

**MAPPING GLOBAL GOVERNANCE OF ANTIBIOTIC STEWARDSHIP: A ONE  
HEALTH MULTI-LEVEL GOVERNANCE APPROACH**

**EYAD SHEDEED**

Thesis submitted to the University of Ottawa  
in partial Fulfillment of the requirements for the  
Political Science M.A.

School of Political Studies  
Faculty of Social Sciences  
University of Ottawa

### Abstract

This study embarks on a critical examination of antibiotic stewardship (ABS) across the interconnected domains of human, animal, and environmental health, in response to the growing challenge of antimicrobial resistance (AMR). Utilizing a scoping review format and including academic and grey literature, the research aims to dissect and evaluate the ABS policies implemented by both public and private sectors. The focus is on unearthing common strategies, identifying patterns, and highlighting disparities among diverse stakeholders within the One Health framework. The study's objective is to uncover effective governance mechanisms that promote ABS strategies that can significantly contribute to the global fight against AMR. By analyzing global governance mechanisms, this research further aspires to inform and enhance the One Health global governance framework. The expected outcome is a novel, comprehensive perspective on ABS, integrating a holistic and interdisciplinary approach that aligns with the multifaceted nature of AMR. This approach promises to yield insights that are vital for shaping future policies and actions in AMR mitigation.

## Table of Contents

Abstract .....	ii
Global Governance of Antibiotic Stewardship.....	1
Chapter 1: Introduction .....	1
Chapter 2: Problematization / Literature Review.....	4
2.1 Definition of Key Concepts and Theories .....	4
2.2 Theoretical Framework .....	9
Chapter 3: Analyzing the Complexity of ABS Governance: Methodological Approach .	10
3.1 Data Collection.....	12
3.2 Strengths and Limitations of the Proposed Methodology.....	13
Chapter 4: Global Governance of Antibiotic Resistance: Results.....	15
4.1 Definition and Significance .....	15
4.2 Historical Evolution of Global Governance .....	16
4.3 Models and Challenges of Governance .....	18
4.3.1 Global Efforts .....	18
4.3.1.1 Types of Global Governance Mechanisms.....	20
4.3.2 Collaborative Alliances .....	28
4.3.3 Individual Initiatives.....	31
4.3.4 Challenges of Current Governance Mechanisms: Multi-Level Governance Perspective .....	32
Chapter 5: Antibiotic Stewardship Policies by AMR Stakeholders: Findings from the Document Analysis .....	37
5.1 Introduction .....	37
5.2 The Pharmaceutical Sector.....	40
5.2.1 Power, Interests, and ABS Implementation: The Case of Indonesia .....	42
5.2.2 Decline of the Antimicrobial Pipeline .....	44
5.3 Biotechnological Firms and Diagnostic Companies.....	47
5.4 Agri-food.....	51
5.4.1 Multi-level governance intersectionality between the agricultural industry, food security, and global health.....	52

5.4.2 Involvement in Governance: How agribusinesses interact with and influence international policies .....	53
5.4.3 The case of Biotech firms, Monsanto, and EU GMO regulations .....	57
5.4.4 Global governance mechanisms to safeguard against agribusiness lobbying.....	59
5.5. Agrifood and food service Industries .....	61
5.5.2 Antimicrobial Use in Livestock.....	62
5.5.2.2.3 <i>The Case of Antibiotic Stewardship in Brazil</i> .....	70
5.5.3 Transnational Corporations, Restaurants, and the Fast-Food Industry.....	72
Chapter 6: Results and Discussion .....	76
6.1 Fragmentation of global governance .....	77
6.2 Polycentric governance as a response to fragmentation .....	80
6.3 Vested interests and power dynamics are barriers to effective ABS implementation.....	82
6.3.1 Interests and power dynamics in the pharmaceutical industry.....	82
6.3.2 Political and regulatory challenges .....	84
6.4 Political will and institutional deadlocks in policy harmonization .....	86
6.5 Socio-Cultural Aspects.....	88
Chapter 7: Integrated Polycentric Glocal Governance Framework (IPGF).....	89
7.1 IPGF and Key Challenges in ABS Global Governance .....	91
7.2 Transnational corporations and the Integrated Polycentric Glocal Framework.....	93
7.3 Challenges and Limitations of the Integrated Polycentric Glocal Framework .....	94
Chapter 8: Conclusion .....	95
References .....	98
Appendix .....	125
Figure 1 .....	125
Figure 2 .....	126
Figure 3 .....	129
Figure 4 .....	130

## Global Governance of Antibiotic Stewardship

### Chapter 1: Introduction

Antimicrobial resistance (AMR) is a rapidly growing global health threat that poses a significant risk to human, environment and animal health, as well as the global economy. Dubbed a “silent tsunami” by the World Health Organization (Votta & Cardillo, 2022), AMR was directly responsible for 1.27 million deaths worldwide and contributed to nearly 5 million deaths in 2019 alone (WHO, 2023). This tragic figure is set to escalate to 10 million deaths per year without effective and comprehensive intervention (Irwin, 2022). Economically, AMR could cost the global economy \$100 trillion by 2050 (O’Neill, 2016), fueled by escalated healthcare costs, hampered productivity, and potential food shortages. Beyond pandemic prevention, the world is currently facing the stark reality of a salient global AMR pandemic. In Europe, approximately 400,000 people are infected with multidrug-resistant bacteria a year leading to at least 25,000 deaths (Hwang & Gums, 2016); the US experiences over 35,000 AMR-related deaths a year (CDC, 2019); and in Africa, AMR fatalities exceed those from HIV/AIDS and malaria combined, with over 27 deaths per 100,000 people directly attributable to AMR (WEF, 2023).

The magnitude of the AMR crisis extends far beyond its human toll, permeating into animal life, agriculture, and natural ecosystems. Antimicrobial resistance not only affects animals but also disrupts the integrity of the food chain and the broader environment. This includes contamination of vital resources such as water and soil, as well as the pollution of air and manure with resistant strains of bacteria (Ma et al., 2021). The resultant AMR-laden ecosystem poses a significant transmittable risk to humans, illustrating how AMR transcends disciplinary boundaries to impact health across species and ecosystems. Despite a decade of intensified research and heightened global focus, the World Health Organization (WHO, 2022) has reported

a persistent increase in antibiotic resistance across these diverse domains. Furthermore, the challenge is particularly acute in low- and middle-income countries (LMICs), where a lack of resources and awareness hinders the implementation of effective antibiotic stewardship programs and comprehensive surveillance systems. This underscores the need for a global, coordinated, transdisciplinary “One Health” response that addresses these disparities and strengthens the capacity of LMICs in the battle against AMR.

In light of this, the proposed study introduces a novel focus on antibiotic stewardship (ABS) within the broader discourse of AMR from a political science perspective. By examining the stewardship of antibiotics, a crucial but often overlooked aspect of AMR governance, the research provides unique insights into the optimization of antibiotic stewardship across different sectors and thus curbing the rise of AMR. The unchecked use of antimicrobials in human and veterinary medicine, agriculture, and aquaculture has hastened the emergence and spread of resistant organisms, necessitating effective global governance to address the interconnected factors contributing to AMR. In this context, the focus on ABS within the global AMR governance framework aims to provide an understudied perspective and contribute to our understanding of effective strategies to combat AMR.

The multifaceted challenge of implementing ABS necessitates a globally coordinated response, employing effective governance to address the myriad of issues that feed the development and spread of resistant organisms. These policies embody various programs and interventions striving to optimize and curtail antimicrobial use in humans, animals, plants, and the environment. This thesis explores the multifaceted challenge of antimicrobial resistance and the crucial role of antibiotic stewardship within a global governance framework. Employing a One Health approach, the study examines the interaction of human, animal, and environmental

health in addressing AMR. It critically analyzes the development and implementation of ABS policies, emphasizing the influence of diverse international actors, including international organizations, non-state actors, private entities, and public-private partnerships. Central to this analysis is the application of multi-level governance theory, which provides a lens to understand the complex interplay of interests (economic, political, and scientific) and their impact on the shaping of global ABS policies. This thesis aims to offer a comprehensive insight into the governance structures and strategies essential for combating AMR, highlighting the necessity of a globally coordinated, multi-sectoral response.

In the following chapters, this paper will present the problematization through an examination of the literature, ultimately concluding that there are various research gaps pertaining to the global governance of the stewardship of antibiotics. In chapter 3, it will explain the methodological approach, featuring an inductive, thematic document analysis of official documents, grey literature and peer-reviewed work; building on the theoretical framework founded by Sprujit and Peterson (2019) and Wernli et al. (2019). Chapter 4 delves into the ‘global governance’ aspect of the study, showcasing a timeline of the evolution of global governance mechanisms, existing global efforts, and the challenges faced in this arena. Chapter 5 presents the results of the thematic document analysis, specifically analyzing several different sectors such as the pharmaceutical sector and agri-food. This paper then holds a critical discussion in chapter 6, highlighting the main issues in formulating global ABS policy. This includes the fragmentation of global governance, the prevalence of vested interests, the bilateral power dynamics, the lack of political will, socio-cultural barriers, and institutional deadlocks in policy harmonization. To this end, chapter 7 presents a novel framework seeking to address the outlined challenges: the Integrated Polycentric Glocal Governance Framework (IPGF).

## **Chapter 2: Problematization / Literature Review**

The global rise in AMR is intrinsically linked to the overuse and misuse of antimicrobials, resulting in increased morbidity, mortality, and healthcare costs (O'Neill, 2016). Policymakers and healthcare organizations worldwide have responded with various strategies and policies promoting optimal antimicrobial use (WHO, 2015). However, the efficacy of antibiotic stewardship policies remains unclear and varies widely across contexts (Llor et al., 2020). The roles of stakeholders, such as healthcare professionals, patients, and policymakers, in antibiotic stewardship remain ambiguous, resulting in fragmented outcomes (Goff et al., 2017).

Given these gaps in current understanding, this research aims to provide an examination of ABS policies and frameworks. The aim is to offer insights into the challenges and opportunities for improving AMR control by understanding the complex landscape of ABS policy implementation and governance. In doing so, this research seeks to bolster global antibiotic stewardship and forge a pathway towards a universally coordinated ABS strategy through understanding the underlying interests and levels of governance in the ABS arena.

### **2.1 Definition of Key Concepts and Theories**

Antibiotic stewardship refers to a set of coordinated interventions designed to optimize the use of antibiotics, with the aim of reducing the emergence and spread of AMR (Barlam et al., 2016). ABS encompasses a range of strategies, including the appropriate selection, dosing, and duration of antibiotics, as well as infection prevention and control measures. There is debate over the most effective strategies for ABS, with some arguing that regulatory approaches (e.g. restricting access to certain antibiotics) may be more effective than voluntary guidelines and education campaigns (Pulcini et al., 2018). There is also contention over the appropriate level of

stewardship intervention, with some advocating for individual-level interventions (e.g. improving prescribing practices), and others arguing for more systemic interventions (e.g. improving drug supply chains and distribution) (Llor et al., 2019).

Contained within the umbrella of ABS are several different perspectives. The ecological perspective considers ABS as a complex adaptive system that includes microorganisms, patients, healthcare providers, and the environment, emphasizing the interconnectedness of these elements and the need to consider the whole system to develop effective ABS interventions (Davey et al., 2017). Conversely, the socio-technical perspective views ABS as a product of the interaction between technical and social systems, emphasizing the importance of understanding the social context of antibiotic use and the role of technology in shaping behavior (Liu & Liu, 2021). Another relevant theory is the commitment-compliance gap proposed by Wernli (2017), which suggests that while many countries have made commitments to address AMR through national action plans, there is often a gap between these commitments and actual implementation due to factors such as inadequate resources, lack of political will, and competing priorities.

The correlation between the three ABS perspectives and the One Health approach can be appreciated through a deeper exploration of the underlying principles and concerns of each perspective within the One Health paradigm. One Health, fundamentally, endorses the interdependence of human, animal, and environmental health, suggesting a necessity for collaborative, interdisciplinary solutions to health challenges (WHO, 2015). The ecological perspective of ABS coincides with this view, emphasizing the connectedness of various components such as microorganisms, patients, healthcare providers, and the environment. It suggests that in developing ABS interventions, the “entire system,” much like the One Health framework, needs to be considered (Davey et al., 2017). The socio-technical perspective,

likewise, shares common ground with One Health. It underlines the dynamic interaction between technical and social systems, hinting at the significance of understanding the social context of antibiotic use and how technology can shape behaviors. Translated into the One Health context, it encourages an incorporation of the social norms and behaviors in both human and animal health settings, and a recognition of how technology can influence these patterns (Liu & Liu, 2021). Lastly, Wernli's (2017) commitment-compliance gap theory also finds relevance in One Health. It highlights the frequent discrepancies between countries' commitments to mitigate AMR and the execution of those plans. One Health, focusing on cross-disciplinary collaboration, can potentially address this gap by promoting cooperative efforts to pool resources, align goals, and prioritize actions against AMR.

Building upon these perspectives, multi-level governance theory offers a vital lens for understanding the broader context in which ABS operates. This theory, as elaborated by recent scholars in governance studies and public health (Sprujit & Peterson, 2019) posits that effective governance encompasses multiple layers, including local, national, and global levels, and involves diverse stakeholders with varying interests and powers. Within the framework of ABS, multi-level governance theory aids in dissecting how ecological, socio-technical, and commitment-compliance factors interact across these varied levels. The ecological perspective, emphasizing the interconnectedness of all elements in ABS, aligns with multi-level governance by showing how local environmental and microorganism interactions influence and are influenced by national and global health policies. Similarly, the socio-technical perspective, highlighting the interplay between social context and technology, reflects the multi-level governance view by examining how technological advancements and social practices at different governance levels shape ABS strategies. Furthermore, Wernli's (2017) commitment-compliance

gap theory resonates with the multi-level governance approach, as it underscores the challenges faced in aligning global commitments with local and national implementation, often impeded by varying resources, political will, and priorities. Therefore, the integration of multi-level governance theory allows for the framing of ABS as a multi-layered governance issue, where effective strategies must consider the intricate interplay of ecological, socio-technical, and policy compliance aspects at various governance levels.

Given the insights provided by these perspectives and their alignment with the One Health approach, it becomes clear that tackling the global challenge of AMR requires a systemic, multifaceted approach. This encompasses a broad spectrum of actors across various disciplines, necessitating an examination of the global governance mechanisms that structure and facilitate their engagement. It is important to note that One Health has been criticized for its criticized neglect of social and political factors that significantly impact health and disease (Murray et al., 2017). Therefore, these perspectives offer insights into ABS that could not only enhance the effectiveness of the One Health approach in addressing AMR but also compensate for its criticized weaknesses.

One Health, with its multidisciplinary emphasis, naturally underlines the necessity of robust collaboration. In the context of ABS programs, this involves a broad range of healthcare professionals - physicians, pharmacists, nurses, and infection control specialists. Numerous studies emphasize this collaboration, arguing its integral role in crafting a comprehensive and effective ABS strategy (Baur et al., 2017; Ventola, 2015). As the strategy must take into account clinical, microbiological, and pharmacological dimensions, a collaborative approach fosters informed decision-making, shared responsibility, and a culture of collective accountability (Charani et al., 2019). Achieving such effective multidisciplinary collaboration, however,

necessitates clear communication, mutual respect, and common objectives (Davey et al., 2017). The implications of these interdependencies are clear: a truly optimized response to AMR through ABS must not only involve multidisciplinary teamwork but also necessitates the consideration of the broader global governance mechanisms. These structures dictate the terms of collaboration, the allocation of resources, the setting of priorities, and the distribution of responsibilities, ultimately influencing the effectiveness of any global effort to combat AMR. Thus, to improve our approach to ABS and AMR more broadly, it is crucial to analyze and understand the underlying global governance mechanisms at play to address the complex challenges posed by antimicrobial resistance.

Global governance, in the context of AMR and ABS, refers to the structures, processes, and institutions that govern global health and related policy areas, including trade, agriculture, and development (Bloom and Cadarette, 2019). The current global governance framework for ABS is complex and multifaceted, involving a range of actors and stakeholders at local, national, and international levels. Some scholars contend that current global governance mechanisms for ABS “lack teeth” and do not effectively address the underlying economic, social, and political drivers of antibiotic overuse and misuse (Laxminarayan et al., 2016). Moreover, developed countries often drive the current global governance framework, leading to a lack of representation and participation from developing countries and attention to issues such as access to affordable and appropriate antibiotics in low-resource settings (Hansen et al., 2018; Hoffman et al., 2015). Therefore, global governance mechanisms must address these power imbalances and ensure that all stakeholders have a voice in decision-making processes. Figure 1 illustrates the global governance mechanisms found in the literature.

## 2.2 Theoretical Framework

Spruijt and Petersen propose a theoretical framework for understanding the multilevel governance of AMR risks (2019). The framework is composed of three key components: the levels of governance, the dimensions of governance, and the drivers of governance. The levels of governance consist of the global, national, and local levels, while the dimensions of governance are the normative, strategic, operational, and evaluative dimensions. Finally, the drivers of governance are scientific evidence, stakeholder interests, and political will. This framework provides a useful tool for understanding the complex nature of governance in addressing AMR risks, highlighting the need for multilevel governance interventions that address the normative, strategic, operational, and evaluative dimensions of governance, while considering its drivers.

One critique of the framework is that it does not adequately address power imbalances between different levels of governance. According to de Lima Hutchison et al., the framework “assumes that power is evenly distributed across levels of governance,” which is not always the case in practice (2020). This can lead to a neglect of local perspectives and priorities, as well as a dominance of global actors and policies. Another critique of the framework is that it does not sufficiently account for the socio-cultural factors shaping AMR governance. As noted by Cairns et al., “the authors do not discuss cultural, social or behavioural factors, which are fundamental to understanding the drivers of AMR and the effectiveness of interventions” (Cairns et al., 2020). This may limit the usefulness of the framework in developing context-specific interventions that are tailored to the social and cultural contexts in which AMR governance occurs.

While there may be varying opinions on specific interventions and strategies for ABS, scholars generally accept that the implementation of One Health policies is crucial in the fight against AMR. However, from these competing views, a main question arises: what is the most

effective strategy for implementing ABS and reducing the emergence and spread of AMR? This question is further informed by the theoretical framework of multilevel governance of AMR risks, which emphasizes the importance of considering the complex interplay between different levels of governance, including global, national, and local, in developing effective interventions (Sprujit & Peterson, 2019). By examining the perspectives and strategies proposed by different policy actors and stakeholders at the global level, while considering the socio-cultural factors and the differing perspectives and interests at each level, I will aim to provide a nuanced understanding of the challenges and opportunities for implementing ABS in different contexts.

### **Chapter 3: Analyzing the Complexity of ABS Governance: Methodological Approach**

This research aims to develop an in-depth understanding of the global governance of antibiotic stewardship within the objective of reducing AMR. The primary methodology for this study will be a scoping review of relevant academic literature and policy documents using inductive thematic analysis to provide a foundation for understanding the existing knowledge on ABS governance. The objective of this study is to investigate ABS policies and the mechanisms governing them through the lens of multi-level governance theory. Central to this exploration will be a mapping exercise delineating the roles and interplay of various stakeholders involved in antibiotic stewardship. These include, but are not limited to, international organizations (IOs), non-state actors (NSAs), private entities, and the dynamic public-private partnerships (PPPs) in the sector. Informed by documents including policies, guidelines, reports, and among others, the research intends to conduct a comprehensive thematic analysis. This procedure intends not to merely identify recurring patterns or ‘themes’ in the conventional sense but to also illuminate underlying systemic issues, potential opportunities, and existing “bottlenecks” (Tandon & Bouzanis, 2021) that could impact the governance of ABS.

This thematic document analysis forms the foundation for addressing the research questions as follows:

1. What are the key principles, norms, and decision-making procedures that govern global ABS stewardship?
2. What are the key ABS stewardship policies and governance mechanisms in place across various sectors at the global level of governance?
3. How are various actors engaged within the global ABS governance structure, and how do their policy positions on governance mechanisms contribute to or impede effective ABS stewardship?
4. What are the opportunities and challenges for improving ABS stewardship through multi-sector collaboration, cooperation and public-private partnerships?

The exploration of these research questions hold significant importance for progressing our comprehension of global ABS. The imperative to delve into these areas stems from several factors. Firstly, understanding the central principles, norms, and decision-making procedures that govern global antimicrobial stewardship is essential for effective policy development and implementation. Secondly, identifying the ABS stewardship policies and governance mechanisms in place across various sectors at the global level is vital for mapping the existing landscape, thus discerning gaps or areas of improvement. This knowledge can inform decision-makers and stakeholders about the strengths and weaknesses of current approaches, enabling the identification of best practices and the implementation of more effective policies. Thirdly, the exploration of how different actors are placed within the global ABS governance structure, and their contributions to ABS stewardship, is vital for promoting multi-sectoral cooperation and encouraging fruitful public-private partnerships. A comprehensive understanding of the roles and

responsibilities of international organizations, non-state actors, the private sector, and public-private partnerships can propel collaboration, discern potential barriers, and highlight opportunities for boosting ABS initiatives.

### **3.1 Data Collection**

The objective of this research is to examine the mechanisms of global governance that surround the issue of ABS. To this end, a comprehensive scoping review was undertaken, comprising both academic and grey literature. The scope of the research spans a wide geographical expanse and various governance levels, focused on the past 13 years.

To construct a comprehensive dataset, an extensive literature search was conducted across a variety of platforms, including Google for grey literature, as well as scholarly databases like PubMed, JSTOR, and SCOPUS. Each platform was selected for its specific merits; PubMed for clinical research, JSTOR for broad academic insights, SCOPUS for its extensive citation database, and Google for accessing the realm of grey literature. Included literature had to meet several criteria: it had to be written in English, be published since 2010, and bear direct relevance to the governance mechanisms of antibiotic resistance. On the other hand, articles were excluded if they were not peer-reviewed (in the case of academic sources), or if they were outdated policy documents.

The search algorithm was designed to be both broad and specific, utilizing keywords such as “global antibiotic governance,” “AMR policies,” and “international cooperation in antibiotic stewardship.” These keywords were crafted to embrace a plethora of perspectives, including governance mechanisms and the underlying paradigms that influence ABS.

What sets this research apart is its intentional inclusion of grey literature—documents and reports that, while not peer-reviewed, carry substantial authority and provide pragmatic insights.

This includes a range of documents such as government policy briefs, white papers from NGOs and INGOs, and industry-specific reports. The addition of grey literature into the research corpus serves a twofold purpose. Firstly, it offers a window into the on-the-ground implementation of policies and strategies that academic articles may not cover or have not been able to assess yet due to the novelty of many ABS initiatives. Secondly, it serves as a mechanism to capture the complexities and nuances of the global governance landscape surrounding antibiotic resistance. This invaluable grey literature was primarily sourced through specialized Google searches and an exhaustive review of the publication sections on the websites of relevant organizations and government agencies.

This research scanned 1333 abstracts and selected 203 articles and documents for analysis. The literature was further categorized into academic and grey literature, with 81 academic articles and 122 documents from grey literature. Subsequently, the articles were imported into NVIVO for more nuanced coding and qualitative analysis. The coding schema was developed around five nodes: ABS Interventions, Driving Forces, Evidence, Policy Implications, and Political Will. These nodes were chosen as they align with the research questions and provide a structured framework for data analysis. *Figure 2* illustrates this coding tree.

### **3.2 Strengths and Limitations of the Proposed Methodology**

This research primarily engages in a thematic document analysis to navigate the global landscape of ABS policies and governance mechanisms. Given the borderless nature of AMR, this global perspective helps in understanding the broader strategies and initiatives deployed worldwide to combat it, which in turn is essential for unravelling complexities and connections between countries and regions, and for identifying common challenges and effective practices (O’Gorman et al., 2018). By examining documents at the global level, such as international

guidelines, agreements, and reports, the study aims to gain insights into the overarching strategies and initiatives implemented worldwide to address AMR. This global perspective is crucial for understanding the complexities and interconnections between different countries and regions, as well as identifying common challenges and best practices in antibiotic stewardship.

However, it is important to acknowledge the limitations associated with focusing solely on the global level. Most importantly, the global perspective may overlook the nuances and variations in antibiotic stewardship practices at national, regional, and local levels. Different countries and healthcare systems may have unique contextual factors, policies, and implementation challenges that can significantly influence the effectiveness of antibiotic stewardship efforts. The potential lack of granularity and contextual specificity can significantly impact the implementation and effectiveness of antibiotic stewardship initiatives. As Rubin (2019) argues, it is important to consider local context in tailoring interventions to specific settings for effective AMR containment, implementing stewardship through the prism of globalization. Findings at the global level may not fully encapsulate the intricacies involved in implementing AB stewardship in specific settings.

Therefore, to complement this global analysis, the study will reference several systematic reviews of ABS from varying economic backgrounds—one from a low-income country (LIC), one from an upper-middle-income country (UMIC), and one from a high-income country (HIC)—to provide a more nuanced understanding. These complementary reviews will serve to deepen the contextual understanding of the practical implications of the global analysis.

Additionally, the reliance on documents may pose limitations in terms of data availability and representativeness. The analysis will be constrained by the quality and accessibility of the selected documents, which may vary across different countries and organizations. There is also a

risk of potential bias or incomplete information in the analyzed documents, which can impact the validity and comprehensiveness of the findings. However, a scoping review, by its very nature, employs a replicable process to identify, select, and analyze relevant literature, hence mitigating some of these challenges.

