5.8: Report on practical strategies to reduce antimicrobial use in dairy farming

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About EuroDairy

EuroDairy spans 14 countries, from Ireland to Poland, and from Sweden to Italy, encompassing 40% of dairy farmers, 45% of cows and 60% of European milk output EuroDairy is an international network to increase the economic, social and environmental sustainability of dairy farming in Europe. EuroDairy fosters the development and dissemination of practice-based innovation in dairy farming, targeting key sustainability issues: socio economic resilience, resource efficiency, animal care, and the integration of milk production with biodiversity objectives.
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1. Summary

One of the (sub) themes within EuroDairy is to reduce the use of antimicrobials at dairy farms. Driven by the risks of antimicrobial resistance for humans and animals almost all EU countries are making efforts for a reduction in and more prudent use of antimicrobials. The only way to sustainably reduce the risk of Antimicrobial Resistance is through an integrated approach to disease control which sustainably improves animal health.

EuroDairy organized activities to cross border exchange knowledge about national approaches and farmers' experiences with the aim to learn from each other how to reduce the use of antimicrobials without adverse impact on animal health and welfare. Though focused on antimicrobial use it all starts with a good animal health as a healthy cow does not need antibiotics!

To exchange and disseminate knowledge EuroDairy organized webinars, exchange visits and a cross border workshop. Technical leaflets were also produced and a digital case study made available.

Antibiotic use in animal husbandry and also in the dairy sector varies greatly by country. This implies some countries, like Sweden, do not need to put extra effort in a reduction as the use is already very low (the lowest in the EU). In this case we can try to learn from the "Swedish model". Other countries have also developed useful approaches, resources, tools and expertise and there would be value in sharing these to facilitate more rapid progress. It is not clear whether research and development in this area was limited or just difficult to access but there is scope for a more integrated approach to R&D on AMU and AMR in Europe.

A national approach to reduce the use of antimicrobials starts with awareness and a broad consensus among farmers and all other relevant stakeholders (like veterinarians). This can be seen in the Dutch approach which has lead to successful reduction. The RESET Mindset Model of Lam et al., 2017 when applied to the experience of the dairy sector in the Netherlands shows how an integrated approach can draw on cues from Rules, Education, Social Pressure, Economics and Tools to influence a behaviour change across an entire industry.

Key factors for early successes are transparency and selective dry cow therapy. To make antimicrobial usage at farm level (and per veterinarian) more transparent a national database and a performance indicator at farm level could be introduced. There is much to be learned from the successes and failures of countries that have already implemented systems. Current benchmarking metrics are complex, difficult to calculate and not easily understood by farmers. Different countries are taking different approaches and there is scope to explore whether a common set of metrics could be developed for the dairy industry in Europe.

Independent of the stages at which the national strategies are and whether measures are voluntary or obligatory for dairy farmers it is always worthwhile to improve animal health and to use antibiotics more prudently. A more prudent use means as little as possible, but as much as necessary to protect animal health. Hotspots for antibiotic use are treatment for mastitis, including dry cow therapy, lameness and foot health, respiratory disease and young stock health. Antimicrobial selection should be based on proper diagnosis, preferably confirmed by susceptibility testing. There is scope for countries to share experiences in developing and updating treatment guidelines to ensure effective treatment and prudent use.

Building sustainable animal health is key to the capacity to realise genetic potential on-farm and to optimising the efficiency of production thereby reducing both costs of production and environmental impact and helping to make farming more sustainable. Precision technologies have the capacity to transform the management of animal health and more precisely forecast animal disease challenges facilitating more rapid and effective control. Animal health and welfare are key to building trust in the supply chain with significant current focus on how antimicrobials are used in livestock. There is scope for improvement in both business and technical skills within the systems which deliver the long-term sustainable improvements in animal health and a reduction in the risk of antimicrobial resistance.

2. Introduction

Antimicrobials, such as antibiotics, are used to treat or prevent infectious diseases. Microbes, collectively, include bacteria, viruses, fungi, and parasites. Antibiotics work by killing bacteria or preventing them from reproducing and spreading. Bacteria naturally develop resistance to antibiotics making their use less effective or ineffective. There is evidence that global levels of resistance are increasing, in part, because of the use of antibiotics in people and in animals.

The use of antibiotics in animals could ultimately affect future treatment efficacy in people, and vice versa, due to the connectedness of microorganism populations via direct contact and the environment. Antibiotic use needs to be reduced in both people and animals to help preserve their effectiveness. Overusing or misusing antimicrobials can make resistance develop even faster. Reducing the use of antimicrobials can help reduce the rate of development and spread of resistance to antimicrobials.

One of the (sub) themes within EuroDairy is to reduce the use of antimicrobials[1] on dairy farms. Driven by the risks of antibiotics resistance for humans and animals almost all EU countries are making efforts for a reduction in and more prudent use of antimicrobials with the aim to reduce the number of antibiotic-resistant bacteria. This is also stimulated by the EU as the first of the three main pillars of its second action plan against antimicrobial resistance (AMR) published in 2017[2] is to make the EU a 'best practice' region in the fight against AMR. This plan is based on a 'One Health' approach as AMR is a consequence of the use of antimicrobials in both human and veterinary medicines.

The aim of EuroDairy is to foster the development and dissemination of practice-based innovation and knowledge. As national approaches and experiences differ between countries, EuroDairy has undertaken activities to promote cross border exchange and wider dissemination of information. Farmers can learn from each other directly or indirectly (e.g. with the help of advisors). As it is also important that knowledge flows from research to practice (and vice versa so research gives answers to practical questions) researchers were also involved in EuroDairy activities.

Improving animal health is key to sustainable reductions in the use of antimicrobials on dairy farms. If the risks for bacterial infections are reduced there will, over time, be less disease and less need for treatment with antibiotics. On the other hand if the use of antibiotics is reduced but no steps are taken to reduce the risk of bacterial infections there will either be more disease resulting in poorer animal welfare or more antibiotics will need to be used to treat the disease which results from the failure to take appropriate preventive measures.

Most dairy farmers manage animal health very well on their farms – it is one of the keys to successful dairy farming - but, as is true for all practices there is a range from the very best in terms of low antibiotic use to the highest users. Whether the parameter you are looking at is milk production, feed efficiency or antibiotic use understanding how farmers achieve high performance provides insights into individual farm businesses in relation to their own unique circumstances. Attention to detail, good advance planning and a willingness to review outcomes and try new ways to improve performance are common to many high performing dairy farms. However, the practical ways in which the best-performing farms achieve their results will be different for different dairy systems.

This deliverable (5.8) focusses on the reduction and a more prudent use of antimicrobials at dairy farm level. It shows how the challenge to reduce antimicrobials use is being addressed by dairy industries in different countries and some of the best practices in use at farm level.

It has to be noted these best practices are only to illustrate good examples to inspire farmers to improve their business operations. For individual farmers in different countries it may not be possible to (fully) implement these practices due to national regulations or other limitations.

[1] The terms antimicrobial and antibiotics are used interchangeably in practice and also in this report. According to EU guidelines the term antimicrobial is used to encompass antibiotics and antibacterial agents, but excludes antiviral, antiparasitics and biocides(including disinfectants). In dairy farming most antimicrobials refer to antibiotics.

[2] A European One Health Action Plan against Antimicrobial Resistance (AMR)
https://ec.europa.eu/health/amr/sites/amr/files/amr_action_plan_2017_en.pdf

3. Methodology

The information in this report is based on the outcome of activities organized by EuroDairy and guidance materials provided.

Survey

As a starting point a survey among all EuroDairy partners was conducted in 2016 to make an inventory of national approaches, projects and farmers' initiatives to reduce the use of antibiotics. The results (for a summary see annex) showed a lot of activities are running. As a follow up there was a more in depth analysis of national approaches and practical experiences in a cross border workshop (see results workshop).

The main concerns of farmers expressed in this survey were the prohibition of preventive use of antibiotics when drying off and setting arbitrary targets not customized to the farmers. On the other hand the farmers were aware of the risk of antibiotic resistance.

Exchange visit

One of the activities mentioned in the survey as desirable were farm visits.

UK farmers – involved in a project of Bristol University to reduce the use of antibiotics - visited the Netherlands from 25 to 27 October 2016 to learn more about the Dutch approach and experiences. The Dutch approach and this farmers' experience is described in thetechnical leaflet "The Dutch way of reducing antibiotic use". One of the farms visited hadsuccessfully stopped drying off for over 5 years combined with a high health status and a very low antibiotics use.

Webinars

Within the theme Animal Care webinars are organized to disseminate knowledge about animal health and antibiotics usage. All webinars are recorded and available through the EuroDairy website.

Hoof health, 24-1-2017
Moderated by Jenny Gibbons of AHDB Jon Huxley (Associate professor at Nottingham University) presented new approaches to lameness control and effective treatment in dairy cattle.

Opportunities and challenges in calf housing and management for the next decade, 4-5-2017
Moderated by Jenny Gibbons of AHDB Professor Nina von Keyserlingk (University of British Columbia, Canada) presented new ways of rearing calves that can both benefit farmers and their calves. Besides optimizing feed management also rearing calves in pairs (instead individual boxes) can improve calf rearing.

Dry cow treatment of the high producing milking cow, 21-6-2017
Jessica Ekström of LRF presented an online seminar with udder/mastitis expert Håkan Landin of the Swedish advisory organization Växa about how to avoid antibiotics in the dry period.

Reducing pressures on the food, key to reduction of lameness, 29-8-2017
Moderated by Jenny Gibbons of AHDB Neil Chesterton ,a New Zealand expert, presented practical ways for farmers to reduce foot damage and subsequent lameness.

Limiter les antibiotiques, c'est possible, 3-4-2018
Coordination by Aurore Wache of l'Institut de l'Elevage (Idele) this webinar in French (the recording including a version with English subtitles will become available) about opportunities to reduce the use of antibiotics included presentations from French experts Isabelle Tourette (GDS), Philippe Roussel (Idele) and Marc Delacroix (veterinary).

Responsible antimicrobial use on UK dairy farms- the Farmer Action Group project 17-10-2018
Moderated by Derek Armstrong of AHDB Dairy Lisa Morgans, PhD student at the University of Bristol, and Graham Wells, a participating farmer, presented their insights into being part of the Farmer Action Group project, and cross-border learning on a EuroDairy trip to the Netherlands.

The Swedish take on responsible antibiotic use, 18-10-2018
Moderated by Jessica Ekström of LFR During this webinar, Ylva Persson of National Veterinary Institute and Växa Sverige discussed how Sweden has the lowest use of antibiotics in EU, and how other countries can lower their use of antibiotics to reach the same level.

Technical leaflets

Two technical leaflets are available on the EuroDairy website:

- The Dutch way of reducing antibiotic use (English and Dutch version)
- Lame cows? No antibiotics without diagnosis! (English) ***(broken link)***

A third leaflet about Dehorning is foreseen to become available in 2018. ***(link when ready WK)***

Digital case study

Animal Care focusses on dry cow treatment 31/01/2018

This case study – together with factsheets are available at the EuroDairy website – describes a decision making protocol at drying-off.

Workshop

A cross border workshop "Reducing antimicrobial use in European dairy farming" was organised by EuroDairy together with the Dutch national committee of IDF at 17th – 18th April 2018 in the Netherlands. The proceedings of this workshop will be available on the EuroDairy website. ***(link when ready WK)***

In total sixteen farmers and experts from Belgium (Flanders), Denmark, Sweden, The Netherlands and United Kingdom participated in this workshop and gave presentations about national approaches and practical experiences.

National approaches

Belgium (Flanders)

An important step to reduce antimicrobial use (AMU) is the founding of AMCRA[3] in 2012 to create a rational AMU reduction for all Belgian livestock sectors. The AMCRA mission is to prevent antimicrobial resistance to both public and animal health and welfare; to achieve a rational reduction or antimicrobial use and a durable policy in veterinary medicine in Belgium; and to analyze, communicate and sensitize in a neutral and objective way.

All stakeholders, including farmers, are involved in AMCRA. In 2016 AMCRA set targets to reduce AMU in 2020 by 50% and Critically Important Antibiotics (CIA) by 75%. Prescription of CIA is now prohibited except as a last resort after diagnosis. AMCRA publishes videos with tips for reducing antibiotic use on farms[4]

IKM-Vlaanderen, the milk quality assurance system, decided in 2018 to join AB Register vzw, the online database in which antibiotic use can be maintained for each individual company. The existing AB Register system, also records use by poultry and pig farmers. Through this initiative, the use of antibiotics in dairy farming on a large scale is charted and there is a basis for analysis and advice. The registration of the antibiotics used in AB-Register is done by the provider. This is usually the farm veterinarian. Dairy farmers do have the responsibility for ensuring the recorded data is correct. From 1 October 2018 the registration of antibiotics use on a dairy farm is required and this was included in the IKM specifications. From this date livestock farmers can register in the AB-Register database.

Belgium (Wallonia)

In Wallonia, ARSIA and AWE have joined forces to create the database called BIGAME (Computer Base for Management of Antibiotics and Medicines in Livestock) and to develop practical and easy registration tools. This system registers the use of antibiotics at the livestock farming level for the Walloon cattle sector. QFL also requires its members to join BIGAME. BIGAME can supplement the information on AMU with some existing data such as the results of analysis and antibiograms. On a voluntary basis and by individual agreement, additional information (pathology diagnosed, reason for treatment) can be collected and submitted by the veterinarian, thus allowing the subsequent identification and reporting of indicators. sanitary and zootechnical performances. This adds to the information for the project DESIR (Epidemiological Device for Surveillance of Infections in Ruminants).

Veterinarians have a powerful tool to use as part of their mission of herd management and their preventive approach to the health of the animals of their farmers, while meeting the various legal obligations.

[3] https://www.amcra.be/en/home/

[4] Reportage AMCRA conseils bovins laitiers

Denmark

The dairy industry set targets for 2020, namely a reduction of AMU with 20% compared to 2012, an average bulk tank somatic cell count of 150,000 per ml and stop using CIA. There is a national data base of AMU with public access. One of the official recommendations is to sample all cows before treatment. Further detail is provided in the case study on Denmark.

Sweden

Sweden has the lowest use of veterinary antimicrobials in the EU and a relatively very high animal health status. So a further reduction in AMU is not a target, but to maintain the possibility of an effective treatment. Healthy cows do not need antibiotics, but sick cows must be treated.

Preventive AMU is not allowed, so only selective dry cow therapy is permitted and individual animals only get treated after diagnosis. The use and resistance is monitored. Further detail is provided in the case study on Sweden.

The Netherlands

In 2017 the use of antibiotics reduced with 49% compared to 2009 and use of CIA were minimized so targets set by the government and implemented by the sector were reached. Consensus and awareness by all stakeholders, including dairy farmers, are main contributors to this reduction. The greatest reduction resulted from the ban of blanket dry cow therapy replaced by selective dry cow therapy. Further detail is provided in the case study on the Netherlands.

United Kingdom

The UK industry set targets that by 2020 Antimicrobial Use on dairy farms would have reduced by 20%, use of CIA should fall by 50% and the application of intramammary tubes during lactation and dry off should reduce by 10% and 20% respectively. The aim is for teat sealant tube usage to increase by 40%.

France and Spain

France and Spain were NOT represented at the workshop. Based on the survey (see annex) Spain has a national plan to develop measures to reduce the risk of antibiotic resistance. France[5].has been setting up a national plan to reduce the risk of antimicrobials resistance in veterinary medicine, since 2012 the so called Ecoantibio Plan. Over five year a reduction of 37% was realized. The follow up plan 2017-2022 focusses among other things on:

- Developing preventive measures against infectious diseases and facilitating the use of alternative treatments.
- Providing and sharing tools for the evaluation and monitoring of antibiotic use and tools for prescribing and administering antibiotic responsibility.

AACTING

Further information on systems for monitoring AMU data at farm level is available on the website of AACTING[6], the "Network on quantification of veterinary Antimicrobial usage at herd level and Analysis, CommunicaTion and benchmarkING to improve responsible usage". The main aim of the AACTING-project is to develop guidelines with practical advice on setting up systems for collection of AMU data at farm level to guide antimicrobial stewardship. In addition, a review of existing systems for the collecting and reporting of farm-level AMU data is being established based on an analysis of strengths and weaknesses of the different systems. The project also aims to make guidelines and information on currently existing systems available through the AACTING-website and to disseminate project outcomes and discuss further developments and challenges.

Sharing practical experiences

At the workshop farmers from Belgium, UK and the Netherlands reported and discussed their experiences with AMU reduction. A low use of antimicrobials starts with a good herd health and freedom from infectious diseases, like BVD and IBR. An AMU reduction is realized on their farms without adverse impact in animal welfare and health by measures like breeding, the use of conductivity sensors and of steam to disinfect the liners of automatic milking system, the type and management of beddings (sand or no deep litter bedding, regular cleaning of stalls and applying lime in them), selective dry cow therapy, diagnostic testing of milk samples, optimizing forage quality and calf rearing management (calf jackets, regularly weighing to monitor growth).

[5]Source: http://agriculture.gouv.fr/telecharger/85737?token=2d0dbaee87c41f823f6b147f996e659e

[6] http://www.aacting.org/swfiles/files/AACTING_annex-systems_V1.4_2018-11-07_41.pdf

4. Case studies

There has not been a co-ordinated approach to addressing the risk of antimicrobial resistance from the use of antimicrobials in dairy farming. Countries have started programs at different times and have adopted different approaches to management of antimicrobial use both at national level and at farm level. There is the potential to learn from the different approaches and practical experiences and a more detailed report was developed on action in Sweden, Denmark, the Netherlands and the United Kingdom.

