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Exploring the barriers and incentives towards effective surveillance for antimicrobial and anthelmintic usage (AMHU) in beef cattle and sheep in Great Britain

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Glossary

AFS	Red Tractor Assured Farm Standards
AHDB	Agriculture and Horticulture Development Board
AHWB	Animal Health and Welfare Board
AHR	Anthelmintic resistance
AHU	Anthelmintic usage
AMHU	Antimicrobial and anthelmintic usage
AMR	Antimicrobial resistance
AMU	Antimicrobial usage
APHA	Animal and Plant Health Agency
BPC	British Poultry Council
BVA	British Veterinary Association
CAP	Common Agricultural Policy
CHAWG	Cattle Health and Welfare Group
COWS	Control of Worms Sustainably
DEFRA	Department for Environmental and Rural Affairs
EEA	European Economic Area
EID	Electronic Identification
EMA	European Medicines Agency
ESVAC	European Surveillance of Veterinary Antimicrobial Consumption
EU	European Union
FEC	Faecal Egg Count
FSA	Food Standards Agency
GB	Great Britain
HP-CIA	Highest Priority Critically Important Antimicrobials
NAP	National Action Plan
NOAH	National Office for Animal Health
NSA	National Sheep Association
PCU	Population Correction Unit
POM-V	Prescription only medicines that can only be prescribed by a veterinarian
POM-VPS	Prescription only medicines prescribed by a veterinarian, pharmacist, or a Suitably Qualified Person
PESTLE	Political, economic, socio-cultural, technological, legal, and environmental
QR	Quick Response

RHAWG	Ruminant Health and Welfare Group
RUMA	Responsible Use of Medicines in Agriculture Alliance
SA	Soil Association
SAGG	Sheep Antibiotic Guardian Group
SCOPS	Sustainable Control of Parasites in Sheep
SHAWG	Sheep Health and Welfare Group
SQP	Suitably Qualified Person
UK	United Kingdom
UK-VARSS	UK-Veterinary Antimicrobial Resistance and Sales Surveillance
VMD	Veterinary Medicines Directorate

Executive summary

Antimicrobial and anthelmintic usage (AMHU) in livestock production has increased over the last 50+ years. Microbial and helminthic exposure to such drugs is understood to have contributed to increased resistance to treatment, causing significant economic impact in the human and animal health sectors. Surveillance of AMHU is an important part of a mitigation-policy cycle for antimicrobial and anthelmintic resistance (AMHR). It is used to guide decisions on treatment, identify populations at risk, understand the epidemiology of AMHR and inform the development and evaluation of strategies and interventions. In this study, we aimed to explore potential barriers and incentives towards enhancing AMHU surveillance in beef cattle and sheep sub-sectors using a PESTLE - Political, Economic, Sociological, Technological, Legal and Environmental factors – analysis.

The United Kingdom (UK) currently collects antimicrobial usage (AMU) data for the purpose of national surveillance, with sales data from the pharmaceutical industry and sub-sector-specific usage data. Increased efforts have been made towards capturing AMU data to understand which are high users and to observe usage trends. Sub-sector-specific AMU surveillance coverage is the largest in poultry, pig, aquaculture, and gamebird sub-sectors who are currently achieving 90% and above (RUMA 2020; VMD 2020).

However, AMU surveillance coverage remains low in the GB beef sub-sector (9.6% of GB slaughtered beef (VMD 2020)) and appears largely absent in the sheep sub-sector. Furthermore, no anthelmintic usage (AHU) data is captured for national surveillance despite the high economic burden of parasitism on grazing livestock, strong efforts by industry-led organisations towards promoting responsible AHU, and evidence of mounting levels of anthelmintic resistance (AHR) (Hennessey et al. 2020). Increased AMU data capture in the beef sub-sector is required to increase representativeness, determine usage level, and observe trends. In sheep, enhanced data capture will help to understand the sub-sector's contribution to total AMU in livestock, and to set targets for reducing AMU. Surveillance of AHU seems particularly relevant in sheep and beef cattle systems, as they are often raised in extensive, grass-based systems and are at higher risk of helminth infection.

Workshops and one-to-one interviews were conducted with 26 stakeholders directly and indirectly implicated in AMU and potential AHU surveillance in the beef cattle and sheep sub-sectors. Workshops and interviews were held in February and March 2021 to discuss these issues from the perspective of stakeholders' roles in the system. In the workshops, barriers, and incentives for enhancing AMU and implementing AHU surveillance in beef and sheep were discussed considering political, economic, socio-cultural, technological, legal, and environmental factors. Additionally, interviews on the same topics were conducted with stakeholders who were unable to attend workshops. Summary notes from workshops and interviews were analysed thematically in an iterative process among the study authors and emerging themes were identified. These were supplemented by knowledge from the literature and used to define recommendations.

Key themes that emerged were the following:

- The heterogeneity of the beef cattle and sheep sub-sectors poses challenges towards the collection and collation of AMU data for national surveillance.
- The apparent lack of human health implications of AHR limits political will towards implementing AHU surveillance.
- Quality and compatibility issues of collected AMU data are barriers towards its use for the purpose of national surveillance.
- Voluntary mechanisms of collecting AMU data are the preferred route (at least in a first instance) in comparison to firmer legal or regulatory requirements for farmers to report AMU data. Firmer requirements may include the following:
 - Accreditation schemes can provide economic incentives to farmers to report AMHU data if medicine reporting were integrated into standards
 - Outcome-based payments have potential to be an opportunity for improved AMU surveillance, such as the proposed Animal Health and Welfare Pathway grant scheme in England, through a requirement for farmers to report AMU data.
- The ability to benchmark medicine usage on-farm can be an incentive for farmers to report data into the Medicine Hub for cattle and sheep (recently launched by the Agriculture and Horticulture Development Board, AHDB). AMU data can be of greater value to farmers when contextualised alongside additionally collected farm data, for example, on animal health and welfare, timing of administration and other measures of productivity.
- The farmer-veterinarian relationship is considered of importance to enhance AMU data capture by encouraging greater accuracy of medicine recording and communicating the benefits of reporting AMU data to farmers (for benchmarking).

There is optimism that the AHDB Medicine Hub for cattle and sheep can be successful in being the central repository for AMU data. Potential strategies for improving AMU data capture in beef and sheep can factor the Hub as the repository for reporting AMU data. In its capacity to record medicine data generally, it can additionally serve as a source of AHU data.

- Anthelmintic drugs are predominantly sold and supplied by non-veterinary outlets. As such, alongside sales data from the pharmaceutical industry and on-farm AHU recording, such non-veterinary sources of anthelmintics potentially serve as a target for AHU data capture.

From our findings, we present 15 recommendations on AMHU data capture and use of AMHU knowledge that span recording and reporting, cooperation and collaboration, co-design and agency, and effective linking and use of data and the information generated.

Recommendations

The recommendations provided are intended to be appraised by decision makers and the different stakeholders implicated in AMHU surveillance as suggestions towards how AMU surveillance could be enhanced, and how AHU surveillance could be implemented. They take into consideration the perspectives of different stakeholders consulted.

AMHU information generation – data capture

- **Voluntary reporting:** A voluntary approach without imposing firmer legal requirements to report data into a central repository such as the new Medicine Hub (established by AHDB) should be given time to prove effective in its acceptability and uptake before firmer legal requirements are considered. Voluntary mechanisms were deemed to be effective and more respectful of the farming community, which is often lacking agency in the system.
- **Continue to use a central repository:** Workshop participants welcomed the Medicine Hub and were supportive of its use. Veterinarians are very well placed to promote the Medicine Hub to their farm clients to encourage uptake and communicate the benefits of its usage to farmers, predominantly in its usefulness for farm-level benchmarking.
- **Use financial incentives to increase reporting:** The proposed Animal Health and Welfare Pathway (or alternative outcome-based payment schemes) could require reporting AMU for payments if an acceptable and feasible mechanism can be identified in participation with farmers and other stakeholders. For successful implementation of the Pathway, there should be sufficient economic incentive to join although penalties should not apply in cases of high AMU where the use is justified. Reporting of AMU data could be a requirement for payment through requiring direct engagement with the Medicine Hub for cattle and sheep.
- **Use accreditation schemes to increase reporting:** Accreditation schemes could also require reporting AMHU, into a central repository such as the Medicine Hub, comparable to Red Tractor Farm Assurance and the electronic Medicines Book for pigs.
- **Cooperation and coordination:** Agreement between accreditation providers to include reporting as a standard across all providers should be encouraged as it would likely have the most beneficial impact on AMU surveillance coverage, reducing pushback from the sectors and eliminating the risk of farmers choosing alternative schemes. Agreements would have to be made between AHDB and the providers of accreditation in order for accreditors to access their licensee's data.
- **Co-design should continue:** Farmers were positive about their involvement in programmes developed by DEFRA and AHDB. For effective implementation of strategies to improve AMHU data capture, co-design with farmer involvement should continue.
- **Transparency of farm data usage is required for voluntary reporting:** Farmers may be disincentivised to report their data, including to the Medicine Hub, for fears of scrutiny and penalisation over their AMU. This can be counteracted by implementing mechanisms that ensure full transparency for farmers on how, and for whom, their medicine data is used.
- **Standardise sales and usage:** Veterinary practice management and farm management software providers should be encouraged to standardise medicine sales and usage recording which is easily shared with the Medicine Hub for cattle and sheep and allows species differentiation. This would ideally be complemented by veterinary practices having separate species accounts.
- **Flexibility in recording AMHU:** The requirement for farmers to record their AMHU data in a particular format may impose a barrier towards its accurate capture. Farmers should be able to record their data in ways that

are efficient and comfortable for them. New methods or algorithms for converting data into formats compatible for national surveillance could standardise data output rather than data input. However, data recording in the form of free text should be discouraged due to the difficulty of its conversion into compatible data.