## **Chapter 4: Global Governance of Antibiotic Resistance: Results**

### **4.1 Definition and Significance**

In the evolving landscape of international collaboration, global governance represents the collective approach to managing shared challenges on the world stage. While the post-World War II era has witnessed numerous triumphs of global governance structures, the current pace and intricacy of emerging global issues often surpass the capacities of international bodies and sovereign states (Director of National Intelligence, 2010). The rapid acceleration of globalization has elevated consequences, transforming previously localized concerns into global security risks. An array of emerging concerns, from ethnic tensions, pandemics, and terror threats to contemporary global challenges such as climate shifts, energy concerns, scarcity of food and water, international population movements, and technological advancements, have come to the forefront in the 21<sup>st</sup> century, necessitating novel global governance mechanisms (2010).

Global governance mechanisms serve as the foundational pillars in the complex architecture of international relations, acting as regulatory bodies that shape policies, facilitate cooperation, and establish norms among states and non-state actors. Their impact spans a wide range of issues, from trade and environmental sustainability to public health and human rights (Wernli, 2017). In the realm of antibiotic resistance, One Health frameworks are critical to curtail its threat. These frameworks, often established under international organizations such as the United Nations, World Health Organization, and World Trade Organization, execute specific

functions aimed at standardizing rules, addressing global challenges, and facilitating conflict resolution.

#### **4.2 Historical Evolution of Global Governance**

The historical evolution of these mechanisms is noteworthy, as it has seen them adapt and expand to meet the ever-changing global landscape, embodying multi-level governance theory. This theory posits that effective governance involves a complex interplay of actions at national, local, and international levels with varying interests and powers. For instance, the United Nations Framework Convention on Climate Change (UNFCCC) was initially adopted in the Kyoto Protocol in 1992 as a response to growing concerns about climate change (UNFCCC, 1992). It transitioned from a “top-down” centralized approach to a more “bottom-up” approach in the 2009 Copenhagen summit, where countries submitted individual pledges called Nationally Determined Contributions (NDCs) (UNFCCC, 2010). Building on the Copenhagen Accord, the true evolutionary leap came with the 2015 Paris Agreement creating a flexible and accountable framework requiring all participating countries – both developed and developing – to submit NDCs (UNFCCC, 2015). Unlike its predecessors, this agreement was designed to accommodate different national circumstances, and influenced various governance innovations such as the Talanoa Dialogue (Mundaca et al., 2019) and the development of the Global Stocktake (Tompkins et al., 2018). This progression in climate governance under the UNFCCC illustrates the evolutionary nature of global governance mechanisms, demonstrating how global structures can adapt to scientific, geopolitical, and stakeholder dynamics.

Parallel to the dynamic shifts observed in climate governance, the domain of antibiotic stewardship has also experienced an increased recognition of its significance and the necessity for coordinated international efforts. Initially, global attention towards antibiotic resistance was

fragmented, localized, and predominantly responsive in nature. As the severity and implications of antibiotic resistance became pronounced, a more strategic and holistic approach began to take shape (Laxminarayan et al., 2013). One such landmark in the journey was the World Health Organization's (WHO) Global Action Plan on Antimicrobial Resistance, launched in 2015. This initiative signified a concerted effort to ensure sustained, effective treatment and prevention of infectious diseases, and marked a significant step in coordinating international efforts by encouraging nations to harmonize their efforts with this global action plan (WHO, 2015). The subsequent years observed an epistemological shift in the understanding of antibiotic resistance, from a purely medical concern to a broader socio-ecological challenge. The One Health approach emerged as a testament to this shift, emphasizing the interconnectedness of human, animal, and environmental health (Queenan, Häslar & Rushton, 2016). Collaborative frameworks, such as the Tripartite Collaboration between WHO, the Food and Agriculture Organization (FAO), and the World Organization for Animal Health (WOAH), underpinned this One Health perspective, exemplifying the multi-sectoral, multi-level response needed to address complex global issues.

Furthermore, the decentralized nature of antibiotic stewardship started gaining momentum, with emphasis on the multi-level governance perspective of empowering individual nations within a supportive global network. While global strategies offered a directional compass, the role of regional collaborations, country-specific interventions, and integrative approaches solidified. Embracing both time-tested and innovative strategies became the linchpin in navigating the multifaceted challenges posed by antibiotic resistance (Holmes et al., 2016).

The evolution of antibiotic stewardship policies within the realm of global governance is a testament to the adaptability and mobilization potential of international mechanisms, as conceptualized in multi-level governance theory. This theory elucidates the dynamic interplay

between centralized coordination and decentralized execution, a pattern evident in the evolution of global governance mechanisms. It captures how these mechanisms evolve in response to advancing scientific knowledge and shifting socio-political landscapes.

### **4.3 Models and Challenges of Governance**

The evolving world of antibiotic resistance demands innovative and adaptable governance models. In One Health fashion, these models need to consider not only the rapid advancements in science but also the geopolitical dynamics that influence international cooperation. Recognizing the gravity of this challenge, the Tripartite organizations – FAO, WOA, and WHO – initiated a groundbreaking collaboration in 2010, laying out a unified vision to address health risks at the intersection of animal-human ecosystems, focusing prominently on AMR, alongside rabies and zoonotic influenza (FAO, 2010). They further extended the inclusion of the United Nations Environment Programme (UNEP) to evolve into the Quadripartite, seeking a fully holistic One Health collaboration to addressing global health issues. This ongoing partnership is characterized by extensive collaborations across global, regional, and national scales, aiming for a unified front against AMR. The next section delves into the intricate mechanisms of the global governance of antibiotic stewardship, offering insights into collaborative endeavors, individual initiatives, and the inherent challenges of antibiotic stewardship.

#### **4.3.1 Global Efforts**

Global governance mechanisms of ABS serve different functions, from legally binding treaties to softer, more voluntary commitments known as National Action Plans (NAPs). Notably, there are international forums such as the G7 and G20 that have made prominent commitments towards tackling AMR (Gurría, 2017; Cecchini, Langer & Slawomirski, 2015).

Another significant governance mechanism is the Codex Alimentarius, jointly governed by the FAO and WHO, which sets international food standards, particularly emphasizing those related to ABS (Codex Alimentarius Commission, 2021). The World Organisation for Animal Health, on the other hand, zeroes in on the animal health front by providing standards and guidance for the prudent use of antimicrobials (WOAH, 2018). In addition to these international standards, major pharmaceutical companies have also entered the arena, committing to reducing the environmental impact of antibiotic production (AMR Industry Alliance, 2020).

In the realm of public health, the World Health Organization has been a frontrunner in implementing governance mechanisms, particularly evident in its Global Action Plan (GAP) targeting antimicrobial resistance (WHO, 2023). This plan was a significant step towards a synchronized global response to AMR, designed to ensure continued and effective treatment against infectious diseases. The plan's blueprint also offered guidance for countries to develop national strategies, ensuring a harmonized global response (WHO, 2015). A multidimensional approach, the GAP's objectives ranged from improving awareness and understanding of AMR to strengthening research and development of new antibiotics.

While the GAP sought to identify and rectify between the differences in healthcare infrastructures and practices across countries, there are criticisms that the GAP and other WHO initiatives do not acknowledge the specific intricacies within local governance of ABS. 2021 TrACSS data suggest NAPs have been adopted by more than 163 countries by drawing upon global guidelines and recommendations (WHO, 2021); however, less than 20% of these NAPs are under implementation with funding and monitoring mechanisms in place (Ya et al., 2023). The diffusion of policies, ideas, and practices “matters less in situations where governments lack the capacity and political attention to put them to practice” (Rubin, 2019). For Rubin, strong

‘glocal’ governance of ABS must extend beyond leveraging policies and practices through NAPs. One ‘glocal’ governance mechanism of ABS would be polycentric governance in the form of horizontal collaboration on the subnational level, building on a network of multiple, transboundary governing authorities capable of drawing on local knowledge, mutual monitoring, and peer learning. Problem-Driven Iterative Adaptation (PDIA) is another proposed governance mechanism of globalization, focusing on solving specific problems in particular local contexts with tight feedback loops and a broad set of actors instead of transplanting “best practice solutions” (Andrews, Pritchett & Woolcock, 2013).

#### **4.3.1.1 Types of Global Governance Mechanisms**

##### ***4.3.1.1.2 Legal Mechanisms***

The most effective global governance mechanism for scholars such as (Padiyara et al., 2018; Piddock, 2016; Hoffman & Behdinan; 2015) are legal mechanisms. Legal mechanisms predominately encompass international treaties, national laws, and regulations explicitly devised to address antibiotic stewardship. The role of these legal frameworks is to establish enforceable standards and practices aimed at mitigating the spread of AMR and tangibly implement effective ABS.

A quintessential example of such a legal framework is the International Health Regulations (2005), a comprehensive agreement binding together 196 countries seeking to standardize health regulations regardless of a state’s interests. Within the sphere of multi-level governance theory, legal global governance mechanisms such as international treaties emerge as pivotal instruments in orchestrating a harmonized approach to global health challenges (Hoffman & Behdinan, 2015). International treaties play integral roles in fostering collaboration, standard-setting, and policy integration across varying governance strata, from local, to global, to ‘glocal’

levels. The structured platform allows countries to convene, deliberate, and forge consensual strategies to combat AMR. This collaborative nature of treaties is vital in harmonizing diverse approaches and methodologies, particularly as critical bridges linking different tiers of governance. In translating overarching global priorities and commitments into actionable national and local policies, legal mechanisms ensure that global imperatives resonate within domestic governance structures. Furthermore, they enhance accountability and compliance – by entering into these treaties, states commit themselves to adhere to agreed-upon standards and norms, a commitment oft accompanied by mechanisms ensuring regular reporting, review, and peer assessment. These legal commitments may also recognize and empower a plethora of non-state actors, including NGOs and civil society organizations.

However, international legal treaties are not fail-proof. In a classical or neorealist sense, these treaties are largely meaningless, as in an anarchic international system there is no higher power to ensure self-interested states adhere to them. It is a “game of cooperation and coordination” for Goldsmith & Posner (2021), positing that international law may only be effective should states act in reciprocity to attain mutual gains. The stability of international law is contingent on ongoing cooperation, as states are motivated by rational self-interest to maintain beneficial agreements. Nonetheless, international law can be, and often is, subject to violations due to changing power dynamics, shifting state preferences, and emerging challenges. While states often preemptively renegotiate obligations to avoid violations, breaches can and do occur, sometimes on a significant scale. Essentially, while international law is normatively desirable for facilitating mutual gains across states, it can also be used in predatory ways, potentially entrenching normatively undesirable outcomes.

#### ***4.3.1.1.3 Public-Private Partnerships in Global Governance***

Within the One Health Framework, Public-Private Partnerships (PPPs), exemplified by the Global Antibiotic Research and Development Partnership (GARDP), are increasingly recognized as pivotal mechanisms for global health governance, specifically designed to coordinate and propel global health initiatives forward. According to a detailed governance analysis by Calore & Fraundorfer (2020), GARDP, despite aligning its vision and objectives with the One Health ethos, is not sufficient on its own to comprehensively address broad public health issues such as effective antibiotic stewardship (ABS). This finding underscores the need for an expansion and diversification of PPPs, advocating for a transformation of the One Health concept from a theoretical framework into a functional governance practice.

The implementation and efficacy of PPPs in the domain of ABS governance, however, are contingent upon several key considerations. Foremost among these is the necessity of aligning the often-divergent interests of public health objectives and private sector business goals. PPPs must navigate this landscape with strategic acumen, ensuring that public health outcomes are not compromised in favor of commercial interests. This necessitates a deliberate and careful structuring of such partnerships, aiming to strike a balance that prioritizes public health imperatives.

Moreover, the principles of transparency and accountability stand as cornerstones in maintaining public trust and effectively managing potential conflicts of interest inherent within PPPs. It is imperative to create and maintain clear governance structures and oversight mechanisms. These frameworks are crucial for ensuring that PPP collaborations are managed ethically and transparently and that they indeed deliver on their public health objectives.

Despite these challenges, the potential of PPPs in advancing global ABS efforts is immense. Initiatives like GARDP and the Innovative Medicines Initiative (IMI) – a collaborative effort between the European Union and the European pharmaceutical industry – have demonstrated the impactful nature of such partnerships. These initiatives have been instrumental in accelerating the development of innovative treatments for antibiotic-resistant infections, thereby highlighting the significant role of PPPs in bridging critical gaps in AMR research and development.

In summation, PPPs within the One Health framework are essential for a coordinated and comprehensive global response to AMR. Their effectiveness, as Calore & Fraundorfer (2020) indicate, relies heavily on the thoughtful structuring of these partnerships to align them with broad public health goals while ensuring transparency and managing conflicts of interest. The expansion and nuanced application of PPPs stand as critical steps in transforming One Health into a tangible and effective governance practice, capable of tackling the multifaceted and evolving challenges presented by the implementation of ABS.

The 2015 WHO Global Action Plan, and several other international policy documents, have stressed the importance of a multilateral approach to enhance ABS. For Wernli et al., who conducted a comprehensive policy assessment of 78 international organizations and global stakeholders on AMR, concluded that a multilateral “whole of UN approach” to AMR within the framework of Sustainable Development Goals to advance the global governance of AMR (Wernli et al., 2022). Key to this approach is the coordination between agencies such as the World Health Organization (WHO), the Food and Agriculture Organization (FAO), and the United Nations Environment Programme (UNEP), each addressing different facets of AMR. The WHO focuses on health-related aspects, FAO on agricultural implications, and UNEP on

environmental factors, together fostering a holistic response to AMR. Further emphasizing the importance of the Global Action Plan, the WHO has engaged in numerous partnerships to bolster its implementation. These partnerships, often involving non-governmental organizations, academic institutions, and private sector entities, aim to leverage a wide range of expertise and resources. For instance, partnerships with academic institutions have been crucial in advancing research and development, while collaborations with private sector entities have focused on innovations in diagnostic tools and treatment methods. These partnerships reflect a growing recognition of the need for diverse expertise in tackling the complex issue of AMR (WHO, 2021).

However, it is imperative to consider a broader array of international collaborations and strategies that contribute significantly to combating AMR. Global Health Partnerships, such as the Global Fund to Fight AIDS, Tuberculosis and Malaria, and Gavi, the Vaccine Alliance, extend their impact beyond direct healthcare provision, focusing on building robust healthcare systems for effective antibiotic management. The One Health Global Leaders Group on Antimicrobial Resistance, established in 2020, exemplifies cross-sectoral alliances, uniting leaders from health, agriculture, environment, and more, to spearhead global action against AMR (UN, 2021). This initiative is complemented by parallel efforts at regional levels. For example, the Asia-Pacific Economic Cooperation (APEC) has undertaken initiatives focusing on AMR, emphasizing the importance of regional collaboration in a globally connected world (Yam et al., 2019). These regional efforts highlight the need for localized approaches, tailored to specific regional challenges and resources, while aligning with global objectives. Such regional initiatives serve as critical links in the chain of global AMR response, ensuring that the strategies are both globally informed and locally applicable.

While the WHO's Global Action Plan is a cornerstone, its implementation is enriched through collaborations with regional health organizations like the European Centre for Disease Prevention and Control (ECDC) and the African Union (WHO, 2022). The European Union's comprehensive AMR action plan, integrating human and veterinary medicine, is an example of effective regional strategies, serving as a model for other regions seeking to integrate various aspects of health governance. Similar initiatives can be seen in other parts of the world, such as the Pan American Health Organization's (PAHO) regional action plan on AMR. These regional strategies often serve as test beds for innovative approaches, which, if successful, can be adapted and adopted by other regions or at a global scale. This showcases the dynamic nature of AMR governance, where regional innovations can influence global policies and vice versa. However, aligning national priorities with global strategies remains a challenge, as does the need for sustainable funding, highlighted by initiatives like the AMR Multi-Partner Trust Fund.

The implementation of this multilateral approach faces several challenges, chiefly in ensuring cohesive policy alignment and operational synergy among diverse organizations with varying mandates and priorities. As the World Bank (2019) explains, low-income countries often struggle with the implementation of ABS due to limited healthcare infrastructure and resource constraints. However, with effective communication, resource sharing, and joint planning, these challenges may be overcome to ensure that the collective efforts of these organizations are aligned towards common goals.

#### ***4.3.1.1.4 Communication and Public Awareness Mechanisms***

In implementing global governance mechanisms for effective antibiotic stewardship, the strategic implementation of communication and awareness programs hold a pivotal role. These initiatives extend beyond information dissemination, instead are dynamic tools for fostering a

cohesive understanding of ABS challenges across diverse governance domains. According to multi-level governance theory, effective communication facilitates the transition of high-level global strategies into locally actionable policies, ensuring that global directives resonate at grassroots levels (Tortola, 2019).

World Antibiotic Awareness Week, an initiative by the World Health Organization, exemplifies the potential of global campaigns in raising consciousness about the prudent use of antibiotics (WHO, 2021). The WHO report that the campaign has increased public and professional engagement on social media and in the press (WHO, 2021). Similarly, the European Antibiotic Awareness Day, orchestrated by the European Centre for Disease Prevention and Control (ECDC), is suggested to have positively influenced public attitudes and behaviours towards antibiotic use (ECDC, 2021). The “Be Antibiotics Aware” campaign by the CDC, is reported by the CDC that surveys conducted post-campaign have indicated improved understanding and awareness of antibiotic resistance among the target audiences (CDC, 2019a). Furthermore, a study conducted by Almutairi et al. in Saudi Arabia revealed that, after AMR education was delivered to high school students in Riyadh, a statistically significant improvement in antimicrobial use had occurred (Almutairi et al., 2023). These findings suggest that educational interventions are a crucial mechanism in ensuring responsible antimicrobial use and lessened antibiotic resistance, as people are then enabled to make better decisions of when to use antibiotics, pharmacists and doctors will be encouraged to responsibly prescribe them, and AMR stewardship initiatives by large will be aided.

However, these initiatives are not without challenges. Barriers such as varying levels of health literacy, cultural resistance, and misinformation present significant hurdles in the effective dissemination of awareness messages. Addressing these challenges requires a multi-stakeholder

approach, integrating the efforts of governments, non-governmental organizations, healthcare providers, and the media.

Ultimately, communication and awareness programs are integral to the global strategy against AMR. They serve as crucial instruments in educating the public, shaping policy, and promoting antibiotic stewardship. Through strategically aligned communication efforts, as recommended by multi-level governance theory, these programs can substantially contribute to mitigating the global threat posed by antimicrobial resistance.

#### ***4.3.1.1.6 Global Surveillance and Information-Sharing Mechanisms. The of Case of GAP and GLASS Implementation in Thailand***

Thailand's approach to curbing antimicrobial resistance (AMR) within its borders serves as a compelling case in the effective implementation of global surveillance and information-sharing mechanisms, particularly in the context of the WHO's Global Action Plan (GAP) and Global Antimicrobial Resistance Surveillance System (GLASS). Recognizing the perils of unchecked antibiotic access, the Thai government instituted stringent regulations, transitioning to a prescription-only model for antibiotics. This critical regulatory shift, as reported by Sirijatuphat et al. (2018), not only effectively reduced misuse but also underscored the importance of healthcare practitioners' judgment in antibiotic dispensation, ensuring their use only when medically necessary. To bring about a paradigm shift in public behavior and perceptions, the Thai government launched comprehensive nationwide awareness campaigns. These campaigns, underpinned by compelling narratives and scientific evidence, aimed to educate the populace about the risks associated with indiscriminate antibiotic usage. The message was clear: antibiotics, if misused, could lose their efficacy, leading to a future where even minor infections

could become lethal. As Thamlikitkul (2019) notes, these initiatives played a pivotal role in reshaping public attitudes, leading to more informed decisions about antibiotic consumption.

To ensure that these efforts bore fruit, the Thai government instituted robust surveillance mechanisms adhering to the WHO's GLASS recommendations. These systems, which meticulously tracked antibiotic sales, resistance patterns, and shifts in public awareness, offered valuable insights into the effectiveness of the interventions. The data from 2017 to 2022 was particularly illuminating, as there was a discernible decline in antibiotic consumption of over 50%, especially in the livestock sector, indicating that the measures were not just superficial but had a tangible impact (Apisarnthanarak et al., 2018). The success of Thailand's multifaceted strategy, firmly anchored in the principles of WHO's GAP, highlights the importance of customizing interventions to align with local contexts and needs. This case exemplifies how national strategies, informed by global guidelines and reinforced through local execution, can lead to substantial progress in the fight against AMR. This approach underscores the potential of nationally tailored initiatives, supported by global surveillance frameworks like GLASS, to achieve meaningful and measurable outcomes in AMR mitigation. *Figure 3* showcases a mind map of the various global governance mechanisms for implementing ABS.

#### **4.3.2 Collaborative Alliances**

While the WHO has been instrumental in driving global initiatives against AMR, collaborative alliances with other organizations have amplified these efforts ensuring an inclusive approach. The quadripartite collaboration is a prime example, but another mechanism strengthening international antibiotic stewardship collaboration is the Codex Alimentarius Commission. A joint initiative by the FAO and WHO, this commission focuses on endorsing food standards, guidelines, and codes of practice. Their emphasis on AMR plays a crucial role in

ensuring the safety and quality of food across global supply chains (Codex Alimentarius Commission, 2021). Complementing this is the World Organisation for Animal Health (WOAH). Recognizing that the judicious use of antimicrobials in animals is paramount to curb AMR, the WOAH provides countries with standards and guidelines to ensure antimicrobials are used responsibly. Their work is pivotal in preventing the misuse of these drugs, which can result in the proliferation of resistant strains (WOAH, 2018). *Figure 4* outlines the various collaborative alliances along with highlighting their individual and collective roles, challenges, and the broader impact they have on policies and research.

Beyond these alliances, the Global Antibiotic Research and Development Partnership (GARDP), a product of collaboration between the WHO and the Drugs for Neglected Diseases initiative (DNDi) emerged in 2013 (DNDi, 2013). GARDP emphasizes developing new or enhanced antibiotic treatments and ensuring their responsible usage and accessibility to all, contributing to the first-ever WHO Paediatric Drug Optimization (PADO) for AMR as well as programs such as SECURE accelerating access to essential antibiotics (GARDP, 2022). Concurrently, ReAct – Action on Antibiotic Resistance stands as an influential independent global network committed to the AMR challenge. By spanning continents, they focus on capacity building, awareness campaigns, and the promotion of policies that embody best practices against AMR (ReAct, 2022). Their Impact Report notes their impact on mobilizing funding for NAPs in many LMICs created with the Multi-Partner Trust Fund on AMR.

Furthermore, the Antibiotic Resistance Coalition (ARC) has been instrumental in shaping policy debates and fostering cooperation (ARC, 2022). As an independent coalition, ARC is made up of members hailing from civil society and intergovernmental organizations across the globe, with collaborations spanning from the European Commission, ReAct Europe, Health Care

Without Harm, International Centre for AMR Solutions, the US PIRG and Food Animal Concerns Trust, the Pan American Health Organization, and more (ARC, 2022). A collaborative platform known as the Joint Programming Initiative on Antimicrobial Resistance (JPIAMR) is yet another collaboration also worth noting. Encompassing 29 countries, JPIAMR aims to streamline and merge resources, infrastructures, and coordinates national research efforts to holistically address AMR (JPIAMR, 2023).

In addition, the AMR Industry Alliance, a conglomeration of entities from the pharmaceutical, biotechnology, generics, and diagnostics sectors, seeks to “drive and measure” the industry’s progress in securing effective ABS (AMR Industry Alliance, 2016). This encompasses a range of areas, from rigorous research to responsible antibiotic use. The Global AMR R&D Hub, backed by the G20 nations, serves as a dynamic platform designed to amplify global AMR R&D endeavors, ensuring the coherent and efficient utilization of all R&D resources (Global AMR R&D Hub & WHO, 2023). The Alliance for the Prudent Use of Antibiotics (APUA, 2005), with over 35 years of operation, stands as a testament to enduring efforts against AMR. By focusing on research, education, and advocacy, APUA has consistently championed the proper use of antibiotics. The Transatlantic Task Force on Antimicrobial Resistance (TATFAR), a joint venture between the European Union and the United States, was established in 2009. Its primary objective is to bolster cooperation in key areas such as the therapeutic use of antimicrobial drugs, prevention strategies against drug-resistant infections, and the devising of strategies to rejuvenate the pipeline of new antimicrobial drugs (CDC, 2016).

These collaborations, each with its distinct focus and strengths, collectively offer a comprehensive approach to combat the ever-looming challenge of ABS. Through synergistic

efforts, they harness collective expertise and resources, enabling more impactful and effective initiatives on the global stage.

### **4.3.3 Individual Initiatives**

Beyond these initiatives, major pharmaceutical companies have committed to reducing the environmental impact of antibiotic production, demonstrating the involvement of the private sector in global governance regarding ABS (AMR Industry Alliance, 2020). For instance, some leading pharmaceutical firms have adopted sustainable manufacturing processes, incorporating eco-friendly practices into their production methods (Hermsen et al., 2020). These initiatives not only contribute to reducing the environmental footprint of antibiotic manufacturing but also underscore the private sector's active involvement in global AMR governance.

The private sector's engagement extends beyond eco-conscious manufacturing. Major pharmaceutical companies have made commitments to responsible antibiotic disposal and sustainable supply chain management (Gregory & Martin, 2022). By addressing the entire lifecycle of antibiotics, they ensure that these vital medicines are produced, used, and disposed of in ways that minimize environmental harm and reduce the risk of AMR development.

Apart from pharmaceutical corporations, several noteworthy individual initiatives significantly contribute to the battle against AMR. The Pew Charitable Trusts' Antibiotic Resistance Project strategically focuses on policy advocacy and research, with the objective of combating the overuse and misuse of antibiotics in both human health and animal agriculture (Hyun, 2023). Employing a multifaceted approach, this project actively engages stakeholders and drives policy transformations aimed at comprehensively tackling ABS. Furthermore, the "Revive Coalition" emerges as a global alliance comprising pharmaceutical companies, regulatory agencies, and public health organizations (GARDP, 2022). This coalition is committed to

reinvigorating antibiotic research and development, with a primary emphasis on supporting innovation and responsible antibiotic usage. Moreover, diverse biotechnology companies are pioneering alternative treatments to antibiotics, including phage therapy and CRISPR-based approaches. Companies such as Locus Biosciences and Eligo Bioscience spearhead this research, offering innovative solutions to combat ABS (Hermsen et al., 2020).

