasibility of recording clinical health indicators on-farm, (iii) to discuss diseases of interest and feedback for farmers, and (iv) to disclose potentially useful data sources. Surveillance is valuable for both producers and the industry if animal health is to be improved, and financial losses are reduced.

Keywords: Focus group - Beef cattle - Sheep - Surveillance - Farmer



ROB CHRISTLEY

Rob Christley is Professor of Epidemiology and One Health and Head of the Department of Epidemiology and Population Health in the Institute of Infection and Global Health, University of Liverpool. He graduated in veterinary science from the University of Sydney, and undertook an internship, residency, Masters and PhD at the same institution, before moving to the University of Glasgow. Rob has been at the University of Liverpool since 2002, where his primary research interest is the interplay between animal health and society; the social effects of animal health issues and the impact of human behaviour on animal health.

Qualitative methods in Animal Health Research

Robert Christley*

Epidemiology and Population Health, University of Liverpool, Neston, United Kingdom

**Corresponding author: robc@liverpool.ac.uk (Robert Christley)*

There has been a dramatic rise in the application of qualitative research (QR) methods to animal health issues over recent years. This has seen a three-fold increase in the number of publications using these approaches, more mainstream inclusion of QR within animal health conferences, and increasing emphasis on multidisciplinary approaches, including animal health funding calls specifically requiring inclusion of QR streams.

Within this presentation I will mainly focus on three areas:

(1) the roles of QR in animal health;

What can QR contribute to animal health research? Within animal health research, QR is often applied descriptively. Whilst this can provide useful information, I will argue that going to the next stage of analysis – that of developing a more theoretical understanding – enables development of richer and more useful insight.

(2) the challenges of applying QR methods;

There are multiple challenges to the application of QR methods in animal health, where quantitative methods are the mainstay of the scientific approach. These challenges include: establishing mutual trust and understanding; developing a common language to facilitate collaboration between qualitative and quantitative researchers; demonstrating the rigour of QR, particularly to people more familiar with quantitative methods; and funding and publication QR and multidisciplinary research.

(3) the future for QR in animal health research;

The role for QR in animal health research is likely to continue to increase. There is, therefore, a need for the development of new training routes to develop the next generation of qualitative and cross-disciplinary researchers, and to "up-skill" existing researchers. These courses are emerging: I will finish by reviewing some of these and future training needs.

Research impact highlights: Qualitative methods are being increasingly used in animal health research.

Evaluation of One Health-ness: insights into interdisciplinary and cross-sectoral integration

Simon Rüegg^{a, b*}, Liza Rosenbaum Nielsen^c, Barbara Häsler^d

^aSection of Veterinary Epidemiology, University of Zurich, Zurich, Switzerland; ^bon behalf of the NEOH consortium, London, United Kingdom; ^cFaculty of Health and Medical Science, University of Copenhagen, Copenhagen, Denmark; ^dRoyal Veterinary College, University of London, London, United Kingdom

**Corresponding author: srueegg@vetclinics.uzh.ch* (Simon Rüegg)

Introduction: One Health (OH) has been promoted as an approach for many current health challenges, particularly those arising from the intertwined spheres of humans, animals and the ecosystems constituting their environment. They are so called wicked problems and the adequate responses must consider features of complex dynamic systems. This is achieved through interdisciplinary and cross-sectoral integration, and participation. The EU COST funded "Network for Evaluation of One Health (NEOH)" has identified characteristic features of OH initiatives and developed an evaluation framework to systematically assess the degree of OH integration associated with outcomes of the initiative.

Material & Methods: The NEOH framework hypothesises that OH initiatives require adaptive leadership to apply systems thinking, flexible planning to respond to unexpected outcomes, and work in a transdisciplinary way. In addition they must be framed with infrastructure providing opportunities for learning at individual, team and organisational levels, which in turn requires sharing of data, information and experiences. The framework provides tools to assess these aspects systematically in a semi-quantitative way and summarizes them in a OH-index and OH-ratio. We illustrate their application in eight case studies and discuss the information it provides.

Results: The assessment tools leave room for some subjectivity in the scoring. Consequently, the summarizing OH-index provides currently only a rough indication of the degree of integration achieved by an initiative. In contrast, the OH-ratio illustrates quite clearly how intentions to tackle the complexity of a challenge are matched with infrastructure for learning and sharing as well as adequate leadership.

Discussion: The framework is useful to assess OH integration in solutions that aim to tackle complex health challenges. The next step is further application to work towards benchmarking and best practices to minimize subjectivities. The concept of the OH-index and OH-ratio produce insights into the comprehensiveness of a given OH initiative.

Research impact highlights: The EU COST Action "Network for Evaluation of One Health (NEOH)" has developed an evaluation framework based on a systems approach. The framework encompasses the assessment of six characteristics of One Health (OH) initiatives. This process evaluation addresses the aspects OH thinking, planning, working, as well as sharing, learning and systemic organisation as mechanisms of cross-disciplinary and cross-sectoral integration. The OH-index and OH-ratio, as summarizing metrics provide insights into the degree of planned or achieved integration, and can be a useful tool to evaluate OH initiatives for external or self-evaluation in various contexts.

Keywords: integrated approaches to health - evaluation - transdisciplinarity

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Making shared responsibilities work? Contested biosecurity spaces in the Australian egg industry

Brian Furze^{a*}, Marta Hernandez-Jover^a, Vaughan Higgins^b, Jenny-Ann Toribio^c, Mini Singh^c

^aGraham Centre for Agricultural Innovation, Charles Sturt University, Wagga, Australia; ^bSocial Sciences, University of Tasmania, Launceston, Australia; ^cSydney School of Veterinary Sciences, University of Sydney, Sydney, Australia

**Corresponding author: bfurze@csu.edu.au (Brian Furze)*

The biosecurity environment in Australia, as in other countries, incorporates integrated biosecurity strategies and practices. Alongside this has been the emergence of a policy/strategy position of 'shared responsibilities', where significant responsibilities for both surveillance and biosecurity practices have been devolved to the producer.

The dual forces underpinning integrated systems of biosecurity – of both regulatory standardisation and responsibility at the producer scale – have the potential to create a contested space. On the one hand, biosecurity practices and expectations are being standardised by government regulators, producer associations and animal health experts. Yet at the local scale, there are multiple practices, assumptions, socio-cultural processes and economic realities that shape the interpretation of both biosecurity threats and forms of practice.

These dual forces can be found in the biosecurity system of the Australian egg industry. Government biosecurity strategies highlight the importance of an approach with shared responsibilities whilst emphasising partnerships across the system and regulatory frameworks reflect standardised approaches (which are supported by industry biosecurity manuals and technical information generated from industry associations and animal health experts). Yet little is known about the multiple practices and processes occurring amongst egg producers which impinge on decision-making, adoption of technical information and perceptions of biosecurity threats.

This paper reports on research focused on these contested spaces. Drawing on semistructured interviews with Government actors, producer associations, animal health professionals and egg producers, the paper explores the linkages between shared responsibilities, standardisation and local practices. It goes on to consider their implications in terms of integrated biosecurity policy and practices, the role of government agencies and producer associations within a shared responsibility approach and the forms of engagement with egg producers necessary to enhance integrated forms of biosecurity practices within the Australian egg industry.

Research impact highlights: This paper presents the results of research focused on understanding the linkages between shared responsibilities, standardised approaches to biosecurity and local practices in the Australian egg industry. The outcomes of the research, the first of its type within the egg industry in Australia, specifically addresses forms of integration within the biosecurity system - policy-to-practice and practice-to-policy linkages in particular - and considers implications both in terms of biosecurity policy, the role of government agencies and producer associations within an integrated, shared responsibility approach and the forms of engagement with egg producers necessary to enhance biosecurity within the Australian egg industry.

Keywords: shared responsibilities - integrated biosecurity - Australian egg industry

Increasing the local relevance of epidemiological research: situated knowledge of cattle disease amongst Basongora pastoralists in Uganda

Erika Chenais^{a*}, Klara Fischer^b

^aDepartment of Disease Control and Epidemiology, National Veterinary Institute, Uppsala, Sweden; ^bDepartment of Urban and Rural Develpoment, Swedish University of Agriculture Sciences, Uppsala, Sweden

**Corresponding author: erika.chenais@sva.se (Erika Chenais)*

Cattle disease might have severe negative impacts on poor peoples' livelihoods. Nevertheless, disease management and outreach often remain suboptimal in low-income settings. This study with Basongora pastoralists in Uganda contributes to increased knowledge of local priorities, understanding, and practices regarding cattle disease with the aim to improve outreach and disease control advice in these contexts. A further aim was to investigate how participatory epidemiology can be better equipped for gathering situated knowledge.

Empirically, we draw on focus group discussions, interviews, participatory mapping and wealth-ranking to perform a thematic, bottom-up analysis. Theoretically we use Haraway's concepts of situated knowledge and embodied objectivity, and insights from participatory research and interdisciplinary dialogue to better embrace local perspectives.

Cowdriosis, Trypanosomiasis, Contagious Bovine Pleuropneumonia, East Coast Fever and Anthrax were diseases frequently prioritised. Lack of control over the animal health situation, and money invested in treatment not guaranteeing recovery were of general importance for theses prioritisations. Participants' descriptions of diseases were in some cases in agreement with textbooks, and in others not. Co-infections, chronic and re-occurring infections, and lack of access to formal knowledge were factors identified as important for this lack of agreement between formal and situated knowledge.

