Master's Thesis of Tsubasa (Kenneth) Kaneko

A chronological analysis of national action plans on antimicrobial resistance from WHO member states, using natural language processing techniques

WHO회원국의 항생제 내성에 대한 자연어 처리를 통한 국가행동계획의 연대기적 분석

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Graduate School of International Studies
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Table of Contents

Abstract

Keyword: Antimicrobial Resistance, World Health Organisation, National Action Plan, Natural Language Processing, Term Frequency, Term Frequency Inverse Document Frequency
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Background: In less than a century after the discovery of Penicillin, Antimicrobial resistance (AMR) has quickly become an issue worldwide that is especially pressing in low-and-middle income countries (LMICs). In light of a need for global coordinated action, WHO endorsed the Global Action Plan (GAP) on AMR in 2015, in an effort to urge the 194 member states of the World Health Organization to integrate the five objectives and corresponding actions of the GAP into national action plans (NAPs). As most NAPs were given an implementation period of 3 to 5 years, member states have begun to develop an updated version that takes into account the post-pandemic climate. Accordingly, this study employs natural language processing (NLP) techniques to quantitatively analyse the extent by which the focus in the NAPs has shifted, in terms of their strategic objectives and interventions.
Methods: The study investigates the alterations in global AMR governance. The extent of alteration is quantified based on term-frequency (TF) and term-frequency-inverse document frequency (TF-IDF). The quantification of TF reveals the relative prominence of strategic objectives and interventions, whereas the quantification of TF-IDF enables the identification of interventions that occur more frequently in a particular AMR-NAP. The sample includes 18 countries that have published two NAPs since the adoption of the GAP-AMR; one prior to and one post-pandemic. The terms in the documents were sorted into 10 domains that correspond to the 5 objectives and interventions and to 5 additional distinct term groups that signify policy design, monitoring and evaluation (M&E).
Results: In terms of the five key objectives listed in the GAP-AMR, terms associated with reducing the incidence of infection through effective sanitation, hygiene, and IPC measures, and improving AMR awareness and understanding through effective communication, education and training saw an increase in its frequency (△13.62%, △4.34% respectively), whereas terms linked to strengthening knowledge and evidence base by bolstering AMR surveillance and research, making an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions, and optimising antimicrobial use in human and animal health saw cuts in TF (▲5.32%, ▲11.12%, ▲19.40%, respectively). In terms of policy design and M&E, terms associated with cost-effectiveness saw its first introduction in the most updated versions of NAPs, while terms associated with international engagement saw the largest decrease (▲15.4%). Meanwhile it must be noted that substantial cross-country variation exists in the distribution of interventions that are distinctly frequent in each AMR-NAP.
Conclusion: From the results of this study, one can deduce that between the first and second NAPs, the focus of countries' AMR strategies has shifted from the pursuit of global coordination to the reinforcement of domestic infection prevention measures, as well as from interventions pertaining to the production of food to its consumption. While various causes may be plausible, it is possible that the COVID-19 pandemic may have been one factor driving the shift towards augmenting infection prevention and control measures, as well as a larger emphasis placed on cost-effectiveness. ODA projects aimed towards the reduction of AMR in LMICs could take the results of this analysis to align their strategies with the priorities of the hosting country, while for international organisations such as WHO, there is a strong implication that the past pandemic may have accelerated the shift away from global coordination towards domestic reinforcement, and that it is consequently pertinent to create mechanisms that may incentivise member states to take a more global approach.

1. Introduction

In 1942, the extraction of penicillin from the fungus Penicillium rubens forever transformed medical practice, as penicillin became the first antimicrobial available for mass production. Though its availability was initially limited to military use, its use in civilian medicine soon followed suit. However, the augmentation of the production capacity of antimicrobials also gave rise to its misuse and overuse. Though numerous classes of antimicrobial agents other than penicillin have been discovered and employed in clinical practice over the last century, the threat of a post-antimicrobial age now looms over the world, as such antimicrobials have steadily been losing its efficacy.

This phenomenon now termed *antimicrobial resistance*, or AMR is the ability of microorganisms, such as bacteria, viruses, fungi, and parasites, to resist the effects of antimicrobial drugs that were previously effective in treating infections caused by these organisms. AMR is a complex issue that must be addressed from the local, country, and global level as well as in various fields including research, clinical practice, governance and international development. For decades, AMR was viewed mainly as an issue that pertains to research and clinical practice, and that a sustained antimicrobial innovation pipeline in addition to its rational use would be sufficient in controlling the progression of AMR. However, in recent years, there has been an increased recognition of AMR as a global health priority that requires multi-dimensional engagement. Notably, it has become clear that the complexity of AMR also necessitates policies that range in diversity. Such policies include antimicrobial stewardship, infection prevention and control, surveillance and public awareness and regulation. Furthermore, such policies must be considered from a "One Health" perspective, accounting for human, animal, and environmental health. Given such challenges, within the field of health policies, there exists considerable interest in governance within AMR policies[1].

The heightened recognition of AMR as a priority in global health consequently culminated in the 2015 publication of the AMR Global Action Plan (hereby abbreviated GAP or GAP-AMR) by the World Health Organisation (WHO), which is a blueprint for action that aims to ensure the continuity of treatment and prevention of infectious diseases with effective and safe medicines[2]. Not only did WHO specify five strategic objectives encompassing 85 recommended interventions on the GAP-AMR, it also expected member countries to develop their own national action plans that are in congruence with the strategic objectives interventions highlighted in the GAP-AMR while also tailoring their approaches to account for local needs and contextual factors. This is due to the notion that like many other global issues, policies pertaining to AMR cannot be applied uniformly, and should be found upon an understanding of the circumstances of each country.

Within five years of the publication of the GAP-AMR in 2015, 119 countries have developed their own NAP[3]. Considering the broadness of its reach, NAPs offer a comprehensive source of information for evaluating the formulation and execution of AMR policy goals in individual countries. In essence, these documents outline a series of strategic objectives deliberated by policymakers to address AMR, detail the interventions planned for advancing these objectives, and delve into various implementation challenges related to monitoring, evaluating AMR initiatives, and allocating resources to the AMR agenda. In light of the fact that NAPs are published country-by-country, it may seem that the response to AMR rests completely within the realm of individual countries' health policies. Contrary to this suggestion, international organisations, donor countries and NGOs have a profound influence on policy decisions, especially in LMICs that rely heavily on external funding schemes to strengthen and implement their capacity to respond to AMR. While it would be ideal for all countries

[1] Anderson et al., 2019
[2] World Health Organisation. 2015
[3] Harant A., 2022

to have the resources required for their own AMR interventions, from the perspective of such donors, it is consequently imperative to systematically compare the content of AMR-NAPs using a standardised methodology to ascertain as to how the priorities presented in these documents differ from country to country, in order to optimise the nature of assistance which is to be provided.

Moreover, given the evolving nature of AMR, its governance has been conceptualised as a dynamic and continuous process that consistently enhances and adapts based on the insights gained from monitoring and evaluation. NAPs have thus been given a specific time frame during which it will be applied, with the expectation that new editions will be published. Seeing that the first edition of NAPs for many WHO member countries were drafted in the years immediately following the publication of the GAP-AMR in 2015, several countries have begun to develop and publish a second NAP. Between the publication of the first and second NAP for such countries, the circumstances encompassing global health have changed drastically, notably due to the outbreak of the COVID-19 pandemic which required an overhaul of global health priorities and strategies. Nonetheless, only a handful of multi-country studies have systematically analysed how these documents have been updated over the past decade, as most studies only aim to capture the most current state of AMR policies, without considering its development. As even less attention has been paid as to how country priorities and strategies have shifted between various versions of NAPs, this study aims to address this particular gap in research and systematically examine the chronological development of the priorities and strategies presented in country NAPs by making use of natural language processing (NLP) techniques to identify themes.

2. Background and Purpose of Research

While global initiatives pertaining to AMR such as the GAP-AMR have only been recently initiated, AMR as an issue traces its origins to the 1950s and 60s, when the first antimicrobials gained widespread usage. Since then, AMR has experienced waves of international attention, with evolving framings on AMR emerging over the course of time In the first four decades following the clinical use of penicillin, AMR was predominantly considered a challenge for the global north, with the belief that it could be addressed through judicious and 'rational drug' use or the imposition of selective drug restrictions. It wasn't until the 1990s that AMR gained consistent attention in international reporting, with an increasing number of reports addressing both human and agricultural aspects of AMR selection. In the 2000s, and particularly after 2010, there was a shift in focus towards the Global South and the One Health approach in international reporting. Presenting AMR as a risk primarily affecting Southern regions has caused a deterritorialization of international policy discussions. This shift has placed mounting pressure on LMICs to implement reforms centred on AMR. Additionally, it has elevated the role of international organisations such as the WHO, which have transformed its role from simple whistleblowing towards their active participation in global governance and surveillance frameworks for AMR. The decade following 2010 witnessed a zenith of global engagement, marked by the release of numerous highly impactful reports and a swift evolution in the framing of AMR within the global health fora. Key themes during this time encompassed the emergence of AMR as a central concern in international policy formation, the concurrent prominence of concepts like One Health and the Global South, and the concomitant transition of the role of international organisations from mere whistleblowing to active governance as previously mentioned. Furthermore, there was a decline in international attention preceding the onset of the COVID-19 pandemic; a trend that has accelerated during and following the pandemic.