- **Alternative strategies where veterinary coverage is scarce:** In regions of GB where access to specialist livestock veterinarians is reduced, alternative strategies need to be investigated further to encourage uptake of data reporting if a voluntary system continues.
- **Include agro-pharmaceutical data:** Sales data from the pharmaceutical industry and agro-suppliers and other non-veterinary suppliers of anthelmintics are a prospective source of AHU data, as they are a major seller in the system and should be considered as enablers in AHU surveillance. Making the reporting of AHU data from non-veterinary suppliers a compulsory activity should be considered, comparable to the reporting of prescription data by pharmacies in EU member states.
- **Fill gaps in anthelmintic usage:** Before a formal AHU surveillance component is designed, gaps in knowledge in AHU and AHR need to be addressed in order to understand the needs and benefits of AHU surveillance. Further research into AHU and AHR (including the environmental implications) and improved feedback mechanisms to communicate AHR back to farmers are required in order to generate evidence for the purpose of AHU surveillance and how the information will be used in the AHR mitigation-policy cycle.

Use of AMHU information

- **Realistic expectations:** Feasible targets enable accurate representation of the national beef and sheep herd/flock and provide confidence in national statistics and observed trends over time. It will take time for beef and sheep AMU surveillance to reach that achieved in poultry, pigs, aquaculture, and gamebirds.
- **Continue linking data:** Efforts should continue towards linking of existing databases into a central repository with effective governance structures that regulate data ownership and accessibility and help to increase data generation for surveillance and to prevent farmers needing to duplicate data entry.
- **Capture different types of data:** National AMHU surveillance may benefit from capturing health, welfare, and geo-temporal data to enhance the knowledge generated from AMHU data and make national statistics more relevant to farmers, veterinarians, and other stakeholders in the system.

Introduction

This study forms part of the project “Achieving more sustainable British beef and sheep food systems in a changing environment” which brings together disciplinary and One Health specialists from the Royal Veterinary College and the University of Hertfordshire, to contribute creatively to solutions for more sustainable beef and sheep food systems in Great Britain.

Antimicrobial and anthelmintic use (AMHU) in livestock production has increased over the last 50+ years and there are arguments that this has contributed to increased resistance to treatment (Heymann, 2006; Klous et al., 2016; Rossi et al., 2017; Tang et al., 2017). A recent paper published by our team reviewed the usage of, and resistance to antimicrobials and antiparasitics on beef and sheep farms in GB (Hennessey et al., 2020). We found a dearth of data on use, a lack of standardised metrics, and higher levels of resistance compared to other livestock species. The most up-to-date UK Veterinary Antibiotic Resistance and Sales Surveillance Report published in November 2020 (UK-VARSS 2019) and its predecessor further emphasise the lack of data collection and reporting of AMHU for beef, and an absence of data capture in sheep systems in the UK in comparison to pigs, poultry, fish and game (VMD 2019; VMD 2020). No anthelmintic use (AHU) data is currently captured for national surveillance in beef cattle or sheep in Great Britain nor in the livestock sector as a whole. Thus, enhancements in sub-sector-specific antimicrobial use (AMU) surveillance in beef and sheep are warranted, whilst the implementation of AHU surveillance should be explored.

The UK-VARSS 2018 report stated that between 2014 and 2018 there was a 53% reduction in sales of antimicrobials for food-producing animals, and a 68% reduction in sales of highest priority critically important antibiotics (VMD 2019). The latest report published in 2020 demonstrated a levelling off of sales, with a small increase of 1.5 mg/kg in sales of antimicrobials in food-producing animals in 2019 (VMD 2020) which may indicate that a limit to reductions in antimicrobials is reached without considering further changes in husbandry, housing and farm management practices. General trends in reductions up to now have been in line with the goals set by the UK’s five-year National Action Plan (NAP) on AMR 2019–2024 (HM Government 2019). Such reduced AMU can be attributed to ongoing efforts by veterinarians, farmers, industry and, governmental and non-governmental organisations through the promotion and implementation of responsible antimicrobial prescription and optimisation of livestock husbandry practices. This includes organisations such as the Responsible Use of Medicines in Agriculture Alliance (RUMA) who, through their Targets Taskforce, since 2016 have aimed to deliver on the government’s objectives of identifying sub-sector-specific targets for the reduction of antimicrobials in the livestock sector (RUMA 2020). In addition, the British Veterinary Association (BVA) in 2019 launched a policy position on the responsible use of antimicrobials in food producing animals, releasing clear and concise recommendations calling for responsible prescribing and stewardship across the veterinary profession and the sector (BVA 2019). Another example is the strengthening of accreditation schemes such as the Red Tractor requirement, which was introduced in June 2018 and requires that Highest Priority Critically Important Antimicrobials (HP-CIAs) are only used as a last resort, alongside antibiotic sensitivity and/or diagnostic testing.

AMU surveillance coverage is at 90% and above in the poultry, pig, fish, and gamebird systems. The same cannot be said for UK beef and sheep production systems, where from the UK-VARSS 2019 report, and from the systematic review conducted by Hennessey et al (2020), there is an evident lack of sales and usage data. In comparison to other UK livestock, AMU estimates from beef cattle have come from a considerably smaller sample (9.6% of all slaughtered GB beef), and therefore are likely to be non-representative of the national beef herd (VMD 2020). It should be noted that it has been a more complex task to establish the best metrics to measure AMU in beef herds due to the range of systems in operation, from dairy calf rearing to suckler cows, store cattle growing to finishing. However, in 2020, the Cattle Health and Welfare Group (CHAWG) responded to calls for standardised metrics in the beef sector, publishing recommendations for measuring and comparing the use of antimicrobials on beef farms in their AMU beef benchmarking metrics report (CHAWG 2020). The core metric agreed upon were the total quantities of antimicrobials used in mg per the average total liveweight in kg of animal population on the farm (mg/kg beef farm) over a 12-month recording period. This was published after consultations with industry stakeholders following recognition that national surveillance data do not allow benchmarking between farms, and the need to accommodate the range of beef production systems present (CHAWG 2020).

There are no estimates for AMU reported for sheep production in the UK-VARSS reports for 2018 or 2019, highlighting significant gaps in this sub-sector. The Sheep Antibiotic Guardian Group (SAGG), a subgroup of the Sheep Health and Welfare Group (SHAWG), in 2019 proposed a core metric of total mass of antibiotic (used in a year) per unit of sheep weight (mg/kg) (SAGG 2019). In the same year, they also provided guidance for veterinary surgeons and farmers on responsible use of antimicrobials in sheep.

Pasture-borne parasites (nematodes/flukes) are ubiquitous where grazing animals (such as cattle and sheep) exist. Like antimicrobials, overuse, and inappropriate use of anthelmintics can lead to the development of resistant parasites (Craig 1993, Mphahlele et al 2019). Increasing resistance to anthelmintics may be exacerbated by climate change and worsening environments, land use changes due to change in agricultural policy and changes in land management. Advice on AHU in sheep exists (e.g. SCOPS Internal Parasite Technical Manual), but surveillance data on AHU in beef and sheep in the UK are sparse.

Sales data are currently a proxy for AMU and surveillance activities increasingly capture more sub-sector-specific data to obtain a more accurate picture of the quantities of AMU in UK livestock production (VMD 2019; VMD 2020). Functional and effective AMHU surveillance systems provide the necessary information to understand the AMHU epidemiology, assess progress towards meeting the goals set by the UK's five-year National Action Plan on AMR 2019–24, and contribute to future goal setting for reducing AMHU.

This study aimed to explore potential barriers and incentives towards enhancing AMHU surveillance in beef cattle and sheep sub-sectors by means of systematic stakeholder consultations and collation of information from the literature.

AMHU surveillance in GB: The current landscape for beef cattle and sheep systems

Since 2005, sales data on antimicrobials have been a statutory requirement for food-producing animals (VMD 2020; Veterinary Medicines Regulations 2005 SI 2005/2745), and the first UK-VARSS report was published in 2013. UK-VARSS reports previously reported total quantities of antimicrobials used in different animal species using sales data provided by manufacturers of antimicrobials licensed for veterinary usage as a proxy for AMU. More recently, they have additionally analysed and reported sub-sector-specific AMU data, provided to the VMD on a voluntary basis from a range of data and collection tools utilised by the different sub-sectors. The VMD has an ongoing working partnership with livestock sub-sectors to develop, facilitate and coordinate AMU data collection systems.

Antimicrobial sales data once collected by the VMD are standardised to enable comparisons between animal species and sub-sectors using the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) method. The ESVAC project collects information on how antimicrobial medicines are used in animals across the European Union (EU). This type of information is considered essential to identify potential risk factors that could lead to the development and spread of AMR in animals. In February 2018, the European Medicines Agency (EMA) published guidance on reporting AMU data by animal species which included standardised metrics of measurement of antimicrobial consumption as mg/kg (bodyweight of a food-producing animal) of antimicrobial drug. This was subsequently corrected to mg/Population Correction Unit (PCU), a theoretical unit formulated by the EMA and adopted by the countries participating in the ESVAC project to standardise sales against an animal population denominator which considers variations in the size and number of animal populations. Using the PCU, overall sales of products authorised for use in food-producing animal species can be presented as mg/PCU and be considered as the average quantity of active ingredient sold per kilogram bodyweight of food-producing animal; it enables year-on-year comparisons. The UK takes data from sales of antimicrobials at manufacturer level, and data from the various animal production sectors, and reports usage in the VARSS reports using the ESVAC method.



At manufacture level, pharmaceutical companies have reported the quantity of authorised veterinary antimicrobials sold throughout the UK to the VMD since 1993, and this has been a statutory requirement since 2005 (VMD 2020; Veterinary Medicines Regulations 2005 SI 2005/2745). UK-VARSS reports use these data as a proxy for usage for all animal species in the UK. Despite not considering wastage, imports or exports of veterinary antimicrobials, such data represent a good approximation of quantities of AMU in animals. Differentiation of quantities by animal species is made through consideration of the indications and licensing of the antibiotics sold. However, this methodology has its own limitations. For example, it is not possible to differentiate usage for animal species where indications and licensing are shared between

multiple animal species, and it is not possible to differentiate between different sub-sectors where an animal species covers different sectors of food production, such as dairy and beef cattle, or laying or broiler poultry (VMD 2020), see **Box 1**.

