

Quantification, Benchmarking and Stewardship of Veterinary Antimicrobial Usage

Fourth International Conference

1-2 February 2024 - Vetmeduni, Vienna, Austria

ABSTRACTS BOOK



Herd level antimicrobial consumption in animals Collect | Analyze | Benchmark | Communicate





<u>Imprint</u>

4th AACTING conference Abstracts book

The authors of the abstracts are responsible for the content of the abstracts.

Unit of Veterinary Public Health and Epidemiology University of Veterinary Medicine, Veterinärplatz 1,

1210 Vienna, Austria

Wien 2023/24



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Conference Programme



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University of Veterinary Medicine, Vienna



Quantification, Benchmarking and Stewardship of Veterinary Antimicrobial Usage

Fourth International Conference 1st-2nd February 2024 in Vienna, Austria

FINAL PROGRAMME

THURSDAY 01 FEBRUARY 2024

09:00	Registration – Welcome coffee – Poster set-up
10:00	Conference opening TBD, VETMEDUNI & AUSTRIAN FEDERAL MINISTRY OF HEALTH
10:15- 11:00	Keynote: The past, present, and future of European surveillance of antimicrobial consumption in animals CRISTINA RIBEIRO-SILVA, EUROPEAN MEDICINES AGENCY
11:00- 11:20	FAO/WOAH guidelines on monitoring antimicrobial use at the farm level Rodolphe Mader, International Centre for Antimicrobial Resistance Solutions Morgan Jeannin, World Organisation for Animal Health (WOAH)
11:20- 11:40	Exploring typologies of antimicrobial use on Argentinean pig farms Laura Valeria Alarcón, National University of La Plata (UNLP), Argentina
11:40- 12:00	Describing differential dairy herd antimicrobial usage patterns in Southwest England using novel means of farm characterisation ELLIOT STANTON, UNIVERSITY OF BRISTOL, BRISTOL VETERINARY SCHOOL, UK
12:00- 13:30	Poster viewing – Lunch & Networking
13:30- 14:15	Keynote: A Model for Change? Implementing a National Antimicrobial Stewardship Programme in Wales. Gwen Rees, Aberystwyth University, Wales, UK
14:15- 14:35	Antimicrobial stewardship: towards a more inclusive intersectoral definition and framework REBECCA HIBBARD, ÉCOLE NATIONALE VÉTÉRINAIRE DE TOULOUSE, FRANCE

14:35- Real-time use data collection demonstrates behavioural changes in antimicrobial 14:55 usage

LAURA MIE JENSEN, DANISH VETERINARY AND FOOD ADMINISTRATION, DENMARK



14:55- The consumption of veterinary antibacterial products in Belgium in 2022 and its

15:15 evolution since 2011

MARIES LISSENS, AMCRA VZW, BRUSSELS, BELGIUM

15:15-16:10 Poster presentations & viewing – Coffee break

- 16:10- Knowledge, attitudes and practices of Austrian veterinarians with respect to
- 16:30 antibiotics: Results of an online survey CLAIR FIRTH, VETMEDUNI VIENNA, AUSTRIA

16:30- 16:50	Assigning defined daily/course doses for antimicrobials used in broiler production in Pakistan and comparing them with the European Medicines Agency values. QAMER MAHMOOD, GHENT UNIVERSITY, BELGIUM
16:50- 17:10	Optimising Global Veterinary Systems for Antimicrobial Stewardship: A Critical Lens on Cross-Country Regulations GABRIELA OLMOS ANTILLON, SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES (SLU), UPPSALA, SWEDEN
17:10- 17:30	Utilising routinely collected veterinary practice data to better understand factors associated with antimicrobial use on UK dairy farms LUCY VASS, UNIVERSITY OF BRISTOL, UK

17:30-17:40 Questions, discussion and conclusions

17:45 End of Day 1

Evening A culinary networking evening in Vienna city centre

FOOD & DRINKS AT MELKER STIFTSKELLER TRADITIONAL AUSTRIAN CUISINE



FRIDAY 02 FEBRUARY 2024

08:00	Poster viewing
08:30	Opening Conference Day 2
08:30- 9:15	Keynote: Recommendations to collect and analyse data of antibiotics use in companion animals – a European working group AACTING Companion Animals Roswitha Merle, Free UNIVERSITY OF BERLIN, GERMANY
09:15- 9:35	Implementation of a pilot benchmarking tool for antimicrobial use in practices of companion animals in Switzerland Anaïs Léger, FSVO, SwitzerLand
9:35- 9:55	Using High level data to develop stewardship strategies and to refine antimicrobial use (AMU) across a large network of Companion Animal Clinics Ian Battersby, Mars Veterinary Health, UK/INTERNATIONAL
9:55- 10:15	Benchmarking of pig farms in Austria: Results and Progress REINHARD FUCHS, AGES, AUSTRIA
10:15- 10:35	Benchmarking Danish pig and cattle veterinarians on antimicrobial prescriptions Amanda Brinch Kruse, University of Copenhagen, Denmark
10:35- 11:30	Poster presentations & viewing – Coffee break
11:30- 11:50	VetTeamAMR – the UK collaboration to improve responsible use Rosie Hughes, RCVS Knowledge, UK
11:50- 12:10	Monitoring antibiotic prescription patterns of veterinarians in the Netherlands: trends and benchmarking PIM SANDERS, THE NETHERLANDS VETERINARY MEDICINES INSTITUTE (SDA), NL
12:10- 12:30	Effect of disincentivising of cephalosporins and fluoroquinolones on their use in farm animals and on resistance in indicator E. coli BERND-ALOIS TENHAGEN, GERMAN FEDERAL INSTITUTE FOR RISK ASSESSMENT (BFR), GERMANY
12:30- 12:50	Measuring farm-level antimicrobial use in low- and middle-income countries as part of implementation research projects RODOLPHE MADER, INTERNATIONAL CENTRE FOR ANTIMICROBIAL RESISTANCE SOLUTIONS
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12:50-13:00 Questions, discussion and conclusions – Conference closing

13:15 Goodbye lunch

* Minor changes may still be made

<u>All posters</u> will be available for viewing throughout the entire conference and viewings are encouraged at all coffee and lunch breaks.

In addition, researchers will be asked to present their posters and be available for questions on specific days at the following coffee breaks:

Thursday 1st February 15:15-16:10 – Posters 1-13: Benchmarking, Communication, 2019/6, etc

Friday 2nd February 10:35-11:30 – Posters 14-27: Data Collection, Data Analysis, etc



Keynote Speakers



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University of Veterinary Medicine, Vienna





Cristina Ribeiro-Silva, Scientific Officer, Veterinary Antimicrobial Monitoring and Resistance Service, EMA

Cristina graduated as a biochemist (2009) and holds a master's in biomedical biochemistry (2011) from the University of Lisbon, Portugal. In 2013, she moved to the Netherlands as part of a Marie Curie ITN consortium to characterize molecular mechanisms of DNA damage response. She holds a PhD (2013-2018) in biomedical sciences from the Erasmus Medical University of Rotterdam and has published several peer-reviewed articles.

Cristina joined EMA's Veterinary Division in 2021 to support the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project that year and was later appointed the project coordinator in 2022 and 2023. During this time, Cristina also provided support to other activities of EMA's AMR service, including the preparation of ESVAC data for the Joint Interagency Antimicrobial Consumption and Resistance Analysis (JIACRA) report, and is actively involved in activities related to the implementation of Article 57 of Regulation (EU) 2019/6.



The past, present, and future of European surveillance of antimicrobial consumption in animals

Cristina Ribeiro-Silva¹ , Anastasia Pickford¹ , Filipa Mendes Oliveira¹ , Barbara Freischem¹ , Zoltan Kunsagi¹

¹ Veterinary Medicines Division, European Medicines Agency, Amsterdam, The Netherlands

Antimicrobial resistance (AMR) is a growing burden in Europe and the world, affecting human, animal and plant health as well as the environment. To decrease the risk of emergence and spread of AMR, multisectoral interventions are urgently needed and knowledge on antimicrobial use is critical for supporting a 'One Health' approach. That is why well-established surveillance programmes on antimicrobial consumption and resistance are essential in Europe and beyond, providing policy makers with up-to-date and reliable data that can be used to develop effective measures. Since 2009, the European Medicines Agency (EMA) has monitored the sales of antimicrobial veterinary medicinal products (VMPs) as part of a surveillance initiative with voluntary participation of European countries: the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project. The project relied on the cooperation and support of the ESVAC Network, composed of national contact points and data managers nominated by the national competent authorities of the participating countries. Over the course of the project, the ESVAC Network increased by more than threefold, reaching a total of 31 European countries in 2017, that continued participating until its end in 2023.

For more than a decade, ESVAC has monitored consumption of antimicrobials in animals across Europe using a standardised and harmonised approach for the collection and reporting of data on the sales of antimicrobial VMPs. These data have been instrumental in shaping and monitoring policies and strategies promoting the responsible use of antibiotics in animals, providing invaluable insights into consumption trends at the European level and within participating countries. It is necessary to ensure that initiatives addressing AMR are carried out within a well-defined framework that fosters collaboration and maximises the impact of each action. Regulation (EU) 2019/6 has introduced legal requirements to strengthen and improve the surveillance of antimicrobial consumption in animals, and all EU/EEA countries now have a legal obligation to collect data on the use of antimicrobials per animal species, in addition to the sales of antimicrobial VMPs. From 2024, countries will start reporting use data to EMA, beginning with the main food-producing species and expanding to other species in a stepwise approach, including companion animals by 2030. In preparation for the new reporting activities, EMA has developed a new IT platform and relevant guidance documents, such as guidelines, manuals, and protocols, that will facilitate the collection and reporting of standardised and harmonised data by Member States to the Agency.

Conclusion

This presentation focuses on the ESVAC project, its main results and lessons learned, and the present and future surveillance of antimicrobial consumption in animals in Europe. For over a decade, the ESVAC project has enabled EMA to report on the progress made towards a more responsible and prudent use of antimicrobials in animals: sales of antimicrobial VMPs have more than halved between 2011 and 2022 in Europe. The success of the ESVAC project would not have been possible without the commitment of the ESVAC Network that has contributed not only by providing sales data, but also by collaborating on the development of protocols, analysis of data and preparation of the annual reports, among other activities. Moving forward, it is essential to build on its legacy by continuing to develop a robust surveillance program that will allow the monitoring of trends and patterns of antimicrobial consumption in animals that require attention.





Gwen Rees BVSc (Hons) PhD MRCVS, Lecturer in Veterinary Science, Aberystwyth University, UK

Dr Rees is Lecturer in Veterinary Science at Aberystwyth University, Veterinary Development Manager with Menter a Busnes and President of the Welsh Branch of the British Veterinary Association.

She leads the Veterinary Prescribing Champions Network on behalf of Arwain DGC, a Welsh Government-funded national program aimed at tackling AMR in ruminants. Gwen received the Royal College of Veterinary Surgeons' Impact Award 2022 for her work with the Veterinary Prescribing Champions Network, and the Network also won the 2023 Antibiotic Guardian Award for Prescribing and Stewardship.

She is Trustee of the Animal Welfare Foundation, Associate Editor for Veterinary Record Case Reports and sits on Welsh Government's AMR in Animals and the Environment Delivery Group.

Qualifying as a vet from the University of Liverpool in 2009, she has worked in farm and equine practice in West Wales and New Zealand. She took up a role at Bristol Vet School as Teaching Fellow in Farm Animal Population Medicine in 2014 and undertook a PhD researching prescription veterinary medicine use by UK dairy farmers.

Gwen's research interests include human behaviour, complex health interventions, antimicrobial stewardship and qualitative research methodologies.



A Model for Change? Implementing a National Antimicrobial Stewardship Programme in Wales.

Dr Gwen Rees BVSc (Hons) PhD MRCVS *Aberystwyth University, UK*

Antimicrobial stewardship is a complex multi-actor process that requires an understanding of behavioural and implementation science as well as a solid grounding in evidence-based prescribing and the mechanisms of antimicrobial resistance. Internationally, there are numerous approaches to improving antimicrobial prescribing in agriculture ranging from legislative change and prescribing restrictions to benchmarking and education. Which approach to take at a national level is context-specific, and depends on the local structural frameworks, the socio-economic and cultural motivations for prescribing as well as the clinical picture.

This presentation outlines the approach taken in Wales, through the Arwain DGC project and the establishment of the Veterinary Prescribing Champions Network – a voluntary initiative which now represents over 90% of all farm and mixed animal practices in Wales. There are key phases identified as important when designing a complex antimicrobial stewardship intervention, namely (i) involving key collaborators in government and industry to stimulate project engagement; (ii) grounding the design in the literature, the results of stakeholder engagement, expert panel input, and veterinary clinician feedback to promote contextual relevance and appropriateness; and (iii) taking a theoretical approach to implementing intervention design to foster critical psychological needs for participant motivation and scheme involvement.

The Veterinary Prescribing Champions (VPCs) are a network of highly trained and motivated veterinary surgeons representing around 90% of all Welsh veterinary practices who service farm animals. The network was initially recruited in 2019 and has received an ongoing programme of training in responsible veterinary medicine use, alongside facilitated discussion sessions, workshops and other in-person and online events. The VPC network has also been responsible for creating and delivering several important outputs, including policy recommendations, and designing and implementing bespoke antimicrobial stewardship interventions within practice. Most recently, the VPC network has worked together with Aberystwyth University and the wider Arwain DGC project to develop two key outputs for the profession with the aim of improving prescribing within the profession. These outputs are a voluntary code of prescribing conduct for Welsh veterinary practices, and a series of prescribing guidelines for key diseases of farm animals in Wales.

By bringing together key collaborative partners, we have been able to help Welsh Government to deliver on the aims of the current AMR in Animals and the Environment 5 Year Implementation Plan and establish a blueprint for approaching animal health challenges successfully. This presentation will outline the award-winning work that Arwain DGC has achieved to date, to illustrate how a voluntary initiative can have meaningful impact in successfully improving responsible use of antimicrobials at a national level.