History of AMR as an Issue

The first international report on AMR was published in 1955 under the title *Proceedings of the first International Conference on the use of antibiotics in agriculture*[4]. This report exclusively delved into the agricultural dimension of AMR. Following this, attention to AMR remained sporadic, with international reports scrutinising threats primarily associated with individual practices, particularly those in agriculture, from the mid-1960s onward. It wasn't until the early to mid-1990s that the recognition of AMR as a burgeoning human health concern prompted more consistent efforts. From the late 1990s onward, there has been a sustained rise in international policy-level attention to AMR, coinciding with a global framing of AMR threats necessitating international intervention. Despite the ongoing intensification of the AMR issue, the number of international reports began to decline after the years of 2017 and 2019. This decrease, coupled with recent reductions in international funding and support from significant national donors, may suggest that the international focus on AMR reached a turning point even before the advent of the COVID-19 pandemic.

The rhetoric employed in reports addressing global antimicrobial use, stewardship, and AMR has closely mirrored broader moral frameworks. Resonating with postwar consumer movements, initial documents concentrated on ensuring effective and suitable ('rational') use of antimicrobials in specific settings, such as hospitals, farms, and community clinics. In contrast to the early emphasis on optimising the value of antibiotics, documents published from the mid-1990s onward progressively

[4] Proceedings of the first International Conference on the use of antibiotics in agriculture. Washington (DC): National Academy of Sciences - National Research Council, 1955.

portrayed AMR as a challenge rooted in resource scarcity, marked by a dearth of new drugs, and advocated for addressing it through conservationist strategies. Despite earlier initiatives in the Global North, it wasn't until the 2000s that the integrated surveillance of antibiotic use gained prominence as a key international policy objective. While various approaches to maintaining antibiotic efficacy were experimented with since the 1940s, the term "antimicrobial stewardship" was coined in 1996[5]. It took several years for stewardship to become a central component of the globally recognized dual strategy for addressing AMR, which involves both antimicrobial innovation and preservation. Although the definitions of stewardship remain somewhat amorphous, the term gained significant traction as a sensitising concept around 2010. Reflecting the delayed integration of international policy in the Global South, stewardship initially focused on Northern contexts and was only gradually extended to LMIC contexts. Despite this evolution, certain aspects of the initial 'rational' use discourse have persisted, manifesting in behaviourist interventions and aspirations for precision medicine, such as targeted diagnostics and treatments.

The duration and potential impacts of the current surge in international attention towards AMR remain uncertain. Some argue that AMR awareness has already peaked. Even before political priorities shifted towards COVID-19, the annual count of international reports dedicated to AMR reached its highest point in 2017[6]. This occurred despite the ongoing escalation of global antimicrobial usage, the rise of AMR, an international outbreak of extensively drug-resistant typhoid, challenges in antibiotic innovation, and a continuous neglect of environmental health within the One Health frameworks. Assessments of numerous NAPs indicate uncertainty regarding the influence of the extension of international AMR governance at national and regional levels[7][8]. Conversely, diminishing international attention highlights the inherent difficulty of addressing AMR as a policy problem. In the perspective of 2021, the historical challenge of international AMR policy lies in being both too discrete and too vast for its own good. When framed as a problem of drug failure, AMR often elicited 'quick fix' solutions, such as partial restrictions, narrow behavioural interventions, and prioritisation of innovation over stewardship. These approaches frequently proved inadequate in the face of the intricate, interconnected ecologies of AMR and the challenges of infectious diseases in both low- and high-income country contexts. However, when analysed comprehensively, addressing AMR becomes a complex task of addressing everything, everywhere, and well-intentioned policy initiatives tend to falter.

Addressing AMR in the Global Health Fora

Despite AMR stewardship being a central component for addressing AMR, its conceptualisation remains rather amorphous. In a broad sense, AMR stewardship can be characterised as a strategy encompassing a cohesive set of actions aimed at fostering responsible use of antimicrobials[9]. The particular actions may differ based on the entity involved, but they exhibit numerous shared characteristics across various levels within a healthcare system and between human and animal health. The influence of AMR stewardship on antibiotic utilisation may vary based on the frequency of resistant infections in clinical environments, geographical locations, and the resources at hand. Currently, there is limited comprehensive evidence regarding the efficacy of Antimicrobial Stewardship Programs (ASPs) in LMIC, where the resources required for monitoring and surveillance are lacking. Meanwhile, as mentioned earlier, the traditional and widely accepted perspective posits

[5] McGowan JE, Gerding DN. 1996;4:370–6.
[6] Clift C., 2019.
[7] Munkholm L, Rubin O., 2020;16:1–11. 80
[8] Munkholm L et al., 2021;42:236–48.
[9] Dyar et al., 2017

that AMR is largely linked to the quantity of antibiotics employed in human and animal sectors, as well as to contagion—namely, the dissemination of AMR pathogens and/or genetic elements of resistance in the environment. However, this notion does not align completely with observations indicating a higher proportion of AMR in various LMICs where antibiotic consumption is considerably lower than in HICs. Indeed, prior evidence demonstrates that the relationship between antibiotic use and the spread of AMR is not consistently correlated, both within individual countries and across different nations.

In contrast to the prevailing viewpoint, the study conducted by Collignon and colleagues revealed positive correlations between AMR proportions and indicators of poorer administrative governance, the ratio of private to public health expenditure, and higher temperatures[10]. The authors identified robust and positive effects of infrastructure and administrative governance, especially in terms of lower corruption levels, in mitigating AMR proportions when multiple factors were considered simultaneously. Unexpectedly, antibiotic consumption did not exhibit a significant association with AMR levels. In their commentary on this discovery, Collignon and Beggs underscored that contagion is the primary contributing factor to global variations in AMR. The transmission of resistant pathogens poses a critical challenge in various healthcare settings and communities. According to the contagion hypothesis, AMR levels tend to be higher in LMIC characterised by inadequate infrastructure, subpar community hygiene, weak administrative governance, and limited social commitment[11]. In general, such results highlighted a dual linear association between the governance index and both antibiotic consumption and AMR[12]. Hence, monitoring and evaluating the condition of governance is a crucial factor to take into account when contemplating the evolution of AMR.

Why AMR is an ongoing issue

Even though AMR, also coined the "silent pandemic" remains a global health crisis under progression, the level of awareness both amongst policy makers and the general public pales in comparison to other issues such as infectious disease. This underscores the inherent complexity of AMR as a policy challenge. From the perspective of 2023, the historical dilemma in international AMR policy lies in its dual nature—being both excessively nuanced and expansively vast, which may pose unique challenges. However, it is essential to note that this does not diminish the significance of AMR as a substantial threat to the ongoing provision of safe healthcare.

According to estimates published on the Lancet by Murray et al., in 2019, 1.27 million deaths (95% uncertainty interval [UI] 0·911–1·71) were directly attributable to resistance, based on the counterfactual scenario that drug-resistant infections were instead drug susceptible[13]. In the 2019 edition of the Global Burden of Disease study, considering a scenario where there are no infections, AMR would have ranked as the third leading cause of death among all underlying causes, surpassed only by ischaemic heart disease and stroke. This places AMR as a significant contributor to global mortality. Under an alternate counterfactual scenario where infections are present but the pathogens are susceptible, AMR would have been the 12th leading cause of death at the GBD Level 3, surpassing both HIV and malaria in global rankings. These findings highlight the substantial impact of AMR on mortality compared to various other causes[14]. Furthermore, the research demonstrated that all-age mortality rates related to AMR were most elevated in certain LMICs, emphasising that AMR

[10] Collignon P, Beggs JJ, Walsh TR, Gandra S, Laxminarayan R. 2018;2(9):e398–405
[11] Collignon P, Beggs JJ. 2019;8(3):86.
[12] Maugeri et al., 2023
[13] Naghavi et al., 2022
[14] Vos T, Lim SS, Abbafati C, et al. 2020; 396: 1204–22.

is not only a significant global health concern but also an especially severe issue for many developing nations.

As mentioned in the previous section, it may seem reasonable to anticipate that in settings with elevated antibiotic consumption, the incidence of bacterial AMR would augment correspondingly. Contrary to this intuition, findings indicate that the highest mortality rates related to bacterial AMR are observed in sub-Saharan Africa and south Asia[15]. The substantial bacterial AMR burdens in these regions stem from both the prevalence of resistance and the underlying frequency of critical infections, such as lower respiratory infections, bloodstream infections, and intra-abdominal infections, which are more prevalent[16]. Several factors contribute to the heightened burden in LMICs, including the lack of laboratory infrastructure, leading to the unavailability of microbiological testing to guide treatment decisions for stopping or narrowing antibiotic use. Additionally, inappropriate antibiotic use driven by lax regulations and ease of acquisition[17], limited access to second-line and third-line antibiotics, the presence of counterfeit or substandard antibiotics fostering resistance, and inadequate sanitation and hygiene contribute even further to the observed disparities[1819].

Pertaining to inappropriate antibiotic use, the volume of antibiotic consumption in non-clinical settings is predominantly linked to the widespread availability of over-the-counter (OTC) antibiotics and the practice of non-prescription antibiotic use. A study revealed a global prevalence of 62% in non-prescription antibiotic sales across community pharmacies, with the highest incidence (78%) observed in South America[20]. Meanwhile, in primary care and outpatient settings, the issue of antibiotic over-prescription remains a significant concern worldwide. Numerous studies have reported elevated rates of antibiotic prescription in outpatient sectors, spanning high-income countries such as the US (59.1%)[21], South Korea (80.9%)[22] and European countries (approximately 90%)[23], as well as in LMICs such as India (69.4%, specifically among patients with acute infections)[24] and China (50.3%)[25].

Studies have also indicated that the improper utilisation of antibiotics may cause a significant economic burden. In Ghana, the associated healthcare costs were estimated to be approximately 20 million USD per year[26]. Similarly, a study in Japan reported substantial costs attributed to inappropriate antibiotic prescriptions for upper respiratory infections (URIs), amounting to 297 million USD in 2016[27], though it may be difficult to draw direct comparisons of its scale due to variations in population size, URI epidemiology, and methodological differences.

