# ROADMAP

## Rethinking of antimicrobial decision-systems in the management of animal production

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# The regulatory framework of AMU in livestock farming and its evolution

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# About the ROADMAP research project

The overall aim of ROADMAP is to foster transitions towards prudent use of antimicrobials (AMs) in animal production in different contexts to manage antimicrobial resistance (AMR). Prudent antimicrobial use (AMU) will be achieved by enhancing antimicrobial decision-systems along the food and drug supply chains. ROADMAP will focus on supporting animal health and welfare through prevention and health promotion actions.

AMR is recognized as a significant threat to global public health and food security. Overuse and improper use of AMs in many parts of the world contribute to the emergence and spread of AMR. Although human and animal health require AMs, it has been estimated that two thirds of the future AMU growth worldwide will be in animal production. Improving the management of AMU in farm animals is therefore a critical component of dealing with AMR and optimizing production in the livestock sector. Nevertheless, the variety of contexts of AMU in the livestock sector is a major challenge to managing AMR. **There is no "one-size-fits-all" solution to improve AMU and strategies must be contextually developed** (for instance, strategies used in the Danish pig industry are difficult to adapt and adopt in the French free-range poultry farming). Successful solutions must be combined and tailored to the production systems and the social and economic context in which they operate.

ROADMAP will meet three general objectives, in line with the EU AMR Action plan: i) Rethink AM decision-systems and animal health management; ii) Develop options for encouraging prudent AMU in animal production; iii) Engage all actors in the food and drug supply chains in fostering a more prudent use of AMs.

# Project consortium

| Part. N° | Participant organisation name (acronym) | Country |
|---|---|---|
| 1 | Institut National de recherche pour l'agriculture, l'alimentation et l'environnement (INRAE) ** | France |
| 2 | Association de coordination technique agricole (ACTA) *** | France |
| 3 | Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) ** | France |
| 4 | University of Liverpool (ULIV) * | United Kingdom |
| 5 | Cardiff University (CU) * | United Kingdom |
| 6 | James Hutton Institute (HUT) ** | United Kingdom |
| 7 | Alma Mater Studiorum - Università di Bologna (UNIBO) * | Italy |
| 8 | Aarhus Universitet (AU) * | Denmark |
| 9 | Eigen Vermogen van het Instituut voor Landbouw en Visserijonderzoek (EV-ILVO) ** | Belgium |
| 10 | Research Institute of Organic Agriculture (FiBL) ** | Switzerland |
| 11 | Stichting Wageningen Research (WR) * | Netherlands |
| 12 | Swedish University of Agricultural Sciences (SLU) * | Sweden |
| 13 | Southern Agriculture and Horticulture Organization (ZLTO) *** | Netherlands |
| 14 | European Forum of Farm Animal Breeders (EFFAB) **** | Netherlands |
| 15 | Fundacion Empresa Universidad Gallega (FEUGA) **** | Spain |
| 16 | Dierengezondheidszorg Vlaanderen (DGZ) *** | Belgium |
| 17 | INRAE Transfert (IT) **** | France |

* Universities/veterinary schools

** Research institutes specialized in both fundamental and applied agricultural and veterinary sciences

*** Public and private advisory services Organisations

**** Knowledge transfer and Innovation organisations

# Table of Contents

# List of Tables



# List of Figures

# List of acronyms and abbreviations

| | |
|---|---|
| AB | Antimicrobial |
| AC | Active compound |
| AMR | Antimicrobial resistance |
| AMU | Antimicrobial use |
| CAC | Codex Alimentarius Commission |
| FAO | Food and Agriculture Organization |
| FDA | United States Food and Drug Administration |
| FU | Fattening unit |
| GAP | Global Action Plan on AMR |
| GLASS | Global Antimicrobial Surveillance System (WHO) |
| HIC | High income countries |
| JVARM | Japanese Veterinary Antimicrobial Resistance Monitoring System |
| LMIC | Low-and-middle income countries |
| NAP | National action plan |
| OIE | World Organisation for Animal Health (Office International des Epizooties) |
| PRRS | Porcine reproductive and respiratory syndrome |
| TrACSS | Tripartite Antimicrobial Resistance and the Country Self-assessment Survey |
| USAID | United States Agency for International Development |
| VMP | Veterinary medical product |
| WU | Weaning unit |
| WHO | World Health Organization |
| WTO | World Trade Organization |

# 1 Summary

Policy strategies targeting the health risks arising from imprudent use of antimicrobials (AMs) in livestock farming have been developed at international, European, and national level, by recognizing a growing burden of antimicrobial resistance (AMR) and the contribution of antimicrobial use (AMU) in food-producing animals to this issue. At international level, the Food and Agriculture Organization of the United Nations (FAO), the World Organisation for Animal Health (OIE), the World Health Organization (WHO) collaborating in a Tripartite agreement have identified AMR as one of the three priority topics for joint actions and developed Global Action Plans on AMR.

The European Union (EU) also promoted a coordinated joint strategy among its member states to minimize the burden of AMR. In 2011, the European Commission delivered an Action plan against the rising threats from AMR (European Commission, 2011). The initiative was relaunched in 2017 through the EU One Health Action Plan against AMR (European Commission, 2017) endorsing the WHO global action issued in 2015 and the member states committed themselves to develop of national action plans (NAPs).

The complexity involving AMR points out the need of a holistic and One Health approach, where the reduction of the overall need and use of antimicrobials in food-producing animals are one of the main goals. Key components of these strategies include the promotion of responsible AMU, development of alternative products and practices, close AMU and AMR monitoring, and the definition of AMU reduction targets.

On this basis, this report (Section 2) identifies the strategies addressing AMU and AMR in livestock farming as policy mixes, a concept that relies on the notion that multiple policy instruments combined and interacting with each other lead to a higher performance concerning the achievement of the policy objective(s) than a single instrument: in other words, for complex issues like AMR there is not a one-size-fits-all solution. Policies from the same scope as well as policies from other domains can also influence directly or indirectly the achievement of the expected outcome.

Among the various analytical frameworks that can be found in the literature to examine the strategies deployed to contrast the growing AMR risks in the agri-food supply chain, this study (Section 3) adopted a FAO classification that distinguishes four main types of actions:

(i) Awareness: the actions addressed to improve awareness on the issue in farmers, veterinarians, other agri-food industry operators, and consumers;

(ii) Evidence: the improvements in the capacity of the animal health and food safety systems to monitor the levels of AMU in farms and the presence of resistant bacteria along the food-supply chain;

(iii) Practices: the best practices concurring to reduce AMU (including technical means like vaccines and alternatives medical products and additives, early disease detection capacities, biosecurity and hygiene measures, improvements in animal welfare, genetic robustness of livestock breeds to diseases, etc.);

(iv) Governance: the actions ensuring effective regulatory and institutional frameworks to provide the capacity and the resources needed to implement trans-sectoral One Health plans against AMR.

The wide social and economic implications of both the AMR and the measures addressing potential hazards from livestock production require actions coordinated at the international and global levels (Section 4). The analysis of the strategies launched by global intergovernmental organizations developed in this study provides the indispensable background information about the type of measures on which it is possible to compare countries and their progression towards increasingly effective policy setups. In this context, also the European framework is presented by considering its evolution, the current articulation of its governance involving EU Commission and several European Agencies engaged in monitoring and advising (mainly the EMA, the ECDC, and the EFSA) and the future improvements already scheduled.

A qualitative comparison (Section 5) of the measures implemented by the countries involved in the ROADMAP project (i.e. Belgium, Denmark, France, Italy, Netherlands, Sweden, Switzerland, United Kingdom, and Vietnam) and other selected countries in Europe (i.e. Germany and Spain) and outside (i.e. Argentina, Australia, Brazil, India, Japan, and the USA) was performed in this study based on data from the Global Database for the Tripartite Antimicrobial Resistance (AMR) and the Country Self-assessment Survey (TrACSS) 2019-2020. The country self-assessments on the progress in the implementation of their respective national action plans (NAP) in the four areas of Awareness, Evidence, Practices, and Governance were translated into scorings, and the progress achieved by each country was measured by comparing the score obtained with respect to the maximum score achievable.

Among the ROADMAP project European countries Denmark obtained the highest score (98% of the maximum score) and the Netherlands and Sweden resulted above 90% too, Belgium, France and Switzerland were above 85%, Italy at 80% and the United Kingdom at 76%. Out of the two non-European countries of the ROADMAP project only Vietnam, scoring 56% of the maximum achievable, was evaluated, since Mozambique did not respond to the TrACSS survey. The examined non-ROADMAP European countries, Germany and Spain, were in the range between 85% and 90% of the maximum score. Regarding the non-ROADMAP and non-European countries, Japan obtained 92% and the USA 85%, Australia 69%, Argentina 56%, Brazil and India 54%.

The countries that obtained the best scores identify the weak points of their NAPs implementation in the training and education on AMR for farmers and supply chain operators, and to fully involve in the plan all relevant sectors (i.e., animal health, food processing and safety) with defined monitoring and evaluation processes in place. Most of the examined countries indicated of not using AMU and AMR monitoring data from all relevant sectors to amend the national strategy and inform decision making. With the diminution of the total scoring the policy areas that appear the most affected in the countries examined are Awareness and Governance, followed by Evidence, especially regarding the AMU monitoring capacity. In general, the policy area in which the examined countries evaluated to have the best levels of NAP implementation with respect to the Global Action Plan's standards is the Practices area. The ROADMAP countries' NAPs in the different policy areas are detailed in Section 5.

Antibiotic-free (AB-free) certifications and labels on animal products (Section 6) demonstrated to be an important driver for AMU reduction, especially when supported by retailers' marketing strategies, public awareness on AMR issues, reliable certification systems, and effective AMU traceability. Furthermore, the impact of AB-free labelling on AMU is likely to increase for those livestock production systems that are more integrated with the downstream industries and the retail sector. The analyses performed by the ROADMAP project partners in Belgium, France, Italy, Switzerland, the United King-

dom on AB-free certifications and labelling shows such common features. The lack of AB-free certifications in Mozambique and Vietnam indicates the problems to develop AB-free product supply-chains in countries where the institutional context and the supply-chain integration are still weak.

AB-free labels can cover the total production cycle of the animal product, or just a part of it: e.g., for some meat production the last months of the fattening phase. With respect to other types of "eco-friendly" labelling, e.g., organic product, the AB-free has the advantage of flexibility, since for animals that can be treated individually, the treatment do not compromise the AB-free status of the whole herd and the treated animals can be used for conventional production. When animals can be treated only in groups, e.g., broilers, the treated flock is addressed to conventional production, then the farm starts a new cycle AB-free.

AB-labels are in most cases accompanied by other labels certifying improved animal welfare standards, or other "eco-friendly" and "healthier" product attributes (organic, OGM-free, only vegetal feed, etc.). Regarding the consumers perceptions and willingness to pay, a hedonic price analysis performed in Italy within the context of the ROADMAP project found that AB-free labelled poultry meat had a mean premium price of 14.6% with respect to similar products that did not have this attribute, which resulted much less than the organic label attribute and less than other "ordinary" attributes like "sliced" and "thin slices".

Actions by individual non-ROADMAP countries outside Europe in the context of the four policy areas identified were examined in Section 7. Regarding Awareness, the case of the USA shows the capacity of the direct initiative of consumer and grass-root movements, beyond government actions, to create pressures and trigger changes in the food industry to create markets also for AB-free products. The Japanese case is important for the Evidence area as regards the use of data from AMR monitoring surveillance for supporting decision-making on risk management measures. As for Practices, the study summarized the cautious path of the USA to introduce limitations in the use of AMs as growth promoters fearing consequences on the competitivity of the country livestock industry. The reinforcement of US governance on the AMR issue that took place during the last decade is also analysed.

To achieve better results on AMU prudent use can be an arduous path. It can require to give-up short-term interests and make hard, but necessary systems changes. However, some countries have shown that it is possible to combine a low use of antimicrobials with good production results, even if this implies economic challenges. In this study, the most favourable situations were found in the countries that are among the most developed in terms of both the general socio-economic context and the agricultural industry, and have a relatively reduced population: Denmark, Netherlands, and Sweden. Here, the achievements obtained in reducing AMU are the outcomes of several main contributing factors: the long tradition of evidence-based guidelines, strong participatory local commitment, and strategy work at the regional and national levels.

With respect to the best performing countries, the results of the comparative analysis show that the gaps in the Practices and the Evidence areas could be more easily filled by the other developed countries, like Belgium, France, Switzerland, Italy, and the UK positioned further back, while the differences for the Awareness and the Governance areas are more persistent. This appear the consequence of the different capacity to involve stakeholders in participatory processes, on the one side, and manage the integration of the multiple processes that need to be activated within the policy mix contrasting AMR, on the other side.

For the ROADMAP European countries, the technical problems related to the effectiveness of solutions for a more prudent AMU in livestock farming and tracing and monitoring veterinary AMU and AMR

seem less important than those related to stakeholder involvement and improvement of their professional skills, within the framework of a coherent and efficacious governance. Actions and measures addressed to these aspects may contribute to significantly advance the European context regarding AMU and AMR in farming, especially for the situation of the bigger countries, like France, Italy, and the United Kingdom, which also for their dimension and relevance of livestock industries are big AM users. For all the European countries, including the more advanced, a crucial point for the Governance policy area in the future is to improve the use of AMU and AMR data to directly monitor the effectiveness of national strategies and operate appropriate adjustments. Regarding the ROADMAP non-European countries, a priority may be attributed to the strengthen of the AMU legal framework and the institutional capacity to implement it.

# 2 Introduction

## 2.1 Problem statement and objectives

Antimicrobials have been used in intensive agri-food production systems since the 1940's as an efficient tool to control disease, increase yields, reduce labour costs and reduce economic risks for producers. Since their introduction in animal farming practices, experts have warned of their possible hazards for human health, but it was not until the 1970's that policymakers in some countries perceived the risks and took action. Varying risk perceptions, economic imperatives, and local patterns of use resulted in a global patchwork of antimicrobial regulations at that time, which became even more fragmented over the next three decades (Kirchhelle, 2018). For instance, the EU took the first steps to regulate AMU in livestock by banning growth promotors in 2003, but with the first country (Sweden) adopting this policy already in 1986[1]. This initiative led to a ban in other countries, such as the USA for example, but today, still 42 countries use AGPs according to the OIE, (2021).

Today, governments operate in entirely new contexts, which are, above all, dynamic, complex, and interdependent, as are the problems they should address. Consequently, many of the health problems that governments confront today transcend national borders and depend on a complex web of interdependences. The separation between domestic and foreign policy agendas has become blurred. The United Nations, with its universal membership, has been moving towards new models for facilitating and coordinating international engagement and governance as traditional forms of cooperation between states are challenged, supplemented and sometimes replaced by new, more flexible types of organizations, alliances and networks (Kickbusch and Gleicher, 2013). There is in fact a global interdependency in the governance of health[2], where no single country can deal alone with health problems, that have no borders.

Hence, the health care systems in many countries are still in different phases of reform and transition. Besides few good examples (some which are members of this project, described in chapter 5), not enough has yet been done to regulate for the prudent[3] use of antimicrobials, or to propose overall guidance on the use of antimicrobials. Many countries still do not have systems for surveillance of antimicrobials resistance, antimicrobial use and hospital-acquired infections, and there is still very little access to sensitivity testing to guide the use of antimicrobials. In most countries there is little education about the prudent use of antimicrobials in medical, veterinary and other health-related professions (TrACSS, 2021), leading to AM overprescribing and misuse. Furthermore, the lack of new effective drugs against bacterial infections represents an additional challenge in the perspective of increasing spread of resistant pathogens.

The increasing interconnections between countries and the globalization of trade and travel further add to the risk of importing bacteria or genes that jeopardize effective treatment or the prevention of bacterial infections, which highlights the need for international standards and data sharing. Against this background, despite the progress noticed in some EU countries, it's not irrational to consider the

[1] Although in 1986 Sweden was not an EU Member State

[2] The "governance for health" is defined as "the attempts of governments or other actors to steer communities, countries or groups of countries in the pursuit of health as integral to well-being through both whole-of-government and whole-of-society approaches" (Kickbusch and Gleicher, 2013).

[3] A specific task of the Roadmap project is devoted to discuss the meaning of "prudent use", so we will not further extend this topic under this report.

current politico-regulatory framework to fight AMR in high- (HIC), and low- and middle-income countries (LMIC) as a failure, since it proved unable to curb either antimicrobial use (AMU) or antimicrobial resistance (AMR) (Kirchhelle, (2018).

Only recently, mainly pushed by countries at the vanguard of the AMR fighting, the main international organizations related to the human, agrifood and environment health sectors took action in this regard. Since 2010 the WHO, FAO and OIE (the Tripartite organisations) started to define strategies to coordinate global activities addressing health risks at the human-animal-ecosystems interfaces. They defined a joint strategic plan and set goals to drive the policies of all countries according to the One Health approach. Thus, in 2015, the 194 WHO country members endorsed a Global Action Plan on AMR and committed in developing multisectoral National Action Plans (NAPs) based on a One Health approach within two years.

However, according to the last 2021 report (136 respondents), which monitored the country's progress on the development of the NAP, only 120 countries have achieved and completed this commitment (TrACSS, 2021), representing 90% of the global population. From these, only 27 countries have funding sources for their NAP in 2019-2020. In Europe, it is only the case for Norway, the Netherlands, Iceland, Sweden, Switzerland, Luxembourg, Croatia & Spain. The same report reveals other alarming figures. Only 76 countries have a multisectoral group to ensure a coordinated and sustained action to address AMR, while 9 have no coordination mechanism at all. Only 81 countries have laws against the use of antimicrobials for growth promotion in agriculture. 125 countries reported to have a surveillance system in place for the human sector and 74 are tracking the AMU at national level. 92 are enrolled in the WHO's Global Antimicrobial Surveillance System (GLASS). 13 countries have no national policy or legislation regarding the quality, safety and efficacy of antimicrobial products, and their distribution, sale or use. Another 45 countries have national legislation in place that covers only some aspects of optimizing use of antimicrobials in animal health. It was not asked to report about the efficacy of national regulations. This survey also reveals that while many countries now have NAPs, they may still require long-term development assistance to implement them at scale by ensuring financial sustainability.

The AMU/AMR countries' policies are found in different stages of progress, and these figures reveal the difficulties faced by countries in order to properly fight AMR as a common global threat with national and international policies and strategies. It's therefore evident the dimension of the challenge, as well as the multitude of areas for policy improvement to achieve satisfactory results at global scale. It undeniably requires a global governance for health, calling into action all stakeholders directly involved to AMU/AMR from all sectors and regions. Individual levels of commitment and perceptions of the problem, but also intricacies related to the different groups of interest, organization and infrastructure evidence the complexity of managing the AMR problem in a global scale.

The current system of global governance has no mechanisms for addressing systemic shocks or for managing globalization fairly and efficiently. Global challenges affect all people in all socioeconomic strata and geographical locations. No better (in this case worst) example than the current COVID-19 global outbreak, which although affecting different people in different degrees, has a global major impact, and could be probably avoided if the right measures would have been taken in the right moment.

The World Bank estimated that if US$3.4 billion were invested annually in One Health systems, a zoonotic disease pandemic such as COVID-19, which has a probability to occur only every 100 years and estimated as costing US$3 trillion, could have saved US$30 billion per year for the international community. In summary, for every US$3.4 billion invested annually, the return is US$30 billion (World Bank,

2008), thus substantially high benefits, not counting the spillover effects in other areas, such as poverty reduction, improved food security and safety. To this day, the final costs of the COVID-19 pandemic are still not estimated, but they would give us a complete overview of the savings from such One Health investments. In a broader perspective, the estimations from the Review on Antimicrobial Resistance (O'Neill, 2014) are in the range of 40 billion USD over a 10-year period to fight AMR. Further, the World Bank estimates that the funding needed for 60 low-income countries and 79 middle-income countries to bring their animal infection prevention and control systems up to OIE and WHO standards ranges from US$1.9 billion to US$3.4 billion per year (The World Bank, 2012).

Moreover, actions to reduce antimicrobial use in livestock production are not only coming from the political sphere. The AMR problem in food systems is also being addressed by private actors, where in several cases, even formal institutions (including regulations) are being imposed (FAO, 2020b, 2019; Grundin et al., 2020). Even further downstream in the agri-food supply chains, individuals have also started to change their purchasing habits. Mainly pushed by retailers who saw an opportunity in product differentiation (new label), an increasing number of consumers are purchasing *antibiotic free* livestock products and especially fresh meat. Such consumers would be willing to pay a premium price to buy fresh products from animals raised without the use of antibiotics (Brewer and Rojas, 2008). It's therefore observed a growing number of labels claiming antibiotic-free production emerging in EU retailers' shelves. Such demand also affects the whole supply chain's practices, where retailers start compelling their suppliers to deliver antibiotic-free products (Sneeringer et al., 2015). Thus, industry and farmers are having to adapt to these requirements and proceed with the necessary changes in their production systems[4].

Årdal et al., (2016) and Dar et al., (2016) reviewed the evidence base for national and regional policies on AMR and called for coordinated global action to support the WHO plan. According to these authors, it requires a multisector response (including the health, agriculture, and veterinary sectors), global coordination and institutional arrangements, and financing mechanisms with sufficient mandates, authority, resources, and power, as well as the direct involvement of the industry in the strategic plans.

The policies to combat AMR need to be sustained on a solid knowledge base and rely on investments in innovation and R&D (Dar et al., 2016). Wernli et al., (2017) provide an overview of global health frames relevant to analyse policies related to AMR. They argue that AMR issues can be tackled by national and international policies from five perspectives or frames such as healthcare problem, a development issue, an innovation challenge, a security issue and most importantly a One Health challenge. All these aspects and frames for tackling the issues of AMR seem legitim, but the One Health approach provides a converging way combining all of them to conceptualize and address AMR. Thus, this policy review will consider the policy mixes, regulations and strategies mostly from the animal production embedded within a One Health framework.

To contribute to a strengthening of global AMR containment, a deep comprehension of the different policy measures, strategies and goals in the various countries' contexts can shed light and bring evidence to confront the complexities of the public health systems and social challenges of AMR globally. It might help to understand which measures are better adapted and effective to the various situations and guide future policies and interventions. Aiming at contributing to such challenges, this policy review first makes an extensive descriptive list and analyses the main regulations and strategies from

[4] Here it's important to notice that "antibiotic free" is a selling label, but also all products produced with adherence to withdrawal periods are antibiotic free. These labels are further described in chapter 6.

both the public and the private sector already implemented in the countries involved in the partnership of the H2020 project ROADMAP (Rethinking of antimicrobial decision-systems in the management of animal production). By comparing the main successful policy instruments and actions, the purpose of this study is to provide policy makers and managers in the different contexts with a broad comparative inventory of policies for the design of measures to combat AMR in Europe and Globally. Different approaches have been applied, and the report is divided into four main sections:

*(i)* *Global and European strategies for a more prudent use of antimicrobials in livestock farming*

In this section, we first identify the main orientations and the global policy strategies for a more prudent AMU in livestock farming indicated by the international organizations (mainly WHO (section 4.1), FAO (section 4.2) and OIE (see section 4.3)), starting with a description of the actions taken at international level as well as the recommendations of these institutions. This provides background information and standards against which it's possible to situate countries and their progress path to fight AMR according to common aims.

We then present the European policy framework and the national strategies (see section 4.5). This section also illustrate the common institutions, regulations and strategies which are adopted on a voluntary or mandatory base at EU level. From these we can subsequently identify the countries which are pushing the standards and those followers.

In order to illustrate the policy patchwork and timeline, we further draw an evolutionary panel of the regulatory and institutional context on AMR/AMU actions implemented by the countries under analysis (see sections 4.6 and 4.7).

Finally, we introduce the EU AMR surveillance systems on humans and animals/food at EU level to situate the stage of development and rigor of the common AMR surveillance actions (see section 4.8).

*(ii)* *Policies and strategies of countries participating in the Roadmap project*

Here, we perform an AMR policy review in the Roadmaps' countries using the guidelines recently issued by the FAO (FAO, 2018, 2020a). This is the core of this report and the base for the general discussions.

This chapter begins with the self-reported assessment of the NAPs done by countries (section 5.1), followed by a presentation and summary of the main policy instruments and strategies developed in the studied countries (sections 5.2; 5.3; 5.4 and 5.5)

*(iii)* *Private standards, certification schemes and labels*

This chapter (6) brings the main industry initiatives regarding private standards, certification schemes and labels for AMU reduction in food products. It presents the actions mainly taken by retailers and processing industry alone concerning product differentiation. Besides this ultimate goal of product differentiation, it also certify the efforts of the good practices taken by the industry concerning AMU reduction, which were presented in the previous chapter.

*(iv)* *Relevant country case studies outside Europe (Mozambique and Vietnam)*

Section 7 presents further examples of policies and strategies to fight AMR from countries outside the EU and the realm of this project. These are useful to place and compare Roadmap's actions (even if Vietnam, Mozambique, and most recently the UK are outside the EU commonalities) to those adopted in other regions. It also serves to bring further innovative ideas of improvements to the debate.

Finally, this report ends in section 8 with a discussion of findings as well as the Conclusions and recommendations taken from this exercise.

## 2.2 The types of policy measures

"A policy mix can be defined as the combination of policy instruments, which interact to influence the quantity and quality of a selected policy objective" (Umpfenbach, 2015 p.20). The concept relies on the notion that multiple policy instruments combined and interacting with each other lead to a higher performance concerning the achievement of the policy objective(s) than a single instrument: in other words, for complex issues like AMR there is not a one-size-fits-all solution. Policies from the same scope as well as policies from other domains can also influence directly or indirectly the achievement of the expected outcome. Most of the efforts for mitigating AMR derived from policies and actions, which target the lowering of AMU in both human, animal or plant sectors. On the other hand, AMU is being increasingly recognized as neither a necessary nor a sufficient condition for AMR emergence, dissemination, and persistence (Noyes et al., 2021).

Thus the boundaries of a policy mix must be delimited and informed for an appropriate analysis (Umpfenbach, 2015). Such instruments should be dynamic and adaptive and well contextualized and communicated. In the context of Roadmap, and according to a specific FAO methodology (FAO, 2020a), a policy mix, and in particular the AMR-relevant legislation, is meant to address different domains influencing AMR, sectors and activities in a holistic approach, and target either:

1) Veterinary Medical Products (VMPs),
2) Animal health and production practices to prevent animal disease in terrestrial and aquatic animals,
3) Feed legislation,
4) Food Safety,
5) Institutional Coordination,
6) Pesticides,
7) Environment, Soil and Waste,
8) Water Quality,
9) Plant Health.

The scope of this report limits the police review presented next to the first five domains, which have a more direct relation to the livestock management. However the other domains might have equal, or even higher importance depending on each individual context. Noyes et al., (2021) point to the role of complex ecological and evolutionary processes that drive AMR within microbes, but also to the overlooked risks of dissemination and spread of AMR. These processes, in turn, are highly sensitive to the environment and/or host in which microbes exist, as well as to anthropogenic and intra/interhost transmission factors. It thus highlights the importance of public health infrastructure, sanitation systems, and governance as potent drivers of AMR.

A strength of policy mixes relies on the fact that the policy instruments can be complementary and sequenced over the time in order to maximize their effectiveness. Policy mixes with a long-time horizon can face a high level of uncertainty and challenges linked to government changes, socioeconomic and technological development and different stakeholders' interests. There is no obvious trend between the absolute number of instruments in a policy mix and its effectiveness. Rather, instruments can play different roles (Fedrigo-Fazio et al., 2014):

- Regulation is often the driving instrument and has proven fundamental for meeting AMU reduction targets, particularly by driving innovation.
- Governmental economic/Market-based instruments (including direct investment instruments) as core instruments have led to relative reduction in AMU.
- Cooperation or collaborative voluntary instruments are weaker but can be useful as a bridge to more ambitious instruments.
- Information tools often have high impacts on consumers and consequently the demand.

In any policy mix, several of these instruments interact to determine efficiency and fitness in achieving a reduction in AMR. The chosen instruments are generally very country specific, since some countries have greater tendency towards market-based solutions, while others more regulatory-based for instance.

Some instruments can be chosen to make the whole mix functional. In general, there are one or more core instruments, which are supported by auxiliary instruments, forming a functional mix. For example, the introduction of new taxes (core instrument) is generally preceded by voluntary agreements (auxiliary instrument) in order to facilitate the process. Information and communication instruments are also commonly used as auxiliary instruments in policy mixes. The effectiveness of some instruments might also change along the time while the context change: e.g., subsidies introduced as an enabling instrument, may become a limiting instrument if it's no longer necessary. Instruments can also change from leading to auxiliary roles, which is the case of scientific knowledge that will assume different roles depending on the policy makers' use of such knowledge. The policy mix choice is generally very context specific. It must fit in the wider governmental policies and country's plans, but also depends on the institutions in place and their capacity of monitoring and enforcement. Social, economic and environment factors also play a major role in the choice of the most suited policy mix (Fedrigo-Fazio et al., 2014).

Such instruments, alone or combined could have different impacts on the rate of innovation. These could be linked to the creation and release of new drugs, welfare, and biosecurity farming practices, or even supply chain innovations such as monitoring tools for instance. The prices of drugs, feed, buildings, machinery, etc. could also vary in function of the policy mix targeting AMR and AMU reduction. The amount of investment spent by farmers to adapt to the new regulations, and the credits made available from governments and banks to support farmers with these investments are also influenced. The products' choice or the demand from consumers seeking AB-free products, as well as the availability or supply of these products in the market will be impacted by the choice of measures. The Figure 2-1 illustrates an example of how should be the dynamic progress of measures adopted targeting a prudent AMU to place AMR at acceptable controlled levels.

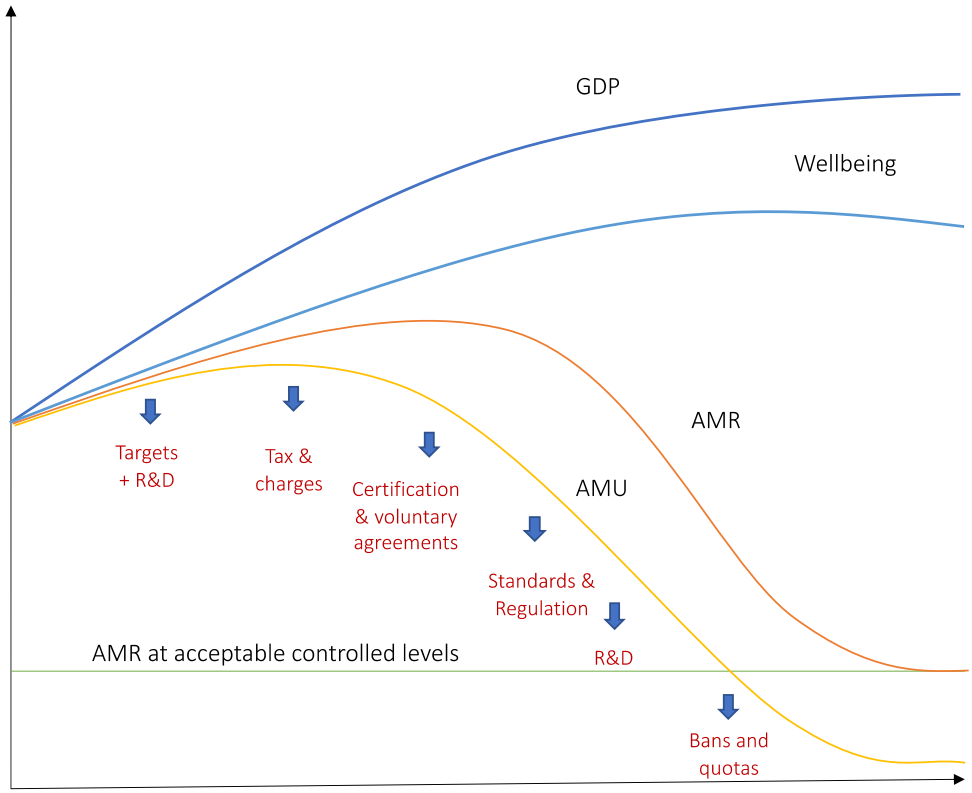


*Figure 2-1 Example of a dynamic policy mix on progress towards prudent AMU. Source: adapted from (Fedrigo-Fazio et al., 2014)*

# 3 Methodological aspects

## 3.1 Methods for reviewing the countries' policy mixes

The methods described here refer to the section " 5.2 Results Policy Domain 1: Awareness; 5.3 Results Policy Domain 2: Evidence; 5.4 Results Policy Domain 3: Practices and 5.5 Results Policy Domain 4: Governance" and " 7 Relevant country case studies outside Europe" of this document.

Different frameworks were developed recently for policy and legislation analysis and development on AMR (FAO, 2020a, 2018; Khan et al., 2020; Legido-Quigley et al., 2019). Here we use insights from that of the FAO, (2018) in order to shed light on the policy mix adopted in each country participant of the ROADMAP project. More specifically, we use the FAO (2018), categorisation of policy targeted measures, or policy domains namely awareness, evidence, practices and governance, in order to discuss the specificities of each of these for each country/region. Our purpose is to offer a broader overview, which is not focused on developing or developed countries particularly.

We conduct a policy review on AMR and AMU in the ROADMAP's countries. This review is based on a series of recently issued documents by the FAO: the FAO action plan on antimicrobial resistance 2016-2020 (FAO, 2016) and; the Antimicrobial Resistance Policy Review and development framework (FAO, 2018). This review is discussed and extended to some other countries beyond the scope of this project that have already implemented good practices related to AMU and AMR in chapter 8, as mentioned above.