PD Dr. med. vet. Roswitha Merle, Senior Researcher, Freie Universität Berlin, Germany

Department of Veterinary Medicine Institute for Veterinary Epidemiology and Biostatistics Freie Universität Berlin, Germany



Current Position: Senior researcher; Deputy Head of the Institute

Education

- 2018 Recognition as Diplomate of the European College of Veterinary Public Health, sub-specialty population medicine (Dipl. ECVPH)
- 2014 Habilitation thesis (Senior lecturer qualification, Dr. med. vet. habil) and license to teach (*venia legendi*) in Veterinary Epidemiology at the Institute of Biostatistics, Epidemiology and Information Processing at the University of Veterinary Medicine in Hannover, Hannover, Germany; Mentor: Prof. Dr. Lothar Kreienbrock
- 2008 Recognition as German veterinary specialist (Fachtierarzt) in Epidemiology
- 2003 Thesis (Dr. med. vet.) at the Centre for Food Science, Department of Hygiene and Technology of Milk, University of Veterinary Medicine in Hannover, Germany; Supervisor: Prof. Dr. Jörn Hamann

2000 Approbation in veterinary medicine, DVM (University of Veterinary Medicine Hannover, Hannover, Germany)

Professional Activities and Academic appointments

- Since 2020: Liaison professor for undergraduate students
- Since 2019: Deputy Head of the FAO Reference Centre Veterinary Public Health at the Department for Veterinary Medicine, Freie Universitaet Berlin
- Since 2019: Representative of the scientific staff in the faculty board, Department for Veterinary Medicine, Freie Universitaet Berlin
- 2016 2020: Guest Professorship (Animal Hygiene and International Veterinary Public Health) at the College of Animal Science and Veterinary Medicine, Shandong Agricultural University, Tai'an, China
- Since 2014: Deputy Head of Institute for Veterinary Epidemiology and Biostatistics, Department of Veterinary Medicine, Freie Universität Berlin, Germany
- 2013 2014: Scientific Staff at Bavarian Authority for Health and Food Safety, Department of Veterinary Pharmaceuticals, Erlangen, Germany
- 2012 2013: Project Manager at QS Quality and Safety GmbH, Bonn, Germany
- 2003 2012: Post-doctoral Position at WHO-Centre for Research and Training in Veterinary Public Health within the Department of Biometry, Epidemiology and Information processing, University of Veterinary Medicine Hannover, Hannover, Germany
- 2001 2003: Doctoral Thesis at the Centre for Food Science, Department of Hygiene and Technology of Milk, University of Veterinary Medicine, Hannover, Germany



Recommendations to collect and analyse data of antibiotics use in companion animals – a European working group AACTING Companion Animals

Roswitha Merle¹, Inge van Geijlswijk², Jan Bernardy³, Suzanne Dewulf⁴, Anaïs Léger⁵, Maries Lissen⁶, Wannes Vanderhaeghen⁶ and the AACTING Companion Animals

consortium

¹Freie Universität Berlin, Institute for Veterinary Epidemiology and Biostatistics, Germany; ²Utrecht University, Pharmacy Department, Netherlands; ³Union of European Veterinary Practitioners; ⁴University of Ghent, Belgium; ⁵Federal Food Safety and Veterinary Office, Switzerland; ⁶AMCRA Knowledge centre on antibiotic use and resistance in animals, Belgium

During the last decade, monitoring systems of antibiotics use in farm animals have been introduced in most European countries allowing for benchmarking, communication and identification of high users within specific sectors of the country. Meanwhile, the focus is extended to antibiotic use in companion animals and some countries already started routine data collection. Although there are many parallels to the monitoring system in farm animals, some new challenges occur in the context of companion animals.

The aim of the working group AACTING Companion Animals is to provide knowledge- and experience-based recommendations that can support countries or organizations that want to collect and analyze data on antibiotics use in companion animals. The aim is to improve the quality of the collected data as well as to facilitate the further development of the systems. Moreover, these guidelines will improve comparability between results from various countries within sectors or species. This will assist interested persons from various backgrounds to easily gain a comprehensive impression of the work done on quantification of veterinary antimicrobial use in companion animals.

We have identified different purposes of data collection in the context of the levels of interest (e.g. national level, research project level) and have discussed which indicators are recommended for which purpose and also for which stage of the implementation of a national monitoring and surveillance system. In general, it is recommended to start with the collection of data that are easily available and start but only informing the public and the veterinarians about the results. After this implementation phase, more detailed data may be necessary to develop a proper benchmarking system.

In the talk, we will present the application of certain indicators addressing the advantages and limitations of each. We will also show some examples that highlight possible bias.

Conclusion

The objectives to evaluate the use of antimicrobials might vary between different purposes and there is not one perfect solution that fits for all. Thus, it is important to balance between cost and effort, data completeness and feasibility as well as between scientific and policy-driven objectives. The recommendations will support decision-makers to weigh out the optimal approach in terms of the respective purpose.



Oral presentations



Herd level antimicrobial consumption in animals Collect | Analyze | Benchmark | Communicate



University of Veterinary Medicine, Vienna



Exploring antimicrobial use in typologies of Argentinean pig farms

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The administration of antimicrobials has been found to increase antimicrobial resistance (AMR) in swine. Resistant E. coli in swine can be a reservoir for resistance genes transferable to other pathogenic and zoonotic bacteria in humans. For these reasons, it is crucial to identify risk factors related to antimicrobial treatments in order to target interventions to limit resistance levels. The objective of this study was to characterize the antimicrobial usage (AMU) of Argentinean pig farms according to the main typologies of farms based on facilities, management practice and biosecurity.

A cohort of Argentinean pig farms (n=40; including farrow-to-finish pig farms) was followed for 12 months between 2021 and 2022 in Buenos Aires, Santa Fe, Córdoba and Entre Ríos provinces. A stratified convenience sample of farms was enrolled: Eleven farms with 100-300 breeding sows were selected along with 13 with 301-700 breeding sows and 16 with >701 breeding sows. Data on AMU were collected for one year using garbage can audits along with reported medicated tons of feed. Production data were downloaded from on-farm software or Excel databases from farms. AMU was calculated using DDDvetCA/1000pig-days (Bosman et al., Can Vet J, 2021). A risk factor survey with 50 questions was designed, piloted and administered on participating farms in order to gather information about facilities, management practices and biosecurity. Exploratory data analysis was conducted using Multiple Correspondence Analysis (MCA) which helped to identify the most important relationships among variables. A hierarchical cluster analysis (HCA) was then used to explore data driven partitioning of farms. Candidate variables were categorized and 44 were selected according to multiple criteria (low variability, no biological relationship to AMU, etc.). Following the results of HCA, the Multi-Response Permutation Procedure Test (MRPP; a nonparametric method to test multivariate differences among pre-defined groups) was used to test for statistically significant differences between partitions. Following this, an indicator value analysis was performed to determine which variables significantly characterized each group. All studies used PC ORD v6 software (Gleneden Beach, Oregon, USA). Finally, the AMU metric (DDDvetCA/1000pig-days) was transformed and the differences between the means of partitions were tested using analysis of variance (significance level: 0.05) and Tukey's range test.

The variance extracted for the first 10 axes was 65.3% and the first two partitions explained 15.8% and 7.6% of the variance, respectively. HCA resulted in the identification of three significant partitions of farms (MRPP, pp, p<0.0001). Partition 1 included 12 farms (mean sows: 300, min: 95, max: 689), Partition 2: 17 farms (mean sows: 713, min: 210, max: 1510), and Partition 3: 11 farms (mean sows: 1813, min: 518, max: 6569). Farms in Partition 1 had poorer facilities, less external biosecurity measures and low disease management. In Partition 2, farms had better facilities but lacked internal biosecurity measures. In Partition 3, farms had more modern facilities, were spread across multiple sites and had better health and biosecurity management. The AMU for Partition 1 was 154.3DDDvetCA/1000pig-days (SD: 78.3), for Partition 2: 449.4 (SD: 431.5), and for Partition 3, 264.6(SD: 183.1). Statistical testing did not reveal any significant difference between AMU in the three partitions (p-value: 0.06).



Conclusion

This approach showed that the application of biosecurity measures, facilities and husbandry in Argentinean swine farms is still diverse (Alarcón et al., 2019). Numerically (but not statistically) highest AMU was observed in a partition of farms which had a moderate number of pigs along with better facilities and economic resources than smaller farms, but with poor internal biosecurity. Descriptive analyses such as these allowed us to classify potential factors for AMU present in smaller datasets of farms where power is limited due to low sample size (often because studies, such as this one, are also designed to explore multiple outcomes, such as longitudinal AMR). Future analyses should be conducted to more exactly identify risk factors and focus efforts on improving biosecurity, along with AMU reduction activities, to reduce the risk of AMR in low-resource settings such as Argentina.



Using high level data to develop stewardship strategies and to refine antimicrobial use (AMU) across a large network of Companion Animal Clinics

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Mars Veterinary Heath (MVH) is a network of over 2900 companion animal veterinary clinics across 27 countries. The hospitals cover different aspects of companion animal work, including specialist referral work only, primary care only, emergency only, or a combination of these services.

MVH is working to embed antibiotic stewardship across their veterinary network by the end of 2025. As such, an initial benchmarking exercise was established to analyse AMU using purchase data as a proxy for prescribing data.

The subsequent analysis facilitated the development of a bespoke report for each group of practices (the largest group compromising of over 1200 hospitals, the smallest group around 100 hospitals) which identified potential opportunities to improve antimicrobial stewardship. A combined analysis of the purchase data from hospitals within the USA, Canada and UK, which together employee over 12,000 veterinarians is currently under review with the Journal of Veterinary Internal Medicine for publication.

This presentation will overview the process and findings of this benchmarking process and how the information was utilised to create a stewardship strategy. The presentation will also address the need to adapt the framework of the strategy at a local level due to different working practices and across different countries.



Benchmarking Danish pig and cattle veterinarians on antimicrobial prescriptions

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Despite a low antimicrobial use (AMU) in the Danish livestock production, responsible AMU is continuously a subject receiving political focus. The main concern is combating expendable AMU to reduce the risk of antimicrobial resistance. The Danish Veterinary and Food Administration (DFVA) listed benchmarking veterinarians on antimicrobial prescription as a new initiative in their national action plan for antimicrobial resistance in livestock and food products from 2021. The goal is to increase the awareness and understanding among the veterinarians of their antimicrobial prescription patterns. Furthermore, the benchmarking system is expected to be useful as a visual tool in relation to the DVFAs supervision of veterinarians responsible for Veterinary Advisory Service Contracts (VASC). As part of a previous project in the Danish Veterinary Consortium (DK-VET), a benchmarking system was designed using antimicrobial prescription data from Danish pig and cattle veterinarians responsible for VASCs. Data were retrieved from VetStat - The Danish database of all prescription drugs sold to animals in Denmark and CHR (the Danish Central Husbandry Register). A model was developed comparing veterinarians based on mean percent treated animals per day (ADD/100 animals/day) for each species and predefined age groups.

The objective of this study was to evaluate the Danish pig and cattle veterinarians understanding of the benchmarking system and identify elements that influenced the perceived relevance. At physical meetings with pig and cattle practices in Denmark, a short introduction of the benchmarking system was given. In an online survey application, each veterinarian could see the benchmarking model with their own mean antimicrobial prescription compared to the mean antimicrobial prescription for all veterinarians (one benchmarking per relevant species and age group). Feedback from the veterinarians were collected through a semi-structured questionnaire included in the application and by notetaking of verbal feedback during the meeting.

Conclusion

The results and conclusion from this study will be presented at the conference.



Knowledge, attitudes and practices of Austrian veterinarians with respect to antibiotics: Results of an online survey

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The aim of this study was to assess the level of knowledge among Austrian veterinarians about antibiotic use and antibiotic resistance, their attitudes towards these factors and their day-to-day practice on use of antibiotics. A "knowledge, attitudes and practice" (KAP) study was carried out using a structured online questionnaire, enabling both qualitative and quantitative data to be collected. KAP studies are particularly common in healthcare and public health, as they can help to provide valuable information for the planning and implementation of certain programmes, such as education about specific diseases. A link to an online questionnaire was sent to Austrian veterinarians via the official e-mail distribution list of the Austrian Chamber of Veterinarians. The link (or QR-code) was also distributed during conferences and via social media, e.g., in private veterinary Facebook groups.

A total of 180 veterinarians completed the survey. There are approximately 3000 veterinarians registered in Austria, meaning that this was a response rate of around 6%. Respondents could be divided into 55.6% companion animal veterinarians (namely pets and/or equine), 30.6% farm animal veterinarians and 13.9% working in mixed practice.

Farm and mixed practice veterinarians were much more likely to have attended training courses on antibiotic use and resistance in the last five years than companion animal vets (82.5% vs 54.0%). Those working with farm animals and in mixed practice were also more likely than companion animal practitioners to have heard of the Austrian government's prudent antibiotic use guidelines for veterinary medicine (92.5% vs 66.0%), however only 55.0% of all 180 veterinarian respondents had actually read these guidelines.

The vast majority (97.2%) of Austrian veterinarians recognised the unofficial and undefined term "reserve antibiotics" (vaguely taken to mean critically important antibiotics that should be reserved for human use), but only 63% knew the term critical antimicrobials. The official terms from the European Medicines Agency (namely Category B), the World Health Organization (HPCIA), and the World Animal Health Organisation (VCIA) were less well known and recognised by only 32.2% (EMA), 26.7% (WHO), and 10.6% (OIE/WOAH) of Austrian veterinarians.

There was also uncertainty about the correct classification of antibiotics. For example, the fluoroquinolone, marbofloxacin, was correctly classified as a critically important antibiotic by only 31.7% of respondents.

Overall, 43.3% of the veterinarians considered the influence on the development of antibiotic resistance when selecting the mode of administration, and the majority correctly stated that oral group therapy has the greatest influence on the development of antimicrobial resistance.

Moreover, there were differences in some practical aspects between companion animal veterinarians and those treating farm animals. For example, 60.0 % of the farm animal veterinarians always or regularly (defined as in around20-50% of cases) used antimicrobial susceptibility testing, compared to 45.0 % of companion animal and only 28.0 % of mixed practice vets.

In addition, 90.0% of the respondents agreed with a statement that critical antibiotics should not be used as a first-line treatments in veterinary medicine.

Conclusion

The online survey presented here demonstrates that there is a continued need for further education and training, as well as improved communication with respect to recommended prudent use guidelines, with a particular focus on veterinarians working with pets and horses, who have not been required to report their antibiotic use to date.



Benchmarking of pig farms in Austria: Results and Progress

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In 2018, the pig sector accounted for more than three quarters of the total amount of antimicrobials dispensed in Austria (28.5 out of 37.4 tonnes). Notably, even taking into account the significantly higher biomass of pigs reared, the consumption of antimicrobials in this sector far exceeded that in other sectors. To raise awareness and to reduce the use of antimicrobials in the pig sector, AGES (on behalf of the ministry for health) has initiated a voluntary benchmarking programme together with the Austrian Pig Farmers' Association (Verband Österreichischer Schweinebauern) and the Austrian Animal Health Service (Österreichischer Tiergesundheitsdienst). First reports were sent out in January 2020. Since 2020, the use of antimicrobials in pigs has decreased by a quarter (from 24.6 to 18.3 tonnes). However, the question arises how the voluntary benchmarking programme has contributed to this reduction? And in particular, is there a difference between farms that participate in benchmarking programme and those who do not?