These private sector initiatives, both individual and collaborative, serve as complementary pillars to global and governmental efforts. They illustrate the diverse array of approaches stakeholders employ to address ABS comprehensively, ranging from responsible manufacturing to research and policy advocacy (Gregory & Martin, 2022). This collective commitment underscores the paramount importance of multidimensional collaboration in the global governance of ABS.

#### **4.3.4 Challenges of Current Governance Mechanisms: Multi-Level Governance Perspective**

Global governance mechanisms have sought to harmonize global best practices and provide a nuanced platform to balance a diverse array of priorities, such as economic development, food security, and healthcare (FAO, 2022). Yet, the existing disparities and varied commitments amongst nations pose significant hurdles for effective global governance of ABS. Countries across the socio-economic spectrum have displayed differing approaches, and especially LMICs find themselves grappling with a complex and growing web of priorities encompassing economic development, food security, healthcare, and ABS governance. The multi-level governance framework provides a nuanced understanding of the varying commitments and approaches adopted by nations across the socio-economic spectrum, especially in Low and Middle-Income Countries that juggle a multitude of pressing concerns.

A stark contrast in regulatory approaches is evident. While European Economic Area (EEA) nations largely have structured action plans against AMR, an alarming number of antibiotics are dispensed without prescription - more than 50% - in many LMICs, signaling a regulatory deficit (WHO, 2019; ECDC, 2019). Carelli (2023) underscored the heterogeneity in national approaches towards international coordination in AMR, highlighting the intricate institutional factors that can inadvertently counteract global efforts. As Carelli illustrates, the effectiveness of these mechanisms is not uniform: countries vary significantly in their approach to international coordination, thus indicating a complex interplay of institutional factors that can sometimes undermine global governance efforts (2023). As the Secretary-General of the United Nations, António Guterres, poignantly remarks:

“We all know that the system is not functioning at its full potential. We are held back by insufficient coordination and accountability on system-wide activities... [We also have] a fragmented funding base delivering a fragmented system undermining results in people’s lives” (United Nations, 2017).

Despite the varied commitments, the utility of governance mechanisms often depends on the political and economic contexts in which they operate. States are generally expected to adopt recommendations from the WHO’s GAP, but these often undergo adaptations to harmonize with national regulatory frameworks. Such adaptations might echo a country’s capacity constraints or, in contrast, its autonomous vision in shaping NAPs. This wide-ranging approach to governance underscores the importance of future global coordination and raises concerns about certain countries' hesitation to adopt an international stance (Carelli, 2023).

The variation in NAP design across countries has given rise to a spectrum of international engagement: from ‘Isolationists’ with little international outreach other than GAP adoption, to

‘Europeanists’ who prefer creating ‘soft’ governance mechanisms under the umbrella of EU institutions (Carelli, 2023). Additionally, there are ‘Hubs’ that prefer multiple channels for policy development and call for increased international coordination. This patchwork of governance approaches suggests that the roles of WHO, the EU, and other organizations are highly differentiated and not universally accepted. The fragmented landscape, with indications that the global response is predominantly driven by High-Income Countries, underscores the need for better communication and equal participation from LMICs in global governance (FAO, 2023).

Another predominant concern dwells in the domain of coordination amongst a plethora of international entities. The tripartite of WHO, FAO, and WOA, despite conjuring strategies and action plans, confront the convoluted task of synchronizing these frameworks amidst the glut of divergent priorities, resource allocations, and regulatory policies across nations and organizations (Padiyara et al., 2018). Hoffman and Outtersson underscore the ensuing challenge, casting light upon the palpable void in stringent accountability and enforcement mechanisms, thereby, enabling potential disparities between commitments and actionable outcomes in the fight against AMR (Hoffman & Outtersson, 2015).

The integrity of data management and reporting across various sectors, encompassing human health, animal health, and agriculture, emerges as a formidable obstacle. Logistical, technical, and standardization challenges in data reporting can lead to the generation of inconsistent and opaque data, thereby consequently inhibiting accurate assessment and global policy development (Padiyara et al., 2018).

The balance between ensuring accessibility and preserving the efficacy of antimicrobials adds another layer to the complexity. Laxminarayan et al. and Årdal et al. illuminate the delicate equilibrium required to guarantee global antimicrobial access while simultaneously preventing

their overuse and misuse, an equilibrium that demands meticulous management amidst the heterogeneity of worldwide healthcare systems (Laximinarayan et al, 2013.; Årdal et al., 2020). Moreover, aligning urgent strategies for enhanced antibiotic stewardship with the overarching sustainability of global health development emerges as a convoluted policy-making endeavor (Tejpar et al., 2023). The efforts to harness AMR strategies that are in harmony with sustainability, encompassing a vast array of environmental and socio-economic facets, continue to pose a challenge to global governance mechanisms.

Navigating through the intricate terrains of global collective action, as illuminated by Hoffman et al., unearths additional challenges, namely the achievement of global consensus amidst the disparities in political, economic, and cultural contexts intrinsic to varied countries. A relevant example is the use of antimicrobial growth promoters; these may align with FAO objectives by enhancing weight gain in livestock, while simultaneously presenting a potential risk to human health — a primary concern for the WHO (Hoffman et al., 2015). Institutions navigate through varied policies, each wielding different levels of influence over state behavior and each being managed by "different delegations with different priorities" (Hoffman et al., 2015). Consequently, the formulation and implementation of collective actions can be constrained by these heterogeneous national policies, divergent economic statuses, and variances in health infrastructure.

The development of international legal frameworks, while maintaining respect for individual nations' sovereignty and addressing ethical dilemmas such as equitable antimicrobial access, warrants an exhaustive negotiation process that respects the distinctive legal and ethical standpoints of all parties (Van Katwyk et al., 2023). Viens and Littmann (2015) notably contextualize this challenge by interrogating whether antibiotic resistance may be categorized as

a slowly emerging disaster, invoking particular ethical and policy responses. Furthermore, the WHO has acknowledged the overarching threat of AMR and has consequently prioritized strategic, coordinated actions across countries, demonstrating an international response to safeguard global health. The endeavor to establish a resilient global system against the AMR threat inevitably intertwines with ethical considerations like health justice (Venkatapuram, 2013), and legal frameworks that delineate the obligations and precautions against infection (Verweij, 2005). This expansive network of interrelated legal and ethical considerations necessitates a multi-faceted, globally cooperative approach to navigate through the challenges posed by AMR, while also ensuring the sustenance and efficacious deployment of antimicrobial agents.

Finally, equitable resource allocation materializes as a significant impediment. Developing economic models that ensure fair and adequate funding and resource distribution to manage AMR across the global stage is an intricate endeavor, necessitating nuanced approaches that accommodate the disparate economic capacities among nations (Padiyara et al., 2018). Current models, as noted by Hillock et al., often rely on ‘future scenarios’ and thereby lack the precision needed to guide the optimal resource allocation for AMR prevention (2022). Governments are actively seeking ‘better models’ for more accurate estimates of country-specific future burdens, but the substantial uncertainties in AMR transmission dynamics make it questionable whether sufficiently accurate estimates are attainable. This underscores the importance of improved surveillance and the precision of ‘statistical forecasting models’ as crucial components in addressing this challenge (Hillock et al., 2022). Additionally, the complexities of ABS, including unpredictable behavioral and social factors, underscore the need for sophisticated models that consider diverse scenarios.

This confluence of disparate governance strategies implies that the roles of pivotal organizations like WHO and the EU are not homogeneously endorsed or adopted across the global stage. A notable propensity towards AMR response orchestration by High-Income Countries necessitates a recalibration, advocating for enhanced communication channels and a more equitably distributed participation, especially for LMICs, in the overarching global governance narrative (FAO, 2023). Consequently, it becomes imperative to establish comprehensive, data-driven models for the fair allocation and mobilization of resources; leverage international cooperation through mechanisms like treaties and legal avenues to address comprehensive ‘glocal’ challenges encompassing relevant socioeconomic factors; and to ensure access to and affordability of essential antibiotics emerges as a fundamental principle for effective and collective antibiotic stewardship. Therefore, navigating the challenges of global governance in ABS through a multi-level governance lens reveals the need for consensus-building amid political, economic, and cultural disparities. The varied policies and priorities of institutions across different countries underscore the complexity of formulating and implementing collective actions within the global governance framework.

## **Chapter 5: Antibiotic Stewardship Policies by AMR Stakeholders: Findings from the Document Analysis**

### **5.1 Introduction**

The multi-faceted challenge of ABS requires concerted efforts from various stakeholders. While governments and international organizations play pivotal roles, the industry remains a significant – yet often underestimated and understudied – player in the ABS ecosystem. Akin to a web of interrelated factors and stakeholders, each contributes to the viability and sustainability of mitigation efforts. Among these, the role of industry – encompassing pharmaceutical companies,

biotech firms, diagnostic entities, agrifood and even the restaurant business – stands out as both uniquely influential and complex.

The involvement of industrial players in AMR control and mitigation is not just a moral or social imperative but also a business necessity. Companies operating in these sectors have a vested interest in ensuring the efficacy of antimicrobial products, both for public health outcomes and long-term market viability (Shafiq et al., 2021). However, the level of commitment and types of initiatives vary significantly across different segments of the industry. As recent surveys of the Alliance for Multidisciplinary Resistance Initiatives (AMRIA) reveal, pharmaceutical companies tend to be more actively engaged in AMR stewardship programs compared to generic manufacturers and smaller biotech firms (AMRIA, 2022). At the forefront of research and development for new antibiotics, antivirals, and other antimicrobial agents, pharmaceutical companies invest significant resources into discovering new molecules, mechanisms of action, and drug delivery systems. New diagnostic tools enable quicker identification of pathogens and their resistance profiles, thus guiding more precise treatment regimens. Such innovations, often backed by rigorous clinical trials and collaborations with academic institutions, pave the way for more effective disease control strategies and the potential mitigation of AMR (Shafiq et al., 2021). Given that 83% of R&D pharmaceutical and 80% of diagnostics companies report having appropriate-use plans in place for AMR-relevant products, there is a pressing need to understand these initiatives' reach, impact, and effectiveness (Shafiq et al., 2021). While numerous studies have scrutinized the epidemiological, sociopolitical, and clinical aspects of AMR, limited attention has been paid to the industry's role in shaping stewardship and appropriate use.

In approaching the intricate landscape of ABS, this chapter employs a multi-level governance lens, recognizing the layered and interconnected nature of governance across various

levels. This analytical perspective is crucial in understanding how global, national, and local governance structures interact and influence antibiotic stewardship practices. The analysis in this chapter is designed to capture key dimensions of governance: normative aspects (such as ethical considerations and standards), strategic elements (including policy strategies and action plans), evaluative components (assessing the effectiveness of policies and practices), political will (indicative of governmental and institutional commitment), and stakeholder interests (reflecting the priorities and influences of various actors in the field). This rigorous process enables a comprehensive analysis that not only dissects the multifaceted nature of ABS governance but also provides insights into how these diverse governance components converge to shape global efforts in combating antimicrobial resistance. By intertwining these layers of governance with empirical evidence drawn from the documents, the chapter aims to offer a nuanced understanding of the challenges and potential pathways forward in the realm of antibiotic stewardship.

Therefore, this chapter seeks to identify the relevant actors in the ABS sphere, their positions, how they would use and implement global governance mechanisms, and the barriers that exist. It will explore the roles and functionalities of key actors in the international arena, focusing on the influence of industry sectors such as pharmaceutical companies, agribusiness, and corporations in shaping international policy and pursuing their interests. The chapter will also delve into the activities, limitations, and impact of International Non-Governmental Organizations (INGOs) as governance mechanisms. Furthermore, it will examine the role of International Organizations (IOs) such as the United Nations and the World Health Organization in formulating policy and setting guidelines. Ultimately, the chapter aims to shed light on the inherent challenges and complexities these actors face in facilitating global transformation.

## 5.2 The Pharmaceutical Sector

The pharmaceutical sector stands at the forefront of the global struggle with ABS. It functions as a pivotal actor, playing a decisive role in several areas that buttress antibiotic stewardship initiatives and covering the entire spectrum from pioneering research and development of novel antimicrobial agents to the ethical marketing and distribution of these drugs (Hermsen, Sibbel & Holland, 2020). However, a concerning trend has emerged wherein many pharmaceutical manufacturers have ended antibiotic research and development efforts, largely driven by economic considerations, particularly the “suboptimal return on investments” (Gregory & Martin, 2022). For a sustainable antimicrobial armamentarium, forging alliance among antibiotic stewardship programs, pharmaceutical industries, and legislative bodies has become imperative, with glimpses of such coalitions becoming visible through initiatives like the Combating Antibiotic-Resistant Bacteria Biopharmaceutical Accelerator (CARB-X) and various legislative policies that blend push and pull incentives (CARB-X, 2023). As the pharmaceutical sector wrestles with these complexities and shoulders multifaceted responsibilities in curbing AMR and fostering ABS, various organizations globally are stirring, attempting to strategize and combat the threat in diverse ways.

One prominent voice amid this global ‘rethink’ of antibiotic stewardship has been the World Veterinary Association. Recognizing the urgency embedded in the escalating concerns surrounding antibiotic stewardship, its strategic plan for 2020-2025 highlights ‘Pharmaceutical Stewardship’ as a pivotal priority area (WVA, 2020). This emphasis not only underscores a universal recognition that AMR solutions traverse beyond the boundaries of mere drug R&D but also stresses the indispensability of a holistic, systemic approach. Here, ‘Stewardship’ emerges not merely as a term but as a call for the judicious and responsible use of medicines, thrusting the

pharmaceutical industry into a dual role: the continuing development of new drugs and ensuring the prudent use of existing ones to extend their efficacy and longevity.

Beyond the traditional role of drug discovery and distribution, certain companies within the pharmaceutical sector have showcased proactive commitment to the stewardship of antimicrobials. As demonstrated by the One Health case of multinational pharmaceutical company Merck & Co., Inc., the industry can move beyond commercial goals to invest in ABS, understanding the twofold benefits of doing good for public health and doing well commercially (Hermsen, Sibbel & Holland, 2020). Companies are realizing the critical importance of not only introducing new antimicrobial agents but also ensuring the responsible and optimal use of existing ones to maximize their lifespan and utility. Collaborative endeavours such as surveillance programs (for example, the SMART program), educational campaigns (Merck's "Time to Vaccinate" program), partnerships for antimicrobial stewardship implementation in hospitals, and initiatives to advance responsible manufacturing underline a comprehensive approach adopted by these companies (Hermsen, Sibbel & Holland, 2020). The largest collaborative endeavour is the AMR Action Fund, a partnership involving over 20 leading biopharmaceutical companies spearheaded by the European Federation of Pharmaceutical Industries and Associations (EFPIA, 2023a). In consideration of the fact that no new classes of antibiotics have been discovered since the 1980s, and that the current pipeline is insufficient to tackle the rise in antibiotic drug resistance (EFPIA, 2023b), the AMR Action Fund's ambitiously seeking two to four new antibiotics delivered to patients by 2030 (EPFIA, 2023a). The most recent progress report on the AMR Action Fund reveals that nearly two-thirds of the alliance members took action to reduce substandard and falsified AMR-relevant products or technologies, enhanced product safety, and engaged in activities to improve quality management systems and

controls (AMR Industry Alliance, 2022). Overall, 89% of surveyed generics companies reported taking actions related to improving product safety through packaging and serialisation, and 92% of surveyed R&D pharmaceutical companies have reported measures taken on appropriate use and stewardship activities.

### **5.2.1 Power, Interests, and ABS Implementation: The Case of Indonesia**

In Indonesia, the implementation of antibiotic stewardship within hospitals represents a vivid example of the role of infrastructure inadequacies, vested interests, and power dynamics in hampering ABS efforts. A qualitative study of Indonesia's ABS policy-implementation since 2015 showcases how the nation's healthcare landscape is characterized by significant infrastructure inadequacies, such as inconsistent capacities and quality of microbiology labs and surgical facilities. This variability, predominantly in public hospitals, is attributed to budget constraints, which prevent standardized operations across regions and hospitals, leading to diverse ABS practices. These challenges are not just due to the absence of infrastructure but also due to limited funding flows, hindering high-quality operations of existing facilities (Limato et al., 2022). For instance, microbiology testing faces issues like ambiguous culture results and stock-outs of essential supplies, which undermine the reliability of diagnostics.

The pharmaceutical industry in Indonesia plays a pivotal role, wielding considerable influence over antibiotic prescribing habits. This influence is primarily exerted through sponsorships and established relationships with healthcare providers, creating a potential conflict of interest that may skew prescribing practices away from optimal ABS guidelines. Such influence is subtle yet profound, impacting the decision-making processes within hospitals regarding antibiotic use (Limato et al., 2022). Despite regulations in place to limit pharmaceutical sponsorship to knowledge and skills building, such as seminars and trainings,

conflicts of interest persist. Hospitals often depend on sponsorships for running programs, including patient health education, which can inhibit the efforts of ABS teams to limit antibiotic procurement. Instances were reported where proposals to stop antibiotic procurement from a pharmaceutical company were countered with the argument that the company had provided sponsorship, indicating an entrenched reliance on these commercial ties. This complex relationship between funding needs and antibiotic stewardship creates a challenging environment for implementing effective ABS programs in Indonesia.

Hospital management, grappling with the dual objectives of ensuring profitability and meeting accreditation standards, often finds itself in a challenging position. This focus can inadvertently lead to a deprioritization of ABS initiatives, as financial and operational goals take precedence. In an environment where hospital administrators are continually balancing economic viability with healthcare quality, ABS programs can be overshadowed by more immediate financial concerns (Limato et al., 2022). Furthermore, healthcare providers face their own set of challenges. Limited resources and operational autonomy within their institutions make strict adherence to ABS guidelines a daunting task. The reality of working in under-resourced settings, often with inadequate support and infrastructure, puts additional pressure on these providers, hampering the effective implementation of stewardship programs. Compounding these issues is the role of insurance providers, particularly the national health insurance scheme, Jaminan Kesehatan Nasional (JKN). The coverage policies and payment models of JKN have a significant impact on the decision-making processes in diagnostics and treatment. However, these policies often fall short of supporting the comprehensive requirements of effective ABS. The lack of coverage for essential diagnostic tests and the constraints imposed by the JKN drug formulary can lead to suboptimal antibiotic use, diverging from the ideals of ABS.

These challenges of power dynamics, vested interests and institutional shortcomings in the Indonesian healthcare system underscores the critical need for a multi-faceted approach to ABS. Addressing the infrastructure gaps, re-aligning the influence of pharmaceutical companies, recalibrating hospital management priorities, empowering healthcare providers, and reforming insurance coverage policies are essential steps. Only by navigating and harmonizing these competing interests and power dynamics can effective ABS be realized in Indonesia, setting a precedent for similar challenges in other developing healthcare systems.

### **5.2.2 Decline of the Antimicrobial Pipeline**

The development and introduction of new antibiotics have historically been heralded as monumental strides in modern medicine. These drugs, once termed “magic bullets,” were celebrated for their capacity to decisively combat bacterial infections, radically reducing mortality rates and transforming the medical landscape (Aminov, 2010). However, in recent decades, there has been a noticeable deceleration in the discovery and development of novel antibiotics. A confluence of factors, including scientific challenges, economic disincentives, and regulatory complexities, have coalesced to hinder the expansion of the antimicrobial pipeline (Morel et al., 2020; Minssen et al., 2020). This decline, juxtaposed against the rising tide of antibiotic resistance, underscores an alarming global health conundrum that demands urgent attention (World Health Organization, 2019).

The antimicrobial pipeline has stalled for several reasons from a pharmaceutical industry standpoint. The primary deterrent for pharmaceutical companies venturing into antibiotic development is the lack of profitability. While the cost of antibiotic development can soar up to \$1.5 billion, recent statistics reveal that the median U.S. sales for newly approved antibiotics stand at a mere \$16.2 million (Plackett, 2020). This financial disparity has caused many leading

pharmaceutical players to retract from antibiotic development. Consequently, the responsibility now largely rests on the shoulders of biotech firms. Astonishingly, over 95% of antibiotics currently under research are spearheaded by these smaller entities, and, of these, two-thirds are navigating this complex terrain for the first time (Milken Institute, 2022). Being predominantly smaller-scale and often reliant on a single product for revenue, these biotech companies face a prolonged and challenging journey to profitability.

Moreover, the underlying market dynamics for antibiotics present unique challenges, setting them apart from other drug categories. Once an antibiotic is developed and introduced to the market, its prudent use becomes paramount to stave off potential resistance. This controlled use inherently caps the drug's profitability, as it is intended to be administered conservatively rather than at the scale seen for other medications. Such dynamics are a stark departure from other therapeutic areas where drugs, once approved, might see widespread and recurrent use, ensuring a steady revenue stream for pharmaceutical companies. This inherent constraint in the antibiotics market, paired with the rigorous regulatory hurdles and the ever-looming threat of drug resistance diminishing an antibiotic's effective shelf life, serves as a powerful disincentive. It is a showcase of a paradox of success: the more effective an antibiotic is, the less it should be used.

This peculiarity in antibiotic market dynamics couples with two major factors that further complicate the landscape: stringent regulatory protocols and the looming spectre of drug resistance. Regulatory agencies, given the immense global stakes of antibiotic resistance, mandate exhaustive data sets that gauge both a drug's efficacy and its propensity to instigate resistance. These demands can prolong the development process and escalate costs, particularly burdensome for smaller biotech entities (Dadgostar, 2019). Moreover, even after gaining

approval, there is no guarantee of widespread clinical adoption. Many physicians, alert to the perils of resistance, prefer reserving newer antibiotics as last-resort options, thus limiting their initial market reach and associated revenue generation.

Additionally, the regulatory landscape for antibiotic approval is notably rigorous. Given the global implications of antibiotic resistance, regulatory agencies necessitate comprehensive data sets to evaluate both efficacy and potential for resistance development. For companies, especially smaller biotech firms, these requirements translate into prolonged development timelines and inflated costs (Dadgostar, 2019). Furthermore, once approved, adoption into clinical practice is yet another hurdle. Physicians, cognizant of the resistance threat, often reserve newer antibiotics, further curtailing their market penetration and revenue potential.

Lastly, historical precedents serve as cautionary tales. The industry has witnessed scenarios wherein significant R&D investments resulted in antibiotics that were quickly rendered obsolete due to emerging resistance or were outcompeted by cheaper alternatives (Payne et al., 2007). Such instances underscore the volatility of the antibiotic market, reinforcing apprehensions regarding sustainable profitability.

To support the research and development of these new antimicrobials from the early stages of basic science to clinical trials, and in identifying the need for more nuanced financial incentives, the EPFIA are prioritizing push and pull mechanisms. Push incentives like tax credits and grants are designed to propel the early stages of antimicrobial R&D (EPFIA, 2023b). On the other hand, pull incentives aim to reward successful antimicrobial innovations that have demonstrated their market relevance. Much emphasis has gone to push incentives, and while important, these are not sufficient to incentivize R&D (Berdud et al., 2019). Contrastingly, pull incentives often find themselves under scrutiny since they are, as Berdud et al. note, “more complex to design and

cost more” (2019). However, one particularly promising pull mechanism is the Transferable Exclusivity Voucher (TEV). This incentive allows companies to extend market exclusivity for another product as a reward for delivering a new, essential antimicrobial. Furthermore, this voucher can be transferred or sold to other entities, ensuring a more dynamic incentive structure that appeals to diverse industry players. The criteria for such 'pull' mechanisms to be effective have been outlined as: timeliness, feasibility, value for money, predictability, and ensuring patient access. The overarching aim of these initiatives, as emphasized by the EFPIA, is to cultivate a sustainable market that both supports patient access and drives innovation in antimicrobial research.

In conclusion, the pharmaceutical sector, with its unique position in the AMR landscape, has a multifaceted role. By focusing on stewardship, transparent operations, and active collaboration, it can significantly contribute to global efforts to combat AMR.

### **5.3 Biotechnological Firms and Diagnostic Companies**

Biotechnological firms play an increasingly pivotal role in addressing the challenges of antibiotic stewardship. Unlike larger pharmaceutical companies, biotech firms have been instrumental in pioneering novel antimicrobial agents and technologies (Sneeringer, Bowman & Clancy, 2019). These firms often lead in the discovery and development phase, exploring unique molecules and mechanisms to combat resistant pathogens. Moreover, the research-intensive nature of the biotech industry has become crucial in the face of declining antibiotic pipelines in the pharmaceutical sector. Their contributions extend beyond antibiotic development; they are also at the forefront of creating advanced diagnostic tools and biological products such as vaccines (Tell et al., 2019). Many of these programs are designed to optimize antibiotic pharmacokinetics by recognizing patient- and disease-specific factors. The overarching aim is to

ensure that antibiotics are used appropriately, maximizing patient outcomes while minimizing potential harm (Ha, Haste & Glickstein, 2017). Both hospital and outpatient settings have established core elements of antibiotic stewardship. For instance, in hospitals, the pharmacy and therapeutics committees play a vital role in formulating and implementing policies to enhance antibiotic use (CDC, 2019a). On the other hand, outpatient stewardship accentuates adherence to clinical practice guidelines (CDC, 2019b).