Following the FAO, the policy review is divided into four policy domains (Figure 3-1). For each of the policy domain, a broad set of actions might be implemented in the country or sector, or none. They can be very preliminary or basic to very developed, multisectoral, covering the whole country. Next we give some examples of such progress path for each category.

1. **Awareness**: Improve awareness on antimicrobial resistance and related threats. Raise awareness and understanding of AMR through effective communication, education and training.

The progress on awareness actions involves: the assessment of awareness and training, identification of gaps. The development of limited AMR campaigns targeting some key stakeholders from livestock, but also from other related sectors. The AMR training courses for vets. They can progress to all regions of the country and all stakeholders and integrate the national political discussions. Finally course on AMR can become mandatory for key stakeholders and the impact of such awareness campaigns on AMU and AMR start to be monitored.

2. **Evidence**: Develop capacity for surveillance and monitoring of antimicrobial resistance and antimicrobial use in food and agriculture. Understand the extent of AMU and AMR in the food and agriculture sectors through data generation as a basis for driving action.

The progress on evidence actions involves: a preliminary understanding of the supply chain of AMU and sales and an assessment and an assessment of the laboratory and surveillance capacity as well as the development of AMU and AMR surveillance plans. Then comes the establishment of the regulatory framework for such monitoring, with data collection and reporting, the reporting of AMU sales and the beginning of AMR surveillance of bacteria in animal-food products. This is followed by the establishment of nationwide systems for monitoring of AM sales/use, specified for subsector, age, type, etc, nationwide laboratory capacity for AMR surveillance. The final step would be a full monitoring for AMU

in all sectors with benchmarking, as well as full coverage (sectorial and territorial) of the AMR surveillance.

3. **Good practices**: Promote good practices in food and agriculture systems and the prudent use of antimicrobials. Develop and support practical measures to be taken in the food and agriculture sectors to minimize the need for antimicrobials, and optimize the use of antimicrobials, to minimize or prevent the spread of AMR.
    a. Responsible use: reducing public demand and supply by prescribers and dispensers
    b. Infection prevention and control to reduce the overall need for antimicrobials

Here the standards, guidelines and codes of practice detailed in the Codex Alimentarius and the OIE Terrestrial Code and OIE Aquatic Code are also considered to assess the good practices implemented in the countries.

The progress on practices actions involves: The review of the legislation covering AMU and AMR and the promotion of initial actions to promote prudent AMU. Then comes the agreement on practices and actions to be developed at national level to promote prudent AMU. Legislation, inspection and sanctions are established to support such practices. Next the guidance plans on prudent AMU are developed at national level as well as the enforcement of the legislation. Guidelines for the HCIAS are also established. Finally, prudent AMU guidelines are available for all sectors and regular reporting on the impacts of such practices and regulations on all sectors, accounting for animal health and welfare.

4. **Governance**: Strengthen governance related to antimicrobial use and Antimicrobial Resistance in food and agriculture. Enhance political commitment, improve policy and ensure a relevant regulatory framework to provide the capacity and resources to combat AMR. Develop and implement a multi-sectoral National Action Plan on AMR.

The progress on governance actions involves: the establishment of a Multi-Sectoral Coordination Group (MCG) to be responsible for development and implementation of the National Action Plan (NAP) on AMR. Then review the existing policies and legislation on AMU and AMR and find methods for progressing. The governmental approvement of the NAP and the strategic-operational plan for implementation + funding for it. Finally, the implementation of an integrated “One Health” NAP, assessed and readjusted periodically by the MCG, supported by the legislation in place.

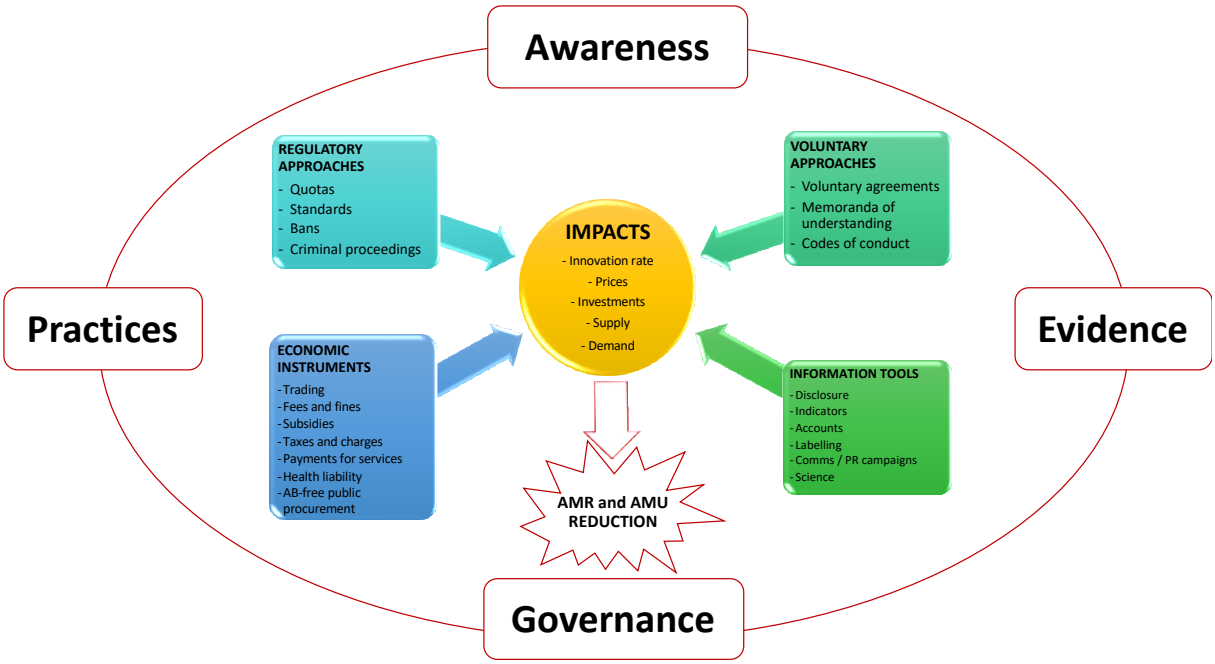


*Figure 3-1 Policy domains and Potential mix of policies. Source: own elaboration*

## 3.2 Data

A questionnaire (see Appendix 1: Questionnaires for data collection) was sent to all Roadmap's country leaders to collect the needed information on legislation and policies related to AMU and AMR, the main strategies and the eventual development of private standards in the different countries. The Roadmap's partners in each country filled the questionnaire and sent us back, together with annexed documents.

# 4 Global and European strategies for a more prudent use of antimicrobials in livestock farming

## 4.1 The Global Action Plan and the Tripartite actions on AMR

In this section we introduce the main projects and activities of the three most AMR concerned international institutions, the WHO, the OIE and the FAO. Since 2010, these intergovernmental entities have set a strategic direction, the so-called Tripartite, to coordinate global activities addressing health risks at the human-animal-ecosystems interfaces, through normative actions, communication, disease detection, risk assessment and management, capacity building and research (FAO, OIE, WHO, 2010). Already in the first year of activity, the Tripartite identified AMR as one of its first and main focus (FAO, OIE, WHO, 2017). This resulted in the coordinated development of the global action plan (GAP) on AMR, to which the individual AMR strategies of the three organizations were aligned. Issued in 2015 (Resolution WHA 68.7), the GAP is based on 5 strategic objectives (WHO, 2015):

1. improve awareness and understanding of antimicrobial resistance;
2. strengthen knowledge through surveillance and research;
3. reduce the incidence of infection;
4. optimize the use of antimicrobial agents; and
5. develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines, and other interventions.

In 2016, the GAP was endorsed by a heads of state meeting of the General Assembly of the United Nations (Resolution A/RES/71/3), who called upon the Tripartite agencies to:

- finalize a global stewardship framework supporting the development of new AM drugs, diagnostic tools, vaccines and other interventions, while preserving the existing ones;
- support the development and implementation of national action plans and AMR activities at the national, regional and global levels, in collaboration with the World Bank and other regional and multilateral development banks, intergovernmental organizations, and stakeholders;
- set an ad hoc inter-agency coordination group providing practical guidance for approaches needed to ensure a sustained effective global action to address AMR.

Meanwhile, the Tripartite had produced a manual that instructs countries to develop National Action Plans (NAPs) on AMR through an incremental approach adaptable to the specific circumstances and available resources of each state (FAO, OIE, WHO, 2016). NAPs can address areas that are cross-cutting or focus on specific, relevant sectors, depending on the individual country's needs, but should ensure consistency and compliance with existing guidance and international standards. NAPs should be aligned with the Global Action Plan and the FAO Action Plan on AMR. A series of tools and templates were also issued to accompany the manual and support the development and implementation of NAPs.The setting and implementation of NAPs at the global level is monitored by annual self-assessment surveys, whose results are stored in a freely accessible database: four surveys were carried out between 2016-2017 and 2019-2020.

In 2019, the Tripartite developed a monitoring and evaluation (M&E) framework, to assess the achievement of the GAP objectives and inform decision makers on AMR. The framework includes two parallel tracks: the first one aims at monitoring the progress of different stakeholders in implementing the GAP and supporting a collective response. The second track assesses the effectiveness of GAP implementation, including monitoring results, and evaluating impact on AMR and AMU. The framework includes indicators agreed across the Tripartite and the UNEP to be calculated and monitored at national, regional, and global levels, country level evaluations, monitoring of research and development, and a global-level independent evaluation.

The framework applicability will be tested in some targeted countries and refined periodically. The framework and the indicators are intended to support the development of relevant AMR monitoring systems in countries, help produce data for monitoring progress at the national and global level, and support strategic decision making.

## 4.2 The FAO Action Plan

Within the Tripartite strategy on AMR, the FAO plays a relevant role for its broad experience in all food and agricultural sectors and to support operatively government actions worldwide: especially where AMR-related risks in food production are most important because of inadequate legislation or lack of enforcement capacity, surveillance and monitoring systems. Furthermore, FAO is a key actor for setting and implementing the standards of the Codex Alimentarius and the International Plant Protection Convention, which imply international regulatory issues relevant for controlling AMR.

The FAO Action Plan on AMR (2016-2020) is structured on four Focus Areas (FAO, 2016):

1. Awareness: improve awareness on AMR and related threats;
2. Evidence: develop capacity for surveillance and monitoring of AMR and AMU in food and agriculture;
3. Governance: strengthen governance related to AMU and AMR in food and agriculture;
4. Practices: promote good practices in food and agriculture systems and the prudent use of AMs;

The first two FAO focus areas are directly related to the corresponding first two objectives of the GAP. The Practices area is connected with the last three GAP objectives: i.e., reduction of infection; legislation, optimization of use; sustainable investment for alternatives and reduced use. The Governance area has implications for all the five GAP objectives. Table 4-1 shows the outputs of each focus areas and their key actions. Obviously, the main targets of this plan are the livestock industry and aquaculture and related supply chains, but the crop sector is also involved in particular for the use of fungicides.

*Table 4-1 FAO Action Plan on AMR (2016-2020): Focus Areas and respective Outputs and Key actions*

| Focus Areas | Outputs and respective Key Actions |
|---|---|
| 1. Awareness | Output 1.1 Awareness on AMR is improved among food and agriculture stakeholders:<br>- Developing communication and advocacy products that reflect FAO's position and approach and are tailored to different target sectors and stakeholders.<br>- Providing support to countries to adapt and disseminate communication and advocacy products, taking into account the specific situations of individual countries/regions and of different audiences in the food and agriculture sectors.<br>- Providing support to countries to develop their own strategies and risk-communication tools for increasing awareness about AMR in food and agriculture.<br><br>Output 1.2 Consideration of AMR is integrated into policy-level discussions on food and agriculture:<br>- Advocating for the inclusion of AMR in high-level meetings (e.g. Committee on Food Security, UN General Assembly, FAO conferences, Committee on Food Security, etc.) and providing technical support to facilitate consideration of AMR in such high-level, policy-making fora.<br>- Organizing or participating in global, regional and national AMR public awareness events in partnership with other organizations (e.g. OIE, WHO, etc.).<br>- Publishing and disseminating reports indicating progress in the implementation of the FAO Action Plan on AMR. |
| 2. Evidence | Output 2.1 Knowledge on AMR and antimicrobial use in the food and agriculture sectors is improved:<br>- Developing training materials (including e-learning modules) on AMU, AMR and related surveillance and monitoring.<br>- Promoting and contributing to research or studies that aim to improve existing knowledge on AMU and AMR in the food and agriculture sectors, including transfer to/from humans and t agriculture and food production environment.<br>- Supporting the inclusion of AMU and AMR as core components of professional education, postgraduate<br><br>Output 2.2 Laboratory capacity on AMR and antimicrobial residue monitoring is improved:<br>- Developing a laboratory mapping tool to assess existing capacities for monitoring AMR and detecting antimicrobial residues.<br>- Helping strengthen national laboratory capacity to monitor AMR and detect antimicrobial residues in food products and the environment.<br>- Designating FAO reference laboratories on AMR and antimicrobial residues.<br><br>Output 2.3: Country-specific integrated surveillance/monitoring systems for AMU and AMR are developed:<br>- Developing a laboratory mapping tool to assess existing capacities for monitoring AMR and detecting antimicrobial residues.<br>- Helping strengthen national laboratory capacity to monitor AMR and detect antimicrobial residues in food products and the environment.<br>- Supporting the revision, adaptation and uptake of guidelines for integrated (food, agriculture and environment) AMR monitoring and surveillance programmes.<br>- Providing assistance to countries in preparing and implementing national plans to improve integrated surveillance and monitoring of AMU and AMR. |

| Focus Areas | Outputs and respective Key Actions |
|---|---|
| | - Conducting country-level assessments of existing systems for surveillance and monitoring of AMU and AMR in the food and agriculture sectors in order to identify need and gaps.<br>- Providing support to OIE in developing and maintaining a global database on the use of antimicrobials in animals and building on the OIE database on veterinary medicines to include production, distribution, commerce, and statistics for food and agriculture production, including commercial-sector data and marketing as well as information/data obtained through consultation with farmers and producers.<br>- Providing assistance to countries in collecting information on the use of antimicrobials in food and agriculture to support the development of systems for monitoring AMU and to link these findings to Antimicrobial Resistance.<br>- Providing assistance to countries in the collection of information on the occurrence of antimicrobials in the environment (water, soil, etc.) and the assessment of those data in terms of their potential impact on the development and spread of AMR |
| 3. Governance | Output 3.1 Information provided in support of improved policy- and decision-making:<br>- Developing studies on regulatory approaches to AMU in food and agriculture.<br>- Providing assistance to countries in the development of policies to phase out the use of antimicrobials as growth promoters.<br>- Producing case studies on the use of antimicrobials and the economic impact of a reduction in the use of antimicrobials as growth promoters when using possible alternatives.<br>- Developing a publicly accessible repository of scientific and technical information on AMR, AMU, and other data relevant to the food and agriculture sectors.<br>- Supporting the standard-setting work of the Codex Alimentarius on AMR by providing the necessary scientific advice, in collaboration with WHO and OIE as appropriate.<br><br>Output 3.2 Development and revision of regulatory frameworks supported, in line with internationally agreed principles and standards:<br>- Providing support to countries and regional organizations to revise and/or develop legislation that meets international guidelines/standards (e.g. Codex), and to strengthen national and regional regulatory capacity on AMR-related areas.<br>- Collecting, reviewing and analysing information on the implementation of existing Codex standards/guidelines related to AMU and AMR to support timely revision of international standards.<br><br>Output 3.3 Enhanced implementation of an integrated “one Health” approach to AMR:<br>- Developing a Progressive Management Pathway11 on AMR in the food and agriculture sectors and providing support to countries in its implementation.<br>- Facilitating the inclusion of AMR and its relevance to food and agriculture in “One Health” platforms and fora.<br>- Organizing, in collaboration with WHO and OIE, an international “One Health” meeting to advise on integrated AMU policies to strengthen governance relevant to addressing AMR |
| 4. Practices | Output 4.1 International standards and guidelines relevant to addressing AMR and applying good practices are adopted at country level:<br>- Supporting the development of country-level capacities for the practical implementation of international standards and guidelines related to AMR and AMU.<br>- Monitoring the adoption and use of relevant Codex standards and guidelines and other international standards/guidelines when feasible.<br>- Supporting the inclusion of considerations on AMR in the development of voluntary guidelines for sustainable agricultural production. |

| Focus Areas | Outputs and respective Key Actions |
|---|---|
| | Output 4.2 Awareness and knowledge on approaches to prudent and responsible use of antimicrobials in the food and agriculture sectors is improved:<br>- Developing and supporting the utilization of education and training materials on responsible use of antimicrobials, the importance of preventing infections in animals, biosecurity, good agricultural practices, and other measures to control the spread of resistant micro-organisms throughout the food chain and the environment.<br>- Developing and communicating recommendations (in collaboration with OIE) to improve animal health and welfare, thus reducing the need for antimicrobials (including, for example, application of effective vaccines, use of good hygiene and husbandry practices, and compliance with good agricultural practices).<br>- Developing guidance and supporting countries to improve national capacity in applying risk-based approaches to address AMR, based on the Codex recommendations.<br>- Providing countries with a comprehensive set of tools to encourage and facilitate the responsible and prudent use of antimicrobials in food and agriculture.<br>Output 4.3 Biosecurity, good practices and other measures to support prudent use of antimicrobials throughout the food chain are improved at country level:<br>- Reviewing and evaluating alternative options to the use of antimicrobials in primary production, including social and economic considerations, and developing guidance on their use.<br>- Providing assistance to countries to implement recommendations to more effectively manage the overall use of antimicrobials in livestock production and aquaculture, and of non-specific applications in treating sick animals.<br>- - Developing capacity to apply good hygiene and biosecurity practices throughout the food chain (from production to consumption) in order to reduce microbial contamination of food and the environment and to minimize the spread of AMR |

Source: FAO, 2016.

## 4.3 The OIE strategy

The OIE assets in the global strategy against AMR are mainly related to its experience in capacity building for the public animal health sector and veterinary services, and setting international standards in such fields, which include regulations and guidelines for the veterinary use of AM active compounds and other products and practices that may contribute to a more prudent AMU.

Table 4-2 summarizes the objectives of the OIE strategy on AMR and the prudent use of AMs and workplans (OIE, 2016).

*Table 4-2 The OIE strategy on AMR and the prudent use of AMs*

| Objectives | Workplans |
|---|---|
| 1. Improve awareness and understanding | - Support Member Countries through the development of targeted communications and advocacy materials designed to foster understanding of the risks of AMR in a large range of actors and encourage the adoption of measures that reduce the use of antimicrobials and slow the emergence and spread of AMR microorganisms. |

| Objectives | Workplans |
|---|---|
| | - Promote awareness of AMR more especially through Veterinary Statutory Bodies and Veterinary Education Establishments to encourage a professional culture that supports the responsible and ethical use of antimicrobial products in animals.<br>- Continue to support professional development goals by organizing and conducting workshops, conferences and symposia that promote the prudent use of antimicrobials and address the issue of AMR at global, regional and national levels.<br>- Expand the portfolio of OIE guidance, educational and scientific reference materials associated with combatting the emergence and spread of AMR microorganisms in animals while promoting good animal husbandry, vaccination and biosecurity measures to prevent diseases and limit the need for antimicrobial treatments, in collaboration with partner organisations and stakeholders.<br>- Collaborate with WHO and FAO to ensure the alignment and coordination of policy and advocacy initiatives aimed at combatting AMR |
| 2. Strengthen knowledge through surveillance and research | - Support Member Countries in developing and implementing monitoring and surveillance systems to detect and report antimicrobial use and the emergence of organisms with AMR characteristics.<br>- Build and maintain a database for collecting and holding data from Member Countries on the use of antimicrobial agents in food-producing and companion animals, with associated analysis and annual reporting.<br>- Enhance the development, use and functionality of WAHIS to ultimately allow analysis of data on antimicrobial use taking into account animal populations of each country and region.<br>- Guide and support research into alternatives to antimicrobials by working alongside partner organisations to encourage the development and uptake of new tools, products and methodologies that will reduce the dependence of animal sectors on antimicrobials and slow the emergence and spread of AMR.<br>- Identify and pursue opportunities for public-private partnerships in AMR research and risk management, working alongside and in conjunction with WHO and FAO efforts. |
| 3. Support good governance and capacity building | - Provide assistance and leadership to Member Countries as they develop and implement Nation-al Action Plans and policies governing the use of antimicrobials in animals, promoting the “One Health” approach and the interconnectedness of the health of humans, animals, plants and eco-systems.<br>- Provide tools and guidance to assist Member Countries in their AMR risk-assessment initiatives associated with antimicrobial agents and use in animals.<br>- Work alongside Member Countries to ensure Veterinary Services have the capacity to implement OIE standards, taking advantage of their engagement in the OIE PVS Pathway.<br>- Support Member Countries to develop and modernize legislation governing the manufacture, marketing authorisation, importation, distribution and use of veterinary products.<br>- Engage Member Countries through regular training of Focal Points on Veterinary Products, establishing direct links and support processes.<br>- Ensure that well-trained veterinarians and veterinary paraprofessionals are at the forefront of national and regional efforts to improve animal health and welfare and the stewardship of antimicrobial products through training initiatives at international, regional and national workshops and conferences |

| Objectives | Workplans |
|---|---|
| 4. Encourage implementation of international standards | - Support individual Member Countries in their efforts to implement OIE international standards for prudent use of antimicrobials and to combat AMR in animals taking into account their respective social, economic and cultural circumstances.<br>- Disseminate and encourage adoption of the recommendations in the OIE List of Antimicrobials of Veterinary Importance.<br>- Strengthen multilateral support for implementation of OIE standards among policymakers, our cooperation partners and donors to contribute to a well-coordinated international effort in the fight against AMR.<br>- Build on the success of the OIE standards development work programme to continue to advance for the animal sectors our comprehensive framework of quality, science-based standards that support the Global Action Plan on AMR.<br>- Collaborate with WHO and FAO to support the development of a comprehensive and aligned framework of international standards and guidelines across human health, animal health, agriculture and the food chain |

Source: OIE, 2016.

## 4.4 Other actions of the Tripartite organizations and other institutions related to AMR control in livestock production

The WHO and the OIE promoted various initiatives to prevent the overuse of critically important AMs, as well as to restrict their use in animals, which are key elements for the preservation of the benefits of AMs. The WHO set a list of Critically Important AMs for human medicine, which classifies and ranks AMs according to criteria such as importance for human treatments, availability of alternatives, cross-resistance selection and frequency of use (WHO, 2019a). This ranking facilitates focusing management efforts, such as restrictions on usage or bans for animal use of AM active principles relevant for human health (e.g., fluoroquinolones, macrolides and 3rd-4th generation cephalosporins) to avoid selection of AM resistant pathogens.

WHO also publishes the WHO Model List of Essential Medicines, which includes categorizations of various antimicrobials into the groups of Access, Watch, and Reserve antimicrobials (AWaRe)[5] as part of the 2017 Essential Medicines List (WHO, 2019b):

- Access antimicrobials are typically used as first line or second line therapies and should be widely available at an affordable cost and of high quality.
- Watch antimicrobials are recommended only for specific indications due to their higher antimicrobial resistance potential.
- Reserve antimicrobials include antimicrobials of last resort, the use of which needs to be highly tailored and monitored to avoid the emergence of resistance to these antimicrobials.

With this categorization, the WHO defined a national-level target of at least 60% of total antimicrobial consumption being in the Access category by 2023.

[5] The category of 'Not Recommended' antimicrobials was added to the framework, encompassing inappropriate fixed dose combinations of antimicrobials that could exacerbate antimicrobial resistance and raise concerns about enhanced toxicity.

The FAO and WHO also established, in 1963 the Codex Alimentarius. It reassembles and defines the international food standards, guidelines and codes of practice developed by the Codex Alimentarius Commission (CAC), which are the international reference standards for food safety, from primary production to consumption and for the purposes of the safety, quality and fairness of international food trade. The CAC is addressing issues of foodborne AMR since 2005, and in 2015 it released the Codex texts on foodborne AMR in support of the Global Action Plan (FAO and WHO, 2015). The CAC established a Task Force on AMR to provide science-based guidance[6] in 2017, and the CAC also approves maximum residue levels (MRLs) for VMPs[7].

The Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) encourages the members of the World Trade Organization (WTO) to base their sanitary measures on international standards, guidelines and recommendations, where they exist. The OIE is the WTO reference organisation for standards relating to animal health and zoonoses, but it has also developed standards related to animal welfare, animal production, VMPs and AMR. Since 2002, the OIE established a permanent Working Group on Animal Production Food Safety (APFSWG) to coordinate its food safety activities. The Working Group's members include experts from the FAO, the WHO and the CAC. The OIE cooperation with the CAC is essential in the provision to governments and other interested parties with consistent, coherent and complementary advice on the management of food safety risks from the farm to the fork.

In this regard, the OIE publishes the International Standards (OIE, 2020) with two codes (Terrestrial and Aquatic) and two manuals (Terrestrial and Aquatic) as the main reference for WTO members. The OIE Terrestrial Animal Health Code (the Terrestrial Code) provides standards for the improvement of animal health and welfare and veterinary public health worldwide, including through standards for safe international trade in terrestrial animals (mammals, reptiles, birds and bees) and their products. The OIE Aquatic Animal Health Code (the Aquatic Code) provides standards for the improvement of aquatic animal health worldwide. It also includes standards for the welfare of farmed fish and use of antimicrobial agents in aquatic animals.

The health and sanitary measures in these Codes should be used by the Veterinary Authorities of importing and exporting countries to provide for early detection, reporting and control agents that are pathogenic to animals or humans, and to prevent their transfer via international trade in animals and animal products, while avoiding unjustified sanitary barriers to trade (OIE, 2020). The manuals offer guidance on animal diseases, VMPs, veterinary public health, AMU and chapters covering specifically AMR. In the area of veterinary medicine, the OIE has developed the List of AM Agents of Veterinary Importance, categorizing AM agents used in food-producing animals as Veterinary Critically Important AMs, Veterinary Highly Important AMs and Veterinary Important AMs (OIE, 2019).

Besides these international organizations, we can also find country level initiatives that have a global reach. This is the case of PREDICT, a project of USAID's Emerging Pandemic Threats (EPT) program, that was initiated in 2009 to strengthen global capacity for detection of viruses with pandemic potential that can move between animals and people.

[6] Ad hoc Codex Intergovernmental Task Force on Antimicrobial Resistance (TFAMR): http://www.fao.org/fao-who-codexalimentarius/committees/committee/en/?committee=TFAMR

[7] Index of Veterinary drugs: http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/vetdrugs/veterinary-drugs/en/

## 4.5 The European policy framework and strategies

Concerns about a continuous, low dose use of antimicrobials in animal feed without any veterinary prescription for the purpose of improving growth and feed conversion in production animals (antimicrobial growth promoters, AGPs) were raised in several European countries soon after the approval of such use back in the early 1950s (Cogliani et al., 2011). These concerns led to a report issued by the Swann Committee[8] established by the British government in 1969 and calling for restricted use of AGP due to the risk of resistance development.

The Swann report argued that antimicrobials in livestock, particularly in subtherapeutic doses, may imply certain hazards to human and animal health and that only antimicrobials which have little, or no application as therapeutic agents should be used as AGPs. The report conclusions contributed to the first limitations on the use of antimicrobials as AGPs in the European Community with the Council Directive 70/524/EEC on additives in feeding-stuffs. This was the first harmonization among the European Community's countries of legislations on medicated animal feed. However, the Directive did not include provisions to withdraw authorizations in the case that antimicrobials allowed as AGPs came into use for human health care at a later time (Wegener, 2003).

Sweden introduced a legislation to ban the use of antimicrobials as AGPs in 1986, being the first country in the world. In 1995, with the EU enlargement to Sweden, the pressures for a more prudent use of antibiotics in European farms intensified. In 1995, Denmark, Norway and Germany rose concern that the use of AGP Avoparcin in animal feed could encourage resistance to certain antimicrobials used in human medicine. On this basis, avoparcin was banned in Denmark in May 1995, in Norway in June 1995, in Germany in January 1996, and finally in all countries of the European Union in April 1997. Finally, in 2003 the Regulation 1831/2003/EC on Feed Additives phased out the use of antimicrobials as AGPs in the EU, by setting a total ban from the year 2006, twenty years after Sweden. This decision was significantly influenced by the scientific opinion issued in 1999 by the European Commission's Scientific Steering Committee (SSC) about the prevalence and development of antimicrobial resistance and its implications for human and animal health.

Since 1998, the European Antimicrobial Resistance (AMR) Surveillance Network (EARS-Net), now run by the European Centre for Disease Prevention and Control (ECDC), has been collecting information from all EU countries regarding invasive bacteria isolated from blood and cerebrospinal fluid in hospitalised patients. In 2001, the European Council issued a Community Strategy against AMR in human health care calling for initiatives in surveillance, research, prevention and international cooperation This led to the adoption of EU recommendations and guidelines and the development by EU member states of national action plans focusing on human health

During the years 2000, potential hazards from AMR originated by AMU in farms were under growing attention and finally included in the 2011-2016 European Action plan against the rising threats from Antimicrobial Resistance (COM(2011)748), as well as in the following One Health Action Plan against Antimicrobial Resistance of 2017 (COM(2017)0339).

The 2017 action plan builds on three main pillars:

[8] Report of Joint Committee on the Use of Antimicrobials in Animal Husbandry and Veterinary Medicine (Swann Committee, Her Majesty's Stationery Office, London, September 1969).

i. making the EU a best practice region by improving evidence, coordination and surveillance, and control measures on AMU and AMR;

ii. boosting research, development and innovation by closing current knowledge gaps, providing novel solutions and tools to prevent and treat infectious diseases, and improving diagnosis in order to control AMR spread;

iii. intensifying EU efforts worldwide to shape the global agenda on AMR and related risks.

Since the implementation of the 2017 Action Plan, important updates have been made to further strengthen the EU response to AMR, for example:

- and the new Regulation (EU) 2019/6 on veterinary medicinal products and the new Regulation (EU) 2019/4 on medicated feeds;
- the Strategic Approach to Pharmaceuticals in the Environment (PiE) in 2019 (COM(2019)128);
- the Pharmaceutical Strategy for Europe in 2020 (COM(2020)761);
- the Farm to Fork strategy's target, set in 2020, to reduce to reduce by 50% of the overall EU sales of antimicrobials for farmed animals and aquaculture by 2030 (COM(2020)381);
- the Commission Implementing Decision (EU) 2020/1729 on the monitoring and reporting of antimicrobial resistance in zoonotic and commensal bacteria;
- the public consultation on the creation of the EU Health Emergency Preparedness and Response Authority (HERA) in 2021;
- the EU4Health Programme 2021-2027 ;

The EU member States provide several examples of recent action at a national and regional level in the fight against AMR. The leading intergovernmental organizations and the EU have launched policy strategies that target a more prudent use of AMs in both the human and the veterinary medicine to face the rising threat of AM resistance. This includes more attentive monitoring on the use of AMs in humans and animals, the spread of infections from resistant bacteria, and the presence of resistant zoonotic and commensal bacteria in animal farms and along the food supply chain. To raise awareness about this issue, the European Centre for Disease Prevention and Control (ECDC) founded the European Antimicrobial Awareness Day (EAAD) which aims to provide a platform and support for national campaigns about prudent antimicrobial use. Over the years, European Antimicrobial Awareness Day - marked annually in November together with the World Antimicrobial Awareness Week organised by WHO - has developed into a platform of global reach, partnering up with many countries outside the EU as well as relevant stakeholders, in line with the Commission's "One-Health" approach to AMR.

As an example of legislative action, to promote harmonized monitoring of AMR in zoonotic and commensal bacteria in the food chain, the EU passed Decision 2013/652/EU. In this Decision, the European Commission identifies the European Medicines Agency (EMA) as the lead agency in the collection of data on sales of veterinary antimicrobial agents in the member states. To ensure an integrated approach, the Decision stipulates that the EMA consult with stakeholders including the ECDC, EFSA and the European Community Reference Laboratory for Antimicrobial Resistance (EURL-AMR). The new legislation ensures harmonized monitoring systems in Europe, fosters comparability between the member states and between the human and veterinary sectors, and facilitates the monitoring of patterns of multi-drug resistance. In addition, the European Surveillance of Veterinary Antimicrobial Con-

sumption (ESVAC) project collects information on how antimicrobial medicines are consumed in animals across the EU (EFSA/ECDC, 2020) (Figure 5-2). Individual EU member countries provide examples of effective policy implementation to monitor AMU (see chapter 5.3 Results Policy Domain 2: Evidence) and AMU benchmarking systems for farmers and veterinarians to reduce the overall use of AMs in food production (e.g. yellow card in Denmark, mandatory targets in the Netherlands).

Legislation in European countries has been very concerned with limiting the veterinary use of critically important AMs (CIAs) to situations where they are the last resort. In some countries, certain CIAs (e.g. 3rd, 4th and 5th generation cephalosporins, fluoroquinolones, macrolides, colistin) have been limited to culture-proven infections, or have been subject to special taxation. Several new EU regulations on veterinary medicinal products are to be incorporated in national legislation by 2022. The implementation of Regulation (EU) 2019/6 is most important in this respect, as this Regulation sets out rules regarding the placing on the market, manufacturing, import, export, supply, distribution, pharmacovigilance, control and use of veterinary medicinal products. As a result of the implementation of this Regulation, the countries will have to expand their monitoring efforts as they will also have to monitor the use of antifungals, antiprotozoals, antivirals and topical antimicrobials at livestock farms. Implementation of this regulation also means that in addition to data on the amounts of antimicrobials used in food-producing animal species, data will also have to be collected for other animals which are bred or kept, including animals kept in other sectors than food production (e.g. companion animals). This means data on antimicrobial veterinary products used in companion animals will have to be collected from the party supplying the antimicrobials (the veterinarian or pharmacy).