Data on dispensed antimicrobials must be reported by all veterinarians operating a veterinary pharmacy in aggregate form for each year as specified in the national regulation (Veterinär-Antibiotika-Mengenströme Verordnung). This data includes the farm ID, the animal species and the total amount used for each marketing authorisation (MA). The substances in each MA were converted to daily doses per year using the defined daily doses for animals (DDDvet) (EMA/223665/2016). The underlying number of animals per farm was obtained from the VIS (Consumer Health Information System) database using data on livestock, animal movements and slaughtered animals. Furthermore, each pig farm is categorised into a specific farm type (fattening, breeding, piglet rearing, farrow-to-finish) and compared only with corresponding farms of the same type.

The Austrian Animal Health Service comprises around 6,300 pig farms, which account for about 95% of the Austrian pig production. A third of these pig farms have agreed to receive a farm individual benchmarking report. It can be shown that farms that have received a report had a more efficient reduction in antimicrobial use than farms that did not participate. It was verified that there was no difference between the two groups before the start of the program.

Benchmarking reports on farm level are an efficient tool for raising awareness for antimicrobial use and promoting its reduction. The farm to fork strategy of the European Commission sets the goal of antimicrobial reduction in farmed animals and aquaculture by 50% compared to 2018 in the EU. Benchmarking reports, even on a voluntary basis, can help to reach this goal.



Antimicrobial stewardship: towards a more inclusive intersectoral definition and framework

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Antimicrobial stewardship (AMS) is a commonly advocated approach to address antimicrobial resistance. It implies a more comprehensive and contextualised understanding of antimicrobial use (AMU) practices than strictly quantitative AMU measures, for it considers not only the quantities of antimicrobials used, but the ways in which and the reasons for which they are used. It encompasses the concepts of both conservation (related to considerations of *when* and *when not* to use antibiotics), and optimisation of AMU (related to considerations of *how* to use antibiotics when their use is indicated), and frames these within the context in which such decisions are made. However, AMS is often defined in different ways depending on where it is applied. A range of different definitions are now in use, each of which may be functional and well-structured for a given context, but that are often ill-adapted for collaborative work across different sectors and settings. This presents difficulties for intersectoral communication on AMS and communication with actors in the field who are often the targets of AMS interventions, and complicates the design, implementation, and evaluation of AMS interventions from a One Health perspective.

To address these challenges, we used boundary object theory to propose a working intersectoral definition for AMS for the human and animal health sectors. Boundary object theory is used to explain how different scientific communities and disciplines collaborate without needing to come to consensus. We applied this approach by analysing AMS as a concept that is flexible enough to be used by different communities, but stable enough to retain a shared meaning across these groups. When looking at AMS as a boundary object, we identified three key elements which were common to AMS in different settings in the human and animal health sectors – a sense of temporal and interpersonal responsibility, flexibility in scale and scope, and contextual contingency (the importance of context in conditioning stewardship actions). Based on these findings, we developed a definition for AMS applicable for the human and animal health sectors, and a list of 'stewardship elements'. This definition is proposed as a first step towards a shared understanding of AMS across the One Health spectrum at an international level. The list of stewardship elements is designed to ground the definition in reality by providing concrete examples of how AMS could be applied in different contexts, to facilitate the design and implementation of AMS interventions in the field. Further extensions of this work could include extension of the definition to incorporate elements pertinent to plant health, and application of the definition and elements to develop indicators for evaluating AMS interventions.



VetTeamAMR - the UK collaboration to improve responsible use

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RCVS Knowledge is the independent charity partner of the RCVS1 sitting at the heart of the veterinary professions with a mission to advance the quality of care for the benefit of animals, the public and society. Its VetTeamAMR initiative champions the responsible use of antimicrobials across the sector. This major collaborative project, part sponsored by the Veterinary Medicines Directorate, brings together a cross-industry consortium to create and use the evidence base to support continuous improvements at the point of care.

As part of VetTeamAMR, in May 2021, the charity launched **Farm Vet Champions (FVC).** This award-winning initiative builds a supportive community who collaborate and share knowledge. FVC work together to apply preventative measures and active management plans to establish and embed good antimicrobial prescribing principles. Alongside continual practical improvements, FVC work through a series of learning modules, created by veterinary AMR experts from across the profession. There are currently 533 dedicated FVC across the UK who are actively applying improved stewardship because of this initiative. A further 218 have accessed the training, despite not being responsible for prescribing in practice. FVC can use the online **SMART Goals tool**. This enables veterinary teams to set goals within teams, to collaborate to target, track and improve their antimicrobial prescribing. An example of an achievement of this tool is the campaign by the Sheep Antibiotic Guardian Group called 'Healthy Feet, Healthy Sheep' for vets and farmers to improve sheep foot health.

In June 2023, the charity launched **free learning modules for Companion Animal and Equine teams** covering; common conditions and the associated recommendations around decision making for antibiotic use; behaviour change theory highlighting measures to support improved prescribing habits; resources for in-house laboratory skills that empower vets to incorporate patient-side diagnostics into their daily work. Module completion leads to Antibiotic Guardian status, at one of 4 increasing levels: Bronze, Silver, Gold, and Platinum. Veterinary practices are encouraged to have at least one Gold Antibiotic Guardian within their practice. To date, 110 people have accessed the training and started their journey to become an Antibiotic Guardian.

The **audit and benchmarking tool for companion animal and equine veterinary teams** to measure and track change related to antimicrobial stewardship is in development, incorporating data from veterinary practices and animal owners/managers. This will be available in 2024.

The charity also runs the annual RCVS Knowledge Awards for Antimicrobial Stewardship. A national scheme that commends excellence and gathers examples of what good antimicrobial stewardship looks like, and the benefits it brings, on a practical level.

Conclusion

The VetTeamAMR project is a social movement for change that builds knowledge and practical applications to lead to improved antimicrobial prescribing in veterinary practices. All content is free to use and accessible to all veterinary team members, whatever their preferred learning approach. Having access to support and evidence-based knowledge enables the user to confidently address barriers to responsible prescribing and helps prevent inappropriate antibiotic use.



Real-time use data collection demonstrates behavioural changes in antimicrobial usage.

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In 1998 Denmark phased out the use of antimicrobial growth promoters, resulting in an increased use of therapeutic antimicrobials for treatment of production animals1. The withdrawal of zinc oxide, in February 2022, as a veterinary medicinal product from the European market was anticipated to result in a similar pattern in Denmark. Using VetStat data we were able to demonstrate an increase in the treatment of gastrointestinal diseases in weaner pigs, as foreseen (Figure 1A). The increase was primarily in the use of neomycin.

In Denmark, neomycin is first-choice for treatment of weaning diarrhea2. A few months after the increase in use of neomycin an increase in the use of apramycin, a Danish second-choice antimicrobial for treatment of weaning diarrhea2, was observed on several farms. On the basis of data from VetStat we were able to do small-scale interventions and initiate communications with veterinarians already in the fall of 2022. The veterinarians supported the presumption, that the use-dependent increase in resistance against neomycin was observed on farm-level only a few months after the transition from zinc oxide utilization for control of weaning diarrhea to therapeutic treatment with neomycin. Increasing resistance levels towards neomycin reduced the effect of treatment and forced the veterinarians to substitute neomycin with apramycin for short periods; and in some instances, switch to only using apramycin (Figure 1B).

The strategy of switching between antimicrobial active substances and the demonstration of this by the use of real-time farm-level data, can support the need for collection of data in this manner.



Figure 1A Visualization of behaviorial change on a national level: a rise in the use of neomycin and apramycin *Figure 1B* Substitution between neomycin and apramycin on farm-level.

The collection of real-time data allows for continuous surveillance of which active substances are being used for treatment. Additionally, having data on farm-level makes it possible to concurrently analyze how choice of active substances can shift over time. Communication with the organization of veterinarians as well as data-availability for farmers makes real-time data useful in the daily management on farms as well as on the public administration side.

Conclusion

The collection and use of real-time data makes it possible to follow changes in treatment-choice closely. Changes in treatment strategy can often be explained directly through the effects on the bacterial flora and the resistance that can develop as a result of antibiotic treatment.

¹**FAO and Denmark Ministry of Environment and Food – Danish Veterinary and Food Administration.** 2019. Tackling antimicrobial use and resistance in pig production: Lessons learned from Denmark. Rome. ²Vejledning om ordinering af antibiotika til svin,

https://foedevarestyrelsen.dk/Media/638193236606138944/FVST_Antibiotikavejledning_april_2018_4sidet.pdf



Implementation of a pilot benchmarking tool for antimicrobial use in practices of companion animals in Switzerland

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Interventions to improve antimicrobial use (AMU) in companion animals, i.e. a more appropriate use of antimicrobials, are implemented worldwide. Literature mentions frequently the development of support, such as national guidelines, stewardship activities at local level (big clinics, teaching hospitals), awareness campaigns for veterinarians and owners. Among all those tools, benchmarking (BM) is recognized as a successful option. It has already been implemented in several sectors such as food producing animals and human health. Benchmarking for companion animals is less frequent and only in selected places, mainly on voluntary basis and never at national level.

Switzerland collects since 2019 AMU data in companion animals with a maximal coverage (mandatory implementation) with a system called IS ABV (Information System on AntiBiotics in Veterinary medicine). A first report analyzing AMU data was published in 2021, reports have been available annually. These reports only address data at national and species level. Quality feedbacks are sent on a monthly basis to veterinary practices to assist them to identify potentially incorrect prescriptions and enhance the quality of data sent to the database. These feedbacks do not include analyses at practice level, which would be of interest for veterinary practices to improve their practices in antimicrobial prescription. This study reports the implementation in 2023 of a pilot benchmarking tool (organized in different implementation phases) at practice level for AMU in companion animals. The analysis is organized in two sections: benchmarking factor and additional data of the practice. The first part focused on the TBI (index for animal treatment), used to classify the practices and identify the bigger users. The TBI was calculated per species and practice type (i.e. practice, clinic or mixed practices). Veterinary practices were asked to provide their number of consultations (i.e. visit from a companion animal at the practice) to be used as denominator for the BM factor. The second part concerns additional data that are relevant to veterinary practices to understand and gain a better overview of their prescription habits. All data (e.g. total number of animal treatments, total weight of prescribed antimicrobial) are compared to a median value for comparable practices.

Conclusion

Many technical and scientific issues have been raised during the implementation of this pilot BM: compliance of veterinarians, choice of useful and understandable factors, categorization of practices, quality of data from IS ABV. This first step is important in the process of the implementation of the BM tool and feedback from veterinary practices are welcomed to tailor this tool in a useful accessory to improve AMU.



The consumption of veterinary antibacterial products in Belgium in 2022 and its evolution since 2011

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The annual consumption of veterinary antibacterial products in Belgium and its evolution since 2011 are reported in the BelVet-SAC report under the authority of the Belgian Federal Agency for Medicines and Health products (FAHMP). The report includes sales data since 2011, covering all animal species and collected from distributors and compound feed manufacturers, and also use data since 2018, collected at farm level via the data collection system Sanitel-Med. Until recently, use data only covered the use in pigs, broilers, laying hens and veal calves, but mandatory data-collection has expanded to all other cattle and all other poultry of the species chicken and turkey since August 10th, 2023.

Overall, the results achieved in 2022 were very good: a total of 122,4 tonnes of active substance were sold, almost 50 tonnes below the 2021 total (171,6 tonnes) and 177 tonnes below the total of the reference year 2011. Taking into account the biomass, the standardised consumption of 61,3 mg antibacterials/kg biomass showed a record decrease of -24,5% compared to 2021 and an overall reduction of -58,2% since 2011. This represents a major leap towards the -65% reduction target included in the AMCRA vision for the end of 2024, and set to evolve towards the median use in Europe (approx. 50 mg/kg biomass). Furthermore, the reduction targets for use of critically important antibiotics, colistin and medicated premixes were all maintained or achieved in 2022.

These positive results are confirmed in the Sanitel-Med use data of pigs and veal calves, where the number of treatment days (BD₁₀₀) at species level in 2022 as compared to 2021 decreased with -28,2% and -9,8%, respectively. For poultry, an increase of +11% was reported, mainly due to an increased use in broilers. Although this setback should raise awareness in that sector, it does not necessarily mean a cause for alarm yet, as the obtained reduction in previous years still resulted in very few broiler farms with a red benchmark colour score (<1%) or an alert user status (0,1%). Further progress is also required in pigs in order to meet the sector-specific reduction pathways and to reduce the number of alarm users (4,5% in 2022) to the aim of maximum 1% by 2024. The most challenging perspectives remain for the veal calf sector, which is still furthest away from these reduction targets with 21% of farms having a red benchmark colour score and almost 14% being defined as an alarm user.

Conclusion

Many challenges are still ahead, but the 2022 results are encouraging for all stakeholders to continue and strengthen their combined efforts in the future.



FAO/WOAH guidelines on monitoring antimicrobial use at the farm level

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Since 2015, the World Organisation for Animal Health (WOAH) has been collecting data from its Members on antimicrobial agents intended for use in animals, with data mainly coming from records of national sales and imports of antimicrobials. To complement this information and improve decision-making, farm-level antimicrobial use (AMU) data are needed, as it allows for better understanding of how antimicrobials are used in the field. Therefore, the Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific (FAO RAP), the WOAH Regional Representation for Asia and the Pacific (WOAH RRAP) and the WOAH Sub-Regional Representation for South-East Asia (WOAH SRR-SEA) jointly developed the guidelines on Monitoring antimicrobial use at the farm level. The guidelines are intended to be used by competent authorities, research institutions and agrifood industry actors who plan to develop or improve an AMU monitoring system at the farm level. Recommendations cover both terrestrial and aquatic food-producing animals and consider a wide range of AMU monitoring capacities.

The guidelines provide detailed guidance on three main steps for establishing a farm-level AMU monitoring system. Step 1 consists of conducting a situational analysis, and guides readers through a series of questions to better understand the context. Step 2 refers to the operational mechanism, i.e. the establishment of a governance and organizational structure (steering committee and coordination unit), as well as funding models. Step 3 is about technical preparation, i.e. (i) defining monitoring objectives, (ii) prioritizing animal species, production types, production systems and antimicrobials, (iii) developing a data collection plan, (iv) developing data management, analysis and communication plans, and (v) expanding farm-level AMU monitoring in a phased approach. The document is illustrated by many examples.