Biotechnological firms are also diversifying their strategies, exploring alternatives to traditional antibiotics. For example, investigations into the utilization of probiotics and prebiotics highlight their capability to impede pathogenic bacteria through the enhancement of beneficial bacterial growth and modification of the host environment, respectively (Abbasiliasi, 2017). Moreover, Small Molecules (SMs) have emerged as a novel strategy to fight Antimicrobial Resistance (AMR), with these non-peptide organic entities being adaptable to improve desired attributes like stability and solubility in challenging environmental conditions (Helmy et al., 2023). Additionally, a cost-efficient, cell-based High Throughput Screening (HTS) approach for accelerated antibacterial molecule discovery has been developed recently by a biotechnological entity (Kumar, 2016). Biotech entities are venturing into a wealth of alternative and innovative solutions, including the examination of organic acids, essential oils, bacteriophages, fecal transplants, and nanoparticles, in an effort to sustain the potency of antibiotics.

These firms cannot work alone; however, as swift and accurate identification of infectious agents is paramount to guiding appropriate treatment, ensuring that antimicrobials are used judiciously. Therefore, diagnostic companies also play a pivotal role. Advanced diagnostic tests not only facilitate timely detection of resistant pathogens but also minimize the unnecessary prescription of antibiotics, thus aiding in the preservation of their efficacy. To accurately provide

antibiotic stewardship, understanding barriers to the uptake of these diagnostics is crucial (Trevas, 2021). Furthermore, advancements in point-of-care diagnostics have shown promise in combating AMR by delivering rapid results, reducing the lag time between detection and treatment initiation (Canada, 2020). By fostering collaboration between healthcare professionals and diagnostic developers, we can optimize the adoption of these crucial tools. Investing in diagnostic innovations and integrating them effectively into healthcare systems is vital for a comprehensive approach to AMR mitigation. In essence, diagnostic companies, with their technological innovations, stand as a frontline defense against the escalating challenge of antimicrobial resistance.

The roles of biotech firms and diagnostic companies in antibiotic stewardship is not without its set of challenges, especially when it comes to collaboration. The fragmented nature of the biotech industry, comprising numerous small and niche entities, often complicates uniform collaborative efforts. A report by the WHO in 2020 underscored that 86% of biotech companies involved in antibiotic development are small-scale enterprises (WHO, 2020). While these firms are at the cutting edge of innovation, their size often poses limitations in terms of resources and outreach, which can hinder extensive collaboration. Moreover, the diagnostic landscape is rapidly evolving, and while innovation is commendable, it also necessitates regular calibration of collaborations to ensure alignment with the latest technological advancements. The uptake of advanced diagnostic tools often depends on their compatibility with existing healthcare infrastructure, which varies across regions and institutions (Majumder et al., 2020). Ensuring this compatibility requires close collaboration not just among diagnostic companies, but also with healthcare providers, policymakers, and other stakeholders.

Financial constraints further exacerbate the collaboration challenges. Both biotech and diagnostic firms often operate on limited budgets, especially when compared to larger pharmaceutical companies. This financial limitation can sometimes lead to guarded knowledge-sharing practices, hampering open collaborations (Cama et al., 2021). Furthermore, while the urgency of combating AMR is globally recognized, the regulatory landscape varies significantly across countries. Differences in regulatory standards, patent laws, and clinical trial requirements can pose barriers to international collaboration (AMRIA, 2022).

To foster a truly collaborative environment, there is a need for platforms where biotech and diagnostic firms can share their innovations, challenges, and insights. Initiatives such as the Davos Declaration on combating antimicrobial resistance, signed by over 100 companies in 2016, offer a glimpse into collaborative possibilities (Shionogi, n.d.). Its influence can be found in initiatives such as the Canadian Declaration on Antimicrobial Resistance, wherein the author(s) wrote:

“We are inspired by the Davos Declaration of January 2016, in which the international pharmaceutical, biotechnology and diagnostics industries identified several interrelated challenges and committed to specific actions to address them. These challenges include the need for a supply of innovative new antibiotics, the need for all antibiotics to be used cautiously to conserve their effects, and the need in many countries to improve access to existing antibiotics” (Infection Prevention and Control Canada, 2018).

Such platforms, anchored in shared research, joint funding, and standardized best practices, not only propel the fight for effective antibiotic stewardship forward but also serve as testament to the efficacy of collaboration between biotech firms, diagnostic companies, and

government bodies. This synergy is well exemplified by the 2019 partnership between bioMérieux and BD, selected by the Fleming Fund – a UK Aid Programme – aimed at countering antimicrobial resistance in Low and Middle-Income Countries (LMICs). A cornerstone of the Fleming Fund’s mission is the bolstering of AMR-surveillance mechanisms within LMICs by championing advancements in laboratory and data management tools (UK Department of Health & Social Care, 2023). This partnership’s success in enhancing laboratory capabilities and advancing antibiotic resistance surveillance systems in Low and Middle-Income Countries, despite the challenges posed by the COVID-19 pandemic, serves as a testament to the potential of global collaboration (AMRIA, 2022). The resulting data holds promise for improving patient treatment strategies and shaping informed national policies to combat bacterial resistance, ultimately contributing to a more resilient healthcare landscape.

#### **5.4 Agri-food**

The multi-faceted arena of antibiotic stewardship has many players, stretching far beyond the confines of human medicine. The agri-food sector – encompassing agriculture, livestock and food production – emerges as a pivotal player in this narrative (Wasan et al., 2023). Agriculture and food systems, by virtue of their sheer scale and interconnectedness, have profound influences on ABS dynamics. The utilization of antimicrobial agents within the realm of animal husbandry, encompassing not only therapeutic applications but also growth promotion, engenders a distinctive array of challenges and ramifications concerning ABS. Furthermore, the food supply chain emerges as a conceivable pathway for the transmission of antimicrobial-resistant bacteria into human communities. This section will delve into the challenges presented by vested interests that may impede such repurposing efforts and the significance of strong public institutions and participatory governance mechanisms. It will further explore the role of

multistakeholder and multisectoral platforms in ensuring transparent and inclusive decision-making processes. Criticisms surrounding the involvement of multinational companies and the influence of private sectors on policymaking, as well as challenges posed by regulatory measures conflicting with trade commitments, will also be highlighted. The discussion will underscore the importance of coordination between various ministries and agencies at national and local levels for effective policy repurposing. The section will conclude by stressing the need to safeguard against conflicts of interest in policy development and decision-making.

#### **5.4.1 Multi-level governance intersectionality between the agricultural industry, food security, and global health**

The agri-food sector, a critical component of global economies and economic development (UN, 2018), confronts an intricate dilemma: ensuring animal, environmental, and human health while mitigating the threat of AMR through antibiotic stewardship. ABS strategies in the agri-food sector necessitate a comprehensive approach, amalgamating policy-making, adherence to regulations, and deployment of alternative health maintenance strategies. Notably, this encompasses the prudent use of antimicrobials, restricting their application to instances of therapeutic necessity rather than habitual prophylactic or growth-promotion purposes. Programs aiming to diminish antimicrobial usage in animal farming must leverage scientific insights, technological advancements, and strategic planning to foster practices that safeguard animal health without propelling AMR. Moreover, the global nature of the agri-food industry prompts a call for international cooperation and standardization in antimicrobial usage practices, forging a unified front to tackle the global peril posed by AMR.

The multi-level governance approach in ABS within the agri-food sector demands a multifaceted strategy, intertwining local, national, and global policymaking, regulatory

adherence, and the adoption of alternative health maintenance strategies. At the local level, policies need to address the specific socio-cultural and economic contexts of agricultural practices, tailoring ABS measures to fit diverse farming realities. Nationally, governments must enforce regulations that limit antimicrobial use to therapeutic necessities, moving away from routine prophylactic or growth-promotion applications. This necessitates a strong political will and stakeholder engagement, ensuring that policies are both pragmatic and enforceable. On a global scale, the interconnected nature of the agri-food industry underscores the necessity for international cooperation and standardization in antimicrobial usage. This requires a concerted effort from international organizations, such as the World Health Organization and the Food and Agriculture Organization, to establish and promote global standards. Such efforts should aim to harmonize regulations across borders, facilitating a unified approach to combat the global threat of AMR. Therefore, this entails a collaboration between government bodies, industry stakeholders, and scientific communities to devise, implement, and monitor antimicrobial use, ensuring that stewardship principles are meticulously integrated into the agri-food production chain, from farm to table.

#### **5.4.2 Involvement in Governance: How agribusinesses interact with and influence international policies**

Agribusinesses, as integral entities of the global food supply chain, exert notable influence over international policies related to agriculture, food production, and environmental sustainability. Through a myriad of channels, including lobbying, participation in international forums, and contributing to policy consultations, agribusinesses utilize their financial prowess and soft power to mold the policy landscape at regional, national, and international levels. For instance, as reported by the Intergovernmental Panel on Climate Change (IPCC), policies around

climate change and land use significantly intertwine with practices in the agri-food sector, demanding prudent risk management and thoughtful decision-making that incorporates both sustainability and food security concerns (Hurlbert et al., 2019). However, the varying interests between agribusinesses, international policies and environmental demands for sustainability cause significant challenges in this arena.

Moreover, Environment America highlights that big agribusiness interests are one of the major obstacles to implementing environmental policies in the United States, such as clean water policies (Madsen et al., 2011). The report unmask a decade (2000-2010) of robust financial steering by ten large agribusinesses, directing over \$35 million to congressional candidates and deploying 159 lobbyists, backed by a staggering \$127 million to lobby Congress and federal agencies between 2005 and 2010. That number has only intensified to a record \$165 million on federal lobbying by agribusiness in just the year 2022, with 61% of the lobbyists coming from former government employees (OpenSecrets, 2022). Agribusiness, particularly in the United States, have often pushed back against stricter regulations regarding antibiotic use in animal agriculture through lobbying, creating alliances with political figures, and deploying counter-narratives in public and policy discourse (Maron, Smith & Nachman, 2013). Such prevalence of firm lobbying raises several concerns, as underscored by the literature, encompassing factors such as their potential to introduce bias into systems of interest representation (Aizenberg & Hanegraaf, 2020), to amplify political systems' tendencies to produce inefficient policy outputs disproportionately favouring specialized and concentrated interests (Kim, 2017) and to shape AMR mitigation efforts based on business needs rather than health priorities (Ollinaho, Pedlowski & Kröger, 2023). Lobbying therefore may be correlated with the potential of

economic decline (Adelino & Dinc, 2014) and may fuel popular dissatisfaction with the efficacy of representative democracy (Hanegraaf & Poletti, 2021).

While American political systems represent the ‘classic’ model in terms of the level of development of interest groups and of lobbying activity, American interests are also lobbied abroad, revealing the extent of the transference of lobbying techniques. The American European Community Association (AECA), the Transatlantic Business Council (TBC), and even the U.S. Chamber of Commerce all have strong presences in international lobbying, shaping policy in favour of U.S. businesses globally. For example, in 2015, several lobbying requests were publicly released for the U.S. to lessen restrictions on agricultural trade (U.S. Government Accountability Office, 2015). In heeding their call, the U.S. thereby announced “to resolve unfair trade barriers around the world for the full range of commodities, food, beverages, and agriculture products used for industrial inputs” a goal that inherently collides with the more restrictive and precautionary international stance towards GMOs (United States Trade Representative, 2018). The subsequent adjustments in U.S. agricultural trade policy led the World Trade Organization to aid the barrier removal in regions like the EU, initiating intricate trade negotiations and policy reviews to reassess existing trade impediments. This strategic approach by the U.S., aligning with nations harboring similar trade aspirations, eventually formed a coalition devoted to sustaining open, predictable trade, especially in the agricultural and food sectors (EU Mission to the WTO, 2022). Notwithstanding, this maneuvering sparked controversies and pushback from various stakeholders, especially those in regions with stringent guidelines regarding GMOs. In certain instances, U.S. initiatives to dismantle trade barriers could potentially be perceived as an imposition of its domestic policies on international platforms, thereby raising ethical and governance concerns amongst global policymakers (Kim,

2017). Furthermore, such lobbying activities illuminates the pervasive influence of private sector interests in shaping public policies not just domestically, but on a global scale, prompting a reevaluation of the equilibrium between corporate influence and governmental policymaking in ensuring equitable global trade practices (Hanegraaf & Poletti, 2021).

In exploring policy influences, it is pivotal to recognize the varied levels of governance that might be affected, ranging from the individual to community, and up to the national and international scales. The acceptance of policies geared towards low-consumption governance, for instance, may vary significantly across these different levels (Mbow et al., 2019). It is also imperative to note that lobbying may not always be for self-serving economic interests. Biotech firms in Europe, for example, have actively lobbied within the EU for the formulation and implementation of policies that aggressively address AMR challenges, with the AMR Industry Alliance being a prime example of a collectively industry effort to steer policy in a direction that can positively impact AMR at various levels – from innovation in AMR-related technologies and medications to antibiotic stewardship (AMR Industry Alliance, 2023). Their lobbying efforts are not just focused on policies that directly benefit the industry but also seek to establish frameworks that facilitate sustained, collaborative, and effective global action for increased ABS.

The multi-level governance framework provides a comprehensive lens to understand the varied and complex ways in which agribusinesses engage with and influence governance at multiple levels. From local communities grappling with the direct impacts of agricultural practices to international bodies shaping policies for global trade and sustainability, the role of agribusinesses is multi-dimensional. This diverse involvement highlights the need for a nuanced approach to policymaking, one that recognizes the intersecting layers of governance and the myriad of stakeholders involved. It underscores the importance of transparent and accountable

mechanisms at each level of governance to ensure that the interests of all parties, especially those of vulnerable populations and the environment, are adequately represented and protected.

Agribusinesses, in aligning with such policy strategies, navigate through these multifaceted layers of governance, ensuring that their influencing strategies are nuanced and adaptable to the contextual dynamics inherent at each level (Thorman, Whitmarsh & Demski, 2020). Beyond protecting their interests, agribusinesses also interact significantly with various regional and international organizations, impacting the integration and institution of policies related to migration, trade, and sustainable development. As the United Nations' World Public Sector Report reveals, their influence permeates through these organizational structures, facilitating links between international migration, trade practices, and overarching policies that guide the industry (UN, 2018). Consequently, agribusinesses not only become beneficiaries but also sculptors of policies that emerge from such international organizational interactions.

#### **5.4.3 The case of Biotech firms, Monsanto, and EU GMO regulations**

Monsanto, now a subsidiary of Bayer AG, demonstrates the substantial influence that agribusinesses exert on international policies. The balance between technological progression and ethical practice within the biotech industry remains a source of perpetual tension. The industry, represented by giants such as Monsanto, has historically wielded significant influence over agricultural and biotechnological regulations through vigorous lobbying effort representation (Aizenberg & Hanegraaf, 2020). A potent example of this influence is the "Monsanto Protection Act," which enabled GM companies to circumvent government barriers in the sale, distribution, and planting of GM seeds (Decision of the Supreme Court, 2013).

In July 2018, European Court of Justice (ECJ) decreed that all products developed from new GM techniques, including CRISPR, are GMOs and thus subject to respective regulations

(Court of Justice of the European Union, 2018). Subsequently, the biotech industry launched an intensive lobbying campaign, employing various strategic tactics. For instance, the European Plant Science Organization (EPSO) orchestrated meetings with select national officials to shape political stances within member states, exploring legal avenues to amend the EU GMO ruling and showcasing ‘flagship projects’ of genome-edited crops designed to captivate both European public and decision-makers (CEO, 2021). To embed the deregulation of genome editing in “climate narratives” and to convince policy makers that deregulating new GM is part of the climate solution, a new ‘Taskforce on Sustainable Agriculture and Innovation’ has been financed with over 1.5 million euro from entities such as the Bill and Melinda Gates Foundation. This committee is dominated by entities known to be in favor of lifting the GMO rules for economic gain – such as Monsanto, BASF and their lobby groups, the US government, and various biotech researchers and lawyers. Despite claims of widespread support from “over 129 research institutes,” the validity of this support has been challenged by universities, asserting that their logos were misused, and noting that most signatures were from individual biotech researchers, not research institutes (CEO, 2021).

The contention arises when the ethicality of such practices is brought under scrutiny. While proponents claim these efforts propel agricultural advancements and that biotechnological inventions such as CRISPR could alleviate the global antibiotic crisis without the need of creating new antibiotics (Kaminski et al., 2021), critics point to potential conflicts of interest and possible consequences for environmental and public health (CEO, 2021). Especially in Europe, biotech lobbying seeks to deregulate new GM crops and animals, implementing a strategy that could potentially result in overarching deregulation. In an era where biotechnology offers tantalizing prospects for tackling global agricultural challenges, the machinations of biotech

behemoths like Monsanto within regulatory arenas highlight the pivotal, yet contentious, interplay between scientific innovation and ethical governance, necessitating a rigorous, transparent, and inclusive discourse that judiciously weighs the imperatives of technological progression against the commitment to safeguarding environmental integrity and public health.

This case also exemplifies the multi-level governance dynamic in the realm of biotechnology regulation. Monsanto's strategies, spanning from national lobbying efforts to influencing EU-wide policies, reflect the complex interplay between corporate interests and governance structures at different levels. At the local and national levels, Monsanto's lobbying efforts aim to shape regulatory landscapes to favor biotech advancements. However, at the international level, especially in the European context, these efforts encounter diverse governance frameworks and varying degrees of public and regulatory resistance. This multi-tiered approach to governance, wherein a single entity like Monsanto engages with and navigates through multiple governance systems, underscores the challenges in achieving coherent and uniform regulatory standards in biotechnology across different jurisdictions. It highlights the need for a collaborative and transparent governance framework that aligns technological advancements with ethical, environmental, and public health considerations at all levels – from local communities to global policy arenas.

#### **5.4.4 Global governance mechanisms to safeguard against agribusiness lobbying**

In international agricultural commerce, regional agreements and self-regulatory mechanisms substantially moderate corporate influence to align with broader socio-economic and environmental aspirations. The European Union (EU), for instance, enforces rigorous regulations that navigate through pesticide utilization, genetically modified organisms (GMOs) deployment, and the enforcement of ethical animal welfare standards, thereby ensuring that

agribusinesses adhere to judicious ecological and humane benchmarks. Similarly, trade agreements like the United States-Mexico-Canada Agreement (USMCA), which succeeded the North American Free Trade Agreement (NAFTA), delineate explicit trade conditions and dispute resolution mechanisms that harmonize agricultural trade practices amongst member nations, effectively arbitrating agribusiness operations and mitigating the risk of monopolistic market dominance. Moreover, through initiatives like the African Union's Comprehensive Africa Agriculture Development Programme (CAADP), regional entities engage in a proactive stance towards eradicating hunger and alleviating poverty, thereby leveraging agriculture as a pivotal tool towards socio-economic stability and development by actively advocating for equitable public spending in the agricultural sector and accountable business involvement. On the other hand, the vestiges of corporate self-regulation, through Corporate Social Responsibility (CSR) endeavors and adherence to sustainability certifications like Fair Trade or Organic Certification, beckon agribusinesses towards a pathway that inherently respects ethical, environmental, and social norms. These autonomous regulatory endeavors not only foster sustainable and ethical practices but also shape consumer perceptions and market access, essentially invoking a paradigm where moral and ecological considerations stand at the forefront of corporate strategy and operations. Collectively, these regulatory and self-imposed frameworks weave a comprehensive tapestry that attempts to safeguard multiple stakeholders – from farmers and consumers to the environment – ensuring that the quest for profit does not overshadow the imperative of sustaining a balanced ecological and socio-economic equilibrium.

Despite prevailing mechanisms ostensibly curating a sustainable, equitable agri-food system, multifaceted critiques emerge regarding their potency and inclusivity in policy formulations and implementations. Scholars and activists decry existing loopholes and lax

enforcement of regional agreements and regulations, contending that these gaps permit corporations to circumvent socio-economic and environmental safeguarding guidelines (Johnson, 2016). Concurrently, the overwhelming influence of vast agribusinesses over policy-making processes, skewing decisions and regulations in their favour, has been a notable concern among observers (Smith & Weber, 2016). Additionally, the utilization of Corporate Social Responsibility (CSR) initiatives and sustainability certifications is critiqued for potentially serving as a greenwashing tool (Lyon & Maxwell, 2011), whilst posing barriers to small-scale farmers in developing regions due to their often-prohibitive cost and complexity (Neilson & Pritchard, 2011). Alternatives, consequently, are underscored by various quarters, advocating for more globally cohesive and rigorously enforced regulations, ensuring wider stakeholder involvement in policymaking (Burch & Lawrence, 2009), and a pivot towards more localized, decentralized food systems which prioritize community agency and sustainability (Clapp, 2017). Furthermore, concepts such as Social and Solidarity Economy (SSE) and models encouraging direct trade between producers and consumers are being proposed and experimented with in certain locales as mechanisms to interweave economic activities closely with socio-environmental welfare (Utting, 2015)

### **5.5. Agrifood and food service Industries**

The global drive to ensure effective ABS has illuminated various sectors, but sectors of particular concern, interest and importance – and severely understudied – are the agrifood and food service industries. Notably, the consumption of antibiotics in food production has been cited as a significant contributor to the broader AMR crisis (FAO et al., 2023), reflecting the entwined relationships between food systems, human health, and microbial ecosystems.

Recent reports on food security and nutrition underscore the critical role governance mechanisms and regulatory frameworks play in the trajectory of ABS, especially within the good sector. The call for strong public institutions and conflict-free participatory governance mechanisms emphasizes the necessity for transparent decision-making processes. This paradigm shift is further evident in the establishment of multistakeholder platforms aiming to align actions around common results with sectors and stakeholders at the subnational level (FAO et al., 2023).

The integration of multinational companies in these initiatives has been controversial, sparking debates over the influence of the private sector in policy-making and its potential to redefine legal parameters to accommodate multistakeholder models (FAO et al., 2023). Notably, major restaurant chains, like McDonald's, have publicly set targets to reduce antibiotic usage in their supply chains. This drew applause for moving the needle – and later criticism for its inconsistencies, and failing to publish any of their new guidelines on AMR (Portillo, 2020). The literature shows a myriad of responses from different stakeholders, including pharmaceutical companies, diagnostic stakeholders, and other food service corporations like Dominoes Pizza Inc. There is an underlying tension between the need for policy inertia and the “regulatory chill” that sometimes hinders governments from repurposing food and agricultural policies (FAO et al., 2023). Similar to agribusinesses, and pharmaceutical industries, the agrifood and food services are also often complicit in manipulating governance mechanisms for profit. However, there are others that have taken initiatives to implement ABS in their food supply networks. This section will therefore explore the various actors in the agrifood and food service industries.

### **5.5.2 Antimicrobial Use in Livestock**

The alarming rise of antimicrobial resistance, while oft attributed to human use, is also intricately tied to the use of antimicrobials in agriculture, predominantly livestock (Woolhouse et

al., 2015). This is largely attributed to the massive scale of their usage, aimed at boosting growth and curbing disease in densely populated conditions (Magouras et al., 2017). Livestock's role in modern food systems is paramount, bolstering food security, economic stability, and livelihoods. Beyond serving as a rich protein source, livestock offers vital services, from manure for crops to draft power (Woolhouse et al., 2015). However, the global surge in meat demand amplifies pressures on these systems, leading to intensified practices. Consequently, there is a heightened reliance on antibiotics for both growth enhancement and disease prevention. A recent study by Mulchandani et al. (2023) sheds light on the magnitude of this issue: in 2020, the global use of antimicrobials in food animals was an astounding 99,502 tonnes and is projected, if trends persist, to increase by 8.0% to 107,472 tonnes by 2030. The concentration of this use is particularly high in Asia, accounting for 67% of the total, whereas Africa contributes to less than 1%. Despite earlier optimistic projections based on 2017 data, this revised estimate suggests a more alarming increase in antimicrobial usage by 2030. This upward trend, particularly noticeable in Asia/Oceania and the Americas, underscores the urgency of the situation.

More concerning is the glaring lack of transparency in reporting antimicrobial use (AMU). Most countries, including six out of the world's ten largest meat producers (Brazil, Russia, India, Argentina, Mexico, Vietnam), do not disclose their AMU statistics to the public. Brazil, despite its global dominance in poultry and cattle exports, remains reticent on its AMU figures, even though it has pledged to enhance antibiotic stewardship as part of its National Action Plan (NAP) (Ministério da Saúde, 2018; Mulchandani et al., 2023). The commitments to increasing antibiotic stewardship efforts with the UN, WHO and FAO have not translated to tangible and measurable progress.

While the Asian nations and Americas have not been advancing antibiotic stewardship efforts effectively, European countries have been actively integrating and developing policies across the water-food-health nexus. One example is the Farm to Fork strategy setting out the objective to reduce by 50% the overall EU sales of antimicrobials for farmed animals and in aquaculture by 2030 (European Commission, 2023). Such integration is imperative to ensure that mitigation strategies are holistic and do not overlook potential transmission routes. Notably, the current EU food system has been criticized for its predominant focus on only one dimension of sustainability, the economic dimension, and therefore it is imperative to implement a paradigm shift away from this “productivist view” (Bock, Bontoux & Rudkin, 2022). Yet, the effectiveness of these policies remains under debate, with challenges emerging in both their design and implementation (Weldon & Hoffman, 2021).

This rampant and often unaccounted use of antibiotics is a ticking time bomb, accelerating the AMR crisis. The associated hazards are multifold, as resistant bacteria find avenues to humans through the ingestion of contaminated food, direct contact with animals, and environmental conduits (Hosain, Kabir & Kamal, 2021; Magouras et al., 2017).

#### ***5.5.2.1 Stakeholder responses in pork and poultry industries***

The poultry and pork sectors dominate the global meat production landscape and consequently play a pivotal role in antibiotic usage in agriculture (Lekagul et al., 2021). These industries, in many high-output nations, are characterized by intensive farming, where animals are closely packed. Such conditions foster rapid disease spread, prompting increased antibiotic administration, both as preventive and curative measures. The substantial economic weight of these sectors underscores the motivation to sustain high yields and minimize losses, which often results in the use and sometimes overuse of antibiotics (Huth et al., 2022). Consequently,

examining how industry frontrunners react to the increasing calls for refined antibiotic stewardship is paramount in understanding efforts to counteract AMR.