Sweden[7]

Statistics on the use of antibiotics in farm animals in Sweden are available since 1980. Sweden has the lowest use of veterinary antimicrobials in the EU. According to the most recent ESVAC report for 2016[8], Sweden continues to report the lowest sales of antimicrobials for use in animals of the EU Member States providing sales data to the ESVAC project. During the period from 2010 to 2016, overall sales of veterinary antimicrobials declined by 20%, to 12.1 mg / Population Correction Unit. Decreases of more than 80% were noted in the sales of certain critically important antimicrobials (3rd & 4th generation cephalosporins and fluoroquinolones), which the ESVAC report attributes to closer adherence to prudent use guidelines and the introduction of national measures to limit their prescribing.

Antimicrobial use and resistance data

Antimicrobial use and resistance is monitored.In Sweden, all veterinary medicinal products are sold by pharmacies. All pharmacies are obliged to report all sales of medicinal and veterinary medicinal products to the eHealth Agency which maintains a database. Reports from Svarm, Swedish Veterinary Antimicrobial Resistance Monitoring, are published annually[9].

The eHealth Agency operates an automated system that pharmacies are obliged to use to report all sales. The species of animals for which the antimicrobials are to be used is recorded when they are dispensed to the animal keepers, which enables information to be extracted concerning the sales of antimicrobials for use in major species of animals. Veterinary medicinal products (including antimicrobials) dispensed to veterinarians by pharmacies are currently recorded under a generic term which limits the ability of the eHealth system to identify the amounts of antimicrobials used by individual veterinarians and the species for which they are used. Veterinarians are required to notify their use of veterinary medicinal products (including antimicrobials) in food producing animals and antimicrobials for systemic use in horses to the Swedish Board of Agriculture.

Long-standing rules prevent veterinarians from offering veterinary medicinal products (including antimicrobials) for retail sale and such products can only be dispensed by pharmacies on veterinary prescription. As an exception, veterinarians may dispense sufficient doses of antimicrobials (without profit) to sustain treatments until the antimicrobials can be obtained from a pharmacy. This measure was considered by the competent authorities to be of fundamental importance in avoiding any financial incentives for veterinarians to prescribe veterinary medicines except when they are needed. Preventive AMU is not allowed, so only selective dry cow therapy is used and individual animals only get treated after diagnosis.

The Medical Products Agency has produced guidance for the use of antimicrobials in cattle and sheep (2013)[10] in cooperation with experts in the field, which included discussions on dosing and treatment length. Penicillin is the first choice for most bacterial infections and there are restrictions on the use of fluoroquinolones and newer generation cephalosporins.

Animal disease data is based on veterinary surgeons reporting information, ie diagnostics, medicines and measures per animal breed, to the Swedish Board of Agriculture (Jordbruksverket, SBA)[11]. Animal disease data is seen as important in order to be able to work more with preventive animal health care at farm level and to get a picture of the overall health situation in the country.

Farmers of certain species of animals may choose to enter into a contract with a veterinarian for 'conditional use of veterinary medicinal products' which enables them to identify and treat specified conditions with a limited range of

[7] www.aacting.org/aacting-project/sba/?lid=3452; http://ec.europa.eu/food/audits-analysis/act_getPDF.cfm?PDF_ID=13639
[8] Sales of veterinary antimicrobial agents in 30 European countries in 2016 Trends from 2010 to 2016 Eighth ESVAC report
[9] https://www.sva.se/en/antibiotika/svarm-reports
[10] https://lakemedelsverket.se/upload/halso-och-sjukvard/behandlingsrek-vet/Dosering%20av%20antibiotika%20till%20n%C3%B6tkreatur%20och%20f%C3%A5r%20-%20ny%20rekommendation.pdf
[11] http://www.jordbruksverket.se/amnesomraden/djur/djurhalsopersonal/djursjukdata.4.7409fe2811f8e7990b88000992.html

veterinary medicinal products (based on the preferred treatments specified in the guidelines for prudent use of antimicrobials). In order to qualify for this scheme, farmers must participate in specific training approved by the Board of Agriculture. The contracts need to be registered with the relevant County Administrative Board and require the practitioner to make regular control visits to the farm, normally every 5 weeks.

Data are not further analysed at farm level in general. However, Växa Sverige[12], the Swedish Dairy Association (the largest advisory organisation in the dairy sector), extracts data from the SBA for dairy farms affiliated to Växa which is reported yearly. There is no benchmarking of results.

Animal Health and Welfare

In relative terms Sweden has a very high animal health status with freedom from BVDv, IBR, Mycobacterium Paratuberculosis, Brucellosis, Chlamydia, Leptospirosis, Tuberculosis and Enzootic Bovine Leucosis and a relatively low incidence of clinical mastitis and low calf mortality. The reported treatments of clinical mastitis in dairy cows have decreased over the last decade to 8.9 recorded treatments per 100 completed / interrupted lactations in 2015/16. Benzylpenicillins accounted for approximately 90% of these treatments. Fluoroquinolones were used in only 0.3 of recorded treatments per 100 completed /interrupted lactations cases (down from 2.5 in 2007).The use of antimicrobials is low so a further reduction in AMU is not a target, but to maintain the possibility of an effective treatment. Healthy cows do not need antibiotics, but sick cows must be treated.

The District Veterinarian[13] organisation is part of the Swedish Board of Agriculture and has approximately 500 veterinarians and nurses in 100 small clinics and in practice on farms. The District Veterinarians have official status and carry out a range of activities for the State. They are on call at all times and can treat all species of animals and deal with acute cases and disease control (epizootic diseases) and also carry out planned preventive animal health visits. These activities provide support and encouragement for farmers in implementing practices to avoid the use of antimicrobials and furthermore, the regular presence of a range of specialists on farms helps ensure good practice is followed at all levels.

The district veterinarians have also distributed a folder to farmers 'To prepare when the veterinarian comes' which highlights good practices and basic requirements to be fulfilled to provide sound hygienic conditions when the veterinarian arrives. The basic requirements include the availability of:

- clean table or surface for the veterinarian's bag and equipment,
- adequate cold and warm water and soap for hand cleaning,
- paper towels for drying, and
- good lighting

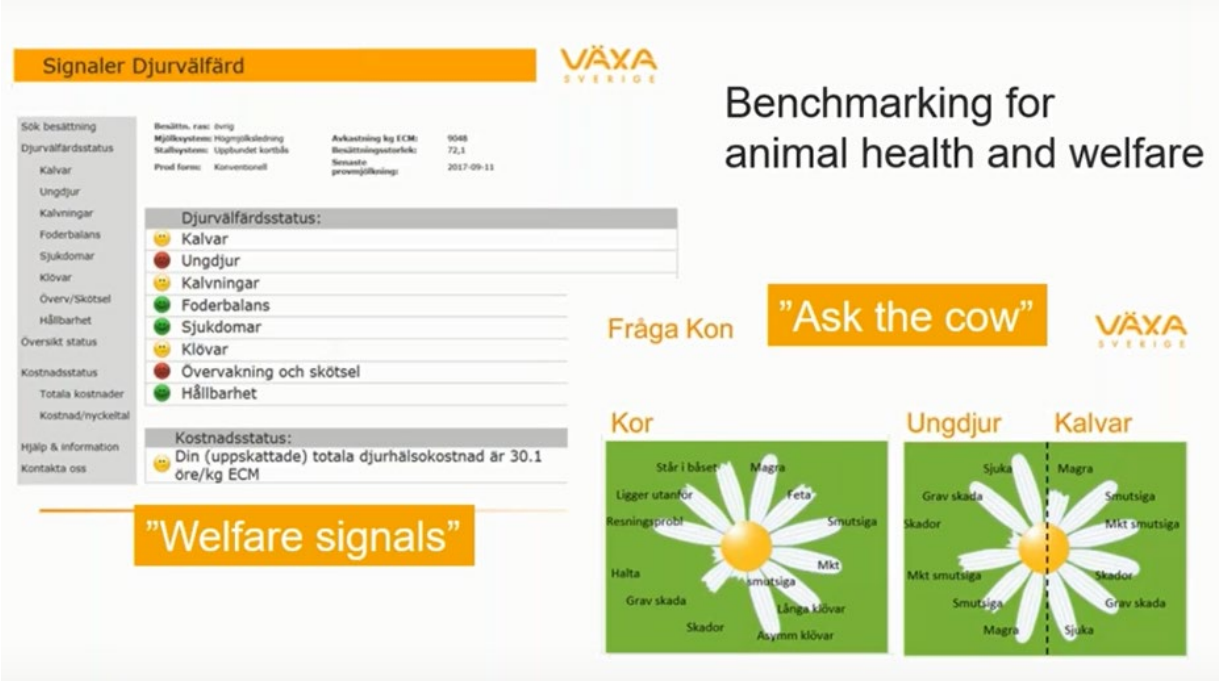
In 2012, the Veterinary Association of Infection Control was founded with the aim of highlighting the increasing need for infection prevention and control, and the prudent use of antimicrobials. There is a dedicated website Smittsäkra.se14, for the biosecurity programme run by the industry eg Växa Sverige and funded by the Swedish Board of Agriculture. The website provides advice on biosecurity and infectious disease control in farm animals. This is a 3 level programme including self-evaluation on the web, web based courses for farmers and courses held on farms and farm visits by veterinarians and other advisors focusing on biosecurity.

All herds in Växa Sverige Kokontrollen also have access to Signaler Djurvälfärd15 (Welfare Signals) and can use the service to see which areas of animal health are the highest priority. Farmers can see the key figures that reflect the animal welfare status of their herd and get the estimated cost of animal health for their herd. They can also see the values for all key ratios and how they changed in the last year. If the herd performance is among the 50% best this is given a green symbol but is the performance is among the 10% worst the symbol is red. A yellow symbols is used if the herd is between green and red.

The Fråga kon[16] (Ask the cow") service focuses on the animals. Through structured, objective animal observations, herds get a comprehensive picture of how the cows, heifers and calves are. Farmers get an action plan to work for better health and profitability. The result is compared to other herds and presented in numbers and in a nice graphical format (petals on a daisy flower) that generates curiosity. Farmers keep an eye out for whole and broken petals in their herd thriving report!

Specially trained counselors observe and systematically record animal signals in cows youngstock and calves, such as mobility, behaviour, lesions and cleanliness. The observation takes two to three hours. The result is presented in an easy-to-read report, along with suggestions for measures that are important to the animals. Farmers use the report to prioritize work and find the most important improvement measures.

[12] https://www.vxa.se/
[13] http://distriktsveterinarerna.se/dv/vara-tjanster/lantbrukets-djur.html
[14] http://www.smittsäkra.se/
[15] https://www.vxa.se/radgivning-och-kurser/analysera-nulaget/analysera-djurhalsan/signaler-djurvalfard/
[16] https://www.vxa.se/radgivning-och-kurser/analysera-nulaget/analysera-djurhalsan/Fraga-kon/



Slide from Ylva Persson presentation - [The Swedish take on responsible antibiotic use](), webinar 18-10-2018.

Euro Dairy Webinar - The Swedish take on responsible antibiotic use

In the Euro Dairy Webinar - The Swedish take on responsible antibiotic use[17] - Ylva Persson outlined the composite strategy which has been adopted in Sweden to deliver a low and controlled use of antibiotics in Sweden:

- Remove unnecessary use = ban on use as growth promoters and take steps to reduce use for routine prophylaxis eg selective dry cow, individual treatment is standard in cows and calves.
- Minimise need = keep animals healthy – in Sweden free from many endemic diseases; good fertility; low incidence of clinical mastitis (7.3%) SCC c. 209K; low calf mortality (up to 60 days < 4%; older calves < 2%); good foot health (treatment incidence 1%; from claw healthrecord, digital dermatitis < 3.5%
- Avoid spread = better biosecurity, infection control, hygiene
- Optimise use when needed = diagnosis and correct selection of appropriate treatment and dose rates
- Monitoring use and resistance = SWEDRES/SVARM report

Underpinning all of this is the communication and collaboration with all stakeholders. The overarching goal of the Swedish strategy is to 'Preserve the possibility of effective treatment of bacterial infections in people and animals.' As an equivalent to the popular 5:2 diet for people Ylva suggested a 5:2 aproach for better udder health to slim your cell counts:

5 routines for contagious bacteria

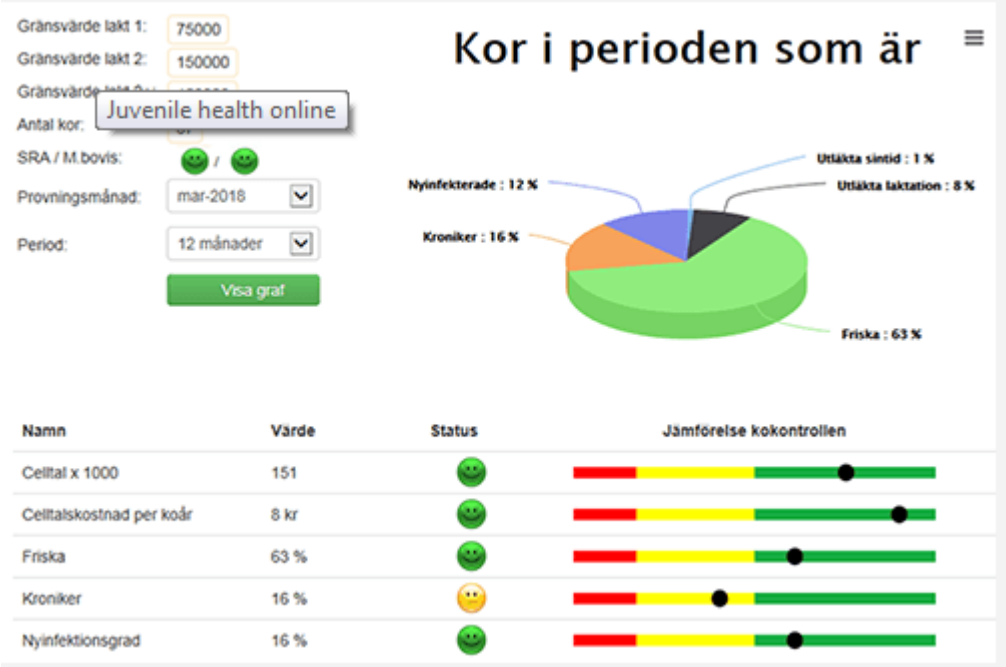
1) Optimal milking routines
2) Teat dip
3) Selective dry cow therapy
4) Treat right cows during lactation
5) Group and cull chronically infected cows

2 routines for environmental pathogens

1) Good hygiene
2) Strengthen cow's immunity

All herds which are part of the Växa Sverige Kokontrollen have access to Juverhälsa på nätet[18] (udder health on the web) - a web based programme for herds where the udder health situation is presented as a dashboard and benchmarked against other herds which have registered their data. If the herd performance is among the 50% best this is given a green symbol but is the performance is among the 10% worst the symbol is red. A yellow symbols is used if the herd is between green and red.

[17] https://www.youtube.com/watch?v=Z4P-PSpcrEE
[18] https://www.vxa.se/radgivning-och-kurser/analysera-nulaget/analysera-djurhalsan/juverhalsa-pa-natet/



Ylva concluded that having healthy animals in Sweden lead to:

- Lower use of antibiotics
- Better animal welfare
- Easier work for the farmer
- More milk (+better quality) and higher growth rates
- More profitable dairy farming
- Higher consumer trust including safe food

Less antibiotic use leads to less AMR and a safer working environment. Sweden has very little MRSA VRE and ESBL.

Diseases can be prevented by identifying and protecting healthy cows and calves and by identifying and minimizing risk factors. Healthy cows don't need antibiotics but when sick cows are treated the use of antibiotics there are systems in place to optimise use.

A range of guidance is available on which veterinarians can base their choice of antimicrobials to treat conditions in animals. This includes comprehensive guidelines for the use of antibiotics in production animals[19] from the Swedish Veterinary Association. The over-arching principles for use of antimicrobials are :

- Antibiotics should only be used to treat diseases with bacterial aetiology or when such aetiology is strongly indicated or suspected.
- Diagnosis of bacterial infections accompanied by sensitivity testing should precede treatment with antibiotics whenever possible.
- When treating bacterially induced diseases in production animals the ambition should always be to use pharmaceuticals with a narrow antibiotic spectrum.
- When treating groups of animals an aetiological diagnosis should be obtained and a treatment plan established.
- When high treatment rates or unorthodox use of antibiotics are discovered the underlying reasons and/or predisposing factors should be investigated and corrected by means of preventive measures whenever possible.

Only acute cases of clinical mastitis are treated during lactation (subclinical or chronic are not treated, only supportive therapy eg anti-inflammatories, or treated during dry period). In all cases the vet will collect a milk sample from cases of mastitis,

Gram positive cases (sensitive to penicillin) are treated with penicillin for 3 -5 days. Mastitis caused by Staphs resistant to penicillin or E coli are not treated with antibiotics. Penicillin resistant Stap[h aureus is now decreasing and responsible for around 2% of clinical mastitis cases.

Dry cow therapy is selective and only cows with mastitis are treated. Healthy cows, 'very' chronic cows (continuous high SCC) and those infected with Staphs producing betalactamase are not treated with dry cow. For infectious conditions of the hoof, such as, footrot and digital dermatitis there is a move away from using antibiotics and treating instead with a local bandage and salicylic acid. For reproductive disorders only treat acute clinical metritis

[19] www.svf.se/Documents/S%C3%A4llskapet/Husdjurssektionen/SVS%20guidelines%20ENG%20nov%202017%20webb.pdf

(first choice is penicillin im (intramuscular) for 5-7 days). The first choice antibiotic for respiratory disease in calves is also penicillin im for 3-5days. Only supportive therapy is used for calf diarrhoea in most cases which tend to be viral or parasitic. Bacterial diarrhoea (E coli F%) may be treated with trimeth/sulpha.