Two regional consultations were organized (8-9 November 2018 and 27-29 April 2021) to ensure that the guidelines meet the needs of countries in Asia and the Pacific, taking stock of previous AMU monitoring initiatives, and receiving additional technical inputs. Participants in these meetings consisted of nominated government representatives from Asia and the Pacific with responsibility for AMU surveillance, along with regional partners and international subject matter experts. These experts were also consulted on an ad hoc basis throughout the guidelines' development process. These guidelines represent the fifth volume of a collection of regional guidelines for the monitoring and surveillance of antimicrobial resistance (AMR), AMU and residues in food and agriculture, steered by FAO RAP and funded by the United States Agency for International Development (USAID).



Conclusion

The guidelines are expected to boost the establishment of monitoring systems and cross-sectional studies on farm-level AMU, especially in low- and middle-income countries. It will also support the implementation of the Codex guidelines on integrated monitoring and surveillance of foodborne antimicrobial resistance. Although developed for Asia and the Pacific, the objectives, scope and progressive approach described in the guidelines may be of interest to and applied in other regions



Measuring farm-level antimicrobial use in low- and middle-income countries as part of implementation research projects

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The International Centre for Antimicrobial Resistance Solutions (ICARS) is working in partnership with low- and middle-income countries (LMICs) to design and test context-specific solutions to tackle antimicrobial resistance (AMR). ICARS works across the One Health spectrum, builds on national action plans and provides both funding and technical expertise to partner LMICs. In 2023, ICARS was supporting 36 projects, including 11 projects targeting the animal sector (6 in poultry, 4 in pigs and 1 in aquaculture). In order to design and test solutions, LMIC governments co-develop projects with local research institutions and other relevant stakeholders with technical support from ICARS. For example, in Zimbabwe and Zambia, ICARS supports farmer field schools, where poultry farmers learn to implement good animal husbandry practices (including farm biosecurity), what to do when their animals are sick and about prudent antimicrobial use (AMU). In Tanzania, a project aims to optimise vaccination against bacterial diseases and biosecurity regimes for local small and medium scale poultry farms, to reducing diseases occurrence and AMU using tailored support and training. In Georgia, the aim is to assess if removing antimicrobials as growth promoters negatively impacts production parameters, after improving biosecurity and day-old chick quality assessment in farms. In these interventions, frequently used outcome variables are antimicrobial use, biosecurity scores and antimicrobial residues. Each project will also assess behavioral change and the economic impact of interventions for farmers.

Multiple challenges in measuring AMU have been faced in the design and implementation of the projects. Challenges encountered include (i) limited expertise within countries on how to collect and analyze farm-level AMU data, (ii) scarcity of AMU data to support sample size calculations, (iii) a potential high drop-out rate of farmers enrolled in the interventions with implications on sample size and study design, (iv) inconsistent record keeping, requiring a close follow-up at farm level, (v) the sale of animals at different ages throughout the production cycles, (vi) the use of substandard and falsified drugs, (vii) the frequent sale and use of antimicrobials without prescriptions, (viii) absent or inaccurate feed labels regarding antimicrobial content and (ix) poor farmer knowledge on antimicrobials.

These challenges highlight the need for a comprehensive understanding of the context, pilot testing research protocols before study implementation and thus the importance of working with local organisations. ICARS helps alleviate some of these challenges by providing technical advice from the project design to the implementation phase. It is essential to keep protocols simple to collect only necessary information. In some projects, when feed labels are absent or inaccurate, animal feed is tested to detect the presence of defined antimicrobial agents, which allows the calculation of count-based AMU indicators. Quantifying antimicrobial concentration in feed and antimicrobial products is, however, costly and such capacity is not always available.



Conclusion

Measuring AMU at farm level in LMICs entails numerous challenges. Some of the solutions to these challenges can be implemented as part of research projects but may not be applicable to monitoring systems. Data collection processes and project design must understand the wider context, and behavioural and economic models can be used in the planning and implementation stages to understand and address these challenges. ICARS-supported projects contribute to better understanding how antimicrobials are used in farms in LMICs, filling a major knowledge gap.



Assigning defined daily/course doses for antimicrobials used in broiler production in Pakistan and comparing them with the European Medicines Agency values.

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Antimicrobial resistance is largely driven by the (mis)use of antibiotics in human and veterinary medicine. To improve the management of antibiotics in farms, a comprehensive evaluation of antimicrobial usage (AMU) in animal production is needed. Various metrics are available for quantifying antimicrobial use. One such metric is Treatment Incidence (TI), which is determined through Defined Daily Dose (DDD) and Defined Course Dose (DCD) values. TIDDD indicates the percentage of time a broiler is subjected to antimicrobial treatment during a defined period. DDD is a standardized unit of measurement that takes into account the different doses of antibiotics that are commercially available for a given animal species (poultry). TIDCD indicates the number of treatments that an animal receives during a specified period. DCD is determined by the total amount of antibiotics required to complete a typical course of treatment for a particular infection in a particular animal species. In the present study, we have established DDDpk and DCDpk values for antimicrobial products employed in broiler production in Pakistan. These values were compared with the respective DDDvet and DCDvet values reported by the European Medicines Agency (EMA).

Based on a survey of 100 broiler farms in Punjab, Pakistan, a list of antimicrobials used in broiler production was determined. DDDpk and DCDpk values were assigned to these antimicrobials based on the recommended doses for main indication from country-specific Summary of Product Characteristics (SPCs). Conversions were made for doses reported in units other than milligram per kilogram body weight. Antimicrobials with salts or derivatives in SPCs were reverted to parent molecules to assign DDDpk and DCDpk values. Separate values were designated for products with synergistic effects. To compare with EMA values, the mean of difference between Pakistani and EMA DDD values was calculated along with standard deviation and percentile of variation. Antimicrobial agents without EMA values were excluded from the comparison.

A total of 39 different antimicrobials belonging to 17 various classes of antibiotics (including: Aminocyclitol, Aminoglycosides, Amphenicols, Chloramphenicol, Quinolones, Lincosamides, Macrolides, Nitrofurans, Penicillins, Phosphonic acid derivatives, Pleuromutilins, Polymyxins, Polypeptides, Streptogramins, Sulfonamides, Tetracyclines, Trimethoprim and derivatives) were found to be used in the surveyed farms. Out of these 39, 35 antimicrobials were assigned DDDpk & DCDpk values for treatment, while 30 antimicrobials were assigned DDDpk and DCDpk values for prevention as well. Important differences were found between Pakistani and EMA values. For example, Amoxicillin in Pakistan had a mean DDDpk value of 25.7mg/kg, 1.61 times higher than the European DDDvet value of 16 mg/kg. Ampicillin registered 173.1 mg/kg, 1.60 times higher than the EMA value of 108 mg/kg, and Apramycin was 1.22 times higher (99 mg/kg vs. 81 mg/kg). In contrast, Chlortetracycline was 0.68 times lower (20.4 mg/kg vs. 30 mg/kg). For Colistin (4.8 mg/kg vs. 5.1 mg/kg), Sulfadiazine-Trimethoprim (33 mg/kg vs. 34 mg/kg) and Tilmicosin (19 mg/kg vs. 18 mg/kg) the values were comparable between. For 13.04% of the antimicrobials the DDDpk closely aligned with the DDDvet values, while in 39.13% of the cases, the DDDpk values were substantially lower compared to the DDDvet values and in 47.83% of the cases, DDDvet values were substantially higher than DDDpk values. These differences may stem from variations in environment, regulations, indications, and animal husbandry practices.



Conclusion:

The discrepancies between Pakistani and EMA DDD and DCD values underscore the necessity of employing locally determined metrics to quantify antimicrobial usage in Pakistani broiler production. Besides, regulatory bodies should ensure consistent reporting of antimicrobial units and dosages by pharmaceutical companies. An official list of authorized veterinary antimicrobials should be developed, along with the maintenance of standardized SPCs.



Optimising Global Veterinary Systems for Antimicrobial Stewardship: A Critical Lens on Cross-Country Regulations

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In the face of the rise of the antimicrobial resistance (AMR) crisis, the critical optimisation of global antimicrobial use (AMU) has become imperative. International collaborations and national programs aim to reduce the overall veterinary AMU, focusing on livestock. This study employs a social practice theory paradigm to examine the contested significance of strategies, focusing on veterinary-AMU practices in Brazil, Spain, and Sweden. We conducted a comprehensive study, critically appraising national AMU/AMR programs, legislation, and guidelines framing AMU in contrasting species (dairy cattle and pets). In-depth interviews (n=20) with national experts provided insights into current best practices, offering a nuanced understanding of how the veterinary profession navigates diverse scenarios.

Our analysis reveals that national programs primarily target human behaviour change through increased awareness and top-down regulatory imperatives. However, guidelines often assume practices outside of each country's realities. A cross-country theme emphasises adherence to basic AMU principles, contingent on a valid veterinary client-patient relationship. Failures in achieving successful relationships, such as lapses in outcome follow-up recording, were identified. The uneven distribution of social accountability places a disproportionate burden on veterinarians and farmers in the livestock sector.

Moreover, the veterinary-client relationship is jeopardised by poor retention and renewal of the veterinary profession due to different problems particular to each country and species. This emphasises the need for comprehensive measures to address the intricacies of veterinary practices.

Conclusion:

Countries globally share the goal of optimising antimicrobial use in the veterinary sector. Still, the emphasis on reducing AMU, while crucial in the short term, may impede long-term progress without robust systems. Strengthening the veterinary client-patient relationship is pivotal, necessitating a deeper understanding of its intricacies. Current national plans exhibit a limited focus on reinforcing veterinary systems. Our key message: we must strengthen veterinary systems globally, anchoring goal oriented changes in sustainable practices for the long-term well-being of our global community. Our finding supports the need for NPs to be revised based on contextual knowledge of specific settings to be meaningful and practical.



Monitoring antibiotic prescription patterns of veterinarians in the Netherlands: trends and benchmarking

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Antibiotic use in the Dutch livestock sectors has decreased substantially. The total amount (in mass) sold in 2022 use was 77.5% lower than sales in 2009, the reference year chosen by the Dutch government. The goal set out by the government; a 70% reduction compared to the 2009 level is achieved. Prudent antibiotic use is considered a shared responsibility of veterinarians and farmers in the Netherlands. One of the important drivers of the reduction in antibiotic usage was making prescription patterns of veterinarians transparent and benchmarking veterinarians. Since 2014 veterinarians are benchmarked in the Netherlands. To this end the Veterinary Benchmark Indicator (VBI) was developed. This indicator was first introduced in 2014 and was recently revised and transformed into a more simplified, intuitive approach. The revised indicator is similar to the indicator used to describe farm level antibiotic use (number of defined daily doses per animal year) and represents the number of days per year the average animal within an animal population for which a particular veterinarian was responsible, was given antibiotics. This VBI is calculated using data from all livestock farms with which the veterinarian concerned had a registered one-to-one relationship, excluding those with persistent high usage levels.

The resulting VBI value is then compared with the benchmark threshold value for the type of farm or production category concerned.

In this presentation the (evolution of the) monitoring system for veterinarians will be explained. Trends in the prescription patterns of veterinarians and developments in benchmarking of veterinarians are illustrated for different animal species. Also experiences with regard to benchmarking veterinarians will be shared.



Describing differential dairy herd antimicrobial usage patterns in Southwest England using novel means of farm characterization

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Understanding the patterns of antimicrobial usage (AMU) on farms with different management styles and production parameters is important to enable evidence-led decision making to design intervention strategies for the purpose of sustainably reducing AMU. There is currently a limited body of research identifying farm-level risk factors for AMU in dairy, with studies mostly considering either the influence of herd size or the incidence of specific diseases. As neither parameter is necessarily (directly) amenable to intervention, a more exploratory and granular investigation - identifying whether specific combinations of production metrics, management practices and health parameters are directly or indirectly associated with herd-level AMU - is warranted.

This research made use of data collected during the 'One Health Selection and Transmission of Antimicrobial Resistance' (OH-STAR) study, in which 53 dairy farms in southwest England were studied between 2016 - 2018. Alongside environmental sampling for antimicrobial resistance, an extensive questionnaire was completed by each farm; veterinary practices associated with each farm provided AMU sales records. Veterinary sales records were processed in line with ESVAC protocols to provide estimates of annual AMU on each farm using mass-, dose- and course-based metrics to mitigate the biases associated with reporting AMU as a single metric.

Facing a situation in which the number of predictors was larger than the number of observations and a general belief that drivers of dairy AMU are likely to be complex and multifaceted, various risk factor analysis methods were initially employed. One method deemed particularly appropriate involved considering how AMU dynamics varied between farm typologies. To achieve this, farm typologies were determined through hierarchical clustering on principal components, with the principal components themselves derived through a factor analysis of mixed data on cleaned questionnaire data (and thus naïve to a farm's estimated AMU). Using this method, farms were grouped in a data-driven way, based on differences in predictors most associated with overall variation within the sample of farms.

By varying the number of clusters of typologies, farms were partitioned and characterised by each resulting typology. Groupings associated with differential AMU could then be identified and their characteristics compared, in order to make inferences surrounding their influence on AMU. Partitioning mainly occurred according to how extensive (as opposed to intensive) a given farm was, how various diseases important to dairy such as mastitis were routinely treated, and whether more progressive dairy farming practices had been adopted. Clusters containing more intensive farms - that were more likely to practice blanket dry cow therapy, treat clinical mastitis for longer periods and use injectable antibiotics in mastitis treatment - were found to have significantly greater levels of AMU than less intensive and more traditional partitions.

Conclusion

Substantial variation between dairy herd AMU is now well established. Using data-driven approaches to partition farms based on key management, production and health parameters is a novel way to reveal that different herd typologies are associated with markedly different AMU profiles. These methods enable improved untangling of the complex networks of often correlated farm characteristics. Identifying traits common to herd typologies with varying levels of AMU provides a valuable tool in facilitating feasible, evidence-led AMU reducing interventions in the livestock sectors.