Under any circumstance, the heightened burden in healthcare systems with limited resources underscores the critical importance, both for individual patient management and AMR surveillance, of well-established national action plans and robust laboratory infrastructure across all regions and countries. Geographically, the pattern of AMR varies significantly, with different pathogens and drug combinations dominating in distinct locations. Consequently, it is essential to customise local responses, as a one-size-fits-all approach may be inappropriate. While antibiotic stewardship is fundamental for curbing the spread of AMR, restricting access to antibiotics is not universally

[15] Naghavi et al., 2022
[16] Vos T, Lim SS, Abbafati C, et al. 2020; 396: 1204–22.
[17] Morgan DJ, Okeke IN, Laxminarayan R, Perencevich EN, Weisenberg S. 2011; 11: 692-701
[18] Collignon P, Beggs JJ, Walsh TR, Gandra S, Laxminarayan R. 2018; 2: e398-e405
[19] Ramay BM Caudell MA Cordón-Rosales C et al. 2020; 1013767
[20] Auta A, Hadi MA, Oga E, Adewuyi EO, Abdu-Aguye SN, Adeloye D, et al. 2019;78:8e18.
[21] Suda KJ, Hicks LA, Roberts RM, Hunkler RJ, Matusiak LM, Schumock GT. 2018;66:185e90.
[22] Yoon YK, Park GC, An H, Chun BC, Sohn JW, Kim MJ. 2015;94: e2100.
[23] ECDC. 2019.
[24] Yin X, Song F, Gong Y, Tu X, Wang Y, Cao S, et al. 2013;68:2445e52.
[25] Kumari Indira K, Chandy S, Jeyaseelan L, Kumar R, Suresh S. 2008;128:165e71.
[26] Janssen et al., 2022
[27] Tsuzuki S, Kimura Y, Ishikane M, Kusama Y, Ohmagari N. 2020;20(1):153.

applicable as a response to AMR in all settings. An argument can be made that increasing access to antibiotics may reduce the AMR burden in certain locations where second-line antibiotics are unavailable, potentially saving lives—this is particularly relevant in western sub-Saharan Africa. Conversely, limiting antibiotic access in south Asia through stewardship programs might be a suitable response for that region, given that antibiotic overuse or misuse is considered a major driver of AMR. In essence, AMR is a global challenge necessitating both global initiatives and tailored responses at the national level. Nonetheless, it has been mentioned that the greatest challenge for most countries is not the drafting of a NAP but rather its implementation and demonstration of sustained action.

AMR governance and ODA

Given that the successful execution of AMR governance necessitates a nuanced blend of strategies and interventions, the entities responsible for implementation, typically public health agencies, must possess both the funds and technical capabilities to uphold these endeavours. As indicated above, this poses a particular challenge for LMICs, which may be lacking in such resources.

A crucial aspect of AMR governance involves implementing Infection Prevention and Control (IPC) measures in healthcare facilities. These measures aim to safeguard patients, healthcare workers, and consequently the community from acquiring and suffering harm due to preventable healthcare-associated infections (HAIs) and AMR. Unfortunately, the neglect of HAIs persists, particularly in resource-limited settings, disproportionately affecting vulnerable populations and resulting in elevated morbidity and mortality rates. As highlighted in the GRAM report, the majority of AMR-related fatalities are attributed to six prominent bacterial pathogens that are also significant causes of HAIs. Klebsiella pneumoniae is responsible for the highest attributable burden in sub-Saharan Africa, while Escherichia coli is more prominenth in South Asia[28]. Effective IPC is indispensable for delivering modern healthcare services of high quality. Practices like hand hygiene, when combined with environmental cleaning and antibiotic stewardship, have proven to be cost-effective and lifesaving by reducing HAIs and associated illnesses. Hand hygiene, as a central component of IPC, necessitates application in multimodal bundles within healthcare facilities, integrating training and real-time feedback loops for effectiveness and to support the required behavioural change. Regrettably, the deficient state of Water, Sanitation, and Hygiene (WASH) services, especially in regions burdened by high levels of AMR, hampers the implementation of IPC activities. Approximately 50% of health facilities in the 47 least-developed countries lack basic water services[29]. Similar challenges extend to sanitation and waste management. Urgent attention and investments are imperative for improving the built infrastructure of health facilities, ensuring the availability of essential materials such as soap and alcohol rub, providing training, and maintaining adequate staffing levels.

Hence, many LMICs heavily depend on external funding to enhance laboratory capacity and implement AMR surveillance programs. Various agencies, including the Fleming Fund, WHO, and the U.S. Centers for Disease Control and Prevention (CDC), provide such external funding[30]. The primary objective of these funding initiatives is to enhance AMR surveillance in LMICs. The United Kingdom Department of Health initiated the Fleming Fund to assist low-income countries in establishing AMR surveillance systems, aligning it with the WHO's Global AMR Surveillance System (GLASS) to support the Global Action Plan on AMR. To bolster capacity in LMICs, the Fleming

[28] Murray et al., 2022
[29] World Health Organization. 2020.
[30] Gandra S, Alvarez-Uria G, Turner P, Joshi J, Limmathurotsakul D, van Doorn HR. 2020

Fund has allocated a total of 265 million pounds to different countries[31]. Bangladesh, India, Laos, Nepal, Pakistan, and Vietnam have received Fleming Fund country grants to launch or reinforce AMR surveillance activities. However, the limited availability of financial resources and the dependence on external funding to enhance laboratory capacity poses an additional challenge, as these investments are typically of a short-term nature, emphasising the necessity for internal funding and government engagement. This predicament can impact the sustainability of the achieved progress unless the government implements internal funding and prioritises health initiatives to fortify the health systems in combating resistance.

Many such organisations that fund ODA initiatives implement such programmes in conjunction with local stakeholders. However, past studies have indicated that global health and development initiatives originating in high-income countries could overshadow local priorities and perpetuate unequal power dynamics, even with good intentions[32333435]. Additionally, studies underscore the significance of thoughtful program design to ensure that these initiatives genuinely benefit lower-income countries. Notably, aligning research funded by ODA with universal concerns and global public goods (GPGs) may divert resources from the specific needs and research priorities of countries eligible for ODA[36]. Although ODA programmes and research serves as a public good with the potential to benefit nations at all income levels, the practical utilisation of new vaccine discoveries or innovative technologies requires in-country capacity. Furthermore, funding mechanisms have the potential to alter the research and clinical landscape in recipient countries, producing both positive and negative unintended consequences. Hence, it is crucial to acquire a comprehensive awareness of local priorities and capacities, considering not only their present status but also how they have evolved over time.

The Juncture of NAPs and AMR Governance

When it comes to understanding local priorities and capacities, AMR NAPs offer a unique perspective due to their consistent format across countries and extensive coverage of over 190 countries. Meanwhile, there is a shortage of national annual progress reports that systematically address the advancements of the NAP. In several countries, reports have described the development of new AMR guidelines during the implementation period of the NAP[37]. These findings suggest that progress is occurring; however, there is a lack of systematic communication.

In order to bridge this gap, there have been several initiatives that have aimed to analyse the content of NAPs as well as the current state of its progress. One such example is the Global Database for Antimicrobial Resistance Country Self-Assessment[38] made available by the Tripartite (WHO, FAO (Food and Agriculture Organisation), WOAH (World Organisation for Animal Health)), which is a database created according to the result of annual surveys completed by member states. Although self-assessments can play a role in sustaining momentum and commitment to the global policy process, the Global Database for Antimicrobial Resistance Country Self-Assessment, intended for providing accurate and objective information on these initiatives, exhibits certain methodological shortcomings. Firstly, relying on self-reporting introduces subjectivity in interpretations and scores,

[31] Gandra S, Alvarez-Uria G, Turner P, Joshi J, Limmathurotsakul D, van Doorn HR. 2020; 33(3):e00048-19.
[32] Bradley M. 2008;18(6):673–85. 23.
[33] Crane J. 2011;377(9775):1388–90. 24.
[34] Edejer TT-T. 1999;319(7207):438. 25.
[35] Matenga TFL, Zulu JM, Corbin JH, Mweemba O. 2019;17:7
[36] Kaul I, Conceição P, Goulven KL, Mendoza RU. 2003. p. 21–53.
[37] Harant A., 2022
[38] Global Database for Antimicrobial Resistance Country Self-Assessment. WHO, FAO, OIE. 2023.

with limited opportunities for third-party triangulation and validation of the reported data. This introduces a degree of arbitrariness as responses depend on the individuals completing the survey, leading to potentially counterintuitive results over time. Secondly, the dataset displays inconsistencies that could be attributed to errors in manual reporting. Thirdly, the survey questions vary from one iteration to the next, hindering the potential for longitudinal analyses. Lastly, the questions do not adequately capture alignment with all five objectives of the Global Action Plan (GAP). While the survey covers aspects related to AMR awareness and surveillance comprehensively, assessing alignment with objectives related to infection prevention and control, optimal medicine usage, and sustainable investments in new diagnostic tools poses greater challenges. Nonetheless, there are currently no other equivalent global datasets that provide information on the alignment of AMR policies.