The objective of the EU policy is not to phase out AMs from animal production but guide farmers to a more cautious utilization by reducing as much as possible prophylactic and metaphylactic treatments and controlling tighter the prescription, marketing, storage and administration of these medicines, especially the active principles of critical importance for human health. To achieve this partial decoupling of livestock farming from AM use, the EU is deploying a mix of measures that include: (i) new stricter regulations on AM use and traceability, (ii) the monitoring of AM use and presence of AM resistant micro-organisms in farms, environment, and the supply chain, (iii) awareness campaigns addressed to farmers, other stakeholders and the general public, (iv) incentives to the improvement of biosecurity, alternative treatments in farms, and the development of private standards related to AM use in livestock production, (vi) training for farmers and veterinarians, (vii) finance to scientific research, (viii) and coordinated initiatives at the global level. The current situation of AM policies at the level of the EU Member States is however quite inhomogeneous: in some countries, the national legislation is already complying with the new EU measures and is even stricter for some aspects, while other countries are likely to have problems for respecting the first deadlines for implementation expiring in 2022 (see next chapters).

## 4.6 Historical Evolution of Policies in EU and Roadmap's countries

Figure 4-1 and Figure 4-2 show the timeline of AMR related policies in Europe and the Roadmap countries respectively. Figure 4-2 shows an overview of the full table that can be found in the annexed to this document.

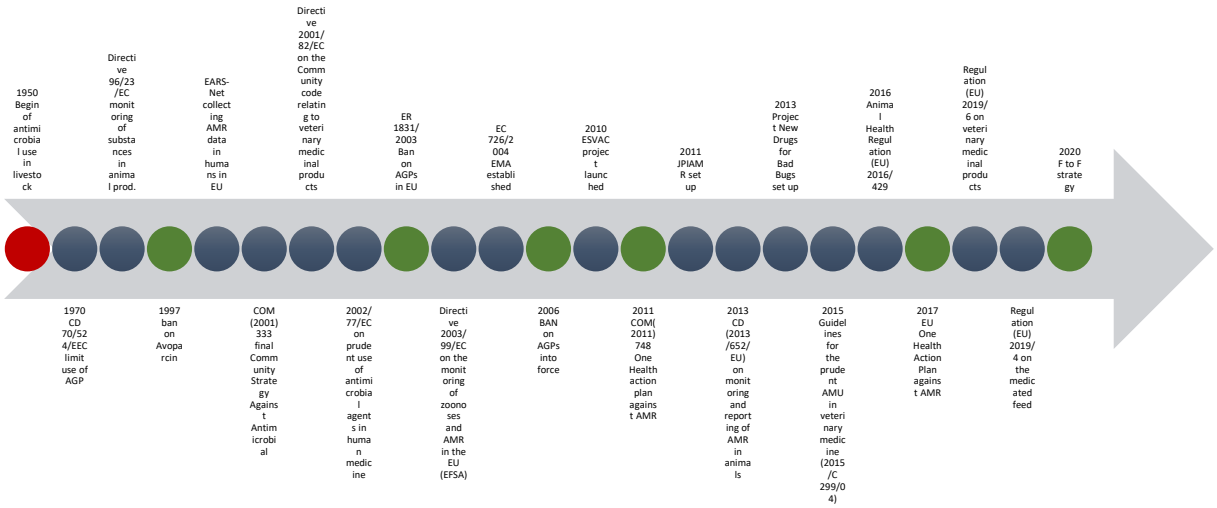


*Figure 4-1 EU main policies against AMR timeline (green dots highlight the main milestones)*

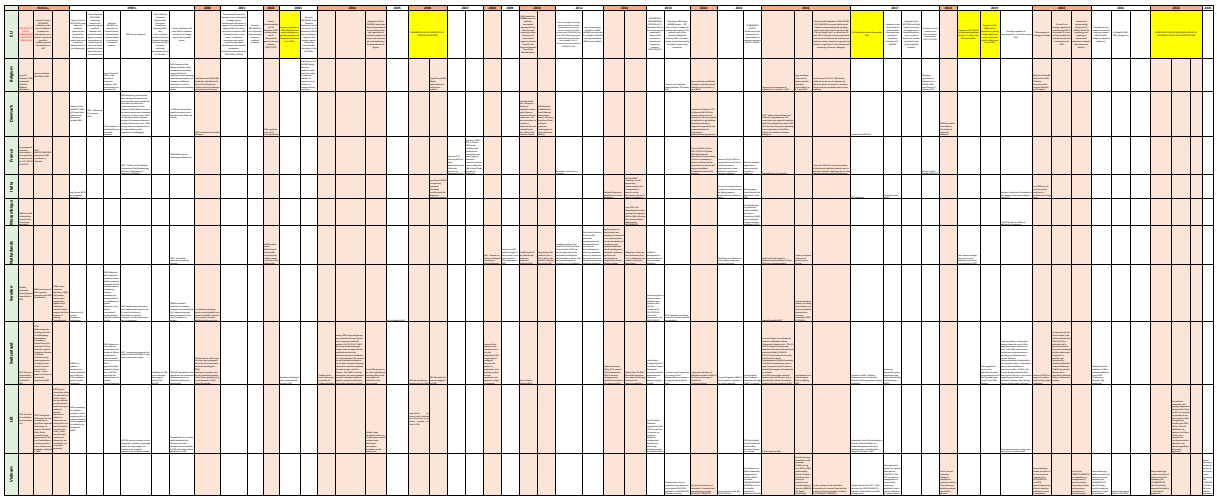

*Figure 4-2 AMR/AMU Policy timeline - EU and Roadmap countries (see the excel table annexed)*

## 4.7 Timing of EU and Global strategies

In this section we could observe that the main actions and concerns for the issues of AMR in livestock production at global level have risen after 2010, with the creation of the Tripartite organization. It's however important to notice that such concerns dates back to the 60s and 70s in individual EU countries and subsequently by the Union (the EU common institutions). Some countries were/are in the vanguard of these actions, such as Sweden, Denmark, Norway and UK for instance, and have driven the common actions at the Union level during the late 80s, 90s and 2000s. Measures were gradually being introduced in all the EU member states. Further restrictions, guidelines and good practices were/are progressively introduced as well. Monitoring institutes and methods are also been standardized and further budget for individual and common actions available.

Such EU concerns and actions have raised the attention for the problem at international level. AMR was then recognized as a global threat in the 2009 USA – EU Summit Declaration and the Transatlantic

Taskforce on Antimicrobial Resistance (TATFAR) was created to address these questions. This consequently led to the establishment of the tripartite organization in 2010 in order to develop a global strategy against AMR, going beyond the borders of USA and EU. In 2011 the European strategic action plan on antimicrobial resistance was published. In 2015 the Global Action Plan was launched by the tripartite highlighting the importance of a One Health approach to fight AMR. This was followed by the 2017 EU One Health Action Plan against AMR.

Since the creation of the tripartite organization, the AMR concerns reached a global level and governments are dedicating increased attention and resources. Until the creation of the tripartite, the EU and some of its individual members were driving the global concerns to the AMR problem, but since then the strategic leadership has been shared, and countries like USA and Japan are also assuming important roles in this matter. The direction of influence between the tripartite and the EU is also blurred, with new recommendations, guidelines, policies, tools, etc. regularly popping up from both sides. The tripartite has no legislative power and the coordination of actions at global level, such as monitoring, guidelines, recommendations, etc., especially those concerning LMICs, can be extremely more complex than actions at the EU level, where most members are HICs, and its institutions have resources and authority to develop such actions.

## 4.8 AMR surveillance system in EU

### 4.8.1 AMR surveillance system in Animals and Food

The EU system for the monitoring of zoonoses was established in 1992 (Directive 92/117/EEC). It was improved through better data comparability and monitoring of additional zoonoses, of antimicrobial resistance (in e.g. in *salmonella* and *campylobacter)* and of foodborne outbreaks in 2003 (Directive 2003/99/EC). The first report based on such data was published by European Food Safety Authority (EFSA) in 2004. In 2013 , detailed rules were set for the harmonised monitoring and reporting of antimicrobial resistance in several bacteria obtained from samples from certain food-producing animal populations by the Member States (Decision 2013/652/EU) and EFSA and European Centre for Disease Prevention and Control (ECDC) jointly published The European Union Summary Report on Antimicrobial Resistance in zoonotic and indicator bacteria from humans, animals and food. In 2020 the European Commission proposed to lay down new technical requirements for AMR monitoring and reporting, applicable as from 1 January 2021 in the Commission Implementing Decision 2020/1729 of 17 November 2020. This lays down specific technical requirements, for the period 2021–2027, for AMR testing and reporting in representative isolates deriving from randomised sampling in food-producing animals performed at farm and/or at slaughter and derived meat performed at retail and at border control posts. They address known implementation issues while scientifically responding to the constantly evolving threat of AMR and ensuring continuity in assessing future trends in AMR after 2020.

The collection and reporting of data are performed at the isolate level, to enable analyses on the occurrence and traits of multidrug resistance. Representative random sampling is performed according to the legislation and the technical specifications issued by EFSA in 2014. Monitoring of AMR in food-producing animals is performed in domestically produced animal populations, corresponding to different production types with the aim of collecting data that could be combined with those on exposure to antimicrobials (European Food Safety Authority and European Centre for Disease Prevention and Control, 2021).

Microdilution methods for testing should be used and results should be interpreted by the application of European Committee on Antimicrobial Susceptibility Testing (EUCAST) epidemiological cut-off (ECOFF) values for the interpretation of 'microbiological' resistance. The harmonised panels of antimicrobials used for Salmonella, Campylobacter and indicator E. coli include substances that either are important for human health, such as critically important antimicrobials (CIAs), or can provide clearer insight into the resistance mechanisms involved. The concentration ranges to be used embrace both the ECOFF and the clinical breakpoints (CBPs), as defined by EUCAST, allowing the comparability of results with human data (European Food Safety Authority and European Centre for Disease Prevention and Control, 2021).

### 4.8.2 AMR surveillance system in Humans

The European Antimicrobial Resistance Surveillance Network (EARS-Net) is the main EU surveillance system for AMR in bacteria that cause serious infections. It defines protocols for guiding the national surveillance systems in the AMR data analysis and collection. All 28 EU Member States and two EEA countries (Iceland and Norway) participate in EARS-Net. The European Committee on Antimicrobial Susceptibility Testing (EUCAST) provides guidelines for antibacterial susceptibility testing (AST), which are adopted by around 89% of the countries' laboratories of the EARS-Net. EARS-Net also conducts external quality assessment on these laboratories. Both EUCAST standard AST guidelines and EARS-Net laboratory quality assessments contribute to improved data quality and reporting comparable AMR data among the different countries. Through the EARS-Net, the ECDC collected data from eight species under surveillance from 30 European countries. The species are: Klebsiella pneumoniae; Acinetobacter spp.; Escherichia coli; Enterococcus faecalis; Enterococcus faecium; Staphylococcus aureus; Streptococcus pneumoniae; Pseudomonas aeruginosa.

To improve comparability, only data from invasive isolates are included in EARS-Net. The EARS-Net protocol also defines the panels of species/antimicrobial agents' combinations under surveillance. EUCAST guidelines also describe the mechanisms of resistance and recommend methods of detection. An isolate can be considered resistant to an antimicrobial agent in accordance with a clinical breakpoint generally defined by the EUCAST. In its reports, ECDC also provides indicators of the population coverage, data representativeness and comparability for means of data validity and reliability (see criteria in the ECDC AMR 2018 report). Such indicators are summarized in Table 4-3.

*Table 4-3 Indicators of population coverage, representativeness and laboratories in ROADMAP's European countries*

| Country | Belgium | Denmark | France | Italy | Netherlands | Spain | Sweden | United Kingdom |
|---|---|---|---|---|---|---|---|---|
| National institutions/organisations participating in EARS-Net | Sciensano | Statens Serum Institut \| Danish Study Group for Antimicrobial Resistance Surveillance (DANRES) | Santé Publique France, \| French National Observatory for the Epidemiology of Bacterial Resistance to Antimicrobials (ONERBA) through 3 participating networks: Azay-Résistance, Île-de-France, Réussir networks \| National Reference Centre for Pneumococci | National Institute of Health | National Institute for Public Health and the Environment | Health Institute Carlos III, \| National Centre for Microbiology | The Public Health Agency of Sweden | Public Health England, \| Health Protection Scotland, \| Public Health Agency Northern Ireland \| Public Health Wales, |
| Percentage laboratories participating in EARS-Net EQA | 82 | 82 | 71 | 95 | 92 | 95 | 100 | 82 |
| Percentage laboratories using EUCAST or EUCAST harmonised guidelines | 91 | 100 | 100 | 100 | 100 | 71 | 100 | 100 |
| Year 2018, or specified | 2017 | | | | | 2017 | | |
| Estimated national population coverage (%) | 30 | 100 | 21 | 36 | 65 | 37 | 51 | Unknown |
| Population sample representativeness | High | High | High | High | High | High | High | Medium |
| Hospital sample representativeness | High | High | High | High | High | High | High | High |
| Blood culture sets/1000 patient-days | 99,1 | 142,9 | 105,2 | 55,4 | Unknown | Unknown | 107 | Unknown |
| Isolate sample representativeness | High | High | High | High | High | High | High | High |

The Percentage laboratories participating in EARS-Net external quality assessment for all ROADMAP's countries in 2018 ranges from 71% in France to 100% in Sweden. The Percentage laboratories using EUCAST or EUCAST harmonized guidelines for all ROADMAP's countries in 2018 ranges from 71% in Spain to 100% in most of other countries. The population sample representativeness is high for all countries but UK and the estimated national coverage varies from 21% in France to 100% in Denmark.

# 5 The ROADMAP's countries policies and strategies

## 5.1 National Action Plan (NAP) on AMR progress development

In this section we perform a comparison of the stage of development of the NAPs from the project's countries using the FAO et al., (2018) report on "Monitoring global progress on addressing antimicrobial resistance", data from the Global Database for the Tripartite Antimicrobial Resistance (AMR) and the Country Self-assessment Survey (TrACSS) 2019/20. This information is used to illustrate each of the sections: awareness, evidence, practices, and governance with indicators self-assessed by those countries. Further eight countries from outside the Roadmap project are also considered for the comparability of results. The countries' choice is based on criteria such as being a global and EU important livestock producer and the geographic location, where different continents were prioritized. The chosen countries are Argentina, Australia, Brazil, Germany, India, Japan, Spain and USA. See in Appendix 2: Links to countries' AMR NAPs, the links to the websites containing the countries NAPs.

In the TrACSS 2019-2020, the countries' responses vary from A to E, or 'Yes' or 'No' depending on the question. As an exercise of countries comparison, we simply attributed a scale of scores varying from 1 to 5 according to the responses, with 'A' receiving the lowest score and 'E' the highest 5, and also attributing scores to answers 'Yes' and 'No', as the following scoring scale:

| E = | D = | C = | B = | A = | YES = | NO = |
|---|---|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 | 3 | 0 |

The scores were just accounted for the thirteen parameters discussed here in this report, which are related to food and animal production on actions related to awareness, evidence, practices, and governance. Others related to human, plants, and environment were not considered. Although simplistic, such scoring gives an idea of comparability among countries and somehow reflects their progress related to AMU and AMR control. The main results are reported in Table 5-1 and Figure 5-1 below. The detailed responses for the assessed parameters are presented in the sequence.

*Table 5-1 Attributed scores TrACSS (top) and scores map (bottom)*

| | ROADMAP Countries | Denmark | Netherlands | Sweden | Belgium | France | Switzerland | Italy | UK | Vietnam | Mozambique | ROADMAP | Japan | Germany | Spain | USA | Australia | Argentina | Brazil | India |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Score TrACSS | 58 | 55 | 53 | 52 | 51 | 50 | 47 | 45 | 33 | N.A | 84% | 54 | 52 | 51 | 50 | 41 | 33 | 32 | 32 |
| | % of Max score | 98% | 93% | 90% | 88% | 86% | 85% | 80% | 76% | 56% | | | 92% | 88% | 86% | 85% | 69% | 56% | 54% | 54% |
| Awareness | 1) Progress on actions for raising awareness and understanding of AMR risks and response | 5 | 5 | 5 | 4 | 5 | 4 | 4 | 4 | 3 | | 75% | 5 | 4 | 5 | 4 | 4 | 3 | 3 | 3 |
| | 2) Training and professional education on AMR in the veterinary sector | 5 | 5 | 4 | 4 | 5 | 4 | 4 | 4 | 2 | | | 4 | 5 | 5 | 5 | 4 | 2 | 3 | 3 |
| | 3) Training and professional education on AMR in farming sector (animal and plant), food production, food safety and the environment | 5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | | | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 1 |
| Evidence | 4) National monitoring system for antimicrobials intended to be used (AMU) in animals (terrestrial and aquatic) (sales/use) | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 4 | 2 | | 87% | 4 | 4 | 3 | 3 | 3 | 4 | 3 | 1 |
| | 5) National surveillance system for antimicrobial resistance (AMR) in animals (terrestrial and aquatic), | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | | | 5 | 5 | 5 | 5 | 4 | 4 | 2 | 4 |
| | 6) Level of the standardization and harmonization of procedures among laboratories included in the AMR surveillance system | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 2 | 1 | | | 5 | 5 | 2 | 4 | 2 | 2 | 1 | 2 |
| Practices | 7) Country has laws or regulations on prescription and sale of antimicrobials for animal use | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | 93% | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | 8) Country has laws or regulations that prohibits the use of antimicrobials for growth promotion in the absence of risk analysis | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | 3 | 3 | 0 | 3 | 3 |
| | 9) Good health, management and hygiene practices to reduce the use of antimicrobials and minimize development and transmission of AMR in animal production (terrestrial and aquatic) | 5 | 5 | 5 | 5 | 5 | 2 | 4 | 3 | 4 | | | 5 | 3 | 5 | 4 | 3 | 3 | 3 | 2 |
| | 10) Optimizing antimicrobial use in animal health (terrestrial and aquatic) | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 3 | | | 5 | 5 | 5 | 3 | 3 | 3 | 3 | 3 |
| Governance | 11) Progress stage of the Multi-sector and One Health collaboration/coordination | 5 | 5 | 5 | 4 | 5 | 5 | 3 | 5 | 2 | | 78% | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 3 |
| | 12) Progress with the development of a NAP on AMR | 4 | 5 | 5 | 3 | 4 | 5 | 4 | 4 | 4 | | | 5 | 4 | 5 | 5 | 4 | 3 | 4 | 4 |
| | 13) Is the country using relevant antimicrobial consumption/use and/or antimicrobial resistance data to amend national strategy and/or inform decision making, atleast annually [Animal heath (terrestrial and aquatic=1; food production=1 and food safety=1)] | 3 | 1 | 1 | 3 | 0 | 3 | 1 | 1 | 1 | | | 3 | 3 | 3 | 3 | 1 | 1 | 0 | 0 |
| | ESVAC (sales in mg/PCU) 2018 | 38,2 | 57,5 | 12,5 | 113,1 | 64,2 | 40,2 | 244,0 | 29,5 | | | | | 88,4 | 219,2 | | | | | |
| | TrACSS weighted by ESVAC (sales in mg/PCU) 2018 | 1,52 | 0,96 | 4,24 | 0,46 | 0,79 | 1,24 | 0,19 | 1,53 | | | | | 0,59 | 0,23 | | | | | |

Mozambique did not send back the 2019-2020 survey responded. When evaluated the TrACSS scores, the ranking reflects Denmark in the first position, followed by Netherlands and Sweden. UK and Vietnam show the lowest performances. The ROADMAP countries achieved a global score of 84% (of the possible maximum) together. The categories of practices and evidence are the two best performing categories for the ROADMAP countries, which achieved together 93% and 87% respectively. In "evidence" the main problems found are related to the harmonization of procedures among laboratories. The categories of governance and awareness are the least performing for the ROADMAP countries, with scores of 78% and 75% respectively. In "governance" the main problems are related to the usage of data for the decision making and strategy. The NAPs on AMR progress development also seems to lower the scores. In the category "awareness" the major issues are related to the training and professional education on AMR of people in farming, environment, food production and safety sectors, but also in the veterinary sector in some countries.

If considered the sales of veterinarian antimicrobials (data from ESVAC 2018 only for European countries) as a weighting factor[9] for the countries' scores, interestingly Sweden moves to the first position, followed by UK and Denmark. Switzerland jumps to the fourth position, then Netherlands, France, Belgium, and Italy closes the ranking.

[9] Dividing the Total Score TrACSS score / Sales in mg/PCU

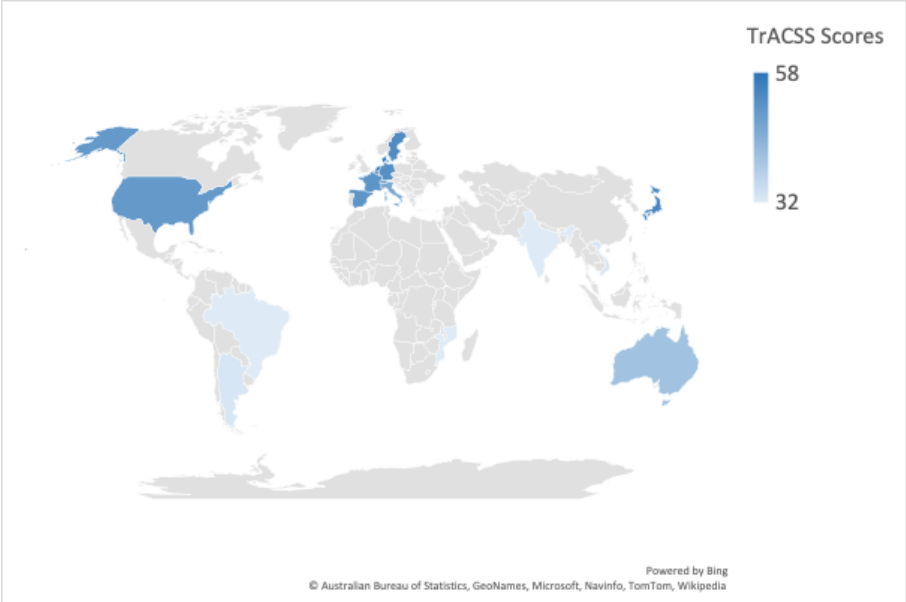


*Figure 5-1 Map of assessed countries with scale of scores*

### 5.1.1 Awareness on NAPs: How the countries evaluated themselves

1) **Progress on actions for raising awareness and understanding of AMR risks and response**:

E - Targeted, nationwide government-supported activities regularly implemented to change behavior of key stakeholders within sectors, with monitoring undertaken over the last 2-5 years = 5 points

D - Nationwide, government-supported antimicrobial resistance awareness campaign targeting all or the majority of priority stakeholder groups, based on stakeholder analysis, utilizing targeted messaging accordingly within sectors = 4 points

C - Limited or small-scale antimicrobial resistance awareness campaign targeting some but not all relevant stakeholders = 3 points

2) The **training and professional education on AMR in the veterinary sector**:

E - AMR is systematically and formally incorporated in curricula for graduating veterinarians and veterinary paraprofessionals and continuing professional training is a formal requirement = 5 points

D - Continuing professional training on antimicrobial resistance and antimicrobial use is available nationwide for veterinary related professionals = 4 points

C - AMR and prudent use of antimicrobial agents are covered in core curricula for graduating veterinarians and for veterinary paraprofessionals in some educational institutions = 3 points

B - Ad hoc AMR training courses available for veterinary related professional = 2 points

3) T**raining and professional education on AMR in farming sector (animal and plant), food production, food safety and the environment**:

E - Tailored AMR training courses are routinely available nationwide and completion of training is a formal requirement for all key stakeholders = 5 points

C - Tailored ad hoc AMR training courses are available for all or the majority of key stakeholders = 3 points

B - Tailored ad hoc AMR training courses available for at least two groups of key stakeholders = 2 points

A - No training provision on AMR for key stakeholders, e.g. farmers and farm workers, extension workers, food and feed processors and retailers, environmental specialists = 1 point

### 5.1.2 Evidence on NAPs: How the countries evaluated themselves

4) The **national monitoring system for antimicrobials intended to be used (AMU) in animals (terrestrial and aquatic) (sales/use)**:

E - Data on antimicrobials used under veterinary supervision in animals are available at farm level, for individual animal species = 5 points

D - On a regular basis, data is collected and reported to the OIE on the total quantity of antimicrobials sold for/used in animals nationally, by antimicrobial class, by species (aquatic or terrestrial), method of administration, and by type of use (therapeutic or growth promotion) = 4 points

C - Data collected and reported on total quantity of antimicrobials sold for/used in animals and their intended type of use (therapeutic or growth promotion) = 3 points

B - Plan agreed for monitoring quantities of antimicrobials sold for/used in animals, based on OIE standards = 2 points

A - No national plan or system for monitoring sales/use of antimicrobials in animals = 1 point

5) The national surveillance system for antimicrobial resistance (AMR) in animals (terrestrial and aquatic):

E - National system of AMR surveillance established for priority animal pathogens, zoonotic and commensal bacterial isolates which follows quality assurance processes in line with intergovernmental standards. Laboratories that report for AMR surveillance follow quality assurance processes = 5 points

D - Priority pathogenic/ commensal bacterial species have been identified for surveillance. Data systematically collected and reported on levels of resistance in at least one of those bacterial species, involving a laboratory that follows quality management processes, e.g. proficiency testing = 4 points

B - National plan for AMR surveillance in place but capacity (including laboratory and for reporting data on AMR) is lacking = 2 points

6) Level of the standardization and harmonization of procedures among laboratories included in the AMR surveillance system:

E - 100% of laboratories use the same Antimicrobial Susceptibility Test (AST) guidelines = 5 points

D - Between 80% and 99% of laboratories follow the same AST guidelines = 4 points

C - Between 30% to 79% of laboratories follow the same AST guidelines = 3 points

B - No standardized national AST guidelines are in place or less than 30% laboratories follow the same AST guidelines = 2 points

A - Information not available = 0 points

### 5.1.3 Practices on NAPs: How the countries evaluated themselves

7) The **country has laws or regulations on prescription and sale of antimicrobials for animal use**: Yes = 3 points; No = 0

8) The **country has laws or regulations that prohibits the use of antimicrobials for growth promotion in the absence of risk analysis**: Yes = 3 points; No = 0

9) Management and hygiene practices to reduce the use of antimicrobials and minimize development and transmission of AMR in animal production (terrestrial and aquatic):

E - Implementation of the nation-wide plan is monitored periodically = 5 points

D - Nationwide implementation of plan to ensure good production practices and national guidance published and disseminated = 4 points

C - National plan agreed to ensure good production practices in line with international standards (e.g. OIE Terrestrial and Aquatic Codes, Codex Alimentarius). Nationally agreed guidance for good production practices developed, adapted for implementation at local farm and food production level = 3 points

B - Some activities in place to develop and promote good production practices: Switzerland. From outside, India is also in this group = 2 points

10) When asked about optimizing antimicrobial use in animal health (terrestrial and aquatic), the Roadmap countries responded:

E - Enforcement processes and control are in place to ensure compliance with legislation = 5 points

D - The national regulatory framework for AM products incorporates all the elements included in the related international standards on responsible and prudent use of antimicrobials (e.g. OIE Terrestrial and Aquatic Codes, Codex Alimentarius) according to animal species and/or production sector = 4 points

C - National legislation covers all aspects of national manufacture, import, marketing authorization, control of safety, quality and efficacy and distribution of antimicrobial products = 3 points

### 5.1.4 Governance on NAPs: How the countries evaluated themselves

11) The **progress stage of the Multi-sector and One Health collaboration/coordination**:

E - Integrated approaches used to implement the national AMR action plan with relevant data and lessons learned from all sectors used to adapt implementation of the action plan = 5 points

D - Joint working on issues including agreement on common objectives = 4 points

C - Multi-sectoral working group(s) is (are) functional, with clear terms of reference, regular meetings, and funding for working group(s) with activities and reporting/accountability arrangements defined = 3 points

B - Multi-sectoral working group(s) or coordination committee on AMR established with Government leadership = 2 points

12) P**rogress with the development of a NAP on AMR**:

E - National AMR action plan has funding sources identified, is being implemented, and has relevant sectors involved with a defined monitoring and evaluation process in place = 5 points

D - National AMR action plan approved by government that reflects Global Action Plan objectives, with a budgeted operational plan and monitoring arrangements = 4 points

C - National AMR action plan developed = 3 points

13) Is the country using relevant antimicrobial consumption/use and/or antimicrobial resistance data to amend national strategy and/or inform decision making, at least annually [Animal heath. Yes to: terrestrial and aquatic=1; food production=1 and food safety=1; otherwise = 0]

The countries' actions, policies and strategies which led to these scores are described in the next sections.

## 5.2 Results Policy Domain 1: Awareness

Country initiatives to increase knowledge and awareness of AMR and AMU are driven and supported by different policy types aligned with national strategies to combat AMR. For example, in Europe, a national strategy called "Communication from the Commission to the European Parliament and the Council: Action plan against rising threats from antimicrobial resistance" was released in 2011 to guide EU action in addressing AMR. This plan describes communication, education and training activities related to AMR and establishes evaluation indicators. Since 2008, public awareness campaigns in European countries have focused on introducing the European Antimicrobial Awareness Day (EAAD), which aims to raise national awareness on prudent antimicrobial use among the general public. EAAD is held annually in November during World Antimicrobial Awareness Week.

### 5.2.1 BELGIUM

**Score of '<u>awareness'</u> measures in the TrACSS 2019-2020: 11/15**

The Knowledge Centre for the Use of Antimicrobials and Antimicrobial Resistance in Animals (AMCRA) organizes, in collaboration with the Federal Agency for the Safety of the Food Chain (FAVV – AFSCA), road shows, during which veterinarians and farmers are informed about the prudent use of antimicrobials and antimicrobial resistance. Participating veterinarians can have this included in their continuing education activities, which are mandatory as of the second year after earning a master diploma. On demand, AMCRA also visits local rare assigned reunions of veterinarians or farmers to present their goals and activities, and sensitize about antimicrobial use. Moreover, TV spots on the prudent use of antimicrobials in veal calves, dairy cattle, poultry, pigs and companion animals and antimicrobial resistance are regularly shown at channels specialised in topics relative to country life and they are also available on the AMCRA website. In addition, stable-proof sector-specific posters with prudent antimicrobial use guidance were developed by AMCRA and financed by Pharma.be. They have been distributed directly to farmers via agricultural fairs and veterinarians. Since 2017, the Regional Association of

Animal Health and Identification - ARSIA (in Wallonia) has the Altibiotic joint project that is financed within the framework of the Walloon Rural Development Programme (PWDR). This project aims to inform and train farmers in good farming practices related to bacterial resistance to antimicrobial substances. In addition, Altibiotique offers farmers the opportunity to assess their farm's health management and zootechnical practices. ARSIA also launched the "Raise, care, produce, ... less the antimicrobial reflex" project that offers Walloon breeders theoretical and practical training on the issue of antimicrobial resistance.

AMCRA will continue to focus on advising, communicating, and raising awareness through all available written and spoken communication channels and through visibility at trade fairs and events. Cooperation with the food processing industry and retailers will be intensified. In addition, AMCRA will develop training packages that can be used for agricultural schools, colleges, postgraduate training courses, etc. This will be done in collaboration with all the AMCRA's partners and the insights obtained from the AM usage data, as analysed by AMCRA's data analysis unit, will be integrated in these training packages. All farmers who have a contract with a herd veterinarian and therefore have the right to have a stock of antimicrobials on their farm, will be obliged to undergo a training in the proper and careful use of these medicines every five years. In addition, this training will also pay attention to the possibilities of preventive measures that can lead to a reduction in AM use (cf. phytosanitary license). Farmers who are in the green zone (low users) will receive an exemption for this training.

### 5.2.2 DENMARK

**Score of 'awareness' measures in the TrACSS 2019-2020: 15/15**

In Denmark, pushed by a strong export-oriented pig sector, the awareness about the use of antimicrobials and AMR increased already in the early 1990's. Since then, authorities, industry and scientists established a close collaboration to develop initiatives and search for solutions (see 7.5 governance). This country offers an example of another behaviour change campaign with their Yellow Card Initiative system. The system helps raise awareness about antimicrobial overuse by giving veterinarians (and farmers) a Yellow Card if they use antimicrobials in a quantity two times higher than the national average. Veterinarians are notified and encouraged to reduce usage. The system has been associated with an overall reduction of 22 percent in antimicrobials use in pigs for the periods 2009-2015 (Ministry of Environment and Food of Denmark. 2016).

### 5.2.3 FRANCE

**Score of 'awareness' measures in the TrACSS 2019-2020: 12/15**

The French Ministry of Agriculture, Agrifood and Forestry and the French Agency for Food, Environmental and Occupational Health and Safety have websites with information and reports (monitoring sales, AMR, expert assessments). The CGAAER (*Conseil général de l'alimentation, de l'agriculture et des espaces ruraux*) reports explained in details the results of the Ecoantibio plan (see section 7.4) and the new regulation Act on the future of agriculture, food and forestry (LAAAF2, Act No. 2014-1170). The Ecoantibio plan also foresee communication and training on the core issues for combating antimicrobial resistance, on rational antimicrobial prescription and on other ways of controlling infectious disease. Provision of tools for assessing and monitoring antimicrobial use. For livestock farming sectors : Adherence to preventive measures; Following training courses on the proper use of antimicrobials and

biosecurity; Improved husbandry methods (hygiene, upkeep of farm buildings, monitoring sanitary status).