Effect of disincentivising of cephalosporins and fluoroquinolones on their use in farm animals and on resistance in indicator *E. coli*

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In 2014, Germany established a benchmarking system for farms housing meat production animals in order to decrease antimicrobial use (AMU) in these farms. In 2018 a further legal amendment was put into place prohibiting off-label use of fluoroquinolones and 3^{rd} and 4^{th} generation cephalosporins. It was the purpose of this study to investigate whether the specific regulations on these substances had an effect on their use in farm animals in Germany (measured by the sale of these substances to veterinarians), whether it decreased treatment frequency with these substances in meat producing animals and whether this had an effect on antimicrobial resistance (AMR) of indicator *E. coli* at slaughter to these substances. Use data were collected in the framework of the benchmarking system und resistance data were collected according to Commission Implementing Decisions 2013/652/EU and (EU) 2020/1729.

The association of changes in AMU and AMR with the legal changes were investigated in two ways. On the one hand, trends of AMU and AMR were analysed using annual and biannual data, respectively. On the other hand, AMU and AMR data summarized between 2014 and 2018 were compared to AMU and AMR data for the period 2019 to 2022.

Sales of the two antimicrobial classes to veterinarians dropped significantly after 2018. Specifically, antimicrobial use decreased in pigs and in cattle for both substance categories. In broilers and turkeys, cephalosporins were not used anyway but treatment frequency with fluoroquinolones also dropped. In contrast, however, antimicrobial resistance to the two substance categories in indicator *E. coli* did not decline after 2018, which was unexpected.

Conclusion

While AMU was apparently influenced by disincentivising use of 3rd and 4th generation cephalosporins and fluoroquinolones, AMR in indicator *E. coli* remained unchanged. As regards cephalosporins, the reason for this could be the low level of AMR to cephalosporins in indicator *E. coli* from calves and pigs at slaughter. However, fluoroquinolone-resistance in *E. coli* from poultry is substantially higher but still no reduction of AMR was observed in *E. coli* from broilers, turkeys, fattening pigs and veal calves at slaughter. The reason for this warrants further investigation.



Utilising routinely collected veterinary practice data to better understand factors associated with antimicrobial use on UK dairy farms

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Improving antimicrobial (AM) stewardship and reducing usage is a key priority for the UK dairy industry. Although AM use within the sector has reduced in the last decade, studies show that there is a large amount of variability in the quantity of AM usage on dairy farms, with some high users being responsible for an unexpectedly large proportion of total usage in the industry. However, there is little evidence for the risk factors for high AM use in UK dairy herds.

Routinely collected veterinary practice data was used to investigate trends and identify predictors for high AM sales to UK dairy farms. Veterinary sales data, milk recording data and herd health planning reports from a large English farm animal practice were obtained via a data sharing agreement. This dataset represented approximately 60,000 dairy cattle from 124 farms from 2010-18 (3.2% of the total UK dairy herd in 2018). A natural language processing algorithm was harnessed for the semi-automated linkage of sales records to antimicrobial product specifications, reducing the labour required to calculate the quantity of AM sales. Milk recording data was used to accurately estimate the number of adult dairy cattle in each herd and calculate mass-based metrics for antimicrobial consumption (mg/PCU). Milk recording data and herd health planning reports were used as a source of contextual information about herd characteristics, health and productivity. Bayesian linear regression models and variable selection were employed to identify factors most strongly associated with high AM sales.

Across the study period, total AM purchases were reduced by 41% (median reduction in mg/PCU), and this decline was driven mostly by historically high-purchasing farms. Despite this, in 2018 there was still a large amount of variation in total AM purchases between the study farms, with the top 20% of purchasers being responsible for 44% of total sales. Regression modelling revealed strong evidence that higher AM purchase frequency, smaller herd size and higher milk yield are associated with increased total AM and intramammary AM sales. Additionally, lower purchase of AM dry cow intramammaries was associated with lower total AM sales and lower AM lactating cow intramammaries sales in the following year.

Conclusion

With appropriate pre-processing and quality control, routinely collected veterinary practice records are a rich source of data for AM stewardship research and allow for the assessment of potential risk factors for high AM use in dairy herds. As well as describing trends in AM sales throughout the period, we found that in SW English dairy herds, smaller, more productive herds purchase more AMs, more frequently. A better understanding of the factors associated with high AM use is essential to designing impactful interventions to continue to reduce AM use in food-producing animals into the future.



Poster presentations



Herd level antimicrobial consumption in animals Collect | Analyze | Benchmark | Communicate



University of Veterinary Medicine, Vienna



Documentation of antimicrobial resistance in veterinary practices in Germany – Is the data homogeneous or heterogeneous?

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The use of antimicrobials in all sectors is considered one of the main contributing factors and has therefore been monitored at national and international level for many years. As there was no system to simultaneously record antimicrobial use and resistance at farm level, in Germany the Veterinary Antimicrobial Usage and Resistance (VetAmUR) project was launched in 2021 to develop such a concept as a pilot project.

Initial experience has shown that collecting data on antimicrobial resistance in routine veterinary practice is not very standardised. From a technical perspective, this is reflected in the different formats in which participating veterinary practices document their data, which is the basis for data collection within our project. The collected data reflect, for example, that the detection and susceptibility test and evaluation method chosen differ between laboratories as well as the type of documentation of the results (e.g. original, interpreted). Depending on the species and the reason for sampling with subsequent resistance testing (e.g. acute health problem, treatment failure, introduction of new group of animals to the farm), a selection bias may be introduced that affects the interpretation.

This presentation discusses the heterogeneity of resistance data documentation in German veterinary practices in terms of content and format, consequences and possible solutions for evaluation.

Conclusion

The heterogeneity highlights the need to develop a common and flexible data structure to support the integrated analysis of antimicrobial use and resistance data at farm level.



Monitoring Antimicrobial Usage by using the VetCAb-ID database in commercial broiler production in Pakistan

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The use of antimicrobial agents (AMU) varies greatly due to (agri-) cultural differences in animal husbandry of respective countries around the world. Particularly in low- and middle-income countries, access to and use of antimicrobials differs from that in industrialized countries. Monitoring data on AMU in livestock at farm level outside of Europe are still lacking.

The database of the "VetCAb-International Documentation" (VetCAb-ID) project allows farmers, veterinarians, scientists or other interested parties to document and analyze data on AMU in animals. For example, the average use of antimicrobials in a given period for a given species, farm, region or country can be determined. To use the database, it needs to be adapted in advance to the needs of the project. The output of the database can be used to evaluate AMU through descriptive and basic analytical epidemiology.

In cooperation with the University of Agriculture in Faisalabad, Pakistan, first data from commercial broiler chicken farms were collected and analyzed. In Pakistan, antimicrobials are used to treat diseased animals, as well as for growth promotion and prophylaxis in animal production. In addition, antimicrobials on the WHO list of "Critically Important Antimicrobials for Human Medicine" (CIA) are widely used in broiler production. Many of the antimicrobials used in poultry production in Pakistan consist of two to five different antimicrobial agents.

For a feasibility study in 2021, data were collected from two poultry farms in Pakistan near Faisalabad with three flocks each, and a number of birds per flock between 25.000 and 30.000. AMU data were analyzed and the therapy frequency per six months was calculated. In previous studies from Pakistan, AMU in poultry farms were recorded by using different metrics. Therefore, a direct comparison with the new data is not possible.

Conclusion

Monitoring of AMU data from poultry farms in Pakistan is feasible using the VetCAb-ID database and therefore a comparability of the therapy frequency on Pakistan poultry farms with data from German poultry farms is possible. First descriptive evaluations of the data set shows an extended use of antimicrobials on poultry farms in Pakistan compared to German poultry farms.



Calypso: the French system to collect antimicrobial use in veterinary medicine

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Calypso is an information system facilitating the share of data between veterinarians and the French administration. It is a secure electronic system financed by the Ministry of Agriculture in order to meet several legislative requirements including the collection of antimicrobial use within the new EU Veterinary Medicines Regulation 2019/6. Calypso is the platform for data collection and storage and is the central database repository for all usage of antimicrobials in France.

Implementation of the system to collect antimicrobial use

Calypso is a wide system with several business processes, among these services, one deals exclusively with the collection of antimicrobial use for the vets, pharmacists and feed mills. The methodology developed for the collection of antimicrobial use favours as much as possible automatic, continuous and controlled transmission of data.



Figure : *Calypso, the French system to collect antimicrobial use for the vets, pharmacists and feed mills*

Calypso has been implemented in April 2023, and is aimed to collect the use of antimicrobials intended to all species (food producing animals and non-food producing animals) from the start of the collection.

How do the vets report their use data?

It was decided that Calypso would work with the connection between IT tools and the French Ministry of Agriculture. A set of Application Programme Interfaces (API) should be developed for all softwares to interact with Calypso. Veterinary softwares include among others: the repository of veterinary medicinal products used in the software of veterinarians to collect standardised information, the repository of animal categories and rules to easily identify fractionning.

Each veterinary tool (prescription & delivery) should be qualified: it means that each software should prove its ability to transfer antimicrobial use data. Each software should apply a set of tests to be sure that use data are correctly registered. Once the tool is qualified, each vet using this tool is able to report its use data in Calypso. An interface for the manual data entry has been implemented in October 2023. Feed mills report directly their deliveries of antimicrobials in Calypso (by API or submission of files)

and the pharmacists use manual input to report their deliveries.



Development of a system evaluating three qualitative aspects of antimicrobial use in dairy cows on farms and appreciating targeted treatment of mastitis

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In the Czech Republic, similarly to the countries with highly developed farming systems, the largest part of antimicrobial use (AMU) in the sector of dairy cattle is associated with mastitis treatment and control. Minimising the incidence of mastitis and its targeted treatment thus represents the greatest potential for AMU reduction.

The system, serving as a tool that utilises data on AMU and udder health monitoring for the complex evaluation of dairy farms, began to be built two years ago. The system will use DLN Cattle software as the AMU data source (already built and noted on the AACTING web). It is intended to evaluate the total quantity of AMU by counting treatment courses (i.e. the use of one AM VMP in one quarter or on an animal via another route), but it also includes three qualitative aspects in each treatment course: 1) EMA-AMEG category of an antimicrobial (AM); 2) Czech "Prudent use regimen classification"; 3) number of antimicrobials per one veterinary medicinal product (VMP) - monocomponent VMPs should be preferred; both injectable (one or two AMs) and intramammary (one or two to four AMs) antimicrobial VMPs will be specifically considered and scored. Malus points will be applied for the use of antimicrobials based on the above 3 aspects. It means that for aspect "1" AMEG, AM are scored as D, C, B with a malus of 10, 20 and 30, respectively. For aspect "2", VMPs classified as under "prudent use regimen" will incur additional 10 malus points. The last scoring aspect "3" which considers the number of AMs per VMP, will assign full points to the AM from the highest AMEG category among AM in the VMP. For the second, third or fourth component, only half the points will be counted (three-component VMP from D + C category should not be scored more prudently than a monocomponent one from B category). All VMPs containing antimicrobials within the scope of obligatory reported ATCvet codes as defined by the Annex of the Commission Delegated Act (EU)2021/578 will be considered in the scoring system. The subsequent part of the system is specifically designed to address targeted mastitis therapy during lactation and drying off. Once the treatment in lactation begins, 40% of malus points will be removed, if there is proof of a pathogen (= treatment will be targeted). Drying off performed without AM will be awarded by 5 bonus points per quarter (i.e. a maximum of 20 bonus points per cow without AM). Udder health scoring will be evaluated according to the test-day somatic cell count (SCC) from milk recording (MR). The frequency of new infections a) during lactation, b) between the last MR test before drying off and the first MR test after delivery will be the main parameters derived from the SCC. Data will be summarised quarterly and made available online for the participants. The planned formal outcomes structure per AMU is as follows: A) Number of treatment courses per 100 cows/year (=36500 feeding days); B) Scoring points per 100 cows/year (including sum, malus and bonus points separately); C) Subgroup "Czech Prudent Use" will be visible separately. Further scoring related to udder health will also be visible for management purposes.

Conclusion

The developed system should comprehensively evaluate not only the quantity and quality of AMU, but also assess targeting of the mastitis treatment and udder health. During the pilot phase, ranking will be conducted among the farms participating voluntarily, and they will be finally classified into three certification categories. If it becomes more widespread within the dairy sector, it could also be linked with subsidy systems. Supported by the Ministry of Agriculture of the Czech Republic - the National Agency for Agricultural Research, Project No. QK22020292.



The influence of antimicrobial substance class choice on the bias in the benchmarking of German broiler farms introduced by using standardized animal weights and daily doses in treatment frequency calculations

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Every system that benchmarks the antimicrobial use (AMU) of farms must strike a balance between accurately measuring AMU and keeping the reporting burden as small as possible. The German Antibiotics Minimization Concept specifies that treatment frequencies are to be used to measure AMU and benchmark farms. Previously, we have investigated how using standardized values for animal weights and daily doses in the calculation of treatment frequencies –a demand often expressed with the goal of lowering reporting burdens– would impact the German benchmarking system (Flor et al., 2022, 2023). We showed that estimating actual treatment frequencies by using DDDvet values (EMA, 2016) and standardized animal weights introduces bias and leads to shifts in the percentile ranking of farms. Here, we extend our analysis to investigate how these shifts are influenced by the choice of antimicrobial substance class in German broiler farms. In order to separate the effect of substance class choice from a farm's absolute treatment frequency we adopted a compositional data approach (Aitchison, 1982). We used actual treatment frequency proportions of substance classes administered on a farm as predictor variables for a farm's percentile rank shift and implemented a compositional regression model with a zero-sum constraint using additive log (base 2) ratios that have the benefit of being easy to interpret (Coenders & Pawlowsky-Glahn, 2020).

With data from the second half of 2017 we found that the substance class with the largest influence on a German broiler farm's percentile rank shift are polymyxins (see Figure 1). If the proportion of polymyxins on a farm was doubled at the expense of other substance classes (i.e. without increasing overall AMU) then that farm would be expected to be ranked 3.2 percentiles higher (i.e. worse) in a benchmarking system based on standardized values. The second strongest influence was found for fixed aminoglycoside/lincosamide combinations where a farm doubling the proportion of these products at the expense of other substance classes would be expected to be ranked 2.2 percentiles lower (i.e. better).



Figure 1. Zero-sum constrained coefficients of a compositional regression using additive log (base 2) ratios of antimicrobial substance class proportions. The interpretation of a substance class's coefficient is that it represents the change in the expected percentile rank shift when the ratio between the proportion of that substance class and each and every of the other substance classes doubles. AG – aminoglycosides, AG_LINC – aminoglycoside/lincosamide (fixed combinations), FQ – fluoroquinolones, MAC – macrolides, PEN – penicillins, PMX – polymyxins, SULF – sulfonamides, $SULF_TMP$ – sulfonamide/trimethoprim (fixed combinations), TET – tetracyclines.

