Comparative analysis of national responses to EU antimicrobial resistance initiatives: Translating a global health threat into effective policy

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1. Introduction

The invention of antibiotics has been recognised as one of the most significant accomplishments in contemporary science. These have helped save millions of lives. Nevertheless, antimicrobial resistance (AMR), compromises this progress and poses serious threats to human health (Marston et al., 2016). Despite AMR lately being in the spotlight, long before antimicrobials were discovered, created, or made available for purchase, AMR was already present. It is a phenomenon that affects all countries and does not understand borders. Prevention is essential to halt AMR, consequently, action to fight it is already present at the regional, national, and international levels.

In terms of its societal relevance, it is considered by the World Health Organization (WHO) (2023) one of the top ten global public health threats. Regarding the European Union (EU), in 2022 it was identified as one of the top three most pressing health threats. At least 700.000 people die from infections every year (Morrison & Zembower, 2020). Research suggests that increasing resistance to AMR by 2050 could result in ten million deaths annually and a 2% to 3.5% drop in Gross Domestic Product (GDP). Moreover, it would cost the globe up to 100 trillion dollars (O'Neill, 2014, p. 6).

There are previous studies of governance approaches to the control of AMR across European countries. However, none of these focus on EU countries with high antibiotic usage (Birgand et al., 2018; Bronzwaer et al, 2002; Therre, 2001). Therefore, this research will address this gap by examining the national policies of countries with high antibiotic use.

The thesis will begin by analysing the existing literature on the topic of AMR and national responses to EU initiatives, identifying the gap in the literature and leading to the research question. Then, a theoretical framework will be established by introducing the main theories together with the conceptualisations. After that, the research design, the case selection, and the data collection will be explained. Subsequently, the coding frame followed by the results and its discussion will be presented. Finally, the thesis will end with a conclusion.

2. Literature Review

2.1. Mitigating AMR

Different scholars identify various ways and strategies to address the issue of AMR. Smith and Coast (2002) contend that global coordination and international action are key and that this containment should be considered a public good. However, this poses a challenge since healthcare remains a national concern. Laxminarayan et al. (2013) also emphasise the need for global solutions, but they argue that coordinated action is currently not present, especially politically speaking. Accordingly, the authors assert that countries with comprehensive national plans have shown the most success in reducing resistance. Likewise, O'Neill (2014) argues that each country should differ in how AMR is addressed since some countries are more affected than others.

Laxminarayan et al. (2013), highlight that little research has been conducted on the burden of convincing policymakers of the urgent need to act. Clear information on antibiotic resistance and its impact on public health is vital for policymakers. Consequently, "research efforts need to be focused on intervention strategies and solutions rather than doom-and-gloom reports" (p. 1064). This is in line with Kingdom's (1984) "Multiple Streams Framework", which offers an angle through which to see the development of AMR as a major policy concern in the European context and globally.

Dadgostar (2019) claims that there is a gap vis-à-vis people's awareness of the safe usage and potential risks of antibiotics. Consequently, Zhou et al. (2020) fill this gap by analysing and addressing the risks of injudicious antibiotic use. They use the Risk Information Seeking and Processing (RISP) model. The results showed that participants who watched the film showed reduced levels of positive affect towards antibiotics, higher risk judgment, and higher knowledge about antibiotic dangers. Morrison and Zembower (2020) also contend that the primary strategy to reduce antibiotic resistance is to encourage responsible antibiotic use. Moreover, the authors also call attention to the agricultural industry, an area that uses antibiotics in large quantities. Despite this, there is a general consensus that it is through public awareness that this issue should be addressed. Stewardship programmes (ASPs) remain of great importance and are considered crucial in the fight against AMR. According to Dyar et al. (2017), these initiatives are critical to

maximising the use of antibiotics in the fight against resistance while maintaining the highest standards for patient care. Tang et al. (2023) conducted a survey to find out public knowledge on antibiotics and its results indicate that, indeed, there is a relationship between AMR and public awareness. Irrational antibiotic use by the public and healthcare personnel can become the norm. ASPs should prioritise both appropriate usage and long-term change in conduct and societal norm reorientation to disrupt this tendency (Laxminarayan et al., 2013).

2.2. AMR in the European Union

The EU's approach to tackling AMR exemplifies how regional governance may handle challenging difficult global health concerns. Various researchers are focusing on AMR in the EU and its effects, in particular in the previously mentioned "One Health" action plan, stating that human, animal, and environmental health are strictly intertwined (WHO, 2017). Scholar evaluations, such as those by Léger et al. (2018), have praised this strategy while emphasising the importance of ongoing adaptation to developing resistance patterns and scientific advances. To do this, they apply the evaluative framework "Network of Evaluation of One Health".

McNulty et al. (2016) and Florez-Cuadrado et al. (2018), focus their research on AMR in the food chain. The first authors target AMR in the meat chain and use five case studies from the EU to conduct their research while the second analyses food safety in general. The EU's policy includes strict legal and regulatory measures to control the use of antibiotics. Aenishaensling et al. (2019) investigated the influence of EU laws on veterinary medical goods and medicated feed, finding considerable reductions in antibiotic use in agriculture. Nevertheless, research reveals that implementation varies among member states highlighting the limitations of harmonising national policies within the EU framework. As to prevention, The European Centre for Disease Prevention and Control (ECDC) has played a key role in improving AMR surveillance and data exchange throughout the EU. Cassini et al. (2019) underline the importance of effective monitoring systems in guiding policy and practice. However, literature evaluations demonstrate limitations in surveillance, notably in the environmental transmission of AMR, emphasising the importance of thorough data collecting and sharing methods (Berendonk et al., 2015).

Marco-Fuentes et al. (2022), albeit criticising that most authors have just been focusing on commensal bacteria in production animals, move away from food, and examine AMR in companion animals and how this also poses a great challenge for the "One Health Approach" in the EU. Velazquez-Meza et al. (2022), also want to evaluate the AMR problem from a health standpoint to better understand the actors involved in One Health. Tacconelli et al. (2018), among others, have stressed the necessity of coordinated activities across EU member states, with surveillance systems such as the European Antimicrobial Resistance Surveillance Network (EARS-Net) providing vital data for policy and practice. Earnshaw et al. (2014), come back to public awareness by analysing public awareness campaigns taking place in the EU and the effect it has on positive attitudes towards antibiotic use. More specifically, they analyse the European Antibiotic Awareness Day (EAAD), a platform to support politically and financially, national campaigns across Europe.

Concerning national policies to tackle AMR, Filippini (2012) discovered that public campaigns can considerably reduce antibiotic use, with an impact ranging from 6.5 to 28.3% in Europe. Goossens (2005) stressed the necessity of properly planned mass education efforts, particularly in countries with high antibiotic use, to enhance antibiotic compliance. Godman (2017) emphasised the importance of many interconnected measures for reducing improper antibiotic prescribing and dispensing. Ferreira (2017) emphasised the significance of standardising methodology and establishing stricter procedures to monitor antibiotic use. These studies collectively demonstrate that, while public campaigns and education are helpful, a more comprehensive approach is required, which includes policy monitoring and harmonisation. The Commission concluded that although all Member States had National Action Plans in place, most of them at least partially based on a One Health concept, there were significant differences in the substance and specifics of these plans (Eur-lex, 2023). Despite the extensive research on AMR, a gap remains in understanding how national policies in EU countries with high antibiotic use align with or diverge from EU initiatives.

Therefore, this thesis aims to investigate the following research question: *How do the national policy measures to EU initiatives in antimicrobial resistance compare among countries with high antibiotic use?*

3. Theoretical framework

3.1. Multilevel Governance and Policy Transfer

To understand how EU initiatives on antimicrobial resistance are translated into national responses, multilevel governance (MLG) theory is crucial. “Multilevel governance is the dispersion of authority to jurisdictions within and beyond national states” (Hooghe, Marks & Schakel, 2019). This theory assumes that states are no longer the monopolising or even required central actors in governance. Rather, players functioning at different levels increasingly shape and share the power of government (Saito-Jense, 2015). Hooghe and Marks (2001) classified this theory into two other types. The first one and the one of interest for this thesis, referred to as nested MLG, is defined as vertically hierarchical governance with a defined structure where a limited number of authorities have decision-making powers. This category of MLG focuses on the relationships between various levels of governance and the policy results. Multilevel governance in the context of AMR would entail making sure that national responses are both tailored to local requirements and circumstances and in line with EU ambitions. According to a report from the Council of Europe (2023, p. 4), even in times of crisis, effective MLG can improve social, economic, and environmental outcomes for people and businesses, foster the development of relationships and communication between different decision makers, and increase the capacity and capability of democratically elected leaders of public governance institutions. National governments are essential to MLG since they are usually in charge of determining the general direction of policy and allocating the necessary funds for the different services and programmes offered throughout the country. They also bear a significant responsibility for putting these policies into action and making sure that the needs of all relevant stakeholders are satisfied (p. 8). Formulating and implementing policies that have an influence on the EU as a whole needs coordination and cooperation between several players, including national, regional, and local governments as well as the EU institutions (p. 12).

MLG is what allows policy transfer to occur and it is essential to conduct this research. According to Dolowitz and Marsh (1996), policy transfer is “a process in which knowledge about policies, administrative arrangements, institutions, etc. in one time and/or place is used in the development of policies, administrative arrangements and

institutions in another time and/or place" (p. 344). Radaelli (2002, p. 26) contends that the EU has transformed into a massive transfer platform for spreading many parts of policy across member states. Transferring policies from one level to another involves a combination of processes and agents which includes four different degrees of transfer: copying, which entails a complete and direct transfer; emulation, which entails a transfer of the concepts underlying the programme or policy; combinations, which entail a mixture of many policies; and inspiration, where a policy change may be motivated by another jurisdiction's policy but the end product does not truly draw from the original (Dolowitz & Marsh, 2000). The case of the EU differs from the others. Indeed, the EU has binding regulations, however, member states "actively and voluntarily shape and adopt the edicts of the Union" (p. 15) in a way that best suits these, so this would be better viewed as a negotiated and voluntary transfer.