Individual studies have also analysed the content and the current status of NAPs. The majority of studies have focused on NAPs of a single country or of a specific region, and have investigated the level of its implementation through consideration of factors such as income, geography, and governance[39][40][41][42]. Other studies have chosen to conduct analysis at the global level, mainly analysing governance strategies listed in NAPs, as it is crucial to shed light on the significant intersection between global governance initiatives and alignment at the national level in order to assess ongoing progress and to guide future planning. For instance, several studies have examined the alignment patterns between current NAPs and the GAP-AMR, investigating the connection between globally influenced health policies and initiatives at the national level[43]. Notably, the study by Özçelik et al. utilised natural language processing (NLP) techniques to systematically assess and compare the alignment of strategic objectives and interventions in AMR-NAPs from 21 OECD and G20 countries with the GAP-AMR. However, as of November 2023, multi-country analyses of NAPs have not incorporated the changes occurring within NAPs from the same country over the years. This oversight is notable despite the earlier mention of the importance of gaining a comprehensive understanding of local priorities and capacities, which involves not only assessing their current status but also acknowledging how they have evolved over time. Hence, this study aims to address this gap in research through the employment of NLP techniques to systematically examine the text extracted from chronologic versions of NAPs.

3. Method

Conceptual Framework

The complex nature of the drivers of AMR necessitates a systematic governance approach, given the need to consider a diverse range of policies encompassing surveillance, awareness, regulation, stewardship, and infection prevention and control, each within the context of human, animal, and environmental health. In order to conduct an objective assessment while incorporating such factors, this study employs the AMR governance framework by Anderson et al. to guide its analysis, which is the first systematic framework for the assessment of AMR-NAPs. In recent years, researchers have utilised the Anderson Framework to methodically evaluate the content of

[39] Chua et al., 2021
[40] Ohkusa et al., 2018
[41] Do et al., 2023
[42] Carelli et al., 2023
[43] Munkholm and Rubin, 2020

AMR-NAPs. This includes studies that analyse the alignment between individual NAPs and the global action plan[44] or assess the inclusion of vaccination as an intervention to reduce antimicrobial resistance[45]. However, as previously mentioned, prior studies on AMR governance have not addressed the evolution in AMR-NAPs. This study aims to fill these research gaps by employing the Anderson Framework to systematically analyse AMR-NAPs both chronologically and across countries.

Furthermore, the methodology of analysis will be modelled after that of Özçelik et al.[46], which was the first study to employ NLP-guided techniques to compare various AMR-NAPs and the GAP-AMR. Specifically, the study by Özçelik et al. measured the degree of alignment between AMR-NAPs and the GAP-AMR using two Natural Language Processing (NLP) metrics: term-frequency (TF) and term-frequency-inverse document frequency (TF-IDF). TF quantification facilitated the comparison of the relative prominence of strategic objectives and interventions, while TF-IDF quantification allowed the identification of interventions that occurred more frequently in each AMR-NAP. Considering this methodology, our study will utilise TF and TF-IDF to evaluate the degree of divergence among various versions of NAPs originating from the same country.

The Anderson framework incorporates 18 distinct domains within three governance areas: implementation tools, policy design, and monitoring and evaluation. The first governance area, implementation tools, pertains to strategic priorities aligned with guidance from international organisations such as the World Health Organization (WHO), the Food and Agriculture Organization (FAO) of the United Nations, the World Organization for Animal Health (OIE), and the European Commission. The second governance area (i.e policy design) includes vital interventions outlined in guidance from WHO, the FAO, the World Organisation for Animal Health, and the European Commission. Elements within the third governance area (i.e., monitoring and evaluation) encompass reporting and feedback mechanisms, facilitating regular review and evaluation of AMR NAPs, along with examining the effectiveness and cost-effectiveness dimensions of various aspects of the NAPs.

Modelled after the study by Özçelik et al., this analysis will specifically concentrate on the 10 domains of the Anderson Framework that coincide with the strategic objectives outlined in the GAP-AMR. Out of the first governance area (i.e implementation tools), these domains include the following: (1) improve AMR awareness and understanding through effective communication, education and training; (2) strengthen knowledge and evidence base by bolstering AMR surveillance and research; (3) reduce the incidence of infection through effective sanitation, hygiene, and infection prevention and control (IPC) measures; (4) optimise antimicrobial use in the human and animal health; and (5) make an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions[47]. Additionally, this study assesses the degree to which AMR-NAPs make reference to a set of 20 interventions recommended in the GAP-AMR, which are aimed to contribute towards the achievement of the strategic objectives. Furthermore, within the second governance area two domains were selected, namely international engagement and One-Health orientation. Lastly, within the third governance area, three domains were selected, namely reporting, funding, and effectiveness. The domains from the second and third governance areas were not subdivided into interventions as there were no corresponding interventions in the GAP-AMR.

Multiple terms from NAPs and the GAP were linked to each intervention/domain by Özçelik et al. to indicate the fulfilment of domain requirements. Their specifics are elaborated in supplementary table 1.

[44] Munkholm and Rubin, 2020
[45] Heuvel et al., 2022
[46] Özçelik et al., 2022
[47] Anderson et al., 2019

Study Sample and Text Normalisation

Defining the Corpus

As NLP-guided techniques were utilised in this analysis, a meticulous selection of the study sample and a round of text normalisation were conducted before proceeding with the analysis. The subsequent section delineates the process that was followed.

To begin, a textual dataset known as a corpus was compiled to enable quantitative analysis. In the realm of Natural Language Processing (NLP), a corpus denotes a structured collection of text documents or spoken language recordings gathered and stored for linguistic analysis, research, or machine learning endeavours. These documents or recordings are commonly sourced from diverse outlets, including books, websites, news articles, social media, academic papers, or transcribed conversations, serving as a foundational resource for the study and comprehension of language.

Corpora play a crucial role in NLP tasks and research for various reasons. For instance, machine learning models in NLP, such as text classifiers, language models, and sentiment analyzers, rely on large and diverse corpora for effective training. These models leverage the data within the corpus to carry out tasks like text classification, machine translation, and sentiment analysis. Moreover, corpora are pivotal in the development and evaluation of NLP algorithms and techniques. Researchers utilise corpora to experiment with new methodologies, compare the performance of different algorithms, and benchmark the accuracy of language processing systems. Search engines and information retrieval systems also frequently utilise corpora to index and retrieve relevant documents in response to user queries, ultimately enhancing the precision and recall of search results.

Corpora may vary in size, purpose, and content. Some are specifically tailored for particular NLP tasks, while others aim to represent a broad range of linguistic diversity. They may be monolingual (containing text in a single language) or multilingual (encompassing text in multiple languages). The creation and maintenance of corpora involve meticulous selection, preprocessing, and annotation of text or speech data to ensure their quality and usability across various NLP applications. The subsequent discussion will delve into the steps taken to assemble the corpus for the specific purpose of this analysis, which seeks to scrutinise the degree of alignment between previous and current AMR-NAPs.

In the process, the initial step involved in constructing the corpus was to identify the AMR-NAPs to be included in the analysis. Countries with multiple versions were pinpointed through sources such as the WHO AMR-NAP Repository, the European Centre for Disease Prevention and Control Repository, and various government websites. Subsequently, the AMR-NAPs from countries with multiple editions were retrieved in .pdf format from the respective sources where they were identified. For the specific scope of this analysis, only the most recent version of the AMR-NAP and the second most recent AMR-NAP were retained, resulting in a total of 24 countries. Supplementary documents, including progress reports, commentaries, news articles, etc., were excluded from the analysis. Among the downloaded PDF documents, those lacking retrievable text information were further excluded, such as .pdfs without text information or with partial text information (i.e., scanned documents). This process yielded the final corpus, comprising 18 countries, including 12 OECD countries and 6 non-OECD countries.

After finalising the corpus, the text data underwent preprocessing for Natural Language Processing. Adopting the approach outlined by Özçelik et al., pages deemed unlikely to contain pertinent information, such as front and back cover pages, as well as bibliography information, were excluded. Subsequently, the unstructured text extracted from the AMR-NAPs underwent a series of steps to be transformed into a quantitative dataset.

Tokenisation

In the domain of Natural Language Processing, each document is viewed as a composition of smaller entities known as tokens[48]. A token serves as the smallest unit or component by which a text document or a sequence of characters can be segmented. Tokens function as the foundational elements employed for deconstructing and analysing text data, playing a vital role in various NLP tasks, including text processing, language modelling, and information retrieval. The complexity of a token can range from a single word to more intricate representations, encompassing parts of words, punctuation marks, or even entire sentences. This variability is contingent on the specific tokenization rules and requirements of a given NLP task.

As the initial step in transforming unstructured text into a quantitative dataset, it is essential to perform text tokenization. Tokenization involves dividing a text document or sentence into individual tokens, a crucial process that converts unstructured text data into a format compatible with Natural Language Processing (NLP) algorithms. Tokens serve as fundamental input units for various NLP tasks, including machine translation, language modelling, and, in the context of this analysis, text classification and information retrieval. Given that tokenization rules may vary based on language, task, and NLP application objectives, all AMR-NAP documents not available in English (Number of countries = 4; French: 2, German: 1, Korean: 1) underwent translation into English using the DeepL machine translation tool. Subsequently, the translated documents were meticulously reviewed and refined by a proficient speaker, defined for the purposes of this research as an individual who is a native speaker or possesses extensive experience using the language in academic or professional contexts. This step aimed to ensure the accurate representation of the original document's nuances.

While certain tokens contribute meaningful information to the substantive content, others offer minimal analytical value (e.g., punctuations, special characters). Recognizing this, the process of separating and eliminating less informative tokens becomes imperative before data analysis can commence[49]. In this analysis, the corpus underwent an initial tokenization, after which punctuations, special characters, white spaces, and website links were removed. Following this step, the entire corpus was converted to lowercase, ensuring that each token appears consistently every time it occurs.