The International Poultry Council (IPC), for instance, has expressed its commitment to responsible antimicrobial use and stewardship in its 2017 position statement (IPC, 2017). However, translating such commitments into tangible on-ground actions remains a challenge (IPC, 2017). Implementation issues arise due to diverse farming methodologies, regional educational disparities, and disparate policies in different countries. The World Farmers' Organization (WFO) is aware of the inadequacy of top-down policies, emphasizing grassroots interventions. Their global influence is amplified by their active participation in international conventions on AMR. Collaborations with the FAO have led to the crafting of farmer-focused guidelines and educational initiatives. For example, Perdue Farms declared in 2016 that 95% of its chickens were raised without any antibiotics (Perdue Farms, 2016). Additionally, there have been significant educational endeavors targeting poultry farmers, emphasizing biosecurity measures to reduce the need for antibiotics.

Within the poultry sector, the absence of clear directives on antibiotic stewardship from leading organizations is evident. For instance, the World Poultry Science Association (WPSA), a significant player in poultry science and education, has yet to release specific guidelines or statements on AMR. Similarly, the Poultry Science Association (PSA), another influential body in the realm of poultry research, remains silent on this pressing matter. This lack of explicit guidance from such pivotal organizations is concerning, given the industry's potential impact on the spread of AMR. While individual poultry producers and regional entities might be taking steps to address antibiotic usage, such as Perdue Farms' "no-antibiotics-ever" initiative seeking to raise no chickens with antibiotics (Corporate Perdue Farms, 2021), the absence of a united

stance from these associations might impede cohesive and widespread adoption of antibiotic stewardship practices across the global industry. The need for these major associations to take a clear stance becomes even more critical as the global community grapples with the challenges posed by AMR.

The pork production sphere, represented in the U.S. most notably by the National Pork Producers Council (NPPC), state in 2018 that their mission is aligned with the WHO's to reduce AMU in animal agriculture. Overseeing the third largest producers of pork in the world, the NPPC's role in reducing global AMU is critical. However, the NPCC has also released press releases explaining that, despite the WHO's call to ban on-farm use of antibiotics, that this would have no effect on human public health, would jeopardize animal health, and instead is "antithetical to pork farmers' and veterinarians' moral obligations" (NPPC, 2018). In comparison to other national pork industries, the U.S. pork producers use seven times the levels of antibiotics per kilogram of animal used in Denmark, the Netherlands, and double the UK (Wallinga, 2018). Despite their stated compliance with FAO, WOAHA, the CDC and WHO's guidelines, the pork production sphere (responsible for 37% of all U.S. livestock sales of medically important antibiotics) is largely unmoved in reducing AMU in their industry. Antibiotic stewardship is severely lacking as well, with the U.S. Food and Drug Administration and U.S. Department of Agriculture both failing to collect "any detailed information" on antibiotic use in animal agriculture (Wallinga, 2018).

These views by the NPPC are shared by stakeholders in the pork industry all around the world; namely, pig farmers. In Brazil for example, 69% of the interviewed farmers stated that restrictions on antimicrobial use and in implementing antibiotic stewardship would have "disastrous impacts on the pig production chain" (Albernaz-Gonçalves, Olmos Antillón, &

Hötzel, 2022). Another study on Brazilian pig farmers showcased that most farmers are “satisfied with the animal welfare standards” and do not believe that AMU is a legitimate issue (Silva, 2021). Concurrently, a study on Australian farmers revealed that only 19% of participants are concerned with the use of antibiotics on their livestock, with the vast majority not believing it to be an issue of note (Huth et al., 2022). Similarly, an interview study in Thailand had 100% of farmers state the necessity of antibiotic use in their pigs – despite the majority of interviewees not understanding the word “antibiotic” nor the differentiation between antibiotics and other medications (Lekagul et al., 2021). These results are consistent in many other studies in Italy, Vietnam, China, Germany, Tanzania, and the United States (Pham-Duc et al., 2019; Dyar et al., 2018; Busch et al., 2020; Kimera et al., 2020). This scoping review of the attitudes of swine stakeholders showcases a consistent theme: the worldwide lack of education on antimicrobial use, and the lack of pressures, whether economic, political, or scientific, for a reformation of their practices. Notable exceptions include Canada and Sweden (Majowicz et al., 2018; Björkman et al., 2019) although knowledge gaps persist.

Additionally, there’s a prevalent view among respondents, mirroring Chandler & Willis’ (2019) observations, that perceives antibiotics as almost “miraculous” remedies for multifaceted challenges (Willis & Chandler, 2019). In their fieldwork, these researchers portrayed antibiotics as a universal remedy, be it for fragmented healthcare systems or productivity optimization across the human-animal-crop nexus. Ultimately their findings suggest that the current antibiotic practices in the pork sector intertwine individual and community economics, political intent, and societal values. Any effective policy addressing antibiotic stewardship requires not just an understanding of AMR dynamics but also actionable input from all significant stakeholders.

An evident gap in the approach to mitigating AMR in the food chain is the oversight of non-traditional stakeholders. While public health initiatives often focus on immediate actors such as veterinarians and farmers, there exists a wider range of influencers in the realms of food and health, including experts in nutrition, food security, international market economics, health communication, and program evaluation. Additionally, professionals from diverse sectors such as law, politics, demography, education, and social innovation offer invaluable insights in enhancing ABS. Expanding engagement to include these broader stakeholders can enrich the strategies deployed for enhanced antibiotic stewardship, providing a multi-dimensional approach to this global challenge (Majowicz et al., 2018).

Policy frameworks, although essential, are merely the beginning. Real transformation arises from a multi-faceted framework of solutions, each tailored to unique contexts and challenges (Goff et al., 2017). A priority in this journey should be to delve deeper into understanding the behaviors and motivations behind antimicrobial use among key players like veterinarians and farmers (Coyne, Hallström, & Söderbäck, 2016). This comprehension can inform nuanced interventions, ensuring sustainable and conscientious antibiotic usage within the livestock sector. Collaboration will be the linchpin of this transformation: engaging entities across the entire food value chain, from production to consumption. Notably, the private sector, encompassing restaurants and food service providers, wields considerable influence. Their role in shaping consumer demand for ethically sourced meat can be a catalyst, potentially diminishing the dependency on antibiotics in livestock rearing.

#### ***5.5.2.2.2 The Case of Poultry and pork industries in the UK***

The UK's approach to antibiotic stewardship in the livestock sector reveals divergent trajectories between the chicken and pork sectors. The British Poultry Council's initiatives

significantly propelled the chicken sector, reaching an antibiotic usage average of 12.4 mg/kg by the end of 2018 (Hughes, Roe & Hocknell, 2021). Notably, this was achieved despite a slight uptick to 17.4 mg/kg in 2019, which was still comfortably within the RUMA Targets Taskforce 2020 goal of 25 mg/kg. A crucial factor contributing to this success has been the concentration of capital in the poultry industry, particularly the coordination role played by dominant poultry-processing corporations such as 2Sisters, Moy Park, and Avara Foods. These entities have streamlined antibiotic usage data collection and management, thanks to their consolidated supply chains, enabling retailers to achieve improved transparency and more direct influence.

However, the pork sector has exhibited a different pattern. Although recent advancements have emerged through corporate coordination of antibiotic usage standards, the sector has been lagging compared to poultry. A significant turning point for the pork industry came with the 2017 introduction of the electronic medicine book for pigs (eMB-Pigs), a joint effort between the AHDB and the VMD (Hughes, Roe & Hocknell, 2021). The system required quarterly data input from farmers and vets, facilitating the aggregation of antibiotic usage data. Yet, challenges persist. Given the endemic diseases present in pigs, a higher average antibiotic usage is anticipated. The sector aimed to diminish the average antibiotic usage to 100 mg/kg by the end of 2020, marking over a 60% decrease since 2015. By 2019, usage was recorded at 110 mg/kg, indicating meaningful progress towards the RUMA target (Hughes, Roe & Hocknell, 2021).

The distinct coordination of antibiotic usage data in the chicken and pork supply chains underscores the variations in corporate structures, antibiotic prescription routines, and data recording practices across the two sectors. Despite the initial lack of concrete scientific benchmarks for species-specific targets, the industry has nonetheless been engaged through the

setting of achievable goals, suggesting that this strategy might be the bedrock for continued progress in antibiotic stewardship in the UK and possibly elsewhere.

The case of the UK's poultry and pork industries also presents an insightful example of multi-level governance in action within the realm of antibiotic stewardship. At the national level, initiatives such as the eMB-Pigs and the actions of the British Poultry Council illustrate how industry-led efforts can align with governmental objectives to achieve significant reductions in antibiotic usage. This showcases a collaborative governance model where private and public sectors work in tandem. Locally, the implementation of these initiatives reflects the diverse operational realities of poultry and pork farms, requiring adaptable strategies that consider local practices and challenges. Internationally, the UK's approach contributes to broader global efforts in combating AMR, setting examples for other countries and potentially influencing international guidelines and standards. This multi-level interaction highlights the importance of considering various governance structures and their interplay when developing and implementing ABS strategies. It also underscores the need for flexible, context-specific approaches that can effectively address the unique challenges and opportunities present in different sectors and regions.

#### ***5.5.2.2 The Case of Antibiotic Stewardship in Brazil***

Brazil's position as a global leader in animal food production, notably in poultry and beef, has significant implications for antibiotic stewardship at the multi-level governance level (global, national and local). As the world's largest chicken exporter and the second-largest chicken producer, Brazil has a poultry stock of 1.5 billion birds (Government of Brazil, 2022). Representatives of Brazil's agricultural industry have stated that "Brazil is one of the most sustainable poultry producers in the world" (Ruiz, 2022). However, there are concerns about the

authenticity of such statements, both considering that Brazil has several institutional issues with antimicrobial policy, and reflecting on Ruiz's affiliation with WATT Global Media, an entity deeply connected to the agribusiness sector.

In the realm of beef production, Brazil is unparalleled. It is not only the world's largest beef exporter, supplying about 20% of global beef exports, but also maintains the second-largest cattle herd, comprising 232 million heads. Notably, Brazil is a major producer of halal meat, further dominating the middle eastern and Muslim markets. This supremacy in beef markets is expected to grow, with projections indicating an increase to 2.9 million metric tons in beef exports by 2028, accounting for 23% of the world's total (USDA, 2019). Moreover, Brazil is also a massive producer of pork, with a significant portion of Brazil's pork exports - around 44%, going to China - a country also known for its AMR measures (or lack thereof) (Shohet, 2023).

The management of antimicrobial agents in Brazilian animal husbandry is a critical factor influencing AMR trends. Rabello et al. (2020) highlight the importance of this management, pointing out that despite extensive research, most studies are limited in scope and regional representativity, thereby affecting the transparency and effectiveness of AMR-related strategies. However, Brazil's struggle with antibiotic stewardship extends beyond agriculture into the healthcare sector. The country, with its diverse geographic and economic landscape, faces significant therapeutic challenges due to AMR. For instance, rates of methicillin-resistant *Staphylococcus aureus* reach up to 60%, significantly higher than in Europe and America, and are associated with an endemic Brazilian clone (Rossi, 2011).

Despite these challenges, the Brazilian government's response to AMR has been marked by governance issues and a lack of prioritization. Corrêa et al. (2023) emphasize the failures in the agenda-setting process for AMR, and in multi-level governance theory fashion they note a

significant lack of political will and awareness of AMR's clinical, social, and economic impacts. This is particularly concerning given the severity of AMR in Brazil, with 33,200 deaths attributable to AMR and 137,900 deaths associated with AMR in 2019 alone. While Brazil has developed various policies for AMR prevention and control, a comprehensive understanding and evaluation of these policies remain lacking (Nunes et al., 2022). These policies have no real timeline and extremely vague language, indicating no real action on combatting AMR or implementing vigorous and effective ABS mechanisms. Therefore, Brazil's prominent role in global animal food production necessitates a more concerted and transparent effort in managing AMR. The country's current approach, characterized by limited research scope, governance challenges, and a lack of political prioritization, poses a significant risk to both local and global health landscapes.

### **5.5.3 Transnational Corporations, Restaurants, and the Fast-Food Industry**

The confluence of antimicrobial resistance and the agri-food industry becomes particularly conspicuous when observing the practices of restaurants, especially the transnational corporate behemoths of the fast-food sector. The restaurant and food service industries hold vital positions in the contemporary global ecosystem, not only for their economic significance but also for their direct and consequential impact on public health. A key concern garnering increased attention in recent years is the use of antibiotics in the food supply chain, particularly in livestock (Source, date).

#### ***5.5.3.1 Transnational Corporations (TNCs)***

Transnational Corporations (TNCs) have emerged as dominant actors in the global market economy, with their economic capabilities often surpassing those of many national governments. This economic prowess extends to a multi-dimensional influence on population

health. Firstly, their production methods, both in terms of product nature and manufacturing techniques, wield direct and indirect implications for health outcomes in communities. Secondly, their vast operations play a decisive role in shaping social determinants of health. TNCs influence employment structures, regional economic dynamics, and even socio-cultural norms, all of which collectively determine access to healthcare, educational quality, and other pivotal health determinants. Moreover, the regulatory landscape is not immune to the reach of TNCs. Their substantial lobbying efforts and global economic outreach provide them avenues to influence the regulatory structures that oversee their activities. Such influence holds potential ramifications, shaping the environment in which global populations reside and operate. The equity dimension of health is crucial in this discourse. TNCs stand at a crossroads where their practices and products could either perpetuate health inequities—by disproportionately affecting disadvantaged groups or catering largely to more privileged sections—or contribute to their alleviation. An exemplar of this intricate relationship can be seen in McDonald's Australia. Despite being a globally-operating entity, the localized effects of its policies and practices in regions like Australia highlight the importance of region-centric health impact assessments. Yet, there exists a concerning research gap; community exposures to TNC policies and practices remain underexplored. The corporate health impact assessment (CHIA) framework provides a potential tool for such endeavors. In sum, the centrality of TNCs in the global economy, combined with their significant socio-political influence, makes them indispensable subjects in the discourse on global health dynamics.

#### ***5.5.3.2 The Case of McDonald's and Domino's Pizza Inc. ABS Commitments***

Leading players in the restaurant industry, particularly fast-food giants like McDonald's and Domino's Pizza., wield significant influence in this context. With vast supply chains

spanning multiple continents, their procurement policies and practices can set standards for a considerable segment of global agricultural production. Consequently, the decisions made by McDonald's and similar industry giants can play large roles in mitigating – or exacerbating – the antimicrobial resistance crisis.

Recognizing the immense responsibility on their shoulders, many such corporations have publicly committed to responsible antibiotic use. McDonald's, for example, has been vocal about its “Global Vision for Antimicrobial Stewardship in Food Animals,” a comprehensive framework that pledges a reduction in the use of medically important antibiotics (Corporate McDonalds, 2018). Their goal, as stated, is to prioritize the therapeutic use of antibiotics, reducing reliance on these vital drugs for preventative measures which can inadvertently lead to resistance. However, as with many large-scale corporate commitments, the gap between ambition and realization can sometimes be vast. Or, as the Natural Resources Defense Council (NRDC) put it: “McDonald's updated antibiotics policy is an optical illusion” (Brook, 2022). After facing criticism and stakeholder pressure to show any AMR initiative after their initial antibiotic policy was announced in 2018, McDonald's introduced a new antibiotic policy in 2022 that removed realistic timelines, time-bound completion dates, and mechanisms of transparency (Corporate McDonalds, 2022). This new policy is also under scrutiny by its stakeholders, citing their inability to plan for, and fulfill commitments, thereby leading to global governance risks (U.S. Securities and Exchange Commission, 2023).

Comparatively, Domino's Pizza Inc., after receiving several shareholder resolutions to increase its stewardship of antibiotics (Green Century Funds, 2019; FAIRR, 2019), asking them to “join other restaurant chains to provide signals and time frames... [to] be willing buyers of antibiotics-free meat,” took public action through the form of a company letter to their

stakeholders (United States Securities and Exchange Commission, 2019). This letter argues that Domino's Pizza Inc. is simply a "company that primarily sells pizzas" and therefore are not required to set out antibiotic guidelines for its meat and dairy producers; that the "stakeholder proposal language is flawed;" and therefore "the proposal is excludable from the 2018 proxy statement" with a no-action response.

Large corporations such as these two have the de facto role and soft power to set standards for agricultural practices through their extensive global supply chains. This influence operates within a multi-level governance framework where corporate decisions have ramifications at various levels, from local farms to international regulatory bodies. At the local level, the procurement policies of McDonald's and Domino's directly impact farming practices, potentially driving changes in antibiotic use. Nationally, these corporations influence policymaking, both through direct lobbying and by creating market pressures that necessitate regulatory adjustments. Internationally, their global reach and market dominance mean that their policies can contribute to shaping global norms and standards for antibiotic stewardship in the food industry. However, the alignment of corporate interests with public health goals is not always straightforward. While these corporations have the capacity to significantly advance ABS efforts, their commitments often reflect a balance between business objectives, stakeholder expectations, and the broader public interest. This delicate balancing act highlights the complex interplay of interests at multiple governance levels, underscoring the need for robust, transparent, and cooperative governance structures that can effectively harness the influence of such corporations for the greater public good, particularly in the global fight against antimicrobial resistance. Or – possibly directing, or limiting, their influence altogether.

## **Chapter 6: Results and Discussion**

This thesis has illustrated the intrinsically multi-layered nature of the global governance of antibiotic stewardship involving a multi-pronged sphere of local, national, and global interests spanning from human, animal, and environmental health sectors. These interests, ranging from economic to political to scientific, profoundly influence the development of policies and programs designed to curtail the spread of resistance mechanisms and adequately surveil antibiotic stewardship programs. Central to this discussion is the exploration of how these varied interests within the multi-level governance theory framework align or conflict within the ambit of global health governance and how such alignments or conflicts shape the effectiveness of antibiotic stewardship policies.

This chapter critically evaluates the adaptability and mobilization potential of international governance mechanisms, as conceptualized in multi-level governance theory. It delves into the dynamic interplay between centralized coordination and decentralized execution, a pattern that is evident in the evolution of global governance mechanisms. Furthermore, the chapter addresses the challenges faced in implementing these mechanisms at various levels, particularly focusing on the issues of coordination among international entities, integrity in data management and reporting, and the delicate balance between ensuring global access to antimicrobials and preventing their misuse.

Additionally, the chapter discusses the role and efficacy of public-private partnerships (PPPs) in ABS governance, underscoring the necessity of aligning divergent interests of public health objectives and private sector business goals. It also reflects on the challenges of achieving global consensus amidst the disparities in political, economic, and cultural contexts intrinsic to different countries.

## 6.1 Fragmentation of global governance

The evolving landscape of global governance, marking a significant shift from a Western-dominated order to a multipolar system, mirrors the complexities in antibiotic stewardship governance. This transformation is a clear manifestation of what the International Monetary Fund identifies as “gloeonomic fragmentation” (Aiyar et al., 2023). This globalized fragmentation, fueled by increased trade tensions and a rise in political populism, has reshaped the landscape of policymaking and implementation. It highlights an increasing complexity and the layering of new initiatives over existing structures, reflecting the diversity and disparity in approaches across nations, as observed by Stephen (2017). Particularly in Low and Middle-Income Countries, this fragmentation intersects with pressing concerns such as economic development, food security, healthcare, and ABS governance, presenting unique challenges and opportunities.

The disparities in ABS governance are striking, especially when comparing the regulatory approaches of European Economic Area nations and many LMICs. EEA countries have established structured action plans for ABS, showcasing a more coherent and unified approach. In contrast, LMICs often face a regulatory deficit, exemplified by over 50% of antibiotics being dispensed without prescription. This stark variance underscores the intricate institutional factors that inadvertently counteract global efforts towards unified ABS governance. It brings to the forefront the observations made by United Nations Secretary-General António Guterres, who noted the detrimental impact of insufficient coordination and accountability across the global system, leading to fragmented approaches that undermine tangible outcomes in people’s lives (United Nations 2017).

This fragmentation in ABS governance is further compounded by the varied commitments of countries to global initiatives like the World Health Organization's Global Action Plan. There is a noticeable divergence in how countries adapt these recommendations within their national regulatory frameworks. This adaptation process reflects either the capacity constraints of these nations or their autonomous vision in shaping National Action Plans (NAPs). Consequently, a spectrum of international engagement emerges, ranging from 'Isolationists' with minimal international outreach to 'Europeanists' who prefer 'soft' governance mechanisms under EU institutions. This diverse patchwork of governance approaches indicates that the roles of WHO, the EU, and other organizations are highly differentiated and not universally accepted, predominantly driven by High-Income Countries.

In the realm of coordination among international entities such as the quadripartite collaboration of the UNEP, WHO, FAO, and WOA, the challenges are significant. Aligning strategies and action plans in a landscape marked by divergent priorities, disparate resource allocations, and varied regulatory policies across nations and organizations is a formidable task. Furthermore, the complexities in data management and reporting across sectors, including human health, animal health, and agriculture, lead to inconsistent and often opaque data. This inconsistency significantly hinders the accurate assessment of ABS trends and the effectiveness of global policy development. It impairs the ability to formulate comprehensive global strategies and limits the understanding of ABS's cross-sectoral impact. The difficulty of navigating this fragmented governance landscape is exemplified by the decision of the tripartite to expand into a 'quadripartite,' including the United Nations Environment Programme (UNEP) in 2021. This expansion aims to further accelerate the policymaking process and engage relevant sectors in One Health coordination (de la Rocque et al., 2022). It reflects an understanding that a multi-

level governance, internationally cooperative approach is necessary to effectively navigate the intricate terrains of global collective action. This approach must seek to establish consensus amid the political, economic, and cultural disparities intrinsic to various countries.

In the navigation of this fragmented landscape, a multi-level governance, internationally cooperative approach is necessary (Aiyar et al., 2023), one that transcends policy alignment and delves into the integration of practices and knowledge-sharing. This approach must navigate the intricate terrains of global collective action, seeking to establish consensus amid the political, economic, and cultural differences. The formulation and implementation of collective actions within this global governance framework are constrained by the heterogeneous national policies, divergent economic statuses, and variances in health infrastructure. Therefore, a nuanced understanding of each country's unique context and challenges is essential to develop effective, localized strategies that complement global efforts.

As a significant player in global animal food production and an emerging power, the example of Brazil's approach to ABS and AMR management reflects the challenges associated with aligning national priorities with international norms. The country's substantial role in poultry and beef production, coupled with internal governance issues and industry influences, leads to a divergence from established international guidelines. This divergence is emblematic of the fragmentation seen in global health governance, where emerging powers, like Brazil, often layer new initiatives over existing structures, contributing to a complex multitude of contradictory policies and practices. It further extends beyond agriculture into the healthcare sector. Despite the severe impact of AMR, the Brazilian government's response has been marked by governance issues, lack of prioritization, and vague policy language, reflecting a misalignment with global health objectives. The situation in Brazil, wherein, for example, 43%

of poultry exports goes to China, a country having limited AMR regulations, highlights a key aspect of fragmentation in global governance: the creation or strengthening of alternative venues by emerging powers, which allows them to circumvent the vested interests and veto players of existing institutions, albeit at the cost of diminishing the utility of established institutions and contributing to overall fragmentation.

Therefore, addressing the fragmentation in the global governance of ABS necessitates a recalibration toward enhanced communication channels and more equitably distributed participation, especially for LMICs. This recalibration should aim to establish comprehensive, data-driven models for resource allocation, leverage international cooperation through mechanisms like treaties and legal avenues, and ensure access to and affordability of essential antibiotics. Emphasizing capacity building and technical support for LMICs is vital to bolster their ability to effectively participate in global governance structures. Such a multi-level governance perspective is not only essential for consensus-building but also for addressing the complexities of formulating and implementing collective actions within the global governance framework. By fostering a more inclusive and equitable global health governance model, the international community can better address the multifaceted challenges posed by ABS and work towards a more coherent and unified global response.

## **6.2 Polycentric governance as a response to fragmentation**

Addressing the challenge of fragmentation in global ABS governance necessitates an innovative and adaptive governance model. A polycentric governance approach, as explored in this paper, offers a promising solution. This approach, characterized by multiple governing authorities operating at different scales, advocates for more localized and context-specific

strategies. It stands in contrast to a monolithic, top-down model, often hindered by the diverse and complex nature of global health issues.

Polycentric governance, in essence, allows for the leveraging of local knowledge and expertise. It acknowledges the varied cultural, political, and economic landscapes across different regions, enabling strategies that are more tailored to specific local needs and conditions (Stephen, 2017). Such an approach is particularly pertinent in the context of ABS and AMR, where local practices in healthcare and agriculture significantly impact the effectiveness of stewardship programs. Furthermore, the polycentric model facilitates mutual monitoring and peer learning. This aspect is crucial for enhancing transparency and accountability among stakeholders. By fostering a culture of shared learning and collective responsibility, countries and regions can benefit from each other's experiences and innovations. This, in turn, can lead to more adaptive and responsive strategies in combating AMR, aligning with the WHO's objectives while respecting the autonomy and specificities of individual nations.

However, as indicated in the earlier sections of this thesis, the implementation of polycentric governance is not without challenges. Key among these are the issues of inconsistent implementation, resource constraints, and lack of coordinated efforts. The current state of global health governance, as evidenced in various case studies including the Brazilian scenario, highlights the gaps in aligning national priorities with international norms, thereby underscoring the need for a more cohesive and yet flexible approach.

To enhance the effectiveness of the polycentric model in addressing ABS, several strategies could be considered. These include strengthened global leadership within the WHO framework, enhanced support for resource-constrained countries, incentive-based approaches to encourage compliance, and the integration of ABS and AMR strategies into broader health

system agendas, as recently suggested by WHO in its novel people-centred approach to AMR (WHO, 2023). Moreover, establishing standardized reporting protocols and advocating for robust legal frameworks at national and international levels could further strengthen this approach.