3.2. Conceptualisation

Antimicrobial Consumption

When this term is referred to in this research, it is analysed using the defined daily dose (DDD) methodology developed by the World Health Organization (WHO) Collaborating Centre for Drug Statistics Methodology. The EU One Health Action Plan (2017) argues that antimicrobials consist of antiprotozoals, antivirals, antifungals, and antibiotics. These are manufactured or natural active ingredients that either destroy or stop the growth of germs. They are essential for both human and animal infection prevention and treatment and are used in everyday medicine. There are four main categories of antimicrobials under surveillance: antibacterials for systemic use; antimycotics and antifungals for systemic use; antimycobacterials for systemic use; and antivirals for systemic use. The main metric for antimicrobial consumption, as previously mentioned, is DDD per 1000 inhabitants per day. It provides a general approximation of the fraction of the population that receives antimicrobial treatment daily. The European Centre for Disease Prevention and Control (ECDC), the European Food Safety Authority (EFSA), and the European Medicines Agency (EMA) have chosen this measure and the primary harmonised outcome indicator for total antibacterial consumption in humans, combining both the community and hospital sectors (ECDC, 2022).

National policy

In this case, a national policy will be conceptualised in terms of how the Centers for Disease Control and Prevention (2015) defines it with relation to public health. This is "the advancement and implementation of public health law, regulations, or voluntary practices that influence systems development, organisational change, and individual behaviour to promote improvements in health". It is also highlighted how working in other sectors, such as education, agriculture, or employment, is another way to achieve public health goals, which emphasises the "One Health" approach.

Antimicrobial resistance

Antimicrobial resistance must be conceptualised to answer the research question. In this case, the conceptualisation of a valuable, reliable, and well-known organisation will be employed. According to the WHO (2023), "AMR occurs when bacteria, viruses, fungi and parasites change over time and no longer respond to medicines making infections harder to treat and increasing the risk of disease spread, severe illness and death. As a result, the medicines become ineffective and infections persist in the body, increasing the risk of spread to others".

3.3. Theoretical expectations

The theoretical expectation of this thesis is that the three countries analysed will exhibit similar responses to AMR initiatives is based on the principles of multilevel governance and policy transfer within the EU. Given the shared challenges, common objectives, and coordinated efforts promoted by the EU, it is reasonable to anticipate convergence in the national policies of these countries.

4. Research Design

4.1. Methodology

In this section, the research design of the research will be presented. The research question will analyse the discrepancies and similarities of national policies on AMR. Therefore, a

comparative case study, specifically a small-N study, will be used while analysing three cases that score high on antibiotic use: France, Spain, and Ireland. By making a cross-country comparison of national action against AMR, a pattern can be established. One way for a researcher to test for the existence of these mechanisms is to choose a small number of examples for deep analysis, (Halperin & Heath, 2020, p. 168), by investigating in this case, anomalous or extreme instances, such as high antibiotic usage. Moreover, by making a cross-country comparison of national action against AMR, a pattern that tests the hypothesis can be established. The reason why a small-N was chosen instead of a single case study is to use the similarities and differences that we find in the real world to determine whether or not the observed variation pattern conforms to our theoretical expectations (Halperin & Heath, 2020). The method of analysis chosen is qualitative content analysis as it provides flexible data gathering and it enables iterative analysis, in which it is possible to develop and change the coding framework and interpretations over time (p. 238).

4.2. Case selection

As mentioned above, the case selection will be based on one criterion: antimicrobial use according to the DDD per 1000 inhabitants per day metric, which "provides a rough estimate of the proportion of the population treated daily with antimicrobials" (ECDC, 2022). The ECDC, in 2022 identifies Cyprus as the country in the EU with the highest antimicrobial consumption, with 33.5 DDD. The second country in the EU is Greece (32.9), followed by Romania (27.6) and Bulgaria (25.7). Nine remaining countries enter the category of "high antibiotic use". These are France (24.3), Malta (24.0), Poland (23.6), Spain (23.2), Ireland (23.1), Italy (21.9), Slovakia (20.8), Belgium (20.4), and Croatia (20.2), respectively from higher to lower.

The three cases examined will be France, Spain, and Ireland. France is currently number 5th in the EU with 24.3 DDD with Spain and Ireland consecutively being number 8th and 9th with 23.2 and 23.2 DDD. The three case studies are above the EU/EEA average. The 2022 EU population mean total (hospital and community combined), consumption of antibacterials was 19.4 DDD per 1000 inhabitants per day, with countries ranging from 9.1 to 33.5 (ECDC, 2022). As Halperin and Heath (2020, p. 168) discuss, a thorough

examination of a case that differs from theoretical assumptions can lead to conclusions which require to significantly alter or reject pre-existing theories.

In addition to these justifications, the language was also a limitation to the case selection, allowing only to choose countries where the language spoken is English, Spanish, or French.

4.3. Data Collection

For this research, the time frame will range from 2011 to 2024, hence the documents analysed. The reason for this choice is that the first policy to tackle AMR by the EU took place in 2011. The data collection for this thesis will only take into consideration national policies to fight AMR and EU documents. For the latter, the documents will be retrieved from official EU websites, such as "Eur-lex" to access EU's law, and those from the European Commission and the European Parliament. The main documents analysed will be the "EU One Health Action Plan" from 2011 and 2017. Furthermore, the "farm to fork" strategy (2020), and the European Parliament resolution of 1 June 2023 on EU action to combat antimicrobial resistance. The main search term to retrieve documents was "EU antimicrobial resistance".

In this case, the national responses will be retrieved from the national government websites. For France, the information necessary will be retrieved from the official website of the Ministry of Health and Solidarity (in French: *Ministère du Travail de la Santé et des Solidarités*), which consists of two documents: the 2022-2025 national strategy to combat AMR, and the interministerial roadmap for controlling AMR. For Spain, the country has a specific website for the national plan against AMR, National Plan Antimicrobial Resistance (in Spainish: *Plan Nacional Resistencia Antibióticos*) (PRAN), where all documents are present. In Ireland's case, there are two policies: 2017-2020 Ireland's national action plan on AMR, and the 2021-2025 Ireland's One Health National Action Plan on AMR, easily available as PDFs on the national government's website. The search terms used here were "France national plan antimicrobial resistance", "España plan nacional resistencia antimicrobiana" (Spain national plan antimicrobial resistance), and "Ireland national plan antimicrobial resistance". All of these sources fulfil the

Halperin & Health (2020) criteria which are: authority, accessibility, accuracy, and purpose.

4.4. Operationalisation: Coding frame

To conduct the qualitative content analysis of national responses, a series of categories and sub-categories were developed using a mix of a concept and a data-driven coding frame. This is to make sure that the coding frame accurately describes the material. (Schreier, 2012, p. 85). The recording unit that will be used in this research will be sentences and paragraphs (Halperin & Heath, 2020, p. 378).

Six main categories compose the coding frame. All of them were predefined based on the amended Anderson's governance framework from Chua et al (2022). Nonetheless, all of the subcategories except stewardship programmes, vaccines, effectiveness, and reporting, were data-driven.

Table 1. Coding frame

Categories	**Sub-categories**	**Sub-Sub-Categories**	**Indicators**	**Description**
Public awareness and education	Scope Target Engagement method		Campaign Awareness Education Programme Importance Knowledge Platform Training	This category includes all the efforts made to educate the citizens in terms of antimicrobial resistance in general.
Surveillance of AMR	Data collection Data sharing Technology integration		Indicators Measure Agenda Data System Surveillance	This category includes how the national action plan (NAP) is planning to keep track and surveille the patterns that AMR offer.

	Trend analysis			
Optimising antimicrobial usage	Stewardship programmes Regulation Public education		Training Programmes Prudent Responsible Prescription Regulate Limit	This category includes all the ways in which the NAP is trying to optimise and reduce antimicrobial usage, in terms of prescription for instance.
Infection prevention & control (IPC)	Policies and guidelines Vaccines	Implementation Education Development	Regulatory Prescription Duration Promote Vaccines Immunisation Guidelines Prevention Hygiene Control	This category includes the ways in which the NAP is trying to implement IPC in the society.
Monitoring and evaluation (M&E)	Effectiveness Reporting		Report Measure Survey Monitor Review Compliance	This category includes all the efforts made by the NAP to measure the effectiveness of certain parts of the plan and to monitor.
Research and Innovation (R&I)	Diagnostics Treatment New alternatives		Research Boost Diagnostic Advance Development Alternative Technologies	This category incorporates how new research is being incorporated into the NAP and in which way.
International Collaboration			Every time “international collaboration”	This category includes all the ways in which the country is

			or the active participation in an international plan is mentioned	trying to get involved in international action.

5. Results

The 2017 EU One Health Action Plan against AMR is the current plan of the EU to fight AMR. One Health can be described as "an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals and ecosystems" (WHO, 2024). This plan builds on the 2011 One Health Action Plan and comprises three main pillars: (i) making the EU a best-practice region, (ii) boosting research, development, and innovation, and (iii) shaping the global agenda (European Commission, 2017, p. 6). The necessity for the EU to take the lead in combating AMR and to enhance Member States' efforts is what drove the creation of this new One Health action plan. Its main objective is to preserve the potential for efficient treatment of infections in both humans and animals. In addition to reducing the onset and spread of AMR, it offers a framework for further, more comprehensive action to boost the creation and accessibility of new antimicrobials both inside and outside the EU (p. 5). To achieve this, the plan outlines different aspects. To make the EU a best-practice region, the plan suggests strengthening the awareness of the challenges of AMR as well as coordination and implementation of EU rules to tackle AMR. It also highlights the need for better prevention and control of AMR, among others. To boost research, development, and innovation on AMR, the plan proposes to develop new alternatives, new preventive vaccines, new economic models and incentives, and most importantly, to reinforce knowledge on how to treat and prevent AMR. Lastly, to shape the global agenda, the proposal aims to enhance the EU's global presence and to have more bilateral partnerships while strengthening cooperation. However, after identifying the need for further coordinated action in human health and the environment, the Council in June 2023 drafted a recommendation to step up EU actions to combat antimicrobial resistance in a One Health approach.