The subsequent step involved the removal of stop words. Stop words refer to a set of words considered to have little value in content and meaning analysis and are therefore filtered out or excluded from text data. They can constitute a substantial portion of a text document. By eliminating stop words, the dimensionality of the data is reduced, rendering it more manageable for analysis and modeling. Common examples of stop words in English include “the”, “and”, “in”, “is”, “it”, “of”, “for”, “that”, “to”, “with”, and “as”. While these words play a crucial role in grammatical structure and sentence construction, they typically do not offer significant semantic information.

After removing stop words, the text underwent stemming, a text normalisation process that aims to reduce words to their root or base form. Although the root form obtained through stemming may not always be a valid word, it captures the core meaning or morphological structure of a word (e.g., the terms “preventing”, “prevention”, “preventative” are converted to "prevent"). The primary goal of stemming is to simplify word variations, treating different forms of the same word as a single, common term. Moreover, stemming enhances word matching and retrieval in search engines and information retrieval systems, reducing the dimensionality of text data by collapsing inflected or derived forms of words into a single representation. For this analysis, a standard list of words in the

[48] Gentzkow M, Kelly B, Taddy M. Text as data. J Econ Lit 2019;57:535–74. doi: 10. 1257/jel.20181020 .

[49] [32] Silge J , Robinson D . Text mining with R: a tidy approach. First Edition. Se- bastopol, CA: O’Reilly Media,Inc; 2017 .

English language provided in the Natural Language Toolkit (NLTK) for Python was utilised for tokenization, removal of stop words, and text stemming.

Finally, the processed text from AMR-NAPs was transformed into a Document-Term Matrix (DTM), a fundamental data structure representing a collection of text documents in a numerical format. In the DTM, rows correspond to documents, and columns correspond to terms (words or phrases), with cell values typically indicating the frequency or some other measure of the term's presence in each document. Storing the corpus in a DTM format is essential for recording the number of term occurrences in a corpus and for data normalisation, preventing bias introduction due to variations in document lengths.

Content Analysis

NLP guided techniques are increasingly utilised to explore various public health topics. These techniques leverage machine learning and language processing to extract insights and valuable information from extensive text data. For instance, they have been deployed to analyse social media posts, news articles, and other online sources, providing a means to track the spread of diseases and detect outbreaks early. Monitoring specific keywords or symptoms on platforms like Twitter can offer real-time information on the prevalence of diseases such as flu or COVID-19. NLP guided techniques are also applied in extracting data from electronic health records (EHRs) or clinical notes, drug discovery and pharmacovigilance, and epidemiological studies.

In this study, a dictionary-based method was employed to evaluate the level of adjustment between previous and current versions of AMR-NAP. This method relies on pre-constructed dictionaries or lexicons, which are essentially collections of words or phrases associated with specific meanings, sentiments, or attributes. These dictionaries categorise words or terms based on their semantic attributes, such as subject matter, topic, or emotion. In the initial phase, a comprehensive term dictionary was created using a two-pronged approach to quantify the level of adjustment between previous and current versions of AMR-NAP.

This study utilised the term dictionary developed by Özçelik et al., which relied on the GAP-AMR as the primary information source for constructing a term dictionary. The GAP-AMR provides detailed descriptions of implementation tools and interventions. Additionally, extra terms were continually added to the list during a review of current AMR literature published after the declaration of a Public Health Emergency of International Concern (PHEIC) on 30 January 2020, related to the outbreak of COVID-19. This step aimed to capture interventions possibly adopted in more recent editions of AMR-NAPs, which might not be referenced in the GAP-AMR or in previous versions of AMR-NAPs. The classification of terms associated with different implementation tools and interventions underwent reassessment upon the inclusion of new terms. Some interventions relevant to more than one tool were labelled with multiple categories to signify their relevance in various domains. For example, integrating AMR into professional education and training not only enhances AMR awareness and understanding but also supports efforts to optimise antimicrobial use.

Lastly, as previously mentioned, this study employs TF and term frequency – inverse document frequency (TF-IDF) for text analysis in order to address differences in document length in the analysis. TF is a numerical representation of how often a term (typically a word) appears in a document relative to its length. This quantification aims to reveal the concept's relative prominence within each individual document. Although TF is a foundational metric for NLP analysis, it does not consider the significance of terms across the entire corpus of documents, presenting a notable limitation. To address this shortcoming, the study integrates the concept of Inverse Document Frequency (IDF), which assigns higher scores to terms that are frequent within a document and rare across the corpus. By incorporating the TF-IDF weighting scheme, the study enables the identification

of interventions that are distinctly emphasised in each AMR-NAP compared to other documents in the corpus. For instance, widely referenced terms like "antibiotic resistance" receive low TF-IDF scores. In this study, the corpus was divided into two parts, which for this study will be called “Group 1” and “Group 2”. Group 1 was composed of the prior edition of the AMR-NAP from a particular country (in the case where countries have published multiple AMR-NAPs, the second to most recent edition), while Group 2 was composed of the most recent version (as of November 2023). The TF and TF-IDF scores from Group 1 and Group 2 were then compared, in order to study as to how country priorities and strategies have shifted over the span of 3 to 5 years.

Sensitivity Checks

Sensitivity checks were conducted in the following manner. Firstly, the visualisation of the five most frequent interventions within each AMR-NAP was employed to enhance comprehension of the primary themes in each plan. Additionally, visualisations were created for the five interventions exhibiting the most significant increase and the five interventions experiencing the most substantial decrease. This approach aimed to visually represent the variation between the previous and current versions of each AMR-NAPs.

3. Results

Overview

Supplementary table 2 presents descriptive statistics on the corpus, which is composed of AMR-NAPs from 18 countries of which 12 are OECD members.

On average, within the corpus, the AMR-NAPs from Group 1 include 49.44 pages (Standard Deviation = 29.38). Prior to the removal of stop words, the average number of terms in the AMR-NAPs stood at 10963.67 (Standard Deviation = 5995.95), which was reduced to 6834.67 (Standard Deviation = 3743.47) after the removal of stop words. The AMR-NAPs from Group 2 include 64.33 pages (Standard Deviation = 50.26). Prior to the removal of stop words, the average number of terms in the AMR-NAPs stood at 15665.94 (Standard Deviation = 10079.98), which was reduced to 9873.11 (Standard Deviation = 6313.57) after the removal of stop words.

The term dictionary included 197 terms associated with various domains and interventions, of which 18 were newly added to the list utilised in the study by Özçelik et al. For this study, the TF and TF-IDF first edition of AMR-NAPs (hereby detailed in the section named “Group 1 results”) and for the second edition of AMR-NAPs (detailed in the section named “Group 2 results”) are calculated separately. Most countries that have published multiple editions of their NAPs to the WHO library of AMR national action plans, have submitted two editions, with the first edition published between 2015-2020 for most countries, and the second between 2018-2023. Certain countries have nonetheless submitted more than two editions of their NAP. As previously mentioned, for the purposes of this study, the most current edition of the NAP and the second to most current edition was employed for analysis.

For ease of reference the domains will be numbered as follows in the section below:
Domains associated with the area of implementation tools:

1) Improve AMR awareness and understanding through effective communication, education and training: Domain 1
2) Strengthen knowledge and evidence base by bolstering AMR surveillance and research: Domain 2

3) Reduce incidence of infection through effective sanitation, hygiene, and IPC measures: Domain 3
4) Optimise antimicrobial use in human and animal health: Domain 4
5) Make an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions: Domain 5

Domains associated with the area of policy design:

6) International Engagement: Domain 6
7) One Health Engagement: Domain 7

Domains associated with the area of monitoring and evaluation

8) Reporting: Domain 8
9) Funding: Domain 9
10) Effectiveness: Domain 10

Results for Group 1

This section describes the results from the analysis of the set of 18 first edition AMR-NAPs (or for countries that have published more than two NAPs, the second to most current edition). For simplicity, TFs (Term Frequency) will be rounded to the fourth decimal in this section.

Taking the average of the 18 AMR-NAPs that were in Group 1, amongst the five domains of the implementation tools, terms associated with Domain 2 (strengthening knowledge and evidence base by bolstering AMR surveillance and research) have the highest frequency. Averaging the results from the 18 first edition NAPs, terms associated with this strategic objective recorded a term frequency of 0.0144. The second domain with the highest TF was Domain 5 (making an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions; TF = 0.0136), followed by Domain 3 (reducing incidence of infection through effective sanitation, hygiene, and IPC measures; TF = 0.0118), Domain 4 (optimising antimicrobial use in human and animal health; TF = 0.0094), and Domain 1 (improving AMR awareness and understanding through effective communication, education and training; TF = 0.0071). Amongst the five domains associated to policy design and monitoring and evaluation, terms associated with Domain 7 (one health engagement; TF = 0.0087) showed the highest frequency, while terms associated to Domain 9 (funding; TF = 0.0016), Domain 6 (international engagement; TF = 0.0015), Domain 8 (reporting; TF = 0.0001), and Domain 10 (effectiveness; TF = 0) were relatively lacking. Notably, terms associated with Domain 10 did not appear across the 18 AMR-NAPs that were in Group 1.

Supplementary table 3 exhibits the term frequencies linked to the 20 recommended interventions for addressing AMR, associated with the five domains of implementation tools, as well as for domains pertaining to policy design and monitoring and evaluation. Notable patterns surface in the distribution of TFs related to various interventions. Across the five domains of the implementation tools, specific interventions in the corpus are consistently discussed more frequently than others. Pertaining to the interventions associated to Domain 5 (making an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions), terms associated with “promoting R&D for AMR innovations”, exhibit considerably higher frequencies (TF = 0.0128) than those linked to “exploring new market models” (TF = 0.0003). Similarly, within interventions associated with Domain 4 (optimising antimicrobial use in human and animal health), terms associated to the intervention of “strengthening antimicrobial stewardship” appear more frequently (TF = 0.006) than terms associated to “monitoring antibiotic consumption” (TF = 0.0012) and “optimising animal feed practices” (TF = 0.0007). On the contrary, in certain domains such as Domain 3 (reducing the incidence of infection through effective sanitation, hygiene, and IPC measures), there is a comparatively even distribution of frequencies among terms associated with various interventions.