### 5.2.4 ITALY

**Score of 'awareness' measures in the TrACSS 2019-2020: 11/15**

The Ministry of health supports communication initiatives aimed at health professionals and the general population, such as the awareness campaign on the prudent use of antimicrobials, in partnership with the yearly campaigns "European Antimicrobial Awareness Day - EAAD" organized by ECDC. The Ministry of health, Italian Medicines Agency (AIFA) and National Health Institute provide some tools (such as dedicated sections of their websites and newsletters) for communication and information in the field of the health education, including the prudent use of AMs. Scientific associations (i.e. SIPA, SISVET, SIVAR), professional bodies and Veterinary Public Institutes Network (IIZZSS – Experimental Animal Disease Prevention Institutes) organise training activities to raise awareness among the health professionals on a more prudent use of antimicrobials and AMR. The National Reference Laboratory for Antimicrobial Resistance (NRL-AR), at IZS of Lazio e Toscana regions, makes available on its website documents and link to additional information on these issues.

Since 2008 AIFA, ISS and the Ministry of Labour, Health and Social Policies conducted a Communication Campaign entitled "Antimicrobials yes, but with caution" with the aim of informing citizens of the importance of resorting to antimicrobials only when necessary and on the prescription of the doctor and to never interrupt therapy before the time indicated by the doctor. Since 2009, AIFA has given life to various communication campaigns (2009, 2010, 2012, 2014-15) which have made use of television and radio broadcasting channels, print media, billboards, dynamic urban advertising and social media awareness actions. The campaign "Antimicrobials don't work without rules", conducted in the two-year period 2014-15, aimed at discouraging the use of antimicrobials when not necessary; highlighted the responsibility of the individual and the community in the appropriate use of antimicrobials to counteract the development of antimicrobial resistance.

For the animal sector, not many awareness campaigns were conducted, especially for producing animals. In 2015 for companion animals the campaign "Correct use of antimicrobials in pets", addressed both to veterinarians, who are required to comply with the guidelines on the subject, and to animal owners, who must scrupulously follow the instructions received from the veterinarian. With the 2014-2018 National Prevention Plan (PNP), the Regions and Autonomous Provinces have been committed to carrying out at least 1 awareness / information / training event / year on the subject, aimed at all stakeholders. As regards the training of health workers in the human sector, experiences have been achieved at local level, at universities and scientific societies but, to date, nothing at national level, structured within university, post-graduate training and continuous updating.

### 5.2.5 MOZAMBIQUE

**Score of 'awareness' measures in the TrACSS 2019-2020: N.A.**

Nothing at the moment. However the NAP includes the objective of training and raising awareness among professionals (agri-industries including the fish sector), policy makers, journalists and the public.

### 5.2.6 NETHERLANDS

**Score of 'awareness' measures in the TrACSS 2019-2020: 13/15**

The 2005 cases of livestock-associated methicillin-resistant Staphylococcus aureus (LA-MRSA) promoted a considerable raise in awareness to the AMR problem in the Netherlands. These cases were reported to be widely spread in the Dutch pig population with occupational transmission to humans, especially farmers and veterinarians. This had a high impact on Dutch hospitals that had controlled MRSA very successfully by restricted antimicrobial use and strict infection control measures and was followed by societal and political pressure to reduce veterinary antimicrobial use. The discovery of pervasive presence of extended spectrum beta-lactamase-producing bacteria (ESBLs) on Dutch poultry meat in 2009 and a possible relationship with a human casualty was greatly disseminated in the media in 2010 and led to further serious public concerns. A debate in parliament followed where the public health concerns of extensive use of antimicrobials in farm animals were discussed. Subsequently, the government introduced a compulsory 50% reduction target in antimicrobial use in farm animals in 2013 compared to 2009 (Speksnijder et al., 2015).

A farm and a veterinary benchmarking system (see next chapter) also promote awareness among these professionals.

### 5.2.7 SWEDEN

**Score of 'awareness' measures in the TrACSS 2019-2020: 12/15**

A debate among politicians and the public was started by the media when they revealed how each year thirty tonnes of antimicrobials were given to healthy animals. Swedish farmers, through the Federation of Swedish Farmers (LRF), reacted proactively and tried to improve their image by petitioning for a total ban on AGP, which indeed happened in 1986[10]. There is a strong agreement today among veterinary personnel, animal keepers and animal health organizations in Sweden on a restrictive and responsible use of antimicrobials.

### 5.2.8 SWITZERLAND

**Score of 'awareness' measures in the TrACSS 2019-2020: 11/15**

In 1985, there were first discussions in the parliament about the use of AM in the Swiss livestock production. In 1988, a first guidance document about the use of AM and AGP was developed by the regional authorities (Cantone). In 1996, a researcher published result of study investigating AMR in Swiss Cheese. These findings led to a prohibition of AGP in 1999. Connected to this prohibition, meat imports had to be labelled as "produced with the aid of AGP".

A National Research Program NRP 49 "Antimicrobial resistance" conducted the first national diagnosis on AMR between 2001 and 2006. The programme " focused on establishing scientific strategies and new methods applicable to a prospective system of resistance monitoring and on the analysis of the

[10] Ståhle, G. (1996). Sweden banned antimicrobial growth promoters 1986 – the reasons (in Swedish). *K Skogs- och Lantbr Akad Tidskr,* 135(15): 53-56.

current situation concerning resistance in Switzerland, in all relevant areas (human and animal populations, agriculture, foodstuffs and the environment). Furthermore, social, legal, ethical and economical consequences of the development of antimicrobial resistance and a possible modification of rulings on the use of antimicrobials have been estimated.

The general public has little knowledge of bacterial infections, resistance and antimicrobials in general. PharmaSuisse, the FMH and OFSP have developed an information sheet for patients.

Communication on StAR (the national one health strategy from 2015) is based on three complementary axes. First, information (eg, prescribing guidelines) is communicated to professionals who prescribe and dispense antimicrobials. Second, the communication is directed to people who have received the antimicrobials (eg, patients or farmers) or to those affected by resistant germs. Thirdly, the entire population is aware: a Confederation media campaign focuses on the importance of antimicrobials for humans and animals as well as on antimicrobial resistance. Connected to the Star Strategy, a second National Research Programme "Antimicrobial Resistance" (NRP 72) is to contribute to reducing antimicrobial resistance as well as decreasing its negative impact on the therapy of infectious diseases. The programme is addressing the one-health approach and covers AMR in the environment, in animal production and hospitals.

The Havas agency in Zurich has come up with a convincing concept "Antimicrobials: when it's needed, it's right". Following the One Health approach, the creators of the campaign portrayed not only human beings, but also all kinds of living organisms present in the ecosystem, for example, in the form of animated characters. In a one-day course, agricultural advisers and official veterinarians received information on current StAR projects and the latest research findings.

### 5.2.9 UNITED KINGDOM

**Score of 'awareness' measures in the TrACSS 2019-2020: 10/15**

Until recently, discourse in the farming press and among agricultural organisations was focused on questioning the link between antimicrobial use in livestock and public health concerns about antimicrobial resistance (Helliwell et al., 2016). The last 5 years have seen a significant increase in stakeholder involvement in addressing antimicrobial use in the beef and dairy sectors, through the initiatives taken by private stakeholders and public authorities.

Knowledge exchange programmes around vaccination and colostrum use have been rolled out by the Agriculture and Horticulture Development Board and the National Office of Animal Health. The Agriculture and Horticulture Development Board also carries out knowledge exchange on health advice and provides guidance for beef and dairy farmers (RUMA, 2020).

A core initiative of the Target Task Force is the creation of Farm Vet Champions. Farm Vet Champions will receive education about antimicrobial use and form of network of vets promoting best practice in the UK (RUMA, 2020).

The UK government also provides resources for livestock keepers about antimicrobial use and resistance. The Welsh Government Farming Connect programme held meetings with farmers in 2019 following the release of the antimicrobial resistance in animals and the environment five-year implementation plan 2019-2024. Scotland's Farm Advisory Service, funded through the EU and the Scottish government provides farmers with information on AMU and AMR. The website Scotland's Healthy An-

imals run by the Scottish Animal Health and Antimicrobial Resistance (SAHAMR) Group provides guidance to animal keepers. In Northern Ireland the Department of Agriculture Environment and Rural Affairs provide information to farmers about AMU and AMR on their website.

A training course on antimicrobial use in the dairy sector called MilkSure was established by the industry body Dairy UK and is available to vets and farmers (MilkSure, 2021).

### 5.2.10 VIETNAM

**Score of 'awareness' measures in the TrACSS 2019-2020: 6/15**

The National Action Plan includes an activity to increase the awareness and risks on occurrence of AMR by firstly assessing the current level of awareness on AMR and AMU and by developing advocacy and communication tools and programs to increase awareness.

Actions consist of organizing meeting during the World Antimicrobial Awareness Week campaign (MoH/MARD), of communication materials developed by FAO and Extensional Centre, and awareness-raising on the agricultural TV channel, newspapers and via social networks for consumers and farmers.

### 5.2.11 Summary of findings and main successful actions: Awareness

- A rather simple, but very effective awareness campaign is the Yellow Card Initiative in Denmark. It uses a football signalling of warning, where a yellow card signals a warning. If a player violates the rules again while having a yellow card, a red card is issued, and the player is suspended from the next match. The system helps raise awareness about antimicrobial overuse by giving veterinarians (and farmers) a Yellow Card if they use antimicrobials in a quantity two times higher than the national average. Veterinarians are notified and encouraged to reduce usage.
- The media interest and reports are very effective in raising concern and motivating the debate around AMR. They have fast and direct impacts on societal pressures for action from authorities and industry.
- The main institutes involved in AMU and AMR in Belgium are very active in organizing awareness campaigns to the farmers, veterinarians, and the public about the importance of these topics. Road shows, fairs, visits, posters and even TV shows are prepared to this purpose.
- In countries such as Italy, France and the Netherlands, the media plays an important role in the awareness of the population about AMR in food producing animals.
- The fact that Swiss Cheese contained AMR bacteria raised public interest in the topic and led to the prohibition of AGP. Based two national research programmes (NFP 49, NFP 72), the knowledge about AMR increased and led to the development of the Swiss StAR strategy, which is based on three complementary axes offering a broad awareness approach on AMR.

## 5.3 Results Policy Domain 2: Evidence

The contrast of the AMR must necessarily start from the knowledge of the dimensions of the problem, for which validated tools are needed to evaluate the trends of the phenomenon and verify the impact of any control measures. Therefore, the surveillance of AMU and AMR is a key point of all recommended strategies to combat it (EU, WHO, FAO, OIE) and of national Action Plans. In most international plans, surveillance is viewed from a "One Health" perspective and aims to collect and analyse, in a coordinated and integrated manner, both data from human medicine, veterinary medicine and animal husbandry. Surveillance activities are of particular importance so that the problem is recognized and addressed in the various areas, for the planning of interventions and their evaluation, for the monitoring of the problem, for the identification of unexpected events dangerous to public health, such as changes in the patterns of AMU and AMR (emergency and spread of new resistance) and epidemic outbreaks, and to be able to implement timely containment measures, to evaluate the effectiveness of the control and stewardship interventions implemented.

Figure 5-2 represents the national consumption of antimicrobials in food producing animals with the sales of active ingredients (all confounded) in mg/PCU from the ESVAC network data. Together with Table 5-2, it gives us an idea about the veterinary antimicrobial consumption trend in the selected countries. It shows Italy and Belgium among the largest consumers, while Sweden, UK and Denmark the lowest.

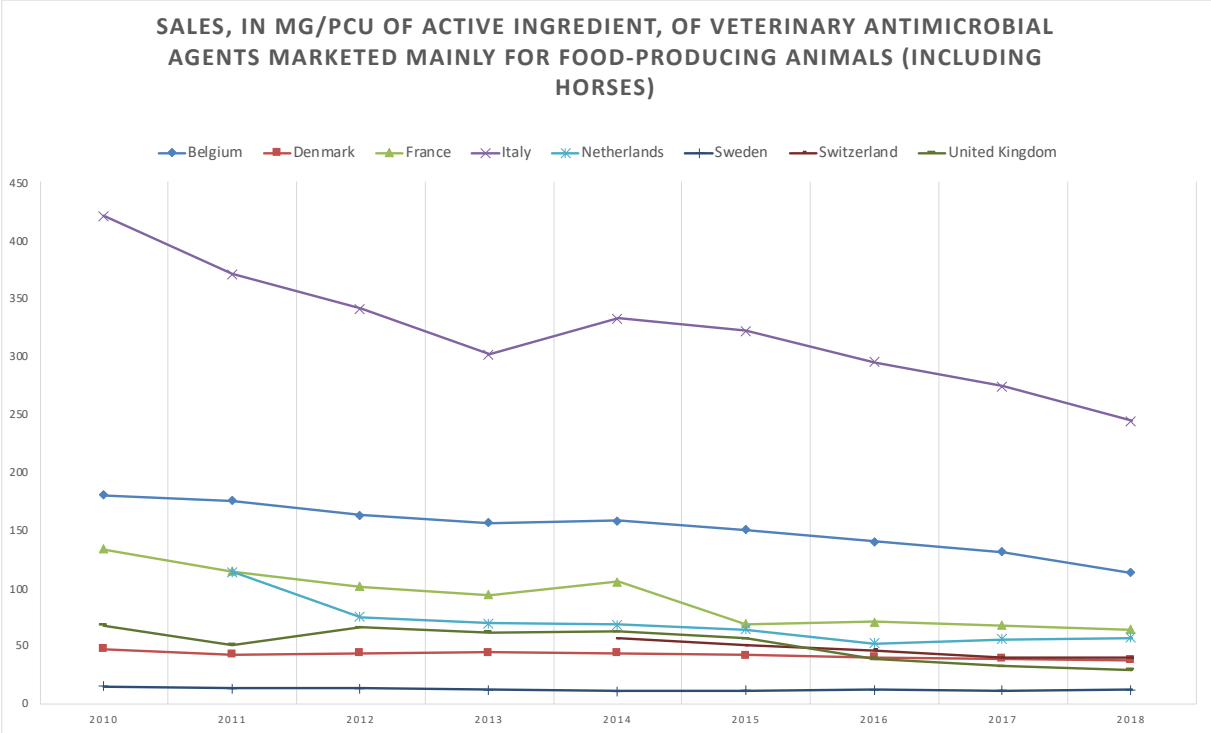


*Figure 5-2 Sales in Mg/PCU of active ingredient of veterinary antimicrobial agents marketed mainly for food-producing animals (including horses). Source EMA/ESVAC.*

The higher decreases in the consumption along the total time series (CAGR series) is found in the UK, Netherlands, and France. This translates the countries' efforts in reducing the total consumption. In the past five years (CAGR 5 years), the sharpest decreases are found in UK, France and Belgium.

*Table 5-2 Compound Annual Growth Rate for the whole series and the last 5 years*

| ROADMAP's Europe countries | Compound Annual Growth Rate - series | CAGR 5 years |
|---|---|---|
| Belgium | -5.65% | -6.30% |
| Denmark | -2.69% | -3.17% |
| France | -8.76% | -7.34% |
| Italy | -6.59% | -4.15% |
| Netherlands | -9.29% | -3.84% |
| Sweden | -2.41% | -0.26% |
| Switzerland | -8.26% | |
| UK | -9.90% | -13.82% |

### 5.3.1 BELGIUM

**Score of '<u>evidence</u>' measures in the TrACSS 2019-2020: 15/15**

In Belgium, global animal antimicrobial consumption is currently measured with sales data. The wholesaler-distributors that are registered for supplying veterinarians and pharmacies in Belgium as well as the feed mills, upload sales data via the secured web-application BelVetSac. Once a year, the data is analysed, and a report is published.

For pigs, veal calves, laying hens and broilers, AMU is also monitored at herd level (compulsory by law) and the herd veterinarian oversees entering the data in the Sanitel-Med database, which is managed by the Federal Agency for Medicine and Health Products (FAMHP) (Royal Decree of 31/01/2017). This database is also connected to several computer applications such as Sanitrace, Beltrace, Cerise, Veeportaal, which allows many animal data to be integrated into the centralized database and made available to other actors. In addition, the Sanitel-Med database is also coupled to other databases that were created by quality labels long before the federal database was developed.

The federal database is therefore coupled to the Flemish AB-register database, which is operated by non-profit organizations that manage quality labels for the pig (Belpork), poultry (Belplume) and dairy (Dairy Quality Assurance (DQA)) sectors. All producers approved within these quality labels are required to have all antimicrobials administered or dispensed registered by the providers of the products. For the Flemish veal calve sector, Sanitel-Med is coupled to the database SGS-BCV veal calves, which is managed by the independent control and certification body SGS and contains the data on deliveries/prescriptions of antimicrobials delivered on veal calf farms that participate in the BCV (Belgian Controlled Veal) quality program. Finally, Sanitel-Med is also linked to the '*Base Informatique de Gestion des Antibiotiques et des Médicaments en Elevage*' (BIGAME), which is the Walloon counterpart

of the AB Register and covers pig, poultry, dairy, and veal calf producers, who's participation is voluntary.

Twice a year, the Federal Agency for Medicine and Health Products (FAMHP) sends farmers a benchmarking report that compares the farm's consumption per species (pig, veal calves, laying Hens, broilers) to two limit values (the 50th and 90th percentiles of the frequency distributions) to define if the producer has a low, a more than average or a large antimicrobial use. Producers approved under a quality label that uses the AB-register receive benchmarking reports more frequently, depending on the species, and have access to online near real-time reporting. Regarding the content of the reports, there are no differences between the ones sent by the labels and the ones sent by the FAMHP.

In addition to farmers, herd veterinarians specialising in pigs, poultry and veal calves are also benchmarked based on the AMU of the farms they have a registered contract with (max. 100). As the farmers, herd veterinarians receive two reports a year.

Finally, drug treatment of farm animals is also documented. For every treatment, the veterinarian gives the farmer a document specifying the treatment carried out and the waiting time to be observed. Both the veterinarian and the farmer also keep a register of veterinary medicines and the farmer also states at what time which animals were treated with which product.

Soon, the monitoring of AMU will be further strengthened in Belgium. According to AMCRA's 2021-2024 strategic plan, AMU will be monitored in all food-producing animals by 2022 and in pets by 2024, meaning that all livestock producers and all veterinarians will be benchmarked by then. Big AM users (yellow and red users) will also have to take actions. Farmers will be required to develop Farm health plans with the help of their herd veterinarians, who will also facilitate the implementation of such plans. In case of a very high AMU, the implementation of a Farm health plan should also be facilitated by a coach.

It is the Belgian national institute for health, Sciensano, that is in charge of monitoring AMR in animals and collect data for the 'The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks. In addition, DGZ and ARSIA also publish reports on the evolution of AMR in Flanders and Wallonia respectively based on the performed sensitivity testing (e.g. antibiograms).

Like the monitoring of AMU, the monitoring of antimicrobial resistance in indicator bacteria will also be strengthened by extending it to non-food producing species and by establishing a national AMR monitoring program in pathogenic bacteria originating from food producing and non-food producing animals. Results from this national monitoring program will be disseminated annually. In addition, a system for reporting and providing access to antimicrobial resistance data to farmers and veterinarians will also be established. Regarding the detection of AMR, a network of laboratories carrying out antimicrobial susceptibility testing according to a harmonized procedure will be established. In addition, all laboratories carrying out antimicrobial susceptibility testing for veterinary medicine, shall have an approval issued annually by a competent authority.

Regarding human health, the 'Healthcare-associated infections & antimicrobial resistance' (NSIH) service of Sciensano (National institute for Health) is responsible for the standardized monitoring of healthcare-associated infections and AMR in hospitals, residential care centres and related healthcare institutions.

### 5.3.2 DENMARK

**Score of 'evidence' measures in the TrACSS 2019-2020: 15/15**

The pig industry, represented by its large cooperative slaughterhouses in Denmark, plays an important role in the national residue surveillance program. Besides complying with the EU directive 96/23/EC on antimicrobials' residues, slaughterhouses have their own control program for detection of pig meat residues. Results of these assessments are made public each year through the report of the Danish Integrated Antimicrobial Resistance Monitoring and Research Programme (DANMAP). DANMAP was established in the mid-1990s as a response from the veterinary and human health sectors to the increasing AMU and the threat caused by an increased observation of AMR. Since then, AMR has been monitored. AMU is monitored based on the detailed sales information from veterinary medicines in the *VetStat* database, while the human medicines is monitored in the *MedStat* database. Denmark monitors the AMU from livestock production since 1994, but the introduction of VetStat in 2000 allowed the detailed separation into consumption at farm and species level (cattle, small ruminants, pigs, poultry, aquaculture, fur animals and other), and consequently to target interventions. VetStat is linked to the database from the Central Husbandry Register (CHR) that contains data on all Danish farms and herds, allowing a precise information on AMU relative to herd size. The age of the target group, the technical dose and the reason of the prescription are also recorded in VetStat, which measures all AMU in animal daily dose (ADD), providing a benchmark system. Pharmacies and veterinarians report the sales of antimicrobials directly in this database. Thus, the time trend consumption at individual farm level, by species and by animal production phase is monitored in Denmark. This detailed and precise monitoring leaded to governmental and voluntary industry interventions, such as the ending of use of third- and fourth-generation cephalosporins and the Yellow Card system (see chapter 4.5). Since 2014, mandatory laboratory diagnostics prior of prescription are required for oral group medication for respiratory or gastrointestinal pig diseases.

### 5.3.3 FRANCE

**Score of 'evidence' measures in the TrACSS 2019-2020: 14/15**

Veterinary antimicrobial sales have been monitored annually by the French Agency for Food, Environmental and Occupational Health and Safety (ANSES) since 1999, based on the recommendations of the OIE. It was only in 2014 with the Act on the future of agriculture, food, and forestry that the declarations of volume sold became mandatory. From 2016 it became mandatory to report electronically. The monitoring of sales of veterinary antimicrobials is based on an annual declaration of sales by the pharmaceutical companies marketing these antimicrobials. The information collected from the pharmaceutical companies covers 100% of authorised veterinary medicinal products and can be used to estimate which species they have been prescribed for. The data on antimicrobial sales volumes alone do not include exact details of their use. To assess animal exposure to antimicrobials, it is necessary to consider the dosage and duration of administration, but also changes in the animal population over time.

The drug monitoring system in France called pharmacovigilance is organised by the CPVL (Centre de Pharmacovigilance Vétérinaire de Lyon) and Anses-ANMV. In France, veterinarians and health advisors/professionals are required to report serious and/or unexpected adverse reactions in animals, as well as adverse effects in humans. Since the European regulation EU 2019/6 of 2018 (7), France has the project to set up an automated system of registration of veterinary prescriptions (Calypso project

started in 2019) which would allow accurate monitoring of uses via prescriptions and not based on estimates from antimicrobial sales. There are no benchmarking or risk warning systems for farmers or vets at national level apart from the private standards or the different companies who have implemented software to follow the antimicrobial consumption of their farmers. Farms in different sectors are sampled and farm level data are collected allowing a monitoring in sampled farms, but no data at national level allows a species/category-specific AMU information.

The French surveillance network for antimicrobial resistance in bacteria from diseased animals (RESAPATH) was set up in 1982 under the name of RESABO (BO for bovines). In 2000, it was expanded to pigs and poultry and in 2007, to other animal species such as small ruminants, companion animals or horses. The RESAPATH is the unique veterinary member of the French National Observatory for Epidemiology of Bacterial Resistance to Antimicrobials (ONERBA), which encompasses 16 other surveillance networks throughout France, all in private or public medical practices (community or healthcare centres). The major impact of the RESAPATH relies on its ability to detect the most resistant and emerging bacteria circulating in animals in France, to measure AMR trends in diseased animals in France (and thus assess NAP efficacy). The RESAPATH is a key component of the EcoAntibio strategic NAPs and One Health NAPs.

Monitoring for human consumption: The declaration of sales of medicinal products is made annually by pharmaceutical companies on a mandatory basis covering all the specialties marketed in France whether they are reimbursable or not (exhaustive data). The Open-Medic data relate to drugs dispensed in city pharmacy and reimbursed by a health insurance scheme. IMS-HEALTH EPPM data: quarterly study on the diseases and prescribing habits of general practitioners and specialists in liberal activity (at least 50%). Up-to-date reports on the consumption of specific products, or on the pharmaceutical market are written and published to keep healthcare professionals and the public informed about medication consumption practices and how they are changing. Created in 1997, the National Observatory of the Epidemiology of Bacterial Resistance to Antimicrobials (ONERBA) is an organization whose scientific and technical activities rely mainly on the networks for surveillance of resistance already established and federate in ONERBA.

### 5.3.4 ITALY

**Score of '<u>evidence</u>' measures in the TrACSS 2019-2020: 14/15**

National veterinary pharmacovigilance system: This system is used to collect information useful in the surveillance of veterinary medicinal products, with particular reference to adverse reactions in animals and in human beings, and to evaluate such information scientifically. The surveillance of the veterinary medicinal product is implemented by the local competent authorities in accordance with the dictates of the current regulations, with the aim of evaluating the traceability of antimicrobials (control over the entire production chain and distributive) and proper use in livestock and companion animals. A compulsory Electronic Veterinary Prescription (e-prescription) system was adopted from 2019 and serves as the main AMU monitoring system for the country's authorities. The system tracks the entire flow of veterinary drugs from producers to retailers (traceability database) up to the application of medicines in the animals (e-prescription database). This system provides data that are used by the authorities to focus official controls on high antimicrobial-using farms or high prescribing veterinarians.

ClassyFarm, a voluntary risk assessment tool is also being implemented in the country with the aim of categorizing the risk of farms in the field of veterinary public health. It allows the detection, collection

and processing of data relating to the following assessment areas: biosecurity; animal welfare; health and production parameters; animal feed; consumption of antimicrobial drugs and injuries found at the slaughterhouse. Some of its modules are becoming progressively mandatory for farms in specific sectors. In the pig sector since 2020, ClassyFarm is mandatory for all farms and the assessment is in charge to the veterinary of the farm. Moreover, periodically the Local Health Unit-LHU veterinary (public body) verifies the score by an audit.

In the human sector, the national surveillance system for antimicrobial resistance and the surveillance system for CPE (bacteremia from carbapenemase producing enterobacteria, a class of broad-spectrum antimicrobials) are active, both coordinated by the Istituto Superiore di Sanità-ISS, connected to the European system EARS-Net/ECDC. The OsMed-AIFA tool measures the consumption of antimicrobials in humans in Italy.

Isolation, identification, and serotyping activities are carried out by the laboratories of the IZS (Instituto Zooprofilattico Sperimentale), by official and / or private laboratories and by CNR-AR, LNR-AR. Resistance surveillance, therefore, is based on a centralized system of laboratories that allows the homogeneity and accuracy of comparable data, as well as comparison with human data.

### 5.3.5 MOZAMBIQUE

**Score of 'evidence' measures in the TrACSS 2019-2020: N.A.**

Nothing at the moment. But the NAP includes the surveillance of antimicrobial resistance, antimicrobial use in humans and animals, the control of antimicrobials residues in meat and fish for local markets and for export, and in the environment. The first step is to develop the lab capacity and skills. Yearly, the Ministry of Agriculture collects data on AB, based on the authorizations delivered for their importations (there is no local production of AB) and following the OIE tool, reporting option 1 (" Overall amount sold for use / used in animals by antimicrobial class, with the possibility to separate by type of use").

### 5.3.6 NETHERLANDS

**Score of 'evidence' measures in the TrACSS 2019-2020: 15/15**

The veterinary monitoring program in The Netherlands started in 1999. From 2002, veterinary antimicrobial use is published annually in a MARAN report (Monitoring of Antimicrobial Resistance and antimicrobial usage in Animals in the Netherlands). Since 2012, these data were combined with the NethMap report with similar data in human healthcare.

The Netherlands Veterinary Medicines Authority (Stichting Diergeneesmiddelenautoriteit, SDa) has been monitoring antimicrobial use at Dutch livestock farms by means of benchmark indicators since 2011. SDa can map out the usage of antimicrobials on more than 40,000 farms in the country. Two benchmark values have been set: a signaling threshold and an action threshold, defining three zones: the target zone, the signaling zone and the action zone. Specific benchmark values have been defined for the various livestock sectors and types of livestock farms. Farms that use amounts of antimicrobials within the action zone should take immediate action. The Veterinary Benchmark Indicator (VBI), published in 2013, also allows monitoring and comparison among veterinarians (Speksnijder et al., 2015).

The National Reference Laboratory (NRL) for antimicrobial resistance in animals coordinate many reference tasks such as managing reference collections of bacterial strains and performing collaborative benchmarking studies. These studies aim to standardise the antimicrobial sensitivity tests performed at veterinary diagnostic laboratories and to improve the quality of these laboratories. Wageningen Bio-veterinary Research plays an important role in the monitoring, operating as a NRL.

### 5.3.7 SWEDEN

**Score of 'evidence' measures in the TrACSS 2019-2020: 14/15**

Sweden has been gathering data on sales of antimicrobials for the use in animals since 1980. The data gathered includes sales from pharmacies to animal owners (prescription dispensed) and to veterinarians (requisition based). Pharmacies are obliged to report their sales to the eHealth Agency who keeps a database and veterinarians are required to report their use of medicinal products (including antimicrobials) to the Swedish Board of Agriculture with regards to production animals and horses (antimicrobials for systemic use). The Public Health Agency of Sweden and the National Veterinary Institute (SVA) have a collaboration that started in 2002, where analysis of data with regards to sales of antimicrobials as well as AMR in animals, humans and food is gathered and presented in an annual report called the Swedres-Svarm report.

When antimicrobials are sold from pharmacies to animal owners via prescription, the species of animal for which the product is intended is recorded. This enables the extraction of information regarding the sales of antimicrobials for use in major species of animals. Antimicrobials sold via requisition to veterinarians or veterinary clinics are recorded under a broad term limiting the ability of the data system to identify the species for which they are used. Thus, the data source is the information in the database of the eHealth Agency on sales from pharmacies to animal owners (prescription dispensed) or to veterinarians (requisition). Species specific information on the use of antimicrobials can however be obtained from other sources such as Växa Sverige (the biggest advisory organization in the dairy sector) and Svensk Fågel (Swedish poultry meat organization) which gather information with regards to animal disease or flock/heard health. This makes it possible to follow the antimicrobial use in their respective sector. SVA has responsibilities with regards to supporting the prudent use of antimicrobials, follow and analyze AMR in animals and act as a national reference laboratory for AMR by performing routine susceptibility tests. They also do research relating to AMR. The result of this work is published in the annual Swedres-Svarm reports.

In 2005 increased surveillance of AMR in pathogenic bacteria causing disease in farm animals was initiated through the Svarm-PAT program. This program is a collaboration between SVA and Farm and Animal Health (Gård och Djurhälsan, an advisory organization with regards to preventive animal health in cattle, sheep, and pigs) and financed by the Swedish Board of Agriculture. The analysis of data collected under the AMR monitoring programs enables developing risks to be identified. In case of any increased level of resistance SVA initiates investigations to identify the causes. The knowledge within the Svarm and Svarm-PAT programs has been applied in the development of guidelines for antimicrobials use created by the Swedish Veterinary Association and the Medical Products Agency.

The monitoring of *Salmonella* is very strict in Sweden. Surveillance is mandatory on all poultry farms where regular sampling for *Salmonella* is performed at farm level. For pigs and cattle random spot checks are being performed in connection with slaughter and sampling of young animals is being done in connection with necropsy.

During the last decades the use of antimicrobial agents in Sweden has decreased both in human and veterinary medicine. Apart from seeing a decrease in the total use of antimicrobials there is also a decrease in the use of broad-spectrum antimicrobials in favour of products with a narrow antibacterial spectrum.

### 5.3.8 SWITZERLAND

**Score of 'evidence' measures in the TrACSS 2019-2020: 13/15**

The ordinance on veterinary drugs (OMedV) from 2004 provides for an obligation to establish statistics. To do this, the quantities of antimicrobials sold by distribution companies (authorization holders) are collected and evaluated. Thus, legal obligations were introduced concerning the use of veterinary medicinal products (Sr 912.212.27 TAMV Tierarzneimittelverordnung). Farmers must report not only medication but also the administered dose of antimicrobials. For milk production, the reports are for each individual treatment. For all other livestock, the group treatments need to be reported. The data remains with the farmers. The TAMV has three focal points: i) the proper/prudent use of all veterinary medicinal products, especially antimicrobials, ii) food safety and iii) animal welfare.

A surveillance program was set up in 2006 concerning resistance to antimicrobials in production animals and sales of antimicrobials for veterinary use (ARCH-Vet). Thus, sales figures for antimicrobials have been systematically listed and evaluated since 2006. The interpretation of sales data is limited in terms of effective treatments for specific animal populations, as most preparations are approved for multiple animal species. Also, different dosages between antimicrobial classes and animal species are not accounted for in sales volumes. Dosages often vary widely. Nevertheless, the distribution quantity is an important and comparatively easy to determine measured.

Until now, however, there has been a lack of data on the consumption of antimicrobials about the various animal species and production types (e.g., calf fattening farm, dairy farm), the individual animal holdings and the individual veterinary practices and clinics. To close this gap, the Information System Antimicrobials in Veterinary Medicine IS ABV was created on behalf of the Parliament. This makes it possible to assess the development of resistance and to identify excessive or inappropriate use of antimicrobials and to initiate appropriate measures. First data is expected in 2021.