The EU is also currently focusing on veterinary products and medicated feed. In May 2020, the European Commission approved the Farm to Fork Strategy, a tool to transform

the EU into a sustainable food system. Its goal is to reduce total EU antibiotic sales for livestock farming and aquaculture by 50% by 2030 (Simjee & Ippolito, 2022). Two other regulations will support this objective. The first one is Regulation (EU) 2019/4 on Medicated Feed, which aims to regulate and control it by needing a prescription. Regulation (EU) 2019/6 on Veterinary Medicinal Products whose main goal is to establish high-quality and safe criteria for veterinary medical products to address common concerns about protecting public and animal health, as well as the environment. At the same time, this Regulation should harmonise the procedures governing the authorisation of veterinary medical goods and their placement on the Union market (p. 2). These initiatives call for actions to combat AMR and encourage more thoughtful and responsible administration of antimicrobials to animals.

Furthermore, the EU4Health Programme 2021-2027, invested 50 million euros to reduce the risks of AMR, this initiative is known as Jamrai 2, being the largest EU-funded action on AMR to date. It focuses on infection prevention and control, surveillance and monitoring, prudent use of antimicrobials, awareness raising, and innovation, including aspects related to animal health and the environment (European Commission, 2024).

In this section, the results will be presented, see Appendix D (results table).

5.1. France

The issue of antimicrobial resistance in France is higher than in other European countries, thus, it is a priority for the government. Multidrug-resistant bacterial infections are predicted to cause 5,500 fatalities annually (Pulcini et al., 2022). The initial Interministerial Committee for Health focused on AMR, particularly antibiotic resistance. In November 2016, the AMR Interministerial National Action Plan was adopted by the French government, taking a One Health approach (p. 1097). Building up on this action plan, the 2022-2025 National strategy for preventing infections and antimicrobial resistance was implemented.

The Interministerial roadmap has four main objectives that are in line with EU initiatives, previously explained. These are: to encourage and develop research into AMR, increase general public awareness, strengthen monitoring through indicators shared between

activity sector, and to improve the use of antibiotics. The 2022-2025 national strategy has two main objectives which are to prevent antibiotic-resistant infections and limit the transmission of antibiotic-resistant bacteria, in particular through hygiene measures, and to limit and rationalise the use of antibiotics. It can be observed, that over time, the main goals have changed to reflect a more focused approach on infection prevention and control, as well as a rationalised use of antibiotics. This shift is a strategic improvement targeted at resolving particular weaknesses found in previous initiatives.

Public awareness and education

The 2016 Interministerial Roadmap placed a strong emphasis on public education and awareness campaigns by including a nationwide intersectoral initiative to increase public knowledge about AMR. This effort used media ads and instructional modules to spread information to a variety of audiences. Increasing public knowledge and comprehension of AMR and its repercussions was the main objective. The new 2022-2025 national strategy targeted health education for young people, adolescents, and doctors. Consequently, the ongoing creation and marketing of the "e-Bug" instructional tool. Digital campaigns, and tools like "Antibio'Malin" are examples of how engagement strategies are evolving to become more complex and dynamic. This shifting is a reflection of the realisation that consistent, targeted instruction is essential to behaviour modification.

Surveillance of AMR

The 2016 plan had substantial emphasis on developing global and specialised indicators to evaluate antibiotic resistance. A strong strategy for tracking AMR trends and responses was demonstrated by the data gathering process, which made use of support networks and awareness. By encouraging biology laboratories to actively participate and developing an indicator dashboard to direct national, regional, and local initiatives, the 2022–2025 strategy, in contrast, emphasises on improving data collecting. This strategy suggests a shift toward more organised and methodical methods of gathering and exchanging data, guaranteeing that monitoring operations are thorough and able to provide useful information.

Optimising antimicrobial usage

Initiatives to encourage appropriate antibiotic usage and regulatory steps to restrict antibiotic prescriptions were included in France's 2016 roadmap. Campaigns for public education were a crucial component of this plan, which attempted to lessen antibiotic overuse. While maintaining this priority, the 2022–2025 strategy gives more weight to the rationalisation of antibiotic usage by encouraging paediatricians and general practitioners to reduce needless prescriptions.

Infection Prevention and Control (IPC)

The 2016 roadmap's infection prevention and control strategies focused on developing IPC professionals' competencies and encouraging initiatives to prevent infections. Annual initiatives like Patient Safety Week and World Hand Hygiene Day were essential to preserving high IPC standards in healthcare settings. Building on these foundations, the 2022–2025 strategy prioritises health education on infection prevention for kids and teens and launches public awareness and healthcare professional programmes.

Monitoring and Evaluation (M&E)

The monitoring and evaluation strategy of the 2016 roadmap comprised creating strategic steering groups to direct research and policy and compiling situational analysis summaries. This paradigm served as a basis for assessing the efficacy of different AMR programmes. By 2022, the approach had changed to incorporate regular monitoring of healthcare personnel's training in infection control and antibiotic resistance as well as comprehensive yearly assessments of the appropriateness of antibiotic usage.

Research and innovation (R&I)

Enhancing in vitro diagnostic tools and offering financial and regulatory incentives for new innovations were among the research and innovation-focused initiatives included in the 2016 roadmap. Supporting the creation of new techniques and therapies to fight AMR was the goal of this strategy. While it still supports new technologies and diagnostic tools, the 2022–2025 strategy gives more weight to promoting research on antibiotic substitutes.

International collaboration

International cooperation is one of the main focuses of the 2016 plan which placed a strong emphasis on collaborating with the OIE and WHO to create monitoring networks. France's commitment to worldwide AMR efforts was demonstrated by its participation in European and international programmes. With a heightened presence in significant European and global initiatives, the 2022–2025 strategy upholds this emphasis.

5.2. Ireland

Antimicrobial resistance has been recognised as a national risk in since 2014. The Irish Government's National Risk Assessment (NRA) document highlights strategic risks that may have a negative impact on Ireland's well-being and seeks to ensure that suitable prevention and mitigation measures are in place (Ireland's National Action Plan on AMR, 2017).

Taking a "One Health" approach, the Irish government developed in 2017 the first national action plan (iNAP), which is in line with the WHO's Global Action Plan on AMR (2015) and the European Action Plan on AMR (2017). The ultimate purpose of iNAP is to ensure the availability of effective antibiotic treatment choices for both human and animal populations for as long as possible, using safe, quality-assured antimicrobials that are used responsibly and made available to all who require them. In 2021, Ireland adopted another national action plan to combat AMR (iNAP2). It was put together in collaboration with a diverse group of stakeholders from many sectors and disciplines. It includes 15 One Health measures to strengthen human and animal health security by strengthening coordination, collaboration, and communication at the human-animal-environment interface. The goal of iNAP2 is to guarantee that people and animals alike will have access to efficient antibiotic treatment alternatives. By limiting the emergence and spread of AMR, this strategy also seeks to safeguard and improve the health of people, animals, and the environment. In addition to tackling the emergence and transmission of AMR in companion animals, iNAP2 places more emphasis on infection prevention and control.

Public awareness and education

The 2017–2020 plan placed a strong emphasis on employing media platforms for public awareness campaigns and including AMR education into both undergraduate and graduate curriculum. Particular programmes, such as the "Live Green" website, provide guidance on antimicrobial disposal and use. The goal of this broad strategy was to raise awareness of the value of careful antibiotic usage among the general public and healthcare professionals. The emphasis on public awareness campaigns and professional development is maintained and increased in the 2021–2025 strategy by educating students and healthcare workers about the improper use of antibiotics.

Surveillance of AMR

Creating a nationwide system to gather information on the use of antibiotics, especially in the veterinary industry, was a crucial part of the 2017–2020 plan. Due to the creation of linked community and hospital databases that enabled coordinated data exchange and trend analysis, the monitoring of AMR becomes more thorough. In the current action plan, additional data gathering systems have been established for the dairy industry, and new instruments have been launched to gather cost data related to AMR. The entire surveillance capacity is boosted by better methods for timely data collection and reporting from public and private laboratories, allowing for more efficient monitoring and AMR trend reaction.

Optimising antimicrobial usage

The 2017-2020 plan called for the delivery of AMR and IPC training programmes in combination with the establishment of national standards for appropriate antibiotic prescribing practices. In order to guarantee responsible prescribing practices in all healthcare settings, regulatory measures were also implemented. With the use of newsletters, vet alert emails, and the Veterinary Journal, the 2021–2025 plan encourages safe prescribing among veterinary professionals. To encourage responsible prescribing practices in all healthcare settings, extensive national prescribing guidelines have been developed.

Infection prevention and control (IPC)

In order to lower infection rates and the need for antibiotics, increasing vaccination uptake among the general public and medical professionals was an important priority in the first national action plan. In the second one, IPC policies still encourage antimicrobial stewardship by promoting hand and respiratory hygiene as well as the use of electronic prescription. Because infection prevention and antibiotic use are intertwined, the HSE Community IPC Strategy is being implemented in accordance with integrated AMR and IPC approaches.

Monitoring and evaluation (M&E)

Regular public surveys and feedback channels were used to track the success of AMR programmes in iNAP. These tools aided in evaluating the results of awareness efforts and provided direction for upcoming changes to policy. The iNAP2 is still evaluating public attitudes and understanding about antibiotics and AMR through regular surveys. AMR tactics remain flexible and effective because of ongoing surveillance of infections linked to healthcare and the success of awareness efforts.

Research and innovation (R&I)

The first plan encouraged the creation of quick diagnostic tools and non-antibiotic therapy options. Encouraging research into new medicines and cutting-edge technology was essential to tackling the changing AMR issues. The 2021–2025 strategy continues to foster the creation of newer treatments and medications while also improving fast diagnostics. It is still a major area of focus for research and innovation.

International cooperation

Ireland worked with the WHO and took an active part in European and international research projects like Horizon 2020. These initiatives demonstrated Ireland's dedication to advancing global AMR strategies and leveraging resources and expertise on a worldwide scale. In the iNAP2, Ireland has a stronger role in international research partnerships and AMR surveillance networks. Ireland's commitment to the global fight against AMR is demonstrated by its continued participation in programmes like the WHO

Global Antimicrobial Resistance Surveillance System (GLASS) and other international research activities.

