ISESSAH 2020 CONFERENCE

Local Organiser: University of Copenhagen (UCPH), Denmark

ISESSAH

International Society for Economics
and Social Sciences of Animal Health

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Welcome Message

We want to welcome you to the fourth conference of the International Society for Economics and Social Sciences of Animal Health (ISESSAH). The conference was originally planned to be held in Copenhagen in May of 2020 in association with the International Conference on Animal Health Surveillance (ICAHS). Due to the COVID-19 pandemic our conference was first postponed to November, and ultimately it became necessary for us to meet virtually. We want to thank you for your patience with these changes and we are pleased that so many people have joined the conference.

These are challenging times from a disease perspective with a growing awareness of the need for more careful investments in the management of the health and welfare of the animals our societies depend on. There has never been a more urgent need for us to work on rational allocation of resources for animal health surveillance, prevention and control measures, and to understand the behaviour of people working and depending in the livestock sectors across the world. Furthermore, the conference turned out to be held in the midst of the largest crisis ever for animal production in Denmark with millions of mink being euthanised to protect public health against a mutated variant of COVID-19. This challenging situation highlights the need for collaboration across different scientific disciplines including economics and social sciences. The fourth ISESSAH conference demonstrates that we are working hard to support animal health systems with careful economic and social science analysis.

We look forward to hearing the talks, viewing the posters and listening to the discussions. In the process ISESSAH will continue to strive to make a contribution towards a safer world.

Jonathan Rushton   Liza Rosenbaum Nielsen
President of ISESSAH   Chair of the Local Organisers
University of Liverpool   University of Copenhagen

Programme

Wednesday 11ᵗʰ of November 2020

At Zoom: https://ucph-ku.zoom.us/j/68136927422
- please join 10 minutes before start

The meeting will run on a professional UCPH Zoom account, which is protected by the agreement DeiC (Danish e-Infrastructure Cooperation) has with Zoom. This provides data protection according to European standards.

All times are Central European Time (CET) = GMT+1 hour after daylight savings end.

13:00	**Opening of ISESSAH by President of ISESSAH Jonathan Rushton** (session chair)	
13:15	Barbara Häsler	Keynote presentation: Unlocking the value of animal health surveillance
13:45	Britt Bang Jensen	Case study: What have we gained from two years of screening all marine farms for salmonid alphavirus?
14:00	Sebastian Moya	Communication between veterinarians and dairy farmers around biosecurity measures on dairy cattle farms
14:15	*Break for 15 minutes*	
	Session chair: Carola Sauter-Louis	
14:30	Shankar Yadav	Evaluation of the impacts of "time to detection" of a foot-and-mouth disease incursion in Central Europe using EuFMDiS modelling tool
14:45	Tove Christensen	Economic incentives in the Danish Salmonella surveillance of the pig production
15:00	Polly Compston	Understanding what shapes disease control: the history of foot and mouth disease in Kenya
15:15	Ben Huntington	The global burden of animal disease
15:30	*Break for 10 minutes*	
15:40	**ISESSAH AGM ~1 hour**	

Thursday 12th of November 2020

At Zoom: https://ucph-ku.zoom.us/j/68511270309

- please join 10 minutes before start

All times are Central European Time (CET) = GMT+1 hour after daylight savings end.

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13:00	**Welcome by Henk Hogeveen** (session chair)	
13:05	Luiza Toma	Keynote presentation: "Reconciling health, welfare and the environment. Economics of surveillance and beyond"
13:35	Henning Otte Hansen	Market price response to African swine fewer outbreaks
13:50	Nico Urner	Hunting for Answers: A Participatory Approach on Measures against African swine fever in Wild Boar in Estonia
14:05	*Break for 15 minutes*	
	Session chair: Didier Raboisson	
14:20	Dagim Belay	Input control and farmers' economic performance: Evidence from the Danish yellow card antibiotic regulation
14:35	Hassaan B. Aslam	Economic impact of endemic low pathogenic H9N2 avian influenza virus in commercial broiler and layer production systems in Pakistan
14:50	Camilla Strang	Antibiotic usage in the GB dairy industry: improving data capture and exploring drivers
15:05	*Break for 10 minutes*	
	Session chair: Bouda Vosough Ahmadi	
15:15	Marit Biesheuvel	Human behaviour and infectious disease modelling: review, gaps and recommendations in the context of cattle diseases
15:30	Tim Capon	Modelling animal disease control and post-outbreak management to improve outbreak response policies
15:45	Margret Krieger	Stakeholders' view on policy options to reduce production diseases on organic dairy farms
16:00	End of the day	

Friday 13th of November 2020

At Zoom: https://ucph-ku.zoom.us/j/63652339279

- please join 10 minutes before start

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All times are Central European Time (CET) = GMT+1 hour after daylight savings end.

13:00	**Welcome by chair George Gunn**	
13:05	Wilma Steeneveld	An empirical analysis on the longevity of dairy cows and the economic performance of herds
13:20	Caroline Ritter	Canadian dairy farmers' perspectives on the future of dairy farms
13:35	Peter Windsor	Can a non-antimicrobial therapy for FMD improve disease surveillance and socioeconomics of disease mitigation by smallholder farmers?
13:50	Cecilie Sviland Walde	Bioeconomic evaluation of different treatment strategy against sealice in Norway
14:05	*Break for 15 minutes*	
	Chair Dustin Pendell	
14:20	Amy Hagerman	Keynote presentation: "Invisible Prices: Livestock Valuation Complexities and Animal Health"
14:50	Christopher Prudenz	Adoption of Secure Beef Supply Plan Biosecurity by U.S. Cow-Calf and Feedlot Producers
15:05	*Break for 10 minutes*	
	Chair Dustin Pendell	
15:15	Ikram Abdouttalib	Estimating veterinary time required to perform veterinary acts in routine using regression analysis
15:30	Norhariani Mohd Nor	Estimation of costs due to Vibriosis in marine cage culture of Asian Sea bass using stochastic model
15:45	Andrea Apolloni	PPR control in a Sahelian Setting: what vaccination strategy for Mauritania?
16:00	**Closing and goodbye President of ISESSAH Jonathan Rushton**	

Keynote Speakers

Barbara Häsler – *"Unlocking the value of animal health surveillance"*

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Dr Barbara Häsler is a Senior Lecturer in Agrihealth at the Royal Veterinary College (RVC) and the London Centre for Integrative Research on Agriculture and Health. She is a veterinary researcher with expertise in livestock and fish food systems, economics applied to animal health / One Health, and evaluation. Her research focuses on livestock and fish food system change and the implications of such change in terms of foodborne and zoonotic diseases, food and nutrition security, animal health, and sustainability. She is interested in transdisciplinary approaches to understand relevant dynamics in these complex systems and to identify systemic solutions. Since 2008, she has been working on various projects on theoretical and practical approaches for the (economic) evaluation of animal health and One Health surveillance. Her quest to further understanding of the value of surveillance and improved resource allocation for surveillance has resulted in various peer-reviewed publications and book chapters. She is currently leading and contributing to projects on evaluation approaches for surveillance of antimicrobial use and resistance from a One Health perspective, as well as projects to evaluate animal health surveillance. For the future, she hopes to deepen the integration of food system and surveillance knowledge.

Unlocking the value of animal health surveillance

Health surveillance is defined for the purpose of this talk as a process encompassing the systematic, continuous collection, collation, analysis, interpretation, and dissemination of health-related data, from defined human or animal populations or the environment, to inform decisions when managing the health of people, animals or ecosystems. The value at stake is the health and well-being of humans, animals and nature. In One Health surveillance, all values need to be considered simultaneously in a transdisciplinary perspective that connects across domains. Surveillance objectives commonly include case finding, measuring the magnitude and distribution of disease, detecting health problems (early), characterising disease and disease agents, monitoring changes in health behaviours and risk factors, assessing the effectiveness of interventions, and demonstrating disease

freedom (in animal populations). This talk explores questions on what and who surveillance is for, what its value is, how this value can be realised and for whom.

Surveillance information helps people to improve health decisions by providing evidence, thereby reducing uncertainty and allowing a broader set of outcomes to be considered. The value of surveillance is stored in the information it produces and is realised when the information is used to generate knowledge that is factored into decisions. This realisation of value in the most straightforward cases follows a rationalised process of identifying a problem, collecting information, and taking action that avoids, reduces or eliminates disease in populations. In animal health surveillance, the resulting health benefits have been shown to outweigh the costs of early warning surveillance for highly contagious diseases such as foot and mouth disease or avian influenza (in populations that are free of the disease). Similarly, there is a recognised case for surveillance of many trade-relevant diseases as well as major zoonoses. For other hazards, the realisation of value is more complex and may be subject to temporal delays, cross-sectoral exchange, decentralised use and individual adjustment of behaviour. Ideally, surveillance information allows people such as farmers, veterinarians or the general public to generate or improve knowledge and understanding and adapt health management decisions.

However, there is considerable inequity in how surveillance information is shared. Disconnects exist between sectors, public and private institutions, as well as those delivering data and those generating and using the information. In many countries, regulatory frameworks define the chain of command from population representing units (e.g. housholds, farms) to healthcare units and authorities and – where applicable - reporting to international institutions. Governments generally have the responsibility for these systems and implement decisions for the benefits of defined populations. Effective feedback and information sharing processes to those delivering raw data for surveillance could realise value at the household or farm level through improved knowledge. However, equitable sharing of information and associated benefits is complex. A transdisciplinary approach that engages and connects the providers and interpreters of data, the users of information, and the beneficiaries may be a way forward. For surveillance information to become a public good and realise values in multiple forms, a sound surveillance infrastructure needs to be combined with participation, knowledge demands, conceptualisation of pluralistic value expectations, understanding of how surveillance information can and is used, surveillance quality requirements, standardisation and effective sharing processes. Examples are discussed to illustrate opportunities for a wider realisation of surveillance value in multifaceted theories of change.

Luiza Toma – *"Reconciling health, welfare and the environment. Economics of surveillance and beyond"*

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Luiza Toma studied statistics and economic forecasting at the Bucharest University of Economic Studies. Following a period of research with the Institute of Agricultural Economics of the Romanian Academy, and consultancy with the World Bank, European Commission, FAO and OECD, she went on to doctoral research on international trade and environment at the Katholieke Universiteit Leuven. Since joining Scotland's Rural College in 2005, she has been applying micro and macroeconomic modelling to animal health and welfare, food waste, environmental efficiency, and technological uptake in over 30 research projects, with findings published in more than 40 refereed journal articles. She is also involved in (mostly postgraduate) teaching and supervision at SRUC and the University of Edinburgh.

Reconciling health, welfare and the environment. Economics of surveillance and beyond

As a tool to forecast risk of disease occurrence, progression and transmission, to demonstrate absence or presence of disease, to monitor disease trends, and to facilitate disease control, the role of animal health surveillance has evolved into a key element of the disease prevention and mitigation agenda.

Just as animal health will have implications for animal welfare, food safety, human health, and the environment, animal health surveillance unsurprisingly transcends into the contiguous fields of food safety, public health and environmental monitoring. Traditionally, there has been a comfortable delimitation between the regulatory and institutional structures underpinning each of these areas, reflected in both policy and research. More recently, however, these boundaries have begun to fade following an universal acknowledgment of their togetherness originating from a sequence of conjoint causalities and resulting in accumulated impact. The transition is echoed in global initiatives such as the One Health agenda and the Sustainable Development Goals, and is being gradually assimilated into national programmes of animal health surveillance.