### **6.3 Vested interests and power dynamics are barriers to effective ABS implementation**

The research has revealed that the landscape of ABS is replete with a diverse array of stakeholders, each wielding varying degrees of influence and driven by distinct, often conflicting, interests. These range from global pharmaceutical giants and agri-food industries to political entities and regulatory bodies, all of which play pivotal roles in shaping ABS policies. The power exerted by these entities manifests in various forms, from economic pressures and lobbying efforts to regulatory challenges and political maneuvering. This interplay of power and vested interests poses significant challenges to the formulation and implementation of effective ABS policies. Policies that are scientifically sound and public health-oriented often encounter resistance or are reshaped by these forces, leading to compromises that can diminish their efficacy. The next section will dissect these dynamics, illuminating the various facets of power and interests that impede ABS policy effectiveness.

#### **6.3.1 Interests and power dynamics in the pharmaceutical industry**

Through its substantial economic power, extensive political network, transnational jurisdiction and strategic lobbying efforts, the pharmaceutical sector exerts enormous influence on the policy creation and implementation of antibiotic stewardship. This complex interplay of commercial interests and public health objectives often leads to significant conflicts, moulding ABS policies in ways that may conflict with the key goal of effective use and stewardship.

Pharmaceutical giants, such as Pfizer and Merck, have historically engaged in strategic lobbying to shape legislative and regulatory environments in their favor. For instance, in the

United States, these companies have been known to lobby against legislative measures like the Preservation of Antibiotics for Medical Treatment Act, which sought to limit the use of medically important antibiotics in livestock (Rizvi, 2021). A study by Wouters (2020) revealed that the U.S. pharmaceutical lobbying expenditures reaches an average of \$233 million a year from 1998-2018, influencing both legislative and election outcomes. This extensive lobbying activity demonstrates a clear prioritization of commercial interests, potentially compromising public health goals by perpetuating the misuse of antibiotics and accelerating the development of antibiotic resistance (Rizvi, 2021).

Further complicating the landscape is the issue of research funding. Pharmaceutical companies are major funders of medical research, including studies on antibiotics. However, this financial involvement often leads to biases in research priorities and outcomes. There is a tendency to fund research that aligns with the company's interests or promises profitable outcomes (Annet, 2021). For Annet, "high drug prices [in the U.S.] distort research priorities, emphasising financial gains and not health gains] (2021). An illustrative example is the relative underfunding of research into antibiotics for multidrug-resistant tuberculosis, a public health need that is not necessarily seen as profitable. Such funding biases can divert scientific efforts away from critical areas in ABS, impacting the development of antibiotics that are crucial for tackling emerging resistant strains.

The quest for profitability in the pharmaceutical sector often overshadows the needs of public health, especially in antibiotic development. The pharmaceutical industry's role extends beyond mere influence over prescribing habits to the heart of antibiotic development. The decline in the discovery and development of new antibiotics, due to economic disincentives and regulatory complexities, as well as the fact that antibiotics were developed in the public domain

in the past vs. the dominance of private companies now, highlights an alarming conundrum. To support the development of new antimicrobials, mechanisms like push and pull incentives are being prioritized, but these too come with their own set of complexities and challenges. The cost of developing a new antibiotic can soar to \$1.5 billion, yet the median U.S. sales for newly approved antibiotics are remarkably low, leading many pharmaceutical giants to withdraw from antibiotic development citing low returns on investment and leaving the task predominantly to smaller biotech firms. These biotech firms – as represented in the Monsanto GMO example – may also operate in terms of their own commercial interests instead of the interests of public health. Therefore, public research efforts must be prioritised over subsidizing private businesses.

In sum, the pharmaceutical industry's influence on ABS policy is a critical concern. The imbalanced act between maximizing profits and ensuring the effective stewardship of antibiotics is fraught with conflicts. Addressing these issues calls for a critical reassessment of the role of pharmaceutical companies in ABS policymaking, ensuring that public health objectives are not overshadowed by commercial interests. It is imperative to realign the economic models of antibiotic development and marketing to better serve the public health goal of preserving antibiotic efficacy for future generations.

### **6.3.2 Political and regulatory challenges**

The efficacy of Antibiotic Stewardship (ABS) policies is inextricably linked to the political and regulatory landscape within which they are formulated and implemented. Political influences, ranging from domestic government agendas to international diplomatic relations, significantly shape the contours of ABS policymaking. This section explores these multifarious challenges, highlighting their impact on the harmonization and effectiveness of ABS initiatives.

At the national level, political agendas play a pivotal role in shaping ABS policies. Governments' approaches to health policy are often influenced by a myriad of factors, including public health priorities, economic considerations, and political ideologies. As the FAO highlighted in their 2022 report, there are various disparities in global governance mechanisms, wherein priorities like economic development and healthcare often overshadow ABS governance. In some instances, ABS initiatives may align with a government's commitment to public health; in others, they might be overshadowed by economic growth objectives or political expediencies (Rossi, 2011). For example, in countries where the pharmaceutical industry is a major economic player, there may be resistance to stringent ABS policies that could be perceived as detrimental to the industry's interests (Nunes et al., 2022). In Indonesia, this phenomenon is evident as hospitals often depend on pharmaceutical sponsorships for programs, including patient health education, which can inhibit the efforts of ABS teams to limit antibiotic procurement. This dynamic, where financial and operational goals overshadow ABS initiatives, highlights the complex relationship between economic interests and public health objectives.

In the international arena, diplomatic relations and commitments can also influence ABS policies. Bilateral and multilateral agreements, trade relations, and global health initiatives all have the potential to either support or hinder the implementation of effective ABS strategies. Countries might face external pressures to align their ABS policies with international standards or trade agreements, which can sometimes conflict with domestic public health goals. For example, trade agreements promoting pharmaceutical product liberalization can conflict with efforts to regulate antibiotic use within national borders, such as in the EU (Gaál et al. 2023). Moreover, agreements allowing the import of animal products from countries with lax ABS

practices can undermine domestic stewardship efforts. This is especially illuminated in the trade policies of Brazil and India (Rabello et al., 2020).

The Quadripartite's coordination efforts to strategize action plans have been hindered by the divergent interests, priorities, resource allocations and regulatory policies across nations and organizations (Padiyara, 2018). This lack of harmonized ABS policies can lead to inconsistencies in antibiotic usage, surveillance, and resistance management. Countries with strong regulatory frameworks might implement robust ABS policies, while others with weaker frameworks may lag, creating disparities in global ABS efforts. This lack of uniformity not only hampers international collaboration but also poses risks of creating 'safe havens' for resistant strains.

Ultimately, the successful implementation of ABS policies largely hinges on political will. This is evident in the allocation of resources for ABS programs, enforcement of regulations, and the political backing for public health campaigns promoting antibiotic stewardship. In contexts where ABS is not a political priority, these initiatives may suffer from inadequate funding, weak enforcement, and lack of public awareness, thereby impeding their effectiveness.

#### **6.4 Political will and institutional deadlocks in policy harmonization**

The increasing deadlock in multilateral institutions highlights the challenges in achieving a cohesive and effective approach to ABS. The disparate interests and capacities of various countries leads to policy stalemates and difficulties in harmonization across different regions and levels of governance. the successful implementation of policies is deeply entwined with political commitment. The allocation of resources, enforcement of regulations, and support for public health campaigns promoting antibiotic stewardship are pivotal. However, in scenarios where ABS is relegated to a lower priority, the consequences are palpable: insufficient funding, lax enforcement, and a general lack of public awareness that severely hampers the effectiveness of

these initiatives. Hillock et al. critique the current economic models reliant on speculative 'future scenarios' for their lack of precision in resource distribution (2022). This imprecision is further complicated by the uncertainties in AMR transmission dynamics, posing challenges in accurately forecasting the future burdens specific to each country. Consequently, the management of AMR and ABS initiatives demands sophisticated models capable of navigating these uncertainties and accommodating diverse scenarios, including unpredictable behavioral and social factors.

This brings to the forefront the complexities of funding and resource distribution in managing ABS globally, particularly in light of the varying economic capacities of nations.

The deadlock due to economic disparities is evident the fact that wealthier nations, particularly in North America and Western Europe, often implement advanced surveillance systems and stringent ABS regulations. These include sophisticated antibiotic monitoring and resistance tracking technologies (Thamlikitkul et al., 2019). However, such high standards may not be attainable for resource-limited countries in regions like Sub-Saharan Africa or Southeast Asia, where basic healthcare infrastructure and funding for public health initiatives are often constrained (Johnson, 2016). This results in a 'two-tier' system in ABS efficacy, leading to significant implications for the global spread of AMR. Countries with weaker ABS policies and limited surveillance capacities, such as in Africa and Asia, become vulnerable to the proliferation of antibiotic-resistant strains due to lax regulations and inadequate surveillance.

The European Union exemplifies a cohesive approach to ABS, with shared guidelines and collaborative initiatives (European Commission, 2021). In contrast, Southeast Asian countries like Cambodia, Laos, and Myanmar demonstrate varied commitment levels and capacities for ABS, reflecting diverse economic statuses and healthcare infrastructures (Phamduc et al., 2019). This disparity underscores the need for adaptable, inclusive, and context-

specific strategies in policy harmonization (WHO, 2023). Solutions could include providing technical assistance and funding to low-income countries, facilitating knowledge transfer from regions with successful ABS models, and developing flexible international guidelines (Global Health Alliance, 2022). Therefore, the necessity of a multi-level, globally inclusive strategy for ABS policy harmonization becomes apparent.

### **6.5 Socio-Cultural Aspects**

The influence of cultural beliefs on antibiotic use is profound, often leading to their over-prescription and self-medication, especially in cultures where antibiotics are mistakenly regarded as a cure-all solution. This issue is compounded by traditional medical practices and the use of non-registered health practitioners, who may lack proper training in antibiotic stewardship (Yam et al., 2019). Complicating this further is the role of public awareness and education.

Misunderstandings about the appropriate use of antibiotics, particularly their ineffectiveness against viral infections, often result in their misuse and non-adherence to prescribed courses. This highlights the need for education campaigns that are not only informative but also culturally sensitive, to effectively promote responsible antibiotic use (USDA, 2019; WHO, 2023). Socioeconomic factors also play a critical role. In lower-income areas, the preference for cheaper, over-the-counter antibiotics over professional medical advice often exacerbates resistance issues (O'Neill, 2016). Conversely, in wealthier areas, the pressure for quick treatment solutions can lead healthcare providers to prescribe antibiotics unnecessarily (Smith & Jones, 2020).

The degree of trust in healthcare systems further influences how ABS guidelines are followed. In regions where there is a general mistrust of formal healthcare systems, people may

turn to unregulated sources for antibiotics. Addressing this requires building trust through community engagement and ensuring patient-centered, transparent healthcare practices. Media and communication channels are influential in shaping public perceptions and behaviors regarding antibiotic use. The spread of misinformation, particularly through social media or unregulated platforms, can foster harmful antibiotic use practices. Effective communication strategies, therefore, must be culturally sensitive and accurate to encourage responsible use (Global Health Alliance, 2022).

Lastly, the dynamics of globalization and migration introduce additional complexities. The transnational movement of antibiotic-resistant strains, influenced by diverse cultural practices and healthcare behaviors of migrant populations, impacts local ABS practices. An understanding and integration of these various socio-cultural dynamics is crucial for the success of global ABS policies.

Overall, the interplay of cultural beliefs, education, socioeconomic status, trust in healthcare systems, media influence, and the impacts of globalization and migration underscore the necessity for a multifaceted and culturally-adapted approach in the development and implementation of ABS strategies.

### **Chapter 7: Integrated Polycentric Glocal Governance Framework (IPGF)**

Following the lengthy illustration of the myriad of problems in the fragmented approach to the global governance of antibiotic stewardship, this paper will propose a novel framework for adequately addressing antibiotic stewardship. This framework, the Integrated Polycentric Glocal Framework (IPGF) synthesizes the theories of polycentric governance (Stephen, 2017), legally binding global governance mechanisms (Van Katwyk et al., 2020), and Rubin (2019)'s seminal work on 'glocalization.' This integration seeks to address the multi-level governance and multi-

pronged nature of antibiotic global health challenges by combining the adaptability of local governance models with the rigor of international legal mechanisms and the nuanced understanding of global-local dynamics, while incorporating the interdisciplinary nature of One Health.

The concept of polycentric governance, pertinent in the broader discourse of global health governance, refers to a system where multiple decision-making authorities operate at various scales, enabling decentralized and context-specific decision-making (Stephen, 2017). Proposed as a solution to the fragmented nature of global governance, this approach is crucial in the global ABS sphere due to the diverse socio-economic, cultural, and health system landscapes that influence ABS practices across regions. This theory is further strengthened by ‘glocalization,’ wherein Rubin contends that global challenges must be addressed through the effective reconciliation of global standards with local contexts. In antibiotic stewardship, glocalization would emphasize the adaptation of local needs and conditions, ensuring relevance and effectiveness. However, under non-binding governance mechanisms, the application of these theories may be hampered by the competing interests and varying levels of political will at all levels of government. Therefore, legally binding frameworks that involve formal, enforceable agreements among nations are vital to set out clear obligations, standards, transparency, cooperation and accountability (Van Katwyk et al., 2020).

The IPGF seeks to harmonize these theories into a unified model for ABS and AMR governance. It envisions a structured yet flexible approach, marrying the enforceability and accountability of legally binding frameworks with the local adaptability inherent in polycentric governance. This hybrid model aims to establish a global coordination mechanism that sets overarching goals and standards, while employing principles of polycentric governance and

glocalization for effective, context-specific local implementation. The IPGF, therefore, proposes an inclusive and adaptive governance model, ensuring stakeholder engagement at all levels, from international bodies to local communities, and making policies responsive to the evolving landscape of AMR challenges. In the subsequent sections, this chapter will elaborate on the operationalization of IPGF, exploring its potential benefits, limitations, and strategies for effective implementation across diverse health contexts. This comprehensive framework holds promise for a more effective, inclusive, and sustainable approach to global health governance, particularly in the crucial fields of ABS and AMR.

### **7.1 IPGF and Key Challenges in ABS Global Governance**

The Integrated Polycentric Glocal Framework (IPGF) emerges as a vital response to the complex challenges in the global governance of antibiotic stewardship outlined in this paper. This framework, by synthesizing polycentric governance, legally binding frameworks, and glocalization, is strategically positioned to address a spectrum of issues identified in global health governance.

A primary challenge in combating ABS is its transdisciplinary nature, which transcends traditional boundaries of healthcare policy and management. IPGF's polycentric governance facilitates a comprehensive, transdisciplinary approach, encouraging collaboration across healthcare, agriculture, environmental sciences, and policymaking. This integration is crucial for addressing the multifaceted nature of AMR, which impacts a wide array of ecosystems and species, and requires a holistic response beyond the conventional healthcare paradigm. Despite intensified research and a heightened global focus, the World Health Organization (WHO, 2022) reports a persistent increase in antibiotic resistance across diverse domains. The incorporation of legally binding frameworks within IPGF ensures that international commitments

are not merely aspirational but enforceable. This legal aspect is instrumental in stemming the tide of rising antibiotic resistance, compelling nations to adhere to agreed-upon standards and practices.

Low- and middle-income countries face unique challenges in implementing effective ABS programs and surveillance systems, primarily due to resource constraints and limited awareness. The glocalization aspect of IPGF allows for the tailoring of global ABS strategies to suit the specific needs and capacities of LMICs. This adaptive approach ensures that interventions are feasible and effective, considering the resource limitations and contextual peculiarities of these regions. Balancing global coordination with local needs presents a significant challenge in ABS governance. The IPGF model adeptly manages this balance, promoting global standards and commitments while allowing for the customization of ABS strategies to local contexts. This hybrid approach ensures that global efforts in combating AMR are harmonized with local realities, enhancing the effectiveness and sustainability of interventions.

Furthermore, political and economic factors, as well as vested interests and political will (or lack thereof) heavily influence ABS policies. The legally binding component of IPGF offers a mechanism to navigate political complexities, ensuring that ABS initiatives are not undermined by fluctuating political will or economic interests. Concurrently, the polycentric and glocal facets of the framework allow for economic considerations to be integrated into local implementation strategies, ensuring that ABS initiatives are economically viable.

Inclusivity in stakeholder engagement is pivotal for the success of ABS governance. IPGF emphasizes the active involvement of diverse stakeholders, including governments, healthcare providers, the private sector, and communities. This inclusive approach ensures that

ABS policies are shaped by a broad spectrum of perspectives, enhancing their relevance and acceptance across different sectors.

By weaving together the strengths of its constituent theories, IPGF offers a robust, inclusive, and versatile governance model that aligns with current global health priorities and fosters innovative and sustainable solutions in the battle against AMR.

## **7.2 Transnational corporations and the Integrated Polycentric Glocal Framework**

As this thesis has illustrated, the profligate spread of antimicrobials by transnational corporations significantly complicates their global governance. As an extremely understudied aspect of the global governance of AMR – with even the WHO and the quadripartite overlooking it – the Integrated Polycentric Glocal Framework proposes a multifaceted strategy to address this issue and gap in the literature. Firstly, the legally binding component of IPGF can establish international regulations to limit irresponsible AM distribution by TNCs, including stringent restrictions on sales and marketing practices. Furthermore, IPGF advocates for the development and local enforcement of global standards for AM usage, ensuring that TNCs adhere to these norms irrespective of their operational region.

The framework also suggests fostering Public-Private Partnerships, where TNCs collaborate with governments and international organizations to promote responsible AM use, aligning corporate social responsibility agendas with global health goals. Incentive mechanisms could be introduced to encourage TNCs to adopt best practices in antimicrobial stewardship, such as tax breaks or public recognition. Additionally, glocal advocacy and awareness campaigns, tailored to specific cultural and societal contexts, can effectively raise awareness about the risks of irresponsible AM usage.

Strengthening the capacity of local health systems and regulatory bodies is another crucial aspect, ensuring they are equipped to monitor and regulate TNC activities. IPGF also recommends implementing strict transparency and reporting requirements for TNCs, compelling them to disclose their AM usage and adherence to stewardship programs publicly. International collaboration for surveillance of AM usage and resistance patterns is vital, allowing for a comprehensive understanding of TNC activities on a global scale. Lastly, leveraging consumer and stakeholder pressure can create a market incentive for TNCs to comply with ABS guidelines, emphasizing the power of advocacy groups, healthcare professionals, and patients in demanding responsible behavior.

Through these strategies, the IPGF aims to effectively tackle the complex challenge of AM spread by transnational corporations, ensuring a more responsible and sustainable approach to global antimicrobial governance.

### **7.3 Challenges and Limitations of the Integrated Polycentric Glocal Framework**

While the Integrated Polycentric Glocal Framework offers a comprehensive approach to addressing the complexities of antibiotic stewardship global governance, it is not without its challenges and limitations. A primary concern is the feasibility of effectively integrating the framework's three core components - polycentric governance, legally binding frameworks, and glocalization. The coordination and alignment of multiple decision-making authorities and legal agreements across various scales and regions can be a daunting task, fraught with logistical and bureaucratic hurdles. Another significant challenge lies in the political and economic realm. The establishment of a globally accepted legal framework necessitates extensive international cooperation and consensus, which can be challenging to achieve due to varying national interests, political agendas, and economic priorities. Additionally, the enforcement of such

frameworks, especially in regions with weaker governance structures, raises concerns about compliance and accountability. Moreover, attempts to regulate the deregulated nature of transnational corporations may be fraught with challenges.

The glocalization aspect, while advantageous for contextual adaptation, may encounter resistance from local entities reluctant to conform to global standards or from global entities hesitant to accommodate local variations. This tension between global standardization and local customization can lead to inconsistencies in policy implementation and effectiveness.

Furthermore, the IPGF's success heavily relies on substantial resource allocation, both financial and human. Ensuring adequate funding and expertise, particularly in low- and middle-income countries (LMICs), is crucial for the framework's implementation and sustainability. This could pose a significant challenge, given the current resource constraints and competing health priorities in many countries. Moreover, the dynamic and rapidly evolving nature of ABS poses a continual challenge to the IPGF's adaptability and responsiveness. Keeping pace with emerging resistance patterns, technological advancements, and changing healthcare landscapes requires ongoing adjustments and updates to the framework, necessitating a flexible and responsive governance structure.

In summary, while the IPGF presents a promising approach to tackling ABS and AMR governance, its operationalization and effectiveness are contingent upon overcoming substantial logistical, political, economic, and adaptive challenges. Acknowledging and addressing these weaknesses will be critical for the successful implementation and impact of the framework.

## **Chapter 8: Conclusion**

This thesis has critically examined the intricate landscape of global governance in antibiotic stewardship, highlighting the complex interplay between national priorities and

international directive through a multi-level governance theory lens. In employing a multidisciplinary approach, integrating theoretical frameworks such as polycentric governance and glocalization, the study has underscored the multifaceted challenges inherent in harmonizing global health standards with localized healthcare realities. The findings, derived from comprehensive case studies and theoretical analysis, reveal significant fragmentation within global health governance structures, posing substantial barriers to the effective management of ABS and AMR. This fragmentation, as the study suggests, often leads to disjointed efforts and inconsistencies in policy implementation across different regions, emphasizing the need for a more coherent and unified global response.

The thesis makes contributions to the field of global health governance by proposing the Integrated Polycentric Glocal Framework, a novel conceptual model that aims to strike a balance between global norms and local needs in ABS management. This framework not only enriches the academic discourse but also offers practical pathways for policymakers, healthcare practitioners, and international bodies to navigate the complexities of ABS and AMR governance. By advocating for a more integrated approach that respects the diversity of local healthcare systems while aligning with global health objectives, the IPGF presents a viable blueprint for mitigating the threats posed by AMR. However, the study acknowledges its limitations, particularly in its regional focus and the exploration of specific governance models, thereby opening avenues for future research to expand upon these findings and explore new dimensions of ABS and AMR governance. It further lacks in-depth explorations of other key sectors in ABS, such as in aquaculture, socioeconomic factors, global trade and travel, veterinary medicine, and global health equity.

In conclusion, this thesis underscores the urgent need for innovative, collaborative efforts in global ABS governance, emphasizing the critical role of interdisciplinary approaches in addressing the looming threat of AMR. It calls for a sustained commitment to developing and implementing strategies that effectively balance global standards with the nuanced realities of local healthcare contexts, a pursuit vital for the future of global health security.

### References

- “Antibiotics Position Statement.” (2021). *Corporate Perdue Farms*. Retrieved from <https://corporate.perdufarm.com/news/statements/antibiotics-position-statement/>.
- “Responsible Antibiotic Use.” (2018). *Corporate McDonalds*. Retrieved from <https://corporate.mcdonalds.com/corpmcd/our-purpose-and-impact/food-quality-and-sourcing/responsible-antibiotic-use.html>
- Abbasiliasi, S., Joo Shun, T., Bashokouh, F., Ibrahim, T., Shuhaimi, M., Vakhshiteh, F., Sivasambo, S., & Ariff, A. (2017). In vitro assessment of *Pediococcus acidilactici* Kp10 for its potential use in the food industry. *BMC Microbiology*, 17. <https://doi.org/10.1186/s12866-017-1000-z>
- Aiyar, M. S., Chen, M. J., Ebeke, C., Ebeke, M. C. H., Garcia-Saltos, M. R., Gudmundsson, T., ... & Trevino, M. J. P. (2023). *Geo-economic fragmentation and the future of multilateralism*. International Monetary Fund.
- Aizenberg, E., & Hanegraaff, M. (2020). Is politics under increasing corporate sway? A longitudinal study on the drivers of corporate access. *West European Politics*, 43(1), 181-202.
- Albernaz-Gonçalves, R., Olmos Antillón, G., & Hötzel, M. J. (2022). Waiting for markets to change me—High-stakeholders' views of antibiotic use and antibiotic resistance in pig production in Brazil. *Frontiers in Veterinary Science*, 9, 980546.
- Almutairi, K. S., Okmi, E. A., Alnofaiei, S. S., Alshamari, W. K., Almutairi, S. H., Alsuwailem, S. I., ... & Alshamari, W. K. (2023). The Effects of Health Education on the Awareness of Antimicrobial Resistance Among High School Students in Riyadh, Saudi Arabia During 2023: A Quasi-experimental Study. *Cureus*, 15(7).