Paying attention to situated knowledge, particular context specific issues, such as the vicinity of the national park, emerged to be of special relevance for local understanding and experiences with disease. Another such example was the local importance ascribed to number of cattle, rather than production levels. These factors need to be taken into consideration while formulating disease control advice, as does the complex disease landscape. The results suggest the importance that research and advice moves beyond curing 'knowledge-gaps' and rather pays attention to different ways of understanding disease for drawing relevant conclusions regarding situated knowledge and how disease control can be improved.

Research impact highlights: This qualitative interview study strived to improve understanding of the situated knowledge and embodied experiences of cattle diseases among Basongora pastoralists in Uganda, with the aim to improve future advice and disease control measures. The study showed how local knowledge on cattle disease is affected by complex disease landscapes and limitations in access to formal information and veterinary services. Further, looking beyond knowledge-gaps, the study showed the pivotal value of embracing and aiming to understand local knowledge and priorities on cattle disease, and to integrate these priorities in future research, interventions and advice.

Keywords: participatory epidemiology - livestock - local knowledge - disease ranking - participatory rural appraisal

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S5-0C19

Participatory evaluation of vaccination services for Newcastle disease control in village poultry in Democratic Republic of Congo

Francis Lwapa^{a*}, Justin Masumu^{a, b}, François Matala^c, Fabrice Mukoko^d, Nassim Moula^e, Nicolas Antoine-Moussiaux^e

^aFaculty of Veterinary Medicine, National Pedagogic University, Kinshasa, Democratic Republic of Congo; ^bInterdisciplinary Center for Health Risk Management (CIGeRS), Kinshasa, Democratic Republic of Congo; ^cCentre Agronomique et Vétérinaire Tropical de Kinshasa (CAVTK), Kinshasa, Democratic Republic of Congo; ^dDirection for Animal production and health, Ministry of Agriculture, Kinshasa, Democratic Republic of Congo; ^eFundamental and Applied Research for Animals and Health (FARAH), University of Liège, Liege, Belgium

**Corresponding author: eilwapa@doct.ulg.ac.be (Francis Lwapa)*

Rural areas of Democratic Republic of Congo (DRC) suffer recurrent food crises. Poultry keeping thus plays a crucial role in households' nutritional and financial security. This study mobilises participatory approaches and stated preference methods to evaluate recent vaccination campaigns against Newcastle disease (ND), led on a cost-recovery basis, and assess the demand for self-sustaining ND vaccination services in Central Kongo province. The survey covered 4 districts (Kasangulu, Madimba, Kolo, Kwilu Ngongo). It included 12 focus groups with farmers and veterinary services and 160 individual semi-structured interviews (snowball-sampled). To value the demand for distinct modalities of vaccination services, a stated preference survey was conducted with 320 poultry keepers. Through proportional piling, field actors estimated that about 80% of households keep chickens. Inside our sample, the mean flock amounted to 9.6 ±9.1 chickens, an adult being sold at 3.5 to 5 USD. ND-compatible syndromes are described as annual and reaching mortality rates around $84\% \pm 18\%$. All interviewees recognized this disease as a main concern and 96% stated an overall willingness to pay for vaccination. Past vaccination campaigns had included 24% of the sampled farmers; 87% of those declared being convinced of vaccine's efficacy. Public veterinary services considered that the various campaigns had been an opportunity to acquire a new working tool, to generate income and constitute for them a positive object of collaboration with smallholders. According to all stakeholders, ND vaccination campaigns are the sole having shown regularity in the zone in the last 5 years. The maximal price evoked in open survey being of 20 US cents, conjoint analysis considered prices per dose of 5, 10 and 15 US cents. The modalities deemed important in vaccination services valuation were the mode of organisation (coordinated vs. individual recourse), the route of administration, and vaccinator's qualification.

Research impact highlights: Animal vaccination campaigns in Democratic Republic of Congo are mostly conducted on an irregular basis with public or foreign funding. Cost-recovery schemes of vaccination in village poultry against Newcastle disease are now tested in the Central Kongo province to promote a more sustainable and permanent service to farmers. Participatory approaches are here proposed as a means of evaluating these first attempts, including farmers perceptions and willingness-to-pay, and propose ways for the future development of such services.

Keywords: vaccination - participatory evaluation - village poultry - Newcastle disease - cost-recovery scheme

Walking at the edge of social and biomedical sciences: a fascinating yet tricky trek!

Nicolas Antoine-Moussiaux^{a*}, Stéphane Leyens^b, Séverine Thys^c, Aurélie Binot^d

^aFundamental and Applied Research for Animals and Health, University of Liege, Liege, Belgium; ^bSciences, Philosophies et Sociétés, Université de Namur, Namur, Belgium; ^cDepartment of Public Health, Institute of Tropical Medicine, Antwerp, Belgium; ^dASTRE, CIRAD, Montpellier, France

**Corresponding author: nantoine@uliege.be (Nicolas Antoine-Moussiaux)*

Complex health problems call for interdisciplinarity. However, major divides remain between disciplines, resulting in projects being split into work-packages, mostly running in silos. This communication considers lessons learnt by scientists experiencing for more than a decade interdisciplinary research. It proposes a framework for further analysis and calls for dialogue to increase added value of interdisciplinarity with a focus on social sciences and biomedical sciences. Indeed, these disciplines handle distinct topics, adopting disciplinary viewpoints requiring very different temporal and spatial scales of study. Hereafter we consider some general and common, though disputable and not exclusive, distinctions between social and natural sciences. The gaps between qualitative or quantitative research processes are a recurrent barrier. Hence, the necessary dialogue remains challenged by the diversity of practices, beliefs and epistemologies. Social sciences mostly rely on a constructivist, inductive and interpretative approach, while biomedicine provides experimental facts based on hypothetico-deductivist methods, and modeling and statistical approaches call for mathematical translation and analysis of reality. Often, debates crystalize around the conception of quality in science. Qualitative research addresses meaning, implying subjective interpretation of data collected within a defined context. On the other hand, quantitative approaches call for representativity of samples to generalize results to populations. Also, experimental science will focus on statistical significance and repeatability within controlled conditions to decontextualize knowledge. Therefore, disciplines diverge about the aptness of truth assessment, the perceived usefulness of knowledge and importance of research questions. Tradeoffs need to be made between reductionism and holism, addressing the various scales of study of disciplines. Further fostered by technical jargons and evolving conceptual frameworks, this misunderstanding leads to severe shortfalls in collaborations. Beyond the sharing of experience, a rigorous analysis of barriers, benefiting from insights from philosophy of science, is needed in order to get more value from interdisciplinary collaboration.

Research impact highlights: Interdisciplinary research is needed to address complex health problems. Yet, major gaps are dividing disciplines, based on profound epistemological divergences. This causes major shortfalls in projects joining social and biomedical sciences. Based on the sharing of experience gained through participation to interdisciplinary research in diverse contexts, the present communication aims at proposing a reflection integrating insights from philosophy of science to propose further analysis and ways forward.

Keywords: interdisciplinarity - epistemology - One Health - complexity - barrier analysis

Scoping review on farmer's attitude and personality as possible risk factors for dairy cattle health, welfare, productivity and farm management

Friedeman Adler^{*}, Amely Campe

Department of Biometry, Epidemiology and Information Processing (IBEI), Univ. of Vet. Med. Hannover, Foundation, Hannover, Germany

**Corresponding author: friedemann.adler@tiho-hannover.de (Friedeman Adler)*

In preparation of a study on dairy cattle a systematic review based on recommendations of the PRISMA-statement was conducted (1) to describe the spectrum of studies on personality and attitude as risk factors for dairy cattle health, welfare, productivity and farm management, (2) to depict how research on personality and attitudes risk factors is reported, (3) to assess, if an overall conclusion can be drawn on the impact of farmers' attitude and personality (e.g. which attitude / personality influences which outcome?).

Database searches captured 777 records, of which 34 were included in the review. A tool to systematically extract information was developed, tested and used to assure quality and entirety of extracted information. The publications came from 19 different countries. Thirty manuscripts assessed farmers' attitude, one their personality and three both as risk factors. 52 different outcome variables were investigated concerning management (15 manuscripts), health (twelve manuscripts), productivity (ten manuscripts) and welfare (four manuscripts). The spectrum of how risk factors were reported showed a great variability.

Therefore, we conclude that an overall conclusion on attitude and personality as risk factors currently is impeded as manuscripts are difficult or even impossible to be compared. We recommend researchers to (1) report clear hypotheses, (2) involve experts from social sciences, (3) thoroughly describe procedures of data collection, processing and analysis, (4) be cautious interpreting results based on p-values, only, and (5) think about possible ways to develop a standardized assessment of farmers' attitudes.

The talk delivers more detailed information on the accomplishment and results of the systematic review and discusses future recommendations for the publication of results to ensure overall analyses like meta-analyses. Additionally, we highlight the importance of cooperation between veterinary and social sciences and encourage a discussion on the necessity of and possibilities for standardization of attitude assessment.

Research impact highlights: We systematically reviewed published analyses of dairy farmer's attitudes and personality as risk factors for dairy cattle health, wellbeing, productivity and management. We investigated which techniques researchers operated to collect, process and interpret these data. We conclude that an overall conclusion on the impact on farmer's attitude and personality currently is not possible due to the great variability of outcome variables assessed and approaches chosen to investigate attitude. Our work highlights the importance of cooperation between veterinary and social sciences, encourages a discussion on the necessity of and possibilities for standardization of attitude assessment and helps researchers conceptualizing future research.