We discuss whether this pattern of evolution may be substantiated not only by economic arguments, as it is more efficient and effective to tackle concurrently systemic factors, but advocated at different levels encompassing animal and environmental ethics, food culture

and human health, institutional and policy collaborative design, and interdisciplinary research. The discussion touches upon the relationship between traditional cost benefit centered animal health economics and behavioural aspects of macroeconomics, punctuated with examples of research bridging animal health, welfare and the environment.

Amy Hagerman - *"Invisible Prices: Livestock Valuation Complexities and Animal Health"*

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Amy D. Hagerman is an Assistant Professor in the Department of Agricultural Economics at Oklahoma State University working on issues related to Agriculture and Food Policy. Dr. Hagerman completed a Bachelor of Science (2004) in Agricultural Economics at Oklahoma State University, and a Master of Science (2005) and a Doctorate of Philosophy (2009) in Agricultural Economics at Texas A&M University. Dr. Hagerman also completed a post-doctoral program at Texas A&M University using applications of mathematical programming to assess economic impacts of foreign animal disease incursions. Prior to joining Oklahoma State University in June, 2018, Dr. Hagerman spent 7 years with the United States Department of Agriculture working on economic consequence assessments of livestock policies on US agricultural industries, first with the Economic Research Service in Washington, DC, and most recently with Animal and Plant Health Inspection Service in Fort Collins, CO. Dr. Hagerman focuses her integrated extension and research program on the understanding and management of the risks of agriculture, including animal health, extreme weather, and market fluctuations.

Invisible Prices: Livestock Valuation Complexities and Animal Health

Economic analysis remains a crucial component in science-based animal health policy making. The inclusion of a thoughtful livestock value component has the potential to support effective, timely action by producers. Livestock valuation can pose a challenge to the analyst since value is fluid, varying considerably with time, space, purpose, and animal characteristics. Further, even in a 'big data' world the prices needed to estimate livestock values is becoming more privatized or scarce (e.g. thin data). Historically, we have relied on public market datasets and sometimes on the purchase of privately collected data. This works well for market ready animals or replacement animals. However, when livestock must be valued at a life stage where a change in ownership is uncommon, other valuation methods may be necessary. The nature of an animal health event may also disrupt livestock supply chains (e.g. movement restrictions and quarantines). This limits market price discovery and adds additional shades of difficulty to the valuation process. This presentation will focus on a relatively simple sounding part of economic analysis that suffers from a number of complexities: livestock valuation. Economic concepts and analytical examples will be presented on values and prices, how to measure values, how different means of value measurement affect economic outcomes, and the influence of price levels on surveillance and other animal health actions.

Selected Speakers

Britt Bang Jensen - Case study: What have we gained from two years of screening all marine farms for salmonid alphavirus?

Infection with salmonid alphavirus (SAV) can give clinical disease with mortality and reduced growth in Atlantic salmon and rainbow trout grown for food production. The cost of clinical outbreak with SAV in an average farm is around €7 million (2013-prices), and between 140-170 farms are infected with SAV each year in Norway (1). The competent authorities seeks to mitigate the disease, and in 2017 a screening program aiming at early detection of new outbreaks was implemented. All farms must now be screened every month for SAV by PCR. The costs of the screening is carried by the producers. Each month, an average of 15,643 samples has been analyzed, to a total cost after 26 months of screening of approximately €10 mio.

The screening programme has ensured early detection of infection with SAV both in an endemic area, and in areas where the infection is not thought to be present. In the latter cases, infected farms has either been stamped-out or containment zones has been implemented. Thus, further spread of infection has been prevented, hindering loss of welfare and production. The compliance of producers has not been optimal, and the competent authorities has not enforced the legislation in these cases. Mostly, producers in areas geographically distant from endemic areas has been hesitant to comply to the screening.

However, the results shows, that the enforcement of screening by legislation is effective in mitigation spread of disease. The screening programme should now be optimized by making it more risk-based. This would likely increase the compliance of the producers.

Sebastián Moya - Communication between veterinarians and dairy farmers around biosecurity measures on dairy cattle farms

Sebastián Moya[1]*, Ray Chan[2], Steve Hinchliffe[2], Henry Buller[2], Josep Espluga[1], Bibiana Benavides[3], Javier Diéguez[4], Eduardo Yus[4], Giovanna Ciaravino[1], Jordi Casal[1], Francisco Tirado[1], Alberto Allepuz[1]

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Introduction: The implementation of biosecurity measures on dairy farms is influenced by the diversity of people and contexts on the farm, where veterinarians are the main source of information for farmers. Thus, the main objective of this study was to explore and examine communication dynamics between veterinarians and dairy farmers in relation to biosecurity.

Materials and methods: This qualitative research was carried out in Galicia and Catalonia with eight focus groups. The focus groups were conducted face-to-face, recorded on tape, reviewed, and transcribed for data analysis. The data was analysed through critical discourse analysis, which allows for a deeper understanding of meanings and helps to understand complex phenomena.

Results: Contradictions between discourses from the veterinary collective and practices of some veterinarians were described, which lead to confusion and questioning by dairy farmers. This was related to the different specialisations of the veterinarians on a farm and therefore, it was pointed out the importance of promoting a higher collaboration among them (through meetings or similar) to deliver unified messages to farmers. Different perceptions on the role that public administration should have in relation to sanction and train to improve biosecurity in dairy farms were also identified. Moreover, participants showed different perceptions about the need of having mandatory biosecurity measures, which could have actions such as subsidies or positive incentives, although an understanding of these measures was highlighted as important.

Discussion: There can be a wide range of factors which can affect dairy farmer-veterinarian communication. In this study we observed that there may be veterinarians who have a low predisposition to recommend biosecurity measures to farmers, which can influence farmer interest. In turn, such predisposition, together with contradictions in advice given by veterinarians, may result in farmers not implementing biosecurity measures. Veterinarians must therefore be proactive advisors and deliver consistent consensus messages, with measures that must be feasible and effective to carry out. Moreover, communication gaps could be overcome by more effective integration among farmers, veterinarians and possibly other collectives (such as public administration, milk buyers, transport companies, among

others) regardless of whether they have different biosecurity frameworks and different perception of problems.

Research highlights: Dairy farmers' understanding of biosecurity practices are shaped by veterinarians, where farmers and veterinarians blame each other for not applying biosecurity measures, although, the responsibility of carrying out such practices is of both. It is reasonable to think that difficulties in implementing biosecurity measures are in both collectives and not only on farmers. The development and establishment of face-to-face meeting participatory that involve at least both farmers and veterinarians, would be beneficial for biosecurity improvement. Likewise, farmers' and veterinarians' perceptions of public administration are findings that need to be further explored and deepened. Thus, this article could be a starting point to unify efforts aimed at developing initiatives for the dairy sector.

Shakar Yadav - Evaluation of the impacts of 'time to detection' of a foot-and-mouth disease incursion in Central Europe using EuFMDiS modelling tool

Shankar Yadav[1]*, Koen Mintiens[1], Maria DeLaPuenteArevalo[1], Richard Bradhurst[2], Graeme Garner[3], Keith Sumption[1]

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Introduction: Foot-and-mouth disease (FMD) virus spread could be difficult to contain within the borders of a single country in the European Union (EU). Free movements of animals, goods and persons between EU Member States may cause cross-border spread of FMD. Also, delayed detection of an incursion could escalate the magnitude of an epidemic and economic losses. The objective of this study was to assess the epidemiologic and economic consequences of different 'time to detection (TTD)' of an FMD incursion in Central Europe using the European Foot-and-Mouth Disease Spread Model (EuFMDiS).

Materials and methods: Using the EuFMDiS, FMD spread was simulated among 316,442 livestock herds distributed in Austria, Croatia, Hungary, and Slovenia. The outbreak was initiated from a large commercial beef herd (Herd size: 121) and transmission was modelled through direct and indirect contacts, local area and airborne spread mechanism. Three separate TTD of FMD incursion (day 14, day 21, and day 28) were considered for each of the four different FMD control strategies (Stamping out of infected holdings (SO) only, SO plus ring culling in 1 km radius of infected holdings (SO_RC), SO plus suppressive vaccination in 3 km radius of infected holdings (SO_SV), and SO plus protective vaccination in 3 km to 8 km (SO_PV; 5 Km donut shape)). Altogether, twelve model scenarios were developed and simulated for 365 days (500 iterations with a time step of 1 day). The numbers of infected holdings (IH) epidemic durations (ED), and total costs (disease control costs plus loss of trade cost) were estimated and compared using Dunne test in R (version 3.5.2).

Results: With an increase in TTD from day 14 to day 28, the number of IH, ED, number of affected countries and total costs increased significantly ($p < 0.05$). Among the control strategies, SO_RC had the least number of IH and shortest ED whereas SO had the largest number of IH and longest ED for all TTD scenarios. The median (Interquartile range; IR) number of IH and ED (in days) were 9 (5, 13) and 53 (48, 59) under SO_RC strategy for day 14, respectively. However, the median (IR) number of IH and ED (in days) were 120 (68, 180) and 101 (84, 124) under SO strategy for day 28, respectively. The median number of affected countries increased from 2 to 3 when the TTD was increased from day 14 to day 28. The disease control cost was highest for SO_SV strategy and lowest for SO strategy. The cost associated with loss of trade, which highly contributed to the total costs, was highest for SO_PV and lowest for SO_RC. Overall, the median (IR) total costs (in million euros) was lowest for SO_RC [128.5 (122.7, 136.3)] for day 14; 141.8 (131.9, 160.1) for day 21; and

160.8 (145.9, 194.3) for day 28] and highest for SO_PV [217.2 (207.6, 224.2 for day 14; 228.7 (219.5, 243.2); and 247.6 (232.3, 561.6) for day 28].

Discussion: The findings demonstrate the importance of early detection along with a chosen control strategy to reduce multi-country spread of FMD.

Research highlights: EuFMDiS, a multi-country simulation model, was used to simulate the FMD spread among 316,442 livestock herds distributed in Central Europe. Early detection of FMD epidemic reduced the epidemic size, length, and economic losses significantly. Though stamping out plus ring culling in 1km radius of infected farm had shortest epidemic duration and smaller number of infected farms, the animal welfare concerns of culling of healthy animals were not considered in the model. The median number of countries affected ranged from 2-3 depending on the time to detection and control measures.

Tove Christensen - Economic incentives in the Danish Salmonella surveillance of the pig production

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Introduction: Since 1995, Denmark has had *Salmonella* action plans for pigs. Earlier studies have pointed to the abattoirs as the cost-effective level in the supply chain of attacking *Salmonella* (Goldbach et al. 2006). However, the analyses also stressed that it is unlikely to reach the target of maximum 1% in fresh meat without also including initiatives at the herd level. As *Salmonella* in pigs is typically not associated with clinical disease, the farmers do not have production-economic incentives to apply *Salmonella*-reducing initiatives. To provide economic incentives for Danish farmers to keep a low level of Salmonella in their herds, the surveillance programme for *Salmonella* is accompanied by an economic incentive scheme. The economic penalty scheme is implemented by the pig slaughter industry, where herds with high sero-prevalence of *Salmonella* face reduced payments for finisher pigs - reductions ranging from two to eight percent of the payments, depending on severity and duration of prevalence. In this study, we investigate how perceived costs and benefits of *Salmonella* control among pig farmers affect their likelihood of delivering finisher pigs with high *Salmonella* prevalence – with particular emphasis on incentives provided by the penalty scheme for finisher pigs.