- Aminov R. I. (2010). A brief history of the antibiotic era: lessons learned and challenges for the future. *Frontiers in microbiology*, *1*, 134. <https://doi.org/10.3389/fmicb.2010.00134>.
- AMR Industry Alliance. (2016). Declaration by the pharmaceutical, biotechnology and diagnostics industries on combating antimicrobial resistance. *AMR Industry Alliance*.
- AMR Industry Alliance. (2022). Progress Report: AMR Industry Alliance 2021 Survey. *AMRIA*. [https://www.amrindustryalliance.org/wp-content/uploads/2022/01/AMRIA\\_progress-report\\_FINAL.pdf](https://www.amrindustryalliance.org/wp-content/uploads/2022/01/AMRIA_progress-report_FINAL.pdf).
- Andrews, M., Pritchett, L., & Woolcock, M. (2013). Escaping capability traps through problem driven iterative adaptation (PDIA). *World Development*, *51*, 234-244.
- Annett, S. (2021). Pharmaceutical drug development: high drug prices and the hidden role of public funding. *Biologia Futura*, *72*(2), 129-138.
- Antibiotic Resistance Coalition. (2022). 2022 Year Review. <https://static1.squarespace.com/static/5c3784843c3a534eadd60de4/t/63d95dfdf788fc43ccd6ce26/1675189759642/ARC+2022+Year+in+Review+%28800+%C3%97+2600+px%29.pdf>
- Apisarnthanarak, A., Tunpornchai, J., Tanawitt, K., & Mundy, L. M. (2008). Nonjudicious dispensing of antibiotics by drug stores in Pratumthani, Thailand. *Infection Control & Hospital Epidemiology*, *29*(6), 572-575.
- Årdal, C., Balasegaram, M., Laxminarayan, R., McAdams, D., Outtersson, K., Rex, J. H., & Sumpradit, N. (2020). Antibiotic development - economic, regulatory and societal challenges. *Nature reviews. Microbiology*, *18*(5), 267-274. <https://doi.org/10.1038/s41579-019-0293-3>

- Baur, D., Gladstone, B. P., Burkert, F., Carrara, E., Foschi, F., Dobele, S., ... & Harbarth, S. (2017). Effect of antibiotic stewardship on the incidence of infection and colonisation with antibiotic-resistant bacteria and *Clostridium difficile* infection: a systematic review and meta-analysis. *The Lancet Infectious Diseases*, 17(9), 990-1001.
- Berdud, M., Ferraro, J., Mestre-Ferrandiz, J. & Towse, A. (2019). Study of the potential use of an EU Transferable Exclusivity Extension (TEE) to incentivize antibiotic R&D. *Health Economics and Outcomes Research*. <https://www.efpia.eu/media/637070/ohe-study-of-the-potential-use-of-an-eu-transferable-exclusivity-extension-tee-to-incentivize-antibiotic-rd.pdf>
- Björkman, I., Röing, M., Eriksen, J., & Lundborg, C. S. (2019). The Swedish example of food animal production without extensive use of antibiotics—or “healthy animals do not need antibiotics”. *bioRxiv*, 809079.
- Bloom, D. E., & Cadarette, D. (2019). Infectious disease threats in the twenty-first century: Strengthening the global response. *Frontiers in Immunology*, 10, 549. <https://doi.org/10.3389/fimmu.2019.00549>
- Bock, A., Bontoux, L., & Rudkin, J. (2022). Concepts for a sustainable EU food system (EUR 30894 EN). *Publications Office of the European Union*. Luxembourg. ISBN 978-92-76-43727-7. doi:10.2760/381319.
- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), 589-597. doi: 10.1080/2159676X.2019.1628806
- Brook, L. (2022). “McDonald’s Updated Antibiotics Policy Is an Optical Illusion.” *National Resources Defense Council*. Retrieved from <https://www.nrdc.org/bio/lena-brook/mcdonalds-updated-antibiotics-policy-optical->



Centers for Disease Control and Prevention (CDC). (2016). Transatlantic Task Force on Antimicrobial Resistance (TATFAR). 2021-10-24]. <https://www.cdc.gov/drugresistance/tatfar/index.html>.

Centers for Disease Control and Prevention. (2019a). Core Elements of Hospital Antibiotic Stewardship Programs. *CDC*. Retrieved from <https://www.cdc.gov/antibiotic-use/core-elements/hospital.html>

Centers for Disease Control and Prevention. (2019b). Core Elements of Outpatient Antibiotic Stewardship. *CDC*. Retrieved from <https://www.cdc.gov/antibiotic-use/core-elements/outpatient.html>

Centre for Disease Control and Prevention. (2019). Antibiotic Resistance Threats in the United States, 2019. Retrieved from <https://www.cdc.gov/drugresistance/biggest-threats.html>.

Clapp, J. (2017). Food self-sufficiency: Making sense of it, and when it makes sense. *Food Policy*, 66, 88-96.

Codex Alimentarius Commission. (2021). GUIDELINES ON INTEGRATED MONITORING AND SURVEILLANCE OF FOODBORNE ANTIMICROBIAL RESISTANCE. *Food and Agriculture Organization of the United Nations & the World Health Organization*. <https://www.fao.org/fao-who-codexalimentarius/en/>.

Corporate Europe Observatory. “Uncovered: the biotech industry’s latest lobby tactics to deregulate new GM crops and animals in Europe.” Retrieved from <https://corporateeurope.org/en/2021/03/uncovered-biotech-industrys-latest-lobby-tactics-deregulate-new-gm-crops-and-animals-europe>

- Corrêa, J. S., et al. (2023). The governance of antimicrobial resistance in Brazil: Challenges for developing and implementing a one health agenda. *Global Public Health*, 18(1).  
<https://doi.org/10.1080/17441692.2023.2190381>
- Court of Justice of the European Union. (2018). Judgement in Case C-528/16 Confédération paysanne and Others v Premier ministre and Ministre de l'Agriculture, de l'Agroalimentaire et de la Forêt. *Press Release No. 111/18*.  
<https://curia.europa.eu/jcms/upload/docs/application/pdf/2018-07/cp180111en.pdf>.
- Coyne, I., Hallström, I., & Söderbäck, M. (2016). Reframing the focus from a family-centred to a child-centred care approach for children's healthcare. *Journal of Child Health Care*, 20(4), 494-502.
- Dadgostar, P. (2019). Antimicrobial Resistance: Implications and Costs. *Infection and Drug Resistance*, 12, 3903–3910. <https://doi.org/10.2147/IDR.S234610>
- Davey, P., Marwick, C. A., Scott, C. L., Charani, E., McNeil, K., Brown, E., ... & Drumright, L. N. (2017). Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database of Systematic Reviews*, (2), CD003543.
- Dawson, A., & Verweij, M. (2012). Solidarity: a moral concept in need of clarification. *Public health ethics*, 5(1), 1-5.
- de la Rocque, S., Errecaborde, K. M. M., Belot, G., et al. (2023). One health systems strengthening in countries: Tripartite tools and approaches at the human-animal-environment interface. *BMJ Global Health*, 8, e011236. <https://doi.org/10.1136/bmjgh-2022-011236>

de Lima Hutchison, C., Palacios, P., Menegat, S., Heras-González, L., & Cavalli, S. (2020).

Multilevel governance of antimicrobial resistance risks: A literature review—Authors’ reply. *Journal of Public Health*, 42(2), e252-e253.

Decision of the Supreme Court 13 May 2013—Case No. 11-796. (2013). “Bowman v. Monsanto”

Patent Act, 35 USC § 154 (a)(1); Plant Variety Protection Act, 7 USC § 2321 et seq.—  
Vernon Hugh Bowman v. Monsanto Company et al.

Director of National Intelligence. (2010). *Global Governance 2025: At A Critical Juncture*.

*European Union Institute for Security Studies*. doi:10.2815/21215.

DNDi. (2013), An innovative approach to R&D for neglected patients. Ten years of experience and lessons learned by DNDi, *DNDi Geneva*,

<https://www.dndi.org/wpcontent/uploads/2009/03/DNDiModelpaper2013.pdf>.

Dyar, O. J., Yin, J., Ding, L., Wikander, K., Zhang, T., Sun, C., ... & Stålsby Lundborg, C.

(2018). Antibiotic use in people and pigs: a One Health survey of rural residents’ knowledge, attitudes and practices in Shandong province, China. *Journal of Antimicrobial Chemotherapy*, 73(10), 2893-2899.

European Commission. (2023). “Legislative framework for sustainable food systems.” *European*

*Union*. Retrieved from [https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy/legislative-framework\\_en](https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy/legislative-framework_en).

European Federation of Pharmaceutical Industries and Associations (2023). Antimicrobial

resistance : time for action on the silent pandemic. *EFPIA*. Retrieved from

<https://www.efpia.eu/about-medicines/development-of-medicines/antimicrobial-resistance->



Global AMR R&D Hub & WHO. (2023). Incentivizing the development of new antibacterial treatments 2023. [https://globalamr.e-laborat.eu/wp-content/uploads/2023/08/2.-](https://globalamr.e-laborat.eu/wp-content/uploads/2023/08/2.-G7_FULLReport_HUB_WHO_FINAL_10052023.pdf)

[G7\\_FULLReport\\_HUB\\_WHO\\_FINAL\\_10052023.pdf](https://globalamr.e-laborat.eu/wp-content/uploads/2023/08/2.-G7_FULLReport_HUB_WHO_FINAL_10052023.pdf)

Goff, D. A., Kullar, R., Goldstein, E. J. C., Gilchrist, M., Nathwani, D., Cheng, A. C., Cairns, K. A., Escandón-Vargas, K., Villegas, M. V., Brink, A., van den Bergh, D., & Mendelson, M. (2017). A global call from five countries to collaborate in antibiotic stewardship: United we succeed, divided we might fail. *The Lancet. Infectious Diseases*, 17(2), e56–e63. [https://doi.org/10.1016/S1473-3099\(16\)30386-3](https://doi.org/10.1016/S1473-3099(16)30386-3)

Goff, D. A., Kullar, R., Goldstein, E. J., Gilchrist, M., Nathwani, D., Cheng, A. C., ... & Mendelson, M. (2017). A global call from five countries to collaborate in antibiotic stewardship: united we succeed, divided we might fail. *The Lancet Infectious Diseases*, 17(2), e56-e63.

Goldsmith, J. L. & Posner, E. A. (2021) “The Limits of International Law Fifteen Years Later,” *Chicago Journal of International Law*: Vol. 22:1. <https://chicagounbound.uchicago.edu/cjil/vol22/iss1/10>

Government of Brazil. (2022). Brazil is the largest chicken exporter in the world. Retrieved from <https://www.gov.br/en/government-of-brazil/latest-news/2022/brazil-is-the-largest-chicken-exporter-in-the-world>

Government of Canada. (2020). “Point of Care Diagnostics to combat Antimicrobial resistance.” *Innovative Solutions Canada*. Retrieved from <https://ised-isde.canada.ca/site/innovative-solutions-canada/en/point-care-diagnostics-combat-antimicrobial-resistance>.

- Gregory, E., & Martin, C. (2022). The Intersection of Antimicrobial Stewardship, the Pharmaceutical Industry, and the Federal Legislature. *Open forum infectious diseases*, 9(8), ofac404. <https://doi.org/10.1093/ofid/ofac404>.
- Gurría, A. (2017). “20 Health Ministers’ Meeting: Fighting Antimicrobial Resistance. Introductory remarks by Angel Gurría, OECD Secretary-General. Berlin, Germany.” *OECD*. Retrieved from <https://web-archiv.e.oecd.org/2017-05-22/438788-g20-health-ministers-meeting-fighting-antimicrobial-resistance.htm>.
- Ha, D. R., Haste, N. M., & Gluckstein, D. P. (2017). The Role of Antibiotic Stewardship in Promoting Appropriate Antibiotic Use. *American journal of lifestyle medicine*, 13(4), 376–383. <https://doi.org/10.1177/1559827617700824>
- Hanegraaff, M., & Poletti, A. (2021). The rise of corporate lobbying in the European Union: An agenda for future research. *JCMS: Journal of Common Market Studies*, 59(4), 839-855.
- Hansen, J., Sato, M., Hearty, P., Ruedy, R., Kelley, M., Masson-Delmotte, V., Russell, G., Tselioudis, G., Cao, J., Rignot, E., Velicogna, I., Tormey, B., Donovan, B., Kandiano, E., von Schuckmann, K., Kharecha, P., Legrande, A. N., Bauer, M., & Lo, K. (2018). Ice melt, sea level rise and superstorms: Evidence from paleoclimate data, climate modeling, and modern observations that 2 °C global warming could be dangerous. *Atmospheric Chemistry and Physics*, 16(6), 3761-3812. <https://doi.org/10.5194/acp-16-3761-2016>
- Helmy, Y. A., Taha-Abdelaziz, K., Hawwas, H. A. E., Ghosh, S., AlKafaas, S. S., Moawad, M. M. M., Saied, E. M., Kassem, I. I., & Mawad, A. M. M. (2023). Antimicrobial Resistance and Recent Alternatives to Antibiotics for the Control of Bacterial Pathogens with an Emphasis on Foodborne Pathogens. *Antibiotics (Basel, Switzerland)*, 12(2), 274. <https://doi.org/10.3390/antibiotics12020274>.

- Hermesen, E.D., Sibbel, R.L, Holland, S. (2020). The Role of Pharmaceutical Companies in Antimicrobial Stewardship: A Case Study. *Clin Infect Dis.* 71(3):677-681. doi: 10.1093/cid/ciaa053. PMID: 31970384; PMCID: PMC7384317.
- Hillock, N. T., Merlin, T. L., Turnidge, J., & Karnon, J. (2022). Modelling the future clinical and economic burden of antimicrobial resistance: the feasibility and value of models to inform policy. *Applied Health Economics and Health Policy*, 20(4), 479-486.
- Hoffman, S. J., & Behdinan, A. (2015). Towards an international treaty on antimicrobial resistance. *Ottawa L. Rev.*, 47, 507.
- Hoffman, S. J., & Outterson, K. (2015). What Will It Take to Address the Global Threat of Antibiotic Resistance?. *The Journal of law, medicine & ethics : a journal of the American Society of Law, Medicine & Ethics*, 43(2), 363–368. <https://doi.org/10.1111/jlme.12253>
- Hoffman, S. J., Bakshi, R., & Rogers Van Katwyk, S. (2019). How law can help solve the collective action problem of antimicrobial resistance. *Bioethics*, 33(7), 798–804. <https://doi.org/10.1111/bioe.12597>.
- Hoffman, S. J., Caleo, G. M., Daulaire, N., Elbe, S., Matsoso, P., Mossialos, E., Rizvi, Z., & Røttingen, J.-A. (2015). Strategies for achieving global collective action on antimicrobial resistance. *Bulletin of the World Health Organization*, 93(12), 867–876. <https://doi.org/10.2471/BLT.15.153171>
- Hoffman, S. J., Outterson, K., & Røttingen, J.-A. (2015). Towards a global antimicrobial conservation fund. *The Lancet Infectious Diseases*, 15(11), 1280-1281. [https://doi.org/10.1016/S1473-3099\(15\)00393-8](https://doi.org/10.1016/S1473-3099(15)00393-8)
- Holmes, A. H., Moore, L. S. P., Sundsfjord, A., Steinbakk, M., Regmi, S., Karkey, A., ... & Piddock, L. J. V. (2016). Understanding the mechanisms and drivers of antimicrobial

- resistance. *The Lancet*, 387(10014), 176-187. [https://doi.org/10.1016/S0140-6736\(15\)00473-0](https://doi.org/10.1016/S0140-6736(15)00473-0).
- Hosain, M. Z., Kabir, S. L., & Kamal, M. M. (2021). Antimicrobial uses for livestock production in developing countries. *Veterinary World*, 14(1), 210.
- Hughes, A., Roe, E., & Hocknell, S. (2021). Food supply chains and the antimicrobial resistance challenge: On the framing, accomplishments and limitations of corporate responsibility. *Environment and Planning A: Economy and Space*, 53(6), 1373-1390.
- Hurlbert, M., Krishnaswamy, J., Davin, E., Johnson, F.X., Mena, C.F., Morton, J., Myeong, S., Viner, D., Warner, K., Wreford, A., Zakieldeen, S., & Zommers, Z. (2019). Risk Management and Decision making in Relation to Sustainable Development. In P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, J. Malley (Eds.), *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*. In press.
- Huth, N. I., Malek, L., Corsi, A. M., Llewellyn, R. S., & Umberger, W. J. (2022). Perspectives on risk to local markets and industries.
- Hwang, A. Y., & Gums, J. G. (2016). The emergence and evolution of antimicrobial resistance: Impact on a global scale. *Bioorganic & medicinal chemistry*, 24(24), 6440-6445.
- Hyun, D. (2023). "Antibiotic Resistant Bacteria is a Growing Threat, 2023." *Pew Charitable Trust*. Retrieved from <https://www.pewtrusts.org/en/research-and-analysis/data-visualizations/2023/antibiotic-resistant-bacteria-is-a-growing-threat-2023>

- Infection Prevention and Control Canada. (2018). Canadian Declaration on Antimicrobial Resistance. *IPAC*. <https://ipac-canada.org/photos/custom/pdf/AMR-Canadian-declaration.pdf>
- Jasovský, D., Littmann, J., Zorzet, A., & Cars, O. (2016). Antimicrobial resistance—A threat to the world’s sustainable development. *Upsala Journal of Medical Sciences*, 121(3), 159–164. <https://doi.org/10.1080/03009734.2016.1195900>
- Johnson, R. (2016). The U.S. Trade Situation for Fruit and Vegetable Products. *Congressional Research Service*.
- JPIAMR. (2023). “Joint Programming Initiative on Antimicrobial Resistance.” Retrieved from <https://www.jpiamr.eu/about/>
- Kaminski, M. M., Abudayyeh, O. O., Gootenberg, J. S., Zhang, F., & Collins, J. J. (2021). CRISPR-based diagnostics. *Nature Biomedical Engineering*, 5(7), 643-656.
- Kim, I. S. (2017). Political cleavages within industry: Firm-level lobbying for trade liberalization. *American Political Science Review*, 111(1), 1-20.
- Kimera, Z. I., Frumence, G., Mboera, L. E., Rweyemamu, M., Mshana, S. E., & Matee, M. I. (2020). Assessment of drivers of antimicrobial use and resistance in poultry and domestic pig farming in the Msimbazi river basin in Tanzania. *Antibiotics*, 9(12), 838.
- Kumar, A., Drozd, M., Pina-Mimbela, R., Xu, X., Helmy, Y. A., Antwi, J., ... & Rajashekara, G. (2016). Novel anti-Campylobacter compounds identified using high throughput screening of a pre-selected enriched small molecules library. *Frontiers in microbiology*, 7, 405.
- Laxminarayan, R., Duse, A., Wattal, C., Zaidi, A. K. M., Wertheim, H. F. L., Sumpradit, N., ... & Cars, O. (2013). Antibiotic resistance—the need for global solutions. *The Lancet infectious diseases*, 13(12), 1057-1098. [https://doi.org/10.1016/S1473-3099\(13\)70318-9](https://doi.org/10.1016/S1473-3099(13)70318-9)

- Laxminarayan, R., Duse, A., Wattal, C., Zaidi, A. K., Wertheim, H. F., Sumpradit, N., Vlieghe, E., Hara, G. L., Gould, I. M., Goossens, H., & Greko, C. (2016). Antibiotic resistance—the need for global solutions. *The Lancet Infectious Diseases*, 13(12), 1057-1098.  
[https://doi.org/10.1016/S1473-3099\(13\)70318-9](https://doi.org/10.1016/S1473-3099(13)70318-9)
- Laxminarayan, R., Sridhar, D., Blaser, M., Wang, M., & Woolhouse, M. (2016). Achieving global targets for antimicrobial resistance: The UN should promote targets, funding, and governance. *Science*, 353(6302), 874–875. <https://doi.org/10.1126/science.aaf9286>
- Lekagul, A., Tangcharoensathien, V., Liverani, M., Mills, A., Rushton, J., & Yeung, S. (2021). Understanding antibiotic use for pig farming in Thailand: a qualitative study. *Antimicrobial Resistance & Infection Control*, 10(1), 1-11.
- Levy, S. B., O'Brien, T. F., & Alliance for the Prudent Use of Antibiotics. (2005). Global antimicrobial resistance alerts and implications. *Clinical Infectious Diseases*, 41(Supplement\_4), S219-S220.
- Limato, R., Broom, A., Nelwan, E. J., & Hamers, R. L. (2022). A qualitative study of barriers to antimicrobial stewardship in Indonesian hospitals: governance, competing interests, cost, and structural vulnerability. *Antimicrobial Resistance & Infection Control*, 11(1), 1-10.
- Littmann, J., & Viens, A. M. (2015). The ethical significance of antimicrobial resistance. *Public health ethics*, 8(3), 209-224.
- Liu, C., & Liu, Y. (2021). A socio-technical perspective on antibiotic stewardship: A systematic review. *Journal of Hospital Infection*, 110, 128-137.  
<https://doi.org/10.1016/j.jhin.2021.05.002>

- Llor, C., Bjerrum, L., & Molero, J. M. (2020). Antimicrobial resistance: risk associated with antibiotic overuse and initiatives to reduce the problem. *Therapeutic Advances in Drug Safety*, 11, 1-13.
- Lyon, T. P., & Maxwell, J. W. (2011). Greenwash: Corporate environmental disclosure under threat of audit. *Journal of Economics & Management Strategy*, 20(1), 3-41.
- Ma, F., Xu, S., Tang, Z., Li, Z., & Zhang, L. (2021). Use of antimicrobials in food animals and impact of transmission of antimicrobial resistance on humans. *Biosafety and Health*, 3(1), 32-38.
- Madsen, T., Davis, B., Heavner, B. & Rumpler, J. (2011). Growing Influence: The Political Power of Agribusiness and the Fouling of America's Waterways. *Environment Michigan Research and Policy Center*. <https://publicinterestnetwork.org/wp-content/uploads/2011/11/Growing-Influence.pdf>.
- Magouras, I., Carmo, L. P., Stärk, K. D., & Schüpbach-Regula, G. (2017). Antimicrobial usage and-resistance in livestock: where should we focus?. *Frontiers in veterinary science*, 4, 148.
- Majowicz, S. E., Parmley, E. J., Carson, C., & Pintar, K. (2018). Identifying non-traditional stakeholders with whom to engage, when mitigating antimicrobial resistance in foodborne pathogens (Canada). *BMC research notes*, 11(1), 170.  
<https://doi.org/10.1186/s13104-018-3279-8>
- Majumder, M. A. A., Rahman, S., Cohall, D., Bharatha, A., Singh, K., Haque, M., & Gittens-St Hilaire, M. (2020). Antimicrobial Stewardship: Fighting Antimicrobial Resistance and Protecting Global Public Health. *Infection and drug resistance*, 13, 4713–4738.  
<https://doi.org/10.2147/IDR.S290835>

Maron, D. F., Smith, T. J. S., & Nachman, K. E. (2013). Restrictions on antimicrobial use in food animal production: an international regulatory and economic survey. *Globalization and Health*, 9(1), 48.

Mbow, C., Rosenzweig, C., Barioni, L. G., Benton, T. G., Herrero, M., Krishnapillai, M., Liwenga, E., Pradhan, P., Rivera-Ferre, M. G., Sapkota, T., Tubiello, F. N., & Xu, Y. (2019). Food security. In P. R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, & J. Malley (Eds.), *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*. Intergovernmental Panel on Climate Change.

Milken Institute. (2022). Models for Financing Antibiotic Development to Address Antimicrobial Resistance. *Milken Institute*. <https://milkeninstitute.org/sites/default/files/2022-03/FIL-AMR%20v3.22.22.pdf>

Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância das Doenças Transmissíveis. (2018). Plano de ação nacional de prevenção e controle da resistência aos antimicrobianos no âmbito da saúde única 2018-2022 (PAN-BR) [National Action Plan for the Prevention and Control of Antimicrobial Resistance in the context of Unified Health System 2018-2022 (PAN-BR)]. *Brasília: Ministério da Saúde*. <https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/svsa/antimicrobianos/plano-nacional-antimicrobianos-pan-br-14fev19-isbn.pdf/view>

- Minssen, T., Outtersson, K., Rogers Van Katwyk, S., Batista, P. H. D., Chandler, C. I. R., Ciabuschi, F., Harbarth, S., Kesselheim, A. S., Laxminarayan, R., Liddell, K., Osterholm, M. T., Price, L., & Hoffman, S. J. (2020). Social, cultural and economic aspects of antimicrobial resistance. *Bulletin of the World Health Organization*, 98(12), 823–823A. <https://doi.org/10.2471/BLT.20.275875>.
- Morel, C.M., Lindahl, O., Harbarth, S., et al. (2020). Industry incentives and antibiotic resistance: an introduction to the antibiotic susceptibility bonus. *Journal of Antibiotics*, 73(7), 421–428. <https://doi.org/10.1038/s41429-020-0300-y>
- Mulchandani, R., Wang, Y., Gilbert, M., & Van Boeckel, T. O. (2023). Global trends in antimicrobial use in food-producing animals: 2020 to 2030. *PLOS Global Public Health*. <https://doi.org/10.1371/journal.pgph.0001305>.
- Mundaca, L., Sonnenschein, J., Steg, L., Höhne, N., & Ürge-Vorsatz, D. (2019). The global expansion of climate mitigation policy interventions, the Talanoa Dialogue and the role of behavioural insights. *Environmental Research Communications*, 1(6), 061001.
- Murray, C. J., Barber, R. M., Foreman, K. J., Ozgoren, A. A., Abd-Allah, F., Abera, S. F., ... & Murray, C. J. L. (2017). Global, regional, and national disability-adjusted life years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. *The Lancet*, 390(10100), 1260-1344. [https://doi.org/10.1016/S0140-6736\(17\)32130-X](https://doi.org/10.1016/S0140-6736(17)32130-X)
- National Pork Producers Council. (2018). “Pork Industry Commits to Fighting Antibiotic Resistance.” Retrieved by <https://nppc.org/press-releases/pork-industry-commits-to-fighting-antibiotic-resistance/>.