For instance, terms associated with “strengthening IPC programs” had a TF of 0.0057, which is not an outlier in comparison to other interventions such as “improving water, hygiene, sanitation, and waste management” (TF = 0.0034) and “enhancing biosecurity” (TF = 0.0017).

The averaged results from Group 1 (hereby simply termed, Group 1) were compared to the GAP-AMR for reference. In the GAP-AMR, terms associated with Domain 5 (making an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions) showed the highest frequency, while terms associated with Domain 2 showed the highest frequency within the corpus. . The domains showing the lowest frequency were identical. These were Domain 8 (reporting; TF = 0 and TF = 0.0002 for the GAP-AMR and Group 1, respectively) and Domain 10 (effectiveness; TF = 0 for both GAP-AMR and Group 1), which are both domains associated with monitoring and evaluation. Furthermore, while the domains in between vary between the GAP-AMR and Group 1 there are similarities in terms of the order of TFs of the domains. Firstly, in terms of the order of TFs, Domains 3, 4, 5, and 7 appear in the 5 domains with relatively higher TFs, while Domains 1, 8, 9, 10 appear in the lower half, for both the GAP-AMR and in Group 1. Meanwhile, the relative TF of Domains 2 (Strengthen knowledge and evidence base by bolstering AMR surveillance and research) and 6 (International engagement) diverged between the GAP-AMR and Group 1. Precisely, the TF for terms associated with Domain 2 showed the highest frequency out of the NAPs included in Group 1 (TF = 0.0144) and sixth out of ten domains in the GAP-AMR (TF = 0.0095). The TF for terms associated with Domain 6 was second out of ten domains in the GAP-AMR (TF = 0.0166) and eighth out of ten domains in Group 1 (TF = 0.0016).

This section outlines the TF of individual interventions, within each domain. In terms of interventions to Improve AMR awareness and understanding through effective communication, education and training (Domain 1), terms linked to integrating AMR in professional education and training showed the highest TF (TF = 0.0047) followed by enhancing AMR awareness in the public (TF = 0.0022), and integrating AMR in school education (TF = 0.0005). These results across interventions mirror the relative significance shown in the GAP-AMR, as the frequencies for the three interventions in the GAP-AMR above were, 0.0043; 0.0024; 0.0004, respectively.

Across interventions that aim to strengthen the knowledge and evidence base by bolstering AMR surveillance and research (Domain 2), terms linked to strengthening AMR surveillance showed the highest TFs within this corpus (TF = 0.0131), followed by interventions aimed at engaging global and regional AMR surveillance networks (TF = 0.00053), promoting new data sources in AMR surveillance (TF = 0.00048), and expanding laboratory network capacity (TF = 0.0003). In comparison, while terms linked to strengthening AMR surveillance also showed the highest TF in the GAP-AMR (TF = 0.0081), the order of other interventions showed divergence from the Group 1 corpus, as the order of interventions by frequency was “Promoting new data sources in AMR surveillance” (TF = 0.0008), “expanding laboratory network capacity” (TF = 0.0004) and “engaging global and regional AMR surveillance networks” (TF = 0.0002).

Across interventions that aim to reduce incidence of infection through effective sanitation, hygiene, and IPC measures (Domain 3), terms linked to strengthening IPC programmes (TF = 0.0057) showed the highest frequency, followed by improving water, hygiene, sanitation, and waste management (TF = 0.0034), enhancing biosecurity (TF = 0.0017), improving vaccination coverage (TF = 0.0014), and promoting food safety and security (TF = 0.0012). These results showed divergence from the frequencies exhibited in the GAP-AMR, where interventions aimed at improving vaccination coverage (TF = 0.0047) and enhancing biosecurity (TF = 0.0047) showed the highest frequency within Domain 3, followed by improving water, hygiene, sanitation, and waste management (TF = 0.0041), strengthening IPC programmes (TF = 0.0041), and promoting food safety and security (TF = 0.0024).

Across interventions that aim to optimise antimicrobial use in human and animal health (Domain 4), terms associated with strengthening antimicrobial stewardship showed the highest frequency (TF = 0.006), followed by monitoring antibiotic consumption (TF = 0.0012). Terms associated with "supporting new drugs, medicines, and technologies", "optimising animal feed practices", "enhancing the use of diagnostic tools", "Restrict the use of antimicrobials as growth promoters", and "limiting antimicrobial sale without prescription, counterfeit or substandard antimicrobial sale, online antibiotic sales" showed TFs of 0.0008; 0.0007; 0.0005; 0.0002; 0.0002, respectively. These results from the corpus of Group 1 partially mirrored the results from the GAP-AMR, which showed the highest frequency for terms associated with strengthening antimicrobial stewardship (TF = 0.0031). However, the order of frequencies for other interventions diverged from Group 1, with terms associated with enhance the use of diagnostic tools (TF = 0.003) and supporting new drugs, medicines, technologies (TF = 0.003) following closely, and the frequency of terms related to optimising animal feed practices, restricting the use of antimicrobials as growth promoters, monitoring antibiotic consumption, and limiting antimicrobial sale without prescription, counterfeit or substandard antimicrobial sale, online antibiotic sales at TF = 0.0006; 0.0004, 0.0002, and 0, respectively. Notably, in the GAP-AMR, there were no appearances of terms associated with limiting antimicrobial sale without prescription, counterfeit or substandard antimicrobial sale, online antibiotic sales.

Across interventions that aim to make an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions (Domain 5), terms associated with promoting R&D for AMR innovations (TF = 0.0128) showed the highest frequency, followed by exploring new market models (TF = 0.0003) and promoting public-private partnerships (PPPs) (TF = 0.0003). These results match the order of frequencies exhibited in the GAP-AMR, that have in the same order as the Group 1 corpus, had TFs of 0.0201; 0.0014; 0.0002, respectively.

Pertaining to interventions associated with Policy Design and Monitoring and Evaluation (Domains 6 through 10), the results were as follows. Across interventions associated with Policy Design, International Engagement (Domain 6) and One Health Engagement (Domain 7) showed TFs of 0.0015 and 0.0087, respectively. This was in stark contrast to the GAP-AMR, which showed TFs of 0.0166 and 0.137, respectively. These frequencies indicate that NAPs have placed reduced emphasis on Policy Design, particularly international policy design, when compared to the GAP-AMR. Across interventions associated with Monitoring and Evaluation, terms associated with Reporting (Domain 8), Funding (Domain 9) and Effectiveness (Domain 10) showed TFs of 0.0001; 0.0016; and 0, respectively. These results from the Group 1 corpus showed similarity to the GAP-AMR, which showed TFs of 0; 0.001; and 0, respectively.

The results also revealed notable regional and country dissimilarities. The 18 countries whose NAPs were included in the corpus were then divided into economic and geographical regions in observe for patterns, namely: OECD countries (# Countries = 12), non-OECD countries (# Countries = 6), countries participating in G7 (# Countries = 5), countries in East Asia (# Countries = 3), countries in Africa and the Middle East (# Countries = 3), EU countries (# Countries = 7), Countries in North America (# Countries = 2). The TF for each region was calculated as the average of the values from the constituent countries. Certain differences were as follows. Pertaining to the order of frequencies, the EU, North America, the G7 and OECD countries, showed the highest level of frequency for Domain 5 (making an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions). However, Non-OECD countries, Africa and the Middle East, and East Asia, showed the highest level of frequency for Domain 2 (Strengthen knowledge and evidence base by bolstering AMR surveillance and research). Out of the 18 NAPs included in the Group 1 corpus, 7 NAPs showed the highest frequency for Domain 2, 5NAPs showed the highest level of frequency for Domain 5, 4 NAPs showed the highest frequency for Domain 3

(Reduce incidence of infection through effective sanitation, hygiene, and IPC measures), 1 NAP showed the highest frequency fo Domain 1 (Improve AMR awareness and understanding through effective communication, education and training), and 1 NAP showed the highest frequency for Domain 4. Furthermore, as previously mentioned, all 18 NAPs did not demonstrate any usage of terms associated with Domain 10 (Effectiveness). 14 out of 18 NAPs did not demonstrate usage of terms associated with Domain 8 (Reporting), indicating reduced emphasis on Monitoring and Evaluation.

This section describes the TF-IDF scores assigned to domains and interventions by country. The TF-IDF scores for the NAPs in Group 1 indicate the presence of cross-country variation.

In Group 1, the NAP from Fiji stands out with significantly high TF-IDF scores for 21 interventions and domains out of 28 in this study. Interventions include enhancing AMR awareness in public (TF-IDF = 0.5116, $p<0.05 = 0.3537$), integrating AMR in school education (TF-IDF = 0.1207, $p<0.05 = 0.0832$), enhancing the use of diagnostic tools (TF-IDF = 0.0997, $p<0.05 = 0.0721$), and promoting food safety and security (TF-IDF = 0.2127, $p<0.05 = 0.1482$), amongst others. Other NAPs with notably high TF-IDF scores for certain interventions or domains include Saudi Arabia, pertaining to the intervention of integrating AMR in professional education and training (TF-IDF = 0.3088, $p<0.05 = 0.0679$), Japan, pertaining to 2d (TF-IDF = 0.3567, $p<0.05 = 0.3771$), the UK pertaining to 5a (TF-IDF = 0.3821, $p<0.05 = 0.3793$), and Canada pertaining to 7 (TF-IDF = 0.2413, $p<0.05 = 0.2486$) amongst other interventions. Additionally, the GAP-AMR showed a notably high TF-IDF pertaining to international engagement (TF-IDF = 0.2237, $p<0.05 = 0.1439$) and 3e (TF-IDF = 0.0621, $p<0.05 = 0.0689$).