Materials and methods: By analyzing register data for all Danish finisher pig herds from 2011 through 2018, we identified the share of herds that was subject to reduced payments. Costs of implementing *Salmonella*-reducing initiatives were calculated for average Danish farms based on existing literature. Finally, farmers' perceived costs and attitudes towards *Salmonella*-reducing activities were elicited in a survey in 2018 involving 162 Danish pig farmers.

Results: We found direct economic consequences of high *Salmonella* prevalence for producers of finisher pigs but only indirect consequences for piglet producers. For an average farm, there is break-even between being categorized as a medium prevalence herd for 6 months and implementing the *Salmonella*-reducing initiatives of vermin control, increased hygiene and changes in feed. Main barriers for improving *Salmonella* control were found to include lack of trust in the effectiveness of proposed initiatives and slow communication of risks of economic penalties.

Discussion: This social science study investigates the perceived effects of various actions to combat in-herd *Salmonella*. By investigating the perceived costs of reducing Salmonella, perceived effects on in-herd *Salmonella* of different actions, and attitudes towards the penalty scheme, we have examined the ability of the penalty scheme to incentivize farmers to take action to solve a public health issue originating from a zoonosis. Future studies to combine our results with documented effects of individual initiatives to reduce Salmonella at farm level are planned.

Research highlights: The majority of farmers were in favour of keeping the monetary incentive scheme but had suggestions for improvements (earlier notifications, more focus on sows and weaner productions). Lack of trust in the effectiveness of proposed initiatives is a main barrier for farmers to engage in Salmonella control.

References: Goldbach S & Alban L 2006. A cost–benefit analysis of Salmonella-control strategies in Danish pork production. Preventive Veterinary Medicine 77, 1-14.

Polly Compston - Understanding what shapes disease control: the history of foot and mouth disease in Kenya

FMD virus was first reported in Kenya in 1915 and serotyped in 1932. Following Kenyan independence from British rule in 1964 a comprehensive disease control programme (DCP) was implemented; however ultimately this was unsuccessful, and FMD is currently endemic throughout Kenya. This review aims to describe and appraise FMD control in Kenya since 1964. Information was assimilated using an historical epidemiological approach to explain changes in FMD distribution and policy.

PubMed, Scopus, CAB abstracts, Science direct, Web of science and Google scholar were used to search and obtain papers, using predetermined search criteria encompassing FMD, Kenya and DCP descriptors.

In total 1234 papers were identified: using the WHO's guidelines for rapid review, duplicates were deleted, remaining articles were screened for relevance, 65 references were included, and information extracted and consolidated.

Following independence, a DCP was implemented in the Rift Valley, comprising compulsory, subsidised vaccination and movement controls/quarantine when outbreaks occurred. Initially FMD incidence decreased. However, endemicity continued and ultimately this DCP was discontinued following changes in veterinary service structure, including privatisation and decentralisation. Little active surveillance has been applied since 1964; most surveillance relies on outbreak reports.

Critical drivers influencing DCP implementation include veterinary service structure, which farming systems are politically active and availability of affordable, matched vaccine. DCP success has been influenced by the interaction of available subsidy and farmer motivation to vaccinate and the emergence of different serotypes and strains. This information can be used to identify leverage points and incorporated into recommendations alongside field-based socioeconomic research to enhance effectiveness of future DCPs.

Ben Huntington – The Global Burden of Animal Disease

Ben Huntington[1]*, Camille Bellet1, Theresa Bernardo[2], Mieghan Bruce[3], Mario Herrero[4], Delia Grace[5], Arie Havelaar[6], Vivek Kapur[7], Tom Marsh[8], Dustin Pendell[9], Alex Shaw[10], Paul Torgerson[11], Kevin Watkins[10], Paul Wood[10], Shannon Mesenhowski[12], Matthew Stone[13], Tim Leyland[14], Julio Pinto[15], David Pigott[16], Barbara Wieland[5], Jaime Romero[16], Marisa Peyre[17], Jonathan Rushton[1]

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The Global Burden of Animal Diseases (GBADs) is essential for evidence-based animal health decision-making. It will challenge the status quo whereby investments are made through: (1) cost benefit analyses based on assumptions or weak data; (2) rules of thumb (heuristics) of whether a problem needs to be addressed; or, (3) reactions to outrage-generating crises. Current decision making based on incomplete scientific evidence has negative outcomes for producers and consumers of livestock products, and ultimately society as a whole. GBADs will add value, as well as inform and update heuristics that decision makers rely upon to meet political, societal and global development demands.

GBADs will build on the successful human Global Burden of Disease studies. It will create information on the economic burden of livestock diseases in order to achieve evidence-based decision-making. GBADs data will be securely and sensitively handled, and the information produced will be supported by material for data interpretation. This comprehensive approach will enable users to make judgements on their investments in terms of optimising the economic efficiency of the livestock sector and minimising any adverse impacts on the environment and public health. The information generated will be categorised by the type of farmers affected with an emphasis on smallholders and also the gender balance of the burdens.

GBADs will provide a societal mirror on the animal disease and health burden and indicating the individuals and communities which are the most impacted. It will describe the burden in economic terms and demonstrate how animal health is associated with and affects agricultural productivity, smallholder household income, the empowerment of women and the equitable provision of a safe, affordable, nutritious diet. GBADs will measure and improve societal outcomes from livestock and have a positive impact on the Sustainable Development Goals.

Henning Otte Hansen - Market price response to African swine fever outbreaks

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Introduction:
Experience from several countries shows that outbreaks of African swine fewer (ASF) lead to market disruptions, which to a large extent also involve price changes. These price changes are of major importance to the players in the value chain, including especially farmers and the meat industry. The extent, the duration and the speed of price changes are thus of great importance.

Materials and methods:
The relationship between ASF and market response - including specific price response - is complex and several methods must be used to identify possible effects. Based on a theoretical basis, possible impacts are identified, as ASF is only one of many significant factors in a relatively volatile market. The special conditions that characterize the market for pork are mapped, as these factors help to explain the market price reactions. Also possible market experiences from previous outbreaks of similar livestock disease are examined. Based on this - and using data from Eurostat and other sources - prices and price changes for pork before and after the outbreaks of ASF in both Europe and Asian countries are then examined.

Results:
The results show, that market price response to ASF is dependent on many factors and that many factors other than ASF affect the market price, making market assessments complex. The conclusion is also that ASF causes major market disruptions and price changes. However, both decreasing and increasing prices occur after ASF outbreaks, and several factors and conditions can explain these price reactions.

Discussion:
The significant impact on markets and on market prices makes both prevention and market prediction important. However, price can be considered an exogenous factor, which individual stakeholders can hardly be prepared to even face or prevent. In some cases, the cost of prevention may outweigh the benefits. In other cases, major net benefits of effective prevention exist.

Research highlights:
The relationship between ASF and market price response is complex and several factors will affect market prices. However, the analysis of several pork markets shows, that ASF does cause major market disruptions and price changes. Depending on several factors and conditions, both decreasing and increasing prices occur after ASF outbreaks. The significant impact on markets and on market prices makes both prevention, adaption and market prediction important.

Nico Urner - Hunting for Answers: A Participatory Approach on Measures against African swine fever in Wild Boar in Estonia

Introduction:
The implementation of control measures and passive surveillance regarding African swine fever (ASF) in wild boar relies mainly on hunters. Therefore, our study used participatory tools to assess the acceptance of control measures and passive surveillance by Estonian hunters.

Material & Methods:
Ten focus group discussions were conducted with Estonian hunters. Using relation diagrams, impact diagrams and various visualisation tools, the satisfaction of relations in the hunters network, the perceived consequences of finding dead wild boar and the acceptance of several control measures were assessed.

Results:
The 46 participating hunters had the highest satisfaction in working with other hunters and limited satisfaction towards local veterinarians and higher authorities. Intensified hunting and control measures supporting hunting were perceived as suitable for controlling ASF and satisfying. Measures constraining hunting (e.g. fencing, involvement of the army) were not accepted. The hunters perceived the consequences of finding dead wild boar as additional work, time consuming and costly. Increased incentives and limiting the hunters reporting duties were the highest rated tools for motivating hunters to report dead wild boar.

Discussion:
Participatory epidemiology proved as a valuable tool to improve the understanding of the hunters point of view in ASF control in Estonia. Small adjustments to existing control measures, like targeted hunting of sows, may lead to a higher acceptance and success of these measures. Establishing a working group to reduce the hunters workload would lead to higher preparedness to report dead wild boar.

Dagim Belay - Input control and farmers economic performance: Evidence from the Danish yellow card antibiotic regulation

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In response to the growing public concern about the potential health risks of antibiotic resistance (AMR) from food production, a range of regulations have been implemented reduce agricultural antibiotic use worldwide. This article provides the first empirical estimates of the effect of Danish yellow card initiative, an antibiotic quantitative restriction, on economic performance of farmers. It exploits the timing variation in the sequential introduction of the Danish yellow card initiative as a quasi-policy experiment. The article applies difference-in-difference and non-parametric order-m conditional efficiency models on Danish Farm Accounts Data to provide the first empirical estimates of the effect of the yellow card initiative on the economic performance of farmers. The results show that the initiative has reduced the gross profit and increased the operating expenses of farmers. The findings also suggest that farmers have spent more labor hours and costs performing biosecurity, increased expenses veterinary/medical services, and feed, which combined with reductions in revenue and cost efficiency, might have driven the reduction in profit. The results indicate that isolated, stringent regulation of antibiotics could undermine the policy incentive for efficiency in the short run. Labeling schemes could help to internalize the additional cost such regulations may impose.

Hassaan B. Aslam - Economic impact of endemic low pathogenic H9N2 avian influenza virus in commercial broiler and layer production systems in Pakistan

Low Pathogenic Avian Influenza (LPAI) H9N2 virus is endemic in Pakistan and impact poultry farmers through disease related mortality of poultry flocks, reduce growth rates, poor weight gain and reduce egg production. The study aim to estimate the farm level economic impact of LPAI H9N2 infection on commercial broiler and layer production systems in Pakistan.

A large survey of 136 broiler farms and 138 layer farms in Pakistan was conducted in 2019. Data were collected, via on-farm questionnaire, on farms production and economic parameters, avian influenza disease parameters and vaccination practices. Famers were asked about changes on production parameters and associated cost during LPAI H9N2 outbreaks. Data was used to develop stochastic production models and estimate gross margins for three broiler and two layers production systems: fully integrated (FI), partially integrated (PI) and Independent farming (IF) systems. The models were run with and without LPAI H9N2. Partial

 budget analyses were then carried out to estimate the financial impact of LPAI H9N2. Results indicate that 63.8% of broilers and 45.5% of layers suffered LPAI H9N2 outbreaks. Yet, 50% of broilers and 100% of layer farms used LPAI H9N2 vaccines. The net cost of disease per broiler bird sold was estimated at Â£-0.95, Â£-0.46 and Â£-0.29 for PI, IP and FI systems, respectively. The disease produced a negative gross margin in PI (Â£-0.34) and IP (Â£-Â£0.36) systems, while remained positive for FI systems (Â£0.42). The net cost of LPAI H9N2 per dozen eggs sold in layer systems were Â£-0.15 and Â£-0.18 for PI and IP respectively, and produce negative gross margin in both systems.