Big-five personality traits of farmers evaluated by self- and other-rating in relation to implementation of animal hygiene measures

Marcus Mergenthaler*

Agriculture, Southwestfalia University of Applied Science, Soest, Germany

**Corresponding author: mergenthaler.marcus@fh-swf.de (Marcus Mergenthaler)*

Improving animal hygiene in intensive livestock production has become an increasingly challenging task. Veterinarians and farm advisors are looking for new approaches to improve their services to farmers and implement more preventive measures. Often measures to improve animal hygiene are implemented at lower levels than recommended. Sociodemografic and farm structural characteristics are weak predictors of the implementation level of hygiene measures. It has been hypothesized that farmers' personality traits might impact implementation levels of hygiene measures. Therefore we employ a unique dataset of 44 intensive pig farmers from a livestock intensive region in north-western Germany who have participated in a three year project for improving animal hygiene in pig production. Comprehensive panel data have been collected on the implementation of numerous hygiene measures at farm level. In addition, big-five personality traits have been collected by self- and other rating. Results show that implementation levels of animal hygiene measures are correlated with several of the big-five personality traits. However, depending on the type of hygiene measures different personality traits are of importance. Whereas conscientiousness is positively and neuroticism is negatively correlated with the implementation of continuous measures, openess combined with conscienteousness is more important when it comes to technical measures of singular implementation. Extraversion and agreeableness are not related to implementation levels of different hygiene measures but play a role when it comes to an evaluation of the consulting process.

Research impact highlights: More emphasize should be given to socio-psychological innovations in animal health advisory processes to improve animal health outcomes. Veterinarians and farm advisors can use the results of this study to develop consulting services tailored to specific personality traits of farmers. In this way, higher implementation levels of animal hygiene measures can be expected.

Keywords: personality - extension - animal hygiene

Stakeholder perceptions of colostrum management for dairy calves in England

Laura Palczynski^{a*}, Emma Bleach^b, Marnie Brennan^c, Philip Robinson^a

^aAnimal Production, Welfare and Veterinary Sciences, Harper Adams University, Newport, United Kingdom; ^bAnimal Production, Welfare and Veterinary Sciences, Harper Adams University, Newport, Shropshire, United Kingdom; ^cSchool of Veterinary Medicine and Science, University of Nottingham, Sutton Bonington Campus, Leicestershire, United Kingdom

^{*}Corresponding author: lpalczynski@harper-adams.ac.uk (Laura Palczynski)

Despite the importance of youngstock performance to farm economic efficiency, calf health is often sub-optimal on dairy farms. Good colostrum management can confer protective immunity to newborn calves, making them less susceptible to infectious disease. However, evidence suggests failure of passive transfer is common. This paper explores stakeholder perceptions of colostrum management and how they might affect administration of colostrum to newborn calves.

Calf rearing on UK dairy farms was investigated using 40 in-depth interviews, 26 with dairy farmers and 14 with advisors including veterinarians, feed and pharmaceutical company representatives. Interviews followed a topic guide but allowed flexibility to explore issues of most importance to participants. Interviews were audio recorded, transcribed and thematically analysed.

Colostrum was considered important by all participants, but farmers and advisors thought colostrum management was poor on some farms, largely due to limited time. The broad principles of colostrum management were adhered to by most participants. Recommended practices were followed to varying degrees using different feeding methods. Stomach tubing was generally considered less favourable than allowing calves to drink from their dam or a bottle. Confusion surrounding the benefits of some measures and their implementation was apparent. Advisors acknowledged difficulties in implementing colostrum protocols on-farm and warned against providing overly-simplistic advice.

Although the value of colostrum was considered common knowledge, farmers may not fully appreciate the specific details of how to achieve adequate passive transfer and only update colostrum protocols to address problems. Advisors should consider providing bespoke advice which highlights the value of individual components of 'good colostrum management', and suggest specific ways in which these practices can be achieved with efforts made to appeal to farm workers' perceptions and priorities.

Research impact highlights: Colostrum management is key to rearing healthy calves but is often suboptimal. In-depth interviews found that colostrum was considered important by farmers, yet their colostrum practices were questionable. Advisors warned against overlysimplistic advice which fails to address difficulties in administering colostrum on farms. This study suggests that current advice conveys general principles for colostrum management but fails to inform farmer decision-making and inspire action. Greater focus on how to enact best practice and efforts to appeal to farm workers' priorities could be beneficial.

Keywords: colostrum - stakeholder perceptions - management - dairy - calves

Adoption of Secure Pork Supply Plan Biosecurity by U.S. Swine Producers

Christopher Pudenz^{a*}, Lee L. Schulz^a, Glynn T. Tonsor^b

^aDepartment of Economics, Iowa State University, Ames, United States; ^bDepartment of Agricultural Economics, Kansas State University, Manhattan, United States

**Corresponding author: ccpudenz@iastate.edu (Christopher Pudenz)*

Existing biosecurity plans offer protection against endemic diseases but heightened precautions are needed for foreign animal diseases. In the event of a foreign animal disease outbreak, maintaining business continuity is critical for animal health and food security. This research focuses on the enhanced biosecurity recommendations outlined in the Secure Pork Supply Plan which include a written site-specific biosecurity plan, a defined perimeter buffer area, and a defined line of separation. The objectives of this research are to determine the factors leading to adoption and the degree of complementarity among biosecurity practices.

This research utilizes data from a 2017 nationwide survey of U.S. swine producers. Nearly 60% of producers report always providing a written site specific biosecurity plan to employees. However, only 39% of producers report always providing a written site specific biosecurity plan to delivery and service personnel. Sixty percent of producers indicate a line of separation is clearly defined on their operation, while only 40% indicate that a perimeter buffer area is clearly defined on their operation. Though many producers believe implementation is feasible on their operation, non-adoption suggests other motivating factors.

Various methods are employed in model specification. Binary Probit models are used to determine impact of operation type, operation size, business arrangement, regional location, past disease experience, risk perception, financial expenditures, and other characteristics on biosecurity adoption decisions. Multinomial Probit, multivariate Probit, and count data regression models are used to examine the complementary nature of adoption.

This research suggests heterogeneity does exist between swine producers and adoption of Secure Pork Supply Plan biosecurity on their operations. A better understanding of biosecurity adoption, or lack thereof, provides research and extension personnel with information as to how to improve program targeting and researchers and stakeholders with insights leading to a better understanding of industry trends and differences among producers.

Research impact highlights: There is growing concern about the negative animal health and supply-chain impacts of a foreign animal disease outbreak in the United States. In response, the Secure Pork Supply Plan has been developed containing several enhanced biosecurity recommendations with the goal of providing a workable business continuity in the event of an outbreak. This research utilizes a 2017 survey of U.S. swine producers to determine the factors leading to adoption and the degree of complementarity among multiple biosecurity practices. Key results include documenting how demographics as well as producer attitudes and motivations for implementing biosecurity impact adoption decisions.

Keywords: animal health - biosecurity adoption - foreign animal disease - Secure Pork Supply Plan - swine

Evaluation of measures to control emerging parasitic diseases (Cystic Echinococcosis and Leishmaniasis) in Veneto region, North-Eastern Italy

Massimo Canali^{a*}, Maurizio Aragrande^b, Andrea Angheben^c, Gioia Capelli^d, Michele Drigo^e, Federico Giovanni Gobbi^c, Rudi Cassini^e

^aDept. of Agricultural and Food Sciences - DISTAL, University of Bologna, Forli (FC), Italy; ^bDept. of Agricultural and Food Sciences - DISTAL, University of Bologna, Bologna (BO), Italy; ^cCentro per le Malattie Tropicali, Ospedale Classificato Equiparato "Sacro Cuore", Negrar (VR), Italy; ^dIstituto Zooprofilattico Sperimentale delle Venezie, Legnaro (PD), Italy; ^eDept. of Animal Medicine, Production and Health - MAPS, University of Padua, Padua (PD), Italy

**Corresponding author: massimo.canali2@unibo.it (Massimo Canali)*

The research evaluates the impact of zoonotic transmissible diseases and the identification of cost-effective policy measures for their control to be implemented by the public health system. According to the One Health (OH) approach, which promotes interdisciplinary and cross-sectoral studies, the research is implemented by experts from different Institutions and various backgrounds (parasitology, epidemiology, animal and human health, public health, and economics). The investigation focuses on Cystic echinococcosis and Leishmaniasis, two emerging parasitic zoonoses in the study area (Veneto Region). The research is organized into three phases: i) design and validation of epidemiological models for the investigated diseases; ii) data collection; iii) cross-sectoral evaluation. An independent Interdisciplinary Network supports the research team with the aim to improve the understanding of the epidemiological models and validate the study results. Data collection consists of literature review, data mining, and field research through surveys and interviews to selected socioeconomic groups. The evaluation phase considers the ex-ante situation (baseline scenario without policy measures) compared to an ex-post situation (after policy implementation) to assess the effectiveness of designed measures, including the identification of a specific OH policy framework for interventions related to surveillance and control of transmissible zoonoses able to effectively influence policymaking at the regional level.

Research impact highlights: The research is concerned with public and private policies of animal and public health surveillance, prevention, and control. The target is to work out a specific One Health framework to design and evaluate interventions for surveillance and control of zoonoses and effectively influence health policymakers, especially for measures related to Cystic echinococcosis and Leishmaniasis.