No antibiotics are used for:

- Most infectious claw diseases
- Most cases of calf diarrhea
- Retained foetal membranes
- Endometritis
- Viral diseases
- Prophylactic use
- Topical treatment of wounds
- Surgery

In most cases narrow spectrum penicillins are used for treatment of dairy cows in Sweden.

EU fact-finding mission to Sweden*

The report of an EU fact-finding mission concluded that "Sweden consistently reports the lowest use of veterinary antimicrobials among EU Member States and also relatively stable and low levels of AMR in animals. Overall, the report concludes that this situation can be attributed to a number of factors including:

a) a long-standing awareness of AMR related issues and actions to avoid them
b) the long-standing efforts to eradicate and prevent the introduction of infectious diseases in farm animals,
c) the so-called 'Swedish Model' of consensus thinking, mutual support and cooperation between government, industry and other stakeholders,
d) the monitoring and evaluation of trends in the development of AMR and the undertaking of actions before they become problematic, and
e) the fact that veterinarians cannot sell veterinary medicines they prescribe."

"A number of aspects of the measures put in place in Sweden aimed at avoiding the need for antimicrobials and encouraging their prudent use when necessary could serve as an illustration of potential good practices to other Member States."

* Final report of a fact-finding mission carried out in Sweden from 10 October 2017 to 18 October 2017 in order to gather information on the prudent use of antimicrobials in animals[20]

Denmark

Sales of antimicrobials, including the critically important antimicrobials (CIAs), for use in animals in Denmark are relatively low compared to other Member States[21]. Data on all sales of veterinary prescription medicine from the pharmacies, private companies, feed mills and veterinarians are sent electronically to a central database called VetStat[22], which is hosted by the Danish Veterinary and Food Administration.

VetStat, a register of the consumption of prescription medicines for animals at the property level has been operational since August 2000. Pharmacies, veterinarians and feed suppliers must report the consumption of

[20] http://ec.europa.eu/food/audits-analysis/act_getPDF.cfm?PDF_ID=13639
[21] European Surveillance of Veterinary Antimicrobial Consumption (ESVAC); Final report of a fact-finding mission carried out in Denmark from 01 2016 to 05 February 2016 in order to gather information on the prudent use of antimicrobials in animals
[22] https://www.foedevarestyrelsen.dk/Leksikon/Sider/VetStat.aspx

prescription drugs, including sera and vaccines to VetStat. Since 1995, the dispensing of medicines by veterinarians for the treatment of animals under their care has been limited to non-profit sales.

VetStat allows farmers and veterinarians to compare their use of antimicrobials in a standardised and objective way to general use patterns across the industry, and whether adaptations in feed, housing, stocking density or other animal husbandry factors might allow their use of antimicrobials to be reduced.

After reporting data, the reported amount of medicine is converted to the number of Animal Daily Doses (ADD), and subsequently linked with the Central Herd Register's (CHR) information about the number of animals. The Danish Veterinary and Food Administration has chosen to calculate the antibiotic consumption in cattle and pigs in ADD per 100 animals per day. ADD (Animal Daily Dose) is a standard unit set by the Danish Veterinary and Food Administration.

Antimicrobial use metrics

- DADD - Defined animal daily dose: DADD is the average maintenance dose per day for a medicine used for its main indication in the appropriate animal species. The DADD is not defined at product level but for each antimicrobial agent, administration route and animal species and when appropriate, also age group. DADD has been specifically defined for use in DANMAP and does not always completely match the "prescribed daily dose" or the recommended dosage in the Summaries of Product Characteristics (SPC). Weighted ADD values were introduced in 2016, in order to discourage the use of certain types of antibiotics and encourage the use of others[23].
- DAPD = DADD per 1,000 animals per day: DAPD is the number of DADDs administered to an animal species during a year (in thousands) divided by the number of standard animals at risk per day. The number of standard animals at risk per day takes into account species differences in average body-mass and life-span. When relevant, the numbers of DADDs and standard animals at risk are estimated for specific age groups, or simply as number of doses (DADDs) used to treat one kg of animal divided with the total estimated biomass (in tonnes).

  DAPD is a statistical measure, providing a rough estimate of the proportion of animals treated daily with an average maintenance dose of a particular antimicrobial agent. For example, 10 DAPDs indicate that an estimated 1% of the population, on average, receives a certain treatment on a given day. The DAPD is also referred to as the treatment proportion. In principle, the metric DAPD is parallel to the metric used in pharmaco-epidemiology for the human sector, Defined daily dose per 1,000 inhabitants per day (DID).In 2016, DAPD calculations were only carried out for pigs but this has not yet been done for dairy.
- The live biomass of the cattle population is estimated from census data [Statistics Denmark] and the average live weight of the different age groups. The Danish cattle population is mainly dairy, particularly Holstein Friesian, but also other breeds such as Jersey and a small population of beef cattle. Most of the cattle slaughtered are dairy cows and bull calves of dairy origin. The average live weight was estimated for 10 different age and gender categories. Sub-categories of cattle: cows, bulls, heifers and steers > 24 months, calves < 12 months and young stock between 12 and 24 months;

Antimicrobial use in cattle (DANMAP)[24]

In 2016, the overall consumption of antimicrobials in cattle decreased by approximately 3% (363 kg) compared with 2015. In 2017, the overall consumption of antimicrobials in cattle decreased by approximately 600 kg compared to the previous two years, mainly due to a decrease in usage for cows and bulls (excl. intramammaries). The production of veal and beef decreased by approximately 5% from 2016 to 2017, while milk production continued to increase. The usage pattern appears to have shifted away from the use of tetracyclines, sulfonamide/trimethoprim, extended spectrum penicillins and cephalosporins and towards an increased use of beta-lactamase sensitive penicillins, macrolides, amphenicols and aminoglycosides.

The majority of antimicrobials administered parenterally to cattle are used for dairy cows and prescribed mainly for mastitis. The overall level of intramammary treatment remained unchanged from 2016 to 2017. Since 2013, the use of penicillins and cephalosporins (all generations) has been reduced while the use of aminoglycoside-benzylpenicillin combinations has increased.

Critically Important antimicrobials in Denmark

The use of fluoroquinolones in cattle has been close to zero for the last decade and no use of fluoroquinolones was reported for cattle in 2016. Fluoroquinolones may only be prescribed to food producing animals, as a last line drug,

[23] https://www.foedevarestyrelsen.dk/Leksikon/Sider/V%C3%A6gtede-ADDer.aspx
[24] https://www.danmap.org/Downloads/Reports.aspx

based on microbiological and resistance testing in an accredited laboratory. Use of fluoroquinolones for food producing animals is also notifiable to the Danish Veterinary and Food Administration (DVFA).

The use of cephalosporins (all generations) used for systemic treatment (orally and parenterally) reduced to 9 kg in 2017. This represents a 69% decrease since 2014 (29 kg), when the cattle industry decided to phase out its use, and an 85% reduction since 2008 (60 kg), when cephalosporin consumption was at its peak. The use of 3rd and 4th generation cephalosporins is low in cattle and mostly used for systemic treatment.

The majority of antimicrobials administered parenterally for cattle are used for dairy cows and mainly prescribed for mastitis. From 2005 to 2013 there was a slight reduction in the overall level of intramammary treatment. Following an increase in 2014 the use of intramammary treatment decreased again in 2015 and 2016.

Antimicrobial strategy in Denmark

Since 2014, the Danish dairy industry (the Danish Agriculture and Food Council) has had a strategy for reducing the amount of antimicrobials used for treatment of mastitis by 20% compared to the 2012 level by 2018. Order (DK) 785/2010 provides legal regulations for the use of antimicrobial agents for mastitis in cattle and the industry has emphasized that farmers should use narrow spectrum penicillins to treat mastitis caused by Gram-positive bacteria, unless sensitivity testing reveals resistance towards these antimicrobials. The overall use of intramammary treatment, measured in DADDs, decreased from 2010 to 2011, but increased again after 2013. Since 2009, the number of antibiotic treatments at drying-off has increased and the relative proportion of drying-off treatment versus therapeutic treatment has shifted markedly from 22% versus 78% in 2010 to 48% versus 52% in 2017. During the same period the use of 3rd and 4th generation cepahlosporins has decreased markedly.

The board of Danish dairy and beef producers has recently renewed its strategy for good udder health. The goals are a 20% reduction in use of antimicrobials for treatment of mastitis and other cattle diseases as well as lowering geometric mean bulk tank cell counts to 150.000 by the year 2020. In addition, the dairy industry will promote use of dry cow therapy and mastitis treatment with simple penicillins.

Antimicrobial supply and prescribing

As a general rule, following a diagnosis, a private veterinary practitioner may supply or prescribe antimicrobials for further treatment of production animals to be administered by the farmer for up to 5 days. If additional treatment is needed, a follow-up visit by the veterinarian is required. For cows, the private veterinary practitioner must administer all treatments unless a 'Veterinary Advisory Service Contract' exists between the private veterinary practitioner and the farmer. The preventive treatment of animals with antimicrobials is prohibited in Denmark.

Farmers are only allowed to store antimicrobials (in secure, clean and appropriate conditions) within the prescription period, unless that prescription has been renewed. Otherwise, after expiry of the prescription period the farmer is required to dispose of the antimicrobials.

A range of differentiated taxes on antimicrobials have been applied since 2013 in order to promote the use of vaccines instead of antimicrobials and to discourage the use of critically important antimicrobials (CIAs). The tax rates applied are: 0% on vaccines, 0.8% on narrow-spectrum penicillins and other veterinary medicines, 5.5% on other veterinary antimicrobials and 10.8% on CIAs.

Health Consultancy Agreement

All dairy herds which had at least 100 cows or 200 young stock must have a mandatory health consultancy agreement (Obligatorisk sundhedsrådgivnings aftale – OSR)[25] (Martin, 2016). Smaller herds may voluntarily choose to enter into an OSR agreement. The private veterinarian, in cooperation with cattle production advisers, develops the agreement. Depending on the herd size, there is different frequency of veterinary visit, obligations and possibilities for the farmer.

Since 2016 all herds with a consultancy agreement must focus on animal welfare at least twice a year, Based on an assessment of relevant ratios and the review of selected animal-related welfare parameters (eg assessment of hocks, BCS or lameness), the farmer and vet jointly identify up to three areas of action for which action plans are drawn up. The impact of the action plans must be evaluated at least twice a year.

At least one annual visit must focus on infection protection. The farmer and veterinarian must identify possible points for improvement and implement action plans to improve them.

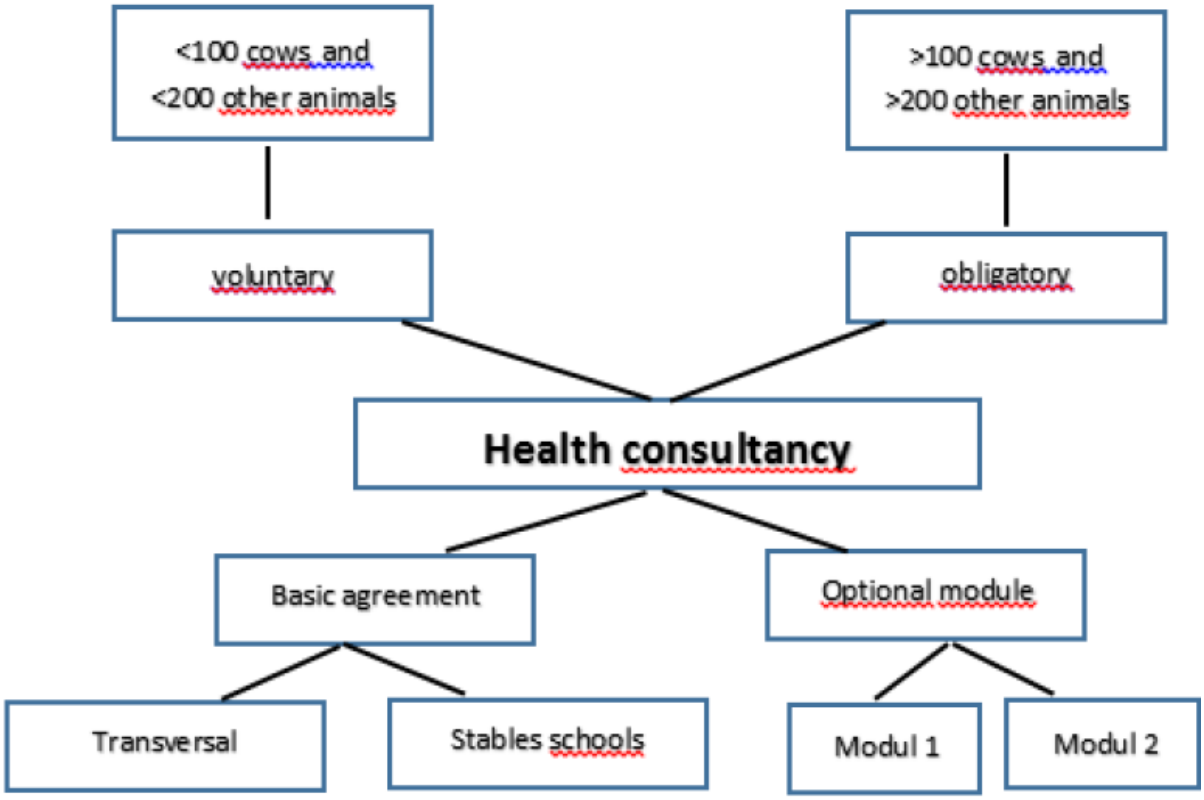
Different counselling agreements can be chosen. There is a choice between 2 core modules: either Interdisciplinary advice or Stable School. There are 2 Elective Modules:

- Optional module 1

[25] Bliv klogere på obligatorisk sundhedsrådgivning, Henrik Læssøe Martin, 2016 https://www.landbrugsinfo.dk/kvaeg/sundhed-og-dyrevelfaerd/sundhedsraadgivning/sider/Spoergsmaalogsvartilobligatorisksundhedsraadgivning.aspx

- Optional module 1 with electronic reporting
- Optional module 2
- Optional module 2 with electronic reporting

Below is an overview of the options for selecting advisory agreements based on Martin, 2016:



If you select the multi-disciplinary advice option you need at least two annual joint visits of both a veterinarian and an agricultural cattle consultant. During the visits there must be focus on animal welfare and related issues. During the two annual visits, the herd's own control program must be reviewed and assessed. On the basis of each visit, one of your advisors must prepare a visit report. This type of contract entered into by all herds, regardless of the degree of farming practice.

If you choose the opportunity to attend a Stable School, you must have at least one yearly visit of the students in the school. In addition, you should have a further visit from your herd veterinarian, and attend meetings with the other participants. A stable school consists of 5-8 farmers and a facilitator. The facilitator can be a vet or professional consultant. During the visits there must be focus on animal welfare and related issues. On the basis of each visit, the facilitator of the school must draw up a report of the meeting. The minutes shall contain a description of the actions undertaken by the farmer to undertake to promote health and well-being in the herd. Health advice with Stable schools can only be made by herds that have not been placed in a category requiring extra counselling.

Implementing a basic agreement will not increase the powers with regard to the use of medicinal products in the herd relative to herds without advisory agreements. The basic agreements are primarily designed for use in organic herds, but can also be used by conventional herds.

An Option Module 1 agreement in addition to health advice, should also include advice on animal welfare and conditions regarding infection protection. Optional module 1 entitles the herd to carry out post-diagnosis treatment of adult cattle as well as self-initiation of treatment in young stock with herd diagnoses. With electronic reporting in Module 1 all disease treatments must be reported electronically to the DMS Animal Registration database. An advantage of electronic reporting is that there is no upper limit for the length of the termination period when prescribing medication. This is a special advantage for herds in the category of General Advice , consisting only of young stock (calves), as with only 4 annual visits these may be allowed to treat animals with herd diagnoses. In addition, costs for drug prescribing can be reduced.

An Option Module 2 agreement is based on a relatively high frequency of animal visits coupled with extended powers for the farmer. Optional module 2 entitles the farmer to carry out first-aid treatment of adult bovine animals if the vet has established a herd diagnosis. During the visits, the vet must evaluate the animals that the

farmer has treated since the last visit and the effect of the treatment. With electronic reporting in Option Module 2 all disease treatments must be reported electronically to the DMS Animal Registration database. On the other hand, there is no upper limit for the length of the termination period when prescribing medication. This reduces the cost of drug prescribing.

Optional module 2 entitles the farmer to first-aid treatment of adult bovine animals if the herd vet has established a herd diagnosis. The veterinarian's access to herd diagnostics and thus the farmer's ability to treat himself extends significantly in relation to the health advisory agreement. Treatments that have previously been reserved for veterinarians can now be carried out by the farmer. Under certain circumstances, farmers will be able to make intravenous administration of Calcium preparations for the treatment of milk fever and retained afterbirth.

Limit values for the use of antibiotics in cattle and pigs provide the individual farmer with a tool that can help the farmer, in collaboration with the herd veterinarian, to focus on animal health, animal welfare and food safety. Herds which exceed limit values for antibiotic consumption must receive additional health advice from a veterinarian and increase the possibility of control. The health advisory agreements will typically include several counselling visits and, in some cases, shorter medication periods (the amount of medicine that must be stored after the delivery / delivery of the veterinarian).

Antibiotics consumption	Cows, as well as bulls, heifers and steers over 24 months.	Calves under 12 months and youngstock between 12 and 24 months.
Antibiotic consumption in ADD per. 100 animals per day from November 2014	2.1	1.2

A similar approach to the yellow card scheme for pigs has also been implemented in the cattle sector, based on age-group dependent benchmark values established from VetStat data and threshold levels for antimicrobial use. Cattle farms exceeding the thresholds for antimicrobial use in cattle farms are classified as being of 'non-compliant status' which results in more visits by the private veterinarian being required with the aim of addressing any animal health issues on the farm and reducing associated antimicrobial use. In 2014 and 2015, the examination of cases where cattle farms had exceeded the thresholds for antimicrobial use resulted in approximately 56% (490 farms out of a total of 870 cases) of them being relegated to non-compliant status.