The study provides understanding of LPAI H9N2 economic impact in Pakistan industry, with evidence from large empirical data. Findings highlight the vulnerability of independent and partially integrated systems to the disease. These findings will allow evaluation of LPAI avian influenza surveillance systems in Pakistan.

Camilla Strang - Antibiotic usage in the GB dairy industry: improving data capture and exploring drivers

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Accurate data capture systems on antibiotic usage (ABU) at farm level are needed for improved surveillance and prevention of antibiotic resistance. Yet, in the dairy sector, no harmonised system to capture this data exists. The objectives of the study were to determine the accuracy of ABU data capture by dairy farmers and to assess the drivers and barriers behind data capture.

A cross-sectional survey of 103 dairy farmers in the South West England and Wales was conducted. On-farm questionnaires collected data on farmers profiles, type of ABU recording systems and attitudes and preferences towards a harmonised system. Data on ABU recording accuracy were collected in two ways: 1) through farmers perceptions on completeness, correctness and timeliness of ABU recording (perceived accuracy); and 2) through review of actual on-farm ABU records for a 12-month period (actual accuracy). ABU recording accuracy scores were developed, and comparative analysis between perceived and actual accuracy conducted. Qualitative content analysis was undertaken on data from open-ended questions and notes taken during interviews.

Results showed that 51% of farmers use a range of software, whilst the rest use paper records only. Overall, farmers perceived themselves to be highly efficient recorders, but with timeliness of data entry (42% record data one week after using antibiotics) being the least efficient. Actual accuracy was variable. Content analysis indicated that benchmarking, transparency of ABU practices and benefits to research were seen as key drivers for ABU recording. However, participants placed concern over incorrect data interpretation, data ownership and security for the use of an ABU centralised system. These findings provide evidence on current ABU recording accuracy and farmers perceptions towards recording, which need to be considered for the development of accurate surveillance systems.

Marit Biesheuvel - Human behaviour and infectious disease modelling: review, gaps and recommendations in the context of cattle diseases

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Introduction: Infectious disease models can reproduce spread of disease and help to plan policies for disease control. However, such models assume homogenous and constant behaviour over time by farmers. To help us incorporate the 'human factor' in mathematical models we first need to understand how and why farmer behaviour changes and then how can it be incorporated in a mathematical model. This literature review was conducted to identify: 1) key behavioural determinants and what theories have been applied to understand farmer behaviour in infectious disease control on cattle farms; and 2) how farmer behaviour has been modelled.

Materials and methods: PubMed was screened in August, 2020 for potentially relevant articles. A search strategy was developed consisting of relevant keywords describing five themes: farmer, veterinarian, behaviour, perception, attitude, believes, and disease control keywords. The broad themes were combined into a single query, Farmers *OR* farmer *OR* veterinarian *OR* veterinarians *OR* veterinary *OR* vets *OR* vet *AND* behaviour *OR* behavior *OR* perception *OR* perceptions *OR* attitude *OR* attitudes *OR* belief *OR* believe *OR* beliefs *AND* disease control *AND* cattle. Additional criteria were formulated for inclusion of manuscripts in the final review: 1) the subject had to be related to prevention and control of cattle disease; 2) a key focus on behavioural barriers and/or facilitators of farmers or veterinarians; and 3) only European countries.

Results and Discussion: Although in the past decade appreciation of social science approaches to understand impact of stakeholders' behaviour has been increased in the veterinary field, the results have only been reported of studies conducted in 12 North-Western European countries. This resulted in 48 reviewed papers with over a half having no theoretical framework used to understand behaviour. Theory of planned behaviour was most the commonly used theory despite its criticisms and limited explanatory power (27%). This particularly resulted in constructs related to the personal environment to be over-extensively looked at. In addition, there is limited evidence to suggest what behaviour change models actually are valid for farming population given limited behaviour change studies. With respect to modelling the farmer behaviour in context of infectious disease control, there seems to be heavy reliance on game theory which tends to be economics focussed (maximising utility) and ignores social and cognitive factors e.g. emotions.

Research highlights: From this review it can be concluded that using theoretical underpinnings in order to understand human behaviour is necessary and that this theoretical underpinning is lacking in veterinary studies, or that psychology theories are used that only focusses on the personals' intention towards a behaviour. Before a human behavioural factor can be incorporated in any animal disease model it is essential to better understand the complex behaviour structures of farmers.

Tim Capon - Modelling animal disease control and post-outbreak management to improve outbreak response policies

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The Foot and Mouth Disease (FMD) Ready project is a transdisciplinary collaboration that aims to strengthen preparedness and facilitate a return to trade for Australia in the event of an emergency animal disease (EAD) incursion, using FMD as a model. One component of this project is focused on developing decision support tools to inform decision-making in response to an outbreak of FMD.

Epidemiological modelling is increasingly recognised as a valuable tool for understanding the risks of FMD spread and control in the event of an outbreak. This presentation will discuss ongoing work to enhance the capabilities of Australias national-scale model of livestock disease spreadâ€"the Australian Animal Disease Spread (AADIS) modelâ€"including approaches to post-outbreak surveillance and management options for vaccinated animals for proof-of-freedom and a faster return to trade. Nine outbreak scenarios with 13 different control strategies (11 of which include vaccination) were used to simulate FMD spread. Data from these simulations were used to support post-outbreak surveillance and economic analyses to evaluate the costs and benefits of different control strategies.

Results indicate control strategies that include vaccination may reduce the duration and size of an FMD outbreak when compared with a culling only strategy in outbreak scenarios where disease is likely to spread most rapidly and exceed response resource capacity (see Figure 1). However, in line with current international animal health standards, the use of vaccination and management of vaccinated animals during the post-outbreak phase may prolong the time taken to regain export markets. Decisions on whether vaccinated animals are removed from the population post-outbreak as part of the control strategy or retained in the population to live out their commercial lives could significantly impact the overall economic cost of an FMD outbreak in Australia.

Findings from this research will strengthen strategic decision-making around disease management and reinforce Australias evidence-based EAD preparedness policy.

Margaret Krieger – Stakeholder's view on policy options to reduce production diseases on organic dairy farms

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The purpose of this study was to evaluate policy options for securing low levels of production diseases on organic dairy farms. Ensuring good animal health is a stated aim of organic livestock farming and an important reason why consumers purchase organic products, although achieved health states are comparable to conventional farming. Stakeholder consultations were conducted in four European countries, involving 39 supply-chain stakeholders (farmers, advisors, veterinarians, certifiers, processors, and retailers). The prevalence of production diseases observed in a prior study of organic dairy farms was discussed and participants were asked to rate their level of agreement with a number of statements describing different ways, including policy change, of addressing the large observed variation in animal health.

Stakeholders saw the need to reduce production diseases on organic dairy farms and generally favoured establishing outcome-oriented animal health requirements. However, there was no agreement on the question of who should be responsible for measuring production diseases and defining minimum requirements for organic farms, i.e. regulators or market actors. Different supply chain actors saw different opportunities and needs for the use of policy instruments, likely due to differing priorities for animal health improvement, reflecting their different interests, e.g. animal health effectiveness, or cost-effectiveness.

The study highlights the importance of measuring health outcomes and defining outcome-oriented requirements. Moreover, opportunities and risks of different policy instruments are described from a stakeholders as well as a scientific perspective.

Wilma Steeneveld – An empirical analysis on the longevity of dairy cows and the economic performance of herds

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Introduction: Longevity of dairy cows can be defined as the age of the cow until removal from the herd. Cows are culled well before the end of their natural lifespan. From the perspective of society there is a wish for an increased longevity as part of increased emphasis on animal welfare and social license to produce. Also from an economic perspective a higher longevity might be interesting as rearing costs will be lower. Empirical studies that support these expectations are however lacking. So, it is not yet known from practice, whether farms with a higher cow longevity perform economically better than farms with a lower cow longevity. The aim of this research is to investigate the association between longevity of dairy cows and the economic performance of dairy herds based on Dutch accounting data.

Materials and methods: Herd data (n=20,796 herds) and farm accounting data (n= 2,809 herds) from Dutch dairy herds from the years 2007-2016 were available. The herd data contained yearly averages on longevity, herd size and several production variables. The farm accounting data contained yearly averages on revenues, fixed and variable costs of the herds. Combining the two datasets resulted in a final dataset containing 921 herds with 9,210 yearly records (all herds had 10 years of data). Records of herds with less than 30 cows, production below 4,000 kg 305d milk per cow or missing data on important variables were removed. Gross-margin (GM) was defined as the total dairy revenues minus the total variable costs. The variable costs did not take labour costs into account. The data was analysed with generalized linear mixed model, with GM as dependent variable. The independent variables were average age of culled cows, year, herd size, herd intensity (milk production per ha), herd expansion rate, soil type, milking system, successor availability, total FTE, heifer ratio (% of heifers per cow) and use of outsourced heifer rearing. Herd was included as random effect and year as a fixed effect.

Results: Descriptive statistics based on all herds over the 10 years indicate that average age of culled cows was 5.88 years (SD=0.79) and average herd size was 88 cows (SD=38.3). Average age of culled cows was stable over the 10 years, and variation within herds was low. The GM was on average €24.82/100 kg milk (SD=4.69). GM was not significantly associated with age of culled cows, but was significantly associated with year, soil type, milking system, herd intensity and the use of outsourced heifer rearing.

Discussion: In the univariate analyses all variables were significantly associated with GM, including age of culled cows. However, inclusion of a random herd effect completely absorbed this effect, indicating that a large part of the variance in culling age (i.e. between herd variance) is captured by structural differences in GM between herds. Variance in

culling age within herds did not significantly influence GM. Another analysis using lifetime milk production of culled cows as longevity variable resulted in similar results.

Acknowledgements: The authors are grateful towards CRV and Flynth accountancy for availability of the data.

Research highlights: Univariately, GM was significantly associated with age of culled cows. There are large differences in age of culled cows between herds, but the within herd variance is much lower. Using a generalized linear mixed model with random herd effect resulted in an insignificant association between GM and age of culled cows. It seems that the herd effect (i.e. driven by management) absorbed the influence of herd differences in culling age. Within herds differences in age of culling were not explaining GM.

Caroline Ritter - Canadian dairy farmers' perspectives on the future of dairy farms

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Introduction: The Canadian dairy industry has recently developed a comprehensive national program (i.e. proAction), which outlines mandatory standards and specifies reinforcement strategies in the areas of animal care, milk quality, food safety, traceability, environmental sustainability, and biosecurity. Given that the dairy industry is dynamic and will continue to change, these policies will need to adapt. The aim of this study was to engage with farmers using a focus group format to discuss their vision of animal care in the future, how the industry can achieve desired goals, and what role policies should play in the direction of the industry.