Box 1

Main limitations of using antimicrobial sales data to approximate AMU in livestock and companion animal species as reported in the UK-VARSS 2019 Report (Veterinary Medicines Directorate 2020)

- Antimicrobial sales data do not allow differentiation by animal species or sub-sector due to some antimicrobials being licensed for usage in multiple animal species.
- It is not possible to know how many doses of antimicrobial have been administered as a certain amount of antimicrobial could comprise many doses for smaller animals, and few doses for large animals
- Sales data generally overestimate AMU, as there is no guarantee that all antibiotics sold will be used (some may be wasted)
- Some antimicrobials may be sold for use in feed which is then purchased and exported outside the UK (i.e. not used in the UK). As there is no way of differentiating these from total UK sales data, these will likely contribute to overestimations of AMU from sales data.
- A given quantity of antimicrobial product may be imported and subsequently used in the UK on a Special Import Certificate and are not included in total sales data analysis.
- Medication sold for use in humans may be used in animals under the cascade system where under certain conditions, they are permitted for use, but these are not included in data analysis for total UK sales data.

To understand AMU within different sub-sectors, usage data are collected and reported voluntarily on a sub-sector-specific basis using a range of tools and methods. For example, in pig production, usage data are collected through the electronic Medicine Book for Pigs (eMB-Pigs) developed by the Agriculture and Horticulture Development Board (AHDB), whilst for meat poultry, the British Poultry Council (BPC) (whose members account for 90% of poultry production in the UK) demand that chicken, turkey and duck producers are responsible for submitting quarterly (chicken, duck) or annual (turkey and all breeders) AMU data that are then collated by the BPC and published in an annual report (VMD 2020). However, coverage of data collection and reporting from the different sub-sectors is varied, and most notably lacking in the beef cattle and sheep sectors.

In beef and dairy cattle, farm-level data are collected and reported using FarmVet Systems, a software company which reports sales data from VetImpress (a veterinary practice management software) to the VMD. However, these data are likely not representative of the GB beef herd due to the small sample size, only representing 9.6% of all slaughtered GB beef (not including dairy cattle). In addition, many farms had to be excluded from the analysis due to also rearing sheep, as it is impossible to know in which species antibiotics licensed for both sheep and cattle were used when using sales data to measure ABU.

In sheep, no data have been analysed or reported in the latest UK-VARSS 2019 report or its predecessors (VMD 2020). Thus, it is not possible to assess the level of AMU in UK sheep systems, to understand to what degree the sub-sector contributes to ABU in food-producing animals, whether it is meeting national antibiotic reduction targets, or to inform decisions with regards AMU and AMR in the sub-sector.



The recording of medicine usage data in food-producing animals is a legal requirement by farmers (Veterinary Medicines Regulations 2005 SI 2005/2745), and antimicrobial sales data from veterinary practice management software are recorded. Therefore, theoretically, there is a wealth of data on AMU that is currently unused for national AMHU surveillance. To be of use for sub-sector-specific surveillance, the data must be species-specific, standardised and accurately recorded (using the appropriate metrics), and a mechanism of onward reporting for collating and analysing AMU data needs to be in place. Part of the issue in the beef cattle and sheep sub-sectors lies

in their diverse structure with a wide range of different production systems, value chains, and farm and veterinary practice management software packages. This poses challenges in capturing AMU data for national surveillance, as highlighted by the RUMA Target Taskforce report for 2020 (RUMA 2020). The success of increasing AMU surveillance coverage in the pig and poultry sub-sectors is largely attributed to the high level of integration in the supply chains of these sub-sectors which simplified strategies towards improving data capture, reporting for national surveillance and target setting. For example, in the pig sub-sector, the higher levels of integration simplify the communication and management of interventions and data capture (RUMA 2020).

Recognising the significant issues with data collection in beef and sheep production systems, work was undertaken by AHDB to develop a new recording tool. Following an initial pilot project with cattle in 2018, a second phase of work on a Medicine Hub was commissioned, this time for both cattle and sheep data. The aim was to enable national sub-sector level reporting of AMU in line with ESVAC requirements, collect farm level data for identification of trends in AMU, and to facilitate benchmarking. Further, the Medicine Hub should link with farm and veterinary databases to collate medicine usage data towards this endeavour. The Medicine Hub was launched by AHDB in January 2021. Such work by AHDB represents positive steps forwards towards establishing AMU surveillance in beef and sheep systems comparable to other UK livestock production systems.

Outside of the data collected and reported from antimicrobial sales data in the VMD UK-VARSS reports, and data recorded by veterinarians and farmers, additional sources of AMU data may exist that could contribute to national surveillance. For example, the Veterinary Companion Animal Surveillance System (VetCompass) research project of the Royal Veterinary College (RVC) is investigating AMU in production animal species. VetCompass started as an initiative aimed at improving companion animal health and identify important risk factors for the most common disorders. This is achieved through the analysis of clinical data from computerised veterinary practice management systems. VetCompass has recognised the need for similar information in food animals. Currently, 28 clinics with farm activities are linked into the VetCompass database; 8 are exclusive farm clinics and 20 are mixed clinics. A three-year study titled “Antimicrobial usage in farm animal veterinary practice in the UK: A mixed-methods approach” under VetCompass aims to estimate current AMU in Farm Veterinary Practice and investigate factors (intrinsic and extrinsic) associated with veterinary decision-making when prescribing antimicrobials and the drivers behind their prescription. As such, VetCompass could provide an additional data stream for AMU in beef cattle and sheep, as well as provide valuable insights into the current drivers of AMU in the UK.

There is currently no reporting or collection of data for AHU in cattle or sheep, despite guidance on responsible AHU being disseminated by organisations such as RUMA, Control of Worms Sustainably (COWS) and Sustainable Control of Parasites in Sheep (SCOPS), amongst others, and the high economic burden of parasitic disease. For example, it is estimated that gastro-intestinal nematodiral disease costs the British sheep industry £84 million per year from the costs of lost performance, preventive measures, and treatment of affected animals (Nieuwhof and Bishop 2005). Thus, discussions towards implementing national level surveillance of AHU is warranted, despite the apparent lack of human health implications of AHR.

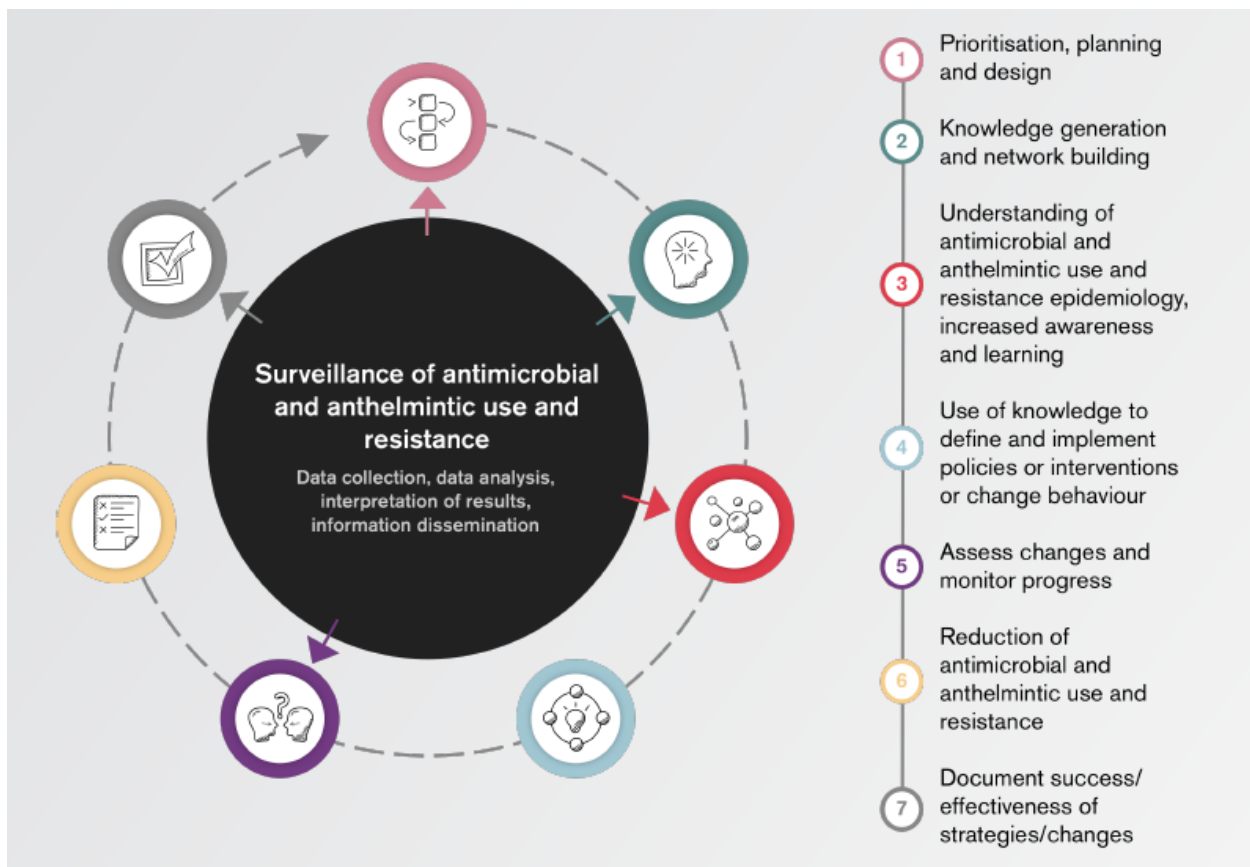


Figure 1. Surveillance components of antimicrobial and anthelmintic use and resistance surveillance and their role in policy-mitigation cycle. Häslér B, based on Aenishaenslin et al, 2021 (doi: 10.3389/fvets.2021.611931)