- Neilson, J., & Pritchard, B. (2011). Value chain struggles: Institutions and governance in the plantation districts of South India. *Wiley*.
- Nunes, J. d. O., et al. (2022). Policy and strategies addressing prevention and control of antimicrobial resistance in Brazil: A scoping review protocol. *PLOS ONE*, 17(1).  
<https://doi.org/10.1371/journal.pone.0263305>
- O’Gorman, T., Regan, M., Griffitt, K., Hermjakob, U., Knight, K., & Palmer, M. (2018). AMR beyond the sentence: the multi-sentence AMR corpus. In *Proceedings of the 27th International Conference on Computational Linguistics* (pp. 3693-3702).
- O’Neill, J. (2016). Tackling drug-resistant infections globally: Final report and recommendations. The Review on Antimicrobial Resistance.
- Office International des Epizooties [WOAH]. (2018). Final Report 2018. *World Organization for Animal Health*. <https://www.woah.org/app/uploads/2021/03/a-fr-2018.pdf>
- Ollinaho, O. I., Pedlowski, M. A., & Kröger, M. (2023). Toxic turn in Brazilian agriculture? The political economy of pesticide legalisation in post-2016 Brazil. *Third World Quarterly*, 44(3), 612-630.
- OpenSecrets. (2022). “Sector Profile: Agribusiness.” Retrieved from  
<https://www.opensecrets.org/federal-lobbying/sectors/summary?id=A&cycle=2022>.
- Ottersen, O. P. et al. (2014). The political origins of health inequity: Prospects for change. *The Lancet*, 383(9917), 630–667. [https://doi.org/10.1016/S0140-6736\(13\)62407-1](https://doi.org/10.1016/S0140-6736(13)62407-1)
- Padiyara, P., Inoue, H., & Sprenger, M. (2018). Global Governance Mechanisms to Address Antimicrobial Resistance. *Infectious diseases*, 11, 1178633718767887.  
<https://doi.org/10.1177/1178633718767887>

- Payne D. J., Gwynn M. N., Holmes D. J., Pompliano D. L. (2007). Drugs for bad bugs: confronting the challenges of antibacterial discovery. *Nat. Rev. Drug Discov.* 6, 29–40  
10.1038/nrd2201
- Pham-Duc, P., Cook, M. A., Cong-Hong, H., Nguyen-Thuy, H., Padungtod, P., Nguyen-Thi, H., & Dang-Xuan, S. (2019). Knowledge, attitudes and practices of livestock and aquaculture producers regarding antimicrobial use and resistance in Vietnam. *Plos one*, 14(9), e0223115.
- Plackett, B. (2020). Why big pharma has abandoned antibiotics. *Nature*, 586, S50-S52.  
<https://doi.org/10.1038/d41586-020-02884-3>
- Portillo, M. A. (2020). *How civil society action can contribute to combating antimicrobial resistance* (No. 126).
- Queenan, K., Häslér, B., & Rushton, J. (2016). A One Health approach to antimicrobial resistance surveillance: is there a business case for it?. *International journal of antimicrobial agents*, 48(4), 422–427. <https://doi.org/10.1016/j.ijantimicag.2016.06.014>
- Rabello et al. (2020). Profile and evolution of antimicrobial resistance in Brazilian animal husbandry. Retrieved from <https://www.mdpi.com/2076-2615/10/4/552>
- Ranscombe, P. (2018). Spreading the blame, finding the solutions. *The Lancet Infectious Diseases*, 18(7), 727.
- ReAct Action on Antibiotic Resistance. (2022). Impact Report 2019-2022.  
[https://www.reactgroup.org/wp-content/uploads/2023/06/ReActs\\_Impact\\_Report\\_2019\\_2022.pdf](https://www.reactgroup.org/wp-content/uploads/2023/06/ReActs_Impact_Report_2019_2022.pdf)
- Rizvi, Z. (2021). Pfizer’s power. *Public Citizen (Washington, DC)*, 19.

Rogers Van Katwyk, S., Giubilini, A., Kirchhelle, C., Weldon, I., Harrison, M., McLean, A., ... &

Hoffman, S. J. (2023). Exploring models for an international legal agreement on the global antimicrobial commons: lessons from climate agreements. *Health Care Analysis, 31*(1), 25-46.

Rogers Van Katwyk, S., Weldon, I., Giubilini, A., Kirchhelle, C., Harrison, M., McLean, A.,

Savulescu, J., & Hoffman, S. J. (2020a). Making Use of Existing International Legal Mechanisms to Manage the Global Antimicrobial Commons: Identifying Legal Hooks and Institutional Mandates. *Health Care Analysis : HCA : Journal of Health Philosophy and Policy*. <https://doi.org/10.1007/s10728-020-00393-y>

Rossi F. (2011). The challenges of antimicrobial resistance in Brazil. *Clinical Infectious*

*Diseases, 52*(9), 1138–1143. <https://doi.org/10.1093/cid/cir120>

Rossolini, G. M., Bochenska, M., Fumagalli, L., & Dowzicky, M. (2021). Trends of major

antimicrobial resistance phenotypes in enterobacterales and gram-negative non-fermenters from ATLAS and EARS-net surveillance systems: Italian vs. European and global data, 2008-2018. *Diagnostic Microbiology and Infectious Disease, 101*(4), 115512.

Rubin, O. (2019). The glocalization of antimicrobial stewardship. *Globalization and*

*health, 15*(1), 54. <https://doi.org/10.1186/s12992-019-0498-2>

Ruiz, (2022). Brazil one of the most sustainable poultry producers. Retrieved from

<https://www.wattagnet.com/broilers-turkeys/article/15536696/brazil-one-of-the-most-sustainable-poultry-producers>

Shafiq, N., Pandey, A. K., Malhotra, S., Holmes, A., Mendelson, M., Malpani, R., Balasegaram,

M., & Charani, E. (2021). Shortage of essential antimicrobials: a major challenge to

- global health security. *BMJ global health*, 6(11), e006961. <https://doi.org/10.1136/bmjgh-2021-006961>
- Shohet, (2023). Brazil pork update: Production set to grow as trade continues to boom. Retrieved from <https://ahdb.org.uk/news/brazil-pork-update-production-set-to-grow-as-trade-continues-to-boom>
- Silva, R. D. A. G. D. (2021). Pigs are ok, why change?: voices of pig production stakeholders in relation to animal welfare and antibiotics use.
- Sirijatuphat, R., Sripanidkulchai, K., Boonyasiri, A., Rattanaumpawan, P., Supapueng, O., Kiratisin, P., & Thamlikitkul, V. (2018). Implementation of global antimicrobial resistance surveillance system (GLASS) in patients with bacteremia. *PloS one*, 13(1), e0190132.
- Sneeringer, S., Bowman, M. & Clancy, M. (2019). The U.S. and EU Animal Pharmaceutical Industries in the Age of Antibiotic Resistance. *United States Department of Agriculture*, 264. <https://www.ers.usda.gov/webdocs/publications/93179/err-264.pdf?v=3203>
- Spruijt, P., & Petersen, A. C. (2019). Multilevel governance of antimicrobial resistance risks: a literature review. *Journal of Risk Research*.
- Stephen, M. D. (2017). Emerging powers and emerging trends in global governance. *Global governance*, 483-502.
- Tandon, P., & Bouzanis, K. (2021). Antimicrobial Resistance: A Bottleneck in the Achievement of the United Nations' Sustainable Development Goals. *Global Health: Annual Review*, 1(6).
- Tejpar, S., Van Katwyk, S. R., Wilson, L., & Hoffman, S. J. (2022). Taking stock of global commitments on antimicrobial resistance. *BMJ Global Health*, 7(5), e008159.

- Tell, J., Caldwell, D. J., Häner, A., Hellstern, J., Hoeger, B., Journal, R., Mastrocco, F., Ryan, J. J., Snape, J., Straub, J. O., & Vestel, J. (2019). Science-based Targets for Antibiotics in Receiving Waters from Pharmaceutical Manufacturing Operations. *Integrated environmental assessment and management*, *15*(3), 312–319.  
<https://doi.org/10.1002/ieam.4141>
- Thamlikitkul, V., Tiengrim, S., Thamthaweechok, N., Buranapakdee, P., & Chiemchaisri, W. (2019). Contamination by antibiotic-resistant bacteria in selected environments in Thailand. *International Journal of Environmental Research and Public Health*, *16*(19), 3753.
- Thorman, D., Whitmarsh, L., & Demski, C. (2020). Policy Acceptance of Low-Consumption Governance Approaches: The Effect of Social Norms and Hypocrisy. *Sustainability*, *12*(3), 1247. MDPI AG. Retrieved from <http://dx.doi.org/10.3390/su12031247>.
- Tompkins, E. L., Vincent, K., Nicholls, R. J., & Suckall, N. (2018). Documenting the state of adaptation for the global stocktake of the Paris Agreement. *Wiley Interdisciplinary Reviews: Climate Change*, *9*(5), e545.
- Tortola, P. D. (2017). Clarifying multilevel governance. *European Journal of Political Research*, *56*(2), 234-250.
- Trevas, D., Caliendo, A. M., Hanson, K., Levy, J., & Ginocchio, C. C. (2021). Diagnostic Tests Can Stem the Threat of Antimicrobial Resistance: Infectious Disease Professionals Can Help. *Clinical Infectious Diseases*, *72*(11), e893–e900.  
<https://doi.org/10.1093/cid/ciaa1527>

- U.S. Department of Agriculture (USDA). (2019). Brazil once again becomes the world's largest beef exporter. Retrieved from <https://www.ers.usda.gov/amber-waves/2019/july/brazil-once-again-becomes-the-world-s-largest-beef-exporter/>
- U.S. Securities and Exchange Commission. (2023). Shareholder Proposal No. 5 on McDonald's Corporation. 2023 Proxy Statement: Advisory Vote on Adoption of Antibiotics Policy. <https://www.sec.gov/Archives/edgar/data/63908/000121465923005605/r418230px14a6g.htm>
- United Kingdom Department of Health & Social Care. (2023). The Fleming Fund Annual Review. Retrieved from <https://www.flemingfund.org/publications/the-fleming-fund-2022-annual-review/>.
- United Nations Framework Convention on Climate Change. (1994). *United Nations Framework Convention on Climate Change, opened for signature June 4, 1992, S. Treaty Doc. No. 102-38 (1992), 31 ILM 849 (1992)*. <https://unfccc.int/resource/docs/convkp/conveng.pdf> (entered into force Mar. 21, 1994) [hereinafter UNFCCC].
- United Nations Framework Convention on Climate Change. (2010). *Decision 2/CP.15 Copenhagen Accord in Report of the Conference of the Parties on its fifteenth session held in Copenhagen from 7 to 19 December 2009*. Addendum, Part Two: the Conference of the Parties at its fifteenth session FCCC/CP/2009/11/Add.1 (hereinafter 'Copenhagen Accord').
- United Nations Framework Convention on Climate Change. (2015). *Paris Agreement to the United Nations Framework Convention on Climate Change, Dec. 12, 2015, T.I.A.S. No. 16-1104*.

United Nations. (2017). Secretary-General's remarks to Economic and Social Council on Repositioning the UN Development System to Deliver on the 2030 Agenda [as delivered]. *United Nations Secretary-General*. Retrieved from <https://www.un.org/sg/en/content/sg/statement/2017-07-05/secretary-generals-remarks-economic-and-social-council-repositioning>

United Nations. (2018). Working Together: Integration, institutions and the Sustainable Development Goals, World Public Sector Report 2018. *Division for Public Administration and Development Management, Department of Economic and Social Affairs (DPADM)*.

United Nations. (2021). The Global Leaders Group on Antimicrobial Resistance. [https://www.un.org/pga/75/wp-content/uploads/sites/100/2021/04/GLG-2-pager-for-HLD-280421\\_final-1.pdf](https://www.un.org/pga/75/wp-content/uploads/sites/100/2021/04/GLG-2-pager-for-HLD-280421_final-1.pdf).

United States Securities and Exchange Commission. (2019). Domino's Pizza, Inc.; Rule 14a-8 No-Action Letter. *Division of Corporation Finance*.

United States Trade Representative. (2018). I. THE PRESIDENT'S TRADE POLICY AGENDA. <https://ustr.gov/sites/default/files/files/Press/Reports/2018/AR/2018%20Annual%20Report%20I.pdf>

Utting, P. (2015). Social and solidarity economy: Beyond the fringe. *Zed Books Ltd.*.

Venkatapuram, S. (2013). *Health justice: An argument from the capabilities approach*. John Wiley & Sons.

Ventola, C. L. (2015). The antibiotic resistance crisis: Part 1: Causes and threats. *P & T: A Peer-Reviewed Journal for Formulary Management*, 40(4), 277–283.

Wallinga, D. (2018). Better Bacon Why its High Time the U.S. Pork Industry Stopped Pigging Out on Antibiotics. *National Resources Defense Council*.

<https://www.nrdc.org/sites/default/files/better-bacon-pork-industry-antibiotics-ib.pdf>

Wasan, H., Singh, D., Reeta, K. H., & Gupta, Y. K. (2023). Landscape of Push Funding in Antibiotic Research: Current Status and Way Forward. *Biology*, *12*(1), 101.

<https://doi.org/10.3390/biology12010101>

Wernli, D., Harbarth, S., Levrat, N., & Pittet, D. (2022). A ‘whole of United Nations approach’ to tackle antimicrobial resistance? A mapping of the mandate and activities of international organisations. *BMJ global health*, *7*(5), e008181.

Wernli, D., Jørgensen, P.S., Harbarth, S., Carroll, S.P., Laxminarayan, R., et al. (2017)

Antimicrobial resistance: The complex challenge of measurement to inform policy and the public. *PLOS Medicine* *14*(8): e1002378.

<https://doi.org/10.1371/journal.pmed.1002378>

World Health Organization. (2002). WHO traditional medicine strategy: 2002-2005. Retrieved from <https://www.who.int/medicines/publications/traditionalpolicy/en/>

World Health Organization. (2019). *Future Global Governance for AMR*.

[https://www.who.int/antimicrobial-resistance/interagency-coordination-group/IACG\\_Future\\_global\\_governance\\_for\\_AMR\\_120718.pdf](https://www.who.int/antimicrobial-resistance/interagency-coordination-group/IACG_Future_global_governance_for_AMR_120718.pdf).

World Health Organization. (2022). “Report signals increasing resistance to antibiotics in bacterial infections in humans and need for better data.” *World Health Organization*. Retrieved from <https://www.who.int/news/item/09-12-2022-report-signals-increasing-resistance-to-antibiotics-in-bacterial-infections-in-humans-and-need-for-better-data>.

Willis, L. D., & Chandler, C. (2019). Quick fix for care, productivity, hygiene and inequality: reframing the entrenched problem of antibiotic overuse. *BMJ global health*, 4(4), e001590.

Wilsdon, T., Robson, A., & Lanting, L. (2022). A framework for assessing the potential net benefits realized through Transferable Exclusivity Extension (TEE) as an incentive for development of novel antimicrobials: FINAL REPORT. *Charles Rivers Associates*.  
<https://www.efpia.eu/media/676634/cra-efpia-a-framework-for-assessing-the-costs-and-benefits-of-tee-final-report.pdf>

Woolhouse, M., Ward, M., van Bunnik, B., & Farrar, J. (2015). Antimicrobial resistance in humans, livestock and the wider environment. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, 370(1670), 20140083.  
<https://doi.org/10.1098/rstb.2014.0083>

World Economic Forum. (2023). “What is antimicrobial resistance and how can we tackle it?” Retrieved from <https://www.weforum.org/agenda/2023/11/antimicrobial-resistance-superbugs-antibiotics/>.

World Health Organization, B. (2019). No time to wait: securing the future from drug-resistant infections. *Report to the Secretary-General of the United Nations. Interagency Coordination Group on Antimicrobial Resistance*.

World Health Organization, Food and Agriculture Organization of the United Nations, & World Organisation for Animal Health. (2016). Antimicrobial resistance: a manual for developing national action plans. *World Health Organization*.  
<https://www.who.int/publications/i/item/antimicrobial-resistance-a-manual-for-developing-national-action-plans>

World Health Organization. (2015). Global action plan on antimicrobial resistance. World Health Organization.

World Health Organization. (2019). Ten threats to global health in 2019. World Health Organization.

World Health Organization. (2021). Global antimicrobial resistance and use surveillance system (GLASS) report: 2021.

World Health Organization. (2022). Antimicrobial resistance surveillance in Europe 2022–2020 data.

World Health Organization. (2023). A one health priority research agenda for antimicrobial resistance.

World Health Organization. (2023). *People-centered approach to addressing antimicrobial resistance in human health*. <https://www.who.int/publications/i/item/9789240082496>

World Veterinary Association. (2020). Strategic Plan 2020-2025. *World Veterinary Association*. [https://worldvet.org/uploads/docs/wva\\_strategic\\_plan\\_2020-2025.pdf](https://worldvet.org/uploads/docs/wva_strategic_plan_2020-2025.pdf)

World Veterinary Association. (2021). Global Repository of Available Guidelines for Responsible Use of Antimicrobials in Animal Health. *World Veterinary Association*. [https://worldvet.org/uploads/news/docs/list\\_of\\_available\\_guidelines\\_on\\_amu\\_-aug2019.pdf](https://worldvet.org/uploads/news/docs/list_of_available_guidelines_on_amu_-aug2019.pdf)

Wouters, O. J. (2020). Lobbying expenditures and campaign contributions by the pharmaceutical and health product industry in the United States, 1999-2018. *JAMA internal medicine*, 180(5), 688-697.

Ya, K. Z., Lambiris, M. J., Levine, G. A., Tediosi, F., & Fink, G. (2023). Coverage of policies to improve antimicrobial stewardship in low and middle income countries: Results from the

first Global Survey of Experts on Antimicrobial Resistance. *BMC Public Health*.

<https://doi.org/10.21203/rs.3.rs-2948309/v1>

Yam, E. L. Y., Hsu, L. Y., Yap, E. P. H., Yeo, T. W., Lee, V., Schlundt, J., ... & Wilder-Smith, A.

(2019). Antimicrobial Resistance in the Asia Pacific region: a meeting report.

Zinsstag, J., Schelling, E., Waltner-Toews, D., Tanner, M., & editors. (2015). One health: The theory and practice of integrated health approaches. CABI.

<https://doi.org/10.1079/9781780643410.0000>

### Appendix

**Figure 1**

Cluster Map of Global Governance Mechanisms found in the literature.



**Figure 2**

ABS Governance Coding Tree.

Codes			Search Project
⊕ Name	▼ Files	References	
⊖ Political Will	0	0	
○ Industry commitment	0	0	
○ Government commitment	0	0	
⊖ Policy Implementation	0	0	
○ Surveillance system	0	0	
○ Stakeholder engagement	0	0	
○ Resource allocation	0	0	
⊖ Evidence	0	0	
○ Scientific research	0	0	
○ Health outcomes	0	0	
○ Epidemiological data	0	0	
○ Clinical trials	0	0	
⊖ Driving forces	0	0	
○ Market dynamics	0	0	
○ Intersectoral interest alignment	0	0	
○ International frameworks	0	0	
○ Economic incentives	0	0	
○ Behavioral practices	0	0	

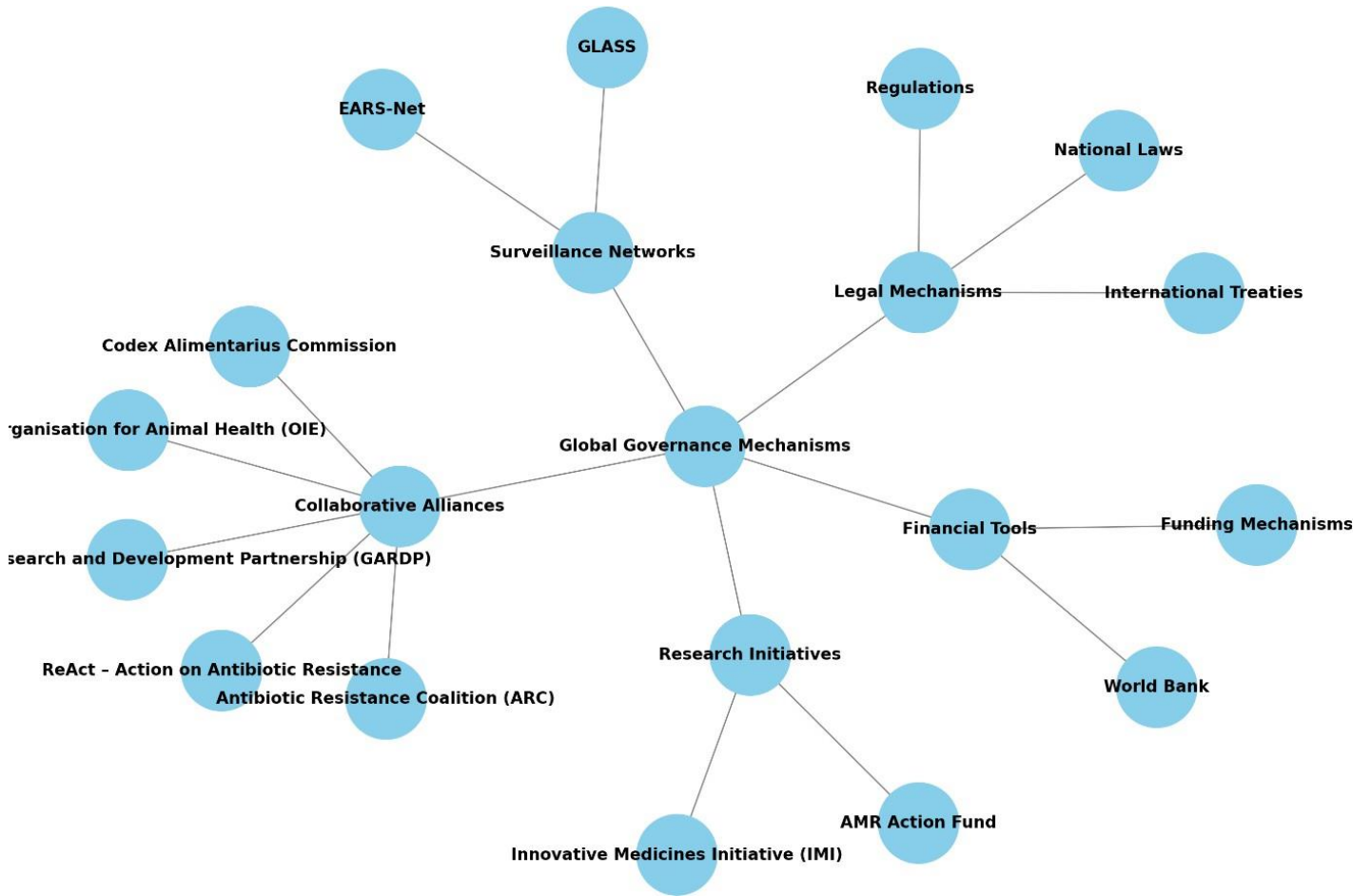
**Codes**

Name	Files	References
ABS Interventions	0	0
IOs	0	0
Regulation of Use	0	0
Public awareness campaigns	0	0
Professional education and traini	0	0
Multisectoral coordination mech	0	0
Infection Control and and Preven	0	0
Antibiotic stewardship guidelines	0	0
INGOs	0	0
Regulation of Use	0	0
Public awareness campaigns	0	0
Professional education and traini	0	0
Multisectoral coordination mech	0	0
Infection Control and and Preven	0	0
Antibiotic stewardship guidelines	0	0
Industry	0	0
Regulation of Use	0	0
Public awareness campaigns	0	0
Professional education and traini	0	0
Multisectoral coordination mech	0	0
Infection Control and and Preven	0	0
Antibiotic stewardship guidelines	0	0

Note. Coding tree of antibiotic stewardship for the qualitative coding of the global governance of ABS. Own work.

**Figure 3**

Mind Map: Global Governance Mechanisms in Combating AMR



Note. Cluster mind map of global governance mechanisms in combatting AMR. Own Work.

**Figure 4.**

Table of AMR collaborative alliances

<b>Collaborative Alliance</b>	<b>Contributions</b>	<b>Interconnectedness</b>	<b>Impact on Policy and Research</b>	<b>Challenges and Limitations</b>
Codex Alimentarius Commission	Endorses food standards, guidelines, and practices impacting AMR in agriculture.	Integrates food safety and AMR management.	Influences international food safety policies and agricultural practices.	Balancing food industry interests with public health goals.
World Organisation for Animal Health (WOAH)	Provides standards and guidelines for responsible antimicrobial use in animals.	Contributes to ecosystem balance by controlling antibiotic use in animals.	Guides national and international policies on animal health and antibiotic use.	Ensuring global adoption and compliance with guidelines.
Global Antibiotic Research and Development Partnership (GARDP)	Focuses on developing new antibiotic treatments and ensuring responsible usage.	Aligns with WHO's broader goals in combating AMR.	Informs global research agendas and healthcare policies on antibiotic development.	Navigating funding challenges and aligning with diverse health systems.
ReAct – Action on Antibiotic Resistance	Mobilizes funding for NAPs, focusing on capacity building and policy advocacy.	Complements national and international efforts in AMR policy formulation.	Advocates for effective AMR policies, especially in LMICs.	Addressing varying national priorities and resource limitations.

Collaborative Alliance	Contributions	Interconnectedness	Impact on Policy and Research	Challenges and Limitations
Antibiotic Resistance Coalition (ARC)	Shapes policy debates and fosters cooperation across civil society and intergovernmental organizations.	Brings diverse stakeholders together for a united approach to AMR.	Contributes to shaping international AMR policy discourse.	Harmonizing diverse stakeholder interests and policy perspectives.
Joint Programming Initiative on Antimicrobial Resistance (JPIAMR)	Streamlines resources and coordinates national research efforts in AMR.	Fosters global research collaboration and resource sharing.	Influences national research policies and priorities in AMR.	Coordinating efforts across countries with differing AMR challenges.
AMR Industry Alliance	Drives progress in research and responsible antibiotic use in the pharmaceutical, biotechnology, and diagnostics sectors.	Synergizes industry efforts with global health objectives.	Impacts industry standards and practices in antibiotic development and use.	Aligning industry actions with global public health needs.
Global AMR R&D Hub	Amplifies global AMR R&D endeavors, promoting efficient use of R&D resources.	Coordinates international investment in AMR research.	Guides global research funding and priorities in AMR.	Securing funding and managing research
Transatlantic Task Force on Antimicrobial Resistance (TATFAR)	Enhances cooperation in key areas such as therapeutic antimicrobial use and prevention strategies.	Facilitates cross-border policy and research collaboration.	Shapes international strategies for AMR prevention and drug development.	Overcoming political and regulatory differences between countries.

Note. Table of collaborative alliances as well as their contributions, interconnectedness, impact and challenges. Own work.