Materials and methods: We asked Canadian dairy farmers that were part of 7 focus groups how they envision the future of dairy cattle care. Using an appreciative inquiry approach, we prompted participants to generate key words that describe the must-haves of dairy farms in 20 years from now, and then discussed how the must-haves can be realized. We focused specifically on the role that farmers believed policy should take in achieving these objectives. Focus group transcripts were analysed using thematic analysis.

Results: Participants generally regarded national policies as a beneficial tool to ensure a minimum standard for animal care in the future, and especially valued on-farm assessments. They argued that proAction has the potential to increase public trust and can be an effective marketing tool for Canadian dairy products. However, participants felt pressured by continuously increasing demands and highlighted the necessity of industry input when developing policies, accounting for farm-specific differences and realistic expectations.

Discussion: Design and implementation of health interventions should include consultations with all stakeholders, including the target population. Therefore, when developing industry-led standards, there are merits in consulting a broader representation of farmers, other than just elected board members.

Research highlights: Identified themes from this research can guide policymakers when developing or revising mandatory standards for animal care on dairy cattle farms. Policies

that reflect the direction farmers perceive the dairy industry should take as it moves forward will support the perceived legitimacy of these policies and likely improve farmer adherence in the long term.

Peter Windsor - Can a non-antimicrobial therapy for FMD improve disease surveillance and socioeconomics of disease mitigation by smallholder farmers?

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Transboundary animal diseases (TADs), including Foot-and-Mouth Disease (FMD) impact negatively on global food security, national economies and farmer livelihoods, particularly in developing countries where veterinary services are often inadequate. International livestock disease assistance programs have had some success in achieving FMD control and eradication. However, this has usually been where international border biosecurity and strategic vaccination programs are achievable, assisting the limitation of disease transmission risks.

Achieving satisfactory biosecurity and vaccination at the farm level in developing countries is challenging, as smallholder farmers have limited understanding of disease risk management. Farmer priority is accessing effective animal therapy. However, they are mostly provided with inappropriate topical and/or parenteral antibiotics for so-called secondary infections, delivered mostly by paraveterinarians inadequately trained in therapeutics and antimicrobial custodianship. This results in negative financial impacts on livelihoods, risking food safety and development of anti-microbial resistance (AMR).
Since April 2019, clinical trials conducted in several countries in Asia and Africa, has shown high level (100%) acceptance by farmers, of the application of a wound therapeutic compound to FMD lesions, using a product developed for pain relief during aversive livestock husbandry procedures (Tri-Solfen, Medical Ethics Australia). Farmers observed improved behaviours and reported more rapid healing of lesions. Further, once awareness of this new medicine occurs, the presentation of affected animals for treatment and reporting of outbreaks improved. This inexpensive non-antimicrobial therapy for FMD has the potential to improve disease surveillance and reduce the socioeconomics impacts of outbreaks. A paradigm shift from treating FMD with antimicrobials that risk AMR, to a new approach of improving animal welfare in TAD management that can motivate farmer interest in disease reporting, is proposed.

Cecilie Sviland - Bioeconomic evaluation of different treatment strategies against salmon lice in Norway

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Introduction

Problems due to salmon lice-infestation in marine salmon farming have escalated. Extensive use of chemotherapeutants has led to salmon lice developing resistance. Around 2016, a paradigm shift occurred in the Norwegian industry's approach to lice control from chemotherapeutants to non-medicinal treatments. Which treatments the different aquaculture companies undertake and the variation within and between production sites, areas, companies and generations is to our knowledge unexplored. When deciding which control strategy would be optimal, information on current treatment measures and their effect and side effects is essential. This ongoing study therefore explores the spatial and temporal frequency distribution and variance of delousing methods and the mortalities associated with delousing.

Materials and methods

The dataset includes production data concerning all treatments performed on salmon transferred to sea between 2014 and 2017 from three Norwegian salmon farming companies. The dataset has a hierarchical structure where the lowest to highest level is harvest cage, farm, and production zone/ region. Key variables are treatment methods, mortality, date, cage id, and production zone. Analysis of spatial and temporal variance in treatment methods within and between cages, production zones and generation are ongoing.

Results

The preliminary dataset includes 4 728 delousing treatments in 1 863 cohorts sea transferred in 2014 to 2017, from 159 unique farms in Norway. The results obtained so far, show that we can expect mortality after all of the delousing methods, variation in mortality between delousing methods, and substantial variability in mortality within the different delousing methods.

Discussion

To our knowledge, there exists no economic analysis comparing the costs to the effect (benefits) of delousing. The current cost calculations of delousing are uncertain due to lack of detailed information on biological costs of delousing. Biological costs being death, reduced growth and reduced slaughter quality. High-resolution production data from several companies can give valuable detailed information on how delousing affects mortality, growth and slaughter quality. And, knowledge of variability makes it possible to account for uncertainty in an economic cost estimation. We found that the mortality increases with all types of treatments, but that it is considerably higher after non-medicinal treatments. The analysis also confirmed the shift from medicinal to non-medicinal treatments during the study period. Even though non-medicinal treatments are causing the highest biological losses, such treatments might be the only option available for the farmer for control of salmon lice.

Christopher Prudenz - Adoption of Secure Beef Supply Plan Biosecurity by U.S. Cow-Calf and Feedlot Producers

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Introduction: The potential for an outbreak of foot-and-mouth disease (FMD) in U.S. livestock populations has motivated development of the Secure Beef Supply (SBS) Plan for Continuity of Business. The SBS Plan encourages producers to voluntarily implement as many enhanced biosecurity practices as is practical before an FMD outbreak occurs and to be ready to implement the remaining biosecurity measures should an outbreak take place. The plan is not expected to have 100% participation, and there may be types of producers who, on average, are less likely to participate. This study is focused on the question of whether or not a voluntary SBS Plan is viable. Our primary objective is to evaluate the role demographics and attitudes have in regard to the propensity to participate in voluntary biosecurity adoption outlined in the SBS Plan.

Materials and methods: This research uses data from a 2018 survey of cow-calf and feedlot producers that solicited responses regarding adoption of biosecurity practices. Cross tabulations of survey respondent biosecurity practice adoption rates according to stated biosecurity practice feasibility ratings are performed for both cow-calf and feedlot producers, as are cross tabulations of cow-calf and feedlot producer adoption rates according to producer and operation characteristics. Complementarity of biosecurity practice adoption is examined by considering the number of other biosecurity practices a respondent has adopted conditional on the adoption of a given practice.

Results: For many biosecurity practices for cow-calf and feedlot producers alike, adoption rates for those respondents indicating that practices are feasible are significantly higher than those for respondents who indicate the practices are infeasible. For example, 3% of cow-calf producers who indicate that having a biosecurity manager is infeasible to implement during an outbreak report that they have adopted this practice. On the other hand, 25% of cow-calf respondents who answered that having a biosecurity manager is feasible have adopted this practice. The complementarity analysis shows adoption decisions for some practices seem to be driven by the complementarity of biosecurity practices. For instance, relatively few cow-calf producers have adopted a biosecurity plan, but those who have are leading adopters of other biosecurity practices.

Discussion: Belief that a biosecurity practice is feasible to implement is highly correlated with adoption of that practice. Even so, adoption rates are remarkably low, even among those who indicate that adoption during an FMD outbreak would be feasible. This indicates

that other factors may influence the adoption decision, one of which is complementarity of adoption. These findings may be used to target educational material and outreach to cattle producers.

Research highlights: Feasibility of adoption perceptions and adoption rates are correlated across SBS Plan biosecurity practices, but our results show that adoption is relatively low regardless of feasibility rankings. This seemingly paradoxical relationship could be because, despite producers thinking it is feasible to adopt SBS Plan practices should an FMD outbreak occur, there is a perceived lack of incentives for producers to adopt practices prior to an outbreak. One possible solution to help increase the share of national biosecurity adoption could be the creation of cost share programs.

Ikram Abdouttalib - Estimating veterinary time required to perform veterinary acts in routine using regression analysis

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Introduction

Increased size of structures and the arrival corporate companies have modified the veterinary landscape. These enabled economies of scale for drugs or pet food purchases, improving the profitability. Increasing profitability requires a better understanding of veterinarian working time needed to perform veterinary acts in routine, what is currently poorly described. Here, we determine the time required for each veterinary act in mixed practices using regression.

Material and Methods

We built a dataset of 581,526 observations, with 3 year-period (2015-2017) data extracted from accounting software of 4 French veterinary mixed practices. Each observation regroups the number of worked days (outcome variable) per veterinarian and per month and the number of acts per month the veterinarians have done, for different acts in companion animal and rural practice (consultation, surgery, herd monitoring). A multivariate regression model with random effect was then run.

Results and Discussion

The model, explaining 69% of the total variability, shows that average rural consultation, cattle herd monitoring, companion animal surgery and consultation, take on average 0.093, 0.358, 0.194, and 0.056 days worked per month, respectively. Based on 8 hours working days, it means that rural consultation, cattle herd monitoring, companion animal surgery and consultation required on average 45 (95%CI=34-48), 172 (95%CI=120-216), 93 (95%CI=72-106) and 27 minutes (95%CI=19-29), respectively.

This is the first time estimates of working time in veterinary practices. This enables setting baseline level of activity, which may be used calibrate mathematical models estimating profitability of veterinary activities, and simulate counterfactual scenarios optimizing allocation of time.

Norhariani Mohd Nor - Estimating the economic losses due to Vibriosis in marine cage culture of Asian Seabass in Malaysia using stochastic model

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Introduction:
The production of Asian seabass has contributed significantly to Malaysia's economic activity and food security. However, the production of Asian seabass can be limited by disease occurrences such as vibriosis which caused economic losses to the farmers. The decision to support change in the cage farm of Asian Sea bass to control and prevent Vibriosis is needed to get insights whether the change can improve the socioeconomics of farmers. The first step towards understanding such change is to estimate the costs of endemic vibriosis using stochastic bioeconomic model. The objective of this study was to determine costs due to vibriosis in Asian seabass rear in cage-cultured farms in Malaysia.

Materials and methods:
A stochastic bioeconomic model was built using @Risk (Palisade, Inc) add-on in Microsoft Excel ® (Microsoft Corp) to estimate costs of grow-out Asian Seabass. The model predicted the health status (healthy, infected and died) of a fish from 0 until 210 days. The model included uncertainty in vibriosis prevalence from a farm in West coast Malaysia (Selangor) sampled monthly for a year, where Vibrio spp found were *V. alginolyticus*, *V. vulnificus* and *V. Harveji*. Inputs were based on literature, expert opinion and farmer. The estimation of costs were determined assuming marine cage-cultured farms in west coast Malaysia. Sensitivity analysis was performed to important biological and economic inputs such as feed conversion ratio and prevalence of vibriosis.

Results:
The model showed 78.7% of simulated Asian seabass survived (west coast scenario). Total vibriosis costs in west coast Malaysia were estimated as USD 0.24/tail/kg of survived Asian seabass, with the mortality rate due to vibriosis at 6.89%.

Discussion:
As an example, surveyed farmers at west coast Malaysia estimated their production of 1,500 tails of 1 kg Asian seabass/cycle, if taking into account the cage culture area with endemic vibriosis that we have estimated, there could be provisional costs estimated at RM1,491 (USD 366) (**7.8%**) in addition to total costs of USD4,689/farm/cycle. Model could be adapted for scenario in east coast Malaysia, where the economic losses was estimated at USD 0.23/tail/kg of survived Asian seabass.