Thus, from 2019, veterinarians should enter any prescription or dispensing of antimicrobials into a national database (SI ABV). This information made it possible to know in which context the antimicrobial treatments are most frequent as well as the prescriber. The SI ABV makes it possible to assess the frequency of antimicrobial treatments for each animal species or form of production and to benchmark with other farmers and veterinarians. The Federal Food Safety and Veterinary Office- BLV oversees collecting this information about AMU in cattle, pig, and poultry. Since January 2019, all group therapies, and since October 2019, all individual animal therapies have been registered by the veterinary profession. These data form an important basis on which statements can be made about the effective treatment of certain animal populations. It will be possible to see how often an animal species is treated on average, or in which type of production certain classes of antimicrobials are used most frequently.

With this data base, problems can be identified more specifically in the future, addressed with targeted information and measures, and their effects measured. Since 2014, the Swiss Center for Antimicrobial Resistance Control (anresis.ch) (created in 2004) collects and publish data on resistance and antimicrobial consumption in human medicine in a representative manner for Switzerland. Although the data

is not publicly available, it is published in aggregate form on the website or in summary form in some scientific publications. It is published annually in a report that also includes the results of resistance monitoring in production animals and allows trends to be analysed over the years. In human medicine, the Sentinella reporting system collects data on antimicrobial prescriptions from participating physician practices.

Created in December 2016, the NARA, 'National Reference Center for the Early Detection of Emerging Resistance to Antimicrobials' analyzes samples of these forms of resistance.

Evidence about the use of AM and AMR was also generated in the research programmes NFP 49 and NFP 72. From NFP 49, the most important and by now operational achievement of NRP 49 is the establishment of SEARCH (Sentinel Surveillance of Antimicrobial Resistance in Switzerland). Based at the University of Bern (www.search.ifik.unibe.ch), it provides representative data on antimicrobial resistance in pathogenic and commensal human isolates from hospitals and the community throughout Switzerland. The project also delivered baseline data on the resistance state in food animals in Switzerland and concluded, that, compared to the situation abroad, the resistance state in Swiss livestock appears to be favourable.

### 5.3.9 UNITED KINGDOM

**Score of 'evidence' measures in the TrACSS 2019-2020: 11/15**

The UK government body Veterinary Medicines Directorate monitors the sale of antimicrobials (Veterinary Medicine Directorate, 2021). The first report from the Veterinary Medicines Directorate covered data from 1993-1998, based on data voluntarily contributed by veterinary pharmaceutical companies. In 2005 the collection of sales data became a statutory requirement using the European Surveillance of Veterinary Antimicrobial Consumption. Data was reported on antimicrobial sales and resistance was published in its current form from 2014. The current iteration of reporting includes antimicrobial usage data from some sectors as well as sales data. Many antimicrobials are authorised for use in several animal species, so it is difficult to get an accurate picture of use by animal species from sales data alone.

The Veterinary Medicines Directorate works with livestock sectors to gather use data for different species. Usage from over 90% of fish, poultry and pig farms is recorded through industry-led recording systems. The usage data in the beef and dairy sectors comes from a smaller sample of farms, gathered through veterinary practice data. The Agriculture and Horticulture Development Board launched an online Medicine Hub in January 2021 which aims to appeal to beef and dairy individual farms to input their antimicrobial use data so they can track and benchmark their own use (AHBD, 2021). The Medicines Hub also aims to import data from other sources such as farm software and veterinary practices. The aim is to link the Medicine Hub data with national compulsory animal traceability systems, of which there are different ones in the four countries of the UK, and to use the data in the Veterinary Medicines Directorate annual report.

Resistance is monitored by the Veterinary Medicines Directorate, the Food Standards Agency and the Animal and Plant Health Agency (Farm Antimicrobials, 2021). The last report on antimicrobial resistance in the livestock sector was published in 2020 when the UK was part of the EU, and the VMD complied with the active surveillance requirement for member states to carry out:

"Susceptibility testing of Escherichia coli obtained from caecal samples taken from healthy pigs at slaughter; Testing for the presence of Extended-Spectrum Beta-Lactamase (ESBL)-, AmpC BetaLactamase (AmpC)-, or carbapenemase-producing E. coli in caecal contents from pigs at slaughter, as well as samples of fresh pork and beef at retail; Susceptibility testing of Salmonella spp. isolates derived from pig carcase samples taken at slaughter by Food Business Operators" (VMD, 2020).

There is also a passive surveillance programme that tests samples submitted to private veterinarians to government laboratories for antimicrobial resistance. This is used to identify new and emerging patterns of resistance.

### 5.3.10 VIETNAM

**Score of 'evidence' measures in the TrACSS 2019-2020: 7/15**

In the NAP, one of the objectives is to establish a national surveillance programme on AMR and AMU in livestock production.

There are lists in districts and communes of livestock farms, but not compiled at national level for all species, except for farms with more than 2000 milk cows which must be registered centrally. There is a work in progress with FAO support to make exhaustive records of milk cow farms in 5 provinces (regulatory obligation in Animal Law 2020). This is also true for poultry production. There is no list of farms < 2000 chickens. However, some programs are currently tested to register the farms with FAO also on poultry production.

On AMU/AMR: no monitoring of sales/usage (only on research program, OUCRU, FAO). For the moment, those programs are at a recent stage. AMU and AMR surveillance are under the control of the Department of Animal Health under the MARD but their monitoring capacities need to be strengthen. There are nine surveillance laboratories: seven Regional Animal Health Offices and two veterinary and animal hygiene centres. Surveillance studies on AMR have been conducted in pigs (E. coli and non-typhoidal Salmonella), aquaculture (E. coli, Salmonella, Aeromonas, Vibrio), in slaughterhouse (antimicrobial residues). The total AMU in livestock production has also been evaluated through several studies. Research programs to develop AMU and AMR monitoring are also conducted to improve data collection.

### 5.3.11 Summary of findings and main successful actions: Evidence

- The VetStat linked to the Central Husbandry Register and the DANMAP in Denmark guarantee an effective surveillance system, which forms the base for subsequent policy measures and actions concerning AMR.
- The AMU and AMR knowledge within the Swedish surveillance programs Swarm and Swarm-PAT has been effectively applied in the development of guidelines for antimicrobials use to support farmers and veterinarians. Specific-pathogen programs are also effective in eradicating targeted diseases.
- Despite the obligations for pharmacies and veterinarians to report their sales and use respectively in Sweden, the data collected today cannot be completely divided into animal species

and production type, neither per region nor establishment. This would help in the identification of production systems with a high use and high risk of resistance and allow veterinarians to access their own prescription data and compare them to national figures.

- The same is true for Belgium, where AMU is monitored at herd level only in pigs, veal calves, laying hens and broilers. Different institutes and databases in Wallonia and Flanders collect and report such data. A larger scope and further standardization would facilitate monitoring, reporting and joint actions.
- The Dutch monitoring system combining AMU and AMR in both humans and animals (at herd level) proved very effective in raising the data, promoting good quality information about the real situation in the country.
- In France, the broad coverage of the surveillance networks, especially the RESAPATH, allows an efficient monitoring of AMR. However, the data collected on AMU does not allow a separation by species, identification of high user farms and veterinarians and benchmarking, thus making difficult the implementation of targeted actions.
- In Italy the e-prescription system and the ClassyFarm tool collect detailed information on AMU and other health management indicators. However, the data is not used for benchmarking of veterinarians and farms and targeted actions. ClassyFarm is still not completely mandatory over all animal production sectors.
- Despite investment in research and monitoring, only since 2019, the possibility of separating and benchmarking data by veterinarians, farms and animal species represents an important step for the monitoring of AMU in Switzerland. An extensive laboratory network and the combined human and veterinary reporting made by the “Swiss Center for Antimicrobial Resistance Control” on AMR is also contributing with important information to Swiss surveillance program.
- Homogenization of consumption indicators in ADD or DDD ensures comparability of consumption of antimicrobials and consequent identification of weak links in the different livestock producing sectors.

## 5.4 Results Policy Domain 3: Practices

The application of fundamental principles of animal health and good husbandry practices can help prevent and / or reduce the introduction, development and spread of animal diseases, including those transmissible to and within an animal population, maximizing the number of healthy animals and, therefore, minimizing the need for the use of antimicrobial agents. Biosecurity represents one of the main prevention tools, together with the adoption of surveillance, eradication and disease control programs.

These programs encompass a wide range of measures including, among others, vaccination programs, which are an effective tool in efforts to combat antimicrobial resistance as they can help limit the occurrence of diseases and hence, the use of antimicrobials. Some regulations are intended to protect the human therapeutic arsenal by limiting their use in veterinary medicine. Animal health, in turn, is interconnected with animal welfare: "Better animal health promotes greater animal welfare, and vice

versa". A good state of health, in fact, helps the animal to maintain its natural resistance to disease and good health is an essential prerequisite for ensuring conditions of animal welfare.

### 5.4.1 BELGIUM

**Score of 'practices' measures in the TrACSS 2019-2020: 16/16**

In Belgium, the veterinarian's role, and the number of visits to farms are defined by law when there is a guidance contract between the veterinarian and the farmer. The farm must be visited at least six times a year with a maximum interval of two months between two visits and the veterinarian is responsible for providing information, advice, supervision, assessing the animals' health status, preventing, and treating diseases, as defined in the royal decree of 02/02/2000. Farmers who have a guidance contract with a veterinary surgeon are allowed to keep a supply of medication to do follow-up treatments for a maximum of two months, compared to three weeks for farmers without a contract. Some quality labels request participating farmers to have a guidance contract (e.g., Certus).

To foster the implementation of good practices, AMCRA (Knowledge Centre for the Use of Antimicrobials and Antimicrobial Resistance in Animals) has developed formularies, which contain guidelines for practising veterinarians on therapeutic indications per animal species (pigs, cattle, horses, dogs, cats and poultry) and per disease. For each pathology, antimicrobial active substances are classified in first, second and third choice. They are given a colour label (yellow, orange, red) reflecting their importance for human and animal health based on the prioritisation given to these by WHO and OIE, respectively.

Since August 2018, third and fourth generation cephalosporins and first, second and third generation fluoroquinolones, can only be prescribed and used in food-producing animals under specific conditions that involve sampling at the time of treatment initiation, sensitivity testing and a re-assessment of the treatment based available sensitivity testing results. "Red antimicrobials" may only be administered by the veterinarian and by the owner/animal keeper to complete the treatment following further examination and may therefore never be present in the livestock farmer's stock. In addition, specification books as drawn by Belpork require their members to make up a plan of action if too many critical antimicrobials are used at company level.

In the near future, Belgium also plans to extend the regulations on the restrictive use of "red antimicrobials" to all animal species (see AMCRA's vision 2021-2024) and to encourage the availability of "yellow antimicrobials", including for minor species. To this end, a working group will be set up which, in cooperation with the government, will assess possible measures.

Regarding the way antimicrobials are used, there are, besides biological production, no measures restricting the prophylactic use of antimicrobials (AB can currently be used preventively in BE) and minimising metaphylactic use except for third and fourth generation cephalosporins and first, second and third generation fluoroquinolones.

Since AMU is monitored at herd level, both veterinarians and farmers are informed at least twice a year of their AMU. However, there are currently no legal consequences for prescribing or using high volumes of antimicrobials. This is bound to change as actions and incentives to help farmers with a high AMU are described in the draft Belgian One Health National Action Plan AMR and the new strategic plan of AMCRA (2021-2024). It is indeed foreseen that intermediate (yellow zone in benchmarking) and large users (red zone in benchmarking) will be actively guided towards improved animal health and reduced use of antimicrobials based on a farm health plan. The preparation and monitoring of the

progress of the health plan shall be facilitated by the herd veterinarian and, for large users, also by an external coach. The operation of these coaches, whose operations shall be supported by the government. In addition, competent authorities could carry out targeted checks on farmers and veterinarians since the reports on the use and supply of antimicrobials make it possible to detect irregularities in terms of quantitative and qualitative use.

Finally, Animal health organizations (e.g. DGZ) are also planning to help veterinarians and farmers design a herd health plan through an app allowing the follow-up of personalised actions to reduce AMU. It is the intention to use the application for coaching purposes to reduce antimicrobial usage through disease prevention and increased biosecurity. The app will also integrate the Biocheck, a scientific risk-based and scoring system to evaluate the quality of on-farm biosecurity developed by the UGhent. The integration of the Biocheck pigs in this application is financed by FASFC. Moreover, quality labels will also use the app and will implement specific biosecurity and health related/AMU guidelines in their standards.

In Belgium, addition to AMU; biosecurity is also becoming the focus of attention and it will soon be compulsory for farmers to assess their farm's biosecurity at least once a year (Royal Decree in the making). AMCRA's vision 2021-2014 also aims to enhance the level of biosecurity and animal disease prevention on livestock farms should be increased by setting up active programs to evaluate the biosecurity and vaccination plan on each farm and to adjust it where possible. Biosafety evaluation will therefore become an integral part of the farm health plan. Critical factors such as stocking density, weaning age, minimum age for transport, etc. shall be actively monitored by the competent authorities.

Finally, there is also a tax on antimicrobials. Marketing authorisation holders pay a tax on veterinary antimicrobial sales based on the volume of sales on the Belgian market (RD. Since April 2018, the tax is € 3.06 per kg of antimicrobial active substance sold and € 4.59 per kg of certain critically important antimicrobials (i.e., fluoroquinolones, cephalosporins and macrolides). The total returns generated by this tax range between 450 000 to 500 000 euro/year and serve the funding of all AMR and prudent antimicrobial use initiatives supported and financed by FAGG – AFMPS and relevant data collection and analysis (e.g., taxes are used to finance AMCRA, BelVet-Sac, the SANITEL-MED application).

### 5.4.2 DENMARK

**Score of '<u>practices</u>' measures in the TrACSS 2019-2020: 16/16**

Disease prevention is the keystone of the Danish pig health system. The concentrated pig industry in Denmark facilitated the effective voluntary bans on the use of antimicrobials. Furthermore, strict industry-driven control of washing and disinfection of lorries transporting animals across the border, limited import of animals, industry rules for quarantine of imports and the Danish Specific Pathogen Free system tool (SPF) have effectively kept Denmark free from several pig diseases. SPF was established in 1971 for the control and improvement of animal health on pig farms. Based on biosecurity measures, health and transportation control, around 75% of Danish pigs are under the SPF system. Besides its use by veterinarians, this system makes public the herd status of each individual herd, used for trading animals between herds. The biosecurity measures are also very strict in Danish pig farms. Besides the SPF system, separate quarantine sections with stricter biosecurity measures and a separate chamber for disinfection before entering the pig facility contribute to reduction of diseases. The sales of pig vaccines have also considerably increased. The herd veterinarians play a central role and

their close collaboration with the farmer is crucial for ensuring the effectiveness of her health strategies. Written reports are issued from the veterinarians' mandatory monthly herd health visits.

In Denmark since 1995 veterinarians were no longer allowed to sell veterinary prescription medicines to farmers to make a profit (only supply on the set price), removing an eventual economic incentive for the prescriptions. The establishment of Veterinary Advisory Service Contracts (VASCs) between farmers and veterinarians allows farmers to stock medicines and treat animals throughout the month following the herd health plan until the next veterinarian monthly visit. Between 1995 and 2010 VASCs were voluntary, and then became mandatory for all large pig herds. The Danish pig herd veterinarians are highly trained experts focused on preventive medicine in order to cope with the continued national efforts to reduce AMU. Danish veterinarians are also supported by prescription guidelines issued by the authorities together with research institutes and industry to achieve the optimum clinical effect of treatment, which consider the human health aspects in their recommendations.

Since the 1990s Denmark has established action plans, integrated in the legislation, for reducing levels of Salmonellae in beef, pork, eggs, and poultry meat and consequently the related human infections. The DVFA conducts inspections to verify the compliance with regulations, providing advice and raising awareness on specific themes to veterinarians, farmers, and industry.

In Denmark, since the 1995 avoparcin is prohibited by law as growth promoter in broiler production. Subsequently in 1998, virginiamycin was also prohibited in broiler, cattle and finishing pigs. Voluntarily, still in 1998 the pig industry ended the use of all antimicrobial growth promoters in finishing pigs. Consequently in 1999 all antimicrobial growth promoters were banned in food-producing animals.

Therapeutic and metaphylactic use is permitted, while prophylactic use of veterinary antimicrobials is forbidden by the Danish law. The DVFA conducts regular inspection to verify the welfare of animals submitted to reduced antimicrobial treatments. All antimicrobials must be administered under the supervision of the herd veterinarian. In the 2000s the veterinarians were audited and benchmarked with colleagues. If any inconsistences or problem was detected, the auditor advised the veterinarian about the new legislation. This practice was replaced by the yellow card initiative in 2010. This initiative was created with the intention of reducing the high antimicrobial use detected in the 2000s, especially in the pig sector.

Launched by the DVFA with support from the industry, the DVA and the Danish Agriculture and Good Council, its initial target was the high consumption farms. It is based on the VetStat database on AMU and attributes a yellow card (warning signal) to farmers exceeding the preestablished thresholds set by the DVFA. Once a 'yellow card' is issued, the farmer has a limited time frame to reduce the antimicrobial consumption, otherwise this farmer receives a 'red card' with further legislative implications, including a mandatory reduction of the stocking density of animals. The system is proving successful for reducing AMU to the government target levels and fighting AMR at national level. The system was further developed by adding a multiplication factor to the antimicrobials more sensitive of causing AMR from a One Health perspective.

From 2013, differentiated taxes on antimicrobials for veterinary use were implemented, which achieved 11% of increase in fluoroquinolones and third- and fourth-generation cephalosporins. The high number of cases of LA-MRSA found in the Danish pig herds lead the authorities to establish expert panels for scientific advice in 2014 and in 2017. This resulted in the reduction of use of tetracyclines, and a target was set to reduce antimicrobial use in pigs by 15 percent by 2018. Other biosecurity measures became also recommended, such as mandatory showering, changing of clothes, handwashing, and disinfection.

### 5.4.3 FRANCE

**Score of '<u>practices'</u> measures in the TrACSS 2019-2020: 16/16**

The first EcoAntibio 2012-2016 plan aimed to reduce the use of antimicrobials by 25% in five years, with particular attention being paid to the use of antimicrobials of critical importance in veterinary and human medicine. These are used when the antimicrobials first prescribed are ineffective. The main objective of the first plan was met, with a 37% decrease in animal exposure to antimicrobials during the five-year period. The new EcoAntibio 2017-2021 plan aims to ensure that the decline in animal exposure to antimicrobials is sustained. It provides for communication and training measures, access to alternatives to antimicrobials, and improved prevention of animal diseases. A specific objective for colistin, is a 50% reduction in five years in the cattle, pig and poultry sectors.

The Act on the future of agriculture, food and forestry from 2014 set a target of a 25% reduction in three years in the use of fluoroquinolones and third- and fourth-generation cephalosporins, with 2013 being the reference year. This objective was achieved and even greatly exceeded in 2016. There is no targets for maximum acceptable levels of antimicrobials on herds and flocks on a national base and only private standards have their own criteria to include herds and flocks. ANSES recommended to reserve the use of latest-generation cephalosporins and fluoroquinolones for specific situations, which should be clearly identified by sector and strictly controlled. The French pig sector had already acted in this direction by introducing in 2010 a volunteer ban on the use of these antimicrobial classes in pig medicine.

The Ecoantibio2 – Action 12 aims at: reducing by 50% in 5 years the exposure to colistin in cattle, pigs and poultry and strengthening control and monitoring of colistin use and resistance development, by defining relevant monitoring indicators, using monitoring methods and indicators shared with the human medicine sector. In addition to these antimicrobials, 50 antimicrobials were classified as "human antimicrobials". Their use is not authorized in veterinary medicine because they are antimicrobials of last resort in human medicine. Veterinary medicinal products have specific marketing authorization for specific species when the clinical studies have been done. However, in some instances, when no veterinary products are available for the specific species, products registered for human use or veterinary product allowed for another species are allowed in animals with a specific regulated prescription system called "la cascade" in France (ARTICLE L. 5143-4 du Code de Santé Publique) with specific milk and meat withdrawal periods (7 and 28 days respectively).

All antimicrobials are by prescription given by the veterinarians following the farm. Therapeutic guidelines have been edited for example by pig veterinarians for the main diseases. The prescriptions of veterinary antimicrobials are regulated in France since 1975 (pharmacists and veterinary doctors are the only ones who can supply veterinary medicinal products). Before any prescription and sale of veterinary medicinal products, the veterinarian must do a diagnosis. The veterinarian is allowed to prescribed antimicrobials or medicated animal feed only if she is the health advisor of the farm with a permanent health monitoring of the animals which includes annual health check-up, care protocol, follow-up visits and regular care. A diagnosis is necessary before to use them but, at the moment, there is no ban on prophylaxis and metaphylaxis practices. Practice vets should make mandatory sanitary visits in cattle, poultry, and pig farms. Farmers are allowed to apply medicinal treatments to the animals of their holding, for curative or preventive purposes. Farmers must then keep a livestock register and keep veterinary prescriptions for at least five years to be able to follow the treatments carried out in their livestock. All herds having access to medicine have health advisory contracts with veterinarians.

Susceptibility testing is required if a second-choice antimicrobial is chosen and often for the first choice for pig and poultry. Two compulsory sanitary visits have been implemented by the law especially on the biosecurity theme. Moreover, in all herds, veterinarians give advice on biosecurity. Recently, new regulations have been implemented for pig and poultry farms to answer to the threat of Influenza viruses and African swine fever.

The French Agency for Food, Environmental and Occupational Health and Safety expert assessments give the information to all the practices for a prudent use of antimicrobials. Moreover, some therapeutical guidelines have been edited by species to help the veterinarians to make choices in their prescription. Further legislation also comes to support the agency in achieving its goals. Decree no. 2007-596 of 24 April 2007 on the conditions and modalities of prescription and retail supply of veterinary medicinal products and amending the Public Health Code (regulatory provisions). Decree of 22 July 2015 on good practice for the use of medicinal products containing one or more antimicrobial substances in veterinary medicine.

The Government, through the General Secretariat for Investment, is setting up a Priority Research programme (PPR) on antimicrobial resistance with €40 million over 10 years. Ecoantibio plan: incentive research with calls for projects every year (2 millions €/year): 190 research or action projects have been financed or co-financed since 2013 with projects focusing on prevention (vaccination, zootechnics…) or antimicrobial resistance (laboratory technics, resistance mechanism…). The goals are the extension of knowledge in immunology to enable development of vaccines against bacterial diseases; Research into alternative treatment methods and the mechanisms underlying resistance; and Methods for the assessment of the risks of antimicrobial resistance.

Humans: Three human national plans were undertaken in 2001–2005, 2007–2010 and 2011–2016 by the Ministry of Health, with the help of the French National Health Insurance system. Interventions were directed at the public, general practitioners (GPs) and hospitals, and included TV campaigns targeting unnecessary antimicrobial prescription. Other measures targeted antimicrobial use in hospitals. In 2012, the French National Health Insurance system introduced a pay for performance process for general practitioners and specialists, with a quantitative indicator targeting a 5% reduction (42% to 37%) in the proportion of patients between 16 and 65 years treated with antimicrobials (excluding patients with long-term illnesses). The first results of these plans were quite impressive and exceeded expectations, with a 26.5% reduction in antimicrobial prescriptions in ambulatory care over the first five years (between 2001 and 2005), especially for young children targeted by the campaigns, and a 50% decrease in penicillin-resistant Streptococcus pneumoniae rate. In parallel, antimicrobial consumption was also reduced in French hospitals and there was a 50% decline in MRSA incidence in acute-care facilities over 15 years. Unfortunately, the MRSA decline was soon followed by the rising incidence of other multidrug-resistant bacteria, especially third-generation cephalosporin-resistant Enterobacteriaceae.

### 5.4.4 ITALY

**Score of '<u>practices</u>' measures in the TrACSS 2019-2020: 14/16**

Various prudent use guidelines (including species-specific ones) have been developed nationally. Overall, the private and public sector initiatives taken in recent years by the poultry industry and regional pilot projects involving pig farms (especially in the Emilia-Romagna region) leaded to considerable reductions in the use of antimicrobials. Several actions and elements can be pointed as responsible for

such success: improved biosecurity, farm advisory services, focus on infection prevention and control, free diagnostic, and laboratory tests to farmers.

The Italian legislation establishes a system of routine checks on farm biosecurity, implemented by Local Health Services, for poultry and pigs in the framework of surveillance plans for specific infectious diseases (avian flu and salmonellosis for poultry, SVD and CSF for pigs). In addition, pig farms to get and maintain the health declaration relating to Aujeszky's disease and Trichinellosis, are monitored to verify the structural and management requirements of biosecurity, as established by the sector regulation (National Biosecurity Plan for swine farms). The Classyfarm system provides a checklist focused on biosecurity (the Belgian UGhent tool for the pork sector), to carry out inspections on the farms involved in the system. Certification agencies offer protocols for labelling a product or a production system regarding specific standard; some of these standards refer to biosecurity, pest management, animal welfare and the overall quality system implemented. Only veterinarians should prescribe antimicrobials to animals; the prescription should be based on a diagnosis following clinical examination and laboratory tests.

Poultry farmers complying with UNAITALIA national plan, are required to renounce any preventive treatment with antimicrobials both on farm and on the hatchery; consequently, antimicrobials are never administered to healthy animals, in absence of a specific etiological diagnosis. The vaccination program is one of the most preventive and effective measures in health management. In Italy, broilers are currently vaccinated for: Marek Disease, Infectious Bronchitis, Newcastle disease, Gumboro disease, infectious anemia, aviary encephalomyelitis, and viral arthritis and coccidiosis. Along with vaccination other preventive measures are applied and have significantly contributed to the reduction of antimicrobial use namely improved biosecurity and the use of feed additives such as probiotics, prebiotics and organic acids which stimulate the immune system reinforcing the health status of animals and preventing the emergence of bacterial diseases.

Only pharmacies are allowed to sell veterinary medicines to farmers following a veterinary prescription. Veterinarians may not sell medicines to farmers. Medicated feeding stuffs are not supplied to farmers or holders of animals except on presentation of a prescription from a registered veterinarian. Medical sale agents can deliver free samples of medicinal products just to a veterinarian.

The use of the antimicrobial agents classified as Highest Priority Critically Important Antimicrobials (HPCIAs) is strongly discouraged in veterinary medicine, while administering to animals Veterinary Critically Important Antimicrobial Agents (VCIAs) is allowed with restrictions. Antimicrobial metaphylaxis should be prescribed only when there is a real need for treatment. In such cases, the veterinarian should justify and document the treatment based on clinical and laboratory findings on the development of a disease in a herd or flock. Prophylaxis should be reserved for exceptional case-specific indications, when the risk of bacterial infection is highly probable, and the consequences of its spread are serious.

Another action that affected the use of antimicrobial in the pig sector was the limitation in the use of colistin, especially with the introduction of the prohibition of its use associated with other antimicrobials. This fact strongly affected the use of colistin on weaned pigs, which today is almost zero. As consequence the use of therapeutic doses of ZnO increased, replacing colistin. The adoption of specific vaccination plans targeted for each farm gained consensus in 2020. The Experimental Zooprophylactic Institute (IZS), coordinates a project to produce vaccines targeted to specific pathogen strains of each farm. Other preventive strategies based on the improvement of the external biosecurity measures has been recently adopted due to the COVID-19 outbreak as well as the risk of diffusion of African Swine

Fever (ASF) that already reach some EU countries. Together with the aforementioned strategies, the adoption of feeding strategy based on the low crude protein content and the use of feed additives like acidifiers, crystalline amino acids and probiotic, concours in increase the natural resistance of the pigs against pathogens.

An example of cooperation between competent veterinary authorities and trade associations on this aspect is represented by the national plans for the responsible use of veterinary drugs and for the fight against antimicrobial resistance. Supervised and issued by the DGSAF in 2013 and 2015, they aim to apply all the tools necessary to develop and consolidate a preventive approach that reduces the use of antimicrobial therapies, defining targets for reducing their use in the implementation period.

### 5.4.5 MOZAMBIQUE

**Score of 'practices' measures in the TrACSS 2019-2020: N.A.**

Regulations, plans and strategies for a prudent use of on AB in vet medicine are limited in Mozambique, but different initiatives are being developed. The list of the registered drugs (Ministério da Agricultura, 1986): There is list of antimicrobials authorized for animals in the "Formulario veterinario". This list identifies the vet drugs allowed in Mozambique (DIPLOMA MINISTERIAL N° 57/86 de 29 de Outubro 1986). It has been established by the Veterinary Faculty and the National Veterinary Institute. From the 159 listed products, 22 are antimicrobials. This list has been set up in 1986 and has not been updated since. According to many experts it does not reflect the present situation anymore. This list indicates also who is allowed to prescribe antimicrobials. Four types of providers of animal health are identified: 1- Livestock assistants; 2- Livestock technical assistant; 3- Livestock ordinary technician; 4- Veterinarian. But, in practice, there is no need of prescription to buy antimicrobials, and these are sold over the counter. The NAP plans to clarify the legislation, so that only vets would be authorized to prescribe AB use in feed and in farms. But this could be problematic: as the number of vets is very limited in the country, this restriction could reduce AB access for many farmers who need them for their animals. Thus, another section of the NAP mentions the objective to support the sale of AB by "authorized AB vendors" in rural area, to limit constraints to drug access. However, it is not clear who should be the authorized vendors of AB.

The Mozambican National Action Plan Against Antimicrobial Resistance (PNA AMR) has been issued in 2019. It responds to the recommendation addressed by FAO/OMS/OIE made to all countries to adopt a national action plan by 2017.

There is an on-going process for the revision of the animal health regulation and the development of a specific regulation for vet drugs, in collaboration with the Ministry of Health. Vet drugs are supposed to be covered by the animal health regulation. But according to OIE 2015 (Veterinary Legislation Support Programme, VLSP, identification mission in Mozambique): "…there is virtually no legislation on some key elements, including veterinary laboratories, animal welfare, and veterinary medicines and biologicals".

Guidelines for prudent AMU are not developed yet, but the NAP includes the objective of developing knowledge on AMR in the courses for professionals and vet students. The NAP targets the elaboration of a best practice guideline for poultry farmers. Critical antimicrobials are under specific targets.

The NAP puts emphasis on the promotion of vaccination as an alternative to AMU. It also intends to test if an increase in the prices for critical antimicrobials could contribute to reduce their use. Improving hygiene in farms and slaughterhouses is also a priority.

### 5.4.6 NETHERLANDS

**Score of 'practices' measures in the TrACSS 2019-2020: 16/16**

After doubling the use of antimicrobials from 1990 and 2007, the Netherlands applied a series of measures, including strict AMU reduction targets, that achieved a 56% reduction in antimicrobial use in farm animals between 2007 and 2012. They present a best practice example for improving national response through a multidimensional approach to AMR reduction. The action plans include vigorous monitoring of antimicrobial use at the herd level, monitoring AMR and a clear designation of responsibilities for antimicrobial use. Farmers have several legal obligations to address AMR. They may procure veterinary services and medicines from only one veterinary practice. This reduces competition between veterinary practices and ensures the veterinarian knows the farm. Farmers must develop and implement Farm Health Plans (FHP) and Farm Treatment Plans (FTP). Both plans should be collaborations between the farmer and the farm veterinarian. The FHP must review farm-specific risk factors regarding infectious diseases. It must also detail specific management measures to control these risk factors and improve animal health. The FTP is a farm-specific treatment protocol for the most common infectious diseases that can be treated by the farmer (only non-CIAs). Farmers must also register all prescribed and delivered antimicrobials.

Farm and veterinary monitoring and benchmarking ensure updated and reliable information about the AMR and AMU situation. After benchmarking, high users and high prescribers can be subjected to disciplinary sanctions by the private quality systems (integrated chain control; quality assurance systems) and the Royal Dutch Veterinary Association (KNMvD), respectively. They can also be subjected to additional controls of the Dutch Food and Consumer Product Safety Authority (NVWA) of the Dutch Government.

In 2011, after recommendations from the Dutch Health Council (HC), private monitoring systems set up specific regulations that radically restricted the use of 3rd and 4th generation cephalosporins and fluoroquinolones in farm animals. The Veterinary Antimicrobial Policy Working Group (WVAB) of the KNMvD reclassified veterinary antimicrobials into first, second and third choice for use in the existing veterinary treatment guidelines and veterinary practice. Still in 2011, the KNMvD proposed the development of a quality system for veterinarians. Incorporated in this quality system are the development of disease-specific treatment guidelines (in 2013) for veterinarians and the introduction of compulsory post-academic education. Such guidelines are incorporated in private quality systems.

Since 2014, the legislation established that the administration of all veterinary antimicrobials should be performed by veterinarians. When farmers meet specific conditions, they are permitted to apply antimicrobials to their animals without physical intervention of a veterinarian.

Dutch veterinary practices hold their own veterinary pharmacy. This implies that they make a direct profit from the drugs they prescribe to farmers. The government says that the economic motives to prescribe would greatly be eliminated by the benchmarking of antimicrobial prescription VBI and use and introduction of strict 1-in-1 relationships with farmers.