Keywords: public and private policies for zoonoses surveillance, prevention, and control -One Health approach - economic evaluation of animal and public health measures - Cystic echinococcosis - Leishmaniasis

Using a food-chain risk analysis to model the cost-effectiveness of porcine cysticercosis diagnosis and treatment in western Kenya

Lian Thomas^{a, b*}, Eric Fèvre^{a, b}, Sam Kariuki^c, Ian Handel^d, Jonathan Rushton^a

^aInstitute of Infection and Global Health, Univeristy of Liverpool, Liverpool, United Kingdom; ^bInternational Livestock Research Institute, Nairobi, Kenya; ^cKenya Medical Research Institute, Nairobi, Kenya; ^dRoslin Institute, Univeristy of Edinburgh, Edinburgh, United Kingdom

**Corresponding author: lian.thomas@zoonotic-diseases.org (Lian Thomas)*

Introduction: The zoonotic tapeworm *Taenia solium* has been ranked as the most important foodborne parasitic disease globally [1]. A novel pen-side diagnostic assay has recently been developed which allows pigs to be tested for the presence of *T. solium* antigens in a field situation with a high degree of sensitivity and specificity. We are investigating the cost-effectiveness of deploying this assay, alongside treatment of infected pigs with oxfendazole, to reduce the number of potentially infected meals being consumed in this community.

Methods: A stochastic risk assessment model was built in the @RISK add-on to Microsoft Excel and is being used to model the effect of providing pork traders with the novel diagnostic assay, to allow screening of pigs prior to purchase. We assume that pigs testing negative would be purchased and sent to slaughter while infected pigs would be treated with 30mg/kg oxfendazole and re-tested prior to purchase 8-10 weeks later. The full economic cost (in US\$) of deploying the assay, oxfendazole treatment of test-positive pigs and stringent condemnation of infected carcasses, is currently being investigated. The model will be used to determine the incremental cost-effectiveness ratio (ICER) per infective meal avoided in comparison to the current situation and the price-differential for uninfected pigs required to incentivise participation in the new program.

Results: The food chain risk model estimated that 22,282 (99% U.I. 622-64,134) potentially infective pork meals are consumed annually within Busia District of western Kenya [2]. The ICER per infective meal avoided and price differential between infected and non-infected pig required for compliance with the proposed program is currently being calculated.

Conclusion: This work seeks to understand the costs and incentives required for implementation of a novel porcine cysticercosis control program and its effectiveness in terms of reduction in potentially infective meals consumed by the community.

Research impact highlights: Taenia. solium cysticercosis is a zoonotic disease of public health and economic importance, particularly within developing nations. Unfortunately, an under-resourced meat inspectorate in many endemic countries struggles to prevent infected animals entering the food-chain. Our study uses a food-chain risk assessment approach to determine the cost-effectiveness of a novel surveillance strategy for porcine cysticercosis and to understand the incentives needed for compliance with such a program.

Keywords: Taenia - Cysticercosis - Cost-effectiveness - risk-analysis - Diagnostics

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Rethinking caprine brucellosis control: lessons from a Mexican study

David Oseguera Montiel*

Universidad Autónoma de Yucatán, Mérida, Mexico

^{*}Corresponding author: oseguera.david@gmail.com (David Oseguera Montiel)

Caprine brucellosis is a main constraint for small-scale goat husbandry systems in the Global South; it negatively affects production parameters and can be transmitted to humans. The bulk of expertise on brucellosis control comes from the Global North, where brucellosis has been controlled and even eradicated in most countries (1). The main control strategies have been vaccination and test-and-cull. However, some of the thoughts, experiences and recommendations with regard to brucellosis control, in particular in small ruminants, may not hold true in the Global South (2). The aim of this paper is to point out context related differences between Global South and Global North countries which may affect control of brucellosis in small-scale goat husbandry systems. Experience from 3 years of fieldwork with Mexican goat smallholders are used as an example.

Qualitative and quantitative methods were conducted in two Mexican states, Jalisco and Michoacán, within the Bajío region. Three paradigms related to brucellosis control were contested. First, 'vaccination is inexpensive'. It was found that vaccination was not cheap for farmers, partly because vaccination needs to be done by licensed veterinarians. Second, 'farmers need to be trained to control brucellosis', indeed, farmers lacked knowledge about brucellosis, but both veterinarians and health authorities knew little about goat husbandry management. Third, 'test-and-cull strategies are out of reach in the Global South'. It is true, costs for culling are high; however, brucellosis eradication through test-and-cull should be possible especially if a niche market for dairy goat products can be realized.

It is concluded that Mexican policy for brucellosis control needs to be redesigned. Brucellosis control is an opportunity for small-scale goat farmers to access a better market and enhance farmers' health and welfare, i.e. their livelihoods. Further research that considers the 'One Health' concept is needed to overcome caprine brucellosis in the Global South.

Research impact highlights: A transdisciplinary approach is useful in assessing brucellosis control in smallholder farming systems. In developing countries like Mexico, caprine brucellosis is a great constraint for smallholder goat farming development and a threat for public health especially for farmers' livelihoods.

Keywords: goats - brucellosis - Mexico - One health - zoonosis

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Impact of Indemnity Expectations on Producer Biosecurity Effort

Glynn Tonsor^{a*}, Lee Schulz^b

^aAgricultural Economics, Kansas State University, Manhattan, KS, United States; ^bAgricultural Economics, Iowa State University, Ames, IA, United States

**Corresponding author: gtonsor@ksu.edu (Glynn Tonsor)*

This study focuses on the impact of livestock producer expectations of government action following high consequence foreign animal disease events on the extent producers are willing to proactively pursue disease mitigation strategies. U.S. swine producers were surveyed in 2017 to examine the impact of possible governmental approaches to indemnity payments on willingness to invest in biosecurity. A choice experiment was conducted where annualized cost, own-farm risk, enhanced market access, and enhanced indemnity status of competing biosecurity options were varied allowing producers to reveal which selection they would make under different conditions. Estimated economic models map out the share of producers who will NOT make additional biosecurity investments and how this varies when costs or own-farm risk effectiveness change.

Nearly one-third of producers expect indemnity payments to "be available only if they could document biosecurity efforts," 38% expect "indemnity payments to be available to all disease impacted producers regardless of biosecurity efforts and documentation," and 31% expect indemnity to not be available to any producers. Beyond this split in views, the impact on how producers make biosecurity decisions is key to understand. Producers viewing indemnity as conditional on their effort are more likely to invest (5% fewer non-investors) and most sensitive to changes in costs and risk reduction reflecting how they take these investment considerations more seriously.

This research suggests efforts to solidify policies surrounding the payment of indemnity is crucial to prospective biosecurity investment. While not detailed here, monetary impacts of changes in annualized costs, risk reduction, and actions of hog buyers on producer willingness to invest in biosecurity are discussed in this study. Given the relevancy of this research, the fact it summarizes completed work using newly collected primary data and cutting-edge economic methods, and includes a series of corresponding implications makes this study a nice fit with ISESSAH.

Research impact highlights: To further strengthen biosecurity adherence on livestock operations it is important to assess how producers make biosecurity investment decisions. The role of indemnity policies in aligning public and private efforts has not been examined. Utilizing a national survey of U.S. swine producers this study highlights the key role of producer expectation on governmental indemnity policy. Key results include documenting how producers anticipating payments of indemnity to be conditional on biosecurity effort exert more desirable, proactive investment that may reduce industry-wide disease risk and impact. Multiple implications for public and private animal disease mitigation efforts will be provided.

Keywords: biosecurity - indemnity - producer expectations - policy design - investment decisions

An overview of prevention and control policies of infectious diseases in commercial poultry farms in Iran

Mohammad Abdoshah^{a*}, Amir Ali Amiri^b, Farhad Moosakhani^c, Nick Sparks^d, Bouda Vosough Ahmadi^d

^aQuality Control Management, Razi Vaccine and Serum Research Institute, Agricultural Research, Education and Extension Organization (AREEO), Karaj, Iran; ^bMehr Poultry Clinic, Tehran, Iran; ^cIslamic Azad University, Karaj Branch, Karaj, Iran; ^dSRUC, Edinburgh, United Kingdom

^{*}Corresponding author: m.abd081@gmail.com (Mohammad Abdoshah)

Iran has the largest poultry industry in the Middle East,annually producing around 2 million tonnes of meat and 940,000tonnes of egg. These volumes are produced on 19,500 and 1,700 broiler and laying farms respectively. Infectious diseases including AI (H9N2), Respiratory Complex Syndrome and IBD and subsequent secondary infectionscause mortality rates of up to 40% in broiler flocks. In the egg sector,AI (H5N8) could cause both mortality and productivity reduction rates reach to 100%. In addition, in this sector Salmonellosis, Newcastle Disease, Respiratory Complex Syndrome, Mycoplasmosis and IBD cause up to a 60% reduction in productivity. Despite these substantial losses, on-farm and industry-wide prevention and control strategies have not been analytically evaluated and adjusted.

The objectives of this study were three folds:i) to critically analyse the financial burden of the major endemic infectious diseases of commercial poultry farms, ii) to assess the cost-effectiveness of prevention and control measures, and iii) to suggest changes required in these measures. Managerial, epidemiological and financial data were collected from the literature and from 20 participated farms. Extracted data for 2016 were then used in a cost calculator/cost-benefit analysis spreadsheet model.

Results suggest that AI alone could impose an annual loss of \$250 million to the industry. Biosecurity measures such as quarantine, changing cloths and taking shower by farm labour and visitors in broiler farms significantly reduced the mortality rate on average from 18% to 11% and was cost-effective. Results in laying farms show that despite o vaccination programmes, poor implementation was responsible for lack of immunity against viral infectious diseases. In general prevention and control strategies were at their highest on parent broiler farms, moderate/acceptable on broiler farms and poor on laying farms. It was concluded that there is a substantial capacity for improving cost-effective prevention and control strategies at farm and industry levels.