Research highlights:

The study found the costs of vibriosis in Malaysia USD0.23 to USD0.24 per tail/kg of survived Asian Seabass. Care must be taken to interpret the findings as the costs of grow-out Asian Sea bass is different for each farm due to different management practices, disease risks and prices. Focus of further research and support by the government includes development of vaccines to enable farmers to make better decisions, for example improving biosecurity to lower economic losses due to Vibriosis.

Andrea Apolloni - PPR control in a Sahelian Setting: what vaccination strategy for Mauritania?

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Introduction: Peste des Petits Ruminants (PPR) is a viral disease affecting domestic and wild small ruminants. PPR causes severe damages to animal production and household economies. In 2015, FAO and OIE launched a global eradication program (GCSE) based on vaccination campaigns. Its success will depend on the implementation of vaccination campaigns, accounting for husbandry practices, mobility and the periodicity of small ruminants' population renewal.

Materials and methods: In Mauritania, PPR outbreaks occur annually. We developed a mathematical model to assess the impact of four vaccination strategies (including the GSCE one), the importance of their timing of implementation (4 months of the year) and the usefulness of animal identification on the reduction of PPR burden. The model was calibrated on collected through ad-hoc surveys about demographic dynamics, disease impact and national seroprevalence. Numerical simulations were used to estimate the number of averted deaths over the next twelve years.

Results: The model results showed that the GSCE strategy prevented the largest number of deaths and provided one of the highest economic returns among all strategies (see Figure). According to its current cost, identification would be a viable investment that could reduce the number of vaccine doses to distribute by 20%-60%. Whilst the implementation of the identification system is crucial for PPR control, its success depends also on a coordinated approach at the regional level.

Discussion: Vaccination should consider demographic trends and be cost-beneficial. We informed a mathematical model with data collected by Onardel/CNERV-Mauritania to test vaccination's scenario. Vaccinating animals following the OIE-FAO recommendations, coupled with identification, results as the most effective strategy

Research highlights: This is one of the few studies that coupled together a dynamical model to a cost-benefit analysis for PPR impact calibrated on field data

Poster Abstracts

Fanny Boudain - Stakeholder Analysis of animal health decision systems to understand antimicrobial use in livestock production in Europe, Mozambique and Vietnam

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Introduction: Antimicrobial use (AMU) in livestock production is expected to rise by 67% worldwide by 2030 as a result of the increased demand for meat and intensive farming. Although AMU is decreasing in the European Union, strong variations in AMU trends have been observed between countries and between farms within a country, with some using 150 times more antimicrobials to raise farm animals. AMU patterns are very much affected by the stakeholders involved in and around farming and by the structures and institutions that guide their behavior. In order to better understand how, and to identify stakeholders and factors that are crucial to further foster a sustainable use of antimicrobials, we investigate all stakeholders influencing animal health management in general and AMU in particular in different pig, dairy, poultry and beef farming systems in eight European countries, in Mozambique, where the availability and accessibility of veterinary drugs and vet services is problematic for most farmers, and in Vietnam, where antimicrobials are used preventively and as growth promoter. The objective is to identify the stakeholders, their role as well as the interactions that exist between the identified stakeholders in order to determine how this affects AMU.

Materials and methods: In every country, relevant sector(s) - pig, beef, dairy or poultry farming - and production system(s) -intensive, organic/label or marginal care – are being analysed, which results in 24 case studies. In each case-studies, a stakeholder mapping was performed or is currently being performed, based on key-informant in-depth interviews with the addition of document analysis, focus groups and analysis of secondary datasets. The gathering of data is being delayed due to the COVID-19 pandemic.

Results: Preliminary results from 6 case studies (Italy (Intensive pig & poultry production), Belgium (intensive vealcalve and pig production), The Netherlands (Turkey production, marginal care) and Vietnam (poultry production, marginal care)) indicate that in most cases, the different types of farmers have a high interest in antimicrobial resistance (AMR)/AMU, but little to moderate influence. In Vietnam, the opposite is observed familial farms that produce semi-intensive poultry, mainly for financial reasons. Influential and interested stakeholders mainly comprise governments, integrators, retailers, exporters and veterinarians, mainly due to the coercive/financial power they have and/or experience. Stakeholders that show low interest appear to be the result of a lack of awareness regarding

AMR and AMU and/or financial interest to sell/use antibiotics. Moreover, the role of pharmaceutical companies and wholesale distributors varied from one country to another, mainly due to the interest showed in guidelines/awareness campaigns at national level.

Discussion: Stakeholder mapping reveals that although farmers occupy a central position in livestock production systems, other stakeholders in the value chain have greater influence on AMU. Understanding livestock production systems is essential to define who and what to target in order to develop cost-effective and tailor-made solutions to promote prudent AMU.

Research highlights: This research aims to identify stakeholders affecting animal health in general and AMU in particular. Through a stakeholder mapping, mainly based on in-depth interviews, we identify influential stakeholders, their roles and the interactions between them. The identified substantial differences between sectors and countries with regard to stakeholders and their interactions will allow to develop tailor-made solutions in order to foster a sustainable use of antimicrobials in a particular sector or country.

Cara Wilson - Beef producers' knowledge influences their practices to prevent hydatid disease transmission.

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Introduction: A recent study using abattoir data found the prevalence of hydatid disease in beef cattle was higher, and the geographic range of infected cattle wider than previously recognised despite control strategies in domestic dogs, such as deworming with praziquantel. This study aimed to determine whether hydatid prevention practices were associated with knowledge and attitudes.

Materials and methods: Between June and August 2019, Australian beef producers responded to an online survey (N=62). Descriptive statistics identified predictors for practices that might influence transmission of the disease and a Bayesian network model evaluated the interrelationships between variables.

Results: Most respondents had heard of hydatid disease in cattle (77%; 48/62), but only 61% knew how it is transmitted (38/62) and almost half did not know how to prevent transmission (48%; 30/62; knowledge). Most producers did not feel well informed about hydatid disease and almost all said they would take action if they found out their cattle were infected (94%; attitude). Of the respondents who owned dogs (n=57), 86% did not deworm their dogs frequently enough to prevent infection (49/57; practice). Bayesian network analysis indicated that implementation of hydatid prevention practices was

associated with good knowledge, and producers who implemented hydatid prevention practices were less concerned about the impact of the disease to their enterprise. However, many producers were not implementing hydatid prevention practices sufficiently to prevent transmission to domestic dogs, wildlife and humans.

Discussion: The results of this survey suggest that improving knowledge among beef producers with regards to hydatid disease might encourage adoption of hydatid disease prevention practices. The survey also indicated that producers would be open to educational programs that could increase their knowledge. A cost-effective method of improving producer awareness of hydatid disease within their own herds would be to provide feedback from abattoir data.

Acknowledgements: Supported in part by Virbac (Australia) Pty Ltd.

Research highlights: Producers are at the forefront of disease control; understanding their knowledge, attitudes and practices is imperative to protect animal industries from disease. This study found associations between producer knowledge, attitudes and practices relating to hydatid disease. Providing feedback from abattoir data could increase awareness and improve adoption of control practices among beef producers.

Veronika Richter - Spatial cluster analysis and economic evaluation of blackleg and malignant edema cases in the federal state of Styria, Austria

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Introduction: In the study presented here, a spatial cluster analysis for the identification of areas with high and low risk for the appearance of blackleg (*Cl. chauvoei*) and malignant edema (*Cl. septicum)* cases in the federal state of Styria was conducted.

Materials and methods: Based on the results of the cluster analysis, costs for the period 1998-2018 were analyzed and costs per animal between districts with high and low risk for blackleg, as well as costs between blackleg and malignant edema were compared. Due to a change in the diagnostic methods used and consequently changes in the payers' structure, the retrospective cost analysis was performed separately for two periods, namely 1998-2014 and 2015-2018. As part of the eradication strategy against the notifiable disease blackleg the federal government of Styria financially supports the use of a clostridial

vaccine. The evaluation of this eradication measure was additionally assessed using a cost-benefit analysis.

Results: Initial results reveal a decrease in average annual costs for blackleg by one third to EUR 102,000 in 2015-2018 compared to 1998-2014, while average annual costs for malignant edema cases almost tripled to EUR 126,000 in 2015-2018 compared to 1998-2014. The largest cost share incurred due to blackleg cases is borne by farmers (vaccination fees, non-compensated mortality costs) while costs due to malignant edema cases are primarily borne by the Styrian animal disease fund. The cost-benefit analysis of a voluntary vaccination program with a clostridial vaccine in Styria reveals a net economic loss (BCR = 0.2) of EUR 549,000 for the period 1998-2014, and EUR 41,100 between 2015-2018, when the epidemiological situation without use of a clostridial vaccine is taken as a baseline for the economic calculation. Thus, in both study periods the use of a clostridial vaccine as preventive measure against blackleg is economically not efficient. However, it is important to note that no animal welfare considerations are included in this economic analysis.

Discussion: The costs due to blackleg and malignant edema cases in Styria were analyzed between districts with high and low risk for disease appearance between 1998-2018. Additionally, the use of a clostridial vaccine was evaluated using a cost-benefit analysis. The results of this study aim to support veterinary authorities in the decision-making process, to which extend mitigation measures are required.

Research highlights:
- Overlapping high risk clusters for blackleg and malignant edema were identified in the federal state of Styria.
- While average annual cost (mortality, diagnostics and vaccination) for blackleg decreased between the two study periods (period 1: 1998-2014, period 2: 2015-2018), average annual costs for malignant edema significantly increased.
- The cost-benefit analysis reveals that the use of a clostridial vaccine as preventive measure against blackleg is economically not efficient. However, it is important to note that no animal welfare considerations are included in this economic analysis.

Sophie Le Bouquin - Biosecurity in poultry farming: a participatory approach to promote compliance with biosecurity measures

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 Introduction: In livestock sciences, biosecurity is defined as all measures taken to prevent both the introduction and the spread of disease agents on the farm and between the farms.

In the recent context of avian influenza outbreaks in France many actions to improve biosecurity have been implemented in poultry farms, in particular a strengthening of legislation requiring poultry keepers to strictly apply certain biosecurity measures. However, it is well known that prescriptive approaches have limitations as regards their effective application. Non-compliance is sometimes linked to a lack of understanding but most of all to the difficulties encountered in implementing them sustainably. As such, the knowledge and perception of biosecurity by the farmers are of major importance. The objective of the project Part'Age is to propose an innovative support for poultry farmers based on a participatory approach, for a substainable change in biosecurity implementation practices.

Materials and methods: The project includes 22 farmers belonging to two groups: one in conventional production and the other in label production. It includes three steps during which each on-site assessments are carried out: initial diagnosis, mid-term evaluation to assess progress and final review. Between each visit, a participatory meeting is organised for each group of farmers to discuss and share on the difficulties encountered and solutions proposed.

Results: 17 farmers attended the first participatory meeting conducted in 2019. The results show the meeting had an overall impact on knowledge (15 farmers). Exchanges and discussions with their peers were widely appreciated by all. More than a third of the farmers (6 farmers) changed their attitudes, in particular towards external stakeholders. Finally, the majority of them (14 farmers) have reported or are planning a change in their practices.