Conclusion

If treatment frequencies in the German benchmarking system were estimated by using standardized values for animal weights and daily doses, antimicrobial substance class choice would influence the ranking of broiler farms such that farms utilizing high proportions of polymyxins at the expense of other antimicrobial substance classes would be ranked worse. Conversely, farms administering high proportions of fixed aminogylcoside/lincosamide combinations would be ranked better.



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Antimicrobial Usage in Dogs and Cats in Germany from 2018-2022

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According to the Regulation (EU) 2019/6, monitoring of antimicrobial use (AMU) in dogs, cats and horses will be mandatory from 2029. In Germany, the Veterinary Medicinal Products Act (TAMG) mandates this recording as of 2026.

Although patient visits to the veterinary practice and medication prescriptions are entered in a management software (PMS), there is currently no central database in which all antibiotic prescriptions are recorded. The aim of our study was to establish a recording system and to develop an evaluation strategy for the AMU. We used retrospective data of more than 200 practices throughout Germany including more than 300,000 dogs, cats and horses between 2016 and 2022. Processing of the data revealed that the completeness and quality of the data varied widely. We developed tools to identify the pharmaceutical names in >70% of the records. Further, we classified the recorded diagnoses into different organ systems and could allocate the organ system in >70% of the records. In our calculations, we used standard mean body weights of horses (500 kg) and cats (4 kg). Breed-specific average body weights were calculated to determine the average weight for dogs and could be allocated to 99% of dog records.

Data analysis was done species-specific and accounting for different substances and substance classes, for combinations of indication and substance as well as for the use of antibiotics of highest critical importance.

In our presentation, we will address the challenges in processing data from routine AMU recordings, present the results of our study and give an outlook on how AMU data can be analyzed for monitoring purposes.

Conclusion

Although the AMU in companion animals is recorded in the PMS, central data collection, data cleaning, data analysis and assessment are challenges that need to be addressed carefully. Stakeholders should also be integrated in the development process.



Farm advisors' perceptions of their relationships with farmers and behaviour change on the farm: An exploratory study

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Farmers are consistently being challenged to adapt their on-farm behaviours to maximise productivity and align with emerging legislation and industry standards. For example, the most recent changes to the EU Veterinary Medicinal Products Regulation (2019/6), which restrict antimicrobial use (AMU) on the farm, necessitate considerable changes to farm behaviours. Teagasc, the Irish agricultural research public agency, has dedicated advisors who provide advice and support to farmers, to facilitate the adoption of beneficial behaviours. However, there is a dearth of literature, exploring how Teagasc advisors deliver this help to farmers. Accordingly, the current study explored how Teagasc advisors support farmers to adapt their on-farm behaviours. Eight semi-structured online/telephone interviews were conducted with Teagasc dairy and pig advisors. Interviews were transcribed and underwent inductive/deductive hybrid thematic analysis. Inductive thematic analysis explored the context of the advisor-farmer relationship, while deductive analysis, employing the Michie Behaviour Change Technique Taxonomy (Version 01), identified specific behaviour change techniques (BCTs), which advisors utilised when working with farmers to facilitate behaviour change. Analysis elucidated five inductive themes and 25 BCTs. Advisors provide individualised assistance, independent well-rounded advice, compassionate counsel, and a safe space for farmer-farmer sharing. This provides a foundation for a trusting relationship to be established between the advisor and farmer, and allows BCTs, such as goal setting and social comparison, to be delivered more effectively. However, their ability to provide this support is moderated by the farmers' stage of change.

Conclusion

The findings illustrate that advisors utilise a variety of strategies to help farmers adapt their on-farm behaviours, including AMU behaviours, and that behaviour change training, which incorporates content on person-centred communication and building motivation, is needed.



Antimicrobial use on Argentinean pig farms

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Antimicrobial resistance (AMR) represents a growing threat to human and animal health. Progress has been made in reducing antimicrobial usage (AMU) in food-producing animals in several European Union member states. In Argentina, work has only recently begun to raise awareness about the need to reduce usage, so obtaining quantitative data to set a baseline for this is vitally important. This study aimed to quantify AMU in Argentine pig farms and to categorize AMU according to patterns of use and risk to human health.

AMU data were collected for 12 months between 2021 and 2022 in Argentina in 40 farrow-to-finish pig farms in the provinces of Buenos Aires, Santa Fe, Córdoba and Entre Ríos. In each group of pigs (sows and piglets, weaners and fatteners), AMU was quantified by counting empty injectable antimicrobial bottles and containers collected in a garbage can audit; quantification also incorporated tons of medicated feed sold to each group. Data on the number of animals on the farm and numbers sent to slaughter along with their average weights were downloaded from farm software or Excel files. The following metrics were calculated: 1) milligrams of antibiotic per Population Correction Unit (mg/PCU; European Surveillance of Veterinary Antimicrobial Consumption); 2) number of Canadian defined daily doses for animals (DDDvetCA, Bosman et al., CVJ, 2021) and 3) Canadian DDD adjusted by animal numbers (DDDvetCA/pig, Bosman et al., CVJ, 2021). The European Medicines Agency categorises antimicrobials for veterinary use according to their importance in human health, with Categories A and B being, respectively, avoidance and restricted use. The amount of antimicrobials used in each category was quantified. The results of the AMU metrics are shown in Table 1.

Table 1. AMU metrics calculated for 40 Argentine farrow-to-finish pig farms

Metrics	Min	Q1	median	Q3	Max
mg/PCU	36,5	178,31	419,91	688,01	2736,23
DDD vetCA/pig	4	45	76	143	526

The highest percentage of DDDvetCA occurred in weaners (median of all farms' medians: 70.7%), followed by fatteners (median: 28.3%); sows and piglets (median: 0.46%) used the fewest antimicrobials.

Category A antimicrobials amounted to 1.8 million DDDvetCA (2.3%), among which Fosfomycin (1.4% of all antimicrobials used) and Virginiamycin (0.95%) were used. Category B antimicrobials amounted to 8.0 million DDDvetCA (10.3%), including quinolones (7.9%) and third generation cephalosporins (2.3%). The most common route for the administration of antimicrobials was through food, followed by water and then injection. In-feed antimicrobials were used preventively 95% of the time.

Conclusion

This is the first study measuring AMU in pig farms in Argentina and provides preliminary data to understand the current situation in the country. Considering that 12.6% of antimicrobials documented are critical for human health, it is essential that Argentine farmers implement measures to reduce their use. The results of this study provide data that can assist with the design of strategies for the rational use



of antimicrobials in swine, especially in lower income countries. Consideration should be given to strengthening diagnoses to identify causative agents and implement vaccination as well as to improving hygiene, environmental control and the biosecurity of farms



Cow Health Monitoring with smaXtec on German Dairy Farms: Impact on Antimicrobial Usage and Farm Economics – First Results

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Background

Driven by the need to slow down the spread of Antimicrobial Resistance in pathogens, Germany has implemented a number of measures. One of the goals formulated in this context is the reduction of Antibiotics sold for veterinary use by 50 % in the timeframe of 2018 to 2030 (Federal Ministry of Health 2023). But how farmers reduce their Antimicrobials Use (AMU) is mostly up to them and their veterinarians. Most of the scientific literature concerning the reduction of AMU in dairy cows is concerned with selective dry cow treatment, be it in Germany (e.g. Schmon 2019, Sorge et al. 2023) or internationally (e.g. Ferreira et al. 2022, Tijs et al. 2022). Continuous cow health monitoring with precision livestock farming technology such as the smaXtec system may offer a way to reduce AMU during lactation by allowing AMU-free therapy options after early detection of illnesses.

Methods

In this ongoing project 6 farms throughout Germany were chosen to gain insight into the effects of implementing continuous cow health monitoring with the smaXtec system on AMU and farm economics. On-farm data was obtained by retroactively collecting records of a two-year timeframe: starting one year before and ending one year after the implementation of smaXtec on the individual farms. Application and Delivery Forms that are mandatory to be filled out by veterinarians on German farms were analysed for AMU data. Economic data was collected from veterinary invoices and further production key figures were gained through milk yield testing data.

Preliminary Results

AMU was expressed in two different indicators: the dosage based Animal-defined daily dosages (ADDD) (e.g. Obritzhauser 2018, Kuipers et al. 2016) and Treatment Frequency (Tfreq) (Veterinary Medicinal Products Act 2022).

AMU	ADDD		T _{freq}			
	before	after	HY1 before	HY2 before	HY1 after	HY2 after
Farm 1	5,20	6,79	1,33	2,14	2,64	2,50
Farm 2	6,30	5,00	2,29	2,79	2,76	3,17
Farm 3	4,73	7,31	2,04	2,38	2,60	3,11
Farm 4	2,50	2,59	1,31	1,70	1,30	1,37
Farm 5	1,67	2,27	1,01	0,78	0,63	1,58

Table 1: Antimicrobial Use (AMU) on the five dairy farms evaluated so far. T_{freq} is calculated every half year (HY)

Conclusion and Outlook

The first preliminary results of the five dairy farms evaluated so far concerning their AMU after introduction of continuous cow health monitoring with smaXtec are inconclusive. At the date of the conference, further results including a more detailed analysis of AMU and use of other drugs, economics and production figures are expected to be presentable. One possible factor influencing AMU immediately after introduction of health monitoring may be an adjustment phase farmers go through with the unfamiliar technology. A further research phase with a longer timeframe is therefore in planning at the moment.



ANIMUSE Global Database: curbing antimicrobial resistance with data

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As the global authority on animal health and welfare, WOAH has been collecting information on the use of antimicrobials in animals since 2015. A report has been published every year to provide access to this crucial and growing set of information and has highlighted steady efforts in the animal health sector worldwide. By 2022, WOAH transitioned from an excel based data collection to ANIMUSE Global Database, an interactive online system publicly accessible at amu.woah.org. This facilitates easier, more accurate data monitoring, visualisation, analysis, and use for surveillance, supporting the Veterinary Services in their National Action Plans (NAPs) against antimicrobial resistance (AMR). During all those years, challenges like training the Veterinary Services, improving data quality, institutionalisation of data collection systems needed to be addressed. Technical advancements were vital, but human collaboration, trust-building, and issue resolution were equally crucial.

The latest annual report on antimicrobial use, assessed global trends on time based on data from 80 participating countries consistently reporting antimicrobial quantities from 2017 to 2019 and representing an estimated 65% of the global biomass. It demonstrates a 13% global decrease in antimicrobial use adjusted by the animal biomass (mg/kg). The latter is determined by adjusting the quantity of antimicrobial agents reported (mg) by the total weight of food producing animals (kg) each year. Additionally, the report showcases that less than 20% of antimicrobials used in animals in 2019 were highest critically important for human health, according to the data provided by 110 countries.

ANIMUSE contributes to the global fight against antimicrobial resistance, by providing the most complete set of data on antimicrobial use in animals. This new system facilitates open access to global and regional data in an interactive way, while also featuring easier reporting, error checks, and data visualisation tools for the Veterinary Services providing the information. Thus, offering solid analysed information to WOAH Member countries for strong evidence-based decision making in the fight against AMR.

Alongside ANIMUSE, already operational since September 2022, WOAH has initiated training Members in the uptake and institutionalisation of data collection, analysis and reporting, supporting them to write and publish national reports to support national decision making. In addition to the global and regional data already provided in ANIMUSE public portal, an increasing number of countries have now also published their national level data enhancing global transparency.

The journey is not over yet, and more developments are foreseen, such as to complement current data sources with data collected directly at the farm level; strengthen integrated analysis with cross-sectoral databases and eventually, surveillance of antimicrobial use and antimicrobial resistance when implementing and updating national action plans.

Conclusion

WOAH has taken a leap forward in curbing AMR with the launch of ANIMUSE Global Database. ANIMUSE has enhanced data collection, analysis and transparency, to enable the Veterinary Services in evidence-based decision-making. The latest AMU annual report, available in its interactive form on ANIMUSE, reflects the global progress of the animal health sector.



Antimicrobial susceptibility testing of bacterial strains isolated from poultry in Hungary

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One of the biggest global challenges of the 21st century is the spread of antimicrobial resistance, which will require a review of the use of active substances not only in animal health but also in public health. In our study, we aimed to comprehensively investigate the antimicrobial susceptibility of commensal strains (Enterococcus spp., Escherichia coli, Staphylococcus spp, Clostridium perfringens) in large domestic flocks at a regional level in Hungary and to compare our results with data from strains isolated from clinical cases and available strains from human cases. A total of 1282 samples were tested, and 21 080 MIC values were determined. The susceptibility of *Enterococcus* spp. isolates (n=499) was high for both amoxicillin (79%) and amoxicillin-clavulanic acid (80%) and acceptable for vancomycin (69%). However, the susceptibility was low for doxycycline (5%) and enrofloxacin (6%). In contrast, the susceptibility to most of the *Escherichia coli* strains (n=411) was low, with amoxicillin (38%), neomycin (28%), doxycycline (49%), florfenicol (37%), enrofloxacin (47%) and potency sulphonamide (0%). The susceptibility to colistin was acceptable at 72%. In Staphylococcus spp. isolates (n=227), strains showed excellent susceptibility to amoxicillin (88%), florfenicol (67%), acceptable susceptibility to tilozin (40%), but 76% susceptibility to vancomycin is a cause for concern and warrants further investigation. The isolated *Clostridium perfringens* strains (n=145) showed excellent susceptibility to amoxicillin (79%), ceftriaxone (79%), imipenem (89%) and an acceptable susceptibility to vancomycin of 77% was observed. Comparing our results for Escherichia coli strains with those from clinical cases and human health, we found that the susceptibility for penicillins were very similar for all three groups (38%; 27%; 48%). However, for the other agents, the resistance rate was significantly higher in animal health.

Conclusion

Overall, our studies support the need for regular surveys at national and regional level. The efficacy of penicillins used for the classical treatment of infections caused by *Enterococcus* strains with emerging human health relevance is still outstanding, but the high resistance to vancomycin certainly requires further metagenomic studies to elucidate the genetic background of phenotypic resistance. The widespread and high level of multiresistance among *Escherichia coli* strains is particularly worrying, with many studies worldwide reporting a similar situation. In case of *Staphylococcus* strains and *Clostridium perfringens* strains, it is also worthwhile to complement our results with metagenomic studies in the future, which could contribute to the construction of geographical resistance gene maps. Comparison of the data with the human health situation and monitoring over time can help in the One Health reflection and in the selection of the right therapy.