Guidance on use of antibiotics

Official guidelines on the use of antimicrobial agents in pigs and cattle have been available since 1996 in Denmark. Initially, guidelines were developed by the National Veterinary Laboratory (currently the National Veterinary Institute DTU). Since 2005, the guidelines have been updated by DVFA in collaboration with the National Veterinary Institute DTU, National Food Institute DTU, the Danish Veterinary Association, university experts, the Danish Association of the Veterinary Pharmaceutical Industry and the Danish Agriculture and Food Council. The guidelines provide specific recommendations on the prudent use of antimicrobial agents for the treatment of all common indications in major production animal species. The latest guidance on use of antibiotics for cattle in Denmark developed in a collaboration between the Videncentret for Landbrug, Kvæg Den Danske Dyrlægeforening KU Sund and Århus Universitet were published in September 2013[26].

Veterinærmedicinsk Industriforening (ViNordic), the Veterinary Pharmaceutical Industry association provides product user information on veterinary medicinal products marketed in Denmark and information on disinfectants and poisons. This guidance is provided in the form of a booklet, a website and a mobile phone app[27].

In 2010, the Danish cattle industry introduced restrictions on the use of broad-spectrum antibiotics for the treatment of mastitis in cows. Only simple penicillins are allowed for the treatment of mastitis unless a laboratory test shows that these will not be effective. The use of antibiotics for dry cow treatment is only permitted if within the last 35 days an indication has been found that the pathogen is present in at least one mammary gland quarter of the cow.

SEGES[28], the main supplier of professional knowledge for the agricultural professions and a part of Landbrug & Fødevarer, has published a range of Standard Operating Procedures (SOP) in association with **DLBR**[29]. The SOP are short descriptions and good drawings of the daily work functions of a cattle farm.

[26] Retningslinjer for brug af antibiotika til kvæg i Danmark; https://www.ddd.dk/sektioner/familiedyr/Documents/Retningslinjer%20for%20brug%20af%20antibiotika%20kv%C3%A6g.pdf
[27] Medicin til Dyr ViNordic http://www.medicintildyr.dk/
[28] https://www.seges.dk/
[29] https://www.dlbr.dk/

På dansk		In English
1. Kalvepasning **a. Kalve** **b. Kalve økologi**		1. Calf care a. Calves b. Calves organic
2. Kælvning		2. Calving
3. Goldning		3. Drying off
4. Reproduktion		4. Reproduction
5. Fodring **a. Fodring** **b. Øko afgræsning**		5. Feeding a. Feeding b. Organic grazing
6. Malkning		6. Milking
7. Smittebeskyttelse		7. Biosecurity
8. Klove		8. Claws

Risk-based medicine controls

A Veterinary Task Force was established in 2003 which, inter alia, carries out inspections on the prescribing and use of veterinary medicinal products. Inspections carried out by the Veterinary Task Force include risk-based medicine controls on veterinarians and farmers across Denmark. The Task Force carries out checks on the illegal import and illegal use of antimicrobials in cooperation with other authorities, monitors the consumption of antimicrobials on pig and cattle farms through the yellow card system and performs inspections in cooperation with police, tax and Board of Health authorities.

Research

Despite decreasing cell numbers at national level, the development of large herds and new milking systems seems to have created new unprecedented opportunities for the spread of contagious mastitis. Thus, the proportion of cows with contagious mastitis bacteria in the analysis of samples at drying off is still over 35% and 70% of the antibiotic consumption in the herds is used to treat udder infections. Research has been funded on effective control against contagious mastitis - STOPMAST[30] (2015 – 2018)

The purpose of the STOPMAST project is

- to investigate the cause of the continued high incidence of contagious mastitis bacteria
- to gain new knowledge about effective control of contagious mastitis
- to utilize the new knowledge to give recommendations and develop tools for making the most effective decisions at both cow and herd levels.

The results of the project could contribute to improved milk quality and animal welfare, reduced antibiotic consumption and increased earnings for individual herd owners.

The project is a cooperation project between the Department of Veterinary and Animal Science (University of Copenhagen), Department of Animal Science (Aarhus University), Veterinary Institute (Technical University of Denmark) and SEGES, Cattle.

More information about the individual work packages is available here:

AP 1 Methods for Detecting and Quantifying Infectious Mastitis Bacteria Without Survival and Infection Dynamics in Infected Cows
(AP leader Søren Saxmose Nielsen, University of Copenhagen)

AP 2 Assessment of spread of infection and methods for reducing spread of infection (AP leader Søren Østergaard, Aarhus University)

AP3 Development of a decision support tool
(AP chairman Tariq Halasa, Technical University of Denmark)

AP4 Documentation and dissemination
(AP leader Michael Farre, SEGES, cattle)

[30] https://ivh.ku.dk/forskning/produktion-og-sundhed/projekter/stopmas/

EU fact-finding mission to Denmark*

The report of an EU fact-finding mission to Denmark concluded that " there are longstanding and highly developed official and voluntary (professional and industry) policies in place regarding the availability and use of antimicrobials (including the critically important antimicrobials) in animals. A noticeable factor is the limitation of dispensing of veterinary medicinal products by veterinarians to non-profit sales. The implementation of these policies is supported by detailed recording and monitoring systems and targeted control actions and sanctions for non-compliance with the official rules. There are indications that these policies have led to more prudent and reduced use of antimicrobials both in production and companion animals. Despite the multifactorial and complex epidemiology of antimicrobial resistance, detailed analysis of the data collected in Denmark (including on sales and antimicrobial resistance monitoring) has shown some impacts of these measures on the levels of antimicrobial resistance in animals, food and humans.

Various aspects of the comprehensive measures put in place in Denmark aimed at encouraging the prudent use of antimicrobials in animals and tackling the broader issue of antimicrobial resistance could serve as an illustration of potential good practices to other Member States."

* Final report of a fact-finding mission carried out in Denmark from 01 February 2016 to 05 February 2016 in order to gather information on the prudent use of antimicrobials in animals[31]

The Netherlands[32]

In 2008 antibiotic usage in animal husbandry became a political issue in the Netherlands. Whereas antibiotic usage in humans was relatively low compared to other European countries, antibiotic usage in the Dutch livestock industry was relatively high. After a number of incidents with Methicillin Resistant Staphylococcus aureus (MRSA) and extended spectrum beta-lactamase producing bacteria (ESBLs) in animals antibiotic resistance became an important issue on the political agenda. The mindset of dairy farmers with respect to the reduction of antibiotic usage in general and in the dairy sector has been generally positive.

Antimicrobial strategy in the Netherlands

In 2008, memoranda of understanding were signed by the animal production sectors and the Royal Veterinary Association of the Netherlands (KNMvD) based on a request from the Dutch Minister of Agriculture. Mandatory reductions in overall antibiotic use of 20% by 2011 and 50% by 2013 (based on sales data from 2009) were agreed with the production sectors (dairy cows, beef cattle, veal calves, pigs and broilers) on 16 April 2010 while the government set an additional target on 26 June 2012 of achieving a 70% reduction by 2015 based on the reduction already achieved in 2011. The aim was to have all antibiotic use on farms transparently recorded by the end of 2011. It should be noted that, in particular, the agreement on the need for transparency of use led to the establishment of the Netherlands Veterinary Medicine Authority (De Autoriteit Diergeneesmiddelen, SDa[33]) in 2010. The Veterinary Medicine Authority has an expert panel that is responsible for monitoring, setting benchmark values and reporting of annual usage data. In addition, the SDa is an advisory body for government and private parties. High users and high prescribers can be subjected to disciplinary sanctions by the private IKB systems (integrated chain control; quality assurance systems) and the KNMvD, respectively. They can also be subjected to additional controls of the Dutch Food and Consumer Product Safety Authority (NVWA) of the Dutch Government.

SDa is an independent organisation funded by the government (50%), with four industry associations and KNMvD (Koninklijke Nederlandse Maatschappij voor Diergeneeskunde, Royal Veterinary Association of the Netherlands) each contributing 10% of the total funding.

Antimicrobial use

[31] http://ec.europa.eu/food/audits-analysis/act_getPDF.cfm?PDF_ID=13639

[32] http://www.aacting.org/matrix/dutch-sector-quality-systems/?lid=1447; http://ec.europa.eu/food/audits-analysis/act_getPDF.cfm?PDF_ID=12902

[33] https://www.autoriteitdiergeneesmiddelen.nl/en

In the ESVAC report for 2016 the sales of veterinary antimicrobial agents in the Netherlands was 52.7 mg sold per population correction unit (PCU). In 2017 the use of antibiotics in dairy cattle had reduced by 47% compared to 2009 and use of CIA were minimized[34] so targets set by the government and implemented by the sector were reached. Consensus and awareness by all stakeholders, including dairy farmers, are main contributors to this reduction. Most reduction was realized with the ban of blanket dry cow therapy replaced by selective dry cow therapy. The amount of antibiotics used in the dairy cattle farming sector rose by 1.5% in 2017. The non-dairy cattle farming sector also recorded an increase, of 2.7%. Nevertheless, usage levels in the cattle farming sector are still low, and the SDa expert panel considers the 2017 increases to be the result of natural variation over time.

Antimicrobial use metrics

The SDa expert panel introduced Defined Daily Dose of Antimicrobials (DDDA) as a measure basically indicating the number of days of antimicrobial treatment per animal per year. The DDDA is calculated at the national ($DDDA_{NAT}$) as well as at the farm level ($DDDA_F$). The $DDDA_F$ is calculated from the total amount of kilograms which could have been treated with the antibiotics used on the farm over a year, divided by the average number of kilograms of animals present on that farm[35]. The exposure of animals on the farm to antibiotics is calculated using an SDa conversion table which holds data on 'treatable kilograms' for all antibiotics registered as veterinary medicines[36]. The table provides data on the number of kg of cattle treated per ml or g or piece for each antibiotic product with a correction factor for duration of action. For example, if the dose rate for an antibiotic product is listed as 1ml per 25kg in cattle then a 100ml bottle could have been used to treat 2500kg of cattle (i.e. 2500 'treatable kilograms'). The denominator is based on the number of animals on the farm and the average weight of the target animals. The target animal is the animal for which the antibiotics are prescribed. The animal numbers are preferably calculated on the basis of data from national databases, such as identification and registration data, which are updated continuously. The average weights of target animals to be used in this calculation are determined by the SDa.

In the Netherlands it has, since 2012, been compulsory to register the use of antibiotics on every cattle farm in the national database, MediRund[37], which was developed by taskforce on antibiotic use in cattle (TAUC). This data, in combination with the number of cattle, is used to calculate the antibiotics use on a particular farm, which is expressed in terms of Defined Daily Dose Animal (DDDA) per animal per year (DD/DJ) at farm level. For example, a DD/DJ of 2 means that, on average, animals at the livestock farm concerned were treated with antibiotics for two days a year. Every three months farmers receive an overview from MediRund, with their specific farm information. The farm levels are used for benchmarking and – if exceeding threshold values – indicate when corrective action is necessary.

The SDa defined specific benchmark thresholds which are used to assess whether the amount of antibiotics used at a particular livestock farm (its $DDDA_F$ value) falls within the target zone, the signalling zone, or the action zone. For the thresholds a traffic light colour coding was implemented, with green (DD/DJ < 4), orange (4-6), indicative of a high use requiring attention, and red (>6), requiring immediate action. If red the dairy farmer and his veterinarian are obliged to develop a plan and if no action is undertaken and DD/DJ remains too high, milk will no longer be collected as agreed in the milk purchasing conditions of the milk buyers/dairies.

Following a revision of the cattle farming sector's benchmarking method, 2017 was the first year in which cattle farms were benchmarked based on just a single (signalling) threshold. The signalling threshold for dairy cattle farms, which was 6 $DDDA_F$ in 2017, is based on the P80 value[38]. Action is required if a cattle farm's usage level has exceeded this signalling threshold two years in a row. 99% of dairy farms recorded target zone usage levels for 2017. The mean $DDDA_F$ was 2.1 for dairy farms in 2017. The performance of this new benchmarking approach for the cattle farming sector will be evaluated in 2019.

Taskforce on Antibiotic Use in Cattle (TAUC)

The dairy sector was not the sector in which most antibiotics were used or that seemed to have a big antibiotic resistance problem, but there were some issues to be addressed. In December 2008 a taskforce on antibiotic use in cattle (TAUC) was established, in which all major stakeholders were represented - farmers organisations, the dairy and meat plants, the veterinarians as well as some technical experts. The challenge for the TAUC was to realize a reduction in antibiotic use although usage was already relatively low and antibiotic resistance was not perceived as a problem by many farmers and veterinarians. Additional challenges were to change practices such as blanket dry cow treatment (DCT) and extended treatment of (sub)clinical mastitis, which had been promoted over the years, as was the use of zero-withdrawal products, which were widely available and used. TAUC also did not want the change in antibiotic policy to have a negative impact on animal health and welfare.

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[34] https://cdn.i-pulse.nl/autoriteitdiergeneesmiddelen/userfiles/Publications/engels-def-rapportage-2017.pdf p.23
[35] https://www.autoriteitdiergeneesmiddelen.nl/nl/dierhouder/berekenen-dierdagdoseringen-(ddd)
[36] https://cdn.i-pulse.nl/autoriteitdiergeneesmiddelen/userfiles/doseringstabel/dg-standaard-04okt2018-tbvwebsite.pdf
[37] [37] https://www.medirund.nl/
[38] https://cdn.i-pulse.nl/autoriteitdiergeneesmiddelen/userfiles/Publications/engels-def-rapportage-2017.pdf p.31

The Dutch government has played a facilitating role in the reduction of veterinary antimicrobial use with private parties taking primary responsibility for the reduction of veterinary antimicrobial use through self-regulation. The government set reduction targets and further facilitated the co-funding of the SDa, incorporated private regulations into legislation, intensified inspection and enforcement of legislation and supported the strengthening of the independent position of veterinarians through the introduction of the UDD measure.

In 2009 the private IKB systems introduced a requirement for farmers to only procure veterinary services and veterinary medicines from one veterinary practice (1-to-1 relationship) to reduce competition between veterinary practices and to ensure a proper knowledge of the farm of the prescribing veterinarian[39]. This measure had been proposed in the MoU in 2008 and in 2012 was imposed for all farmers by the Product Boards for Livestock, Meat and Eggs (PVE; public–private organization with legislative powers for the whole livestock sector). In 2011 PVE introduced requirements for Farm Health Plans (FHP) and Farm Treatment Plans (FTP) and central registration of all antimicrobials prescribed and delivered on farms. These measures were subsequently incorporated in the existing private IKB systems for different livestock sectors.

The FHP and FTP must be developed by the farmer and their farm vet together and evaluated annually. The FHP should contain information about farm-specific risk factors for the introduction and spread of infectious diseases and the specific management measures as proposed by the farmer to control these risk factors and improve the health status of the animals. The FHP focuses on prevention. Animal health and antibiotic usage in the previous year is monitored and reviewed. The management of the herd, infection pressure and host resistance are evaluated and includes covering issues such as biosecurity, pathogen transmission, feeding, housing and milking.

The FTP is a farm-specific treatment protocol for the most common (infectious) diseases on that farm (eg mastitis, lameness) and is intended to optimize antibiotic treatments carried out by the farmer. These recommendations are based on relevant farm-specific information like susceptibility patterns of cultured pathogens and historical treatment results and on national guidelines eg the formularies developed by the KNMvD[40]. In principle, only first-choice (non-critically important) antimicrobials from the formularies are allowed in this FTP.

KNMvD's working party on veterinary antimicrobial policies set up a classification system for antimicrobials used in veterinary medicines. Since 2012 it has classified antibiotics to reduce the selection pressure for AMR as follows:

- 1st choice antimicrobials are ESBL-indifferent antimicrobial agents and can be prescribed for empirical therapy after diagnosis (amphenicols, tetracyclines, trimethoprim/sulphonamides, some macrolides/lincosamides, some penicillins)
- 2nd choice antimicrobials are antimicrobial agents not meeting the criteria for 1st or 3rd choice. They are not to be used unless the need for prescription and use is substantiated by a clinical examination and history, diagnostic and susceptibility testing (polymyxins such as colistin, all beta-lactams and aminoglycosides, quinolones, 1st and 2nd generation cephalosporins, some macrolides/lincosamides)
- 3rd choice antimicrobials are antimicrobials regarded as of critical importance for human medicine and are only to be prescribed and used in individual animals after performing diagnostic and susceptibility testing to show that there are no alternatives. This is a legal obligation (3rd and 4th generation cephalosporins and fluoroquinolones).

Preventive use of antimicrobials in veterinary medicine, which includes blanket dry cow therapy, has been prohibited since 2012 in the Netherlands. Most (c. 70%) of the antibiotics used in dairy cattle in the Netherlands is administered via the intramammary route (c. $^1/_3$ in mastitis treatment and $^2/_3$ as DCT. A KNMvD guideline in 2014 stated that dry cow antibiotics were only allowed after intramammary infections (IMI) had been diagnosed at drying off. As an indication of IMI, somatic cell count (SCC) can be used. In 2014, antibiotic DCT was used in 61% of cows dried off, where it was 94% in 2009, without a deterioration in udder health. Feeding waste-milk is not allowed and has been highly discouraged.