Research impact highlights: We modelled the burden of key endemic infectious diseases and cost-effectiveness of existing prevention and control measures in commercial poultry farms in Iran. It was concluded that there is substantial capacity for improving cost-effective prevention and control strategies at farm and post-farm levels. A coherent, practical and, economically viable plan has to be devised and implemented by the poultry chain players. The involvement of the day-old chick and pullet producers, broiler and laying hen farmers, the insurance sector, retailers and the government (ministry of agriculture and veterinary organisations) is essential in designing and implementing such a comprehensive strategy.

Keywords: Poultry - Infectious diseases - Prevention and control policy - Economics - Iran

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One Health economic evaluation of different policies for controlling Anthrax in Bangladesh: A recommendation to policy makers

Kamrul Islam^{*}

IEDCR, Dhaka, Dhaka

**Corresponding author: kamruldvm13@gmail.com (Kamrul Islam)*

Introduction: Anthrax, an acute highly infectious bacterial zoonotic disease, poses an prominent public health threat and causes enormous socio-economic hammering in the livestock industry in Bangladesh. One of the main challenges is preventing people from slaughtering anthrax- affected animals and selling the meat cheaply, results in localized outbreaks of cutaneous anthrax in people. Hence integrated approach of controlling anthrax in animals is likely to have a major impact in humans.

Materials and methods: An excel-based economic analysis tool has been used to compare a range of policy options for controlling anthrax in humans and animals to identify the most cost-effective approach that could be applied under Bangladesh circumstances. Cost-benefit Analysis (CBA) of 4 anthrax control policy options using an excel-based economic analysis tool (HandEcon) over 10 years, 5% discount rate.

Results and discussion: The options include different combinations of four policies including public awareness in whole country (A/W), cattle & goat vaccination in whole country (V/W), cattle & goat vaccination in anthrax-risk areas (V/AR), public awareness and vaccination in anthrax-risk areas (A/W+V/AR) under the challenging setting faced in Bangladesh. The result depicts policy 1 (A/W) – lowest economic benefits (NPV and B/C) as doesn't reduce disease incidence in animals. Policy 2 (V/W) – highest economic benefits as reduces incidence in animals and humans in whole country, but relatively expensive. Policy 3 (V/AR) – moderate economic benefits and moderate cost per human case and per DALY saved, as only reducing human incidence in high risk areas. Policy 4 (A/W+V/AR) – moderate economic benefits and cost per human case and per DALY saved is lower than policy 2 and policy 3.

Conclusion: National public awareness program and vaccination of ruminants in anthrax-risk areas is recommended as the national policy for controlling anthrax in Bangladesh.

Research impact highlights: The generic economic analysis tool is designed to facilitate economic evaluation of control policies for a range of zoonotic diseases, supporting epidemiologists and policy advisors who do not have an in-depth knowledge of economic analysis to evaluate different disease control policy options.

Keywords: Anthrax - economic policy evaluation - HandEcon - Control policy

The Unhealthy Poultry and Pig Commodity Chains in Northern Vietnam: How Actors Influence Disease Dissemination

Ngoc Mai Hoang^{a*}, Thi Phuong Nguyen^a, Dinh Tien Nguyen^a, Quang Hanh Han^a, Dinh Ton Vu^a, Marisa Peyre^b

^aFaculty of Animal Science, Vietnam National University of Agriculture, Hanoi, Vietnam; ^bASTRE research unit, French Research Center for Agricultural Development (CIRAD), Montpellier, Frace

**Corresponding author: mai.hoangngoc@uq.net.au (Ngoc Mai Hoang)*

Trade in sick poultry and pigs has been observed in Northern Vietnam.^{1,2} Such illegal trade in sick animals, representing an alternative to disease reporting, may adversely affect the dissemination of infectious diseases. The objective of our work was to investigate this practice and understand its degree of organization. Two independent studies on poultry and pigs were carried out between January 2016 and March 2017 in two provinces in Northern Vietnam. Poultry and pig farmers (n=200) and middlemen, traders, slaughterhouse managers, slaughter workers and consumers (n=25) were interviewed using participatory approaches. Information about their practices in dealing with sick animals were collected. A majority of farmers confirmed trading sick poultry or pigs (67%). The sick poultry and pig trading networks turned out to be well organized and structured commodity chains. Farmers were trading sick animals below the market price as a means for rapid carcass disposal and disease management at the farm level. The commodity chains in 'sick' and 'healthy' animals were closely linked, which represents a major risk for the spread of diseases. Moreover, the actors of these unhealthy animal commodity chains influence disease dissemination in significantly dissimilar ways and at different levels. The study highlighted the risk for public health and environmental pollution, linked to sick animal movement and processing under limited biosecurity and safety practices. The economic market forces and negligence of local authorities were also surveyed. The aim of the two studies is to create a point of departure for evaluating the risk of infectious disease dissemination, leading to long-term influences on human health. The studies have confirmed that trading in sick poultry and pigs represents an important alternative to disease reporting for farmers. The rationale behind such practices should be taken into consideration to better inform disease management and control in Vietnam.

Research impact highlights: This study represents the first attempt to understand and characterize decision making among poultry and pig farmers regarding their management of sick animals. It implemented participatory approaches, which is recent in the field of animal health surveillance in Vietnam. It provides an interesting case study on local constraints and practices for improving the animal health surveillance in Vietnam. The study is indispensable and relevant to anticipate imminent epidemic risks within a broad range of livestock towards preventing critical damage to the environment and human health caused by the consumption of unhealthy meat. This remains a critical food safety issue.

Keywords: sick poultry and pigs - commodity chain - disease dissemination - animal diseases – Vietnam

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Economic cost of Lumpy Skin Disease (LSD) outbreaks in three Balkan countries: Albania, Bulgaria and Macedonia (2016-2017)

Jordi Casal^{a, b*}, Alberto Allepuz^{a, b}, Aleksandra Miteva^c, Ledi Pite^d, Blagojco Tabakovsky^e, Dimitar Terzievski^e, Tsvyatko Alexandrov^c, Daniel Beltrán-Alcrudo^f

^aSanitat i Anatomia animals, Universitat Autònoma de Barcelona, Bellaterra, Spain; ^bCReSA, IRTA, Bellaterra, Spain; ^cAnimal Health & Welfare Directorate, Bulgarian Food Safety Agency, Sofia, Bulgaria; ^dEpidemiology and Identification Registration, Ministry of Agriculture and Rural DevelopSector of Epidement, Tirana, Albania; ^eAnimal Health and Animal Welfare, Food and Veterinary Agency of Republic of Macedonia, Skopje, Macedonia; ^fRegional Office for Europe and Central Asia, Food and Agriculture Organization, Budapest, Hungary

**Corresponding author: jordi.casal@uab.cat (Jordi Casal)*

Lumpy skin disease (LSD) is an emerging viral disease that was detected for the first time in the Balkan Peninsula in Greece in 2015. In April 2016, there was a reoccurrence in Greece and the spread of the disease for the first time into Bulgaria, the Former Yugoslav Republic of Macedonia, Serbia, Kosovo, Albania and Montenegro. The veterinary services of the countries responded with different strategies to control the disease, mostly based on mass vaccination campaigns and diverse stamping out approaches. During 2017, the epidemic was mostly controlled except for outbreaks reported in Albania, Greece and Republic of Macedonia.

The study aims to quantify the cost of disease and control measures in three selected Balkan countries, i.e. Albania, Bulgaria and Republic of Macedonia, which were differently affected by the disease, had different animal production structures and implemented different control strategies.

The total cost for the three countries was 20.9 million Euro (EUR 20.9m), mostly incurred in 2016 (EUR 16.6m), when the disease was spreading throughout the Balkan region. In 2017 (data until October), the cost was EUR 4.0m, mainly due to vaccination costs. Bulgaria was the country with the highest total cost at EUR 8.6m, followed by FYROM (EUR 6.7m) and Albania (EUR 5.3m). According to our data, the average cost per affected herd in 2016 was EUR 47, EUR 104 and EUR 245 in Albania, Bulgaria and Republic of Macedonia, respectively.

About 90% of the LSD cost in the three countries was assumed by the government. The cost for the farmers was limited to the direct cost of the disease, the indirect cost related to the loss of opportunity after depopulation and the side effects of the vaccines.

Research impact highlights: Lumpy skin disease (LSD) is an emerging viral disease that has irrupted in Europe and east Asia in the last years The study aims to quantify the cost of disease and control measures in three Balkan countries, which were differently affected by the disease, had different animal production structures and implemented different control strategies. The study contributes to the cost assessment and decision making for the surveillance and control of the LSD and can improve the animal health policy in affected countries.