5.3. Spain

In 2012, there was increasing international pressure on the national level to address the issue of resistance. Even then, Spain was not prioritising the battle against resistance in politics, despite having the highest incidence of antibiotic consumption in the country. The Spanish Agency for Medicines and Health Products (AEMPS) made the decision to address this issue after realising that the emergence and spread of infections brought on by bacteria resistant to antibiotics pose one of the biggest threats to public health. The project started in 2012 and was approved in 2014 as the National Plan against Antibiotic Resistance (PRAN).

Public awareness and education

The goals of the 2014–2018 plan were to increase public awareness of AMR and encourage healthcare professionals at all career stages to learn more about it. Campaigns sought to improve knowledge and alter antibiotic-related behaviours. In the 2019-2021 plan, the focus was on broad educational initiatives to establish a foundation of knowledge for the general public. The emphasis was expanded to include public campaigns and instructional resources created especially with kids in mind. The PRAN-EDUCA initiative was developed in conjunction with the National Centre of Innovation and Educational Investigation (in Spanish: *Centro Nacional de Innovación e Investigación Educativa*) with the goal of teaching educators, parents, and kids about antimicrobial resistance. Unexpectedly, in the last national action plan, there was no specific mention of ways to enhance public awareness nor education.

Surveillance of AMR

The 2014–2018 plan includes measures aimed at enhancing data gathering on trends of antibiotic usage and resistance. Enhancing mechanisms for veterinary use, such as the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC), was part of this. Under the second plan, data collection tools were updated and improved, while

ongoing projects like ESVAC were maintained and consolidated. To make it easier for veterinarians to electronically declare antibiotic prescriptions, new apps like as PRESVET have been developed. The goal of these improvements was to present a more accurate and thorough picture of antibiotic use and resistance. With an emphasis on utilising cutting-edge technology like the free AMR surveillance programme offered by the CNM-ISCIII, surveillance operations have been further integrated in the last action plan.

Optimising antimicrobial usage

In the 2014-2018 plan, particular recommendations for the prudent use of antibiotics in different animal species were created. Controls over the dispensing of antibiotics and proper container sizes were implemented. The objective of these strategies was to minimise needless prescriptions and maximise the proper use of antibiotics. In the 2019-2021 plan, delay in prescribing methods was added to training programmes for patients and healthcare providers. This strategy encouraged medical professionals to hold off on writing antibiotic prescriptions until they are absolutely necessary in order to limit the number of needless prescriptions. The last plan places a strong emphasis on the nationwide implementation of outpatient prescribing support systems that include quick diagnostic testing, treatment guidelines, and delayed prescriptions.

Infection prevention and control (IPC)

The first plan mentions there are established national guidelines and recommendations for hospital infection prevention. By standardising IPC practices across healthcare facilities, these guidelines aim to lower the risk of infections and the need for antibiotics in the wake of an infection. However, the last two plans do not provide specific guidelines and measures related to IPC.

Monitoring and evaluation (M&E)

To guide future measures, the 2014-2018 plan called for regular examination of data on antibiotic consumption and resistance. This continuous assessment was essential to determining the efficacy of measures put into practice and facilitating the required

modifications. In the second national action plan, the framework for assessing AMR programmes' efficacy was reinforced. Frequent reports on antibiotic use and resistance were generated, offering insightful information about the results of policies put in place and directing future efforts. The 2022-2024 strategy included yearly assessments of the national AMR programme, along with the formulation of corrective measures. Keeping an eye on healthcare providers' compliance to antibiotic stewardship initiatives and IPC regulations guarantees that tactics continue to be successful and flexible enough to address evolving difficulties.

Research and innovation (R&I)

Initially, new techniques for AMR characterisation and detection were promoted. To address the long-term problem of AMR, research into novel therapies and preventive measures as alternatives to antibiotics has been encouraged. In the second strategy, the creation of innovative technology and quick diagnostic tools for AMR detection was still supported. To remain ahead of growing resistance patterns, the plan also encouraged research into more advanced diagnostic and preventive technologies. The 2022-2024 action plan, stressed to continue funding research into novel diagnostic techniques and complementary therapies. In order to promote innovation in the fight against AMR, the plan promotes cooperation with partners in academia and business.

International collaboration

Spain took an active involvement in AMR research and monitoring initiatives on a European and worldwide level. With the help of this partnership, Spain was able to exchange resources and information and maintain its leadership position in the worldwide AMR movement. In the 2019-2021 plan, the importance of Spain's involvement in other international forums including the European Joint Action on AMR and Healthcare-Associated Infections (EU-JAMRAI) was underlined. The purpose of these partnerships was to share best practices and coordinate national initiatives with larger European and international initiatives. Nowadays, Spain is still heavily involved in international and European research and policy projects. The country will continue to be an important player in the worldwide fight against AMR thanks to increased funding and involvement

in initiatives like the Joint Programming Initiative on Antimicrobial Resistance (JPI-AMR).

6. Discussion

Returning to the research question: *How do the national policy measures to EU initiatives in antimicrobial resistance compare among countries with high antibiotic use?* This discussion will seek to find an answer.

The analysis of national responses to EU AMR programmes in France, Ireland, and Spain demonstrates unique but converging patterns and strategies, reflecting the changing goals and frameworks that guide these initiatives. All of these answers search to be in conformity with EU directives and the more comprehensive One Health strategy, but are shaped by the different healthcare systems, national plans, and governance frameworks of each country. This exhaustive study frames the findings within the theoretical frameworks of MLG and policy transfer, highlighting trends, similarities, and differences between the three countries' policies.

All three countries emphasise the importance of public awareness and education in combating AMR. France uses highly interactive digital campaigns and media collaborations, such as "Antibio'Malin" and the "e-Bug" tool, to engage and educate the public using new digital means. Ireland emphasises ongoing professional development and incorporates media into public education activities, underlining the significance of national media in raising AMR awareness. Spain targets early education using materials specifically developed for students and runs annual programmes like PRAN-EDUCA to emphasise the necessity of teaching the younger generation.

In terms of surveillance of AMR, France initially focused on establishing global and specialised indicators, the initiative evolved to encourage active engagement from biology laboratories and the creation of an indicator dashboard for strategic planning. Ireland expanded from basic data gathering systems to advanced tools for cost data and timely reporting, combining community and hospital databases for a more complete approach. Spain’s focus has shifted from improving veterinary data gathering techniques

to sustaining and improving systems such as PRESVET, which emphasises modern technology for complete data collection.

To optimise antibiotics, France has shifted its focus from regulatory measures and public education campaigns to rationalising antibiotic usage among healthcare professionals, urging them to reduce needless prescriptions. National guidelines and training programmes were developed in Ireland, followed by the implementation of digital technologies such as the National Digital Veterinary Prescription System, which highlighted the significance of technology in stewardship initiatives. Spain initially focused on species-specific recommendations and training, then expanded to incorporate assisted prescription systems and fast diagnostic tests.

In terms of infection prevention and control, both France and Ireland moved from implementing measures to prioritising health education on infection prevention, such as vaccination and hygiene promotion. Yet, Spain focused on establishing national guidelines for hospital infection prevention.

The three countries have a similar approach towards monitoring and evaluation. France's plan included strategic committees and situational analysis, evolving to more detailed annual evaluations and monitoring of treatment appropriateness. Similarly, Ireland implemented feedback mechanisms and campaign effectiveness, progressing to regular public surveys and continuous monitoring. Spain included regular analysis of antibiotic consumption and resistance data. The latest plans introduced detailed annual evaluations. On one hand, France and Spain consistently supported the research of diagnostic tools and creative goods, with a trend toward antibiotic alternative research. On the other hand, Ireland focused on improving quick diagnostic tools and developing clinical protocols, with a heavy emphasis on diagnostic capability.

Lastly, all three countries engage in extensive international collaboration. France, Ireland and Spain actively engage in European projects and networks, as well as in global forums and research.

The theoretical frameworks of MLG and policy transfer can be strongly related to the comparative analysis of national responses in France, Ireland, and Spain to EU AMR

efforts. MLG theory anticipates that effective AMR strategies will involve coordinated efforts across multiple levels of governance – local, national, and supranational – to ensure comprehensive and harmonised policy implementation. The development of surveillance systems, public education and awareness campaigns, and antimicrobial stewardship initiatives in these countries exemplifies the principles of MLG, which calls for cooperation between different levels of governance in order to address complex issues such as AMR. The synchronisation of surveillance data systems among various levels of governance, for example, guarantees an exhaustive and well-coordinated strategy for tracking and addressing AMR developments. Furthermore, the idea of policy transfer, where policies are not only replicated but rather adjusted according to local contexts based on effectiveness and contextual needs, is demonstrated by the adaptation and improvement of public awareness campaigns in each country. This supports the idea put forth by Dolowitz and Marsh (2000) that policy transfer entails learning from other situations and adapting policies accordingly. The combination of these theories helps explain the differences and similarities in the AMR policies of France, Ireland, and Spain by emphasising the importance of personalised and coordinated approaches in successfully addressing AMR within the EU framework.

7. Conclusion

In light of the high rates of antibiotic usage in these nations, this thesis examined and contrasted the national approaches taken by France, Ireland, and Spain in response to EU AMR initiatives. The analysis of this qualitative study reveals that, although France, Ireland, and Spain have similar objectives and general approaches to combating AMR, there are notable differences in their particular strategies. The results emphasise the significance of customised strategies to achieve a balance between harmonisation and local adaptation, in contrast to the theoretical expectation that high antibiotic use would result in very similar responses. This constant engagement makes sure that national policies are specific to the needs of the country and effective, all the while being in line with larger EU goals.

France has a strong alignment with policy transfer principles, as evidenced by its concentration on sophisticated digital advertising and regulatory measures. The country

adjusts and refines its initiatives based on their efficacy. Ireland's emphasis on ongoing professional development and its all-encompassing, cross-sectoral approach to surveillance highlight how crucial it is to integrate national programmes with larger EU frameworks. Spain has demonstrated an individualised strategy that utilises innovation and early education to have long-term impact through its developments in veterinarian surveillance and focused teaching initiatives. In the end, these three states' national responses to EU AMR initiatives highlight the significance of context-specific methods that satisfy local requirements and are in line with more general EU directives.