Fig. 1 illustrates interventions (for Domains 1 through 5) and domains (for Domains 6 through 10, which do not have interventions) chosen based on the top 5 TF-IDF scores across countries, revealing notable cross-country variations. Terms associated with strengthening antimicrobial stewardship (an intervention within Domain 4 “Optimise antimicrobial use in human and animal health”) were more heavily featured in the NAPs of Australia, Canada, China, Fiji, Ireland, Malta, Netherlands, Spain, Sweden and the US. Terms associated with the promotion of R&D for AMR innovations (an intervention within Domain 5 “Make an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions") were more heavily featured in the NAPs of France and the UK than in other countries. Austria, Cameroon, Japan, South Korea, and Tanzania emphasised strengthening AMR surveillance (an intervention within Domain 2 “Strengthen knowledge and evidence base by bolstering AMR surveillance and research”). Saudi Arabia stands out for their more pronounced discussions on the integration of AMR in professional education and training (an intervention within Domain 1 “Improve AMR awareness and understanding through effective communication, education and training”)

Results for Group 2

This section describes the results from the analysis of the most current set of 18 AMR-NAPs. For simplicity, TFs (Term Frequency) will be rounded to the fourth decimal in this section.

Taking the average of the 18 AMR-NAPs that were in Group 2, amongst the five domains of the implementation tools, terms associated with Domain 2 (strengthening knowledge and evidence base by bolstering AMR surveillance and research)have the highest frequency. Averaging the results from the 18 first edition NAPs, terms associated with this strategic objective recorded a term frequency of 0.0137. The domain with the second highest TF was Domain 3 (reducing incidence of infection through effective sanitation, hygiene, and IPC measures; TF = 0.0134), followed by Domain 5 (making an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions; TF = 0.0115), Domain 4 (optimising antimicrobial use in human and animal

health; TF = 0.0076), and Domain 1 (improving AMR awareness and understanding through effective communication, education and training; TF = 0.0074). Amongst the five domains associated to policy design and monitoring and evaluation, terms associated with Domain 7 (one health engagement; TF = 0.0109) showed the highest frequency, while terms associated to Domain 9 (funding; TF = 0.0018), Domain 6 (international engagement; TF = 0.0012), Domain 8 (reporting; TF = 0.0002), and Domain 10 (effectiveness; TF = 0) were relatively lacking. Notably, the order of frequencies of the average of Group 2 was identical to that of Group 1.

Supplementary table 4 exhibits the term frequencies linked to the 20 recommended interventions for addressing AMR, associated with the five domains of implementation tools, as well as for domains pertaining to policy design and monitoring and evaluation. Similar to Group 1, notable patterns surface in the distribution of TFs related to various interventions. Across the five domains of the implementation tools, specific interventions in the corpus are consistently discussed more frequently than others. Pertaining to the interventions associated with Domain 5, terms associated with “promoting R&D for AMR innovations”, exhibit higher frequencies (TF = 0.0108) than those linked to “exploring new market models” (TF = 0.0003) and “promoting PPPs” (TF = 0.0003). Within interventions associated with Domain 4, terms associated to the intervention of “strengthening antimicrobial stewardship” appear more frequently (TF = 0.0048) than terms associated to “monitoring antibiotic consumption” (TF = 0.001), “optimising animal feed practices” (TF = 0.0009) and “restricting the use of antimicrobials as growth promoters” (TF = 0.0001). Within Domain 3, terms associated with “strengthening IPC programmes” (TF = 0.0074) appeared more frequently than terms associated with “improving water, hygiene, sanitation, and waste management” (TF = 0.003) and improving vaccination coverage (TF = 0.0014). Within Domain 2, terms associated with “strengthening AMR surveillance” (TF = 0.0124), appeared more frequently than terms associated with “engaging global and regional AMR surveillance networks” and “promoting new data sources in AMR surveillance”. Within Domain 1, terms associated with “integrating AMR in professional education and training” (TF = 0.0052) appear more frequently than terms associated with “enhancing AMR awareness in public” (TF = 0.002) and “integrating AMR in school education ” (TF = 0.0006).

The results also revealed notable regional and country dissimilarities. The 18 countries whose NAPs were included in the corpus of Group 2 were then divided into economic and geographical regions to observe for patterns. These subdivisions are identical to those of Group 1, and the TF for each region was calculated as the average of the values from the constituent countries. Notable differences were as follows. Pertaining to the order of frequencies, The average of Non-OECD countries in the corpus, East Asia, Africa and the Middle East showed the highest frequency for Domain 2. The average of OECD countries in the corpus as well as the EU showed the highest frequency for Domain 3, while North America and G7 countries showed the highest frequency for Domain 5. This may indicate that there are regional differences even within developed economies. Out of the 18 NAPs included in the Group 2 corpus, 6 NAPs showed the highest level of frequency for Domain 2 and 6 NAPs showed the highest frequency for Domain 3. 4 NAPs showed the highest frequency for Domain 5, 1 NAP showed the highest frequency for Domain 1, and 1 NAP showed the highest frequency for Domain 4. Moreover, mirroring the results from Group 1, all 18 NAPs did not demonstrate any usage of terms associated with Domain 10. 11 out of 18 NAPs did not demonstrate usage of terms associated with Domain 8, indicating a reduced emphasis on Monitoring and Evaluation, which also mirrors results from Group 1 pertaining to the order of frequency.

This section describes the TF-IDF scores assigned to domains and interventions by country. The TF-IDF scores for the NAPs in Group 2 indicate the presence of cross-country variation.

In Group 2, the NAP from Australia stood out, with the highest TF-IDF score for 14 interventions and domains out of 28 in this study. Interventions where the NAP from Australia showed significant values include improving AMR awareness and understanding through effective

communication, education and training (TF-IDF = 0.3833, p<0.05 = 0.3340), integrating AMR in school education (TF-IDF = 0.0805, p<0.05 = 0.0735), strengthening antimicrobial stewardship (TF-IDF = 0.8049, p<0.05 = 0.6576), monitoring antibiotic consumption (TF-IDF = 0.1648, p<0.05 = 0.1409), and exploring new market models (TF-IDF = 0.2300, p<0.05 = 0.1912) amongst others. Other NAPs with notably high TF-IDF scores for certain interventions or domains include Cameroon, pertaining to 2a (TF-IDF = 0.1686, p<0.05 = 0.1457) amongst others, Austria, pertaining to 3a (TF-IDF = 0.2299, p<0.05 = 0.1944), the Netherlands, pertaining to 9 (TF-IDF = 0.1040, p<0.05 = 0.0881), China, pertaining to 2d (TF-IDF = 0.3405, p<0.05 = 0.3617), Spain, pertaining to 5c (TF-IDF = 0.02390, p<0.05 = 0.0236, Ireland, pertaining to One Health engagement (TF-IDF = 0.3501, p<0.05 = 0.3189), Saudi Arabia, pertaining to the integration of AMR in professional education and training (TF-IDF = 0.2591, p<0.05 = 0.2440), and the UK, pertaining to enhancing biosecurity (TF-IDF = 0.1065, p<0.05 = 0.0820).

Mirroring the method taken for Group 1, Fig. 2 illustrates interventions and domains chosen based on the top 5 TF-IDF scores across countries. Terms associated with the promotion of R&D for AMR innovations were more heavily featured in the NAPs of Canada, the UK and the US than in other countries. Terms associated with strengthening antimicrobial stewardship were more heavily featured in the NAPs of Australia, Cameroon, France, Malta, South Korea, Malta, Sweden and Spain than in other countries. Austria, China, Japan, Tanzania and Saudi Arabia placed a distinct focus on initiatives related to strengthening AMR surveillance, while Fiji and the Netherlands emphasised the importance of strengthening IPC programmes (an intervention within Domain 3 “Reduce incidence of infection through effective sanitation, hygiene, and IPC measures”). Ireland diverged from other countries by being the only country that more heavily featured Domain 7 “One Health engagement”, which is a domain related to policy design.

Comparing the results from Group 2 to Group 1

This section compares the results from the analysis of Group 1 and Group 2, starting with the TF followed by the TF-IDF. Notable differences between the two datasets and observed patterns will also be described. For simplicity, TFs (Term Frequency) will be rounded to the fourth decimal in this section as done before. Supplementary table 5 compares the term frequencies linked to the 20 recommended interventions for addressing AMR, associated with the five domains of implementation tools, as well as for domains pertaining to policy design and monitoring and evaluation, between group 1 and group 2

Firstly, taking the average of the 18 countries that were compared, the word count of Group 2 NAPs were 44.5% greater than that of Group 1 (Group 1: 6688.11, Group 2: 9664.50), indicating a general increase in the volume of NAPs over the past 5 years.