Veterinarians

In 2014, new legislation required the administration of all veterinary antimicrobials to be performed by veterinarians (UDD Measure)[41]. When farmers meet specific conditions, they are permitted to administer antimicrobials to their animals. These conditions are the 1-to-1 relationship with a vet, mandatory periodical herd inspections by the veterinarian and annual evaluation of the FHP and FTP. Under these conditions, farmers are allowed to have first-choice antimicrobials in stock for one treatment of 15% of the susceptible animals. Until 2016, exemptions have been made for a few second-choice antimicrobials that were regarded essential to treat animals for specific indications and where no first-choice alternatives are available. These antimicrobials may be

[39] D.C. Speksnijder, D.J. Mevius, C.J. Bruschke, J.A. Wagenaar Reduction of veterinary antimicrobial use in the Netherlands. The Dutch success model. Zoonoses Public Health, 62 (Suppl 1) (2015), pp. 79-87 doi: 10.1111/zph.12167
[40] https://www.knmvd.nl/app/uploads/sites/4/2018/11/181108-formularium-melkvee-versie-1.3-definitief.docx-1.pdf
[41] https://zoek.officielebekendmakingen.nl/stcrt-2013-23390.html

administered by farmers to identified animals for a maximum period of 14 days on the condition that their veterinarian has made a clinical diagnosis.

A benchmarking method for veterinarians, the Veterinary Benchmark Indicator (VBI) was introduced in March 2014. A veterinarian's VBI is livestock sector specific and can range from 0 to 1. As the VBI is sector specific, a veterinarian active in various livestock sectors will be assigned several VBIs. The VBI reflects the probability of livestock farms with which the veterinarian has a one-to-one relationship recording action zone usage levels. For the majority of livestock sectors, the number of veterinarians included in the target zone has increased over the past few years due to the livestock farms reducing their usage levels. All of the livestock sectors except the veal farming sector show a steep decline in the number of veterinarians included in the signalling and action zones.

In 2017 the mean VBI for dairy farms was 0.06 which means that 6% of the livestock farms with which the veterinarian concerned has a one-to-one relationship are included in the action zone.

Udder Health

A Dutch Udder Health Center (UGCN) was established in 2005 as a joint initiative of NZO (Dutch Dairy Organization) LTO (Land- en Tuinbouw Organisatie) and PZ (Productschap Zuivel) and was delivered by the Animal Health Service (GD). The aim of the UGCN project (2005-2010) was to improve udder health in the Netherlands. More than 8 million euros was invested from the PZ levies, half of which was spent on practical research and the other half on making existing and new knowledge useful and available.

The UGCN used various ways to implement knowledge in practice - organizing symposiums, open days, study group meetings via veterinarians (over 3100 participants), e-mail newsletters, the UGCN Magazine, tear-off calendars and campaigns. The results[42] were presented at the end of 2010 during the closure of the Long-term Udder Health Plan. After the UGCN project has ended, the information that the project delivered is beingupdated and made available via the GD website[43].

The approach is based on the principle that udder inflammation arises when the balance between the degree of resistance of the cow and the weight of the infection pressure in its environment is overcome. If the resistance of the cow is too low or the infection pressure in its environment is too high or both then a cow will get inflammation of the udder.

The practical tips from UGCN are organised into 5 areas on the GD website:

Controle - Monitoring
Planning and control cycle; Setting goals; Automated data processing; National developments in udder health; Economics

Infectiedruk - Infection pressure
Environment; Contagious infection pressure; Diagnostics; Tips; Practical tools - Hygiene scorecard

Weerstand - Resistance
Teat sphincter and teat canal; Immune system of the udder; Vaccination; Breeding; Housing; Stress; Other conditions that undermine resistance

Melken - Milking
Milking machine and milking technique are important especially in the transfer of contagious bacteria. Practical tools

Behandelen - Treatment
Farm treatment plan; Clinical mastitis; Subclinical mastitis; Mastitis in heifers at calving; Specific mastitis pathogens; Practical tools

The norm values for good udder health:

Clinical mastitis	less than 15%
Average cell count	less than 150,000 cl / ml
Number of animals with an increased cell count	less than 10%
Number of animals with a new increased cell count	less than 6%

[42] www.gddiergezondheid.nl/~/media/Files/Presentaties/Vijf jaar UGCN in een notendop.ashx
[43] https://www.gddiergezondheid.nl/uiergezondheid

Culling for udder health or teat problems	less than 5%
Repeat cases	less than 10%
Number of teats underpants	less than 2%
New infections in dry period (cell count low in and high out)	less than 10%
Cure rate in dry period (cell count high in and low out)	more than 70%

RESET Mindset Model

In a review paper Lam et al. (2017) used the strategy of the TAUC taskforce as an example to show how the RESET Mindset Model can be applied to the approach uised to change behaviour of dairy farmers[44]. The specific issues involved in the communication process and the decisions that were made were described, as was the approach to change the mindset of dairy farmers and veterinarians towards reduction of antibiotic usage in dairy cattle in the Netherlands. The most important actions taken were summarised in Table 1 from the paper below.

Rules	Education	Social Pressure	Economics	Tools
1-to-1 relationship dairy farmer and vet No preventive antibiotic usage (no bDCT) Herd health plan Transparency on antibiotic usage Limitations on use of specific antibiotics Action plan when antibiotic usage too high	Publications in scientific and farmer journals Press releases Guidelines on antibiotic usage Specific courses for veterinarians on herd health plans Study groups on antibiotic usage for farmers Lectures, meetings, symposia	Public opinion on responsibility towards human health Initiation of the 'antibiotic number' $DDDA_F$ Benchmark on DDDA for farmers and veterinarians - Discussions on alternative (preventive) approaches with different herd health advisors	Costs of dry cow antibiotics Imminent threat of sanctions when failing to commit - Indirect threat of losing customer trust, national and international	Herd health and treatment plan Medi-Rund Standard treatment protocols Colour codes for passing signalling and action thresholds on antibiotic usage Setting signalling and actions thresholds on antibiotic usage

Table 1: The most important simultaneous RESET actions taken by involved stakeholders to decrease antibiotic usage in dairy cattle in the Netherlands[45]

As in the UK vets had hardly ever discussed the importance of preventing antibiotic resistance in the past. Many farmers had never heard about the potential effect of certain types of antibiotics on antibiotic resistance in animals and humans, including themselves. Parameters that were considered important with respect to the usage of antibiotics were treatment efficacy, withdrawal time and costs. Veterinarians and other advisors talked about the effect of suboptimal use of antibiotics on antibiotic resistance before.

One of the keys to driving change in the Netherlands was social pressure. Farmers were aware of the growing societal concerns about the risks of antimicrobial resistance. There was also the potential for sanctions if the dairy industry failed to engage with the goals for more responsible use. Veterinarians and other herd health advisors made it clear antibiotic use was important and advocated prevention of disease. The $DDDA_F$ or 'antibiotic number' as it is commonly referred to has been a major factor in increasing transparency of antibiotic usage. It has become a key performance indicator for dairy farmers with which farmers are very familiar and some are happy to share in public meetings their low number for antibiotic use and that they are among the best in the benchmarking. The requirement for a herd health and a treatment plan also acts as social pressure for both farmer and veterinarian who have to work together on the plans. Milk purchasers and processors are also important players in the social network. Other advisors had influence because they saw a market opportunity for feed additives that were assumed to have positive effects on dairy health, such as vitamins, minerals, probiotics and certain oils.

[44] Lam *et al.* The RESET Mindset Model applied ondecreasing antibiotic usage in dairy cattlein the Netherlands Irish Veterinary Journal (2017) 70:5 irishvetjournal.biomedcentral.com/articles/10.1186/s13620-017-0085-x
[45] Lam *et al.* The RESET Mindset Model applied ondecreasing antibiotic usage in dairy cattlein the Netherlands Irish Veterinary Journal (2017) 70:5 irishvetjournal.biomedcentral.com/articles/10.1186/s13620-017-0085-x

Mastitis has significant economic effects through the costs of treatment, prevention, unsaleable milk and other direct effects including loss of production. Moving to selective use of dry cow treatment and using less antibiotics at drying off has had minimal effects of the incidence of mastitis but reduced costs. A concern for vets was was the risk of losing pharmacy sales as a source of income.

A range of of tools have been made available to dairy farmers in the Netherlands ranging from the MediRund database, the automated processing of milk recording data data to the herd health and treatment plans, the KNMvD guidelines of antibiotic use and on selective DCT. For udder health a range of practical tools, scorecards, protocols and developed through the Udder Health and other projects are available to download[46].

Lam et al. concluded that the different cues from these activities combined together had helped to change the mindset of dairy farmers and veterinarians towards antibiotic usage on dairy farms. As an example of this change in mindset they point out that despite the fact that information provided on DCT and on critically important antibiotics was contrary to information provided by veterinary practitioners and in national projects previously, most farmers were convinced that SDCT and the selective use of antibiotics in general were a sound approach. The integrated approach is thought to have played a crucial role in the reduction of antibiotic usage in dairy cattle in the Netherlands. As the change in behaviour of dairy farmers in the Netherlands towards antibiotic usage seems to be based on an actual change of mindset it is thought more likely to be successful in the long term.

MediRund example farm report from the Netherlands

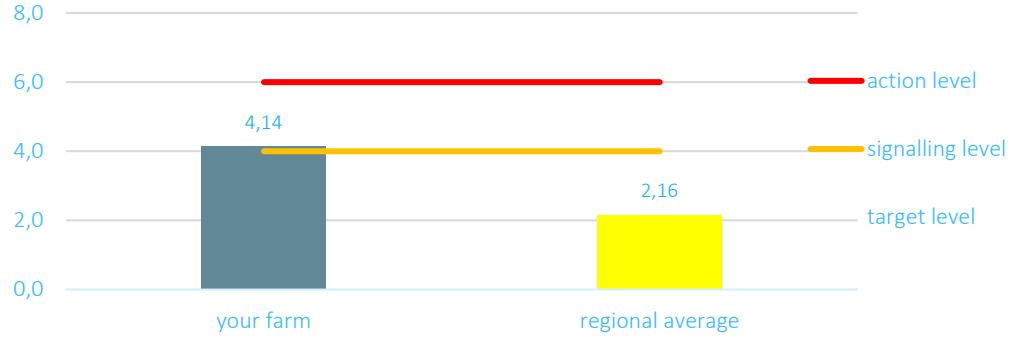
In the Netherlands it has, since 2012, been compulsory to register the use of antibiotics on every cattle farm in the national database, MediRund[47]. This data, in combination with the number of cattle, is used to calculate the antibiotics use on a particular farm, which is expressed in terms of Defined Daily Dose Animal (DDDA) per animal per year (DD/DJ) at farm level. For example, a DD/DJ of 2 means that, on average, animals at the livestock farm concerned were treated with antibiotics for two days a year. The farm levels are used for benchmarking and – if exceeding threshold values – indicate when corrective action is necessary. For the thresholds a traffic light colour coding is implemented, with green (DD/DJ < 4), orange (4-6), indicative of a high use requiring attention, and red (>6), requiring immediate action. If no action is undertaken and DD/DJ remains too high, milk will no longer be collected as agreed in the milk purchasing conditions of the milk buyers/dairies.

Report on antibiotic use

Farm UBN:	1234556
Reporting period:	01-07-2016 to 30-06-2017
Calculation date:	15-07-2017

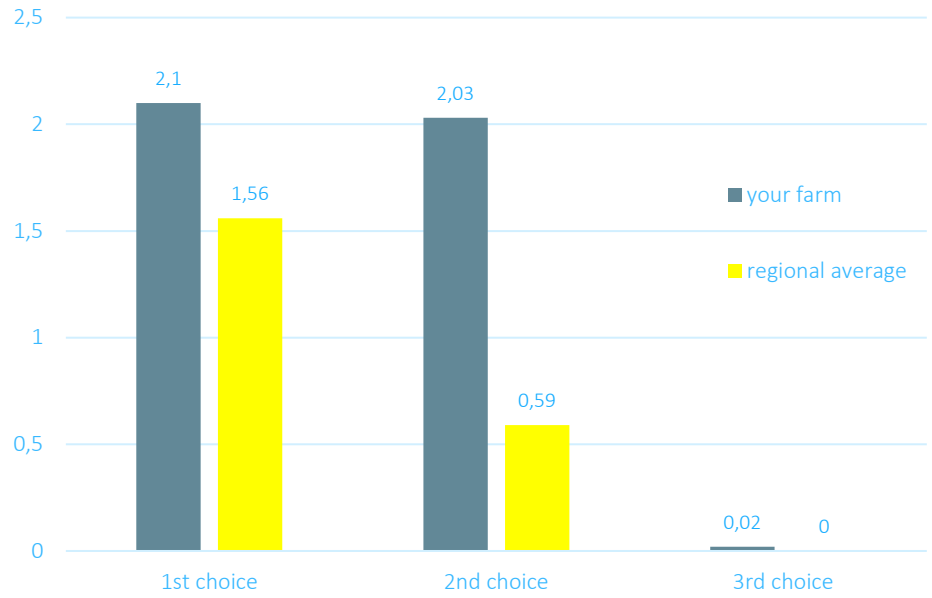
DD / DJ of your farm and the national average of all dairy farms

The calculated DD/DJ of your farm is 4.14.

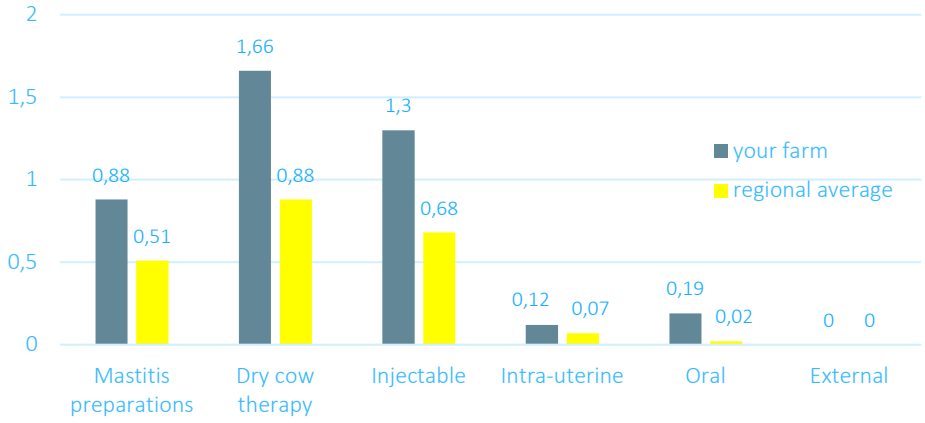


DD / DJ and the use of first, second and third choice antibiotics

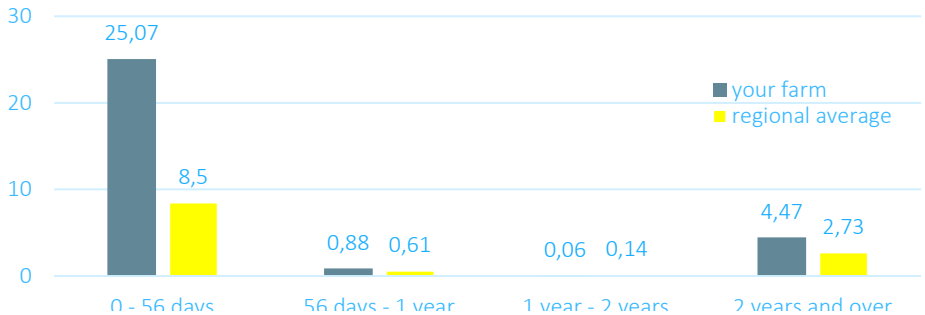
[46] https://www.gddiergezondheid.nl/ugatools
[47] https://www.medirund.nl/



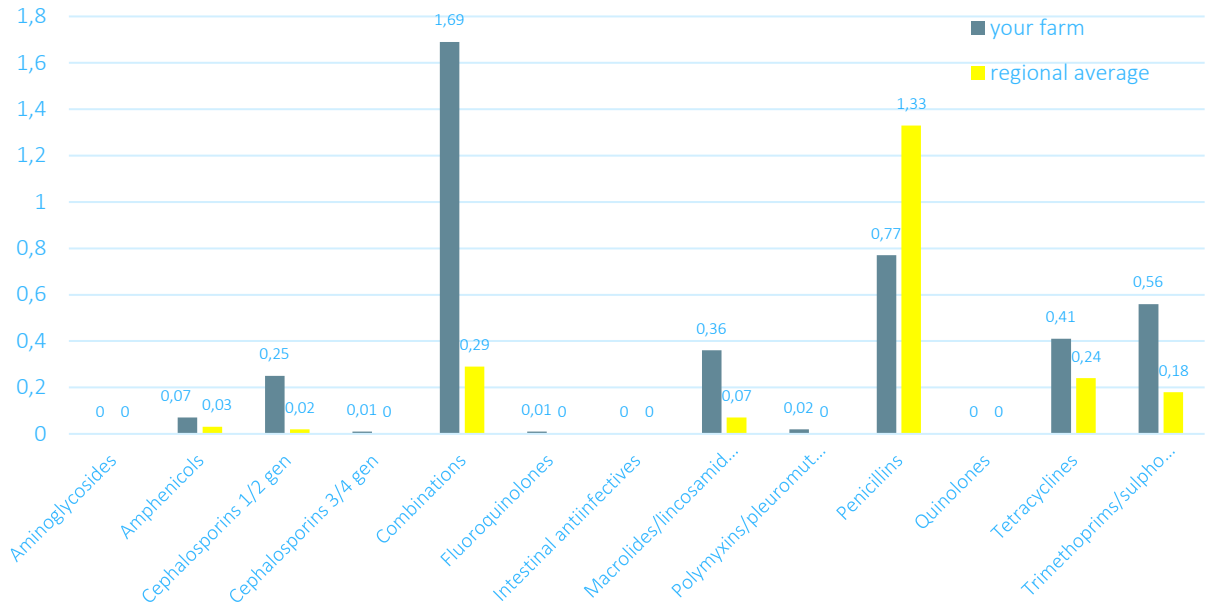
DD / DJ by route of administration



DD / DJ by age category



DD / DJ by therapeutic group



EU fact-finding mission to the Netherlands*

The report of an EU fact-finding mission to the Netherlands concluded that "good practices applied in the Netherlands include transparency as regards recording and benchmarking of antibiotic use on farms, benchmarking of the prescribing patterns of veterinarians, strengthening the role of veterinarians, taking measures to improve animal health and promoting prudent use in line with official reduction targets. Promotion of the prudent use of antibiotics in animals has also been achieved by implementing policies based on expert scientific advice, monitoring antimicrobial resistance and promoting research and specific initiatives by producer organisations, with the support of government. These initiatives have been backed up with official supervision and controls in an overall One Health context. The findings highlight the progress that can be achieved in a relatively short time period to reduce the use of antibiotics in animals, and associated antimicrobial resistance, while safeguarding animal health and welfare, the economic viability of producers and avoiding an excessively legislative approach. In the near future, sector specific reduction strategies will be developed and executed. Future strategies will focus more specifically on farms and veterinarians with persistent high use and high prescribing patterns of antibiotics respectively.