Despite the valuable insights gained, this thesis has several limitations that must be acknowledged. Firstly, the language barrier allowed only to select documents which were in English, French or Spanish. This, for example, leaves out the 1st European country ranked in terms of high antibiotic use, which would have been a valuable case study: Cyprus. Secondly, the study was done using official policy documents, which might not accurately represent how these policies are actually implemented and what happens as a result. To have a deeper understanding of the practical aspects of implementing an AMR strategy, future study could benefit from using primary data collection methods, such as interviews with healthcare professionals and policymakers. A most similar systems design could also bring a useful contribution to the literature in which one country scores very high in antibiotic usage and the other one very low. Furthermore, future research could focus on how different healthcare systems might have an effect on how different countries tackle AMR.

8. Bibliography

2022-2025 National strategy for preventing infections and antibiotic resistance. (2022). Retrieved from https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/france-national-strategy-for-preventing-infections-and-antibiotic-resistance-2022-2025.pdf?sfvrsn=e624860d_5&download=true

Aenishaenslin, C., Häsler, B., Ravel, A., Parmley, J., Stärk, K., & Buckeridge, D. (2019). Evidence needed for antimicrobial resistance surveillance systems. *Bulletin of the World Health Organization*, *97*(4), 283–289. doi: 10.2471/BLT.18.218917

Berendonk, T. U., Manaia, C. M., Merlin, C., Fatta-Kassinos, D., Cytryn, E., Walsh, F., Buergmann, H., Sorum, H., Norstrom, M., Pons, M.-N., Kreuzinger, N., Huovinen, P., Stefani, S., Schwartz, T., Kisand, V., Baquero, F., & Luis Martinez, J. (2015). Tackling antibiotic resistance: The environmental framework. *Nature Reviews. Microbiology*, *13*(5), 310–317. doi: 10.1038/nrmicro3439

Birgand, G., Castro-Sánchez, E., Hansen, S., Gastmeier, P., Lucet, J.-C., Ferlie, E., Holmes, A., & Ahmad, R. (2018). Comparison of governance approaches for the control of antimicrobial resistance: Analysis of three European countries. *Antimicrobial Resistance & Infection Control*, *7*(1), 28. doi: 10.1186/s13756-018-0321-5

Bronzwaer, S. L. A. M., Cars, O., Buchholz, U., Mölstad, S., Goettsch, W., Veldhuijzen, I. K., … Degener, J. E. (2002). The relationship between antimicrobial use and antimicrobial resistance in Europe. *Emerging Infectious Diseases*, *8*(3), 278–282. doi: 10.3201/eid0803.010192

Cassini, A., Högberg, L. D., Plachouras, D., Quattrocchi, A., Hoxha, A., Simonsen, G. S., Colomb-Cotinat, M., Kretzschmar, M. E., Devleesschauwer, B., Cecchini, M., Ouakrim, D. A., Oliveira, T. C., Struelens, M. J., Suetens, C., & Monnet, D. L. (2019). Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in

2015: A population-level modeling analysis. *The Lancet Infectious Diseases, 19*(1), 56-66. doi: 10.1016/S1473-3099(18)30605-4

Centers for Disease Control and Prevention. (n.d.). *Definition of policy.* Retrieved from https://www.cdc.gov/policy/paeo/process/definition.html

Chua, A. Q., Verma, M., Hsu, L. Y., & Legido-Quigley, H. (2021). An analysis of national action plans on antimicrobial resistance in Southeast Asia using a governance framework approach. *The Lancet Regional Health - Western Pacific, 7,* 1-22. doi: 10.1016/j.lanwpc.2020.100084

Council of Europe. (2023, November). *Report on multilevel governance*. Retrieved from https://rm.coe.int/report-on-multilevel-governance-final-2768-6653-0568-v-1/1680ad9120

Dadgostar, P. (2019). Antimicrobial resistance: Implications and costs. *Infection and Drug Resistance, 12*, 3903–3910. doi: 10.2147/IDR.S234610

Dolowitz, D. P., & Marsh, D. (2000). Learning from abroad: The role of policy transfer in contemporary policy-making. *Governance, 13*(1), 5-23. doi: 10.1111/0952-1895.00121

Dyar, O. J., Huttner, B., Schouten, J., & Pulcini, C. (2017). What is antimicrobial stewardship? *Clinical Microbiology and Infection*, *23*(11), 793–798. doi: 10.1016/j.cmi.2017.08.026

Earnshaw, S., Mancarella, G., Mendez, A., Todorova, B., Magiorakos, A. P., Possenti, E., Stryk, M., Gilbro, S., Goossens, H., Albiger, B., & Monnet, D. L. (2014). European Antibiotic Awareness Day: A five-year perspective of Europe-wide actions to promote prudent use of antibiotics. *Euro Surveillance, 19*(41), 1-50. doi: 10.2807/1560-7917.es2014.19.41.20928

EUR-Lex. (2023). *Council recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023H0622%2801%29

European Centre for Disease Prevention and Control. (2022). *Antimicrobial consumption in the EU/EEA – Annual epidemiological report for 2021*. Retrieved from https://www.ecdc.europa.eu/en/publications-data/surveillance-antimicrobial-consumption-europe-2021

European Commission. (2017). *A European one health action plan against Antimicrobial Resistance (AMR).* Retrieved from https://health.ec.europa.eu/antimicrobial-resistance/eu-action-antimicrobial-resistance_en

European Commission. (2017). *Antimicrobial resistance and causes of non-prudent use of antibiotics in human medicine in the EU Health and food safety*. Retrieved from https://health.ec.europa.eu/document/download/2341fa41-ebda-4106-8ec9-480aae029b05_en

European Commission. (n.d.). *Commission supports two new Health Union actions with €126 million from the EU4Health programme*. Retrieved from https://health.ec.europa.eu/latest-updates/commission-supports-two-new-health-union-actions-eu126-million-eu4health-programme-2024-02-13_en

European Commission. (n.d.). *Farm to fork strategy*. Retrieved from https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

Ferreira, J. P., & Staerk, K. (2017). Antimicrobial resistance and antimicrobial use animal monitoring policies in Europe: Where are we? *Journal of Public Health Policy*, *38*(2), 185–202. doi: 10.1057/s41271-017-0067-y

Filippini, M., Ortiz, L. G. G., & Masiero, G. (2012). Assessing the impact of national antibiotic campaigns in Europe. *The European Journal of Health Economics*, *14*(4), 587–599. doi: 10.1007/s10198-012-0404-9

Florez-Cuadrado, D., Moreno, M., Ugarte-Ruíz, M., & Domínguez, L. (2018). Chapter 5 – Antimicrobial resistance in the food chain in the European Union. *Advances in Food and Nutrition Research, 86*, 115-136. doi: 10.1016/bs.afnr.2018.04.004

Godman, B., Fadare, J., Kibuule, D., Lyna Irawati, Mwangana Mubita, Ogunleye, O., … Truter, I. (2017). Initiatives Across Countries to Reduce Antibiotic Utilisation and Resistance Patterns: Impact and Implications. In G. Arora, A. Sajib, & V. C. Kalia (Eds.), *Drug resistance in bacteria, fungi, malaria, and cancer* (pp. 539–576). Springer. https://doi.org/10.1007/978-3-319-48683-3_24

Goossens, H., Guillemot, D., Ferech, M., Schlemmer, B., Costers, M., van Breda, M., … Davey, P. G. (2006). National campaigns to improve antibiotic use. *European Journal of Clinical Pharmacology*, *62*(5), 373–379. doi: 10.1007/s00228-005-0094-7

Halperin, S. & Heath, O. (2020). *Political research: Methods and practical skills*. Oxford: Oxford University Press.

Hooghe, L., & Marks, G. (2001). *Multi-level governance and European integration*. Lanham: Rowman & Littlefield.

Hooghe, L., Marks, G., & Schakel, A. (2019). *Multilevel governance*. Retrieved from https://hooghe.web.unc.edu/wp-content/uploads/sites/11492/2020/11/2020_hooghe-marks-schakel_multilevel-governance_reduced-size-Caramani.pdf

Interministerial committee on health. (2016). *Interministerial roadmap for controlling antimicrobial resistance*. Retrieved from https://sante.gouv.fr/IMG/pdf/interministerial_amr_roadmap_en.docx.pdf

Laxminarayan, R., Duse, A., Wattal, C., Zaidi, A., Wertheim, H., Sumpradit, N., Vlieghe, E., Hara, G., Gould, I., Goossens, H., Greko, C., So, A., Bigdeli, M., Tomson, G., Woodhouse, W., Ombaka, E., Peralta, A., Qamar, F., Mir, F., … Cars, O. (2013).

Antibiotic resistance: The need for global solutions. *The Lancet Infectious Diseases, 13(*12), 1057-1098. doi: 10.1016/S1473-3099(13)70318-9

Léger, A., Stärk, K. D. C., Rushton, J., & Nielsen, L. R. (2018). A One Health evaluation of the University of Copenhagen Research Centre for Control of Antibiotic Resistance. *Frontiers in Veterinary Science, 5,* 1-14. doi: 10.3389/fvets.2018.00194

Marco-Fuertes, A., Marin, C., Lorenzo-Rebenaque, L., Vega, S., & Montoro-Dasi, L. (2022). Antimicrobial resistance in companion animals: A new challenge for the One Health Approach in the European Union. *Veterinary Sciences, 9*(5), 1-16. doi: 10.3390/vetsci9050208

Marston, H. D., Dixon, D. M., Knisely, J. M., Palmore, T. N., & Fauci, A. S. (2016). Antimicrobial resistance. *The Journal of the American Medical Association, 316*(11), 1193–1204. doi: 10.1001/jama.2016.11764

Ministerio de sanidad, consumo y bienestar social. (2014, November). *Plan estratégico y de acción para reducir el riesgo de selección y diseminación de la resistencia a los antibióticos*. Retreived from https://resistenciaantibioticos.es/es

Ministerio de sanidad, consumo y bienestar social. (2019). *Plan nacional frente a la resistencia a los antibióticos 2019-2021*. Retrieved from https://resistenciaantibioticos.es/es

Ministerio de sanidad. (2022, September). *Plan nacional frente a la resistencia a los antibióticos 2022-2024.* Retrieved from https://resistenciaantibioticos.es/es

Morrison, L., & Zembower, T. R. (2020). Antimicrobial Resistance. *Gastrointestinal Endoscopy Clinics of North America, 30*(4), 619–635. doi: 10.1016/j.giec.2020.06.004

Nulty, K. M., Soon, J. M., Wallace, C. A., & Nastasijevic, I. (2016). Antimicrobial resistance monitoring and surveillance in the meat chain: A report from five

countries in the European Union and European Economic Area. *Trends in Food Science & Technology, 58*, 1-13. doi: 10.1016/j.tifs.2016.09.010

O'Neill, J. The Review on Antimicrobial Resistance. (2014). *Antimicrobial resistance: Tackling a crisis for the health and wealth of nations*. Retrieved from https://wellcomecollection.org/works/rdpck35v

Pulcini, C., Berger-Carbonne, A., Coignard, B., & Salomon, J. (2022). National Antibiotic Resistance Strategy for Human Health in France. *China CDC Weekly*, *4*(49), 1097–1100. doi: 10.46234/ccdcw2022.222

Radaelli, C. M. (2000). Policy transfer in the European Union: Institutional isomorphism as a source of legitimacy. *Governance, 13*(1), 25–43. doi: 10.1111/0952-1895.00122

Saito-Jensen, M. (2015). Theories and methods for the study of multi-level environmental governance. *Guideline*. doi: 10.17528/cifor/005541

Schreier, M. (2012). Qualitative content analysis in practice. *Scientific study of literature, 3*(1), 165-168.