Surveillance of AMHU is an important part of a mitigation-policy cycle for antimicrobial and anthelmintic resistance (AMHR). Surveillance components comprise data collection, data analysis, interpretation of results, and information dissemination. The outputs of AMHU surveillance can be used to guide decisions on treatment, identify populations at risk, understand the epidemiology of AMHR and inform the development and evaluation of strategies and interventions. The value of surveillance is realised when the information it produces is used to make decisions or change behaviours (Figure 1). The BVA recommends improved data capture, analysis, dissemination, and benchmarking across all sectors to underpin future interventions alongside efforts needed to provide AMU data rather than sales data. A greater focus on improving surveillance and the flow of information and communication between sectors including farmers, veterinarians, laboratories and national bodies would improve cross-sectoral understanding of disease incidence as well as medicines and vaccine use, which would promote One Health decision-making to tackle AMR (BVA 2019). To achieve this, the expertise and perspectives of different stakeholders may need to be considered and integrated. This would allow contentious issues and different opinions on issues to be raised and considered to facilitate mutual benefits from interventions and promote

effective and sustainable changes. Alterations in the wider AMHU surveillance system should aim to satisfy the recommendations and goals of governmental and non-governmental organisations, as well as meet the needs of veterinary surgeons and farmers. When discussing and implementing changes in the system, the benefits to animal health and welfare are also important considerations.

Data collection: Stakeholder workshops, interviews, and literature review

General overview

Data were obtained from a combination of online stakeholder workshops and interviews with stakeholders involved in or influencing the surveillance system. Those interviewed included stakeholders who had been invited to the workshops yet were unable to attend due to other commitments, allowing them to share their perspectives. Ethical approval was sought from and received by the Social Sciences Research Ethical Review Board (SSRERB) at the Royal Veterinary College (approval number URN SR2020-0245).

The workshops aimed to highlight potential barriers and incentives towards enhancing AMHU surveillance in the beef cattle and sheep sub-sectors and to explore how other data streams could be integrated into the system.

A PESTLE approach (Aguilar 1967, Perera 2017) was used to structure the discussions in break-out groups and plenary sessions. Summary notes were taken by designated note-takers during workshops, and by the interviewer during interviews. These were structured in a narrative format by the study team and used in team discussions to identify and describe emerging themes and elaborate recommendations. The findings are presented in this report supported by literature where relevant and available.

PESTLE analysis

PESTLE analysis is used in business environments to identify, evaluate, and appraise business factors to inform decision-making (Aguilar 1967, Perera 2017). It considers that a business interacts with its external environment, yet many external factors are out of its direct control, while being directly or indirectly impactful (Cadle et al. 2010). The evaluation model has the strengths of being applicable to the analysis of highly dynamic landscapes, and flexible to suit different environments or contexts for which it is applied. It can be utilised to identify barriers and opportunities for success by appraising six broad categories of environments: 1) Political, 2) Economic, 3) Socio-Cultural, 4) Technological, 5) Legal, and 6) Environmental.

The AMHU surveillance landscape for beef cattle and sheep sub-sectors is complex, with its factors falling broadly within the six PESTLE categories of environments. The PESTLE format was used to facilitate structured discussions in the workshops and to organise the information collected.

Workshops and interviews

Two stakeholder workshops were conducted online on the 25th and 26th February 2021 using Zoom software. The first workshop included 12 participants from governmental and non-governmental organisations of relevance to AMHU surveillance, whilst the second included eight farmers and veterinarians involved in the GB beef and sheep sectors (Table 1).

Workshops lasted two hours in duration. Consent was obtained from participants prior to commencement. Following introductions and explanation of the project and purpose of the workshop, participants were put into breakout rooms in groups of four with a facilitator and note taker from the study team. In the break-out rooms, each group was encouraged to start the discussion with two or three different factors of the PESTLE, and if time allowed to move onto the others. Facilitators had a list of questions that they could use to start the discussion and use as prompts throughout if needed, but

the preference was to allow for an open, free-flowing discussion. Following the break-out sessions, participants were invited to share their key topics of discussion with other groups in a plenary session; everybody was invited to react and comment further.

Table 1. Summary of stakeholder attendance of workshops

Stakeholder	No. of representatives	Workshop attended
Animal Health and Welfare Board (AHWB)	1	Workshop 1: Thursday 25th February 2021
Animal and Plant Health Agency (APHA)	2	
British Veterinary Association (BVA)	1	
Food Standards Agency (FSA)	2	
National Sheep Association (NSA)	1	
Red Tractor Assured Farm Standards (AFS)	1	
Ruminant Health and Welfare Group (RHAWG)	1	
Veterinary Medicines Directorate (VMD)	3	
Large Animal Veterinarians*	4	Workshop 2: Friday 26th February 2021
Beef and/or sheep farmers	4	

* Working with beef and sheep clients

Interviews were conducted with a sheep farmer, two representatives from the National Office for Animal Health (NOAH), and representatives from RUMA, the Soil Association (SA) and the Sustainable Control of Parasites in Sheep (SCOPS). Online interviews were conducted by a researcher from the Royal Veterinary College and lasted approximately one hour in duration. Interviewees were provided summary notes from stakeholder workshops in advance, and informed consent was obtained prior to commencing any interview. Interviewees were asked to share their views on the topics of discussion from the workshops. They were also asked to highlight any critical challenges and incentives towards effective AMHU surveillance that they believed were neglected in the workshops. Interviews were not recorded, and summary notes were taken which contributed to the data gathered from the stakeholder workshops.

Additional organisations including non-governmental providers of agricultural AMU and AMR guidance and recommendations, veterinary pharmaceutical companies, and agro-suppliers were contacted for participation but were unable to engage within the short time frame available for this study.

Data analysis

Summary notes from stakeholder workshops and interviews were first organised by grouping the discussion topics broadly by political, economic, socio-cultural, technological, legal, and environmental factors. This allowed repetition of discussion topics to emerge and the identification of consensus and conflicting views from different stakeholders. In addition, topics of discussion which fell across two or more of the groups of factors comprising the PESTLE were made apparent from the workshop and interview data. From these, broader emerging themes were identified through an inductive approach. These were supplemented by knowledge from the literature and used by the study team to elaborate recommendations.

Findings

Diversity of the beef cattle and sheep sub-sectors complicates surveillance

One study participant explained that if the entire livestock sector is appraised as a whole, its efforts to capture AMU data should be applauded, as great steps have been made in acquiring a greater quantity and quality of data. This was said to be notable in the pig, poultry, fish, and gamebird sub-sectors and has led to good knowledge generation for AMU in total livestock. This would be justified from the VMD's UK-VARSS report for 2019, and evidence from previous UK-VARSS reports, where sub-sector-specific AMU and AMR information has improved year-on-year (VMD 2019; VMD 2020). These improvements have facilitated target setting by RUMA's Targets Task Force for reductions in AMU amongst the sub-sectors and contributed to wider AMR activities. However, there was recognition amongst participants that beef cattle and sheep sub-sectors are behind others in capturing AMU data. A major factor for this would be the diversity of these sub-sectors in comparison to those where surveillance activities for AMU are well established and more advanced.

The success of increasing AMU surveillance coverage in pigs and poultry was largely attributed by participants in workshop 1 and interviewees from non-governmental organisations to the high level of integration in their system which simplified

strategies towards improving data capture and reporting for national statistics. They discussed that it provides a less complex landscape to identify targets for intervention whilst additionally simplifying the process of buy-in. As highlighted in the RUMA Targets Task Force Report for 2020, higher levels of integration simplify the communication and management of interventions and data capture (RUMA 2020). However, the level of integration was not the only factor involved. It was mentioned by various workshop participants and interviewees that the pig and poultry industry had strong leadership, that there was recognition of their responsibilities and pressure to reduce their usage and "do the right thing". RUMA's Target Task Force was said to bring

together the different sub-sectors, enabling comparisons in their levels of AMU and "holding them to account". The requirement by Red Tractor for pig farmers to report ABU data into the centralised electronic Medicine Book for pigs (AHDB) was highlighted as a "game changer" for pigs, resulting in the greater than 90% coverage for sub-sector-specific AMU we have today (UK-VARSS 2020). However, there was consensus among most participating stakeholders that the beef cattle and sheep sub-sectors are more heterogenous which has implications for AMHU surveillance.

Participants from all stakeholder groups described a greater number of producers and actors in the system, a wider range of production systems but also fewer specialised veterinarians compared to other livestock sub-sectors. The implications for AMHU include the usage of a range of farm management and veterinary practice management software based on the needs and preferences of different farmers and veterinarians (and metrics used for data recording) and different farmer needs for farm-level benchmarking (and the accuracy of data recording that can be used for national surveillance).

The existence of different production systems with different age groups (such as suckler herds for beef) has implications for which farmers see benefit in joining accreditation schemes or outcome-based payments. These schemes or payment



systems were identified by participants from both workshops and those interviewed as potential targets for enhancing AMU surveillance; they are discussed in more detail in the following sections. Some participants stated that antimicrobials are used predominantly in young stock and efforts to improve surveillance could focus on young stock rearing systems. It was additionally suggested by a public institution representative that small farms need attention in the system, as these are those who are less likely to have regular contact and good rapport with a veterinarian. Participants observed that veterinarians have the ability to influence the quality of medicine recording, highlight the importance of AMU surveillance, and communicate developments in the system such as the launch of the Medicine Hub for cattle and sheep by AHDB in January 2021 or new technologies that make data recording a less arduous task.