A number of aspects of the measures put in place in the Netherlands aimed at encouraging the prudent use of antimicrobials in animals could serve as an illustration of potential good practices

* Final report of a fact-finding mission carried out in the Netherlands from 13 September 2016 to 20 September 2016 in order to gather information on the prudent use of antimicrobials in animals[48]

United Kingdom

In 2017 sector-specific targets for the UK were developed by a 'Targets Task Force', facilitated by the Responsible Use of Medicines in Agriculture (RUMA) Alliance[49]. The dairy cattle sector committed to a 20% reduction in the use of antimicrobials by 2020, with a particular focus on halving use of the highest priority CIAs. There are also targets to reduce intramammary HP-CIAs by 50% and dry cow use and lactating cow use by 20% and 10% respectively by 2020, again using 2015 as the baseline. The work to achieve this is being led by a newly-created Dairy Antimicrobial Stewardship Group (DASG) which includes all key organisations in the sector.

Antimicrobial use

[48] http://ec.europa.eu/food/audits-analysis/act_getPDF.cfm?PDF_ID=12902
[49] https://www.ruma.org.uk/wp-content/uploads/2017/10/RUMA-Targets-Task-Force-Report-2017-FINAL.pdf

The 2017 UK Veterinary Antibiotic Resistance and Sales Surveillance Report (UK-VARSS) was published in October 2018[50]. As in previous years, pencillins/1st generation cephalosporins, tetracyclines, aminoglycosides and macrolides were the most commonly used antibiotic classes. Four tonnes of active ingredient were used in the sample of dairy farms in 2017, which represented 17 mg/kg PCU, a reduction of 29% since 2015. Reductions were seen across all antibiotic classes, with particularly marked decreases in the HP-CIAs, which represented 0.6 mg/kg (4% of active ingredient administered) in 2017. The majority of active ingredient was administered by injection (69%) and the oral route (19%).

The data from dairy farms were taken from FarmVet Systems, a software company which extracts and cleanses sales data from vet Practice Management Systems and which can determine whether the medicine was delivered to a farm keeping cattle. The sample for 2017 represents 31% UK dairy cows in Great Britain. For both the beef and dairy farms, the VMD converted the aggregate usage data into amount of active ingredient using the standard ESVAC methodology. The dairy data for 2017 cover 2,923 farms and represent 31% of all dairy cows in the UK, with relatively higher coverage in England and Northern Ireland than in Wales and Scotland. The mean herd size within the sample is 204, which is 28% higher than the overall UK mean. This is a convenience sample which may not be representative of the whole UK dairy population and because of differences in the sample population of farms between years, caution should be taken when interpreting trends.

Some of the strategies to achieve these goals in dairy farming include reducing the use of antibiotic dry cow therapy and injectable products, and cutting back on group treatments such as antibiotic footbaths for lameness which remain largely unproven, instead using topical and targeted treatments. Good progress is being made towards reaching these targets, especially in reducing the use of HP-CIAs .

Table 2: UK Dairy cattle antibiotics usage – progress towards targets (baseline data shown in the shaded cells)

	2015	2016	2017	Target	Target % change	2015-17 change
HP-CIA injectable for cattle (mg/PCU)*	1.075	0.959	0.760	0.538	-50%	-29%
HP-CIA intra-mammary use (DCDVet)*	0.332	0.308	0.223	0.166	-50%	-33%
Intra-mammary tubes – dry cow (DCDVet)*	0.732	0.748	0.677	0.586	-20%	-8%
Intra-mammary tubes – lactating cow (DCDVet)*	0.808	0.977	0.818	0.727	-10%	+1%
Sealant tube usage (average no. of courses per dairy cow)*	0.5	N/A	N/A	0.7	+40%	
Total usage in dairy cows (mg/PCU)**	24	26.2	17	21.0	-20%	-29%

* From VARSS sales data; ** From FarmVet systems data of a sample of dairy farms representing 31% of all dairy cattle in the UK in 2017 (N/A = not available)

The dairy usage data indicates a very positive situation for all the metrics where data is available showing a reduction compared to 2016. Notably the target of 21mg/kg total usage has been achieved with data for 2017 showing a total antibiotic usage for dairy of 17 mg/kg. This is a reduction of 29% compared to 2015. As this is still only a subset of data from a convenience sample, with differences in the sample population of farms between years, caution should be urged when interpreting trends until more data is available. In addition, the average herd size for the farms in the sample is 28% higher than the overall UK mean and the antibiotic usage in this sample of farms may not be representative of all dairy farms across the UK. No data is available for the use of internal teat sealants due to the way this data is reported currently to the VMD, this should be available in 2019.

A quantitative analysis of antimicrobial use on 358 British dairy farms[51] that while dairy cattle farm AMU appeared to be lower than UK livestock average, there were a selection of outlying farms with extremely high AMU, with the

[50] www.gov.uk/government/publications/veterinary-antimicrobial-resistance-and-sales-surveillance-2017

[51] Hyde et al. (2017) Quantitative analysis of antimicrobial use on British dairy farms Veterinary Record 181, 683. doi: 10.1136/vr.104614

top 25 per cent of farms contributing greater than 50 per cent of AMU by mass. Identification of these high use farms may enable targeted AMU reduction strategies and facilitate a significant reduction in overall dairy cattle AMU.

Data capture and benchmarking

AHDB has successfully developed an electronic medicine book for the Pork industry[52] and this has played a vital role in providing robust evidence of antibiotic use at an industry level. It is now also part of the Red Tractor Pigs assurance scheme, helping farmers and their vets work together to reduce antibiotic use across the sector.

AHDB has commissioned development of a pilot eMB-Cattle system based on the structure of eMB-Pigs. The pilot will record antimicrobial usage data from beef and dairy farms. The aims for eMB-Cattle are:

- Provide a structure for national reporting of antimicrobial usage that complies with the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) calculation
- Provide benchmarks for monitoring antimicrobial use at farm level.
- Provide a lead for industry in encouraging collation of medicine use at farm level
- Provide a tool for use to promote responsible use of medicine messages to industry.
- Provide a database of medicine use that could enable the sharing of medicine treatments for individual cattle across the supply chain.

The specification for eMB-Cattle has been designed for both beef and dairy cattle, enabling individual animal treatment entry and additional reporting capabilities which provide details of all medicine treatments over time and by age category.

The intention with the electronic medicine book is to provide a robust data hub for industry level antibiotic usage data and to allow farms to benchmarking their antibiotic use with other similar farm types. The objective is not to duplicate services which are provided by commercial herd management software.

The University of Nottingham School of Veterinary Medicine and Science Herd Health Group have developed an online calculator to evaluate antibiotic use on dairy farms. The Antimicrobial Use (AMU) Calculator[53] can be used to evaluate key areas and to encourage antibiotics use more responsibly. The medicines used on the farm can be entered into the calculator and the products are converted into commonly used measurements of antimicrobial use (mg/Population Correction Unit (PCU) – PCU and Defined Daily Dose – DDD). Use of highest priority critically important antimicrobials (CIAs) can also be highlighted. To complement the antibiotic calculator, the University of Nottingham have also created an Antimicrobial Use (AMU) Benchmarking Tool[54], designed to make benchmarking dairy farm antimicrobial usage rapid and simple.

Responsible Use of Medicines in Agriculture[55]

The Responsible Use of Medicines in Agriculture Alliance (RUMA) was established in the UK in 1997 to promote the highest standards of food safety, animal health and animal welfare in the British livestock industry. It is an independent non-profit group involving organisations that represent all stages of the food chain from 'farm to fork'. Its membership includes organisations representing interests in agriculture, veterinary practice, animal medicines industry, farm assurance, training, retailers, consumers and animal welfare interests.

RUMA aims to produce a co-ordinated and integrated approach to best practice in animal medicine use. RUMA first published guidelines on for farmers and vets on the Responsible Use of Antimicrobials in Cattle Production in 2000. The 3rd edition, published in August 2015, is available to download from the RUMA website[56].The guidelines stress the need to manage farms to reduce disease challenge and minimise antimicrobial use and encourage farmers and vets to work together to achieve this. A holistic approach based on Four Golden Rules for Disease Control aims to reduce the need to use antimicrobials, including antibiotics, without adversely affecting animal welfare

Disease Control: Four Guiding Principles	
Review biosecurity for new cattle introduced into a herd	Diseases spread around and between farms mostly by contact with other cattle. Screening and monitoring will help to limit the spread of disease. REMEMBER contact can also be INDIRECT, for example by a needle, surgical instrument, manure or people.

[52] https://emb-pigs.ahdb.org.uk/
[53] https://dairy.ahdb.org.uk/resources-library/technical-information/health-welfare/amu-calculator/
[54] https://dairy.ahdb.org.uk/resources-library/technical-information/health-welfare/amu-benchmarking-tool/
[55] www.ruma.org.uk
[56] https://www.ruma.org.uk/cattle/

"Stress" is a killer.	Stressed animals are far more likely to become diseased. This includes not only obvious physical stress factors such as overcrowding or management procedures e.g. handling; but also exposure to micro-organisms which cause major stress to the immune system e.g. BVD. THINK - If a procedure causes the cattle to become stressed, ask "can this be done in a less stressful manner?" e.g. castration, introduction of heifers to the dairy herd.
Good Management and Hygiene	There is no substitute for good management, hygiene and biosecurity measures. Cleaning buildings and equipment coupled with good hygiene will all make a difference. Don't spread disease by poor management and hygiene and exceeding stocking densities.
Good Nutrition	Good intakes of colostrum provide essential antibodies to protect calves as their immune system is developing. Balanced diets with adequate levels of energy, fibre and proteins, in appropriate forms, along with trace elements, vitamins and anti-oxidants are essential if the immune system of cattle is to work properly in tackling diseases. It is essential to ensure adequate dry matter intake for all ages.

A linked website on antibiotics and UK farming, **www.farmantibiotics.org**, provides news, facts, statistics, science, reports and best practice case studies and inspiration for farmers who want to work with their vets to ensure they are using antibiotics responsibly.

RUMA also co-ordinates campaigns to support reductions, replacements or refinements in antibiotic use. The #colostrumisgold campaign in spring 2108 aimed to cut the need for antibiotics in neonatal and older animals through improved colostrum management at birth. A #VaccinesWork campaign running in autumn 2018 promoted the role vaccines can play in helping to protect health and welfare in all farm animal sectors[57]. In support of the RUMA Targets Task Force AHDB and MSD Animal Health published a report on the 'Use of vaccines and vaccination in dairy and beef cattle production 2011- 2017'[58] in November 2018 which showed that total number of vaccine doses sold for use in cattle increased by 15 per cent between 2011 and 2017.

RUMA also published a policy position of on feeding of waste milk to calves in August 2018. *"Waste milk (excluding colostrum*) from cows under the statutory withdrawal period for antibiotics should not be fed to youngstock. Based on current evidence it is recommended that a practical solution for on-farm disposal is to dispose of waste milk in the slurry pit. RUMA encourages further research into disposal options to identify practical alternatives and to gain a better understanding of any potential environmental interactions associated with disposal via this route."*

**Colostrum from treated cows can be fed to newborn calves for the first 24 hours of life as the benefits to calf health are, based on current evidence, viewed to outweigh any potential negatives. AHDB has further detailed information about feeding colostrum and newborn calf health."*

Dairy Antimicrobial Stewardship Group

The Dairy Antimicrobial Stewardship Group was set up to create an overall strategy for meeting the targets set for the dairy sector. The group aims to coordinate a positive and proactive campaign to drive awareness and engagement of antimicrobial stewardship within the dairy sector to support the reduction targets. This will include identifying appropriate changes in farm management practices; identifying gaps in research and knowledge; liaising with relevant sector stakeholders to achieve the desired changes; and clarifying the responsibilities of actors within the supply chain in communicating best practice to farmers and vets.

The Group seeks to support and engage with wider industry data collection projects, to avoid duplication where possible and encourage linkages between data sources to capture and report an accurate picture of antibiotic usage in the dairy sector as well as progress against commitments. A common language and methodology for data collection and benchmarking suitable for national reporting and engagement at farm level is a key focus.

The Group strategy is to encourage the use of excellent husbandry and farm management practices that will help prevent disease and avoid welfare issues along with the aim to reduce the need for antibiotics. Particular priority is given to promoting dynamic farm health plans and best practice on herd management and supporting knowledge transfer exchange and farmer and vet training to improve disease prevention and responsible antimicrobial use. It also supports veterinary antimicrobial stewardship and training in the dairy sector to strengthen the position of veterinary surgeons as gatekeepers of antibiotics. The DASG also encourage first purchasers of milk to support and engage in non-competitive initiatives and activities with both their contracted farmers and the veterinary sector to enable the implementation of the AMR strategy.

[57] https://www.vaccineswork.org.uk/

[58] https://ahdb.org.uk/knowledge-library/use-of-vaccines-in-dairy-and-beef-cattle-production-2011-17

The Cattle Health and Welfare Group Antimicrobial Use (AMU) Group is working with DASG and the industry to agree standard benchmarking metrics for use on UK dairy farms

Farm assurance

The Red Tractor Assurance for farms Dairy scheme sets out to maintain, develop and promote Assurance standards within the dairy industry. The aim is to provide consumers and retailers with confidence about product quality attributes of the milk leaving the farm premises, including food safety, animal welfare and environmental protection.

Red Tractor revises its standards every three years with the goal of matching production standards with what consumers expect from their food. Red Tractor implemented Version 4 of the Dairy standards in 2017[59]. The scheme standards on animal health, Welfare and medicine use on dairy farms include:

- Medicine records must provide an annual collation of total antibiotic used for the unit either by a vet from prescription data or completed by a farmer from medicine records.
- An annual review of antibiotics used must be undertaken by the vet. All livestock leaving the farm must be accompanied by a declaration confirming what medicine withdrawal periods are applicable.
- Highest Priority Critically Important Antibiotics must only be used as a last resort under veterinary direction
- It is recommended that at least one member of staff responsible for administering medicines has undertaken training and holds a certificate of competence.
- A Livestock Health Plan to proactively manage and improve health and welfare of livestock must be established and implemented
- Records of the health and performance of livestock must be maintained and reviewed regularly
- A written annual livestock health and performance review must be undertaken by a vet

Training

An Animal Medicines Best Practice (AMBP) Programme developed by the National Office of Animal Health (NOAH) in partnership with a working group of stakeholders from across the industry including farmers, vets, the Responsible Use of Medicines in Agriculture Alliance (RUMA), the Veterinary Medicines Directorate (VMD), the British Retail Consortium (BRC) and leading academics. The training programme gives farmers and vets access to new resources, enabling a coordinated and consistent approach to farmer training to support the responsible use of antibiotics on UK farms.

The new training is available at www.noah.co.uk/farmer-training/ or direct from Lantra at www.elearning.lantra.co.uk. Each sector (Dairy, Beef, Sheep and Pig) has a set of modules, including two core modules and a sector focus module. The core modules cover the fundamentals of antibiotics, AMR and responsible use with a mix of theory and practical applications. The focus modules address key areas of interest with a broad choice for the beef and dairy sectors.

Dairy UK in conjunction with BCVA (the British Cattle Veterinary Association) has developed the MilkSure[60] initiative for British dairy farmers. Its mission is to safeguard the production of wholesome milk which is free of veterinary medicine residues (above legal limits). MilkSure is a training course for British dairy farmers and their employees. Training is provided by vets for their own clients, using a workbook and other learning materials. The course covers all the technical and practical aspects necessary to safeguard residue free milk.

Udder health

Four of the six targets set by the RUMA Targets Task Force are directly linked to mastitis control, and the remaining two (HP-CIA (Highest Priority Critically Important Antibiotics) usage and Total Usage) are heavily influenced by mastitis treatment choices. The AHDB Dairy Mastitis Control Plan[61] (DMCP) is an effective, evidence-based, nationwide plan for mastitis control that has been shown to have excellent clinical efficacy. In published, peer-reviewed research on commercial dairy farms there was an average reduction of 22% per year in

[59] https://assurance.redtractor.org.uk/contentfiles/Farmers-6802.pdf
[60] https://milksure.co.uk/about-milksure/
[61] http://www.mastitiscontrolplan.co.uk/

clinical mastitis and high somatic cell counts as a result of implementing the Plan[62]. Optimising udder health in dairy cows has benefits in terms of animal welfare and productivity, product quality, supply chain efficiency, dairy farm economics and reduction of antimicrobial use. Trained vets and consultants, also known as Plan Deliverers, use farm-specific information, such as milk records, clinical records and on-farm questionnaires, to identify the main factors contributing to mastitis on farm. All of this information is brought together to produce a farm-specific set of practical recommendations.