Discussion: These first results are consistent with the plebiscite for the exchanges between peers. Changes of attitudes and practices were observed in the short time, while others were comforted in their choices, their knowledge. However, progress is done step by step. This type of approach needs to be built over time because it requires for certain changes in the way things are viewed and done. Training tools will be developed at the end of this project, i.e. in the first half of 2021, in order to transfer this method to the management structures that would like to develop it.

Research highlights: The objective of the project PartAge is to propose an innovative support for poultry farmers based on a participatory approach, for a sustainable change in biosecurity implementation practices. The first results show this method seems to be effective by presenting a positive impact for accompanying farmers in their changes, trigger changes in attitudes or practices and reinforce farmers in their choice of practices.

Stefania Crovato - Consumers' perception of rabbit housing systems and animal welfare in Italy

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Introduction: Italy is one of the world's leading producers of rabbit meat, where different housing systems are currently used. However, a decrease in rabbit meat consumption has been recognized in the last few years. Moreover, the EU parliament is still working on minimum welfare standard for meat rabbits, promoting the adoption of more welfare-friendly solutions. The attention to animal welfare rising from consumers' concerns might meet farmers' interests, since it is generally acknowledged that appropriate living conditions positively influence health performances.

This study focuses on consumers' perception related to breeding practices, food safety and animal welfare, emphasizing social and ethical concerns associated with rabbit meat production and consumption. The study is part of a wider research project that compares alternative housing systems considering economic, social and health implications

Materials and methods: The study adopts a mixed-methods research design. A quantitative online survey was administered to Italian consumers. 1000 meat consumers, 705 of which were
rabbit meat consumers, filled in the questionnaire. Furthermore, 4 focus groups were realized involving 32 rabbit meat consumers divided into two groups considering their age (<50; >50) and their frequency in consumption (occasional or frequent)

Results: Two main dimensions were analysed through the survey: the consumers' perceptions related to rabbit welfare and the use of cages; the consumers' concerns related to meat safety. The majority of the sample believe that the use of cages is not a way of breeding compatible with the concept of animal welfare. Results showed the consumers' availability to pay more for meat of animals raised in compliance with welfare criteria. Almost all respondents declare that there are no health risks for consumers associated with the consumption of rabbit meat.
Regarding the relation among animal welfare, food safety and human health, relevant differences emerged between occasional young consumers and regular elder consumers. Occasional consumers seem to be more interested in the ethical issues of rabbit breeding related to animal welfare than regular consumers are. Whereas regular consumers are more focused on the food product and its features; they prefer to buy rabbit meat that comes from extensive farming because it is considered safer than the meat from intensive one.

Discussion: The analysis of consumers' opinions and perceptions is crucial for the promotion of actions aimed at improving animal welfare, combining product enhancement with new social sensitivities.

Research highlights

This interdisciplinary study compares different housing systems for meat rabbits focusing on three main dimensions: animal health, economic sustainability and consumer perception of animal welfare. The research represents an original contribution, highlighting how societal concerns and ethical consumers' implications may affect the supply chain management.

Andreas Rienhoff - The farm dog – an underestimated factor for livestock health in dairy farms?

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Introduction:

The health status of dairy cows is influenced by various factors and actors. Also a farm dog can transmit germs during e.g. daily movement over the farm or into stables. The hygiene awareness of cattle keepers is estimated to be low compared to keepers of pigs or poultry. An online survey aimed to provide information on the actual hygiene awareness of farm managers and on the perceived habitat of their farm dogs. Additionally, photographic images of farm dogs in hygienically risky situations should be taken parallel to on-farm recordings of movement patters.

Materials and methods:

In a voluntarily participating dairy farm the dog was prepared with a GOPro camera (Hero+LCD) and GPS tracker (model GT-750FL, Canmore GPS Route Logger) for the recording of the movement patterns. These pattern and images were taken over a period of one month.

Parallel, an online survey was conducted among 66 professional dairy farmers in north-western Germany. Data sets were analyzed by descriptive statistics.

Results:

Survey: Most of the survey participants (n=82%) watched their free running dog eating milk leftovers, food and afterbirths. These statements were also not seen as critical by the dog owners, because the perceived risk would come from dogs outside the company. So (n=42%) of the participants rated a foreign dog as an extremely high risk in contrast to less than 8% for their own dog. Furthermore (n=89%) of respondents stated that their farm dogs are considered as family dogs.

"Action-Cam-Dog": Images showed more than 20 risky contact points between the farm dog and animals and food.

Discussion:

The role of a farm dog perceived as a full family member represents an underestimated risk for farm animals and could weaken the hygiene situation. In spite of that farmers should be sensitized to keep the farm dog away from hygienically critical places in order to maintain the individual health status of the farm animals.

Research highlights:

The dog in animal-keeping farms is rather seen as a companion than a possible source of hazard for pathogen transmission. The analysis of the daily movement profile of a dog equipped with a goPro-Camera showed about 20 critical contact points which can lead to a relevant pathogen transfer every day**.**

Sabrina Burkert The unused potential of *in-vitro* susceptibility tests in animal husbandry practice

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Introduction: The development and spread of antimicrobial resistance are also influenced by the indispensable antimicrobial treatment of sick animals. Since the result of *in-vitro* susceptibility tests, which is obligatory in Germany, is only available after a delay of several days. Infected animals are first treated with an antimicrobial agent selected by the veterinarian ("first prescription"). The research project "Change in paradigm of resistance monitoring" focusses to improve the selection of the first prescribed antimicrobial agent based on already available qualitative data on the specific *in-vitro* sensitivity situation in the respective livestock.

Materials and methods: Results from *in-vitro* susceptibility tests (years 2016-2018) of a pig-specialized veterinarian practice in Germany were retrospectively analyzed. The findings were divided into five districts to determine the possibility of local differences. In this study only results from piglets` feces in which E. coli could be isolated were evaluated.

Results: In total, the isolates represent 64 different farms. The outcomes of the analyses indicate that there are local differences in *in-vitro* susceptibility levels. For marbofloxacin, *in-vitro* susceptibility levels between 85% and 66% are obtained. For enrofloxacin, *in-vitro* susceptibility levels of 85% and 64% are found and for danofloxacin from 79% to 46%, respectively. The resistance profiles were different between the respective livestock farms. This means that the selected antimicrobial agent might be effective.

Discussion: The linked data sets will not only benefit the veterinarian, they can also be used for an anonymous analysis. For this purpose, it is necessary to be able to dynamically update the resistance profiles for the respective livestock farm. Therefore, supported by FarmTool Farmsoftware GmbH (Gescher, Germany) an application software for veterinary practice was developed. Due to the software, results from *in-vitro* susceptibility tests are made digitally usable. This could also lead to a reduction in the use of antibiotics and also improve the profitability of livestock farmers.

Acknowledgements This project is funded by the Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MULNV).

Research highlights: The outcomes of the analyses indicate that there are local and farm-specific differences in *in-vitro* susceptibility levels. An application software for veterinary practice is developed to set up farm-specific antimicrobial susceptibility profiles. Due to the developed software, results from *in-vitro* susceptibility tests are made digitally usable.

Nyayu Lathifah - Family Business in The Western Java Poultry Farms: Challenge and Strategy to Handle The Economic Impact of Animal Disease

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Introduction: Family business as the most common business practice in the Indonesia poultry farms faces a challenge from the animal diseases. The poultry farms in Indonesia are constantly facing the disease problems that reduce their economic performance. For instance, in 2017, AIV H9N2 outbreaks caused farmers suffered from economical loss by 40% to 70%. Most affected farms are small-medium family enterprises. This issue is due to the limited information about the disease control strategy to handle the impact in the family poultry farm. Furthermore, it is due to the limited resources and biosecurity measures and infrastructures to protect the family farm business from the disease impacts. The purpose of this study is to provide control measures strategies that support the resilience of family business in the poultry value chain.

Materials and methods: This study reviewed related works of literature on family business and disease control measure to describe the challenge and propose strategies that can bridge poultry family business to become more resilience to the disease impacts. Survey conducted to family business located in the Western Java poultry farms to collect information on disease experience and the impact to farm economic performance. Then, the study employed the SWOT analysis and collected information from experts by using semi-structure questionnaire.

Results: The study highlighted two important challenges, namely biosecurity practices and capital usages. Limited biosecurity is practiced by the most of family business in the Indonesia. It was determined by awareness, knowledge, and farmer's willingness to do the control measures. Thus, the total value of the disease impacts was higher than the available capital for the family business to recover their business. The available capital availability was driven by social capital reinforcement, capital allocation and FB management. In this case, Indonesia's FB in the poultry farm was found not able to have less incentive to improve their awareness, knowledge and do control measures.

Discussion: Based on SWOT, the proposed strategy for FB was to overcome the threat of animal disease outbreak by using its social capital reinforcement and FB management related to capital usage. These findings highlighted the importance of strengthening FB in poultry farms based on each strength to overcome animal disease impact and take the opportunity to improve their farming system. This paper provides insight for FB in poultry farms to get handle the impact of animal disease. It also contributes to the limited source of references literature regarding FB in agriculture in Indonesia.

Research highlights: Understanding family business and their strategy to counteract economic impact of disease is very useful in carrying out effective control program. The study finds two important challenges, biosecurity practices and capital usages. The study suggests to use social capital reinforcement and capital usage to handle the animal disease impact. Moreover, to strengthen the family business strengths.

Francesco Galli - Identification of latent contact pathways between pig premises using the Mental Model Approach

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Introduction: The spread of infectious diseases between premises depends on the type and frequency of transmission pathways between them. In addition to officially recorded animal transports, a range of indirect contacts between premises occur that are not (systematically) recorded. The role of these latent contacts in disease propagation is largely unknown within the Swiss pig industry. Gathering unbiased knowledge of indirect contacts may be challenging as, for instance, farmers might not want to reveal unsafe practices. The aim of this study was to identify the most important contact pathways between pig premises beyond pig transport.

Materials and methods: We adapted the standard procedures from the Mental Model Approach (MMA), a commonly used expert-elicitation method in risk research. In a first step, seven experts (veterinarians specialized on pig health, collaborators of governmental agencies and animal transport company workers) were interviewed. Based on their input, an initial disease pathway model was established and a guideline for open interviews with pig farmers was created. This second step is used to validate the latent contacts identified by the experts and set them in relation to farm size, label type, production stage and language region (German, French, Italian). A total of twenty farmers were selected. As of October 2020, 15 interviews were performed. Interviews are transcribed and coded using MaxQDA 2020.

Results: Indirect disease transmission pathways can be grouped into contacts via pig transport (e.g. lorry drivers entering the premises, undeclared boar sharing), professional and social contacts between farmers (e.g. sharing of farming tools, meeting at the carcass collection points), external collaborators accessing the barns (e.g. feed advisors, veterinarians) and living vectors (e.g. wild boar, rodents, cats). Moreover, a variety of factors have an impact on reducing or increasing the risk of disease transmission through the identified pathways, such as knowledge of biosecurity rules, production system, affiliation to a trading company and outdoor access for pigs. All disease pathways identified by the expert pool, except boar sharing, were also mentioned by farmers during the first 15 interviews, with varying importance.