Simjee, S., & Ippolito, G. (2022). European regulations on prevention use of antimicrobials from January 2022. *Brazilian Journal of Veterinary Medicine*, *44*. doi: 10.29374/2527-2179.bjvm000822

Smith, R. D., & Coast, J. (2002). Antimicrobial resistance: A global response. *Bulletin of the World Health Organization*, *80*(2), 126–133. doi: 10.1590/S0042-96862002000200008

Tacconelli, E., Carrara, E., Savoldi, A., Harbarth, S., Mendelson, M., Monnet, D. L., Pulcini, C., Kahlmeter, G., Kluytmans, J., Carmeli, Y., Ouellette, M., Outterson, K., Patel, J., Cavaleri, M., Cox, E. M., Houchens, C. R., Grayson, M. L., Hansen, P., Singh, N., Theuretzbacher, U., … WHO Pathogens Priority List Working Group. (2018). Discovery, research, and development of new antibiotics: The

WHO priority list of antibiotic-resistant bacteria and tuberculosis. *The Lancet Infectious Diseases, 18*(3), 318–327. doi: 10.1016/S1473-3099(17)30753-3

Tang, K., Millar, B. C., & Moore, J. E. (2023). Antimicrobial resistance (AMR). *British Journal of Biomedical Science, 80*, 1-11. doi: 10.3389/bjbs.2023.11387

The department of Agriculture, Food, and the Marines. (2021). *Ireland's second One Health national action plan on antimicrobial resistance 2021-2025*. Retrieved from https://www.gov.ie/en/collection/8f0dd5-antimicrobial-resistance-amr/

The department of health. (2017). *Ireland's national action plan on antimicrobial resistance 2017-2020*. Retrieved from https://www.gov.ie/en/collection/8f0dd5-antimicrobial-resistance-amr/

Therre, H. (2001). National policies for preventing antimicrobial resistance: The situation in 17 European countries in late 2000. *Eurosurveillance, 6*(1), 5–14. doi: 10.2807/esm.06.01.00227-en

Velazquez-Meza, M. E., Galarde-López, M., Carrillo-Quiróz, B., & Alpuche-Aranda, C. M. (2022). Antimicrobial resistance: One Health approach. *Veterinary World, 15*(3), 743–749. doi: 10.14202/vetworld.2022.743-749

World Health Organization. (2016). *Global action plan on antimicrobial resistance*. Retrieved from https://www.who.int/publications/i/item/9789241509763

World Health Organization. (2017, September 21). *One Health*. Retrieved from https://www.who.int/news-room/questions-and-answers/item/one-health

World Health Organization. (2023, November 21). *Antimicrobial resistance*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance

World Health Organization. (2023). *One Health*. Retrieved from https://www.who.int/health-topics/one-health#tab=tab_1

Zhou, Y., Acevedo Callejas, M. L., & MacGeorge, E. L. (2020). Targeting perceptions of risk from injudicious antibiotic use: An application of the risk information seeking and processing model. *Journal of Health Communication, 25*(5), 345–352. doi: 10.1080/10810730.2020.1762140

9. Appendices

Appendix A. France coding frame

Interministerial Roadmap for controlling antimicrobial resistance (17 November 2016)			
Categories	**Sub-categories**	**Sub-Sub-Categories**	**Recorded units**
Public awareness and education	Scope		Launch the first national intersectoral programme to raise awareness on prevention of antimicrobial resistance
	Target		Reinforce health education for populations, especially young people and animal owners Upgrade the importance of antimicrobial resistance in the healthcare professional's initial training, especially for pharmacists, midwives, nurses, and dentists.
	Engagement method		Through educational modules ("e-bug" programmes in a school setting, training in secondary schools and in colleges) and the media ("Entertainment Education").
	Duration		Setting up a long-lasting intersectoral communication programme on AMR
Surveillance on AMR	Data collection		At national and European level, develop new global and specific indicators aimed at measuring antibiotic resistance and exposure to antibiotics on a common basis in humans, animals, and the environment.
	Data sharing		Keep an updated, shared agenda of European and international events relating to controlling antibiotic resistance, in order to strengthen France's place in the most important initiatives.
	Technology integration		-

	Trend analysis		Use vigilance and support networks to generate proximity indicators on consumption and resistance data for human-healthcare professionals.
Optimising antimicrobial usage	Stewardship programmes		-
	Regulation		In human medicine, use regulatory provisions to limit prescription duration to a maximum of 7 days for common infections. Follow the progress of the objective set in the medical convention on limiting the prescribing rate for so-called “critically important” antibiotics On antibiotic packaging, insert a warning message for patients or stockbreeders.
	Public education		-
Infection prevention & control (IPC)	Policies and guidelines		-
	Vaccines	Implementation	-
		Education	Promote preventive vaccination against infections in humans and animals

		Development	-
Monitoring and evaluation (M&E)	Effectiveness		Summarise the situational analysis of the various plans in order to define common themes to the various sectors, with the objective of gathering them into an overall, co—ordinated action plan to tackle antibiotic resistance.
	Reporting		Install a strategic steering committee for research into AMR. Summarise essential interministerial positions on controlling antibiotic resistance.
Research and Innovation (R&I)	Diagnostics		Improve the use of in vitro diagnostic (IVD) tools contributing to control antimicrobial resistance, thanks to a better use of those technologies.
	Treatment		-
	New alternatives		Provide Innovative products and technologies contributing to the control of AMR with a set of regulatory and financial incentive mechanisms.
International Collaboration			In collaboration with the WHO and the OIE, develop a network for monitoring the emergence and spread of resistance to antibiotics (in humans, animals, and the environment) in low-income countries, by relying on existing networks. At the international level and with the help of the European Union, promote the adoption of

			measures for checking that antibiotics are used properly, in particular prohibition to use antibacterial agents as growth promoters in stockbreeding.

2022-2025 National strategy for preventing infections and antimicrobial resistance			
Categories	**Sub-categories**	**Sub-Sub-Categories**	**Recorded units**
Public awareness and education	Scope		-
	Target		Improving health education on the prevention of infections and antibiotic resistance among children and teenagers so that they can gain the minimum necessary knowledge and know how to apply good everyday practices. An educational campaign (press, digital) targeting healthcare professionals. For example: distributing videos of experts on the new recommendations, editorials/publications on antibiotic resistance in the professional press, organising symposiums, developing Antibioclic The educational campaign (digital, press relations) aimed at the general public and referring to Antibio'Malin. Examples of content that can be produced: infographics, quizzes, digital videos, audio or video press kits. Media partnerships (with content producers or influencers). Press contacts to promote the editorial on the subject. These educational campaigns will prime the population for the awareness-raising campaign.
	Engagement method		Continuing to develop and promote the use of the e-Bug tool, which is an educational resource available online here that offers free and interactive tools to facilitate teaching about prevention of infection and antibiotic resistance The educational campaign (digital, press relations) aimed at the general public and

			referring to Antibio'Malin. Examples of content that can be produced: infographics, quizzes, digital videos, audio or video press kits. Media partnerships (with content producers or influencers). Press contacts to promote the editorial on the subject. These educational campaigns will prime the population for the awareness-raising campaign.
	Duration		-
Surveillance of AMR	Data collection		Encouraging biology laboratories to actively participate in the collection of data on antibiotic resistance
	Data sharing		Having an indicator dashboard with targets to guide the national/regional/ local strategy for infection prevention and control and antibiotic stewardship and to improve the national and regional sharing of available data and indicators to promote their use for taking action.
	Technology integration		-
	Trend analysis		-
Optimising antimicrobial usage	Stewardship programmes		Encouraging general practitioners and paediatricians not to prescribe antibiotics where possible, and by exploring additional developments in this non-prescription pad (e.g. poster, card, desk display formats, targeting patients; adaptation to other professionals such as dentists and pharmacists). Consolidating the role of preventing infection and antibiotic resistance in the initial training of healthcare professionals.
	Regulation		-

	Public education		Informing patients about avoiding the use of antibiotics where possible by continuing to promote Antibio'Malin
Infection prevention & control (IPC)	Policies and guidelines		Establishing a set of core competencies for IPC specialists by defining, on the basis of standardised guidelines, the minimum content of an academic qualification (DU) in IPC with some essential teaching methods. Prioritising the prevention of infections and antibiotic resistance (particularly hand hygiene) including the prevention of accidental exposure to blood (AEB) in the various annual promotion and awareness-raising campaigns among health system stakeholders (including World Hand Hygiene Day promoted by the WHO on 5 May, Global Handwashing Day promoted by Unicef and WHO aimed at children on 15 October, and Patient Safety Week organised by the MSS/DGOS during November).
	Vaccines	Implementation	-
		Education	Improving vaccination uptake among target populations and healthcare and medicosocial professionals by means of information and awareness-raising campaigns in line with the national vaccination strategy.
		Development	-
	Effectiveness		-

Monitoring and evaluation (M&E)	Reporting		Annual evaluation of the percentage of professionals in the healthcare and medicosocial sectors trained in the prevention of infections and antibiotic resistance. Monitoring the appropriateness of antibiotic treatment in the three care sectors (ES, ESMS and community care), in particular using point-prevalence surveys and automated data collection from existing databases;
Research and Innovation (R&I)	Diagnostics		-
	Treatment		-
	New alternatives		Encouraging research into alternatives to antibiotic treatment (new products to combat infections and antibiotic resistance).
International Collaboration			The MSS will increase its involvement in key European and international events and initiatives, e.g. as part of the French Presidency of the Council of the European Union in the first half of 2022, in the EU Antimicrobial Resistance One Health Network coordinated by the European Commission or in initiatives led by the WHO Continuing to explore the possibility of funding international bodies, such as the WHO or OECD, for measures preventing infections and antibiotic resistance.