In September 2018 AHDB Dairy launched a Mastitis Pattern Tool[63] which can also be used with the DMCP. The tool was developed by the University of Nottingham and Quality Milk Management Services (QMMS). The tool is an interactive Excel spreadsheet which provides a fully automated method of assessing the predominant mastitis infection patterns present on farm, using somatic cell count (SCC) and clinical mastitis records. It produces a mastitis pattern report that allows farmers and vets to assess and prioritise key management areas and potentially detect emerging problems. The tool converts and merges records into a simple output allowing farmers to assess the patterns of mastitis in the herd. The outputs indicates whether the mastitis cases seen on farm are likely to be environmental or contagious in origin and also whether infection is occurring mainly in the dry period or during lactation. The tool also indicates whether there is a problem with mastitis in heifers and also gives an indication of whether there is any seasonality to the patterns of mastitis seen on farm. Milk recording herds are at an advantage as cow SCC information is readily available. The information from the tool should help make better decisions on mastitis control and prevention and ultimately lead to more responsible antibiotic use.

A new initiative ("Quarter PRO") will start in 2019 and aims to provide and promote a rapid approach to monitoring and improving udder health, accessible to all dairy farmers. The approach provides a four-step iterative process for identifying a herd's "mastitis pattern" and providing support to optimise udder health:

1. Automated data analysis identifying and ranking farm specific mastitis issues.

2. Identification of key management areas related to these issues.

3. Use of resources to identify relevant actions.

4. Quarterly reassessment.

This initiative will provide wider and easier access to elements of the AHDB Mastitis Control Plan and a means of co-ordinating udder health promotion materials. It is hoped that it will attract further widespread support across the industry.

AHDB Dairy have also published a series of factsheets and two short films about controlling mastitis through dry cow management developed in conjunction with the University of Nottingham and QMMS[64].The factsheets 'Dry cow management: a practical guide to effective mastitis control' and films provide information and recommendations for farmers on drying off, along with a pictorial protocol on clean infusion technique at dry-off. The guidance encourages farmers and their farm staff to work together with their veterinary surgeons to decide on the most effective dry cow management strategy to prevent new infection and the development of mastitis in the next lactation. The resources cover:

- decision making at dry off,
- drying-off,
- clean infusion technique,
- monitoring the dry period performance as well as
- consideration on nutrition, housing and calving management.

Healthy Feet Programme

The AHDB Dairy Healthy Feet Programme (DHFP)[65] aims to help dairy farmers reduce the number of lame cows on their farms by identifying and applying the right management techniques. It takes a structured approach to help dairy farmers make important progress towards diagnosing the problems, devising an action plan, and develop the skills necessary for long-term lameness control. The DHFP approach is based around 'four success factors'

1. Low infection pressure
2. Good horn quality and hoof shape
3. Low forces on the feet – good cow comfort and cow flow
4. Early detection and prompt, effective treatment of lame cows

[62] Green M. J., Leach K. A., Breen J. E., Green L. E. & Bradley A. J. (2007) National intervention study of mastitis control in dairy herds in England and Wales. Veterinary Record 160, 287–293 doi:10.1136/vr.160.9.287
[63] https://dairy.ahdb.org.uk/resources-library/technical-information/health-welfare/mastitis-pattern-tool
[64] https://dairy.ahdb.org.uk/news/news-articles/march-2018/drying-off-make-it-count/
[65] https://dairy.ahdb.org.uk/technical-services/healthy-feet-programme

Trained providers (vets or foot trimmers who have attended a specialist course) facilitate the whole process and act as one-to-one advisers, or 'mobility mentors'.

Calf health and respiratory disease

Two other areas of focus for the responsible use of medicines are calf health and respiratory disease. Improved calf health and welfare through proactive calf health planning was part of a recent AHDB Dairy Calf to Calving (C2C) initiative[66] . There is a strong link between good colostrum intake at birth and better health with good natural immunity. This means less disease, and less need for antibiotic treatments. RUMA, CHAWG and other stakeholders have focused on raising awareness of how to improve calf health through provision of sound science-based advice and campaigns eg #CalfHealth #ColostrumIsGold and #VaccinesWork. There is a particular focus on reducing enteric diseases in calves using colostrum and good hygiene effectively to prevent scours and using fluids and electrolytes as the main first avenue of treatment when they occur.

Pneumonia is one of the most common diseases in dairy calves and young stock. There is a focus on prevention of Bovine Respiratory Disease by taking specific preventive measures appropriate for the farm situation such as reducing infection pressure (e.g. better ventilation, reduced stocking rates, hygiene), and improving immunity (e.g. colostrum management, vaccination). In a disease outbreak, it is very important to work with the farm vet to identify the cause of the pneumonia, eg necropsy of all dead calves to check for viruses and mycoplasma, so appropriate strategies can be developed.. Pneumonia can be preventable, as well as treatable, by developing a good prevention plan with the farm vet.

Euro Dairy Webinar - the Farmer Action Group project[67]

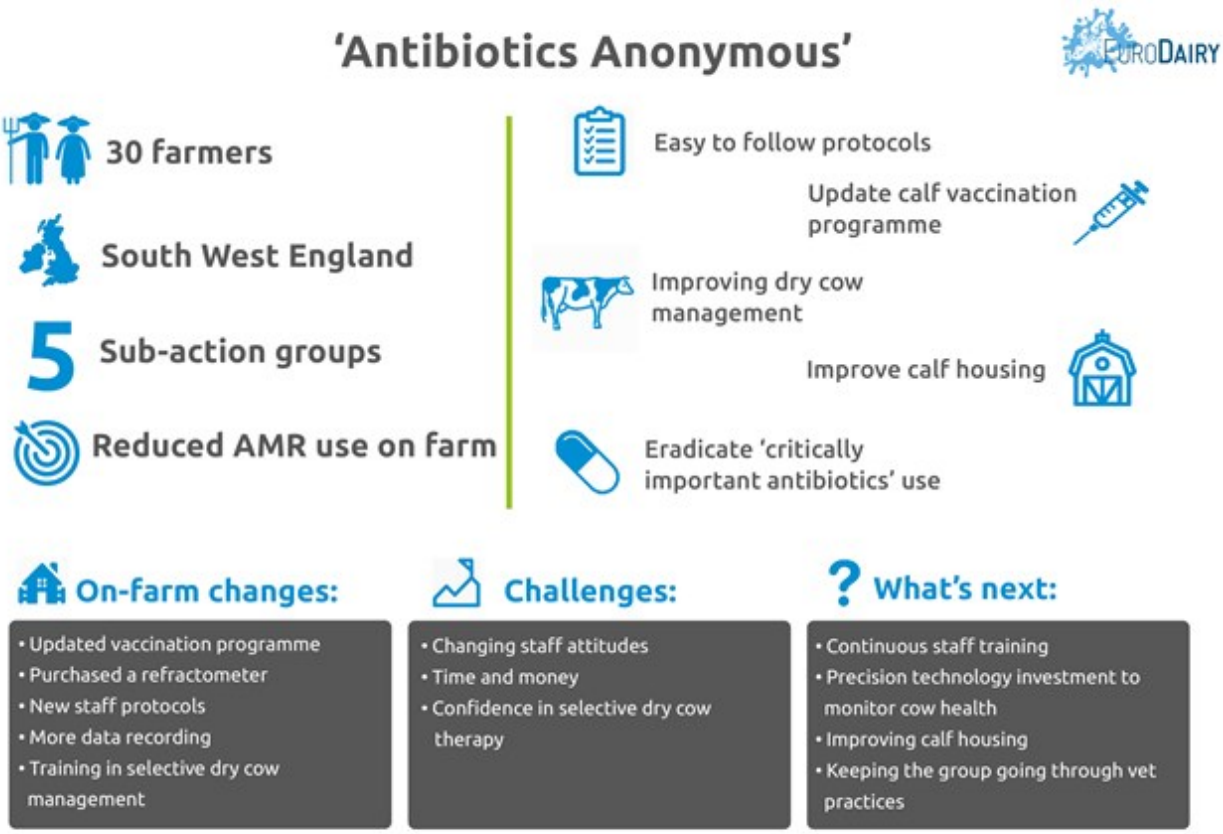
Lisa Morgans, a PhD student at the University of Bristol, has been working with 30 dairy farmers in South-West England to look at how farmers could work together to reduce their use of antibiotics on-farm. Graham Wells and his family team managing and running a 280 strong H-F herd in Somerset, averaging over 8000L/cow/year in an all year round calving pattern was part of the Farmer Action Group project

The farmers came up with the name, ‘Antibiotics Anonymous’, for the groups of 5-8 farms which met up on each other’s farm every 6 weeks. There was a wide range of farming systems - organic, conventional, 60 to 600 cow herds, block and all year round calving, grazing and housed; all with different opportunities and challenges. The meetings centred around a farm walk, with the spotlight being on disease treatments, prevention and antimicrobial use. After the farm walk a group discussion activity helped to produce a practical action plan for the host farmer to reduce antibiotic use.

Speaking at the final super-farmer action group meeting, Lisa said: “Reducing reliance of antibiotics reduction is a key focus in the dairy industry, all of the farmers involved in the action group put in 100 per cent to try and reduce their reliance on antibiotics. One farmer in particular stands out, as he successfully implement over 90 per cent of the practical ideas on his action plan.”

Farmer-to-farmer learning has been a benefit for many involved in the project, “Going round other farms allowed us to cherry pick ideas from each other and when you go home you start to think how you could implement similar changes on your own farm,” explained one farmer.

[66] https://dairy.ahdb.org.uk/technical-information/calf-to-calving
[67] https://www.youtube.com/watch?v=PHEJh9U1SqE&feature=youtu.be



Next steps

An EU fact-finding mission was carried out in the United Kingdom from 16 May 2018 to 25 May 2018 in order to gather information on the prudent use of antimicrobials in animals. Although not an audit the report will be published on the European Commission website pages for Health and Food audits and analysis.

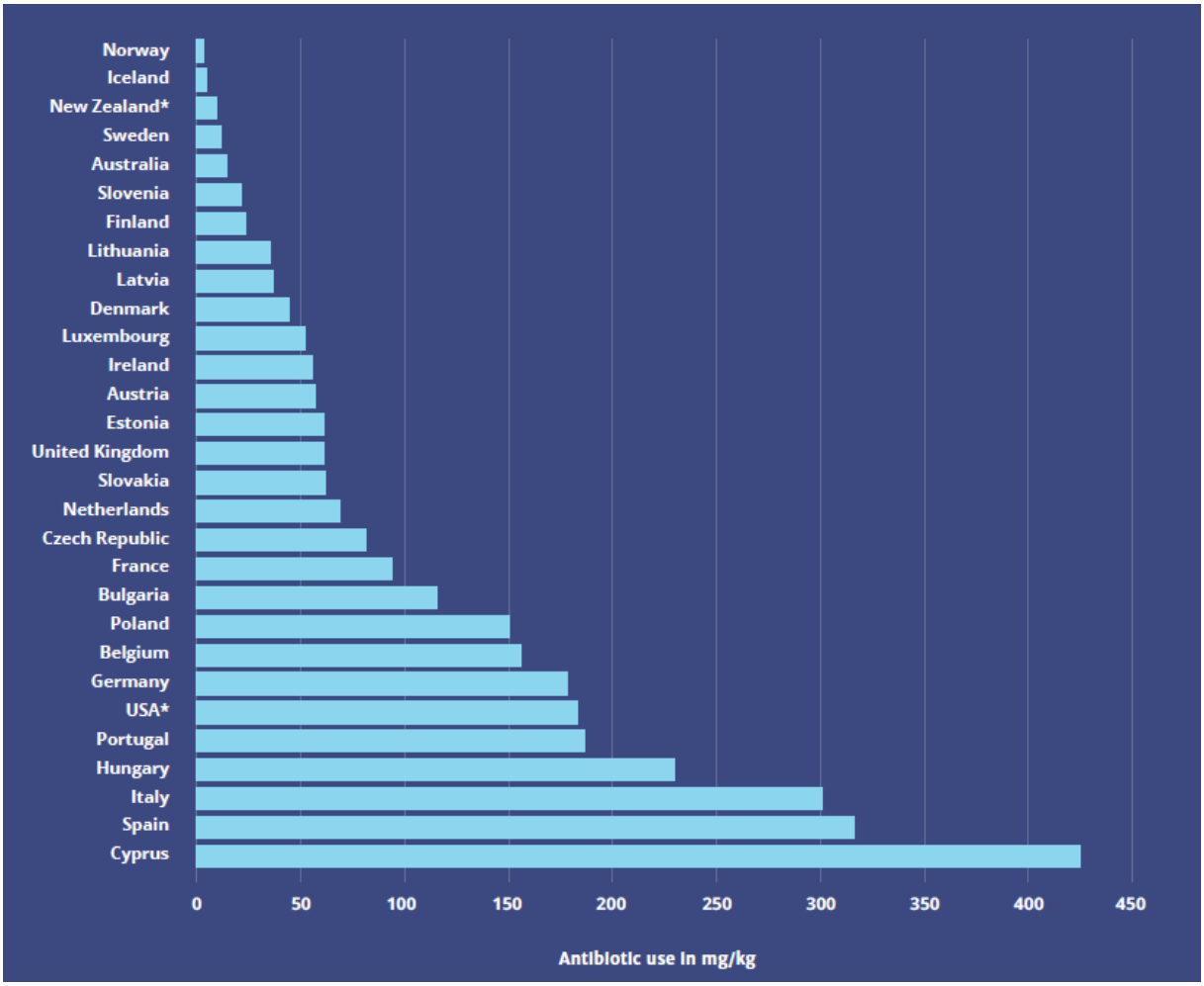
The UK dairy industry continues to develop its antimicrobial stewardship strategy in close liaison with Government, RUMA and farm assurance. Developing better systems for data capture and benchmarking is recognised as key to driving responsible use. RUMA is updating its antimicrobial strategy and continues to lead on the co-ordination of Knowledge Exchange across all the sectors on improving animal health to reduce the need for antibiotic use. Behavioural change must continue with regard to use of antibiotics from both a veterinary and a farmer perspective. Further activity needs to be informed by research in this field and experience in other countries. The key to sustainable reductions in the risk of antimicobial resistance is high standards of sustainable animal health rather than a sole focus on numerical reductions in usage.

5. The way forward

Antibiotic use

There is no good overview of antibiotic usein dairy farming in the different EU countries figure 1 – based on antibiotic use for all animals and 2011 data – is used to give a good illustration of the great variation in use.

Figure 1 Antibiotic use in milligram per kg of livestock.



Source: European Medicines Agency (2011)

The use of antibiotics shows a huge difference between EuroDairy countries from lowest Sweden (13 mg/kg) to highest Italy and Spain (> 330 mg/kg). Although these data are out of date and not specified for different animal species, it shows the great differences in use between countries. But the greater the differences the greater the opportunities to learn from each other!

The European Medicines Agency (EMA) launched the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project in September 2009, following a request from the EC to develop a harmonised approach to the collection and reporting of data on the use of antimicrobial agents in animals from the Member States. A total of 30 European countries — 29 EU/EEA countries and Switzerland — submitted data on sales or prescriptions (two countries) of antimicrobial veterinary medicinal products (VMPs) to the European Medicines Agency for 2016.

A population correction unit (PCU) is applied as a proxy for the size of the food-producing animal population (including horses). The main indicator used in the eighth report to express the sales is milligrams of active ingredient sold per population correction unit — mg/PCU. A large difference in the sales, expressed as mg/PCU, was observed between the most- and least-selling countries (range 2.9 to 453.4 mg/PCU) for 2016; the total sales for all 30 countries which delivered data in 2016 was 124.6 mg/PCU, while the median was 57.0 mg/PCU. The sales patterns of the antimicrobial classes also varied substantially between the countries. However, the report cautions against use of data presented in the report to directly compare countries as more detailed insight and analysis may be needed.

Table . Sales, in tonnes of active ingredient, of veterinary antimicrobial agents marketed mainly for food-producing animals1, population correction unit (PCU) and sales in mg/PCU, by country, for 2016

Country	Sales (tonnes) for food-producing animals	PCU (1000 tonnes)	mg/PCU
Austria	44.1	957	46.1
Belgium	240.4	1,715	140.1
Bulgaria	61.1	393	155.3
Croatia	26.6	286	92.9
Cyprus	46.3	102	453.4
Czech Republic	43.2	705	61.2
Denmark	98.7	2,420	40.8
Estonia	7.2	113	64.0
Finland	9.7	521	18.6
France	513.9	7,143	71.9
Germany	779.2	8,734	89.2
Greece	79.9	1,258	63.5
Hungary	155.6	832	187.1
Iceland	0.6	120	4.7
Ireland	102.3	1,963	52.1
Italy	1,213.2	4,116	294.8
Latvia	5.4	180	29.9
Lithuania	12.7	338	37.7
Luxembourg	1.9	55	35.5
Netherlands	181.7	3,446	52.7
Norway	5.6	1,896	2.9
Poland	570.2	4,407	129.4
Portugal	210.9	1,014	208.0
Romania	265.4	3,116	85.2
Slovakia	12.2	242	50.4
Slovenia	5.4	178	30.3
Spain	2,724.9	7,518	362.5
Sweden	9.8	805	12.1
Switzerland	37.6	806	46.6
United Kingdom	321.7	7,142	45.0
Total 30 countries	**7,787.1**	**62,521**	**124.6***

The European Medicines Agency (EMA) has established standardised units of measurement for reporting antimicrobial consumption in specific animal species, called the 'defined daily dose' and 'defined course dose' for animals[68]. The European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) activity has prioritised establishing 'defined daily dose for animals' (DDDvet) and 'defined course dose for animals' (DCDvet) values for antimicrobials used in three major food-producing animal species: pigs, cattle and broilers (poultry). The values are based on an assumed average daily dose (DDDvet) or treatment course dose (DCDvet) of active substance. They take account of differences in dosing, pharmaceutical form and route of administration used in the different species. The lists of DDDvet and DCDvet values are available in PDF or Excel format

[68] https://www.ema.europa.eu/veterinary-regulatory/overview/antimicrobial-resistance/european-surveillance-veterinary-antimicrobial-consumption/standardised-units-measurement-veterinary-antimicrobials

National approaches to reduce antimicrobial use

National approaches are initiated by the government, but it is good to realize it is ultimately the farmers who - together with their veterinarian - have to implement measures reduce the use of antimicrobials. Why should a dairy farmer use less if he runs the risk of his cows becoming infected and/or not being cured?