### 5.4.7 SWEDEN

**Score of 'practices' measures in the TrACSS 2019-2020: 16/16**

From the 1986 AGP ban, all antimicrobials were classed as veterinary medicines and were available by veterinary prescription only. Swedish veterinarians are not allowed to sell pharmaceuticals that they prescribe, this "decoupling" of prescription and economic return is regarded as one of the pillars of the low use of antimicrobials. In 1998 the Swedish Veterinary Association (Sveriges Veterinärförbund, SVF) adopted a general policy document for the use of antimicrobials in animals. Since then, specific policies/guidelines for antimicrobial use in dogs and cats, horses and production animals (i.e., cattle, pigs, sheep and goats) have been accepted. The overall goal of the guidelines is to preserve and possibly improve the comparatively favourable situation in Sweden with regard to antimicrobial resistance, limit environmental consequences and provide consumers with safe foods. For production animals this implies achieving a low and controlled use of antimicrobials so that the first-hand choices of treatment remain efficient and that the spread of antimicrobial resistance, among animals and herds as well as in the food chain, is kept at a minimum. The Swedish general policy document augments the essentiality of preventive measures to ensure that infectious disease does not occur. It is of fundamental importance that antimicrobials only be used when necessary and that occurrence of infection should be counteracted, when possible, by preventive measures. If there are equivalent treatment methods without the use of antimicrobials, these should be the chosen course of therapy. Antimicrobial treatment for general prevention ("just in case") in the absence of a confirmed diagnosis is not acceptable and prophylactic use of antimicrobials should never compensate for poor hygiene.

The limited access to antimicrobials puts a high demand on an optimal environment and optimal management routines to reach high productivity and this restrictiveness has an important animal-welfare aspect. With the ban on AGP Sweden began a reform change towards a more sustainable animal production, when big efforts were put into research and field studies on how to prevent disease without the continuous use of antimicrobials.

A lot of work has been undertaken and is still being carried out to improve rearing systems, the construction and climatic conditions of the stables and management methods and to employ available techniques regarding age-grouping, sectioning, and planned production. No negative clinical effects of the ban on AGP were described in the production of slaughter pigs, cattle (milk and meat production) and turkeys. It was in piglet production and in broiler chicken production that the consequences of the ban were the most significant, increasing diseases and mortality. During the years following the ban large efforts were put into field studies and research projects leading to improved management routines, housing systems and changes in feed. As a result, health problems arising as a consequence of the ban could be managed and the initial increase in the prescription of antimicrobials for therapeutic use could be reduced, and in the case of broiler production completely discontinued[11] (Wierup, 2001).

In Sweden there are rules to prevent veterinarians from offering medicinal products for retail sale as they can only be handed out by pharmacies on veterinary prescription. Farmers in Sweden have access to a substantial range of support and advisory services such as Farm and Animal Health, Växa Sverige, the Swedish poultry meat organization and the district veterinarians. The district veterinarians also

[11] Weirup, M. (1996). Sweden banned antimicrobial growth promoters 1986 – what happened to animal health (in Swedish). *K Skogs- och Lantbr Akad Tidskr,* 135(15): 69-78.

perform planned visits with regards to preventive animal health. Farmers working with certain species of animals (i.e. dairy or beef cattle, pigs, sheep, goats, poultry or fur animals that are kept for the production of meat, eggs, wool, fur or skin or farmed fish) can choose to sign a contract with a veterinarian for "conditional use of veterinary medicinal products".

This contract enables them to identify and treat specified clinical conditions with a limited range of veterinary medicinal products. Farmers wishing to enter such a contract need to take an educational course approved by the Swedish Board of Agriculture and the veterinarian must perform regular control visits on the farm (about every 5 weeks). Certain criteria must be met at farm level with regards to animal health and welfare and the use of medicinal products if the contract is to be valid. These criteria and regular on-farm visits from the veterinarian motivate a focus on preventive work. There are currently no specific legal requirements for authorization and distribution of veterinary medicinal products containing critically important antimicrobials, there is however legislation restricting the use of such substances since 2013.

The Swedish Farmer´s Disease Control Program (Svenska Djurbönders Smittskyddskotnroll, SDS) was formed in 1995 when Sweden joined the EU. Farmer owned, it has the objective of implementing voluntary stricter health controls of imported animals than the official requirements set by the Swedish Board of Agriculture. These import requirements must be followed to be allowed to send animals to the slaughterhouses and to deliver milk to the dairy plant for example. Strict conditions for import help to prevent introduction of diseases and aid in eradication programs. Furthermore, specie-specific-disease national programs are also in place to prevent diseases outbreaks for the potentially most problematic ones. For example, authorities and the industry work in close collaboration to prevent and eradicate *Salmonella* thorough legislated and voluntary control programs. If salmonella is detected in a farm level, restrictions are put on the facility, blocking all movements of animals and animal products, and an eradication plan is initiated. How this is done depends on animal species, type of production, salmonella type etc. Hygiene and management routines are enforced, the facility is cleaned and disinfected, and manure and other potentially contaminated products are destroyed or disposed of. Sometimes it can be necessary to kill animals on the farm for welfare reasons instead of waiting for natural healing of the infection, or to be able to empty and clean infected areas. In the case of salmonella outbreak at poultry farms, all animals are euthanized instantly because any other way to stop the infection is not practically possible.

In 1988 the Swedish poultry meat organization, together with authorities, started a control program with the purpose of reducing Campylobacter in Swedish poultry. In 2001 this control program was upgraded to a four-year EU-financed project together with the Swedish Board of Agriculture, Swedish Food Agency, SVA and the Public Health Agency to perform targeted studies on individual farms with the purpose to further reduce the number of positive flocks. Today the program is driven by the Swedish poultry meat organization and besides testing for Campylobacter in every flock in connection with slaughter, targeted studies are being performed. PRRS was first detected in Sweden in 2007 in a sample taken within the surveillance program. The outbreak was combatted thanks to a resolute intervention from the industry and the government and PRRS was eradicated the same year. Since 2008 the program constitutes both sampling of pigs at slaughter and in herds.

Sweden also has a high level of on-farm biosecurity with quarantine for breeding animals and animals that are being bought into the herd, strict hygiene requirements for visitors and deliveries as well as for feed/water and good routines for managing pests and dead animals leading to a better hygiene

and healthier animals. A lot of focus is also put on housing design, stocking density and the quality of the feed. Sweden has stricter animal health- and welfare regulations than the rest of the EU.

Veterinary rights to prescribe certain antimicrobials was limited in 2013 with the introduction of SJVFS 2013:42. In Swedish legislation there are restrictions for the use of quinolones and 3rd and 4th generation cephalosporins to exceptional cases where susceptibility testing demonstrate an absolute need, and a ban on veterinary use of certain antimicrobial substances (SJVFS 2019:32, D9).

### 5.4.8 SWITZERLAND

**Score of 'practices' measures in the TrACSS 2019-2020: 13/16**

Since 1999, it has been prohibited to add antimicrobials to animal feed to boost their performance as AGPs. The use of AM to produce imported meat has to be labelled. In 2004, new legal obligations (OMedV) were introduced concerning the use of veterinary medicinal products, among which the following rules: obligation to record all use of medicinal products by the veterinarian and by animal keepers in the field of production animals, visits the herd veterinarian on the farm in the event of the delivery of drugs as stocks, or the ban on the use of antimicrobials in production animals without veterinary prescription. In addition, since that date, the cantonal veterinary offices have carried out regular checks on farms, relating to compliance with the obligation to record and the storage of medicines.

In 2016, the new Federal Act on Medicinal Products and Medical Devises (Therapeutic Products acts - TPA; SR 812.21) entered into force and initiated the revision of the veterinary ordinance OMedV (TAMV SR 812.212.27). Critical antimicrobials (Dephalosporine 3th/4th Generation, macrolide flourchinolone) may no longer be kept on stock by farmers and with the exception of treatments for mastitis. The OMeDV encourages contracts between vets and farmers; such a contract allows stocks of medicinal products except for AMs. The revision of the Veterinary Medicines Ordinance (OMedV) of 2016 states: it is forbidden to supply antimicrobials as stocks for the preventive treatment of production animals (prophylactic).

A Veterinary therapeutic guide to decide whether the use of antimicrobials is necessary or not and, if so, to choose the appropriate antimicrobials, was developed by the Vetsuisse faculty and the specialist sections of the Society of Swiss Veterinarians (SVS), under the coordination of the OSAV and in collaboration with the SVS. The first version, published in early 2017, was limited to the most important pig and cattle diseases. Recommendations on diseases in sheep and goats are under development. A similar guide for small animal medicine is also in preparation. The recommendations in the treatment guides have all been included in the online tool "AntimicrobialScout". This tool is an online help tool for the prudent use of antimicrobial substances.

A guide on pig vaccination has been produced. It contains technical and scientific recommendations and gives veterinarians a quick overview so they can choose the right vaccination strategy. In the case of calves, a research project aims to establish basic principles, which should be incorporated later in the guide on vaccination. In dairy cows, selective drying-off is increasingly considered and is making a major contribution to reducing the use of antimicrobials in veterinary medicine.

Swissnoso (national centre for the prevention of infections) draws up and publishes recommendations aimed at combating infections, and all university hospitals now have internal guidelines in this area. A new online tool aims to encourage physicians to be more rational in the use of antimicrobials. The site

www.infect.info presents in a clear and intuitive way the most recent data concerning the antimicrobial resistance of different bacteria, both regionally and nationally.

In 2019, a new guide to avoid AMR for farmers was published by Agridea. It informs farmers about AMR and gives a focus on preventive measures and animal health, welfare, breeding strategies, feeding and biosecurity. The guide contains a list of good practices for cattle, pig and poultry.

The NFP 72 research project will end in 2023. Up to now, first results of a veal calf fatting systems using less AM was presented in 2021. The so called "outdoor veal calf", veal farmers should only buy new calves from local farmers, thus the short transportation distances make it unnecessary to mix animals from different farms. During the first few weeks after arrival, the calves are housed outdoors in individual igloos and vaccinated against pneumonia. They are moved to small groups of up to ten calves, where they spend the remainder of their fattening period (four months on average), only after this quarantine period. During that time, the calves always stay outdoors, where they have constant access to a group igloo and to a covered paddock with deep straw bedding.

### 5.4.9 UNITED KINGDOM

**Score of '<u>practices'</u> measures in the TrACSS 2019-2020: 14/16**

The first antimicrobials legislation in the UK was the 1947 Penicillin Act which stipulated that antimicrobials could only be prescribed by doctors and veterinarians because of concerns about resistance. This was reversed in the 1953 Therapeutic Substances Act which allowed for the inclusion of antimicrobials in animal feed because of a desire to improve productivity and reduce imported feed (Kirchhelle, 2018). Antimicrobial use and resistance in livestock were of growing concern to the public in the 1960s, in part thanks to the publication 'Animal Machines' by Ruth Harrison which details animal health and welfare and public health concerns associated with 'industrial' farming practices. The influential Swann report published in 1969 linked antimicrobial use in livestock with resistance in humans (Kirchhelle, 2018). The report also recommended the teaching of preventive veterinary epidemiology in university veterinary courses. The report recommended a ban on the use of certain antimicrobials of important therapeutic use as growth promoters. According to Kirchhelle (2018) this was a landmark in precautionary legislation. The report did not however suggest a ban on preventive use of antimicrobials, which were used in higher doses than growth promoters. This is seen as a compromise between the different interests involved in the creation of the report (Kirchhelle, 2018).

However, antimicrobial use and resistance continued to rise in the UK livestock sector in the following decades. The UK implemented a programme to monitor meat for resistance in 1981 after joining the EEC in 1973. In the 1980s the UK government rolled back involvement in animal health to zoonotic and exotic diseases through a neoliberal policy framework (Woods, 2011). In an attempt to restore public trust in agriculture after the BSE crisis, the UK government supported the EU ban of additional antimicrobials as growth promoters and the systematisation of antimicrobial monitoring (Kirchhelle, 2018).

Responsibility for livestock biosecurity has been increasingly devolved from central government to devolved administrations in recent decades: from Westminster to the National Assembly for Wales in 2006 (National Assembly for Wales, 2011); to the Scottish parliament in 1999; to the Northern Ireland Assembly in 1998 (Northern Ireland Office, 1998); and devolution of the animal health budget to England, Scotland and Wales in 2011 (Defra, 2011).

The use of antimicrobials in farm animals is currently regulated by the Veterinary Medicines Regulation 2013. This covers the manufacture, supply, sale and use of antimicrobials. According to the regulation, antimicrobials can only be prescribed by a veterinarian when the animal is under the veterinarian's care and when they have carried out a clinical assessment of the animal (HM Government, 2013).

The UK left the EU on the 31st of December 2020 following the Brexit referendum. The Great Repeal Bill implemented in 2018 repeals the European Communities Act 1972 and provides legal authority for EU law to have an effect as domestic law. It is unclear how the Veterinary Medicines Regulation will be implemented into UK law. UK legislation does not currently ban preventive use of antimicrobials. The Veterinary Medicine Directorate published a "Code of practice on the responsible use of animal medicines on the farm" in 2014 which does not endorse routine use of antimicrobials. Though the UK government's 2019 five-year action plan for tackling antimicrobial resistance does not mention the ban of preventive use in livestock.

Following Brexit, imports of pharmaceuticals from the EU to the UK must receive authorisation as of June 2021 (HM Government, 2021).

### 5.4.10 VIETNAM

**Score of 'practices' measures in the TrACSS 2019-2020: 13/16**

The FAO and the DLP have developed in link with the Extensional Centres, biosecurity guidelines, supports for training of trainers and communication support. Training to become Biosecurity model farms (followed by DLP and FAO) - program from 6 months to 1 year (practices and infrastructures) with control of FAO members three times per farms. Farmers should then share their experiences with others during Model Farms Opening Days. Poultry has been chosen to start working on biosecurity and on animal registration. The NAP also points the need to develop alternative medicines. In Vietnam, there are several companies producing alternative medicines as essential oil or yeast.

In the NAP, research institutes are tasked with some activities, such as assess awareness on AMU and AMR management, development of the AMU and AMR communication and guidance package, quantifying the impacts of AMU management in livestock production and aquaculture and the occurrence of AMR in livestock production and aquaculture, AMR surveillance programme in livestock production and aquaculture and share AMR surveillance results to relevant stakeholders.

Pork, poultry have been first targeted by the surveillance programme, which will be extended to aquaculture products (fish and shrimps).

Veterinary Medicines Products are defined in the law on Animal Health that specify the condition of sales, import, export, manufacture, and trading (2015). The list of veterinary drugs permitted to be marketed and banned from use in Vietnam was also published under a circular (2016). In the NAP implemented in 2017, the stress has been put in the need to improve legal documents for AMR and AMU management and to monitor their implementation and the Flehming Fund report (2019) has also highlighted several lake or contradiction in the legislation.

Antimicrobials are not allowed anymore in the feed for growth promotion since 2018 (law on animal husbandry). This law has been further developed by a decree in 2020: antimicrobials in medicated feed for disease prevention in "young animals" (0-21 days for chickens) will be forbidden for particularly important antimicrobials for humans by 31/12/20, for very important antimicrobials by 31/12/21, for important antimicrobials by 31/12/2022, and all the others by 31/12/2025 (cf decree on Animal law

2020). Prescriptions of antimicrobials are under the supervision of a veterinarian (law on Animal Health, 2015 and circular and decree, 2017). However, antimicrobials can be bought without veterinary prescription. A new circular that defines the condition of prescription, the need of this prescription to sale an antimicrobial as well as recording prescription has been implemented in 2020.

### 5.4.11 Summary of findings and main successful actions: Practices

- The yellow card initiative in Denmark is a very effective measure to identify high antimicrobial users among farmers (and their veterinarians), and associate penalizations. It's also an important instrument for reducing the usage of critically important antimicrobials.
- High level of on-farm biosecurity with quarantine for breeding animals and animals that are being bought into the herd, strict hygiene requirements for visitors and deliveries as well as for feed/water and good routines for managing pests and dead animals lead to a better hygiene and healthier animals and reduce AMU.
- Antimicrobial use as growth promoter must be banned in all countries as a Global initiative. Countries that still allow such practice should initiate a stepwise phasing out, inspired on countries that already did. This measure can be required through international conventions and trade agreements.
- Imported meat and dairy products should comply with the same restrictions on animal health and welfare, AMU, and AMR.
- The 1986 AGP ban and the 1998 general policy document for the use of antimicrobials in animals leaded Sweden to a complete transformation on animal husbandry towards a more sustainable animal production, with big efforts put into research and field studies on how to prevent disease without the continuous use of antimicrobials.
- A strong animal health and welfare regulation is an important measure to ensure better practices at farm level and consequent AMU reduction. In the fight against AMR, it could be useful to put the focus on preventive health work and optimal environments rather than on the lowering of antimicrobial use.
- Stricter regulations jointly defined and agreed within the sector, have the power to change farmers' and veterinarians' attitudes and behaviour on antimicrobial use has over time.
- Special economic/bonus incentives for broiler producers following the animal welfare program are improving the total level of quality for the production in Sweden. Producers with low standards are forced out of business.
- Regulations, inspections, and border controls of imported animals help in the prevention of cross-country contamination.
- Countries still allow the prophylactic use of AM
- In the Netherlands, veterinarians can still sell drugs. A 1 in 1 - veterinarian in farm mandatory system and an effective benchmarking system attempt to remove the economic motivation from the veterinarian to sell drugs.

- In a franchising-like association with the farmer, the most common production system in the Italian pork and poultry sectors, the integrated company veterinarian manages the health status of the farm and the choices related to the medication. The integrated company can also produce medicated feed, having an even stronger influence in the AMU. Guidelines of good practices at regional and national level and vaccination programs are supporting AMU reduction in Italy.
- Vaccination programs, strict rules on prophylactic use and the online tool containing a veterinary therapeutic guide for the prudent use of antimicrobials are among the main practices supporting a reduction of AMU and AMR in Switzerland.

## 5.5 Results Policy Domain 4: Governance

"Governance is the sum of the many ways individuals and institutions, public and private, manage their common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and co- operative action may be taken. It includes formal institutions and regimes empowered to enforce compliance, as well as informal arrangements that people and institutions either have agreed to or perceive to be in their interest" (Commission on Global Governance, 1995).

Governance mechanisms require a One Health, multi-stakeholder approach and involves nongovernmental resources. The World Bank estimates savings in the range of 10 to 15 % of the total costs of a global surveillance and disease control system with the One Health approach compared to separate animal or human health campaigns (The World Bank, 2012).

Table 5-3 shows the main national and international actors involved in the governance and their concerns regarding AMR.

*Table 5-3 Global governance of antimicrobial resistance (AMR): sectors, actors and frames*

| Sector | International Organizations | National actors | Main concerns |
|---|---|---|---|
| Human health | WHO | Ministry of Health | Health impact of AMR on human health |
| Animal health | OIE | Ministry of Agriculture | Health impact of AMR on animal health |
| Food system | FAO | Ministry of Health/ Agriculture | Transmission of AMR through food systems |
| Environment | UNEP | Ministry of Environment | Consequences of AMR on the environment |
| Development | UNDP | Bilateral development agencies | AMR as an obstacle to development |
| Trade and Intellectual Property | WTO, WIPO | Ministry of Trade | Market failure and lack of access to antimicrobials |

| | | | |
|---|---|---|---|
| Security | UN Security Council | Ministry of Foreign Affairs | AMR as threat to the stability of social systems |

Source: adapted from Wernli et al., (2017)

### 5.5.1 BELGIUM

**Score of 'governance' measures in the TrACSS 2019-2020: 10/13**

In Belgium, two entities have been focussing on AMU and AMR in veterinary medicine: the non-profit organisation AMCRA (Knowledge Centre for the Use of Antimicrobials and Antimicrobial Resistance in Animals) and the Belgian Antimicrobial Policy Coordination Committee (BAPCOC).

BAPCOC is a multidisciplinary body that is competent for the collection of data regarding antimicrobial consumption and resistance in different ecosystems as well as information and awareness-raising thereto (Royal Decree of 26 April 1999). The committee is composed of five working groups: ambulatory medicine, hospital medicine, platforms for hospital hygiene, awareness-raising, and veterinary medicine; the last of which is in close collaboration with AMCRA and endorsed the goals of AMCRA's first strategic plan (2016-2020 strategic plan (; halving the use of antimicrobials by the end of 2020, reducing by 75% the use of most critical antimicrobials by the end of 2020 and halving the use of medicated premixes containing antimicrobials by 2017) for its 'Policy paper for the 2014-2019 term.

AMCRA is the Knowledge Centre for the Use of Antimicrobials and Antimicrobial Resistance in Animals. Its executive board is composed of representatives of the pharmaceutical industry (Pharma.be), Farmers' association (Boerenbond), veterinarians' association (SAVAB-Flanders, VDV and UPV), feed association (BFA) and of the academic world (UGhent). Together with the Steering committee (BAPCOC, FAMPH & Federal Agency for the Safety of the Food Chain (FASFC)), the executive board defines the objectives to be achieved, which are then translated into an action plan (AMCRA's vision). Over time, AMCRA has moved from developing guidelines for self-regulation of the animal industry to co-regulation with the Belgian government, by translating its two action plans (2017-2020 and 2021 to 2024) into covenants, signed by the Federal Government (Ministers for Health and for Agriculture and relevant agencies), AMCRA and all sector partners relevant to reducing antimicrobial use in the veterinary sector. The latest covenant, implemented in January 2021, contains the strategic reduction targets set out in the AMCRA for 2021-2024 plan, financial information, information about AMCRA's support, the commitments of the different stakeholders and the measures that can be taken by public authorities if the set targets are not met, as the convention is based on co-regulation. To get the relevant sectors to commit themselves as much as possible, efforts were made to ensure full representation of the different (sub)sectors within the covenant, including the pet sector, the "Orde of veterinarians" and AB-Register, which manages an AMU monitoring system for several quality labels. The relevant stakeholders were also given the opportunity to annex a list of actions that will contribute to the achievement of the strategic objectives. A steering committee is also evaluating the convention yearly. The establishment of such covenants also means that the government will only set regulations if the sector fails to achieve the set goals.

In addition to being translated into a covenant, AMCRA's action plan 2021-2024 was also incorporated into the recently released One Health National Action Plan AMR, following the June 17, 2016 Council conclusions. The drafting of the plan was coordinated by the Federal Public Service Public Health, Food Chain Safety and Environment (= Federal Ministry), the Federal Agency for Medicines and Health Products (FAMHP), the Federal Agency for the Safety of the Food Chain (FASFC), the National Institute for

Health and Disability Insurance (NIHDI), Belgian Antimicrobial Policy Coordination Committee (BAP-COC) and the Knowledge Centre for the Use of Antimicrobials and Antimicrobial Resistance in Animals (AMCRA), but has not yet been validated by the federal government. Pending government validation, AMCRA's vision 2021-2024 was already translated in an official covenant, as stated above.

### 5.5.2 DENMARK

**Score of 'governance' measures in the TrACSS 2019-2020: 12/13**

In 2010 Denmark established the Danish National Antimicrobial Council in 2010, with representatives from government, universities, hospitals, veterinarians, and other stakeholders to discuss and find solutions to the national and international problems attributed to AMU and AMR using a One Health approach. The Danish Veterinary Association regroups the private and public veterinarians. These stakeholders discuss the animal health, welfare and use of antimicrobials for food-producing animals related issues inside the Danish Veterinary and Food Administration (DVFA). The DFVA is also responsible for the inspections and auditing of veterinarians, farmers, and industry. The whole agri-food supply chain is controlled by the Ministry of Environment and Food of Denmark (MEFD).

In 2017, politicians decided to set up an Advisory Committee on Veterinary Medicines, establish new national targets for antimicrobial use and reduction, and highlight champion farms. It comprises both human and veterinary professionals. They form an independent committee to advise the Minister of Environment and Food on veterinary issues. As a consequence of initiating AMU monitoring in the 1990s, the DVFA published guidelines for veterinarian prudent AMU. After the launch of the first 2010 One Health NAP, these guidelines were revised, and health authorities released guidelines for prudent AMU in humans, targeting reduction in critical antimicrobials. The veterinarian guidelines were again revised in 2018, after the publication of the second One Health NAP in 2017.

The pig sector in Denmark is highly concentrated in large cooperatives owned and controlled by farmers. This structure facilitates the organization of all kinds of initiatives (research, dissemination of best practices, etc.) at country level, including those related to AMU and AMR issues.

### 5.5.3 FRANCE

**Score of 'governance' measures in the TrACSS 2019-2020: 9/13**

The Ecoantibio Plan (the French NAP) is a public policy set up by the Ministry of Agriculture, Agrifood and Forestry. It relates to all animal sectors (including pets) and covers all French territories. The aim of the Plan is to reduce the risks of antimicrobial resistance in veterinary medicine and to safeguard the efficacy of the antimicrobials as recommended by the tripartite. The first Ecoantibio Plan, launched on 2011, was spread over five years, from 2012 to 2016 inclusive. Following the globally recognised success of the first Ecoantibio Plan 2012-2016 (a reduction of 37% over five years), the objective now is to consolidate these results and continue the efforts under way. The second 2017-2021 Ecoantibio Plan promotes prudent, calculated use of antimicrobials. Over time, it aims to reduce the exposure of livestock to antimicrobials. It provides for communication and training programmes, access to alternatives to antimicrobials and improved prevention of animal diseases. The Ecoantibio Plan, promoted by the Ministry of Agriculture, is part of a wider project known as the Agro-Ecology Project.

In 2015, the Minister of Health appointed an expert group to make concrete proposals, specifically in the field of research and development of new antimicrobials and new diagnostic tests. New measures are undertaken with the new National Health Strategy 2018-2022. In 2012 the French National Agency for Medicines and Health Products (ANSM) was created.

The authorities involved in the strategy are the French Ministry of Agriculture, Agrifood and Forestry; French Agency for Food, Environmental and Occupational Health & Safety (Anses); French Ministry of Health; French National Agency for Medicines and Health Products (ANSM).

### 5.5.4 ITALY

**Score of 'governance' measures in the TrACSS 2019-2020: 8/13**

The national One Health action plan (NAP or PNCAR) on AMR was adopted in November 2017 in Italy. The plan was prepared by a Working Group, set up in 2015 at the general direction (GD) for Health Prevention, in which participated the GD for Animal Health and Veterinary Medicines, the GD for Hygiene and Food Safety and Nutrition participated, the GD for health planning, the GD for medical devices and the pharmaceutical service, the GD for research and innovation in health, the Italian Medicines Agency (AIFA), the ISS, representatives of the Regions and some scientific societies. On 2017, by decree of the Director General of Health Prevention, the Working Group for the coordination and execution of PNCAR and the national law enforcement strategy was established, in which, in addition to the stakeholders already identified for the drafting of the Plan, also participated the Ministry economy and finance (MEF), the Ministry of Agricultural and Forestry Policies and the Ministry of the Environment, as well as Cittadinanzattiva.

The Italian Ministry of Health (MoH) is the central body of the National Health Service. It is organized in a General Secretariat and 12 Directorates-General. The following three Directorates deal with hygiene and food safety, nutrition and veterinary public health and are directly involved in actions related to AMR: Directorate-General for animal health and veterinary medicinal products (DGSAF); Directorate-General for hygiene, food safety and nutrition (DGISAN); Directorate-General for collegial bodies for health protection (DGOCTS). The Ministry of health drawn the action plan to prevent antimicrobial resistance (PNCAR) and the pharmaco-surveillance programme. Its tasks also involve monitoring the training activities for veterinarians and farmers arranged by their professional associations, regarding the prudent use of antimicrobials. Other institutes involved on AMR actions are the Regional and Local Health Services; the Veterinary Public Institutes Network (IIZZSS – Experimental Animal Disease Prevention Institutes); the National Health Institute (ISS).

At National Level, a first Plan for the responsible use of veterinary medicines and the fighting against antimicrobial resistance in poultry was adopted in 2015 for the period 2015-16, which was followed by the 2017 NAP.

### 5.5.5 MOZAMBIQUE

**Score of 'governance' measures in the TrACSS 2019-2020: N.A.**

The Mozambique has joined the Global Antimicrobial Resistance Partnership (GARP) and a situational analysis has been published in 2015. From 2012, the Mozambique has been working for designing a NAP on AMR; following the recommendation addressed by FAO/OMS/OIE made to all countries to

adopt a national action plan by 2017[12]. The Mozambican National Action Plan Against Antimicrobial Resistance (PNA AMR) has been issued in 2019. The cost for implementing the NAP has not been estimated yet; and the sources of funding have not yet been identified.

The national authorities that involved in the implementation of the NAP are the ones that have been involved in designing it: Ministry of Health (MISAU): National Directorates of Pharmacy, Public Health and Medical Assistance; Ministry of Agriculture and Food Security (MASA): National Veterinary Directorate (Dinav); Ministry of Land, Environment and Rural Development (MITADER); Ministry of the Sea, Inland Waters and Fisheries (MIMAIP); Ministry of Economy and Finance (MEF); Ministry of Public Works, Housing and Water Resources (MOPHRH); Ministry of Education and Human Development (MINED); Technical group, composed of several sub-groups according to the specifications, should include: Academics and clinical specialists covering the following specialties: Microbiology, Pharmacy, Clinical Pharmacology, Pediatrics and Internal Medicine, Infection Control, Infectious Diseases, Veterinarians, Public Health, Strengthening Health Systems, Sanitation, Public and Private Laboratories; Order of Veterinary Physicians; Medical Association and professional associations; Order of Nurses; Association of Pharmacists; Research institutions; Education and training institutions, colleges of health and veterinary sciences; National inspection; Representatives of food producers and livestock associations, traders, owners of pharmacies and laboratories; Representatives of patient organizations and civil society; Donors and partners such as WHO, FAO, USAID, OIE and Centre for Disease Control and Prevention (CDC).

This process has stimulated the revision of the veterinary legislation and the design of veterinary drug legislation. This process has been initiated in 2015, with the support of OIE (through the Veterinary Legislation Support Programme, VLSP). This process relies also on guidelines edited by SADC, Southern African Development Community in 2011 ("Regional guidelines for the regulation of veterinary drugs in SADC member states").

### 5.5.6 NETHERLANDS

**Score of 'governance' measures in the TrACSS 2019-2020: 11/13**

In 2008 it was set-up the Taskforce Antimicrobial Resistance in Animal Husbandry. This taskforce comprised representatives from all parties within the animal production chain (advocacy organizations of farmers, meat processing industries, feed suppliers), the Royal Dutch Veterinary Association (KNMvD), the Ministry of Agriculture and the Ministry of Health. This Taskforce developed action plans per animal production sector (cattle, veal calves, poultry, and pigs) as part of a Memorandum of Understanding (MoU), with the aim to control antimicrobial resistance in livestock. The action plans aimed at detailed monitoring of antimicrobial use at herd level, the monitoring of antimicrobial resistance, a clear separation of responsibilities for veterinarians and farmers in antimicrobial prescriptions and the introduction of Farm Treatment Plans and Farm Health Plans. In 2010, the independent Netherlands Veterinary Medicines Authority (SDa) was established as a public–private partnership between the government, the KNMvD and livestock industries. The task of the SDa is (i) to collect and report reliable antimicrobial usage and prescription data from all individual farms and veterinarians and (ii) to set annual targets for antimicrobial use in the different major livestock sectors, including species-specific

[12] República de Moçambique, 2019. Plano Nacional de Acção Contra a Resistência Antimicrobiana 2019 - 2023 (Antimicrobial Resistance National Action Plan) Mozambique. (not available in English)

(and categories within species) benchmark indicators that differentiate between moderate, high and very high users (farmers) and prescribers (veterinarians).

Instead of a high-level, centrally controlled set of legal mandates, the Dutch implemented a system that combines legal mandates, widespread business practices and voluntary actions. The Taskforce on Antimicrobial Resistance in Animal Husbandry was established to develop industry-specific action plans on AMR and a memorandum of understanding between stakeholders. The Taskforce includes representatives from every component of the food animal value chain as well as government officials. The legal obligations and practices discussed in the previous sections were developed and are implemented by public-private partnerships. The system's foundation is evidence-based practical legislation and its success is due to effective enforcement and clear designation of power and authority.

### 5.5.7 SWEDEN

**Score of 'governance' measures in the TrACSS 2019-2020: 11/13**

With the ban on AGP Sweden began a reform change towards a more sustainable animal production. These early actions taken by professional, official and industry bodies marked the beginning of the development of the so-called "Swedish Model" of consensus thinking and a cooperative, supportive approach. The Swedish Model is characterized by a close collaboration between stakeholders such as farmers, veterinarians, authorities, advisors and academy and a holistic view on the connection between preventive work, healthy animal environments and a low use of antimicrobials. The first One Health national strategy against antimicrobial resistance (AMR) was presented in 2005. This strategy has since been updated and the latest version was published in 2016 and is based on current AMR work, the Global Action Plan on AMR (WHO) and other relevant documentation (evaluations, action plans and other strategies). In the NAP, seven objectives were defined, and their respective action plans designed. The Swedish Board of Agriculture and the Public Health Agency put together an intersectional coordination mechanism, involving twenty-three agencies, to bring together the expertise from appropriate sectors to work against AMR.

An important contributor to the good health status in Swedish broiler production and to the successful adaption of the broiler production to the new situation is that a majority of producers are members of the industry body the Swedish Poultry Meat Association (Svensk Fågel). The mission of this organization is to make sure that members follow the Swedish animal health- and welfare legislation and the even stricter quality- and control programs for animal welfare set up by the organization.

To motivate farmers to continue working for good animal management and care a classification system was introduced within the organization for breeding and production farms giving a special bonus for producers following the animal welfare program improving the total level of quality for the production. Producers who fulfil certain requirements are permitted higher population density with up to 36 kg per square meter (basic population density is 20 kg per square meter). If providing good care, producers are rewarded with higher allowed population densities, without risking animal welfare, reaching an economically competitive production level while at the same time retaining the best animal welfare. Producers with low standards are forced out of business. The organization's welfare program is even stricter than the Swedish animal welfare legislation and is approved by the Swedish Board of Agriculture.