Funding

Project no. RRF-2.3.1-21-2022-00001 has been implemented with the support provided by the Recovery and Resilience Facility (RRF), financed under the National Recovery Fund budget estimate, RRF-2.3.1-21 funding scheme.



Standardization of Therapeutic Measures in Antibiotic Consumption Monitoring to Compare Different Livestock Populations

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Using sales data, information on antimicrobial consumption in animals is collected cumulatively across the European Union and member countries of the European Economic Area, which is documented and reported by every country and published within annual reports by the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC). These serve to perform cross-border comparisons of antimicrobial consumption, despite their ambiguity due to the different units and key figures used. To improve comparability, the European Medicines Agency has introduced the population correction unit (PCU), which represents the biomass of a livestock population and is related to antibiotic consumption.

However, the PCU does not consider the variability of how a livestock population is composed structurally regarding the proportions of production types contained therein. To achieve better comparability between the different geographical areas, we therefore applied a system of standardization in different examples and in real antimicrobial consumption data. This was done by quantifying the consumption of antibiotics by livestock in exemplary regions and countries (Denmark, Germany, France) by means of the active substance used (mg/kg) and subjecting it to a direct and indirect standardization procedure to identify and measure differences in consumption in relation to the composition of livestock demographics.

The consideration of livestock demographics results in substantial effects when comparing antimicrobial usage in livestock.

Conclusion

To achieve a more compelling comparability in the context of monitoring antibiotic consumption in livestock populations, we recommend using an indirect standardization method, to control potential confounding effects caused by different livestock demographics. This assumes that animal populations can be structured accordingly well. Correspondingly, detailed information on antimicrobial usage by species should be available for this type of stratification.

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Factors associated with antibiotic use in semi-intensive and free-range systems in Uganda

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Livestock associated antimicrobial resistance (AMR) can reduce productivity and cause economic losses, threatening the livelihoods of poor farming communities in low-income settings. Data on antimicrobial consumption in small and medium sized chicken farms in Uganda is scarce. We investigated the practices and risk factors for increased antibiotic use in semi-intensive (200-500 chicken kept indoors) and free-range (5-50 chicken left scavenging outdoors) poultry farms in Uganda. 402 farms were randomly selected with 202 farms under the free-range system and 200 farms under the semi-intensive system. A modified version of the "Antimicrobial use in livestock production" questionnaire (AMUSE tool) developed by ILRI was used to capture antimicrobial use practices on farms. The data were analyzed in Stata/SE 17.0 and in R version 4.2.3. Antimicrobial use was measured by frequency of use in a month assessed during the farm visit by interview. The most used drugs were vaccines followed by vitamins and antibiotics. The commonly used antibiotic classes were tetracyclines, sulphonamides and fluoroquinolones. Significant associations were observed between a higher frequency of antibiotic use and farms that reported disease within the preceding three months (OR=1.33, p=0.05), larger farm sizes (51 to 1000 chickens: OR=2.57, p=0.001; more than 1000 chickens: OR=4.53, p=0.001), and the utilization of commercial feed (OR=9.74, p=0.001). Semi-intensive farmers had better knowledge on antibiotic use compared to farmers in the free-range system. Together, our findings highlight the need for increased awareness of prudent antibiotic use and good farm management practices in poultry production in Uganda.

Keywords: antibiotic, chicken, stewardship, LMIC, Africa.



Relationship between antimicrobial usage, management factors and animal health, and welfare indicators in Swiss dairy cattle

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Health and welfare of farm animals as well as antimicrobial usage (AMU) and the development of antimicrobial resistance (AMR) are ongoing concerns for farmers, consumers, and the society. Health and welfare status can be assessed using animal-based and data-based indicators. For dairy cattle, numerous indicators have been described and established and the amount of available health data that can be used as a proxy has increased substantially in the recent years. Dairy cows are of particular interest because they contribute in large parts to the total AMU of livestock in Switzerland. The evaluation of AMU in Switzerland is facilitated by data from the recently implemented "informationsystem on AMU in veterinary medicine" (IS-ABV). The aim of this study is to investigate the associations between health and welfare indicators, management factors, AMU and AMR patterns.

In a first step, a set of indicators to assess health and welfare of dairy cows was put together with the use of existing welfare protocols and expert opinion in a previous study. These indicators were then used for assessment on 50 Swiss dairy farms grouped into farms with high (n= 22) and low (n=28) AMU based on data from IS-ABV. Farm visits were carried out between February and September 2023. To determine the current situation of AMR, fecal samples were taken from 15 cows (3 pools) and 5 preweaned calves (1 pool) per farm. Samples were inoculated on an Enterobacterales-selective medium and tested for AMR using the broth microdilution method. Sensitivity to each of the 15 antimicrobial agents tested is determined according to EUCAST cutoff values. Additionally, a questionnaire was used to collect information on animal husbandry and management practices, including the use of antimicrobial agents.

The application of health and welfare indicators in the field has proven to be feasible under diverse conditions and husbandry systems. With small adaptations, assessments can be carried out in different seasons and in both tie-stalls and free stalls.

At the time of submission of this abstract, data acquisition for data-based indicators is still under way. The next steps consist of comparing animal health and welfare status on farm level with management factors and AMU patterns. Findings associated with high AMU will be of special interest in order to identify specific risk factors that drive this usage. These results will be available at the time of the conference. Preliminary results from analyzed fecal samples present a resistance situation similar to previous studies in Switzerland. Final results with more comprehensive analyses of the AMR data will be available at the time of the conference.

Conclusion

This study provides insights into the animal health and welfare status of dairy cows on Swiss farms, and how these relate to AMU and AMR. With all data obtained, the AMR situation within the study population will be presented in detail together with results from AMU analysis.



Collecting farm level antibiotic use data for the UK pig industry

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In 2014 the UK Pig Health and Welfare Council hosted an Antibiotic Resistance Roundtable for government and industry. At the time, there was no consistent or national system for recording antibiotic use in pigs in the UK. One of the main outcomes from the Roundtable was that the Agriculture and Horticulture Development Board (AHDB) was asked to develop a tool to collect farm level data and provide the industry with annual national usage figures.

Launched in 2016, the Electronic Medicine Book for Pigs (eMB) enables farmers to upload details of antibiotics used and pig population to a central database. Initially data were collected from 2015 to set an industry baseline. Within the UK, this data collection is voluntary, although since 2017 uploading data to eMB has been a requirement for members of Red Tractor and Quality Meat Scotland (QMS) farm assurance schemes. Since 2018, data have been collected for over 95% of UK-reared pigs.

Farmers enter data quarterly and can benchmark their use against similar farms. They can allow their vet to view their data to facilitate discussions around herd health.

AHDB analyses trends in antibiotic use and highlights areas requiring industry input. Industry initiatives have targeted 'persistently high users' by requiring those in the top 5% in each farm category to work with their vet to create and continuously review an antibiotic reduction plan.

Usage is reported annually, and industry works to agree targets and activities that further enhance antibiotic stewardship. Data show that antibiotic use has reduced in the UK pig herd by **74%** between 2015 and 2022 (as shown in Figure 1), with a **95%** reduction in highest priority critically important antibiotics (HP-CIAs). No Colistin has been used since 2019.



Figure 2: Annual trend in antibiotic use in UK pigs

Conclusion

eMB helps drive responsible antibiotic use by providing a single platform to allow farmers and their vets to review their usage with trend and benchmarking reports. This is a key tool for on-farm health planning and helps to educate and engage farmers.

The UK pig industry now has evidence of which antibiotics are used and how much. This evidence of responsible usage promotes the reputation of the industry across the supply chain, supports exports and helps to reassure consumers.



Occurrence and drug resistance of staphylococci isolated from external ear canal in dogs

Are dogs with otitis externa at greater risk of being colonized by multidrug-resistant staphylococci? - a preliminary report

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The occurrence of *Staphylococcus spp.* in animals may cause infections leading to *otitis externa*. The research aimed to compare clinical symptoms and macroscopic and cytological images of the external ear canal with the presence of staphylococci in both healthy dogs and ones with symptoms of otitis externa. Each case underwent clinical examination that consisted of the pinna and the external ear canal examination through otoscopy. The presence of otitis externa was confirmed based on clinical and cytological examination. 50 dogs were assigned into 2 groups. A total of 33 healthy dogs and 17 dogs with otitis externa symptoms were analysed. Bacteriological examination was performed on each dog. The antibiotic resistance of the evaluated coagulase-positive (CoPS; n=23) and coagulase-negative (CoNS; n=20) strains was also examined. In 24 (73%) healthy individuals and in 11 (65%) individuals with inflammation Staphylococcus spp. were isolated. The frequency of Staphylococcus isolation did not depend on health status (p>0.05). The drug resistance of both CoPS and CoNS staphylococci was determined with the disc diffusion method. The highest percentage of resistant CoPS strains was obtained for ampicillin, penicillin G and methicillin and in case of CoNS strains for penicillin G, erythromycin, clindamycin. Multi-drug resistance occurred in 48% of coagulase-positive staphylococci isolates and in 30% of coagulase-negative staphylococci. In cytology, the neutrophilic inflammation was found only in 3 cases of otitis externa . No bacteria were isolated among 6 animals presenting clinical symptoms of *otitis externa*, however the cocci were observed in 3 otic smears.

In cytology of healthy animals, cocci were found in 6 smears, but the presence of staphylococci was confirmed in 4 cases.

Conclusion

The results suggest that staphylococci are common in both healthy dogs and in dogs suffering from *otitis externa*. The most common species is *S. pseudintermedius*. Multi-drug resistance of *S. pseudintermedius* is a widespread phenomenon occurring in examined isolates which indicates a great risk in conducting an effective therapy of this disease. The most commonly dispensed antibiotics such as penicillin and erythromycin show no effectiveness against many staphylococci isolates which creates a great risk of an insufficient therapeutic response. Cytological examination is a useful tool and can be used to plan treatment in symptomatic individuals



Implementation of sales and use data collection according to Regulation (EU) 2019/6 within national legal specificities in Germany – challenges and first results

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With Regulation (EU) 2019/6, harmonised regulations on veterinary medicinal products came into force in January 2022. The new European legislation covers not only rules on the authorisation and marketing of veterinary medicinal products (VMPs), but also measures to combat antimicrobial resistance (AMR). These measures include, among others, the collection of data on sales and use of antimicrobials in veterinary medicine in all European Member States. In Germany, the monitoring of sales volumes of antimicrobial VMPs supplied to veterinarians was already implemented in national law in 2010. In addition, a benchmarking system based on the frequency of antimicrobial treatments was launched in 2014 for certain farms in order to reduce antimicrobial consumption.

According to Regulation (EU) 2019/6, data on veterinary antimicrobials sold in 2023 will have to be reported to the European Medicines Agency (EMA) in 2024. There will be slight shifts in the veterinary medicinal products to be covered and the group of recipients relevant for coverage has been extended. Sales data of antimicrobial VMPs from 2022, which were still collected according to national legislation, were sent to the EMA in June (ESVAC report) and published by BVL in the autumn 2023. For the collection of use data, Regulation (EU) 2019/6 allows a stepwise national implementation. First, annual data on the use of antimicrobials in cattle, pigs, chickens and turkeys have to be reported to the EMA in 2024. Next, data on the use of antimicrobials in further food-producing animal species, including horses, will have to be reported in 2027. Finally, data on use of antimicrobials in dogs, cats and fur animals will have to be submitted to the EMA in 2030. However, according to the German Veterinary Medicines Act, use data of dogs and cats have to be collected earlier in Germany, starting from 1rst January 2025. For implementation of the first stage of use data collection, the state database "HI-Tier" (Herkunftssicherungs- und Informationssystem für Tiere) was expanded, which now serves as a central database for data on national benchmarking and use data to be reported to the EMA. At the end of the reporting period, the data are transferred to the BVL, which acts as the data administrator, where they are enriched following quality checks and sent via an interface to the EMA. Meanwhile, implementation of the next stages of use data collection is being worked on. The German benchmarking system has also been adapted as part of the national implementation of use data collection. It now also takes into account the quality of the antibiotics used by reducing the attractiveness of 3rd and 4th generation cephalosporins, fluorochinolones and colistin. Both, the benchmarking system and the use data collection rely on the submission of data by veterinarians, which are the central data supplier in Germany.

Conclusions

Overall, it remains a challenging task for all stakeholders, including federal and state authorities, veterinarians, the pharmaceutical industry, animal owners, etc., to implement the new European veterinary legislation. In Germany, the main challenges in implementing the collection of data on sales and use were the timely establishment of a functioning system, the compliance of data suppliers and human resources. However, data on antimicrobial use and AMR are indispensable for analysing the current situation and evaluating the measures taken to combat AMR. With the new European veterinary legislation, harmonised and standardised data on sales and use of antimicrobials in the European Member States will be available.



Engagement of veterinary clinics to collect herd-level AMU data for the Canadian Dairy Network for Antimicrobial Stewardship and Resistance Program

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In 2019, the Canadian Dairy Network for Antimicrobial Stewardship and Resistance (CaDNetASR) was implemented in 5 major dairy producing provinces (Alberta, British Columbia, Nova Scotia, Ontario, and Québec) across Canada. This program has a requirement to provide herd-level estimates of antimicrobial use (AMU) for public health surveillance purposes.

The aim of this study was to investigate the feasibility and logistics associated with the provision of herd-level veterinary dispensing data as a source of AMU data.

A short questionnaire was developed with research ethics approval and emailed to all veterinary clinics servicing the 150 dairy herds enrolled in the CaDNetASR program. Responses to the survey were received between April 8 to June 7, 2021. Questions included identifying veterinary software used by clinics when dispensing drug products to dairy producers, the method of dispensation (direct vs pharmacy), the ability to extract and share herd-level dispensing information, and the willingness of veterinarians to share this information.

The response rate to the survey was 47% (23/49 veterinary clinics) with all participating provinces represented. A total of 8 different veterinary softwares were identified, including VetExpert, AVIMark, Impromed, Cornerstone, eVetPractice, ezyVet, HerdRx, and Quickbooks. Twenty-one clinics dispensed veterinary drugs directly to producers, whereas 1 clinic dispensed through a pharmacy and 1 clinic used both a pharmacy and direct dispensing. In some cases, product pricing was found to be helpful in identifying product formats (e.g., single bottle vs case). The majority of clinics (16/23) indicated that an administrator would extract the data. In total, 87% (20/23) of respondents indicated that they were willing and able to provide herd-level veterinary dispensing data to the program.