Appendix B. Ireland coding frame

Ireland's National Action Plan on AMR 2017-2020			
Categories	**Sub-categories**	**Sub-Sub-Categories**	**Recorded units**
	Scope		-

Public awareness and education	Target		Undergraduate and post-graduate core curriculum training and examinations to include infection and disease prevention, AMR and responsible use of antibiotics e-Bug initiative should be incorporated into primary, post primary curriculum for schools. To educate and improve understanding of AMR amongst the general public
	Engagement method		Implement AMR campaigns utilising a variety of messaging/ campaign platforms to capture widest reach e.g. website, social media, patient stories, radio and TV. Use of the Live Green website (a National Sustainability Information Portal for Householders (www.epa.ie/livegreen), to provide advice on medicines (including antimicrobials) in the home and how to dispose of them correctly.
	Duration		-
Surveillance of AMR	Data collection		Develop a system for the collection of data from veterinary practices. Implement a national system for the collection of data on antimicrobial use
	Data sharing		A coordinated approach to sharing of data for action across health sectors e.g. development of integrated community and hospital databases with public health and epidemiological data systems.
	Technology integration		Develop tools that allow farmers to readily assess the volume and the cost of antibiotics being used on their farms.
	Trend analysis		Produce joint surveillance report(s) between animal and human health sector.

Optimising antimicrobial usage	Stewardship programmes		National guidance for good antibiotic prescribing practice for all healthcare settings are available and updated as required in line with NCEC Standards for Clinical Practice Guidance. These need to be integrated with clinical care programmes. Develop and deliver AMR and IPC training programmes.
	Regulation		Develop National Policy Guidelines for prudent prescribing practice for the medical and veterinary professions as part of a programme to promote responsible prescribing practice. Antibiotics should remain prescription only.
	Public education		Explore and develop programmes to promote consistent availability and access to high quality antimicrobials.
Infection prevention & control (IPC)	Policies and guidelines		Implement measures aimed at improving infection and disease prevention on farms in Ireland, thereby reducing the need for antibiotics. Implement national guidance in line with NCEC Standards for Clinical Practice Guidance for infection prevention and control for all healthcare settings. Establish processes to create a requirement that all new builds and refurbishment programmes comply with relevant national standards and are developed with engagement of IPC personnel.
	Vaccines	Implementation	Maximise uptake of immunisation for general population and healthcare workers in all healthcare settings.

			Maximise uptake of immunisation for general population and healthcare workers in all healthcare settings.
		Education	-
		Development	-
Monitoring and evaluation (M&E)	Effectiveness		Carry out a survey to identify research currently underway or that has been carried out in the area of AMR and animal populations and identify gaps in knowledge needed to inform future policy options with the purpose of guiding future research funding by DAFM. Active surveillance feedback mechanisms to inform performance and activities and promote improvement. Monitor effectiveness of awareness campaigns.
	Reporting		Collection and reporting of data regarding levels and persistence of certain antimicrobials (e.g. macrolide antibiotics) within specific environments in line with priority list of substances for Union-wide monitoring. Collaborate with the health sector in the production of a One Health AMR Surveillance Report. Produce joint surveillance report(s) between animal and human health sector.
Research and Innovation (R&I)	Diagnostics		Research in relation to development of better rapid diagnostic tools

	Treatment		Examine methods to promote the development of alternative treatment and prevention options.
	New alternatives		Examine methods to promote the development of alternative treatment and prevention options. Examine options for establishing links with academic and industry partners to promote the development of new medicines as alternative treatment options.
International Collaboration			Identify Ireland's contribution including funding and research activity in the global research field. This could include examination of the World Economic Forum (Davos) project on public/private sector collaboration on tackling AMR. National participation in Horizon 2020 Societal Challenge Five initiatives around AMR.

Ireland's National Action Plan on AMR 2021-2025			
Categories	**Sub-categories**	**Sub-Sub-Categories**	**Recorded units**
Public awareness and education	Scope		-
	Target		Working with relevant organisations to increase awareness of inappropriate antibiotic use to students and younger audiences Encourage the participation of GPs, pharmacists, registered nurses, registered midwives and other healthcare staff in continuous professional development and education on AMR, IPC and AMS by promotion of resources and increased awareness of the importance of these areas for practice.

			Continuing and expanding the current communications campaigns to raise awareness about prudent use of antibiotics with key public and professional audiences AMR related topic to be included in each annual Veterinary Ireland Continuing Veterinary Education event including VICAS conferences.
	Engagement method		Promote awareness and explore opportunities to have AMR issues highlighted in national newsprint, radio and television programmes such as the 10 Things to Know About series, and through press releases for published research
	Duration		Continued roll out of the RESIST communications programme and the ongoing public and professional information campaigns around AMR, AMS and IPC. Promoting year-round public awareness campaigns
Surveillance of AMR	Data collection		Develop a tool to collect a core data set and collection / survey methodology for the collection of costs attributable to AMR at a point in time, to initially consider public healthcare perspective. Develop and implement a system for the collection of data in relation to usage of intramammary tubes in the dairy sector. Develop a tool to collect a core data set and collection / survey methodology for the collection of costs attributable to AMR at a point in time, to initially consider public healthcare perspective.
	Data sharing		
	Technology integration		Develop and implement systems and processes to provide more timely collation, frequency and reporting of key antimicrobial routine resistance

			data from microbiology laboratories including both public and private laboratories built on the existing EARS-Net process. Contribute to the development and implementation of medical laboratory systems and eHealth systems to ensure they support AMR and IPC surveillance.
	Trend analysis		Develop systems/databases to feedback AM/PM abattoir findings to cattle, pig and sheep farmers and their veterinary practitioners.
Optimising antimicrobial usage	Stewardship programmes		Promote awareness of responsible prescribing and use of antimicrobials by companion animal veterinary practitioners through newsletters/vet alert emails and the Veterinary Journal.
	Regulation		Develop national policy on methodology and management of antimicrobial susceptibility testing to support prudent prescribing and antimicrobial stewardship. Construct a National Digital Veterinary Prescription System (NVPS) to align with requirements under new Veterinary Medicine Regulations 2019/6 (Article 104 (2)) which will measure the usage of antibiotics as well as all other prescription medicines. To support the development and distribution of national prescribing guidelines for Companion Animal Veterinarians
	Public education		-

Infection prevention & control (IPC)	Policies and guidelines		Promote hand and respiratory hygiene as a cornerstone of good IPC practice in society. Progress implementation of electronic prescribing throughout the healthcare systems, in order to support antimicrobial stewardship and audit. Implement the HSE Community IPC Strategy in line with the integrated approach to AMR and IPC and cognisant of the related recommendations in the Nursing Home Expert Panel Report on COVID-19 (2020).
	Vaccines	Implementation	Continue to promote vaccination as a means of preventing and limiting infection in line with the National Guidelines from the National Immunisation Advisory Committee.
		Education	Continue to promote vaccination as a means of preventing and limiting infection in line with the National Guidelines from the National Immunisation Advisory Committee.
		Development	-
Monitoring and evaluation (M&E)	Effectiveness		Continue to carry out regular surveys to assess knowledge, belief and attitudes of the general public (for example, Healthy Ireland Survey), as well as healthcare professionals, about antibiotics, antibiotic use and AMR and IPC. Also, seek to assess impact of awareness campaigns.

	Reporting		Establish a national system for continuous and enhanced monitoring of HCAIs in intensive care units. Develop and publish the One Health Surveillance data report for 2017/2018/2019. Undertake sufficiency review on environmental monitoring in surface waters for AM residues under WFD Watch list. Develop sustainability and governance for continuation and further development of the One Health Surveillance Reporting system to include multi-disciplinary professional and clinical/administrative support. With regard to the relevant monitoring programmes, inspection reports to include details of compliance plan responses from providers outlining how they will come into compliance with required regulations or standards
Research and Innovation (R&I)	Diagnostics		Enhance rapid laboratory diagnostic capacity to support AMR and IPC stewardship, which may enhance patient flow.
	Treatment		Develop diagnostic and therapeutic protocols for selected clinical presentations across species, with emphasis on those where AST is not possible in advance of treatment.
	New alternatives		-

International Collaboration			Continue to strengthen, develop, and invest in relevant cofunded research collaborations at EU and Global level including the Joint Programming Initiatives on Antimicrobial Resistance (JPIAMR). Support participation in, and contribute to development, of the WHO Global Antimicrobial Resistance Surveillance System (GLASS).