### 5.5.8 SWITZERLAND

**Score of 'governance' measures in the TrACSS 2019-2020: 13/13**

In 1999, the use of AGP was prohibited in Switzerland. The prohibition is connected to a total reform of the agricultural law with a stronger focus on environmental protection, multifunctionality, markets and quality. The import of meat produced with AGP should be labelled.

From 2001 to 2006, NRP 49 collected data on AMU and AMR in Switzerland to inform policy makers. In 2012, the former Federal Veterinary Office (FVO, current FSVO) developed an internal strategy against antimicrobial resistance in the veterinary field. The aim was to reduce the use of antimicrobials in veterinary medicine and to improve the resistance situation in the production animal sector in the long term. This antimicrobial resistance strategy overlapped in various points with the "Animal health strategy in Switzerland 2010+".

In 2008, the Federal Office for the Environment (FOEN) and the Federal Office for Agriculture (FOAG) jointly published environmental objectives for agriculture based on existing legal requirements and covering the areas biodiversity, landscape, water and soil but also AMU. These environmental goals were evaluated by the two Federal Offices and a Status Report published in 2016. It documents the degree of achievement of the objectives and the expected development considering the measures adopted so far. The goals set to reduce AMU and AMR were not met.

In July 2013, the heads of the Federal Department of Home Affairs (FDHO / EDI) and the Federal Department of the Economic Affairs, Education and Research (EAER / WBF) instructed the FOPH / BAG, the FSOV / BLV, the FOAG / BLW and the FOEN / BAFU to develop a comprehensive strategy to fight resistance antimicrobials in Switzerland. This was also an integral part of the Federal Council's health policy strategy (Health2020). The Parliament confirmed its intention to deal with the problem of antimicrobial resistance by means of the law on epidemics (LEp), in 2016. From then on, the FOPH was responsible for developing, with the assistance of the cantons, national programs in the areas of resistance to pathogens and healthcare-associated infections.

In 2015, the Federal Council launched a national research program (NRP 72) "Antimicrobial resistance: a one-health approach", to which it allocated 20 million francs. The Swiss National Science Foundation (SNSF) was responsible for carrying out this program. The NRP 72 started in 2017 and will end in 2023.

The one health Swiss Antimicrobial Resistance Strategy (StAR) was created in close cooperation between the Federal Office of Public Health (FOPH), the Federal Food Safety and Veterinary Office (FSVO), the Federal Office for Agriculture (FOAG), the Federal Office for the Environment (FOEN), and the Swiss Conference of Cantonal Ministers of Public Health. Other immediately affected stakeholders were also involved: in particular, universities (of applied science), learned societies and expert groups, representatives of various sectors, associations and other key individuals.

This broad network is also of major importance for the implementation of StAR. The strategy's implementation began in early 2016.

### 5.5.9 UNITED KINGDOM

**Score of 'governance' measures in the TrACSS 2019-2020: 10/13**

The Veterinary Medicines Directive (VMD) is the executive agency of the Department of Environment, Food and Rural Affairs (Defra), which is responsible for enforcing legislation, monitoring the sale of

antimicrobials and antimicrobial (AM) resistance, and advising government ministers on updating AM policy. The VMD operates across the 4 countries in the UK (Veterinary Medicine Directorate, 2021).

The UK government set out a five year action plan for tackling antimicrobial resistance in 2019 which aims to reduce the need for antimicrobials, optimise the use of antimicrobials and invest in innovations in the supply chain (HM Government, 2019). The mechanisms for bringing about change in antimicrobial use in the farm animal sector are primarily through industry rather than government initiatives. The UK government commissioned a report on antimicrobial use in the livestock sector, called the O'Neill report, published in 2016 (O'Neill, 2016). The report recommended the establishment of an industry task force to set targets for reducing antimicrobials in the livestock sector. In response, the Responsible Use of Antimicrobials in Animals Alliance (RUMA), an independent group made up of industry bodies, established the Targets Task Force in 2017 (RUMA, 2017). The Targets Task Force set targets for reductions in antimicrobials use by sector for 2020 (RUMA, 2020). It updated its targets in 2020 and set out an action plan for achieving them.

Animal health is a devolved area of government meaning that the devolved administrations in Scotland, Northern Ireland and Wales also create their own strategies and policy. The Scottish Government set out an animal health and welfare strategy in 2016 (Scottish Government, 2016).

In 2015 the Scottish Animal Health and Antimicrobial Resistance Group was formed with the aim of providing leadership on antimicrobial use in the Scottish livestock sector (Scottish Animal Health and Antimicrobial Resistance Group, 2021). The group is made up of industry and government bodies who meet 3 times a year. A sub-group, the Scottish Veterinary Antimicrobial Stewardship Group (SVASG) aims to develop a strategy for antimicrobial management in livestock.

The Welsh Government launched a strategy for antimicrobial resistance in animals and the environment in 2019 (Welsh Government 2019) and an Animal and Environment Antimicrobial Resistance Delivery Group to implement the strategy. In Northern Ireland a One Health strategy was launched for tackling antimicrobial resistance in 2019 (Department of Health et al., 2019).

### 5.5.10 VIETNAM

**Score of 'governance' measures in the TrACSS 2019-2020: 7/13**

NAP MARD 2017: National Action Plan for management of antimicrobial use and control of antimicrobial resistance in livestock production and aquaculture. The NAP includes timelines for implementation of activities, but no specific targets or indicators have been defined. It focused on livestock and aquaculture, but it's not specie specific.

The new NAP 2021 – 2030 is elaborated by MoH and MARD with the support of FAO and other partners.

The National authorities involved in the strategy are the MoH/ Vietnam Food Administration; the Vietnam's Ministry of Agriculture and Rural Development (MARD): MARD/Department of Livestock production (DLP), MARD/Plant protection department, MARD/Department of Fisheries, the MARD/Department of Animal Health; the Ministry of Natural Resources and Environment MoNRE; the MoH/Vietnam administration of medical services and MoH/General department of preventive medicine. There is also a National Steering Committee on antimicrobial resistance that involve the different ministries of both human and animal health.

The FAO headquarter in Bangkok is also coordinating a regional plan for combating AMR among the southeast Asian countries.

### 5.5.11 Summary of findings and main successful actions: Governance

- The Veterinary Advisory Service Contracts (VASCs) in Denmark strengthen the relationships and reinforce the role and responsibility of veterinarians in the herd health management, animal welfare and disease prevention
- Joint actions from strong public and private structures, involving a close collaboration between stakeholders such as farmers, veterinarians, authorities, advisors and academy and a holistic view on the connection between preventive work, healthy animal environments and a low use of antimicrobials proved to be highly effective in the development of innovative solutions to fight AMR, while increasing productivity and competitiveness.
- The Swedish Board of Agriculture and the Public Health Agency put together an inter-sectional coordination mechanism, involving twenty-three agencies, to bring together the expertise from appropriate sectors to work against AMR.
- The Swedish Poultry Meat Association make sure that members follow the Swedish animal health- and welfare legislation and the even stricter quality- and control programs for animal welfare set up by the association.
- Belgium efforts to draw a One Health NAP and centralize the authority in AMCRA is a step forward in the national governance. It will help the coordination of joint actions among the different institutes and sectors in the fight against AMR.
- The main drivers of change in the use of antimicrobials in farm animals in the UK are led by the industry rather than government.
- Mozambique and Vietnam have assessed the current status of antimicrobial access and resistance and have begun to develop national action plans. Mozambique is a recent entrant into the national antimicrobial resistance policy process in Africa, and has completed a situation analysis with recommendations on addressing antimicrobial resistance.
- In Switzerland pushed by the government with an important budget, but the involvement of various stakeholders, a national wide one health strategy is already being implemented.

# 6 Private standards, certification schemes and labels

AB free labels leaded by the industry and retailers can be an important driver or AMU reduction, especially in countries where governmental controls/legislation are less strict. This form of governance interact with public regulation and comes to add to the countries' policy mix for a prudent AMU and the fight against AMR. Evidences from the previous section 5 shows that the well-organized industry in countries where the government fails, disregard or is slow to create and enforce strategies for AMU/AMR can established their own mechanisms to fill this gap. Therefore these stakeholders become responsible and are sometimes the main actors for increasing the AM stewardship in their respective countries. They could push the governments to act faster and more efficiently in this regard, or even create parallel instruments to reinforce the existing public norms. Therefore, this report also highlights the impact that the end users, or consumers have in the reduction of antimicrobial use in the supply chains as well as in the overall AM stewardship.

## 6.1 Belgium

In Belgium, there is a growing interest of retail in low AMU (e.g. Colruyt uses AMCRA guidelines as standards, Carrefour wants to promote AB-free meat). Most of the labels for livestock production certify that there are no antimicrobial residues in the meat, thereby prohibiting AMU in the weeks before slaughter. Some also request the producers to monitor their AMU with apps to ensure traceability. Labels are managed by retail or by non-profit organisations that set up the specifications, often in response to demands of consumers, retail, and export. Compliance with these specifications is verified by independent organisations, recognized by the Belgian authorities. In addition, the selling point of some farms is an antimicrobial-free production. However, they are not using a label for this.

For poultry: Carrefour quality meat: Chicken d'Antan/ Weleer - no antimicrobials after 2 weeks of life & no preventive treatment. Carrefour "no antimicrobials" label: No antimicrobials at all

For pork: Carrefour "no antimicrobials" label: Pigs wear an electronic badge and do not receive antimicrobial treatment as long as their health does not require it. If for some reason the animals have to be treated with antimicrobials, the identification badge is scanned and the animal goes to the conventional chain.

For fish: ASC: There is no "antimicrobial free" label, but strict requirements regarding production. These are species specific.

## 6.2 France

The reduction in the use of antimicrobials is financed by the market and consumers through the various private standards without antimicrobials. Private standards including criteria for reducing or banning the use of antimicrobials appeared in France in the early 2010s and have multiplied significantly since then. Almost all the players in the pig industry - producer organizations, slaughterers, meat processors, retailors - have created their own specifications to meet the demands of their clients. The specifications without antimicrobials are generally private, on the one hand because it is complicated to modify the official specifications (SIQO), on the other hand because it is a way to distinguish itself from competitors. In general, the antimicrobials free (AF) specification is included in a more global valuation approach combining the absence of GMOs in feed, the absence of antimicrobials and other social,

environmental and animal welfare criteria. Pig farmers producing within these specifications receive a few cents of added value per kilogram of carcass. Private standards and actions of AB-free in the pork sector include:

- Carrefour and its « Filières Qualité » (Quality lines) (2013)
- Système U : la Nouvelle Agriculture (2014) et U Confiance (2018)
- Intermarché and Casino (2016)
- Fleury Michon with AVRIL cooperative: « Filière engagée dans l'élevage » approach, marketed under the brand « J'aime » (2015)
- « Herta s'engage » and the « Filière Préférence » (2017)
- COOPERL (Brocéliande) and its range of products « Bien élevés » [well cared] (2013)
- PORVEO and its range of products « La Nouvelle Agriculture » (2014) and « Bien produire Bien consommer » (2016)
- PORC ARMOR EVOLUTION and its Product Conformity Certificat « Porc Armorique »
- TRISKALIA: LR Opale, Pork Confiance (2018)
- AGRIAL and the "Porcristal" specification (2017)

The antimicrobials free (AF) specifications have multiplied to such an extent that the quality managers of the producer organizations set up excel tables to list the different approaches and summarize the differences between them, which are sometimes minimal. In addition, some criteria are barely understandable by technicians or quality manager. With regard to a final objective of reducing the use of antimicrobials, actors at different levels of these AF specifications are pleading for a simplification of these procedures. Indeed, the AF claim is not the subject of any legal definition leading to very diverse labeling practices - "without antimicrobial treatment from the end of weaning" or "after 42 days of age" or "from birth" for the pig - with a risk of misunderstanding and doubt consumers and a lack of transparency. In 2015, the Directorate General of Consumption (DGCCRF) worked on a decree to regulate the "antimicrobial-free" claim, all sectors combined. Its work aimed to harmonize and standardize performance indicators, which differ between each sector and each company. Several indicators were then mentioned: exposure index to antimicrobials, mortality rate in the farm, percentage of animals treated with antimicrobials. The work of the DGCCRF was suspended in favor of an inter-professional initiative.

For the poultry flocks, the situation is similar for the specific private standards. According to the broiler production system, the use of antimicrobials can vary. Stakeholder interview and professional press review indicate that for Label Rouge and Organic production systems, antimicrobial use is limited, with slow-growing strains and low density allowing for less disease occurrences. For broiler meat production, ITAVI listed ten "antimicrobial-free" claims in France, and two demedication strategies. The identification code is mainly "élevé sans traitement antibiotique" (raised without antimicrobial treatment). Some claims exist on the number of flocks raised without treatment or on the avoidance of on specific critical molecule or treatments but without any labels (see Table 6-1). The certification can either be provided through independent third party companies such as Bureau Veritas, or through audits commissioned by clients. On the other hand, there are no public label giving specifications on antimicrobial use in poultry, except for the Organic production.

Table 6-1 List of known private standards on antimicrobial reduction strategies for the broiler sector in France

| PRODUCTION SYSTEM | CLAIM | STARTING YEAR | PRODUCERS ORGANIZATION / GROUP | PARTNERSHIP WITH DISTRIBUTION CHANNEL OR INDUSTRY |
|---|---|---|---|---|
| **CCP (CERTIFIED)** | 90% of flocks without treatment | 2008 | Groupe Michel | |
| **LABEL ROUGE, ORGANIC** | Antimicrobial free – less than 1% animal treated in 2017 | 2014 | Volaille de Lyré | Auchan filière responsable |
| **CONVENTIONAL, CCP, LABEL ROUGE, ORGANIC** | Antimicrobial free | 2015 | Terrena | Système U, Fleury Michon, Compass |
| **LABEL ROUGE** | Antimicrobial free | 2013 | Syvofa | Filière Qualité Carrefour |
| **STANDARD** | Antimicrobial free | 2017 | Ronsard | |
| **CERTIFIED, LABEL ROUGE, ORGANIC** | Antimicrobial free | 2018 | | Monoprix |
| **CONVENTIONAL, CCP, LABEL ROUGE, ORGANIC** | Antimicrobial free | 2014 | | Casino |
| **CONVENTIONAL** | Colistine banned in broiler production | 2019 | Gaevol | McDonald's |
| **LABEL ROUGE** | No preventive antimicrobial except anticoccidiosis | 2020 | Fermiers du Périgord | |
| **ORGANIC** | Antimicrobial free | | Bodin | |

Source : ITAVI based on company websites and technical press

Most of these labels appear after the launching of the Ecoantibio program in 2012 and are frequently part of a larger strategy plan such as corporate social responsibility plan or included in a more global differentiation strategy (GMO-free feed, animal welfare…). Even though data on produced volumes aren't available, we can observe that most of the claims are made on top of an already official label (CCP, Label Rouge, Organic). Unsurprisingly most of these antimicrobial free or reduction labels are aiming at retail channels (except McDonald's), the catering sector giving far less transparency on meat product. For instance, a new law proposal on compulsory indication of the country of origin of meat sold in the food service sector was just approved by Parliament in 2020

Retailers also engage in antimicrobial free labels, with different strategies. Most retailers sell both industrial brands and owned brands with all types of official product segmentation. However, strategies

to answer societal demand differ according to company and product type. For antimicrobial use, Carrefour and Auchan "quality brands" are in partnership with Label Rouge producers organizations selling antimicrobial free products. The claim doesn't apply for all product sold under their owned brand, however some other antimicrobial free brands such as "C'est qui le Patron!?" or "La Nouvelle Agriculture" can be sold by these retailers. Casino and Monoprix committed in selling 100% of their owned brand broilers with antimicrobial free claims. Other major retailers such as Intermarché, Leclerc or Lidl don't have, to our knowledge, specific claims on an antimicrobial reduction scheme for their owned brand and only sell antimicrobial free broilers through private brands.

## 6.3 Italy

In the poultry sector, in Italy, thanks to the high level of integration of poultry companies, a fast decrease on the use of antimicrobials was observed with a percentage of antimicrobial free production raising above the 30 % of total production. Since 2016, the main supermarket chains have been proposing lines of animal products obtained without or with a reduced use of antimicrobials in farms, which recorded a 203% increase in sales between 2017 and 2019. In the poultry meat market, about 40% of total sales are certified production obtained without using antimicrobials (2020 estimations).

Together with the institutional action, the request of retailers for pork meat produced with specific claims or labels (e.g. welfare, antimicrobial free, organic), coexist in the process of reduction of the AMU in the pig food chain. Farms included on this process are usually associated to large cooperative groups or part of the integrated groups that can guarantee to the retailers a constant provision of the meat.

In the scope of the Roadmap project, a study conducted in northern Italy assessed the consumer's WTP of antimicrobial-free labels in poultry meat. Data on prices and commercial characteristics of broiler breast were collected in supermarkets of three towns in Northern Italy. 173 observations led to identify 75 different product attributes related to price: production systems (e.g. organic, without antimicrobials, improved animal welfare, etc.), types of cuts (slices, thin slices, etc.), size and types of packaging, brands, supermarket chains, shop size and location (city center, suburbs, etc.). A hedonic price model was developed by aggregating the identified attributes into 14 binary variables. The aggregation was validated by interviews to marketing experts from two big companies of the poultry industry.

The hedonic price analysis assumes a condition of competitive market equilibrium and that the price of one good results from consumer preferences for its specific attributes. In this model, broiler breast produced without antimicrobials and with improved animal welfare standards benefits on average a 14.6% price increase with respect to similar products not claiming this characteristic. The attribute showing the higher impact on price is the "organic product" certification, with a 66.4% price increase. Other characteristics originating remarkable price increases are the cut in slices (+15.6%) and thin slices (+21.4%), producer brands (+18.6%) compared to supermarket and discount brands, and shop location in metropolitan city centres (+12.4%).

The 14.6% average price increase for "antimicrobial-free" products in the Italian competitive market of broiler breast is justified by greater utility perceived by consumers. However, this increase is about of the same size of other more conventional marketing attributes, like the type of cut and brands. The rapid growth of "antimicrobial-free" poultry meat supply may have already led Italian consumers to

consider this attribute as an ordinary feature of the product. The significantly higher prices paid for "organic" broiler breast is supposedly due to higher production costs and its destination to more willing-to-spend consumers. But it may also be assumed that consumers consider organic products as "antimicrobial-free", which is not true under the current EU regulations. This aspect should be further investigated.

## 6.4 Switzerland

There is one brand claiming AM-free production in Switzerland. It is called Porco-Sano and stands for AM-free pig breeding and finishing. The system was developed by a feed mill. In 2019, 8 farmers produced pork according the Porco-Sano rules. The meat is exported to Hongkong and not available on the Swiss market.

There are several farmers involved in direct selling and advertising meat as produced without the use of AM. Meat comes mainly from suckler cows.

In the organic sector the use of AM is not prohibited, but limited, and critical AM are not allowed to be used. The reduced use of AM is an attribute of organic meat, to which consumers are interested in. There is mainly one organic farmers organisation in Switzerland, Bio Suisse. Hence their private standard is applied on almost 98% of all organic farms in Switzerland. Bio Suisse has always strived to keep the use of antimicrobials to a minimum. The health and performance of the animals are to be promoted through species-appropriate husbandry and feeding, the choice of suitable breeds and breeding methods. Natural remedies and complementary medical methods also have priority. Bio Suisse offered extension services for their farmers on animal health and welfare. In the case a treatment is needed, the main principles are:

- Plant based alternatives to AM and complementary medicine
- AM only after prescription of a vet
- No preventive application
- A maximum of 3 treatments per year, for animals less than 1 year old to slaughter, only 1 treatment.
- First treatment only with non-critical AB and further limitations regarding the use of critical AB.

## 6.5 United Kingdom

Most of the major supermarket chains in the UK have some kind of regulation in place for their suppliers (i.e. farmers)of animal products. These are not linked to particular labels, but part of the retailers' more general corporate sustainability policies. A 2019 report from the 'Alliance to Save Our Antimicrobials' highlights the major differences between these retailer-led regulations:

"The supermarkets' public policies show that six supermarkets have bans on their suppliers using antimicrobials routinely for disease prevention (Co-op, Lidl, M&S, Sainsbury's, Tesco and Waitrose), one has a ban in some species of animal (Morrisons), one recommends that routine use be avoided but has no ban (Aldi) and two as yet have no restrictions other than minimum legal restrictions (Asda and Iceland)."

Retailers and beef and milk processing companies also have a significant influence on antimicrobial governance in the beef and dairy sectors. Dairy farmers who are on 'supermarket aligned' contracts may be subject to different rules about their antimicrobial use which are a condition of their contract. Similarly, some processing companies are introducing additional rules about the use of antimicrobials. Organic standards in the UK do not allow for routine use of antimicrobials and restrict the use of critically important antimicrobials.

In addition to individual retailer schemes, a key mechanism for changing antimicrobial use in the UK livestock sector is the 'Red Tractor' quality assurance scheme. The Red Tractor scheme is an industry led quality assurance and food safety certification scheme in England, Wales and Northern Ireland run by industry bodies. To have their products marketed under the Red Tractor label farmers need to sign up to species specific production standards. All of the livestock standards include restrictions on the use of antimicrobials and requirements to keep records on the use of animal medicines as well as the establishment of a 'veterinary health plan' and completion of courses on the use of animal medicines. Restrictions generally consist of a ban on routine use of antimicrobials and limitation to use through veterinary prescriptions.

In 2018 the Red Tractor changed their guidance on antimicrobial use to stipulate that dairy and beef farmers have to carry out an annual review of antimicrobial use with their vet; highest priority critically important antimicrobials must only be used as a last resort under veterinary direction, including a sensitivity or diagnostic test; and it is recommended that one member of staff carry out training on antimicrobial handling and administration (Red Tractor Assurance, 2018). The Quality Meat Scotland scheme covers a higher proportion of beef farmers. The Quality Meat Scotland rules state similarly that the farmer should collate antimicrobial use every year and highest priority critically important antimicrobials should only be used as a last resort. Similarly, members of the Northern Ireland Beef and Lamb Farm Quality Assurance Scheme (NIBL FQAS) need to make a written animal health plan, are encouraged to try to reduce where possible the use of 3$^{rd}$ and 4$^{th}$ generation Highest Priority Critically Important Antimicrobials from 2018 (LMC, 2018), and to undertake training on the responsible use of antimicrobials from February 2020 (LMC, 2020).

The 2020 Responsible Use of Medicines in Agriculture Alliance (RUMA) targets set specific objectives for calves for the first time. These included a 25% reduction in the sector wide use of antimicrobials by 2024; 7.5 fewer animals treated per 100 calves in 2024 compared to 2020/2021; establish baseline use of highest priority critically important antimicrobials and decide if a reduction in use is possible; and a 1% annual reduction in mortality for calves under 6 months by 2024 compared to 2018 levels (RUMA, 2020).

In the organic beef and dairy sectors the routine use of antimicrobials as a preventive measure is banned. Antimicrobials can be used to treat sick animals (Soil Association, 2021).

## 6.6 Vietnam

In Vietnam there are some private initiatives to reduce the use of antimicrobials use in agrifood products, but to the present there are no antimicrobial-free labels. Those initiatives are conducted by even large chicken companies (as CP) or by smaller companies or cooperatives that sell their products in specialized shops (on organic vegetables and "natural" products). On the product it is indicated "no use of prohibited substance" or "no antimicrobial residues". To reduce the use of antimicrobials also

involve individual private farmers that produce chickens without using AB but with no antimicrobial-free label

On organic production, the National Standards have been developed in 2018-2019 by the MARD with the help of the Vietnam Organic Agriculture Association In Vietnam. The PGS Organic Standard developed by IFOAM which is a participatory system of organic production including farmers and retailers is also present in Vietnam. However, this concern mainly vegetables for the moment.

When consumers choose to buy antibiotic free products in the shelves of supermarkets, retailers became prone to demand such products to their suppliers, the processing companies. These are directly linked to the farmers through contracts of integration or supply and require animals to be raised without (or limited use) of antimicrobials. Companies (and public institutes in many cases) can provide farmers with financial incentives, training, access to equipment and tools needed for this purpose. Indeed, it is important that producers have the tools for change before implementing a new law/regulation. Strategies must be followed by resources.

# 7 Relevant country case studies outside Europe

## 7.1 Awareness: Beyond ROADMAP's countries

Awareness campaigns have occurred in different parts of the world. The "Get Smart About Antimicrobials Week" takes place every November in the United States of America. The Centre for Disease Control (CDC) is the lead agency in planning national awareness raising efforts. However, initiatives trickle down to other federal agencies and to the state and local level. Besides governmental actions, awareness-raising initiatives in USA were also driven by consumer advocacy groups through campaigns targeting specific groups, media reports, menu labels and behaviour change campaigns. Consumer advocacy organizations have demonstrated their role in shaping AMR policy by influencing consumer preferences for antimicrobial-free animal products. Consumer's pressure on food processing companies, such as McDonalds, KFC and Tyson Foods for instance, led them to start a change into antimicrobial-free products, generating a market for such products.

In Southeast-Asia, Thailand offers a good example of successful awareness campaign for the human healthcare sector that is worthen mentioning, since actions like this certainly have positive spill-overs in the livestock sector and the whole society from a One Health perspective. The Antimicrobial Resistance Containment Program (2012-2016) included the Antimicrobials, Smart Use (ASU) program, released in 2007. ASU focuses on behaviour change among human healthcare providers. The rational use of antimicrobials is prioritised by actions that passed by the strengthening of human resource, improving health facility structure and empowering communities.

## 7.2 Evidence: Beyond Roadmap's countries

Japan and the United States of America provide examples of joint surveillance activities between sectors. In Japan, the National Veterinary Assay Laboratory (NVAL) oversees the technical aspect and the management of the Japanese Veterinary Antimicrobial Resistance Monitoring (JVARM) established in 1999. JVARM monitors the occurrence of AMR bacteria in food producing animals and the consumption of antimicrobials. Every year the AMR and AMU monitoring data are published. NVAL serves as the contact point with the human monitoring system called Japan Nosocomial Infectious Surveillance under the Ministry of Agriculture, Forestry and Fisheries. NVAL's research activities play a significant role in decision-making on risk management measures. Japan uses data collected from the JVARM to conduct risk assessments to determine animal feed additives. Japan is currently implementing the following risk management measures to control what substances are added to animal feed: i. substances which pose a risk to human health are not designated as antimicrobial feed additives; ii. specifying applicable animal species and breeding stages (products for lactation period, for fattening period, etc.); and iii. standard amounts to be added in feed. In addition, Japan conducts an annual national survey under JVARM to identify trends in AMR and to evaluate the effectiveness of each risk management measure.

In the United States of America, the National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS) was established in 1996. NARMS is a collaboration among state and local public health departments, CDC, the United States of America Food and Drug Administration (FDA), and the United States Department of Agriculture (USDA). This national public health surveillance system tracks

changes in the antimicrobial susceptibility of certain intestinal bacteria found in sick people (CDC), retail meats (FDA), and food animals (USDA). The NARMS program at CDC helps protect public health by providing information about emerging bacterial resistance, how resistance is spread, and how resistant infections differ from susceptible infections. In 2008, Congress required drug producers to report to the FDA on sales and distribution of antimicrobials for use in food-producing animals. Congress also directed the FDA to issue a summary public report that protects companies' proprietary information. Over time, the report has grown in length with the 2014 report providing more information on quantities of antibacterial classes labelled for administration to food animals. However, the reports do not yet provide information on exactly how the products are being used on-farm, such as the total amount of antimicrobials used for production efficiency, disease prevention, or control or treatment within each animal species.

In Australia, government and industry collect data to monitor AMR in pigs, chicken meat, chicken eggs and salmon. The Australian Pesticides and Veterinary Medicines Authority (APVMA) evaluates and registers antimicrobials for animal use in Australia. This involves a risk assessment, including the risk of AMR developing. The APVMA released a report on antimicrobial resistance in animals in August 2017. The report addresses the major AMR issues associated with antimicrobial use in animals. A report on antimicrobial products sold for vet use in Australia provides data on sales between 2005 and 2010.

## 7.3 Practices: Beyond ROADMAP's countries

There are numerous examples of countries implementing bans on antimicrobials for growth promotion. The Republic of Korea provides a unique example as they were the first Asian country to implement a ban on antimicrobials as growth promoters in 2011. The Ministry of Agriculture, Food and Rural Affairs (MAFRA) implemented the ban to preserve the effectiveness of some antimicrobials used to treat infections in humans.

In the last decade, the U.S. Food and Drug Administration (FDA) has also taken various steps to curb the development and spread of AMR, leading up to eliminating the use of medically important antimicrobials for production purposes: FDA Final Rule: Veterinary Feed Directive, 2015; FDA Guidance for Industry #209: The Judicious Use of Medically Important Antimicrobial Drugs in Food-Producing Animals, 2012; FDA Guidance for Industry #213: New Animal Drugs and New Animal Drug Combination Products Administered in or on Medicated Feed or Drinking Water of Food-Producing Animals: Recommendations for Drug Sponsors for Voluntarily Aligning Product Use Conditions with GFI #209, 2013; The timeline of FDA Action on Antimicrobial Resistance can be seen at: https://www.fda.gov/Animal-Veterinary/SafetyHealth/AntimicrobialResistance/ucm438426.htm

The United States has directly restricted the use of some classes of antimicrobials in food-producing animals since the 1990s. In 2017 the Guidance for Industry #213 made it illegal to use antimicrobials important to human medicine for production purposes (growth promotion or improved feed efficiency), and brought other feed and water uses of medically important antimicrobials under veterinary oversight. In the final year before the guidance took full effect (2016), 96 percent of medically important antimicrobials approved for use in food-producing animals were sold over the counter (U.S. FDA, 2017).

Australia has not registered fluoroquinolones, colistin and fourth generation cephalosporins for use in food producing animals. Nearly all antimicrobials used in animals are Schedule 4 medicines, meaning a veterinarian must prescribe them. Veterinary surgeons' boards exist in each state and territory in

Australia. Each board controls the practice of veterinary science in line with state or territory laws. This includes how veterinarians use, prescribe and supply antimicrobials. By law, states and territories are responsible for controlling the use of all veterinary medicines.

## 7.4 Governance: Beyond ROADMAP's countries

Japan's approach is based on the principles of risk analysis established by international standards. It considers the impacts of risk assessments on antimicrobial resistant bacteria on human health through food. The Food Safety Commission of Japan, the Ministry of Agriculture, Forestry and Fisheries formulate and implement risk management measures in accordance with the extent of the risks, taking into account the on-farm feasibility of such measures.

In the USA, the National Security Council, in collaboration with the Office of Science and Technology Policy, coordinated with multiple agencies to develop a strategy in 2014 that culminated in a 5-Year National Action Plan in 2015. The creation of the Presidential Advisory Council on Combating Antimicrobial Resistant Bacteria was created under a Presidential Executive Order by President Obama in 2014. This federal advisory committee was formed in 2015 to provide a formal mechanism for information sharing on national action plan progress by multiple agencies and to make recommendations to the Secretary of Health and Human Services who relays them to the President. Internationally, the United States of America demonstrated formal coordination on AMR through the Transatlantic Task Force Against AMR (TATFAR) together with the European Union in 2009 and by initiating the Global Health Security Agenda (GHSA) in 2014. The GHSA will also include international cooperation on AMR.

Australia has measures in place to prevent and manage antimicrobial resistance (AMR) in food producing animals. These include antimicrobial stewardship resources for veterinarians and food producing animal industries. In 2014, the Australian Government commissioned a report on antimicrobial resistance and use in Australian livestock and agriculture industries. The report provided direction for planning future surveillance and reporting of AMR in Australia.

# 8 Conclusions and recommendations

It is important to note that the path to achieve better results on AMR can be arduous. Sometimes it can be required to go against economic interests and make the hard, but necessary system changes. However, some countries have shown that it is possible to combine a low use of antimicrobials with good production results, even if this can mean economic challenges. This report suggests that those countries are taking leadership in the EU and international cooperation in the fight against AMR. To find an interested audience from other countries, it is important to have documentation of facts: are the animals kept healthy? How is the productivity? Is it profitable? It is important to be able to motivate other countries with health – and productivity measures on how much there is to gain in production with good animal husbandry instead of a high use of antimicrobials. In this report we find out that the progress made can be matched with large-scale animal production.

In most countries, antimicrobial regulation ultimately remains subject to a risk benefit matrix, which prioritised the rationale of cheap and reliable animal proteins over more abstract considerations of antimicrobial use. In many ways, current policymakers remain subject to the path dependencies and blind spots of the past 80 years of antimicrobial use and regulation. Furthermore, whenever policy-makers are deciding on which policies or interventions to choose when developing the NAP on AMR, according to different social constructions related to AMR, alternative policies may be viewed in terms of benefits or burdens to certain groups. The political power and interests of the targeted populations may also influence the support or opposition for certain policies (Legido-Quigley et al., 2019), and define whether a health policy measure will be adopted or not in a country/region.

The favourable situation in best practice countries, such as Denmark, Netherlands, and Sweden for instance, with regards to the use of antimicrobials and levels of AMR is a result of several important contributing factors. One of the most essential keys to success has been the long tradition of evidence-based guidelines and strong local commitment, but also strategy work on both regional and national level. Since the ban on AGP in those countries, (even before the EU ban) a lot of work has been put into lowering the need for antimicrobials without evidence of negative impacts on animal health and welfare. It's also important to notice that participatory approaches, involving the main concerned stakeholders, were mostly adopted for the development of joint actions in these countries.