Additionally, the heterogeneity of the two sub-sectors has resulted in broader and more complex value chains with different farmers incentivised by different factors. This is perhaps demonstrated by the relatively low levels of uptake of accreditation schemes, with representatives from the National Sheep Association and SCOPS estimating that only approximately 50% of sheep farmers in GB are Red Tractor Farm Assured. Low uptake was also suggested by some governmental and non-governmental representatives to be due to sales going through livestock markets rather than more directly to retail through processors where there is no perceived benefit of being Farm Assured.

The wider range of stakeholders in these sub-sectors adds further challenges to coordinate and agree upon issues and strategies for improving AMU surveillance. One participant observed that there may be less buy-in or will to enhance AMU surveillance, as the industries perceive themselves to be lower users of antimicrobials, and the pressures to “do the right thing” may not be as strong an incentive for change. Indeed, AMU in sheep and cattle in Britain appear to be below the UK average for all livestock (Hennessey et al. 2020; VMD 2020), but these figures may not be truly representative of the national herd/flock.

Despite these challenges, there was apparent optimism amongst participants that with the correct strategies they could be overcome. Participants from all stakeholder groups voiced that expectations for increasing AMU surveillance coverage should perhaps be more conservative than for other sub-sectors, and that it will likely take time to see positive changes in the system. Similar considerations would apply for AHU surveillance.

Limited interest in the challenge of AHR inhibits AHU surveillance

There was consensus among all stakeholder groups that there is much less will towards the threat of AHR compared to political will and action towards AMR. Participants explained that they believed this was due to the apparent lack of public health implications of AHR.

AMR has been described as the quintessential One Health issue (Robinson et al. 2016), with development and multidirectional spread to and from humans, animals, and the environment. This would include the development and spread of ABR from animals to humans from direct contact with livestock, via the food chain or via environmental contamination with resistant bacteria, their genes or antibiotic residues (Graham et al. 2019; Landers et al. 2012; Koch et al. 2017; Smith et al. 2005). Political will and desire for the UK to be a global leader in action towards mitigating the threat of AMR has led towards activities to monitor and act against the challenge. The Prime Minister commissioned the O’Neill report in 2014 which subsequently made recommendations that have had an impact on policy change against AMR. This included for the need for improved surveillance of AMR and AMU across all sectors including agriculture (O’Neill 2016). It was confirmed by a representative from a public institution that there exists strong political interest in enhancing AMR and AMU surveillance in the agricultural sector, including the beef and sheep sub-sectors where it has been recognised that surveillance coverage has been poor. Another representative from a public institution commented that despite there being an apparently high level of discussion and activity around improving AMU surveillance in beef cattle and sheep (particularly around the issues of data collection), there was a (perceived) lack of a comprehensive and coordinated approach to the challenge (i.e. there exists political will to enhance the system, but no firm political support).

However, the same cannot be said for AHR and efforts to monitor its usage, levels of resistance and impacts on the health and welfare of livestock in GB. Indeed, participants from all stakeholder groups described how action against AHR is far behind that for AMR, including aspects of data collection and reporting of AHU and AHR. This would include a lack of

agreed standardised metrics for AHU which was identified as an issue by Hennessey et al. (2020). Downstream impacts of a lack of surveillance were highlighted by participants, including for food safety. One participant commented that the lack of information generated poses challenges to setting anthelmintic residue limits and routine testing of food for residues. Another one added that there is currently no policy arm at the VMD for AHU and AHR despite interest of some employees. However, they also noted that there is interest in what developments are being made in this field so that the VMD can consider starting to investigate how AHU data can be captured.

A lack of channels to collect and feedback AHU and AHR data was believed by participants from different stakeholder groups in workshop 1 to challenge information and knowledge generation which could drive support towards implementing surveillance for AHU and AHR. It was noted that most major farm animal practices and farmers themselves will perform their own faecal egg counts (FEC) to monitor worm burdens. Alongside any AHR testing that is undertaken, data on AHR often goes no further than the farm or the veterinarian, whilst it was also said that cases are often not investigated. A representative from a public institution highlighted that there are a lack of feedback mechanisms to inform farmers that their sheep or cattle were found to have high worm burdens at post-mortem, inhibiting knowledge being reported back to farmers that they have a disease problem or that their anthelmintic treatments may be ineffective.

Overall, wider gaps in knowledge for AHR was an issue agreed upon by participants of all stakeholder groups. This would concur with the work by Hennessey et al. (2020) who emphasised the lack and fragmented nature of research in AHR and AHU in beef and sheep. Considering the high economic burden of AHR in these sectors (Nieuwhof and Bishop in 2005 estimated that AHR costs the British sheep industry £84 million annually) and strong industry led initiatives to control AHU (SCOPS and COWS), efforts for enhanced data capture seem advisable.

It was highlighted by a representative from a non-government body that work towards raising awareness of the threat of AHR and the responsible AHU is being carried out by relatively few number of organisations (e.g. SCOPS and COWS) who are relatively small organisations with limited funding. The work carried out by such organisations was described as “enormous” in comparison to their funding. Such work includes providing national forecasts for parasitic diseases, producing, and disseminating guidelines for farmers and suitably qualified persons (SQPs) for responsible AHU and prescription and improving training for SQPs and awareness raising. Farmers were described in the workshops to be more motivated by ease of access and use of anthelmintics, and lax prescription practices and decision making amongst SQPs were described. However, other participants pointed out that SQPs are well regulated by Animal Medicines Training Regulatory Authority (AMTRA), and that similar to veterinarians, a mixture of good and bad prescription practices can be observed. As such, it was noted that SQPs should not be demonised. In some regions of GB with reduced access to veterinarians, they were described to be the most frequent and well trusted point of contact for animal health. Thus, it can be concluded that SQPs should be considered in conversations about AHR and AHU as they are well placed and knowledgeable in these fields.

Farmers were described by different stakeholders to be largely aware of the issue of AHR, yet it was observed by some participants that many may feel that the issue of AHR does not apply to them, and the reality of the issue will only sink in once they are directly affected (i.e. inefficacy of treatment in their livestock). Part of this may be due to a lack of access and number of specialised sheep and, to a lesser degree, beef cattle veterinarians, and low frequency of contact with veterinarians who can advise on AHU. The farmer-veterinarian relationship was often discussed in both workshops as being a crucial driver for change, yet flock and herd health plans were described by some as being of poor quality and the relationship being poorer in comparison to other livestock sub-sectors. Workshop 1 participants commented that even when flock or herd health plans were of good quality and the farmer-veterinarian relationship was good, the fact that anthelmintics were mostly procured from SQPs without the need for a veterinary prescription decoupled the advice given by veterinarians on AHU. It was also added that regarding benchmarking, monitoring AHU was considered a less important activity by farmers in comparison to AMU inhibiting efforts to change behaviour towards AHU.

Several representatives from non-government organisations suggested that information would be needed on the value of implementing AHU surveillance, particularly at sector-specific level. It was noted that anthelmintic sales data should be available from the pharmaceutical industry and from the agro-retailers and other anthelmintic retailers, and would surveillance at this level of accuracy be sufficient or even required? The argument was made that considering the limited funds available to bodies like SCOPS and COWS to influence change towards AHU and AHR, and the amount of time, effort and resources required to implement an AHU surveillance system, resources and efforts should perhaps be better

spent towards improving awareness and action against AHR and promoting responsible on-farm AHU and SQP training rather than sub-sector-level AHU surveillance.

Regardless, different stakeholder groups in workshop 1 and 2 noted that research in AHU and AHR in the beef and sheep sectors was limited and that better knowledge would help to make decisions on the design and implementation of AHU surveillance.

A voluntary system of data reporting is preferred

Within the current system, the reporting of veterinary antibiotic sales data by the pharmaceutical industry to the VMD is a statutory requirement (Veterinary Medicines Regulations 2005 (SI 2005/2745)). However, as many antibiotics are authorised for use in multiple species, it is not possible to determine how much is used by each animal species, or to differentiate usage by individual sector using this data (Veterinary Medicines Directorate 2020). For sub-sector-specific

usage surveillance, farm-level data is required to be recorded and reported, either from on-farm recording or from sales data from veterinarians (provided these are recorded by species).

In the UK, it is a legal requirement for farmers to record medicine usage in food-producing animals (Veterinary Medicines Regulations 2005 (SI 2005/2745)), but voluntary mechanisms of reporting to the VMD have been the preferred approach of collecting sub-sector-specific data to date. However, considering there is recognition that AMU surveillance coverage is low in the beef cattle and sheep sub-sectors whilst data is available, questions of whether voluntary mechanisms are sufficient or whether firmer legal or regulatory requirements to report usage



data are necessary were discussed during the workshops.

Certain stakeholders highlighted how the voluntary system imbues a sense of ownership of the reporting process to each sector and reduced the risk of pushback from the industry which could impede the process of enhancing AMU surveillance. It was also explained how the work of RUMA and its Targets Taskforce were bringing the different sub-sectors together and holding them to account for their usage against one another, resulting in voluntary mechanisms of change. Workshop participants agreed that the poultry and pig sectors were highly integrated with strong leadership which simplified and facilitated the effectiveness of reporting. In comparison, the heterogenous structure of the beef and sheep sub-sectors would bring up more barriers towards voluntary mechanisms enhancing surveillance.

Despite these, the majority of participants across all stakeholder groups favoured the voluntary approach in the beef and sheep sub-sectors and suggested that it should be given time to demonstrate effectiveness. This approach was supported with regards AHDB's launch of the Medicine Hub for cattle and sheep in January 2021 for which there was optimism as a centralised repository for AMU data and a mechanism for improving surveillance coverage in the sectors.