A national approach will not be successful in changing the behavior of dairy farmers (and veterinarians) if they are not aware of the need to reduce AMR. This can be learned from the Dutch approach and successful reduction. In 2017 the use of antibiotics at dairy farms in the Netherlands reduced with 49% compared to 2009 and the use of critically important antimicrobials (CIA) has been minimized.

Healthy cows do not need antibiotics

Ylva Persson (Sweden)

Use can be reduced when less is needed because the cattle health status at national and farm level is good. The "Swedish model" shows a good control or eradication program for infectious diseases minimize need for antibiotics and avoid spread of infectious diseases. Sweden is e.g. free from BVD, IBR, paratuberculosis (Johne's disease) and has a very low prevalence of salmonella.

The low use in Swedish dairy herds is achieved and maintained by removing unnecessary use (like no blanket dry cow treatment), benchmarking farms for animal health and welfare ("Ask the cow") and optimizing use when needed. The use and resistance is also monitored.On the other hand the health status of Swedish dairy herd is characterized by a good fertility, low incidence of clinical mastitis and low calf mortality.

Sustainable reductions in the use of antibiotics can only be achieved if the health of animals is improved and the incidence of new bacterial infections requiring treatment with antimicrobials is reduced.

In earlier days it was not commonly known or discussed that the use of antibiotics in animals could be a risk for the development of AMR in human diseases. So there were limited restrictions in the use of antibiotics (other than the withholding period) to cure and to prevent diseases, like udder infections. To change this behavior a national approach should start with making farmers and veterinarians aware of the risks and to involve them from the beginning in the process of setting targets and developing a practical strategy.

For example in Belgium all stakeholders (farmers, veterinarians, government, pharmaceutical and feeding companies, academia) are involved in an independent institute AMCRA, which aims to reduce antimicrobials by 50% by 2020.

Changing behavior is changing the mindset

Theo Lam (Netherlands)

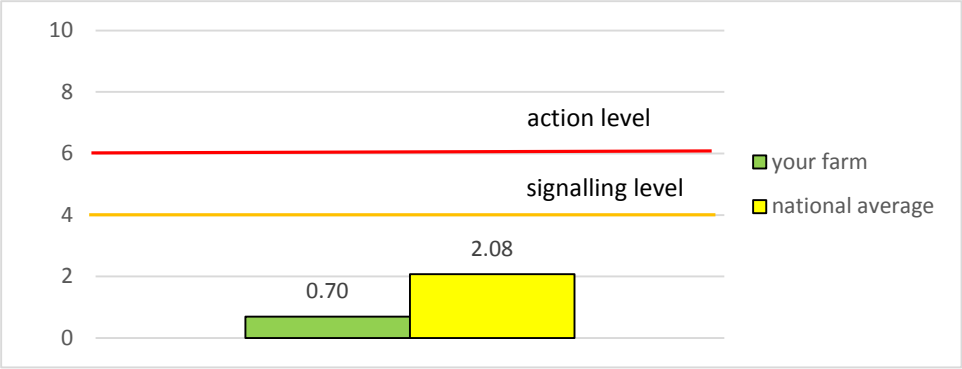
Lam et al. concluded that the different cues from Rules, Economics, Social Pressure, Econmics and Tools, combined together had helped to change the mindset of dairy farmers and veterinarians towards antibiotic usage on dairy farms. As an example of this change in mindset they point out that despite the fact that information provided on DCT and on critically important antibiotics was contrary to information provided by veterinary practitioners and in national projects previously, most farmers were convinced that SDCT and the selective use of antibiotics in general were a sound approach. The integrated approach is thought to have played a crucial role in the reduction of antibiotic usage in dairy cattle in the Netherlands. As the change in behaviour of dairy farmers in the Netherlands towards antibiotic usage seems to be based on an actual change of mindset it is thought more likely to be successful in the long term.

Measuring and monitoring

To realize a reduction it is necessary to make antibiotic use transparent otherwise it is not possible to evaluate if national reductions targets are being met. Measuring use at farm level also makes it possible to develop benchmarking tools.

In Denmark, Sweden and the Netherlands the use of antibiotics on dairy farms is reported to national databases and other countries are developing systems for national recording. The data from the existing systems are available for benchmarking at farm level and for veterinarians. Benchmarking tools make it possible for farmers and veterinarians to compare their usage with colleagues and to see developments over time. In additions thresholds can be used to encourage a further reduction.

For example the Dutch benchmarking thresholds are based on 'traffic lights' with green (<4) OK, amber (4-6) indicates a high use requiring action and red (>6) immediate action is necessary. In the last case if no immediate action is undertaken milk will no longer be collected.



The Population Correction Unit or PCU used by ESVAC is a technical unit which refers to the weight of animals at risk and is based on a standardised average weight at time of treatment. For dairy farms the kg of PCU is calculated by multiplying the average number of adult dairy cows greater than 2 years of age by 425 kg – the number of youngstock or calves are not included on dairy farms. For dairy herds 425 kg is the weight used by ESVAC as the Population Correction Unit[69].

The University of Bristol has reviewed a selection of metrics for AMU in the dairy industry: total mg, total mg/kg, daily dose and daily course metrics. In order to be used widely, a metric should be understandable and relevant to the veterinarians and farmers who are prescribing and using antimicrobials. This means that clear methods, assumptions (and possible biases), standardised values and exceptions should be published for all metrics. Particularly relevant are assumptions around the number and weight of cattle at risk of treatment and definitions of dose rates and course lengths; incorrect assumptions can mean metrics over- or under-represent AMU. The authors recommend that the UK dairy industry work towards UK-specific metrics using UK-specific medicine dose and course regimens as well as cattle weights in order to monitor trends nationally. The paper was published in the Veterinary Record[70].

Most of the metrics used are complex. Denmark uses Defined animal daily dose (DADD) and the Netherlands use Defined Daily Dose of Antimicrobials (DDDA). They are similar metrics but calculated in slightly different complex ways and used in ways which mean they are not directly comparable. They are not easy to calculate and difficult to explain to farmers but once they are used to the figures, trends and benchmarks they can be used in practical ways by farmers and vets.

A simpler system is used in Germany - the Used Daily Dose which is the average number of daily doses used for treatment per animal. Essentially every time any animal is treated with an antibiotic this counts as one daily dose. The UK is discussing using a variant of this for monitoring the use of intramammary mastitis tubes – 4 dry cow tubes would count as one used course of dry cow treatment and 3 lactating cow tubes would count as a used course of lactation treatment. This has the advantage of being relatively simple and easily understood by farmers.

It would be good if the dairy industry in Europe could work towards a single set of metrics which would allow easy comparison and benchmarking of use of antimicrobials and which in some way related to the risk of antimicrobial resistance. The metrics should ideally also be easily understood by farmer and simple to calculate.

Countries also use different databases to capture antimicrobial use data. Pharmacies and/or veterinarians and/or farmers are either required to report medicine use to the database or in some cases can do so on a voluntary basis. The widespread uptake of smartphones offers an opportunity both to make reporting usage easier and it should also be practical to provide useful information, metrics and reminders to users. There is scope for countries developing new systems to learn from the experience of those who have been operating systems for some time.

[69] Understanding the mg/PCU calculation used for antibiotic monitoring in food producing animals, https://www.gov.uk/government/publications/understanding-the-mgpcu-calculation-used-for-antibiotic-monitoring-in-food-producing-animals

[70] https://veterinaryrecord.bmj.com/content/182/13/379

How to reduce antimicrobial use at farm level?

As quoted before healthy animals do not need antibiotics, so it all starts with good animal health of the herd. Long term investment in good housing and breeding combined with management measures can improve animal health, profitability and – last but not least – labour satisfaction. Give special attention when rearing young cattle as calves are more vulnerable for diseases like pneumonia; select sires of bulls with good breeding values for animal health; use hygiene measures during milking and take sensible precautions if enlarging your herd by bringing animals in from outside your farm.

A systematic approach in cooperation with your veterinarian like a herd health and treatment plan is a useful tool to improve animal health. Making these plans costs money and time, but will have a positive return on investment when it leads to less treatments. In general it is better to prevent than to cure.

Healthy partners*

In the Netherlands there is an innovative pilot (Healthy partners) for a new model of cooperation between farmer and veterinarian with a shared responsibility for the herd health. Together they set targets, for example reduce the number of cows with mastitis. If this goal is reached the vet gets 100% of his visit and advisory costs. If the target is not reached the vet gets a part e.g. 2/3 of their costs. This innovative approach means the vet is not paid for sick cows, but for preventing cows to become sick.

*Courage, the innovation organization for Dutch dairy sector ,https://www.courage2025.nl/projecten/gezonde-partners.

When preventive measures have failed and a bacterial infection has been diagnosed and treatment is indicated it is important that antibiotics are used responsibly and prudently. Ideally, antimicrobial selection should be based on proper diagnosis, preferably confirmed by susceptibility testing. Many general recommendations for prudent use have been proposed in different countries including the implementation of treatment guidelines to support prescribers in the choice of the right antimicrobial. There is scope to share experiences in developing treatment guidelines between countries to improve the effectiveness of use of antimicrobials.

A significant proportion of the use of antibiotics in dairy farming is linked to udder health especially mastitis. It used to be common practice to infuse antibiotics in each quarter at drying off, the so called blanket antibiotic dry cow therapy (ADCT). As preventive use of antibiotics is under scrutiny – in some countries blanket ADCT is already prohibited - farmers could be supported with guidelines to move away from blanket ADCT to selective DCT resulting in a lower antibiotic use. Swedish – has always had a low antibiotic use- and Dutch – realized a strong reduction - practical experiences can be useful for other farmers.

In 2017 a group of international experts developed a consensus statement is to optimize the prudent use of antibiotics while respecting animal health and welfare and taking into account risk management for every cow and herd. They made the following recommendations for drying off[71]:

1. Use Internal Teat Sealing (ITS) for all cows at drying off.
2. A different approach for ‘low risk’ herds (bulk somatic cell count less than 250,000/ml) and ‘high risk’ herds (bulk scc > 250,000/ml).
3. Selective DCT for ‘low risk’ herds which means after diagnostics only antibiotics for cows likely to be infected. So no antibiotics for cows unlikely to be infected.
4. Blanket ADCT for ‘high risk herds’.

It should be noted these recommendations have not the ambition nor the intention to overrule national legislation. In fact in certain countries they do not comply with legislations and/or national guidelines. For other countries it could be a first step in reducing the use of antibiotics.

Swedish and Dutch experiences show a low and significantly reduced use of antibiotics does not lead to more animal health problems. Working with the farm vet preventive use of antibiotics can be replaced by management measures and better monitoring.

[71] Consensus statement Dry Cow Therapy https://www.farmantibiotics.org/tool_links/consensus-statement-dry-cow-therapy/ The result of a workshop in 2017 hosted by Boehringer Ingelheim with experts A. Bradley, A de Vliegher. M. Farre, L.M. Jiminez, T. Peters, E. Schmitt-van de Leemput and T van Werven.

6. Conclusion and recommendation

1. Healthy cows do not need antibiotics! If the farmer has a healthy herd and good animal welfare the need to use antibiotics on the farm will be much reduced. The incidence of infectious diseases can be minimized by strict biosecurity, good hygiene, good control of the environment, vaccination and elimination of infectious diseases eg BVD, IBR. There is scope for countries to share experiences in national approaches to improving animal health through elimination, extension and management. Many countries have developed excellent resources and tools and there is scope for sharing materials and expertise so that more rapid progress can be made by all.

2. Though there are big differences in the use and in national plans for reduction, there is a now a much greater awareness – also among dairy farmers – of the risks of antibiotic resistance and the need for a more prudent use. In addition to the risks of resistance in infections of humans and animals another argument for prudent use is to keep antibiotics available when they are really needed to treat and cure bacterial infections. Healthy cows do not need antibiotics, but sick cows must be treated! It is important to continue to monitor Antimicrobial Resistance and to identify, understand and react appropriately to any changes in resistance patterns. Sharing intelligence on the development of AMR will be critical as AMR will not respect any geographic borders.

3. A low and prudent use of antimicrobials is possible, but plans to reduce use and to make changes in management to achieve this starts with the mindset of farmers. The first step in changing behaviour is to motivate farmers. For this it is also necessary to involve farmers (representatives) at an early stage in the development of national approaches and setting targets. Other stakeholders, vets, advisors and dairy industry, should also be involved in the planning. The RESET Mindset Model (Lam et al. , 2017) applied to the approach taken to antimicrobial reduction in the dairy industry in the Netherlands provides a useful framework for reviewing and developing national approaches. In the Netherlands different cues from Rules, Economics, Social Pressure, Education and Tools, combined together helped to change the mindset of dairy farmers and veterinarians towards antibiotic usage on dairy farms

4. For monitoring reduction and other targets a national database to record the use of antimicrobials seems indispensable. Using this database for benchmarking of farms (and vets) is of added value. You cannot monitor what you do not measure and data recording provides insight into whether the targets are being achieved, and can also be used for benchmarking at farm level to help incentivise improvement. To compare and discuss the use on an individual farm with a peer group as in the Stable Schools in Denmark and the Farmer Learning Groups in the UK has been shown to help farmers identify possibilities to improve.

5. An important step for a prudent use of antimicrobials at farm level is to restrict the use to animals that have been diagnosed with a treatable illness so for example no preventive use at drying off. Selective dry cow therapy without adverse effect on animal health has been a successful measure to reduce to (The Netherlands) and to maintain (Sweden) a low level of antibiotic usage on dairy farms. When cattle need to be treated antimicrobial selection should be based on proper diagnosis, preferably confirmed by susceptibility testing. There is scope for countries to share experiences in developing and updating treatment guidelines guidelines to ensure effective treatment and prudent use.

7. Annex

Summary of the antibiotic survey in EURODAIRY

Countries responding: UK, E, DK, IT, NL, SWE and F
A healthy cow doesn't need antibiotics!

Present situation in brief

Sweden doesn't have any specific project running right now. It´s an ongoing work. We don´t allow preventive or systematic use of antibiotics and only the individual who is diagnosed gets treated with antibiotics. After the treatment the milk is in quarantine for a time before it can be delivered to the dairy again.

In the UK there is an Electronic Medicine book in the pig-industry. The poultry and pig industry is far ahead in the work with reducing use of antibiotics. The Ruminant industry has high demands on them to reduce antibiotic use.

Italy have a policy that they should reduce the use of antibiotics. No goal is mentioned.

The Netherlands are not having a project right now but is working ongoing with the issue! The use of antibiotics is only prescribed by veterinarians and a compulsory inspection and assessment of farms by veterinarians.

France have been setting up a national plan since 2012. In the dairy sector the main goal is to reduce the use of antibiotics to control mastitis (prevent mastitis and to move from systematic treatment in the beginning of the dry period to selective treatment). The first data is in and the targets should be set in 2017.

Ongoing projects

UK: Bristol University is running a project on reducing veterinary medicines input through the use of farmer groups.

Es: In Spain the objective of the National Action Plan is to develop a series of necessary strategic lines and actions to reduce the risk of selection and dissemination of antibiotic resistance and subsequently, reduce its consequences for the health of animals and humans, thus conserving the existing therapeutic arsenal in a sustainable manner.

NL: An information exchange project between farmers in India and the Netherland that sounds interesting. What are their experiences?! Exchange visits between British and Dutch farmers are also ongoing

S: In Sweden the dairy Arla has been running a series of workshops for its farmers on

Selective Dry Cow Therapy, as part of the rollout of ArlaFarm (Arlas controlprogram). Individual veterinary practices have also put on events for their clients.

I: BEST: a sensor system aimed at monitoring quality, health and traceability of the chain of the bovine milk

F: A lot of ongoing projects but no specified. It seems that it´s a process in changing the farmers way of thinking and working on the farm in a preventive way.

Initiative from farmers to reduce the use of antibiotics

- Local studygroups with a vet discussing a theme-subject

- Breeders organizations in Italy have engaged to define best practices for the use of antimicrobial drugs in animal production

- Arla has been running a series of workshops for it's farmers focusing on the dry period. This is a part from their program The Arla-farm (Arla Garden).

- Local groups of French farmers who are trying to reduce the use of antibiotics by using homeopathy and/or phytotherapy.

Main concerns from farmers

- Prohibition of preventive use In drying off

- Risk of AB resistance

- Setting of arbitrary targets, not customized to farm or to sector

Suggested activities between farmers sharing information/knowledge?

Sharing Techniques and approaches

Sharing impact on animal health

Sharing benchmarking performances

Sharing economical measures

Farm visits

The Swedish farmers/advisory organizations welcome activity's to share their knowledge and experience in having the lowest use of antibiotics in Europe for ex farm visits, webinars etc.

Hearing about keys to success stories

Learning about the use of phytotherapy

8. Glossary

ADD	Animal Daily Doses (Denmark)
AMR	Antimicrobial Resistance
AMU	Antimicrobial Use
CIA	Critically Important Antimicrobials
DDDA	Defined Daily Dose for animals
DCDA	Defined Course Dose for animals
DDDvet	Defined Daily Dose for animals defined by EMA in the scope of the ESVAC project
DCDvet	Defined Course Dose for animals defined by EMA in the scope of the ESVAC project
EMA	European Medicines Agency
ESVAC	European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project
im	intramuscular
PCU	Population Correction Unit
sDCT	Selective Dry Cow Therapy
TF	Treatment frequency
UDD	Used Daily Dose
UCD	Used Course Dose
VMP	Veterinary medicinal product