This has been done with the use of preventive routines for infectious disease control and extensive animal husbandry. Control and eradication programs are being applied for some diseases that can drive antimicrobial use as well. These countries have a long-standing consciousness of AMR and actions to avoid resistance development and also long-standing efforts to eradicate and prevent introduction of infectious diseases. Another highlighted strength is the long-standing strategy of consensus thinking and collaboration between veterinarians, stakeholders, the industry and the government on how diseases should be controlled and combatted. This collaboration leads to known knowledge being used in practice. A strong animal protection legislation also leads to reduced spread of infection and a higher resilience among production animals.

A good control situation can also be attributed to vanguard countries' long-standing monitoring and evaluation of the development of AMR and taking action before a negative trend becomes problematic. Collaboration with the industry and authorities, a science-based incentive for the restrictive use of antimicrobials by their research on resistance mechanisms is also fundamental. In the absence of data on antimicrobial use, it is not possible to control their usage. Efficient surveillance and data completely divided into animal species and production type, per region or establishment is necessary to

identify production systems with a high use and high risk of resistance. This makes it possible to identify focus areas for promoting prudent use.

Veterinarians also need to be able to access their own prescription data and compare them to national figures. To facilitate comparability of data, the methodology for AMR surveillance should be harmonised across countries as far as possible. The main issues when comparing AMR data originating from different countries are the use of different laboratory methods and different interpretive criteria of resistance. In order to respond effectively to the constantly evolving threat of AMR, further enhancements and specific adaptations should be regularly required on an ongoing basis.

Simply banning AGPs or developing general agreements without strict close targets might be insufficient to reduce antimicrobial use in food animals. Uncompromised intentions might not work in the reduction of veterinary antimicrobial use as economics interest (from industry, veterinarians, farmers) might eventually be prevailing above public health. Thus, an important part in lowering the unnecessary use of antimicrobials is taking steps to limit financial conflicts of interest that may incentivize veterinarians to prescribe antimicrobials excessively. A prerequisite for this is that ways exists for veterinarians to earn a living without the selling of pharmaceuticals. In Europe many veterinarians have this as a main source of income. It is important that veterinarians can charge for their knowledge and their advisory services, not just for medicines and other products. This highlights the importance of structural and cultural change in the behaviour of both veterinarians and farmers.

In this regard, motivation is an important success factor in the work towards a prudent use of antimicrobials. Many times, motivation is connected to knowledge and education. From one side connect science and expertise with veterinary field work and from the other side educate producers on preventive work and the correct use of antimicrobials is central to increase motivation and change attitudes. Preventive measures to avoid the need for antimicrobials must be backed up by comprehensive guidelines and restrictions and a broad support for farmers and veterinarians to encourage the prudent use of antimicrobials when needed. Besides motivating producers and veterinarians through knowledge, education, policies and guidelines, it seems advisable to build up a system with an economic incentive for the producer to undertake action.

These findings also show that stricter regulations jointly defined and agreed within the sector, have the power to change farmers' and veterinarians' attitudes and behaviour on antimicrobial use over time. Overall stricter and more uniform global regulations on antimicrobial use could be an effective measure for reducing antimicrobial use. This should be directly connected to increased animal health and welfare regulations as well, since the amount of antimicrobials farmers and veterinarians perceive as needed can be partly attributed to a long-standing culture of using more antimicrobials, rather than working with animal health and welfare in other ways. This shows that it could be useful to put the focus on preventive health work and optimal environments rather than on the lowering of antimicrobial use. With intersectional, collaborative work towards optimizing environments and prevent diseases, lower antimicrobial use should come as a secondary effect.

Furthermore, prescription of antimicrobials should be favoured for individual treatment over groups/flocks treatment, where only the animal that is sick receive antimicrobials. In some EU member states up to 90 % of antimicrobials are given as group/flock treatment via feed or drinking water. Once again, this shows the importance of national policies and guidelines for antimicrobial use. The recent adopted EU regulation on veterinary medicinal products ((EU) 2019/6), which will be in force from 2022, is clear about this matter: "*Antimicrobial medicinal products shall not be applied routinely nor to compensate for poor hygiene, inadequate husbandry or lack of care or to compensate for poor farm*

*management...Antimicrobial medicinal products shall not be used for prophylaxis other than in exceptional cases, to an individual animal".*

There is a large interest in combatting AMR in the EU, however there are large differences in prescribing patterns between member states. Legal restrictions can have an impact; for example limiting the use in veterinary medicine of critically important antimicrobials (i.e. mainly 3rd and 4th generation cephalosporins and fluoroquinolones) for the treatment of people. Regulation of the overall use is more complex. Strategies to reduce use must be targeted toward both disease prevention and non-responsible use. The prohibition of prophylactic use in the EU that will be valid from 2022 will considerably reduce AMU in most of the countries, especially the largest consumers, such as Italy, Belgium and France, for instance. More prudence with the metaphylactic use is also contributing to lower AMU. The competent authorities must support this transition with guidelines which promote the understanding of risk factors associated with metaphylaxis and include criteria for its application.

The higher restrictions and increased monitoring that starts in 2022 for the AMs market authorizations, and the veterinary prescriptions also help to reinforce the control activities and avoid malpractices and abuses. One of the next challenges for the livestock production in the EU, especially for the pig sector, will be the restrictions in zinc oxide. Today it's widely used during the first two weeks after weaning to minimize diarrhoea in piglets. Due to negative environmental impacts, the EU is banning its use on veterinary medicines from 2022. This measure raises concerns that zinc oxide will be substituted by antimicrobials for diarrhoea treatment, increasing their consumption. Prudent use of antimicrobials and effective health measures for preventing weaning diarrhoea are already been researched and discussed at EU and national levels.

The regulations on the restrictive use of CIAs should be extended to all animal species. At the same time, the availability of non-CIAs should be encouraged, including for minor species. These last must always be able to be used as a priority on the CIAs, which may only be administered by the veterinarian and by the owner/animal keeper to complete the treatment following further examination. CIAs may therefore never be present in the livestock farmer's stock. The level of biosecurity and animal disease prevention on livestock farms should be increased. To this end, active programs should be set up to evaluate the biosecurity and vaccination plan on each farm and to adjust it where possible. Biosecurity evaluation should therefore become an integral part of the farm health plan. Critical factors such as stocking density, weaning age, minimum age for transport, etc. must be actively monitored by the competent authorities.

We also stress the necessity for stronger commitment of the authorities on what concerns the rules of the international trade. In order to not cause disadvantages to local farmers, the import of cheaper meat and dairy products produced under less strict conditions must be forbidden. The compliance with the same rules must be required for both local and imported products.

Several policy measures were identified in this report that lead to different results in terms of AMU and AMR reduction. Their direct impact remains to be assessed and poses a huge challenge to researchers. One of the challenges in identifying the policy mix, is that instruments are added along the time to complement the mix and contribute to its goals, and their identification is subject to interpretation. Policy makers usually have a tendency to add things to the existing mix, rather than rethink the existing mix. In the ROADMAP's countries for instance, the case study leaders decided to report the instruments they judged being part of the policy mix to combat AMR. Another challenge refers to the complex causality and effects of a specific instrument within a policy mix. A complete policy evaluation analysing the criteria of relevance, effectiveness, welfare of the society and cost-effectiveness of the

policy mixes, was not within the scope of this report. Future studies should consider such a broad qualitative and quantitative analysis, contemplating these criteria in order to bring evidence about the evaluation of each policy instrument or mix in each country/region.

The models and strategies already in use in some most AMR-fighting advanced countries are finding their way into European legislation and the international conventions and strategies. A share of knowledge, experiences and even tools, like the UGhent biosecurity assessment tool shared between Belgium and Italy for example, must be promoted inside and outside the Union. In this way the laggards don't need to start with actions from the scratch and we can all move faster in the direction of a prudent AMU and achieve better results in terms of reduced AMR Globally. It is important however that producers have the tools for change before implementing a new law/regulation. Strategies must be followed by resources. These countries could have made the transition easier for both animals and producers with a clear strategy to counteract expected problems. For the others, maybe it is only when facing the reality that the real motivation for change takes place. In any case, when the opportunity surges or the evidences of the prejudice became clearer, it's necessary to take action and avoid further damages.

Indeed, a window of opportunity can be an important driver for policy changes and exists when several conditions are present: (i) clearly measurable indicators describing the problem, (ii) a 'focusing event' that draws attention to the problem, (iii) policy entrepreneurs drawing attention to the problem and iv) the existence of practical policy alternatives to replace a certain policy (Speksnijder et al., 2015). Perhaps one of the only good outcomes from the recent COVID-19 pandemic is the raised awareness to the AMR problem. This creates a real motivation for change and a window of opportunity for further developing and strengthening policies and actions to fight AMR at global level.

# 9 Acknowledgements

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# 11 Appendix

## 11.1 Appendix 1: Questionnaires for data collection

**ROADMAP - TASK 1.3**

**Prudent use of antimicrobials in livestock farming**
**Evolutionary analysis of the regulatory and institutional context**

# Information on national legislation and policies to be provided by case-study leaders

## (Detailed outline for reporting)

**Sections**

1. **National action plans and strategies for a more prudent use of AMs in veterinary medicine:**
2. **Monitoring AM veterinary use and AM resistance in animal farms and along the food-supply chain:**
3. **Implementation of new European Legislation on veterinary medicinal products - Reg. (EU) 2019/6:**
4. **Implementation of new European Legislation on medicated animal feeds - Reg. (EU) 2019/4:**
5. **Private standards**

The Roadmap case-study (CS) Leaders will provide the T1.3 leader the information concerning their own countries detailed under points from 1 to 5 below. **Deadline is the 15th of May 2020.**

## 1. National action plans and strategies for a more prudent use of AMs in veterinary medicine:

Provide the English version(s) of the document(s) that define the national strategy or action plan of your country or a synthesis in English.

Provide also detailed information on the following aspects:

1.1. Areas covered:

1.1.1. Monitoring and surveillance of AMR and antimicrobial use in both humans and animals;

1.1.2. Risk management measures

1.1.3. Risk communication strategies;

1.1.4. Guidelines for:

- prudent use;
- treatment and husbandry management;
- education and training;
- research;

1.2. Targets or indicators for monitoring and reporting the implementation progress and assessing the effectiveness of the measures undertaken

1.3. Animal species targeted and respective priorities;

1.4. AM categories under specific targets

1.5. National authorities involved in the strategy (responsible for food, agriculture, environment, human health and animal health)

1.6. Systems for registering and identifying herds and flocks to facilitate monitoring;

1.7. Targets for reducing AM use;

1.8. Measures restricting the prophylactic use of antimicrobials and minimising metaphylactic use;

1.9. Financial measures to promote the prudent AM use and the use of alternatives (e.g. differentiated taxes on sales and differentiated fees for granting marketing authorisations for certain medicines);

1.10. Measures for resolving potential conflicts of interest where parties are involved in AM prescription or supply;

1.11. Measures strengthening the position of the AM prescriber in relation to the farmer (e.g. registered contracts between farmers and veterinary practitioners which include regular visits by the veterinarian to the farm; guidelines including requirements to perform susceptibility testing);

1.12. Controls on the biosecurity standards in herds and flocks;

1.13. Treatment guidelines covering the choice of treatment and issuing of prescriptions by veterinarians, and the administration of antimicrobials to animals by farmers;

1.14. Maximum acceptable levels of AM use in herds and flocks, and action plans for reducing use where it is currently above the set limits;

1.15. Benchmarking systems to identify farms with high AM use and obligations for reduction;

1.16. Risk warning systems for veterinary practitioners prescribing AM high volumes, and farmers administering high levels of AMs to their animals;

Incentives to support animal health improvements on an ongoing basis, preventing diseases and ameliorating hygiene standards;

1.17. Animal health programmes based on good hygiene practices and other preventive measures, and discouraging routine prophylaxis;

1.18. Control measures preventing the spread of AM resistant bacteria;

1.19. Risk-based controls and other measures provided for by legislation, following guidance (e.g. codes of practice) on prudent AM use;

1.20. Methods for evaluating and assessing the effectiveness of the measures taken under the national strategy on AMR.

1.21. Total financial resources devoted to the national plan/strategy and to specific actions;

1.22. Inclusion of specific measures related to the issue in the national Rural Development Policy;

1.23. Existence of regional plans, coordination with the national and the European level, monitoring and reporting on regional plan implementation;

## 2. Monitoring AM veterinary use and AM resistance in animal farms and along the food-supply chain:

1.24. Documentation related to the monitoring on AM veterinary use has to be provided within the framework of the Task T1.2;

1.25. Provide an English version (or syntheses in English) of the national reports on monitoring AM resistance in animal farms and along the food supply chain issued in the last five years according to the Commission Implementing Decision 2013/652/EU of 12 November 2013;

1.26. Provide the available information and data on other indicators (than those related to points 2.1 and 2.2 above) testing the efficacy of the national strategy for a more prudent AM use in your country;

## 3. Implementation of new European Legislation on veterinary medicinal products - Reg. (EU) 2019/6:

Provide detailed information on the current state of implementation in your country of the following provisions of the Reg. (EU) 2019/6 related to AMs, by specifying if and how the provisions have already been implemented, and if your country have provided on the same issues stricter rules and criteria than those indicated by the European regulation:

- Marketing authorizations (subject to taking into consideration potential development of AMR – art. 5, 8, 35, 36, 37);
    - Art. 5 - Validity of a marketing authorisation for a veterinary medicinal product for an unlimited period of time;
    - Art. 8 - Additional information for authorizations of AM veterinary medicinal products:

        - (a) documentation on the direct or indirect risks to public or animal health or to the environment of use of the antimicrobial veterinary medicinal product in animals;
        - (b) information about risk mitigation measures to limit antimicrobial resistance development related to the use of the veterinary medicinal product;
    - Art. 35 – The assessment report for the authorization should include special conditions for use, including restrictions on the use of antimicrobial and antiparasitic veterinary medicinal products in order to limit the risk of development of resistance;
    - Art. 36 - Post-authorisation studies for AM veterinary medicinal products requested by competent authorities to ensure that the benefit-risk balance remains positive given the potential development of AMR;
    - Art. 37 – Marketing authorization refusal in case that:
        - the risk for public health in case of development of antimicrobial resistance or antiparasitic resistance outweighs the benefits of the veterinary medicinal product to animal health;
        - the antimicrobial is reserved for treatment of certain infections in humans (subject to criteria and a specific list to be issued by Commissions).
- Art.34 - Classification of AM as veterinary medicinal products subject to veterinary prescriptions;
- Art. 57-59 - Collection of AMU data and responsibility of pharmaceutical sellers:
    - data collection on the volume of sales and the use per animal species and per types of antimicrobial medicinal products:
        - data collection on the volume of sales and the use per types of antimicrobial medicinal products for poultry and pigs;
        - data collection on the volume of sales and the use per types of antimicrobial medicinal products for food-producing animals other than poultry and pigs;
        - data collection on the volume of sales and the use per types of antimicrobial medicinal products for all types of animals bred or kept;
    - obligations of marketing authorisation holders:
        - record the dates its authorised veterinary medicinal products are placed on the market;
        - record information on the availability for each veterinary medicinal product;
        - provide the competent authorities with all data in its possession relating to the volume of sales of the veterinary medicinal product concerned;
        - record in the product database the annual volume of sales for each of its veterinary medicinal products;

- Art. 105 - Prescriptions of veterinary AM;
    - Prescriptions for metaphylaxis shall only be issued after a diagnosis of the infectious disease by a veterinarian;
    - Justification for a veterinary prescription of antimicrobial medicinal products, in particular for metaphylaxis and for prophylaxis;
    - Issue of veterinary prescriptions only after a clinical examination or any other proper assessment of the health status of the animal or group of animals by a veterinarian.
    - Exclusion of prescriptions of antimicrobial medicinal products by professionals other than veterinarians;
    - Veterinary prescriptions shall contain any warnings necessary to ensure prudent use of antimicrobials, where relevant;
    - Prescription of antimicrobial medicinal products for metaphylaxis or prophylaxis only for a limited duration to cover the period of risk;
    - Validity of veterinary prescriptions for antimicrobial medicinal products for five days from the date of its issue;
- Art. 107 - Use of veterinary AM:
    - forbidden use by routine or to compensate for poor hygiene, inadequate animal husbandry or lack of care or poor farm management;
    - forbidden use as growth promotes or to increase yield;
    - forbidden use for prophylaxis other than in exceptional cases, for the administration to an individual animal or a restricted number of animals when the risk of an infection or of an infectious disease is very high and the consequences are likely to be severe; limitation, in such cases, of the use of antibiotic medicinal products for prophylaxis to the administration to an individual animal only;
    - allowed use for metaphylaxis only when the risk of spread of an infection or of an infectious disease in the group of animals is high and where no other appropriate alternatives are available;
        - provision of guidance by the competent authorities regarding such other appropriate alternatives and active support to the development;
        - application of guidelines which promote the understanding of risk factors associated with metaphylaxis and include criteria for its application;
    - forbidden derogated use outside the terms of the marketing authorisation for the antimicrobials reserved for treatment of certain infections in humans (Article 37(5));
    - establishment of lists of antimicrobials which shall not be used outside the terms of the marketing authorisation or shall only be used subject to certain conditions and further restrictions to the use of certain antimicrobials in relation with the implementation of a national policy on prudent AM use.

- Art. 119 – Forbidden distribution of antimicrobial veterinary medicinal products for promotional purposes as samples or in any other presentation.

## 4. Implementation of new European Legislation on medicated animal feeds - Reg. (EU) 2019/4:

Provide detailed information on the current state of implementation in your country of the following provisions of the Reg. (EU) 2019/4 related to AMs in medicated animal feeds, by specifying if and how the provisions have already been implemented, and if your country have provided on the same issues stricter rules and criteria than those indicated by the European regulation:

- Art. 4 – Application to medicated feed and intermediate products of the provisions related to collection of AMU data by Member States and responsibilities of pharmaceutical sellers (art. 57-59, Reg. 2019/6);
- Art. 7 - Specific maximum levels of cross-contamination in non-target feed from AM active substances used in medicated feed and related methods of analysis;
- Art. 11 – Forbidden distribution of medicated feed containing antimicrobial veterinary medicinal products for promotional purposes as samples or in any other presentation;
- Art. 16 – Prescription of medicated feed:
    - exclusion of prescriptions of medicated feed containing antimicrobial veterinary medicinal products by professionals other than veterinarians;
    - forbidden use for food-producing animals of medicated feed for more than one treatment under the same veterinary prescription;
    - duration of a treatment complying with the summary of product characteristics of the veterinary medicinal product incorporated in the feed and, where not specified, not exceeding one month, or two weeks in case of a medicated feed containing antibiotic veterinary medicinal products;
    - validity of the prescription of medicated feed containing antimicrobial veterinary medicinal products for a maximum period of five days;
    - exclusion of veterinary prescriptions of medicated feed with more than one veterinary medicinal product containing antimicrobials;
- Art. 17 – Use of medicated feed:
    - use of medicated feed containing antimicrobial veterinary medicinal in accordance with Article 107 of Regulation (EU) 2019/6;
    - exclusion of the use of medicated feed containing antimicrobials for prophylaxis (except in extraordinary cases when the risk of an infection or of an infectious disease is very high and the consequences are likely to be severe (Article 107 (3) of Reg.n (EU) 2019/6);
- Annex 3 – Label information that inappropriate disposal of medicated feed poses serious threats to the environment and may, where relevant, contribute to antimicrobial resistance;

- Annex 4 – Application of a 10% tolerance when the composition of a medicated feed or an intermediate product deviates from the amount of an antimicrobial active substance indicated on the label;

## 5. Private standards

1.27. Briefly describe the functioning of the system framing, in your country, the independent certification protocols for label claims related to livestock products obtained without the use of antibiotics, by detailing the main actors involved and respective roles played in setting up the system: certification agencies, producers organizations and unions, control authorities, downstream industries and their associations, retailers, and other any other group of stakeholders concerned.

1.28. For the livestock products listed below indicate the presence, in your country, of independent certification protocols for labels claiming that the product is obtained without the use of antibiotics during the whole production process or during a part of it.

For each type of product identify the existing certification protocols and for each protocol indicate the following:

- Identification code;
- Label claim;
- Application scope (e.g.: production without use of antibiotics in breeding farm, traceability system in slaughterhouses and meat processing factories);
- Protocol key points;

1.28.1. Poultry eggs;

1.28.2. Poultry meat;

1.28.3. Pig meat;

1.28.4. Bovine meat;

1.28.5. Sheep meat;

1.28.6. Other meat;

1.28.7. Cow milk;

1.28.8. Non-cow milk;

1.28.9. Fish;

1.28.10. Other animal products.

## 11.2 Appendix 2: Links to countries' AMR NAPs

*Tab A 1 Links to AMR NAPs*

| | |
|---|---|
| Argentina | http://servicios.infoleg.gob.ar/infolegInternet/verNorma.do?id=248651<br>http://servicios.infoleg.gob.ar/infolegInternet/anexos/275000-279999/276685/norma.htm<br>http://www.senasa.gob.ar/normativas/resolucion-5912015<br>https://www.argentina.gob.ar/normativa/nacional/resoluci%C3%B3n-178-2018-315751<br>https://www.argentina.gob.ar/normativa/nacional/resoluci%C3%B3n-690-2018-317302 |
| Armenia | https://www.arlis.am/DocumentView.aspx?DocID=99255 |
| Australia | www.amr.gov.au |
| Austria | https://www.sozialministerium.at/Themen/Gesundheit/Antimikrobielle-Resistenzen-und-Gesundheitssystem-assoziierte-Infektionen/Antimikrobielle-Resistenzen/NAP-AMR--Der-Nationale-Aktionsplan-zur-Antibiotikaresistenz.html |
| Bahrain | on WHO website |
| Bangladesh | https://www.who.int/antimicrobial-resistance/national-action-plans/library/en/ |
| Belgium | NAP not yet published but some info on www.resistanceantimicrobiens.be or www.antimicrobieleresistentie.be |
| Bhutan | https://www.flemingfund.org/wp-content/uploads/bc4ead8018642e9793ff86c34dde4a96.pdf |
| Brazil | https://portalarquivos2.saude.gov.br/images/pdf/2018/dezembro/20/af-pan-br-17dez18-20x28-csa.pdf<br>https://www.gov.br/agricultura/pt-br/assuntos/insumos-agropecuarios/insumos-pecuarios/programas-especiais/resistencia-antimicrobianos/arquivos/PAN-BRAGROv.1.0maio2018.pdf<br>http://portal.anvisa.gov.br/documents/3487091/3697444/Plano+de+a%C3%A7%C3%A3o+da+vigil%C3%A2ncia+sanit%C3%A1ria/09f85d62-bc23-4ccf-8c86-0a6431a355f9 |
| Cambodia | www.cdcmoh.gov.kh, Multi-Sectoral Action Plan on Antimicrobial Resistance in Cambodia 2019-2023 |
| Canada | https://www.canada.ca/en/health-canada/services/publications/drugs-health-products/tackling-antimicrobial-resistance-use-pan-canadian-framework-action.html |
| Chile | https://diprece.minsal.cl/wrdprss_minsal/wp-content/uploads/2017/08/Plan-Nacional-contra-la-resistencia-a-los-antimicrobianos.pdf |
| Colombia | https://www.minsalud.gov.co/sites/rid/Lists/BibliotecaDigital/RIDE/VS/MET/plan-respuesta-resistencia-antimicrobianos.pdf |
| Costa Rica | https://www.ministeriodesalud.go.cr/index.php/vigilancia-de-la-salud/normas-protocolos-y-guias/resistencia-microbiana/3811-plan-de-accion-nacional-de-lucha-contra-la-resistencia-a-los-antimicrobianos-costa-rica-2018-2025/file |
| Cyprus | https://www.moh.gov.cy/moh/moh.nsf/0/6b4121829d8502a5c2257c210026e74c/$FILE/ATTLV98V/ΕΘΝΙΚΗ%20ΣΤΡΑΤΗΓΙΚΗ%20ΜΑ%20ΤΕΛΙΚΟ.pdf |
| Czech Republic (the) | http://szu.cz/tema/akcni-plan-nap-2019-2022 |

| | |
|---|---|
| Denmark | https://sum.dk/English/~/media/Filer%20-%20Publikationer_i_pdf/2017/Antibiotika-One-Health-Strategy/UK-One-Health-04072017.ashx https://sum.dk/Temaer/Antibiotikaresistens/~/media/Filer%20-%20Publikationer_i_pdf/2017/Antibiotika-handlingsplan-frem-mod-2020/UK-National-handlingsplan-for-antibiotika-til-mennesker-101117.pdf |
| Ecuador | https://aplicaciones.msp.gob.ec/salud/archivosdigitales/documentosDirecciones/dnn/archivos/AC-00011-2019%20AGOSTO%2007.PDF |
| Estonia | The veterinary action plan- https://www.agri.ee/sites/default/files/content/arengukavad/tegevuskava-amr-2019-2023.pdf |
| Ethiopia | already submitted during the last time assessment |
| Fiji | http://extwprlegs1.fao.org/docs/pdf/fij169634.pdf |
| Finland | http://urn.fi/URN:ISBN:978-952-00-3965-3 |
| France | https://solidarites-sante.gouv.fr/IMG/pdf/feuille_de_route_antibioresistance_nov_2016.pdf |
| Germany | https://www.bundesgesundheitsministerium.de/fileadmin/Dateien/3_Downloads/D/DART_2020/BMG_DART_2020_Bericht_en.pdf |
| Ghana | http://www.moh.gov.gh/wp-content/uploads/2018/04/NAP_FINAL_PDF_A4_19.03.2018-SIGNED-1.pdf |
| Iceland | https://www.land-laeknir.is/servlet/file/store93/item32375/Greinarger%C3%B0%20starfsh%C3%B3ps%20um%20a%C3%B0ger%C3%B0ir%20til%20a%C3%B0%20draga%20%C3%BAr%20%C3%BAtbrei%C3%B0slu%20s%C3%BDklalyfja%C3%B3n%C3%A6mra%20bakter%C3%ADa%20%C3%A1%20%C3%8Dslandi.pdf |
| India | https://ncdc.gov.in/WriteReadData/linkimages/AMR/File645.pdf |
| Iraq | www.who.int/antimicrobial-resistance/national-action-plans/library/en/ |
| Ireland | https://www.gov.ie/en/publication/ec1fdf-irelands-national-action-plan-on-antimicrobial-resistance-2017-2020/ |
| Italy | http://www.salute.gov.it/imgs/C_17_pubblicazioni_2660_allegato.pdf |
| Japan | http://www.kantei.go.jp/jp/singi/kokusai_kansen/pdf/yakuzai_honbun.pdf |
| Jordan | https://www.moh.gov.jo/communicable/InfoPageDaynamic/128/221 |
| Lao People's Democratic Republic | National AMR Strategic Plan 2019-2023 |
| Latvia | https://likumi.lv/ta/id/308758-par-antimikrobialas-rezistences-ierobezosanas-un-piesardzigas-antibiotiku-lietosanas-planu-viena-veseliba-2019-2020-gadam |
| Luxembourg | http://sante.public.lu/fr/publications/p/plan-national-antibiotiques-2018-2022/index.html |
| Malaysia | http://www.moh.gov.my/moh/resources/Penerbitan/Garis%20Panduan/Pengurusan%20KEsihatan%20&%20kawalan%20pykit/Malaysian_Action_Plan_on_Antimicrobial_Resistance_(MyAP-AMR)_2017-2021.pdf |
| Maldives | http://www.health.gov.mv/Uploads/Downloads//Informations/Informations(43).pdf |
| Malta | www.nec.gov.mt |
| Mongolia | uploaded in 2018 |
| Montenegro | http://www.gov.me/biblioteka/strategije |
| Myanmar | https://www.who.int/antimicrobial-resistance/national-action-plans/library/en/ |
| Netherlands | https://www.rijksoverheid.nl/documenten/kamerstukken/2015/06/24/kamerbrief-over-aanpak-antimicrobialaresistentie |

| | |
|---|---|
| New Zealand | https://www.health.govt.nz/publication/new-zealand-antimicrobial-resistance-action-plan |
| Nicaragua | http://www.minsa.gob.ni/index.php/repository/Descargas-MINSA/Direcci%C3%B3n-General-Vigilancia-de-la-Salud-P%C3%BAblica/Resistencia-Antimicrobiana/ |
| Nigeria | https://ncdc.gov.ng/themes/common/docs/protocols/77_1511368219.pdf |
| North Macedonia | . http://zdravstvo.gov.mk/strategii/ |
| Norway | https://www.regjeringen.no/contentassets/5eaf66ac392143b3b2054aed90b85210/antimicrobial-resistance-engelsk-lavopploslig-versjon-for-nett-10-09-15.pdf<br>https://www.regjeringen.no/contentassets/915655269bc04a47928fce917e4b25f5/handlingsplan-antibiotikaresistens.pdf<br>https://www.regjeringen.no/contentassets/714aa1437e2545f7bb4914a3474cd691/handlingsplan-for-et-bedre-smittevern.pdf |
| Pakistan | https://www.nih.org.pk/wp-content/uploads/2018/08/AMR-National-Action-Plan-Pakistan.pdf |
| Paraguay | http://vigisalud.gov.py/webdgvs/files/documentos/ram.pdf |
| Peru | antimicrobianos.ins.gob.pe |
| Portugal | https://www.dgs.pt/documentos-e-publicacoes/plano-nacional-de-combate-a-resistencia-aos-antimicrobianos-2019-2023.aspx |
| Republic of Moldova | http://particip.gov.md/proiectview.php?l=ro&idd=6630 |
| Russian Federation | consultantplus://offline/ref=C98FB72AB2CCEF7F33BE7F32F80D28EB68B2997908E049A90D5DFD3A7C8295CB2338EC0B67DDD5FCEA758C34D945DD132606A3625CBCDFECe5M9J<br>consultantplus://offline/ref=B0C63EF7A795F72F80CBADE444FACA52507214A7A896F16B4DB0998989BBC28D539793ECA423E4E4A6BED51749A9D87D272EFAFD1C550CF800AEB2B07FMAJ |
| Sierra Leone | https://www.who.int/antimicrobial-resistance/national-action-plans/library/en/ |
| Singapore | https://www.ncid.sg/About-NCID/OurDepartments/Antimicrobial-Resistance-Coordinating-Office/Documents/National%20Strategic%20Action%20Plan%20on%20Antimicrobial%20Resistance.pdf |
| Slovakia | https://www.slov-lex.sk/legislativne-procesy?p_p_id=processDetail_WAR_portletsel&p_p_lifecycle=2&p_p_state=normal&p_p_ mode=view&p_p_cacheability=cacheLevelPage&p_p_col_id=column-2&p_p_col_count=1&_processDetail_WAR_portletsel_fileCooaddr=COO.2145.1000.3.2792659&_processDetail_WAR_portletsel_file=vlastnymaterial.docx&_processDetail_WAR_portletsel_action=getFile |
| Slovenia | https://www.gov.si/novice/nov-vlada-sprejela-drzavno-strategijo-eno-zdravje-za-obvladovanje-odpornosti-mikrobov-2019-2024-z-akcijskim-nacrtom-za-obdobje-2019-2021/ |
| South Africa | www.health.gov.za/index.php/antimicrobial-resistance |
| Spain | http://www.resistenciaantimicrobialos.es/es/publicaciones/plan-nacional-frente-la-resistencia-los-antimicrobialos-pran-2019-2021 |

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| Sri Lanka | www.health.gov.lk |
| Sudan | https://www.who.int/antimicrobial-resistance/national-action-plans/library/en/ |
| Sweden | https://www.regeringen.se/491cdd/globalassets/regeringen/dokument/socialdepartementet/fokhalsa-och-sjukvard/svensk-strategi-for-arbetet-mot-antibiotikaresistens-2020-2023.pdf (Translation into English in progress); https://www.folkhalsomyndigheten.se/contentassets/44ff3f12017d4dc38abbcf9377be108b/reviderad-tvarsektoriell-handlingsplan-2018-2020-18002.pdf https://www2.jordbruksverket.se/download/18.693595921700d430c72b254f/1580906107699/ovr524.pdf / (In English) |
| Switzerland | https://www.star.admin.ch/dam/star/en/dokumente/strategiebericht-star.pdf.download.pdf/strategy-on-antimicrobial-resistance-en.pdf |
| Tajikistan | https://www.who.int/antimicrobial-resistance/national-action-plans/library/en/ |
| Thailand | http://www.fda.moph.go.th/sites/drug/Shared%20Documents/AMR/04.pdf, www.amrthailand.net |
| Timor-Leste | https://www.ms.gov.tl/dnfm |
| Tunisia | http://www.santetunisie.rns.tn/fr/toutes-les-actualites/1036-plan-d-action-national-de-lutte-contre-la-r%C3%A9sistance-aux-antimicrobiens-en-tunisie-2019-2023 |
| Turkey | Our National AMR Action Plan is still in the publication phase. |
| United Arab Emirates | under process |
| United Kingdom of Great Britain and Northern Ireland (the) | https://www.gov.uk/government/publications/uk-5-year-action-plan-for-antimicrobial-resistance-2019-to-2024 |
| United Republic of Tanzania | https://www.afro.who.int/publications/national-action-plan-antimicrobial-resistance-2017-2022 |
| United States of America | https://obamawhitehouse.archives.gov/sites/default/files/docs/national_action_plan_for_combating_antibotic-resistant_bacteria.pdf |
| Viet Nam | http://amr.moh.gov.vn/tailieu; http://www.cucthuy.gov.vn/vanban/Pages/quyet-dinh-2625-qd-bnn-ty.aspx |
| Zambia | https://www.afro.who.int/publications/multi-sectoral-national-action-plan-antimicrobial-resistance-2017-2027 |