Few participants believed that legal requirements to report AMU data were needed. Arguments were made that enforcing data reporting or using the "stick" approach would assist in standardising the quality of data collection needed for AMU surveillance. Some participants thought that only the "good farmers" would voluntarily report their usage data, i.e. those considered to be progressive, aware of the dangers of inappropriate AMU, and interested in reducing their AMU. It was

suggested that it would be the other farms where AMU was likely to be less judicious that are of greater importance for surveillance activities. Some farmer participants stated that if reporting were to be a legal requirement, they would comply with it to avoid penalisation. This sentiment was supported by a representative from an industry group who agreed that their members would be happy to share data if it were a legal requirement. However, concerns were expressed that farmers would be wary of how their data would be used and whether their AMU would open up their business to scrutiny or penalisation over AMU. Some participants observed that firmer regulatory enforcement would risk pushback from the industry, being non-motivational for farmers and take time, effort, resources and be non-motivational for farmers.

There were strategies suggested to enhance AMU surveillance including utilising accreditation schemes and the opportunities provided by the replacement of the Common Agricultural Policy (CAP) and new out-come based payment schemes (discussed in more detail below). Such would act as mechanisms for voluntary change by providing economic incentives to report data. However, there was consensus among participants from all stakeholder groups that fear of scrutiny and penalisation (or lack of access to payments or certification) had potential to disincentivise the uptake of such schemes. There was thus agreement that farmers should not be penalised for high AMHU and mechanisms should be provided to explain why usage may have been high. Some veterinarians and farmers highlighted that high usage does not always reflect poor health and welfare on-farm and that in some years there are higher incidences of disease necessitating high levels of AMU.

Overall, there was general agreement across stakeholder groups that time should be given to the voluntary system before firmer regulatory options are pursued, and that incentive-based methods should be trialled first.

Quality and compatibility issues of collected AMU data are barriers towards its use for national surveillance

The recording of medicine usage in food-producing animals is a legal requirement for producers. Veterinary practice management software packages additionally serve as databases for data on sales of antimicrobials to the beef and sheep sub-sectors. Knowing that such data are available but not being used for surveillance activities was frustrating to some participants and brought up questions about how they could be utilised. It was explained by some participants that for national surveillance and sub-sector-specific differentiation, it is necessary for usage and sales data to be recorded in the correct format. This includes for products to be linked to their unique identifier (e.g. market authorisation number), recorded in standard units (e.g. ml, mg, items) and to be converted into standard units (number of items), and the species for which the product is prescribed for or used in. However, a lack of standardisation of data collection or quality of data recording was highlighted by numerous participants as a technological barrier towards utilising collected data by farmers and veterinarians.

Up to now, beef-specific national data reported by the VMD has been only obtained from FarmVet systems and their VetImpress software which is used for recording and subsequent cleaning of sales data before being reported to the VMD for national statistics (VMD 2020). But as data is currently only being sourced from this platform, the sample size is small resulting in low AMU surveillance. Untapped data is elsewhere being collected which could be of use for national statistics including data for sheep for which no national level statistics are currently reported.

It was discussed amongst all stakeholder groups that there are a range of different data recording systems available and used by farmers which have different fields and levels for data entry, whilst some farmers may be using physical recording methods (such as paper-based medicine books). Additionally, the accuracy of recording may vary amongst farmers. There was consensus that a range of quality of data is recorded and that there is a lack of standardisation. Workshop one participants commented that recording on a mg/kg basis for AMU may not be standard between farmers, and it was also suggested that the varying demography of farmers may have an impact on issues of data recording and compatibility of data.

For veterinary practice data, one challenge highlighted by a representative from a public institution and some veterinarians was that although sales data are likely to be accurately recorded, some practice management software may not enable species differentiation when an antimicrobial is prescribed and sold. They felt that this should be a simple

technological barrier to overcome and that sub-sector-specific data capture from practice management software would be greatly improved if such changes were made. To overcome this issue, the industry is reportedly encouraging veterinarians to set up separate sub-accounts within their practice management system for sheep and cattle.

The recently launched Medicine Hub for cattle and sheep established by AHDB aims to link with both veterinary and farm electronic databases. However, for databases to be linked, data will have to be recorded and shared in the correct format. Certain participants in workshops 1 and 2 highlighted that if a preferred software database was unable to be shared, farmers would be obliged to duplicate data entry. Medicine recording was already reported to be a time-consuming task for farmers and having to duplicate entry would be a major disincentive to sharing their data into the Hub. One solution would be for farmers to record their medicine use directly using the Hub, but certain challenges exist towards farmer (and veterinary) engagement with the Medicine Hub (details are discussed in the following sections).

Other solutions to improving data recording quality would be to make recording a simpler and less time-consuming activity for farmers. This included discussions in workshop 2, by farmers and veterinarians, of taking advantage of new app-based technology and the ability to read barcodes on medicine packaging or introducing Quick Response codes (QR codes) on packaging to facilitate this, with such technologies developed through co-design. There were also suggestions in workshop 1 by a representative from a non-government institution that electronic ear tag technology could be a “missed trick” to ease medicine recording at individual animal level, particularly in the sheep sector where it is a greater challenge for farmers to record AMU at individual animal level due to the structure of the production system.

Regarding compatibility issues and data standardisation, it was mentioned by a participant from a public institution that veterinarians and farmers could put pressure on their software providers to standardise data collection in the required formats required for sharing with the Hub or for the purposes of national surveillance. It was commented by a farmer that for software providers, this would not be a challenge from a technological point of view, but would require investment on their part to implement changes to their software.

Accreditation schemes can provide economic incentive to report data

In pigs, the use of Red Tractor Farm Assurance and introducing a requirement to report medicine data into the electronic Medicine Book for pigs was a crucial driver in achieving the current levels of AMU surveillance coverage.

There was some optimism amongst participants that a mechanism of using accreditation schemes would also be effective in the beef and sheep sub-sectors and provide an economic incentive to collect standardised, accurate data and to report into the Medicine Hub. However, it was pointed out that only approximately 50% of GB sheep and beef cattle farmers are Red Tractor Farm Assured. However, it was noted by a participant from a non-government institution that there appears to be little will to change standards due to the large effort and resources required to do so, and the potential business implications it may have on accreditation bodies. Introducing reporting into the Hub could potentially introduce a barrier to some farmers to want to join or are current members due to concerns of how their data would be used and may go elsewhere for accreditation. It was suggested that such concerns could be solved by ensuring that all accreditors have the same standards for AMU reporting. From the same participant, there was optimism that the different accreditation bodies could coordinate towards making data reporting into the Medicine Hub a common standard, highlighting that if Red Tractor were to do so, others would likely follow as they would not want to appear to have lower standards. Agreements with accreditors and farmers would have to be elaborated carefully to address issues of data ownership and data privacy.

There was also discussion in workshop 1 and with some interviewees on how accreditation schemes could be linked to outcome-based grant schemes (such as the Animal Health and Welfare Pathway). It was suggested that to access payments, a farmer would need to be accredited which would facilitate onward reporting of data if reporting were part of accreditation standards. However, greater clarity on the proposed schemes would be required in to understand how such a mechanism could work in practice.

However, it was agreed that such a mechanism should not be expected to provide the same degree of impact as in the pig industry considering the diversity of the beef and sheep sub-sectors, and lower numbers of farmers from these who are Farm Assured by Red Tractor, or are licensees to other schemes. For many farmers, and in sheep in particular, it was commented that there is less economic incentive to be accredited due to the wide range of alternative markets available to them. It was commented that farmers may only see the value of accreditation after they have joined, enabling them to see and be part of the “bigger picture”. Furthermore, it was stated that mainly farmers producing fattened livestock have interest in accreditation schemes. They do not need to buy assured stock to sell them as part of a scheme, yet much of AMHU occurs at the beginning of an animal’s life. However, it was noted that there is no market call for whole life assurance which challenges its inclusion as a standard.

When discussing the role of accreditation schemes, the question of how much improvement is enough and what would be the added benefit of achieving equivalent levels of coverage as for other sub-sectors was raised by several participants. Some participants suggested that any systematic data capture from sheep would be a step up from the current situation and that expectations for the beef and sheep sub-sectors should be managed taking into account their structure and dynamics.

Outcome-based payments can be a target for improved surveillance

There was much discussion amongst participants from all stakeholder groups on the potential of outcome-based payment schemes, as proposed in the replacement of the Common Agricultural Policy (CAP) as a result of exiting the EU, as a target for improving data capture for AMU surveillance. In particular the proposed Animal Health and Welfare Pathway was deemed likely to “engage farmers in ways that farmers have never been engaged before” through its co-design with farmers and veterinarians. However, it would only apply to farmers in England, and other payment schemes that apply for the other GB nations would need to be considered in parallel.

To access payments, many participants agreed that farmers would likely be required to have at least an annual veterinary visit or inspection. This would be of benefit to the farmer providing an opportunity for a farm health assessment and veterinary consultation which would additionally strengthen the farmer-veterinarian relationship. Part of this inspection would likely require auditing of medicine records. As regular interactions and inspections would be a pre-requisite to access payments, it was argued that the Animal Health and Welfare Pathway could be a target for improved data recording and reporting by making it a requirement to either report medicine data into the Medicine Hub, or be signed up to an accreditation scheme who could introduce requirements to report to the Medicine Hub, or provide evidence they have reported to the Medicine Hub directly. As such, the Animal Health and Welfare Pathway, or indeed, other outcome-based payment schemes that are proposed, could provide economic incentives for improved data capture. However, it was argued by one participant that such schemes should serve to enhance the sub-sectors, and not serve to provide payments or subsidise veterinary visits which should be occurring on at least an annual basis anyway, particularly if they are receiving POM-V antimicrobials.