Discussion: The MMA helped to identify a variety of latent contact pathways, highlighting the potentially high risk of indirect contacts for disease transmission between Swiss pig premises. The large overlap between disease pathways mentioned by experts and farmers shows that MMA is an appropriate tool to minimize social desirability bias when asking to reveal sensitive information. As a next step, a workshop with all experts will be conducted in order to find a final agreement on the importance and frequency of each indirect contact pathway in the Swiss context. An infectious disease spread model will be built based on both indirect contact and official transport data, to evaluate the relevance of latent contacts for disease propagation and to more efficiently plan disease surveillance strategies.

Research highlights: Infectious disease models based on trade networks are widespread, but connectivity is often underestimated when considering only official trade records. This study presents an innovative use of a classical methodology in social sciences, the MMA, to identify latent contacts between premises and increase accuracy of disease simulations. The Mental Model Approach proved to be an effective tool to gather sensitive information from the relevant stakeholders in a short time frame and with limited resources.

Nichola Naylor - Economically Evaluating Antibiotic Usage Policy from Agricultural and Healthcare Systems' perspectives: A Flexible Compartmental Model

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Introduction: Antibiotic resistance across animal health and human health, and respective related productivity, has been highlighted as a major issue globally. As a result, there have been many calls for restricted use of antibiotics across healthcare and agricultural systems. However, there are few economic impact evaluations of antibiotic usage (ABU) policy. This work developed a flexible model and user-friendly interface that allows microeconomic evaluation of such policy from farm and healthcare system perspectives.

Materials and methods: A deterministic compartmental model was built using R software. Two linked sub-models representing farms and the healthcare system were built, with a function linking ABU in farms and antibiotic resistance levels in humans. Excess unit costs, unit income and unit health-related quality of life weights were attached to the different animal and human states within the state transitions modelled. The outputs estimated are cost-utility (from the healthcare system perspective) and cost-benefit (from the agricultural and cross-sectoral perspectives). The R Shiny was then utilised to transfer this model into a web-application.

Results: The model included over 30 parameters across health (both animal and human) and productivity factors, highlighting the following user-defined inputs; willingness-to-pay for quality -adjusted life years averted, farm animal health and productivity factors (such as cost and income per animal), human health-related costs and the link between ABU and

antibiotic resistance. Place-holder parameters were based on literature, with theoretical scenarios tested. An R Shiny app adequately handled such inputs and presents associated cost-utility and cost-benefit outcomes in a user-friendly way.

Discussion: This work presents the first microeconomic evaluation app in ABU across agriculture and healthcare systems, to the authors' knowledge. In future, this model needs to be tested on a specific setting to present robust impact estimates. Model code- and data-sharing will be key in tackling antimicrobial resistance globally.

Research highlights:
We present a novel, open-access model for understanding the cross-sectoral of antibiotic usage.
This project suggests such models are feasible and can provide useful outputs for decision makers, if described parameter values are available.
The model inputs can be adapted through a user-friendly web-application, and the model structure can be adapted through the code shared via an open-access repository.

Antoine Boudreau - Ecosystemic bioethics: Heath, agriculture and ecology

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Introduction: Antimicrobial resistance results from the inappropriate use of antibiotics in health and agriculture, which reduces their effectiveness. Collaborations between physicians, farmers and ecologists are becoming necessary, but remain limited by many technical (e.g., data sharing) and ethical (e.g., consent and safety) challenges to data sharing. This study is part of the current movement to grow the field One Health field (i.e., a systemic network, approach and thinking to issues of health, agriculture and ecology), which requires the structuring of its networks for data sharing, human collaboration, knowledge communication and, more broadly, the collective construction of knowledge. The objective of this poster is to map these socioethical challenges to global networking by providing a framework that sets out the places and processes needed to conduct collective reflexions (i.e., study the facts, decide on the action and judge its intelligence).

Materials and methods: A feasibility study (2018-2021) on the implementation of monitoring the use of veterinary antibiotics in Quebec is serving as a case study for a socioethical analysis of policy program developments and governance. The concern was to identify the challenges affecting the flow of data between fields to propose an optimal model for data sharing. The analysis maps relationships between key stakeholders for this network which also be relevant to a wider One health system. A collaborative ethnographic design was conducted within and with a multidisciplinary team (observation, interviews, consultation and dialogue) on real, potential and perceived challenges and facilitators encountered by stakeholders. Close dialectical and iterative exchanges with the team and

directly with stakeholders allowed for reflection on potential problems (such as gaps or conflicts of interest, values, skills, responsibilities and other constraints) to the institution of mechanisms for systematic and collective reflection (an ethical governance process).

Results: The framework applies the philosophy of ecosystemic approaches to bioethics and thus aims to strengthen collective reflection processes by specifying where ethics should be realized. Three scales of observation are recognizable: interpersonal (or value), normative (or institutional) and global networks. The last is inaccessible (e.g., physical chaos), although fundamental. The institution of collaborative governance (1st interface) facilitates the structuring of interpersonal reflection (dialogue), while emerging philosophies such as transition management (2nd interface) aims to coordinate in pairs the paradigmatic and structural transformations of human organizations.

Discussion: Ethics should be understood as the set of reflective processes preceding an action in order to judge its value by integrating lessons from the past and posing prospective solutions. Throughout the feasibility study, the collaborative process was based on two theoretical frameworks: collaborative governance and transition management. Their collaboration not only allowed us to refine how to apply this model, but also to accurately test the application mechanics making these multi-scale thinking processes plausible (dialogue, deliberation and declaration). Thus, the results of this socio-ethical analysis framework should ultimately support an applied governance framework for a program to monitor the use of veterinary antibiotics in Quebec.

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Research highlights: The intention is to provide input on the role of ethics in solving global health problems from a pragmatic perspective of public-private-academic-social partnership. Those questions help to navigate through this socio-ethical analysis of a One-Health Data Sharing System: What is ethics, governance & resilience? How to connect individual, institutional and life, in general? Can the global ultimately be a unique networked collaboration mechanism?

Yanan Jia - Assessing the Efficiency of Veterinary Feed Directive in Reducing Food Animal Antibiotics use

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Introduction: United States farmers managing an animal condition (e.g., mastitis) that may require antibiotics make several decisions. Until recently they have chosen whether to administer directly, to call a veterinarian first, or to test before doing either. Now the first is forbidden and a veterinarian must decide whether antibiotics are appropriate. By increasing

to infinity the cost of antibiotics when used outside the Client-Patient Relationship, we study how the Veterinary Feed Directive (VFD) has changed antibiotics choices. We also consider alternative policies, including an antibiotics tax a subsidy for antibiotics related testing, and subsidies on veterinarian services.

Materials and methods: Our decision model addresses choices where the farmer is uncertain about whether antibiotics will be effective, but can purchase certainty by way of a test or both certainty and reduced loss by way of a veterinary visit. The key parameters are test cost, veterinary service cost, antibiotics cost when prescribed by a veterinarian, and antibiotics cost when purchased over the counter (if allowed).

Results and discussion: The outcome of VFD depends on the combination of test cost, veterinary service cost, and treatment cost. We show that, compared with the socially efficient outcome from the perspective of economics, while veterinary oversight as required by VFD may reduce unnecessary use or increase appropriate use of antibiotics, it may also generate animal welfare concerns through non-use in cases where farmers decide non-use is in their best economic interest. Here unnecessary use refers to antibiotics use in mastitis cases which can not be cured by antibiotics, and appropriate use refers to antibiotic use in mastitis cases which can be cured by antibiotics.

Research highlights:
- VFD can decrease a farmer's antibiotic consumption and this is the likely outcome.
- However, circumstances exist where VFD will drive a farmer's optimal decisions towards a less socially efficient outcome.
  - The VFD outcome depends on the combination of test cost, veterinary service cost, and treatment cost. Compared with the socially efficient outcome from the perspective of economics, VFD may reduce medically unnecessary use, or increase medically appropriate use of antibiotics, or likely reduce animal welfare through non-use where use is medically appropriate.
- The effect of test subsidy on antibiotics demand depends on the current level of treatment costs.

When treatment cost is low, then a test subsidy effectively reduces antibiotic demand, while the response is reversed when treatment cost is at a moderate level. When treatment cost is high, a test subsidy won't affect antibiotic dem

Jarkko K. Niemi - Assessing financial losses associated with disease challenges in pig fattening

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Introduction: Inadequacies in hygiene and herd management can lead to elevated incidence of diseases in pigs, mortality and carcass condemnations, deteriorated animal welfare,

increased antimicrobial usage and reduced productive and economic performance of pig fattening. The occurrence and economic consequences of production diseases are influenced by farm management, the animal and the pathogen, and these diseases are particularly important in relation to hygiene and management. When assessing economic implications of diseases it is important to account for both clinical and subclinical diseases although studies often give inadequate attention to the latter. The aim of this study was to analyse financial impacts of four frequently studied types of sanitary challenges with influence on the feed intake and growth response in a fattening pig operation.

Materials and methods: Four sanitary challenges were investigated, namely: 1) digestive bacterial infections mainly with *Escherichia coli*; 2) poor housing conditions, including poor hygiene, space allowance and temperature stress; 3) lipopolysaccharide (LPS) challenges, which included experimental inflammation of pigs with LPS from *E. coli*; and 4) dietary intoxications with mycotoxins. Based on our earlier work (Stygar et al., 2016), a stochastic dynamic optimization model was developed to simulate the growth of pigs, implications of a disease challenge on production parameters, and to optimize the timing of slaughter in a heterogeneous group of pigs under each challenge. A scenario for each of four challenges was developed and the model was parametrized by using a previously published meta-analysis (Pastorelli et al., 2012). This allowed us to account for both subclinical and clinical forms of diseases.

Results: Mycotoxin challenges resulted in the largest financial loss, €11.55 per fattening pig, followed by digestive bacterial infections which incurred a loss of €8.64 per fattening pig. Losses associated with poor housing conditions and LPS challenges were both between €4 and €5 per fattening pig. Disease challenges were expected to result in increased variation of production results and time needed to finish a group of pigs which also incurred losses to the farmer.

Discussion: Farmers may face substantial financial losses due to inadequate herd health management and sanitary measures, and increased volatility of returns caused by animal diseases. Sanitary measures related to feed hygiene can be particularly important. Interventions designed to mitigate disease can benefit farmers financially, but in some cases the adoption of preventive sanitary measures may be costly. This study provided an example on how the effects of disease (clinical and subclinical disease) can be evaluated. However, further work on the model is needed.

References: Pastorelli H, van Milgen J, Lovatto P, Montagne L. 2012. Meta-analysis of feed intake and growth responses of growing pigs after a sanitary challenge. *Animal* 6: 952-961. doi: 10.1017/S175173111100228X. Stygar A, Niemi J, Oliviero C, Laurila T, Heinonen M. 2016. Economic value of mitigating *Actinobacillus pleuropneumoniae* infections in pig fattening herds. *Agricultural Systems* 144:113–21. doi: 10.1016/j.agsy.2016.02.005

Research highlights: Inadequacies in hygiene and herd management can lead to elevated incidence of diseases in pigs, mortality and carcass condemnations, deteriorated animal welfare, increased antimicrobial usage and reduced productive and economic performance

of pig fattening. This study illustrates how the financial effects of a disease and the adoption of good farming practices can be evaluated. It points out that sanitary challenges can substantially reduce financial return of the farm.