Appendix C. Spain coding frame

Plan estratégico y de acción para reducir el riesgo de selección y diseminación de la resistencia a los antibióticos 2014-2018			
Categories	**Sub-categories**	**Sub-Sub-Categories**	**Recorded units**
Public awareness and education	Scope		-
	Target		Promover la formación de los profesionales sanitarios en todos los periodos de formación: universitaria, especializada y continuada. Campañas para la población en general
	Engagement method		-
	Duration		-
Surveillance of AMR	Data collection		Redes de vigilancia de RA (ESVAC, monitorización en patógenos zoonósicos, ESAC-net y EARS-net)
	Data sharing		-
	Technology integration		-

	Trend analysis		-
Optimising antimicrobial usage	Stewardship programmes		-
	Regulation		Desarrollar de forma más amplia un apartado específico de buen uso de antibióticos, para cada especie animal en las guías de uso responsable.
	Public education		Puesta en marcha de programas de promoción de uso prudente de antibióticos.
Infection prevention & control (IPC)	Policies and guidelines		Desarrollar a nivel nacional recomendaciones y/o guías de prevención de la infección en el ámbito hospitalario.
	Vaccines	Implementation	-
		Education	-

		Development	-
Monitoring and evaluation (M&E)	Effectiveness		-
	Reporting		Cruzar la información de RA y las de consumo para hacer una presentación bienal de los resultados, identificando los pares de anti biótico y bacteria especialmente representativos.
Research and Innovation (R&I)	Diagnostics		Promover el desarrollo de nuevos métodos de detección y caracterización de RA. Promover el desarrollo y uso de pruebas de sensibilidad y métodos de diagnóstico rápido
	Treatment		-
	New alternatives		Promover la investigación de alternativas a los antibióticos en el campo de la inmunidad.
International Collaboration			Continuar la contribución en los distintos proyectos europeos ya en desarrollo, sobre el consumo y el uso de antibióticos, y participar en otras actividades tanto europeas como internacionales para intercambiar información.

Plan Nacional frente a la resistencia a los antibióticos 2019-2021			
Categories	**Sub-categories**	**Sub-Sub-Categories**	**Recorded units**

Public awareness and education	Scope		-
	Target		Informar y concienciar a los alumnos desde las primeras etapas de formación hasta bachillerato sobre el problema de la resistencia a los antibióticos. En colaboración con el Centro Nacional de Innovación e Investigación Educativa (CNIIE), elaborar material educativo-divulgativo para niños, padres y profesores (PRAN-EDUCA)
	Engagement method		Elaborar un curso online avanzado y dirigido a la formación postgrado.
	Duration		-
Surveillance of AMR	Data collection		-
	Data sharing		-
	Technology integration		Mantenimiento y consolidación del proyecto ESVAC con acciones concretas encaminadas a finalizar la mejora y actualización de la herramienta de recogida de ventas de antibióticos. Evaluar las posibles mejoras y ampliar las funciones de la nueva aplicación informática para la declaración electrónica de prescripciones de antibióticos, PRESVET (Ministerio de Agricultura).
	Trend analysis		Evaluar el consumo en el ámbito de la granja con el objetivo de aportar datos al proyecto ESVAC en el año 2020. Realizar el seguimiento de las tendencias de prescripción de antibióticos y los determinantes de estas tendencias. Evaluar el impacto de las intervenciones realizadas en el periodo del PRAN.

Optimising antimicrobial usage	Stewardship programmes		Formación del profesional sanitario y el paciente en el ámbito de la prescripción diferida.
	Regulation		Controlar y vigilar la dispensación de antibióticos sin receta en las oficinas de farmacia Volver a revisar los formatos de los envases y evaluar su adecuación a las recomendaciones actuales de los síndromes infecciosos más prevalentes en la comunidad. Elaborar y difundir informes anuales sobre consumo de antibióticos.
	Public education		Concienciar sobre la importancia del uso prudente de los antibióticos y desterrar falsas creencias en torno a su funcionamiento. Organizar la campaña de concienciación anual del PRAN dirigida a público general para sensibilizar sobre la importancia del uso prudente de los antibióticos
Infection prevention & control (IPC)	Policies and guidelines		-
	Vaccines	Implementation	-
		Education	-
		Development	-
Monitoring and evaluation (M&E)	Effectiveness		Establecer el marco e implementar de forma efectiva un sistema nacional de vigilancia de la resistencia a los antibióticos.

	Reporting		Elaborar y difundir informes anuales sobre consumo de antibióticos. Elaborar un informe de conclusiones que permita desarrollar acciones futuras.
Research and Innovation (R&I)	Diagnostics		Apoyar el desarrollo de una gama más amplia de herramientas de diagnóstico rápido. Fomentar la investigación y el desarrollo de mejores tecnologías para la prevención, el diagnóstico y el desarrollo de nuevos antibióticos.
	Treatment		-
	New alternatives		Fomentar la investigación y el desarrollo de mejores tecnologías para la prevención, el diagnóstico y el desarrollo de nuevos antibióticos.
International Collaboration			Participar en la Acción Conjunta Europea sobre Resistencia Antimicrobiana e Infecciones Asociadas a la Asistencia Sanitaria (EU-JAMRAI). Consolidar el programa HUB AMR Global R & D – G20. Proyecto ARNA: participación en el proyecto ARNA (Antimicrobial Resistance and causes of Non-prudent use of Antibiotics), centrado en la evaluación del consumo de antibióticos sin prescripción en medicina humana en Europa. AMR One Health Network: participación activa en la Red de 'Una sola salud' frente a la Resistencia a los Antibióticos de la Comisión

			Europea, AMR One Health Network, cuyo objetivo es compartir prácticas y políticas exitosas frente al problema de la resistencia en la UE. JPI-AMR: todas las medidas del PRAN en materia de investigación están alineadas con la Agenda Estratégica de Investigación de la iniciativa europea JPI-AMR (Joint Programming Initiative on Antimicrobial Resistance), en la que la estrategia nacional colabora con el ISCIII. CHAFEA/DG SANTE: participación activa en los proyectos de CHAFEA y la Dirección General sobre Salud y Seguridad Alimentaria de la Comisión Europea (DG SANTE).

Plan Nacional frente a la resistencia a los antibióticos 2022-2024			
Categories	**Sub-categories**	**Sub-Sub-Categories**	**Recorded units**
Public awareness and education	Scope		-
	Target		-
	Engagement method		-
	Duration		-
Surveillance of AMR	Data collection		-
	Data sharing		-
	Technology integration		Fomentar el uso del Programa de Vigilancia de RAM gratuito del CNM-ISCIII para la determinación de mecanismos de resistencia emergentes, epidemiología molecular y caracterización de brotes mediante su integración con RedLabRA

	Trend analysis		Identificar las tendencias pertinentes en el volumen de ventas y en el uso de antimicrobianos en animales
Optimising antimicrobial usage	Stewardship programmes		Formación tanto de profesionales sanitarios como de pacientes en el ámbito de la prescripción diferida Formación específica y de calidad para el mayor número de profesionales sanitarios, sobre la implementación de equipos PROA en los hospitales españoles Formación específica y de calidad dirigida a veterinarios clínicos, sobre el uso racional de los antibióticos en hospitales y clínicas de pequeños animales
	Regulation		Implementación nacional de sistemas de ayuda a la prescripción extrahospitalaria, asistida por consejos de prescripción y que además integre la prescripción diferida, las pruebas de diagnóstico rápido y la guía terapéutica antimicrobiana del SNS
	Public education		Campañas anuales dirigidas al público general sobre el uso prudente de los antibióticos
Infection prevention & control (IPC)	Policies and guidelines		-

	Vaccines	Implementation	-
		Education	-
		Development	-
Monitoring and evaluation (M&E)	Effectiveness		Evaluar anualmente el programa de HM estableciendo acciones para la mejora. Monitorizar el cumplimiento de las medidas y difundir sus resultados a todos los implicados para identificar y aplicar acciones de mejora.
	Reporting		Realización de informes semestrales de consumo hospitalario y comunitario que se enviarán de manera activa a cada CC . AA
Research and Innovation (R&I)	Diagnostics		-
	Treatment		-
	New alternatives		-

International Collaboration			Participación en el estudio europeo de incidencia de un año del ECDC de infecciones en residentes de centros de larga estancia Participación en foros europeos e internacionales para influir y apoyar medidas relacionadas con la resistencia a los antibióticos: - Acuerdo mundial histórico sobre prevención, preparación y respuesta frente a pandemias. - Agenda Estratégica de Investigación e Innovación (SRIA). - Agenda Estratégica Europea de Investigación en RAM elaborada en el marco de la JPIAMR. - Asociación Europea One Health AMR. Aumento de financiación, participación y éxito de grupos españoles en las convocatorias de la JPI-AMR

Appendix D. Results table

	France	**Ireland**	**Spain**
Public awareness and education	Transitioned from initial intersectoral programmes and educational modules to more sophisticated digital campaigns and media partnerships.	Evolved from integrating AMR education in curricula and using various media platforms to a broader focus on professional development and national media promotion.	Moved from promoting AMR education for healthcare professionals and general public campaigns to targeted educational materials for students and consistent annual campaigns.
Surveillance of AMR	Maintained a focus on developing indicators and leveraging existing networks, with an increased emphasis on laboratory participation and dashboard indicators.	Expanded from data collection systems and coordinated sharing to more advanced tools for cost data and timely reporting	Progressed from the ESVAC project to more integrated surveillance programmes like CNM-ISCIII and comprehensive data collection improvements.

Optimising antimicrobial usage	Consistently used regulatory measures and public education campaigns, later emphasising encouragement to avoid unnecessary prescriptions	Developed from national guidelines and training programmes to implementing digital tools like the National Digital Veterinary Prescription System	Focused on species-specific guidelines and training, evolving to include assisted prescription systems and rapid diagnostic tests
Infection prevention and control (IPC)	Continued to promote vaccination and established competencies for IPC specialists, with consistent annual campaigns	Emphasised IPC measures in agricultural and healthcare settings, later incorporating hygiene promotion and electronic prescribing	Developed national guidelines and specific training, with continued focus on compliance monitoring and guideline implementation
Monitoring and evaluation (M&E)	Transitioned from strategic committees to more detailed annual evaluations and monitoring of treatment appropriateness	Focused on feedback mechanisms and campaign effectiveness, later incorporating regular public surveys and continuous monitoring	Maintained a national surveillance system with detailed reports, later enhancing annual evaluations and compliance dissemination
Research and innovation (R&I)	Consistently promoted diagnostic tools and innovative products, later encouraging research into alternatives	Focused on rapid diagnostic tools and clinical protocols, enhancing diagnostic capacity over time.	Supported development of new detection methods and technologies, continuing to promote research on alternatives and new antibiotics
International Collaboration	Maintained collaboration with international organisations and funding support, with increased involvement in events	Contributed to global research and participated in European programmes, strengthening co-funded collaborations	Continued participation in European projects and networks, with more active engagement in global forums