A lack of clarity on the specifics of the Animal Health and Welfare Pathway was highlighted by participants of workshop 1 as being a challenge towards understanding how to utilise it as a mechanism for improved data capture, or how great an impact AMU surveillance it is likely to have. To some, it was unclear whether it would be mandatory or voluntary to engage with the Pathway, and what level of funding for what outcomes farmers can expect to be available. It was noted by participants across all stakeholder groups that grant schemes would not be attractive to farmers if there was little financial reward available for the amount of effort or investment required, or if minimum payments are required by farmers to access the schemes. Some observed that farmers are often reliant on such payments to keep their businesses afloat and deemed it likely that many would join voluntarily. However, there were concerns amongst some participants in workshop 1 that farmers could get equivalent remuneration for joining schemes that have little impact on the health and welfare of their animals and which would not necessitate veterinary inspections or the auditing of medicine records. One farmer highlighted that there is a risk of overcomplicating the proposals and access to the payments by farmers which would be an additional disincentive towards its uptake. It was generally agreed that until the specifics of the proposed

outcome- based payments become clearer, there are barriers towards understanding how they could be targeted to improve AMU surveillance coverage.

The ability to benchmark at farm level can be an incentive for reporting

There was consensus amongst different stakeholder groups that there is a disconnect between national surveillance information and farmers. Nationally reported figures for AMU in the sectors was said to provide little benefit and be irrelevant to their activities, considering it is not linked to health, welfare, time, or space. It was discussed that people farm for many reasons, but that the business dimension was an important consideration. Farmers were described to be aware that good health and welfare in their animals is a financial advantage to their business, but a proportion of farmers may not see the benefit of accurate data recording and reporting. Therefore, to improve data collection and reporting for national level surveillance, the data have to be useful for farm-level benchmarking and decision making.

Benchmarking enables farmers to monitor their usage, compare their usage against others, and contextualise their AMU against other collected data on health, welfare and production performance which may incentivise better data collection and encourage reporting of AMU data beyond the farm. Participants agreed that a simple recording and feedback system would facilitate both accurate recording as well as the use of the information. Some farmers noted that benchmarking against themselves is often a greater incentive than being able to benchmark against others. The diversity of the beef and sheep sub-sectors means that farmers will manage their farms in very different ways and are on their “own journey” and benchmarking against themselves is a greater motivator. The point was made that farmers may not see the benefit of using the Medicine Hub if they cannot benchmark against themselves using their own data.

One of the prominent benefits of the AHDB Medicine Hub for cattle and sheep reported by different stakeholders was its ability to both collate reported data for use for national surveillance and farm-level benchmarking. This was indeed a strong incentive for pig farmers to voluntarily report into the electronic Medicine Book for pigs and helped towards improving surveillance coverage in this sector (RUMA 2020). It was explained by a participant from a non-government institution veterinarians can help with effective recording by assisting farmers in the use of the Medicine Hub (i.e. how to accurately input medicine usage data), and can play a key role in communicating the benefits of using the Hub for benchmarking purposes as well as the relevance of the data itself. However, there were concerns among some veterinarians on their already substantial workload and that extra responsibilities would need to be well considered.

One farmer pointed out that priority should be given to the health and welfare of beef cattle and sheep when discussing the relevance of benchmarking for farmers. Indeed, there was much discussion and agreement across all stakeholder groups that for data on AMU to be useful to farmers, it is important to contextualise it against health and welfare outcomes, as well as points in time and locality. In workshop 2, participants agreed that it is not always useful to look at the total usage as it is also critical to be able to intervene

at the right times considering that certain diseases requiring antimicrobial therapy are more prevalent at certain times of



year. On AHU, two participants pointed out that recording would be more useful if temporal data were captured as part of surveillance to be of greater use to their work and for farmers.

Such information would also enhance the knowledge generated from national surveillance and reporting. Understanding where AMU is highest would help understand which parts of GB require either a greater focus for interventions, and in combination with disease and welfare data could identify which regions require greater assistance. Overall, national surveillance could analyse AMU data in line with additional data which would provide more useful information for farmers and organisations who could make use of such information for their individual agendas. It would also shift the focus from reducing AMU towards more responsible AMU, as the point was often made by veterinarians and farmers that reducing AMU does not necessarily indicate better health and welfare outcomes. Considering changing environments as a result of climate change, contextualising AMHU data would enable comparisons with climate data to be made towards understanding the impacts of climate change on AMHU and, from a wider lens, the challenges posed by climate change on AMHR.

The farmer-veterinarian relationship is an important consideration

There was consensus amongst all stakeholder groups that the farmer-veterinarian relationship is an essential part of the conversation towards how the current AMU surveillance system can be enhanced, and how AHU surveillance could be implemented.

There was much discussion towards there being an opportunity to translate positive farmer-veterinarian relationships into improved data capture. Indeed, it was highlighted by one farmer that best knowledge exchange occurs through farmers and veterinarians working together. From the perspectives of veterinarians, a critical role of the veterinarian is to disseminate good practice including support for accurate medicine recording and reporting. However, it was noted that along with this comes substantial political pressure to “do the right thing” such as to act as guardians of AMU and advisors on responsible AMU.

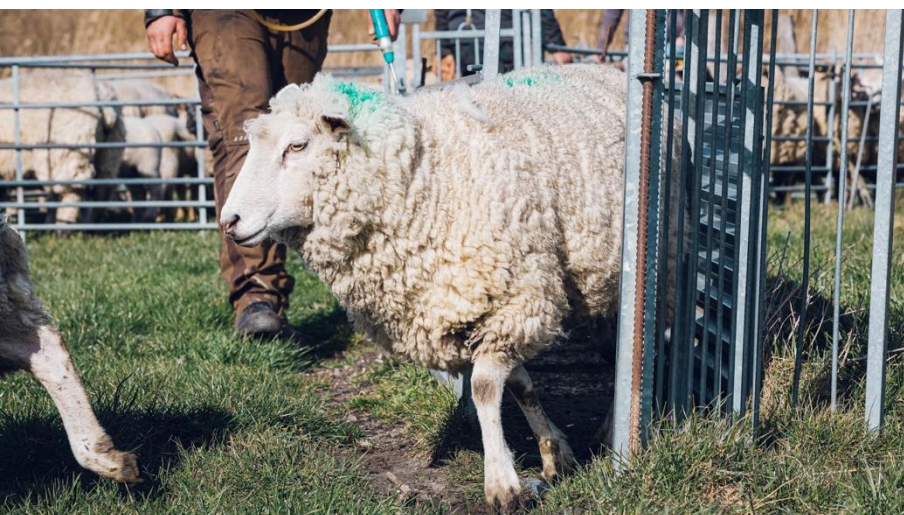
As previously discussed, farmers may be concerned about sharing their data for fear of penalisation or uncertainty on how their data may be used. There was general agreement amongst veterinarians that incentivising farmers to record and report data accurately (including engaging with the Medicine Hub or by including this as part of flock or herd health plans) would be preferential in contrast to legal requirements, and that veterinarians could play an important role in this endeavour. But veterinarians observed that they would resent being the “government truncheons” if reporting were to be enforced legally and do not want to be part of the “big stick to beat farmers”. Constructive interventions that benefit both national surveillance and farmers would be welcomed and able to be mediated by veterinarians.

If reporting AMU data into the Medicine Hub were to become a standard as part of accreditation schemes or linked to the Animal Health and Welfare Pathway (or other schemes), there was consensus amongst different stakeholder groups that veterinarians would be well placed to communicate the benefits of such activities to farmers and be able to encourage their uptake. Uptake of such schemes would engage farmers with veterinarians to a greater degree than before and act to strengthen the farmer-veterinarian relationship.

Most veterinarians in workshop 2 acknowledged that most farmers are knowledgeable and want to do the right thing. However, there were certain comments that implied some mistrust in the will of some farmers to record AMU accurately or engage with reporting activities with the result being a mixture of good and bad practice. Some farmers observed that accurate medicine recording was indeed a burden.

Veterinarians commented that many farmers are keen to protect the health and welfare of their animals whilst also enhancing their business. Therefore, a case was made that framing medicine recording and reporting as a beneficial activity towards their animals and business could be a powerful incentive, which veterinarians could play a crucial role in communicating.

Despite the potential for veterinarians to have a positive influence on AMU surveillance activities, several points were made that challenge their potential impact in the system. It was highlighted by participants of all stakeholder groups that the sheep and beef sub-sectors have lower engagement with veterinarians with lower numbers of specialised veterinarians than others. For beef and sheep, it was commented in workshop 1 that veterinarians often engage with the most engaged farmers, whereas those not engaging would often require greater veterinary assistance. However, this was contrasted by farmers and some government and industry body representatives that observed that some veterinarians are uninterested in beef and sheep practice with implications for the quality of flock/herd health plans, advice given, and a general will to engage with farmers of these sub-sectors. They said that this contributed to the more distant farmer-veterinarian



relationship compared to other livestock sub-sectors. In addition, it was argued by participants in workshop 1 and a farmer that it may well be larger, more commercially oriented farms who engage more, having the means and business incentive for veterinary consultation. For many sheep and beef farmers (more notably in sheep), it was said that it is often not cost-effective to call a veterinarian on farm. One participant commented that some farmers pride themselves on not requiring veterinary assistance. The situation is complicated further when considering that some sheep and beef farms are in remote regions of GB with limited access to veterinary services even if there was desire to engage more. Overall, participants of all stakeholder groups

agreed that the farmer-veterinarian relationship is very different in comparison to other sub-sectors which could have implications for the role of veterinarians in mediating improvements in AMU surveillance.

Optimism in the AHDB Medicine Hub for cattle and sheep towards improving AMU surveillance coverage and a potential role for AHU data collection

Although farmers are legally required to record the quantity of AMs they have used, these data are used for individual farm management and farm assurance schemes, and not stored in a central database and therefore not readily available for AMU surveillance. However, the recent launch of the Medicine Hub for cattle and sheep by AHDB could change the AMU surveillance landscape considerably, acting as a central hub for the capture, collation, and dissemination of AMU data for national surveillance.