Keywords: Lumpy skin disease - Economic cost

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A systematic integrative framework to describe comprehensively the Flemish swine health system

Cristina Rojo-Gimeno^{a, b*}, Jeroen Dewulf^b, Dominiek Maes^b, Erwin Wauters^a

^aSocial Sciences Unit, ILVO, Merelbeke, Belgium; ^bDepartment of Reproduction Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium

**Corresponding author: cristina.rojo.gimeno@gmail.com (Cristina Rojo-Gimeno)*

The objective of this study was to unravel the complexity of the swine health system of Flanders (northern part of Belgium) by using a systems thinking approach. To that end, qualitative interviews were held with 33 relevant stakeholders. An hybrid thematic analysis was conducted which consisted of two phases. First, an inductive thematic analysis was conducted and secondly, the resulting themes were classified into the building blocks of a systemic framework. This framework combined a structural and a functional analysis that allowed to identify key actors and their functions. Additionally, a transformational analysis assessed how structures and the entire swine health system enable or disable functions. Findings revealed several merits of the swine health system such as the synchronization of policies and sector's agreements to reduce antimicrobial use and the presence of a rich network of universities that contribute to the education of health professionals. Nevertheless, several systemic failures were observed such as the lack of a good professional body representing the swine veterinarians, the tradition that veterinary advice is provided for 'free' by feed mill companies, and the shortage of reliable farm productivity data. Both last failures may hinder swine practitioners to provide integrative advice. Veterinarians are almost never directly remunerated for advice and their business model is largely based on the sale of medicines. Thus, veterinarians entail often a conflict of interest when advising treatments (e.g. vaccines) and, in turn, farmers distrust their advice. On a positive note, veterinarians and farmers suggested alternatives to the traditional business model which may indicate that there is intention to change, but the broader institutional and socio-cultural environment does not facilitate it. Our findings can aid policy makers to anticipate the effects of proposed interventions and regulations, so that they can be fine-tuned before being enforced.

Research impact highlights: This is the first study using a systems thinking approach to capture the complexity of a swine health system. New insights offered here can aid policy makers to make system-informed decisions and anticipate the effects of proposed interventions on the swine health system, so that they can fine tune their policy decisions before enforcing them. While the findings are specific for Flanders (northern part of Belgium), the integrative research framework can be used by other countries and livestock species. We advocate that future research uses systemic approaches to understand the decisions made by actors influencing animal health.

Keywords: systems thinking - swine health systems - integrative framework - qualitative interviews - policy

Importance of qualitative approaches to adapt control strategy of cystic echinococcosis according to conditions of an endemic region in Morocco

Aouatif Saadi^{a*}, Fatima Amrir^b, Hind Filali^c, Sevrine Thys^d, Nathalie Kirschvink^e, Tanguy Marcotty^e, Mohamed Oukessou^b, Hamid Sahibi^b, Nicolas Antoine-Mousseaux^a

^aFundamental and Applied Research for Animals and Health, University of Liege, Liège, Belgium; ^bDepartment of Pathology and Veterinary Public Health, IAV Hassan II, Rabat, Morocco; ^cNational School of Public Health, Rabat, Morocco; ^dDepartment of Public Health, Institute of Tropical Medicine, Antwerp, Belgium; ^eDepartment of Veterinary Medicine, University of Namur, Namur, Belgium

**Corresponding author: saadi.vet@gmail.com (Aouatif Saadi)*

Cystic echinococcosis (CE) is a parasitic zoonosis caused by Echinococcus granulosus. It causes serious consequences for human health and animal production. CE is highly prevalent in Morocco despite a national control program launched in 2005. This study aims at assessing risk behaviors and perceptions of control measures of CE in order to identify an approach that would take into consideration the socio-cultural conditions of Morocco. To carry out this work, 17 focus groups and 39 individual interviews were conducted in the Mid Atlas region, which shows the highest prevalence of CE in the country. The focus groups consisted of 6 to 14 participants each. They gathered separately the following stakeholders categories: breeders, wholesale butcher, women and schoolchildren. Individual interviews were conducted with veterinarians, doctors, animal health technicians, tripe butchers, patients, associative agents, religious leaders and teachers. We facilitated the discussions using visual tools as proportional piling. Qualitative data were analyzed using R software (RQDA package). The study showed that stakeholders don't consider CE as a priority. Some degree of awareness is present but knowledge of the life cycle of the parasite is lacking and important confusions are noted. Human behaviors play an important role in the persistence of the disease: unsuitable practices around slaughter (at home and slaughterhouses), unhygienic behavior habits, consumption of unwashed wild fruits by children without the knowledge of their parents, and close contacts with mostly non-dewormed dogs. The study collected the viewpoints of the population on the different control measures and their own proposal to improve them. It helped understanding failure factors of control programs in this region. It is important to adapt each control measure according to the conditions of each region and category of population involved. A participatory approach joining civil society and public services is essential for a sustainable control of this zoonosis.

Research impact highlights: Cystic echinococcosis is major zoonosis in Morocco despite the national control program, running since 2005. This study uses qualitative approaches to better understand factors of this persistence and improve the control strategy. It shows the usefulness of social sciences in the building of disease control programs. In many developing countries, indeed, the implementation of foreign methods as blueprints not taking socio-cultural frameworks into account causes control programs to fail. Social sciences should have a more profound role in the co-building of adapted solutions, not only one of allowing for extension of an exogenously defined strategy.

Keywords: Cystic echinococcosis - qualitative approaches - control strategy - Middle Atlas - Morocco

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Saving Our Bacon without Hamstringing the Industry: FMD Free Status Recovery after a Simulated Outbreak in the US with Emergency Vaccination

Amy Hagerman^{a*}, Kamina Johnson^a, Ann Hillberg Seitzinger^a, Stephanie Shwiff^b

^aCenter for Epidemiology and Animal Health, USDA-APHIS-VS, Fort Collins, United States; ^bNational Wildlife Research Center, USDA-APHIS-WS, Fort Collins, United States

**Corresponding author: amy.d.hagerman@aphis.usda.gov (Amy Hagerman)*

The inclusion of emergency vaccination in a US Foot-and-mouth disease (FMD) eradication program has both epidemiologic and economic consequences. Emergency vaccination has the potential to confine virus spread to a smaller region, reduce shedding and thereby reduce the number of infected animals and shorten the duration of an outbreak. FMD vaccination also has the potential, among other factors, to delay the re-opening of international markets, particularly if vaccinates live out their productive life before being harvested—vaccinate to retain—or are harvested for consumption—vaccinate to salvage. Both cases may introduce additional costs of post-outbreak management of vaccinated animals compared to their depopulation.

This study estimates the costs of post-outbreak surveillance and management of vaccinated animals under vaccinate to retain and vaccinate to salvage scenarios including tracking, companion diagnostic testing for herds that have been vaccinated, and the price and trade impacts of the timing of marketing vaccinated animals. Initial economic results across a series of simulated US FMD outbreaks using InterSpread Plus indicate that vaccination potentially reduces on-farm response costs, job losses and GDP losses during the outbreak year. Vaccination also has the potential to reduce negative market impacts 5 years post-outbreak. Ongoing research further breaks down the results in the post-outbreak period to closely examine the impact of alternative management of vaccinated animals.

The results of this study would inform governments, companies, and labs of how much diagnostic testing for vaccinated animals could cost and the benefits of such testing as well as the demand for diagnostics during the disease recovery effort. This study is part of a larger body of work with the objective to derive inference on the consequences of emergency vaccine use for FMD control using multiple measures of economic impact in the post-outbreak period for vaccinate to retain and vaccinate to salvage scenarios.

Research impact highlights: This topic emphasizes implementation of post-outbreak surveillance including initial adoption of a companion diagnostic tool to FMD vaccine in a country that has been historically free of FMD. Veterinary science is focused on the eradication of the disease where our role in economics and social sciences is to provide information on the wider impacts of response programs such as vaccination, so that industry's viability is not unduly impacted. We believe this presentation will be of interest to attendees representing industry, academia and government.

Keywords: Economics - Foot and Mouth Disease - Vaccination - Markets - Post-Outbreak Recovery

An economic perspective of brucellosis control in a high prevalence setting in Mato Grosso, Brazil

Vitor Goncalves^{a*}, Janice Barddal^b, Marcelo Barros^c, Jociane Quixabeira^c, Risia Negreiros^c, Barbara Rosa^d, Ronaldo Teixeira^d, Jaime Romero^e

^aFAV, University of Brasilia, Brasilia, Brasil; ^bSFA-MT-MAPA, Cuiaba, Brasil; ^cINDEA, Cuiaba, Brasil; ^dDSA-SDA-MAPA, Brasilia, Brasil; ^eIICA, Lima, Peru

**Corresponding author: vitorspg@unb.br (Vitor Goncalves)*

Mato Grosso (MT) is a large state in the Midwest of Brazil, with a cattle population of about 30 million, predominantly of extensive beef cattle production systems. The brucellosis control programme was implemented in the state in 2003, after a study revealed that herd prevalence was 41.2% and animal prevalence was 10.2%. Since then, compulsory vaccination of heifers with S19, restrictions on animal movement and slaughtering of test-positive animals, contributed to reduce herd prevalence to 24% and animal prevalence to 5.1%, according to a new study conducted in 2014. The present study aimed at estimating the costs and benefits of brucellosis control in MT over that period, as well as gaining insights into the spread of investments and returns over time, from a societal perspective, including the public and the private sectors.

We conducted a cost-benefit analysis over 12 years and used a mathematical model to predict the annual change of prevalence. We considered losses such as abortions, mortality and replacement of slaughtered cows and costs of vaccination, diagnostic tests, as well as the public investment of the state veterinary service – INDEA. The benefits were calculated from 2007 onwards, as it would have taken some years to see a real impact of disease control measures. We considered the reduction of perinatal mortality, of cow replacement rate and mortality, as well as the gain in milk production. Preliminary results revealed a NPV of R\$ 117,143,999 and a BCR of 1.69, confirming that the investment was worthwhile, even if the public health and potential favorable trade impact have not been considered. These results show that brucellosis control yields major economic gains for society at high levels of disease prevalence and the model provides a basis for planning future interventions to further reduce disease prevalence.