Conclusion

This questionnaire process succeeded in laying the groundwork for veterinary clinic engagement across Canada to facilitate the provision of herd-level dispensing data. These data will be compared with other methods of collecting AMU data from dairy herds (e.g., the garbage can audit that was conducted through the CaDNetASR program in 2019). It will also be used to assess the functionality of these data within veterinary clinics for the purposes of benchmarking between herds within a clinic, and also within/between regions in Canada. AMU estimates derived from these data will support enhanced antimicrobial stewardship and public health surveillance in the Canadian dairy sector.



Antibiotic use and resistance in poultry – a global evaluation

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The increase in antibiotic resistance is a global concern for human and animal health. Poultry is one of the world's fastest-growing sources of meat production. The objective of this review was to provide a global evaluation of published data on the type and amount of antibiotics used in poultry production and the level of antibiotic resistance in *E. coli* isolated from broilers. Analysis of data for information was obtained from national monitoring programs and research studies conducted in the large poultry-producing regions, that together produce more than 60% of chicken meat globally: the US, China, Brazil and some EU countries - Poland, United Kingdom, Germany, France and Spain. There is no public long-term quantitative data available on the amount of antibiotics used in poultry, with the exception of France. However, data from the registration perspective on approved antimicrobials is available in all large meat producing countries. Therefore, qualitative data of registered antibiotics enabled their evaluation and comparison. Additionally, evaluation of antibiotic resistance clearly indicates the use of antimicrobials.

Available quantitative data on antimicrobial use since 1999 from France demonstrates overall reduction of antimicrobial use. The decrease in the use of tetracycline between 2006 and 2016 was accompanied by a decrease of tetracycline-resistance rates in E. coli between 2006 and 2016. Thus, less use of tetracyclines resulted in less resistance to those antibiotics.

The qualitative evaluation of global data provides insides on the approval of highest priority critically important antimicrobials for poultry in large poultry producing regions. Resulted evaluation of data shows that third generation cephalosporins can be used in the U.S and Brazil; glycopeptides are not approved for use in poultry production in any of the regions and macrolides and ketolides can be used everywhere. Polymyxins can be used everywhere except China and quinolones can be used everywhere except the U.S. Additionally, the comparison of resistance rates to some antimicrobials where use is approved or banned provides reasonable evaluation on the efficacy of the restrictions on the national level. The fluoroquinolones, 3rd generation cephalosporins and macrolides are approved for use in large poultry-producing regions, with the exception of fluoroquinolones in the US and cephalosporins in the EU. The resistance rates to fluoroquinolones in the US, where fluoroquinolones are not registered for use, are below 5%, while the average of resistant E. coli is above 40% in Brazil, China and EU, where use of fluoroquinolones is legalized. Tetracyclines, aminoglycosides, sulfonamides and penicillins are registered for use in poultry in all evaluated countries. The average resistance rates in E. coli to representatives of these antibiotic classes are higher than 40% in all countries, with the exception of ampicillin in the US.

Conclusion:

The global harmonized approach in the monitoring of antibiotic use and evaluation of resistances using the same methodology is needed. However, available data enables the comparison of antimicrobial use and resistance rates over time in some regions. Additionally, the approach to evaluate the registration status of approved antimicrobials and compare it with the resistance rates provides valuable input on the reasonability of the regulatory restrictions of antimicrobial use.



Comparison of different antimicrobial use indicators and antimicrobial resistance data in food-producing animals

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Objectives

To explore the effects of using different indicators to quantify antimicrobial usage (AMU) in livestock and compare outcomes with antimicrobial resistance (AMR) data.

Methods

Three indicators were used to quantify AMU, two indicators in which the denominator varied: defined daily doses per average mass of the animals present per year (DDD/AY) and defined daily doses per population correction unit (DDD/PCU) and one in which the numerator varied: milligrams of active ingredient per PCU (mg/PCU). AMU was compared with antimicrobial resistance data from the national monitoring programme from 2013 to 2018 with the proportion of Escherichia coli isolates fully susceptible to a predefined panel of antimicrobials for the broiler, dairy cattle and pig farming livestock sectors in the Netherlands.

Results

The ranking of livestock sectors differs between sectors when using different indicators to express AMU. Dairy cattle rank lowest when expressing AMU in DDD/AY, followed by pigs and broilers corresponding to the rankings of the sectors for AMR. When changing the denominator to PCU, the ranking in AMU is reversed: use ranks highest in dairy cattle and lowest broilers.

Conclusions

Using different denominators in AMU indicators has a major impact on measured use. This might result in misinterpretation of effects of interventions on AMU and the associations of AMU with AMR across animal sectors. This might also bias associations between AMU in animals and AMR in humans in One Health focused analyses on the contribution of AMU in animal to occurrence of resistance in humans. From an epidemiological perspective, indicators that take into account time at risk of exposure to antimicrobials are to be preferred and reflect the AMR risk most accurately.



Towards antimicrobial use reduction in pig farming: insights from the slaughterhouse

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Reducing the use of antimicrobials in food-producing animals to tackle antimicrobial resistance (AMR) is a cornerstone of animal and public health. Balancing AMR reduction and animal health can be challenging and requires a broad approach that encompasses biosecurity, animal welfare, vaccination and management. Slaughterhouses provide a convenient observation point for identifying potential threats to animal and public health. An integrated analysis of AMU data and abattoir lesion scores could improve decision making by veterinarians and farmers and provides feedback on the success and failure of antimicrobial treatments. Nevertheless, there are few data available on the relationship between AMU and lesions found at slaughter. Although declining, antimicrobial sales in Italy are among the highest in Europe and pig production is one of the sectors with the highest AMU. The aim of this study was to compare AMU with lung and pleural scores collected at slaughter. Data were collected in two large Italian slaughterhouses between 2020 and 2022. In total, 236 batches from 113 fattening farms were examined, resulting in 24,752 scored carcasses with a median of 130 (interquartile range, IOR 15) pigs inspected per batch. Lungs were scored using the Madec's grid (score range = 0 to 28) and pleuritis with the 'Slaughterhouse Pleuritis Evaluation System' (SPES, score range = 0 to 4). Batch-level scores were calculated as the sum of individual scores within a batch on the number of examined carcasses multiplied by 28 and 4, respectively. Obtained batch-level scores can range from 0 to 1 and represent the proportion (or percentage) of the maximum theoretical score a batch would reach if all the individuals obtained the worst scores. The AMU was estimated at farm-level considering the six months preceding the slaughter of each batch. All data required for the calculations were extracted from the Italian monitoring system ClassyFarm (www.classyfarm.it). The AMU was expressed as a treatment index 100 (TI_{100}) using the defined daily dose animal for Italy (DDDAit) as a metric. Antimicrobials belonging to EMA's category B (3rd and 4th generation cephalosporins, polymyxins and quinolones) were considered critical. The relationships between batch-level Madec's grids, SPES scores and AMU were examined using mixed beta regressions. Median values of 0.07 (IQR 0.06) and 0.20 (IQR 0.15) were found for the Madec's grids and SPES scores, respectively. The two scores were positively correlated ($\rho=0.29$; p<0.001).

Antimicrobials were administered in 97.0% of the farms in the six months prior to slaughter, with a median TI_{100} of 5.2 (IQR 7.1). Critical antimicrobials were administered in 15.2% of cases with a median TI_{100} of 0.06 (IQR 0.5). The Madec's score was not associated with total AMU, but positive associations were found with the use of critical antimicrobials (coefficient estimate±standard error = 0.07 ± 0.03 ; p=0.041) and macrolides (0.08±0.04; p=0.044). The SPES score was not associated with any of the examined variables.

Conclusion

Madec's grids and SPES scores were positively correlated, as was expected given the aetiopathogenesis of the lesions involved. The AMU in the investigated farms was about half than that reported in a previous Italian study using the same standards but based on 2015 data. This result is consistent with the general reduction of AMU in the Italian livestock sector over the last few years. Madec's scores were positively associated with usage of macrolides and critical classes but such antimicrobials should only be prescribed as a last resort after a susceptibility test. It is therefore possible that batches with worse scores were first unsuccessfully treated with first-choice antimicrobials. This result highlights the importance of preventing and reducing the severity of respiratory disease in pigs. Issues found at the slaughterhouse could drive towards a reduction of AMU, for example by providing feedback that leads to the identification of gaps in biosecurity or inadequate vaccination on the farm.



Anomaly detection in the antibiotic prescription surveillance system (IS ABV)

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To develop the surveillance of antimicrobial use (AMU), Switzerland introduced the "Informationssystem Antibiotika in der Veterinärmedizin" (IS ABV) in 2019, mandating electronic registration of antibiotic prescriptions by all veterinarians in Switzerland. However, initial data analysis revealed a considerable amount of implausible data entries, potentially compromising data quality and reliability. To address this issue efficiently, we propose a two-stage anomaly detection framework utilizing machine learning algorithms. In this study, our primary focus was on cattle treatments with either single or group therapy, as they were the species with highest prescription volume. Anomalies may be errors, input inaccuracies or instances of severe over-/under-dosage. However, not all outliers are necessarily incorrect; some may be legitimate but unusual antibiotic treatments. Thus, expert review plays a crucial role in distinguishing authentic outliers from actual errors. Initially, relevant prescription features were extracted and pre-processed with a custom-built scaler. A set of unsupervised algorithms calculated the probability of each data point and identified the most likely outliers. In collaboration with experts, we annotated outliers and established anomaly thresholds for each category of use and preparation. These expert-annotated labels were then used to fine-tune the final supervised algorithms.

Conclusion

With this methodology, we identified 22,816 anomalies from a total of 1,994,170 prescriptions in cattle (1.1%). Cattle with no further specified production type had the most (2%) anomalies with 7,758 out of 379,995 prescriptions. For the first time, we were able to consistently identify prescriptions with insufficient dosages. Furthermore, the versatility of this framework could enable its adaptation to different species within IS ABV and potentially to other prescription-based surveillance systems. If applied on upcoming prescriptions, it should decrease the systematic input errors over time and therefore enhance the validity of the system in the long term.



The contribution of antibiotic use data to a better assessment of the exposure of cats and dogs in France

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Until now, exposure of cats and dogs in France has been assessed on the basis of annual declarations by marketing authorisation holders (MAH). The latter estimate the breakdown of drug sales for the "cats and dogs" category, as the majority of pet drugs are authorised for both species. The antimicrobial use data collected at national level will therefore make it possible to distinguish between use in dogs and use in cats. However, a number of methodological difficulties remains.

Deconditioning

The daily dose and duration of treatment recommended in the SPC for the main indication are used to calculate the numbers of ADD and ACD and estimate the exposure of pets to antibiotics in France. Considering only oral and injectable treatments, tablets will account for 75% of exposure of cats and dogs in 2022. Nearly two-thirds of marketed presentations contain more than 100 tablets per presentation. Many presentations contain more than 10 blisters of tablets, and deconditioning of the veterinary medicinal product is common practice. The collection of use data in France is based in particular on the declaration of prescription and delivery data by veterinarians, via a dematerialised flow with their software. When the software was being qualified, it was agreed to offer two ways of declaring the quantities dispensed for tablets: either by declaring a number (whole or decimal) of presentations, or by declaring a number of tablets dispensed. Despite the implementation of a number of controls, it seems that there are sometimes erroneous declarations in the use data firstly collected in France. Reflection is underway to define the criteria for identifying incorrect declarations linked to deconditioning, which can lead to assess incorrectly the quantities of antibiotics dispensed. As part of communication campaigns on the prudent use of antibiotics, veterinarians may need to be reminded of the importance of properly recording the quantities dispensed.

Topical products

It is difficult to define a quantity administered for each topical treatment in order to calculate an exposure indicator. Nevertheless, an initial estimate of the number of treatments per animal in France has been made on the basis of MAH sales declarations. The assumption used to estimate the number of animals treated is that one presentation unit sold corresponds to one animal treated. The use data firstly collected seems to confirm this assumption, with the exception of a few drug presentations for which deconditioning may be involved. Nearly 2 out of 10 pets receive a topical treatment containing antibiotics during the year in France. Topical medicines are mainly used for ear and eye treatments in cats and dogs. This route of exposure is therefore not insignificant, and shows the importance of collecting data on all types of antibiotic medication in order to better analyse the risk of antibiotic resistance in pets

While the collection of use data for cats and dogs was launched in 2023 in France, this communication describes the methodological challenges and difficulties that remain



Disparities between veterinary-reported antibiotic dispensing and paper documentation on Austrian dairy farms – a pilot study

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In Austria, between 2015 and 2024, it was mandatory for farm veterinarians to report antibiotics that they dispensed for use in farm animals, but not those antibiotics that they administered themselves. During a research study of 51 dairy farms in 2020, data were collected on farm and from veterinary practices on antibiotics both administered and dispensed. Due to initial difficulties accessing a variety of data types recorded in veterinary practice software, it was decided to collect copies of paper documentation on farm. The authors also had access to the mandatory reporting records for each farm with respect to the antibiotics dispensed by farm veterinarians. Here, we compare the records for intramammary lactating and dry cow tubes as these were considered the antibiotic preparations most likely to always be dispensed rather than administered by the herd veterinarians themselves.

The dispensed antibiotics were quantified as the total number of Defined Course Doses (nDCDvet) and the DCDvet per cow and year.

The quantity of udder injectors dispensed during lactation, as calculated from the paper documentation, was a total of DCD_{vet} 17.50 for all 51 farms. In comparison, the total number of Defined Course Doses officially reported was DCD_{vet} 21.76. On average, a DCD_{vet}/cow/year value of 0.34 (min. 0; max. 1.25; median: 0.27) and 0.43 (min. 0; max. 1.25; median: 0.32) was calculated for the paper documentation and reported data, respectively. A similar ratio was obtained for dry cow therapy (DC). The total quantity of udder injectors for drying off was DC-DCD_{vet} 52.14 from the paper documentation and DC-DCD_{vet} 63.01 for the reported data. The mean values for drying off were DCD_{vet}/cow/year 1.02 (min. 0; max. 4.62; median: 0.80) for paper documentation and 1.24 (min. 0; max. 3.55; median: 0.95) for the reported data.

Conclusion

In this study, it was demonstrated that the reported quantities of antibiotics to an official authority do not always align with the written records found on farm. These discrepancies may be attributed to errors in record-keeping on farm, irregularities in the reported data, or even deliberate underreporting or overreporting. These facts underscore the importance of enhancing data collection processes and promoting accuracy and transparency in reporting antibiotic consumption and dispensation. From 2024, Austrian farm vets will be required to report all antibiotic use in food-producing animals, which should simplify the process of flagging implausible reports.