Participants from all stakeholder groups were generally optimistic towards the success of the Medicine Hub for improving AMU surveillance in the beef and sheep sub-sectors, and in its potential to standardise and simplify data capture. Farmers appreciated their involvement in its design believing that this would ensure its ease of use and benefit to them. It was discussed in workshop 1 and by one interviewee that there is strong will, "more than ever before", from the industries for the Medicine Hub to be the central repository for medicine use in cattle and sheep, providing a mechanism for connecting farm and veterinary practice data and supplying national data. One of the prominent benefits of the AHDB Medicine Hub for cattle and sheep reported by participants from different stakeholder groups was in its dual ability to collate reported data for use for national surveillance, and for farm-level benchmarking.

The Medicine Hub promises to be able to link with farm management and veterinary practice management databases to collate medicine usage data. However, some participants had concerns about the ease of use and accessibility of the hub for its potential users, in particular in regard to linking data to the Medicine Hub from different databases. Points were made in both workshops that if farmers were unable to link their data with the Hub, they would be forced to duplicate data entry which was described as laborious and a disincentive towards its engagement. However, the notion that the Hub was not currently user-friendly was refuted by some veterinarians and farmers, and that from their experience, it appeared to be easy to interact with. One participant said that AHDB were keen to avoid data duplication, yet the challenge was to link databases due to a lack of standardised data collection and metrics used. In addition, one farmer felt that AHDB would be unlikely to cover the cost of fixing such technological issues, but that there was technology present to be built upon to fix these issues in the future.

Some participants argued that farmers should be allowed to use whatever tool is most efficient and easiest for them to use to facilitate accurate medicine recording, with recording often described by participants as a burden to farmers. They argued, however, that technological challenges can be expected in the first stages of the Medicine Hub and it should be accepted that it will take time for issues with linking with databases to be “ironed out”. There was agreement across all stakeholder groups that the Medicine Hub should be given time to prove effective, particularly considering the optimism for its efficacy, and its potential to be connected to different strategies for improving data capture, such as accreditation schemes and outcome-based payments. Towards solving the issue of difficulties in linking certain databases to the Medicine Hub, one participant suggested that one-off grants could be offered to the various farm management and veterinary practice management software companies for them to modify their software to enable standardisation of data recording and for data to be able to be exported in formats that are compatible with the systems used by the Medicine Hub. Another suggestion was for farmers and veterinarians to put pressure on their software providers to ensure that collected

data is shareable with the Medicine Hub. However, it was noted by one farmer that many providers of the software are small companies meaning that implementing changes are likely to be costly and time consuming.

An additional challenge identified was that its engagement is purely voluntary, and not currently linked to any accreditation schemes or outcome-based payments. In addition, it was commented by participants in workshop 1 that it was unclear that rollout had been universal with concerns that many farmers and veterinarians may be unaware of the Hub. This was reportedly related to the “soft launch” of the Hub which had not been widely publicised. Indeed, according to a representative of an industry body,

receptivity of the Medicine Hub, or awareness of its launch, by its members was low, even amongst farmers who are considered progressive or highly regarded in the sector. It was added that even sheep veterinarians who could advise farmers about engaging with the Hub had poor awareness of its launch. However, the majority of veterinarians and farmers who participated in workshop 2 were aware of the Hub. They explained that its launch and benefits had been well communicated to them through channels such as veterinary societies and webinars.

Many farmers have concerns about how their data is being managed as has previously been discussed. There was agreement from all stakeholder groups that in order to encourage farmer confidence in engaging with the hub, there should be full transparency regarding how their data will be used and who would have access to it. Additionally, that data used for national surveillance should be anonymised. Some went as far to suggest that the farmer should be given control over how their data will be used (i.e. the hub should provide mechanisms for a user to be able to provide consent



or indicate their preferences for how their data can be used or who is allowed to view their data such as veterinarians, accreditors, the supply chain etc).

Differences in the procurement and administration of antimicrobials and anthelmintics necessitates different strategies

It was commonly noted amongst participants from all stakeholder groups that there are distinct differences in how antimicrobials and anthelmintics are procured by farmers for use in beef and sheep. While antimicrobials are POM-V and their supply falls under the control and jurisdiction of the prescribing veterinarian, the majority of anthelmintics are POM-VPS, meaning they can be prescribed and supplied by SQPs. Participants explained that agro-retailers and online retailers of veterinary medicines are the most common source for farmers. Indeed, veterinarians concurred that they rarely, if at all, prescribe or sold anthelmintics to farmers, and farmers confirmed that they obtain them from non-veterinary sources. Guidance for their prescription by SQPs appears to suggest that a lower level of scrutiny, and no clinical assessment is required, but that sufficient information about the animal and the condition to be treated is needed to enable them to prescribe and supply the most appropriate product.

Despite the work of SCOPs and COWs to improve training of SQPs and their prescribing habits, one farmer made a point that the prescription of anthelmintics to farmers is in their view lax. Some observed that farmers desire products that are easy to use and are cost-effective, and as a result, agro-suppliers stock and sell a limited range of products, many of which are non-specific combined worm and fluke treatments. A lack of stock of flukicides was described by one farmer as a disincentive to farmers to purchase specific flukicides and would accept a combined treatment as an alternative rather than wait. In addition, workshop 2 participants explained that some farmers would perhaps ask for a flukicide but be prescribed a combined treatment instead, and that many were unaware of the product that had been supplied to them. However, this point was countered by a representative from an industry body who stated that farmers nowadays were well “clued up” about the different anthelmintic treatments available to them and most would be aware of the intended usage of the product supplied to them. Furthermore, some participants believed that responsibility for appropriate purchasing and supplying of anthelmintics should be shared between SQPs and farmers, believing that farmers should be more responsible in their demand for products and ensuring they ask for products targeted for the conditions they want to treat.

There was consensus among participants that data should be available at pharmaceutical industry level, but species differentiation issues would be the same as for antimicrobials. It was noted that although many are licensed in multiple species, some are formulated differently for different species so the possibility exists for some sector specific data to be obtained from this avenue. However, it was conceded that many drugs are not and accurate data for sector-specific AHU would be challenging or impossible to obtain. Compared to antimicrobials, AHU data will likely be negligible from veterinary practice management software as was confirmed by veterinarians in workshop 2. However, sales data should be available from agro-retailers and other suppliers of anthelmintics to farmers. It was agreed that such providers of anthelmintics could be a target for data collection and reporting if a surveillance system for AHU were to be designed.

It is worth noting that it was highlighted by participants from all stakeholder groups that anthelmintics are often used, and data recorded, at flock or farm level, which would have implications for the standardisation of data collection for reporting and agreement on appropriate metrics of AHU.

Conclusions

The findings in this report highlight the complexities of AMHU surveillance in the beef cattle and sheep sub-sectors in GB. The heterogeneity of these systems hinders the accurate and standardised capturing of AMU data for national surveillance. The recent launch of the Medicine Hub for cattle and sheep is an important change in the system. The emergence of a central repository that collates and disseminates data for both national surveillance and back to farmers for farm-level benchmarking has raised high hopes for increasing AMU surveillance coverage whilst providing a valuable tool for the beef and sheep sub-sectors. There is great optimism that the Medicine Hub can bridge the gap between on-farm data collection and national surveillance, ensuring that the collection and reporting of AMU data by farmers is a relevant and valuable process. This is considered crucial if a preferred voluntary system of reporting AMU data is to be effective, particularly in the face of the concerns of farmers towards how their data will be used and the implications such would have on their business. Given the complexities in the system, targets, and expectations for improving AMU surveillance in these sub-sectors should be feasible and realistic, and time should be given for voluntary mechanisms of capturing data to prove effective before considering firmer legal requirements.

Mechanisms to improve AMU data capture are proposed, predominantly those that provide economic incentives to report AMU data. They include accreditation schemes incorporating AMU reporting as a standard, or new outcome-based payment schemes as proposed in the upcoming replacement of the Common Agricultural Policy, notably the Animal Health and Welfare Pathway. Although only approximately 50% of sheep and beef farms are believed to be Red Tractor Farm Assured, it is suggested that the current AMU surveillance coverage can be increased using a mechanism using accreditation schemes. The Animal Health and Welfare Pathway may be better suited to capture further smaller-scale farmers who may not regard veterinary involvement in their enterprises as cost-effective. Whilst this approach shows promise for AMU data reporting, benefitting the farmer and veterinarian relationship, and improving animal health and welfare, adequate economic incentives to join would need to be provided to encourage its uptake. Furthermore, any mechanism that encourages AMU data reporting must ensure transparency in how farmers' data are used, and who can access them. Fear of scrutinization or penalisation for AMU is a genuine barrier to farm-level data reporting which requires careful consideration when strategizing mechanisms to increase data reporting by farmers.

Farmers were complimentary of having been included in the development of the Medicine Hub and by DEFRA in the proposed Animal Health and Welfare Pathway (and other proposed schemes). Such co-design was regarded as “refreshing” and increases the likelihood of success of such developments by considering the challenges and needs of farmers, and thus aspirations of improving health and welfare of beef cattle and sheep. Through the lens of AMU surveillance, co-design of mechanisms with potential for enhancing data capture should be positively regarded, and future changes in the surveillance system should involve farmers to ensure there is mutual benefit.



Knowledge on AHR and AHU is far behind that for AMU, inhibited by an apparent lack of public health implications of AHR and an associated lack of political attention. This is highlighted by a dearth of mechanisms to disseminate data on

AHU and AHR from farms and veterinary practices, and to provide feedback to farmers on potential AHR (e.g. from the results of post-mortem examinations). As such, limited knowledge is available that could be used to design effective AHU and AHR surveillance. In addition, further progress needs to be made towards standardised metrics for measuring AHU. Proposed metrics for AHU would have to consider differences in the way that anthelmintics are used on farm in comparison to antimicrobials (i.e. flock/herd level treatment vs individual treatment). Although sales data on anthelmintics should be available from the pharmaceutical industry, non-veterinary sources of anthelmintics would need to be considered as an important source of AHU data considering that the majority of anthelmintics are sourced from these by farmers.

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