Research impact highlights: We conducted a cost-benefit analysis over 12 years and used a mathematical model, coupled with cross-sectional studies, to predict the annual change of prevalence. We demonstrated that brucellosis control yields major economic gains for society at high levels of disease prevalence and for a state with a large population of cattle The model provides a basis for planning future interventions to further reduce disease prevalence and brings insights into the critical issues that have to be considered from an economic perspective. We discuss the public and private investments in disease control and how they contribute to society costs and benefits.

Keywords: Brucellosis - Cost-benefit Analysis - Mato Grosso - public and private investment

Evaluation of strategies and measures to control Highly Pathogenic Avian Influenza H5N1 in Indonesia

Muchammad Gumilang Pramuwidyatama^{a*}, Helmut Saatkamp^a, Henk Hogeveen^{a, b}

^aBusiness Economics Group, Wageningen University and Research, Wageningen, Netherlands; ^bFarm Animal Health, Utrecht University, Utrecht, Netherlands

^{*}Corresponding author: muchammad.gumilang@wur.nl (Muchammad Gumilang Pramuwidyatama)

In the past years, many different measures to control HPAI H5N1 in Indonesia have been applied. However, the effectivity of these measures has never been systematically evaluated. Our study objectives are to (1) establish an inventory of measures on HPAI H5N1 control in Indonesia since the first outbreak in 2004 and (2) review and evaluate HPAI H5N1 control measures applied in Indonesia at a strategic and tactical level.

Steps in this study were (1) inventorize and describe of the development of HPAI H5N1 and measures in Indonesia, (2) development of an HPAI H5N1 disease management framework (Longworth and Saatkamp, 2006) for an endemic situation, and (3) review and systematic evaluate strategies and measures on HPAI H5N1 disease management.

In our literature review, the number of the reported outbreak in livestock and human has declined over the past years. In addition, the study systematically evaluated in total 36 measures. The framework helps to evaluate and establish a strategic decision-making regarding appropriate strategy with its sets of measures aimed at different events of disease and disease status in a population. In our framework, we defined the following strategies: prevention, monitoring, control, mitigation, and human protection. For the Indonesian situation, the mitigation strategy was seen as the priority strategy for many cities or regencies. The aim of the mitigation strategy is to reduce the prevalence of the virus to a level where eradication measures will be feasible. A mitigation strategy consists of a mix of prevention, monitoring, and control measures. The priority measures could be monitoring and surveillance, vaccination, selective depopulation, and biosecurity. In a next step, research on the motivation of farmers to implement different measures in combination with an evaluation of the expected impact of different measures within the mitigation strategy is needed to determine an effective and efficient mitigation approach.

Research impact highlights: Highly pathogenic avian influence (HPAI) H5N1 is endemic in Indonesia. Mitigation and, eradication of HPAI requires a long-term commitment of all stakeholders. Our study aimed at a systematic evaluation of applied control measures in Indonesia in the past years. This study links to the theme of economics in animal health policy making. The evaluation is carried out based upon an adapted AI disease management framework (Longworth and Saatkamp, 2006) and will lead to a prioritization of control measures and the associated allocation of financial resources specifically for the HPAI situation in Indonesia.

Keywords: Avian Influenza - endemic - policy - strategy - control measures

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ABDOSHAH Mohammad Razi Vaccine and Serum Research Institute KARAJ - IRAN m.abd081@gmail.com

ADLER Friedemann University of Veterinary Medicine Hannover HANNOVER - GERMANY friedemann.adler@tiho-hannover.de

AENISHAENSLIN Cécile McGill University MONTREAL - CANADA cecile.aenishaenslin@mail.mcgill.ca

AFONSO João University of Liverpool COIMBRA - PORTUGAL jafonso@liverpool.ac.uk

ALEXANDER Peter The University of Sydney BEGA - AUSTRALIA petera@begacobargovet.com

ALLEPUZ Alberto Autonomous University of Barcelona BARCELONA - SPAIN alberto.allepuz@uab.cat

ANTOINE-MOUSSIAUX Nicolas University of Liège LIÈGE - BELGIUM nantoine@uliege.be

ASADUZZAMAN Muhammad ICDDRB DHAKA - BANGLADESH asaduzzaman@icddrb.org

ASOYAN Vigen Nork Infection Diseases Hospital YEREVAN - ARMENIA vigenasoyan@yahoo.com

BAGNOL Brigitte The University of Sydney AVIGNON - FRANCE bagnolbrigitte@gmail.com

BALDET Thierry UMR Astre Cirad-Inra MONTPELLIER - FRANCE thierry.baldet@cirad.fr

BARNETT Tony LSHTM LONDON - UK tony.barnett@lshtm.ac.uk

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BARRATT Alyson SRUC EDINBURGH - UK alyson.barratt@sruc.ac.uk

BEAUGRAND Florence UMR BioEpAR - Inra - ONIRIS NANTES - FRANCE florence.beaugrand@oniris-nantes.fr

BELLET Camille Institute of Infection and Global Health LIVERPOOL - UK camille.bellet@liverpool.ac.uk

BEN AICHA Elhem National Center of Zoosanitary vigilance TUNIS - TUNISIA benaichae@yahoo.fr

BINOT Aurélie Cirad MONTPELLIER - FRANCE binot@cirad.fr

BOIREAU Clémence Anses LYON - FRANCE clemence.boireau@anses.fr

BONNET Pascal Cirad MONTPELLIER - FRANCE pascal.bonnet@cirad.fr

BORDIER Marion Cirad HANOI - VIETNAM marion.bordier@cirad.fr

BUCINI Gabriela University of Vermont BURLINGTON - USA gbucini@uvm.edu

CANALI Massimo University of Bologna FORLI - ITALY massimo.canali2@unibo.it

CASAL Jordi Universitat Autónoma de Barcelona BELLATERRA - SPAIN jordi.casal@uab.cat

CASSINI Rudi University of Padova LEGNARO - ITALY rudi.cassini@unipd.it **CHAVEZ PACHECO Xyomara**

APHP - URC Eco - Association Robert Debré PARIS - FRANCE xyomara.chavez@urc-eco.fr

CHENAIS Erika National Veterinary Institute UPPSALA - SWEDEN erika.chenais@sva.se

CHRISTLEY Robert University of Liverpool NESTON - UK robc@liverpool.ac.uk

CIARAVINO Giovanna Universitat Autónoma de Barcelona BELLATERRA - SPAIN giovanna.ciaravino@uab.cat

COYNE Lucy University of Liverpool NESTON - UK I.a.coyne@liverpool.ac.uk

DANELYAN Hrant Republican Veterinary Laboratory YEREVAN - ARMENIA danelyanh@mail.ru

DAVIDYANTS Mher Yerevan State Medical University YEREVAN - ARMENIA davidyants@gmail.com

DEL RIO VILAS Victor Javier University of Surrey GUILDFORD - UK vdelriovilas@yahoo.co.uk

DELABOUGLISE Alexis Pennsylvania State University UNIVERSITY PARK - USA aud334@psu.edu

DEME Isabelle IRD MONTPELLIER - FRANCE isabelle.deme@ird.fr

DICKS Mike AEConsulting, LLC ARVADA, CO - USA aecnslt@gmail.com

DUBOZ Raphaël Institut Pasteur du Cambodge PHNOM PENH - CAMBODIA rduboz@pasteur-kh.org ENTICOTT Gareth Cardiff University CARDIFF - UK enticottg@cardiff.ac.uk

FALZON Laura University of Liverpool LIVERPOOL - UK laura.falzon@liverpool.ac.uk

FERCHIOU Ahmed École Nationale Vétérinaire TOULOUSE - FRANCE ferchiouahmed@gmail.com

FORTANÉ Nicolas Inra PARIS - FRANCE nicolas.fortane@inra.fr

FURZE Brian Charles Sturt University ALBURY - AUSTRALIA bfurze@csu.edu.au

GARKAVENKO Tetiana State Scientific and Research Institute KYIV - UKRAINE tag77@i.ua

GBADEGESIN Peter Olutayo University of Ibadan IBADAN - NIGERIA simeonolowe@gmail.com

GETHMANN Jörn Friedrich-Loeffler-Institut GREIFSWALD - GERMANY joern.gethmann@fli.de

GILBERT William University of Liverpool LIVERPOOL - UK w.gilbert@liverpool.ac.uk

GÓMEZ-BAGGETHUN Erik Norwegian University of Life Sciences ÅS - NORWAY erik.gomez@nmbu.no

GONCALVES Vitor University of Brasilia BRASILIA - BRAZIL vitorspg@unb.br

GOUTARD Flavie Luce Cirad MONTPELLIER - FRANCE goutard@cirad.fr GROSBOIS Vladimir Cirad MONTPELLIER - FRANCE vladimir.grosbois@cirad.fr

GUNN George SRUC INVERNESS - UK jane.brennan@sruc.ac.uk

HAESLER Barbara Royal Veterinary College HATFIELD - UK bhaesler@rvc.ac.uk

HIDAYAT Andi Kementerian Pertanian Republik Indonesia JAKARTA - INDONESIA mm.hidayat@pertanian.go.id

HOANG NGOC Mai Vietnam National University of Agriculture HANOI - VIETNAM mai.hoangngoc@uq.net.au

HØG Erling London School of Hygiene & Tropical Medicine LONDON - UK erling.hoeg@lshtm.ac.uk

HOGEVEEN Henk Wageningen UR WAGENINGEN - THE NETHERLANDS henk.hogeveen@wur.nl

ILUKOR John World Bank Uganda KAMPALA - UGANDA john.ilukor@gmail.com

INDRAWAN Dikky Wageningen University and Research WAGENINGEN - THE NETHERLANDS dikky.indrawan@wur.nl

INES Ayari Institut National Agronomique de Tunisie TUNIS - TUNISIA ines.ayari555@gmail.com

JAIME Gloria Cirad MONTPELLIER - FRANCE gloria.jaime@cirad.fr JANI Vjola Institute of Public Health TIRANA - ALBANIA janiviola99@hotmail.com

JOHNSON Kamina USDA - APHIS FORT COLLINS, CO - USA kamina.k.johnson@aphis.usda.gov

JOSSERAN Loïc Université de Versailles - APHP PARIS - FRANCE loic.josseran@aphp.fr

KHADKA Ganga United Spring Water and Mineral Resources KATHMANDU - NEPAL gangakhadka765@gmail.com

KHOUNSY Syseng Ministry of Agriculture and Forestry SIKHOTTHABONG - LAOS s.khounsy@gmail.com

KNIFIC Tanja Veterinary Faculty of the University LJUBLJANA - SLOVENIA tanja.knific@vf.uni-lj.si

LAMIELLE Gael Food and Agriculture Organization of the UN ROME - ITALY gael.lamielle@fao.org

LÉGER Anaïs SAFOSO AG LIEBEFELD - SWITZERLAND anais.leger@safoso.ch

LHERMIE Guillaume Cornell University ITHACA - USA gl467@cornell.edu

LINDBERG Ann National Veterinary Institute UPPSALA - SWEDEN ann.lindberg@sva.se

LUDWIG Antoinette Public Health Agency of Canada SAINT-HYACINTHE (QB) - CANADA antoinette.ludwig@canada.ca

LWAPA EMBELE ISENGE Francis University of Liège LIÈGE - BELGIUM eilwapa@doct.uliege.be MANOLI Claire Goupe ESA ANGERS - FRANCE c.manoli@groupe-esa.com

MARKOSYAN Tigran Scientific Centre for RAA in Food Safety YEREVAN - ARMENIA tigran79hm@yandex.ru

MARSH Thomas Washington State Unversity PULLMAN, WA - USA tl_marsh@wsu.edu

MELIKYAN Artur State Service for Food Safety of the Ministr YEREVAN - ARMENIA artmelikyan@mail.ru

MERGENTHALER Marcus Southwestfalia University of Applied Science SOEST - GERMANY mergenthaler.marcus@fh-swf.de

MINVIEL Jean Joseph Inra - ENVT TOULOUSE - FRANCE j.minviel@envt.fr

MITCHELL Andrew Animal & Plant Health Agency NEW HAW - UK andrew.mitchell@apha.gsi.gov.uk

MLALA Sofia Anses - Laboratoire de Lyon LYON - FRANCE sofia.mlala@anses.fr

MOEGENBURG Susan University of Vermont BURLINGTON, VT - USA susan.moegenburg@uvm.edu

MOLIA Sophie Cirad MONTPELLIER - FRANCE sophie.molia@cirad.fr

MOYA DURÁN Sebastián Jesús Universitat Autónoma de Barcelona BELLATERRA - SPAIN jesus.duran.taa@gmail.com

NAMPANYA Sonevilay The University of Sydney CAMDEN - AUSTRALIA sonevilay@yahoo.co.uk

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NAPOLÉON Véronique Cirad MONTPELLIER - FRANCE veronique.napoleon@cirad.fr

NGUYEN THI Dien Vietnam National University of Agriculture HANOI - VIETNAM ntdien@vnua.edu.vn

NIAZYAN Lyudmila CH2M Armeina branch office YEREVAN - ARMENIA lyudmila.niazyan@ch2m.com

NIELSEN Liza Rosenbaum University of Copenhagen FREDERIKSBERG C - DENMARK liza@sund.ku.dk

NIEMI Jarkko Natural Resources Institute Finland (Luke) SEINÄJOKI - FINLAND jarkko.niemi@luke.fi

NIJS Hanne University of Warwick COVENTRY - UK h.nijs@warwick.ac.uk

OSEGUERA MONTIEL David Universidad Autónoma de Yucatán MÉRIDA - MEXICO oseguera.david@gmail.com

PALCZYNSKI Laura Harper Adams University NEWPORT - UK Ipalczynski@harper-adams.ac.uk

PASTOR Alfonso Zamora National Center for Animal and Plant Health SAN JOSE LAJAS - CUBA pastor.alfonso@infomed.sld.cu

PATTAMAKAEW Sakulrat PODD Project CHIANG MAI - THAILAND sakulrat035@hotmail.com

PECK Dannele USDA-ARS - PA - RRSRU FORT COLLINS, CO - USA dannele.peck@ars.usda.gov

PEDERSEN Lars SEGES Dairy & Beef Research Centre AARHUS - DENMARK larp@seges.dk PENDELL Dustin

Kansas State University MANHATTAN, NY - USA dpendell@ksu.edu

PEREIRA DOS SANTOS Taissa MIVEGEC - IRD MONTPELLIER - FRANCE taissa.pereira-dos-santos@ird.fr

PEYRE Marisa Cirad MONTPELLIER - FRANCE marisa.peyre@cirad.fr

PRAMUWIDYATAMA Muchammad Gumilang Wageningen University & Research WAGENINGEN - THE NETHERLANDS muchammad.gumilang@wur.nl

PUCKEN Valerie-Beau Vetsuisse Faculty - University of Bern BERN - SWITZERLAND valerie.pucken@vetsuisse.unibe.ch

PUDENZ Christopher Iowa State University AMES - USA ccpudenz@iastate.edu

PUTTHANA Vannaphone Faculty of Agriculture - NUOL XAYTHANY - LAOS v.phouthana@nuol.edu.la

RABOISSON Didier ENVT - Inra TOULOUSE - FRANCE d.raboisson@envt.fr

RAULT Arnaud Inra NANTES - FRANCE arnaud.rault@inra.fr

RAUT Bishal Sustainable Agriculture Development Program POKHARA - NEPAL bishalraut832@gmail.com

REES Gwen University of Bristol LANGFORD - UK gwen.rees@bristol.ac.uk RENTER David Kansas State University MANHATTAN, NY - USA drenter@vet.ksu.edu

RICH Karl ILRI HANOI - VIETNAM k.rich@cgiar.org

ROGER Francois Cirad MONTPELLIER - FRANCE francois.roger@cirad.fr

RÜEGG Simon University of Zurich ZURICH - SWITZERLAND srueegg@vetclinics.uzh.ch

RUSHTON Jonathan University of Liverpool LIVERPOOL - UK j.rushton@liverpool.ac.uk

SAADI Aouatif Université de Liège LIÈGE - BELGIUM aouatif.saadi@doct.uliege.be

SARTORE Sabrina Istituto Zooprofilattico Sperimentale Venezie LEGNARO - ITALY ssartore@izsvenezie.it

SCARAMOZZINO Paola Istituto Zooprofilattico Sperimentale ROME - ITALY paola.scaramozzino@izsłt.it

SCHELLING Esther Swiss Tropical and Public Health Institute BASEL - SWITZERLAND esther.schelling@swisstph.ch

SHRESTHA Subi Mana Sarobar Nepal KATHMANDU - NEPAL subi.shrestha@yahoo.com SINGH CHAUHAN Abhimanyu Université de Liège LIEGE - BELGIUM aschauhan@student.uliege.be

STERNBERG LEWERIN Susanna Swedish University of Agricultural Sciences UPPSALA - SWEDEN susanna.sternberg-lewerin@slu.se

TABUE NGOMDJUM Raymond PNLP-Cameroon YAOUNDÉ - CAMEROON tnraymon@yahoo.fr

TAST LAHTI Elina National Veterinary Institute UPPSALA - SWEDEN elina.lahti@sva.se

THOMAS Lian University of Liverpool LIVERPOOL - UK lian.thomas@liverpool.ac.uk

TONSOR Glynn Kansas State University MANHATTAN, KS - USA gtonsor@ksu.edu

TOROSYAN Liana National Center of Diseases control and prev YEREVAN - ARMENIA liana_torosyan@mail.ru

TREICH Nicolas Inra TOULOUSE - FRANCE ntreich@inra.fr

VAN SCHAIK Gerdien GD Animal Health DEVENTER - THE NETHERLANDS g.v.schaik@gdanimalhealth.com **VAN VLAENDEREN IIse**

Chess In Health BONHEIDEN - BELGIUM ivanvlaenderen@chessinhealth.com

VILLARD Pierre Anses LYON - FRANCE pierre.villard@anses.fr

VOSOUGH AHMADI Bouda SRUC EDINBURGH - UK bouda.v.ahmadi@sruc.ac.uk

VU TIEN VIET Dung OUCRU Hanoi HANOI - VIETNAM dungvtv@oucru.org

WAUTERS Erwin Flanders research institute for agriculture, fisheries and food MERELBEKE - BELGIUM erwin.wauters@ilvo.vlaanderen.be

WINDSOR Peter The University of Sydney CAMDEN - AUSTRALIA peter.windsor@sydney.edu.au

YUE Xiaomei Wageningen University and Research WAGENINGEN - THE NETHERLANDS xiaomei.yue@wur.nl

YUSUF Havan Airlangga University SURABAYA - INDONESIA havanyusuf@yahoo.com

ZAHRO Aisyah Faculty of Veterinary Medicine SURABAYA - INDONESIA zahroaisyah95@gmail.com

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