Secondly, on average, an increase in TF between the two datasets was observed in the following domains (TF values are rounded to the fourth decimal): Domain 8 “Reporting” (+32.76%; Group 1 TF = 0.0001, Group 2 TF = 0.0002), Domain 7 “One Health engagement” (+24.95%; Group 1 TF = 0.0087, Group 2 TF = 0.0109), Domain 9 “Funding” (+14.60%; Group 1 TF = 0.0016, Group 2 TF = 0.0018), Domain 3 “Reducing the incidence of infection through effective sanitation, hygiene, and IPC measures” (+13.62%; Group 1 TF = 0.0118, Group 2 TF = 0.0134), and Domain 1 “Improving AMR awareness and understanding through effective communication, education and training” (+4.34%; Group 1 TF = 0.0071, Group 2 TF = 0.0074) and Domain 10 “Effectiveness”, of which the terms associated to this domain were not present in any NAP in Group 1. Taken from the perspective of governance areas, while at least one domain from all three governance areas (i.e. implementation tools, policy design, and monitoring and evaluation) saw an increase in frequency, domains within the governance area of monitoring and evaluation (i.e. reporting and funding) saw a

comparatively larger increase compared to policy design and implementation tools. However, it should be noted that the average TF for the domain of reporting, which saw the largest average increase over the two datasets, remains quite miniscule at approximately one or two words over 10,000 words. Furthermore, a decrease in TF between the two datasets was observed in the following domains: Domain 4 “Optimising antimicrobial use in human and animal health” (-19.40%; Group 1 TF = 0.0094, Group 2 TF = 0.0076), Domain 6 “International engagement” (-15.90%; Group 1 TF = 0.0015, Group 2 TF = 0.0012), Domain 5 “Making an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions” (-11.11%; Group 1 TF = 0.0136, Group 2 TF = 0.0115) and Domain 2 “Strengthening knowledge and evidence base by bolstering AMR surveillance and research (-5.32%; Group 1 TF = 0.0144, Group 2 TF = 0.0137). Taken from the perspective of governance areas, three domains from the area of implementation tools saw a decrease in TF (Domain 2, 4 and 5), as well as one domain in the area of policy design (Domain 6). However, it must be noted that in general, the domains belonging to the governance area of implementation tools retain their tendency for a larger TF compared to domains in the other two governance areas. The table below summarises the domains that saw the most significant increase of TF in each country.

Domain with largest decrease in TF, by country

Country	Domain with largest decrease in TF (Group 2/ Group 1 Ratio)		Domain (1 through 5) with largest decrease in TF (Ratio)	
Australia	Domain 7	1.837	Domain 5	1.1537
Austria	Domain 9	2.6723	Domain 1	2.2636
Cameroon	Domain 1	2.5848		
Canada	Domain 7	1.1260	Domain 3	1.0678
China	Domain 7	2.7249	Domain 3	2.2588
Fiji	Domain 6	5.4020	Domain 1	2.0528
France	Domain 2	2.1021		
Ireland	Domain 3	1.9929		
Japan	Domain 4	1.4027		
South Korea	Domain 8	1.8732	Domain 4	1.8530
Malta	Domain 8	2.5356	Domain 2	1.0906
Netherlands	Domain 9	6.3181	Domain 3	1.5331
Saudi Arabia	Domain 2	1.2998		
Spain	Domain 1	1.3263		
Sweden	Domain 7	1.5470	Domain 5	1.6032
Tanzania	Domain 9	8.6560	Domain 1	1.1496
UK	Domain 6	3.6078	Domain 3	2.1383

US	Domain 7	2.0925	Domain 3	1.7705

Notable cross-country and cross-region variations surface when comparing Groups 1 and 2. To take the example of the average TF taken from OECD countries as opposed to the average TF taken from non-OECD countries, the two domains with the largest margin of increase were Domain 7 (+33.90%; Group 1 TF = 0.0086, Group 2 TF = 0.0115) and Domain 3 (+25.24%; Group 1 TF = 0.0108, Group 2 TF = 0.0136) for the former, while they were Domain 8 (+374.00%; Group 1 TF = 0.0001, Group 2 TF = 0.0007) and Domain 6 (+45.32%; Group 1 TF = 0.0070, Group 2 TF = 0.0101). This indicates cross-country and cross-region diversity in the development of NAPs over the past few years. Meanwhile, terms associated with Domain 10 "Effectiveness" were largely absent from NAPs in Group 1 but present in all 18 NAPs in Group 2, which was a commonality.

Thirdly, the table below displays the domains that experienced the most significant decrease of TF in each country. In the latest version of the UK NAP, the TF for Domain 1 (Enhance AMR awareness and understanding through effective communication, education, and training) exhibited the greatest decrease (Group 2/Group 1 Ratio, hereinafter referred to as "Ratio", = 0.5253). When considering only the ratios for Domains 1 through 5, which relate to intervention tools, Domain 1 exhibited the most substantial decrease in ratio for France (Ratio = 0.1991), Japan (Ratio = 0.7334), Malta (Ratio = 0.9119), and Sweden (Ratio = 0.5906). In countries such as Cameroon (Ratio = 0.0952) and Saudi Arabia (Ratio = 0.4765), the TF for terms associated with Domain 3 (Reduce the incidence of infection through effective sanitation, hygiene, and IPC measures) saw the most significant decrease. For countries like Canada, Fiji, Tanzania, and the US, the TF for Domain 4 (Optimize antimicrobial use in human and animal health) witnessed the greatest decrease (Ratio = 0.5211, 0.5345, 0.3989, 0.4634 respectively). Australia (Ratio = 0.7706), Ireland (Ratio = 0.6117), Spain (Ratio = 0.7089) and the Netherlands (Ratio = 0.1602) stood out with a substantial TF decrease in Domain 4, despite experiencing the largest TF decrease in domains 6-10. Domain 6 (International Engagement) experienced the most substantial TF decrease in Australia (Ratio = 0.4635), France (Ratio = 0), Japan (Ratio = 0.6323), and the Netherlands (Ratio = 0.1053). Domain 8 (Reporting) witnessed the largest TF decrease in Ireland (Ratio = 0.1947) and Sweden (Ratio = 0). Domain 9 (Funding) exhibited the most substantial TF decrease in China (Ratio = 0.1987), France (Ratio = 0), South Korea (Ratio = 0.2634), and Malta (Ratio = 0.8452).

Domain with largest decrease in TF, by country

Country	Domain with largest decrease in TF (Group 2/ Group 1 Ratio)		Domain (1 through 5) with largest decrease in TF (Ratio)	
Australia	Domain 6	0.4635	Domain 4	0.7706
Austria	Domain 4	0.7206		
Cameroon	Domain 3	0.0952		
Canada	Domain 4	0.5211		
China	Domain 9	0.1987	Domain 1	0.9537
Fiji	Domain 4	0.5345		
France	Domains 6; 9	0; 0	Domain 1	0.1991
Ireland	Domain 8	0.1947	Domain 4	0.6117

Japan	Domain 6	0.6323	Domain 1	0.7334
South Korea	Domain 9	0.2634	Domain 3	0.8429
Malta	Domain 9	0.8452	Domain 1	0.9119
Netherlands	Domain 6	0.1053	Domain 4	0.1602
Saudi Arabia	Domain 3	0.4765		
Spain	Domain 4	0.7089		
Sweden	Domain 8	0	Domain 1	0.5906
Tanzania	Domain 4	0.3989		
UK	Domain 1	0.5235		
US	Domain 4	0.4634		

To visualise cross-country differences across domains, a basic count was conducted for each domain, noting the number of countries where there was an increase, downturn, or a marginal difference of less than 10% in the marginal disparity between the TF of groups 1 and 2. A simple tally as such, offers a distinct viewpoint compared to an average, highlighting country variations more effectively. The result is exhibited in the table below. Domains 3 “Reduce incidence of infection through effective sanitation, hygiene, and IPC measures” and Domain 7 “One Health Engagement” saw an increased TF in the highest number of countries within the corpus, at 9 out of 18 countries. On the contrary, Domains 4 “Strengthen antimicrobial stewardship” and 6 “International engagement” each saw a downturn of its TF in the most number of countries within the corpus, at 10 out of 18 countries. This table also reveals that specific domains exhibit a more even distribution between countries where their TF increased or decreased, whereas others show a pronounced skew toward one end. Domain 1, which is an example of the former, saw an increase in TF in 6 countries, a marginal difference in 5 countries, and a downturn in 7 countries. Additionally, it is noticeable that the fluctuations in TF for certain domains vary significantly among countries. Two such examples would be Domains 3 and 4, both with only two countries that exhibited a marginal difference. It is worth mentioning that both Domains 3 and 4 demonstrate a considerable number of countries in both of the trends of either an increase or a decrease in TF, indicating a divergence in priorities among countries in these domains. Lastly, Domains 7 and 8 exhibit a higher ratio of TF increase in comparison to Domain 3. This arises from the fact that terms linked to these domains exclusively emerge in Group 2. Although this discovery is notable, it underscores the notion that terms related to these domains have a less prominent presence in NAPs overall.

# of Countries with TF Increase/Decrease, by Domain

	Only appears in Group 2	TF Increase	Marginal Difference (<10%)	TF Decrease	Only appears in Group 1	TF Ratio Group 2 /Group 1
Domain 1	-	6	5	7	-	1.0434
Domain 2	-	4	5	9	-	0.9468

Domain 3	-	9	2	7	-	1.1362
Domain 4	-	6	2	10	-	0.8060
Domain 5	-	6	4	8	-	0.8888
Domain 6	2	4	-	10	2	0.8410
Domain 7	2	9	3	4	-	1.2495
Domain 8	13	2	-	2	1	1.3276
Domain 9	2	5	2	8	1	1.1460
Domain 10	18	-	-	-	-	N/A

A significant degree of cross-country disparity was observed concerning the interventions and domains that have gained prominence compared to the previous rendition of NAPs, according to the ratio of Group 2 TF-IDF to Group 1 TF-IDF. Details are elaborated in supplementary table 6. Countries such as China, Fiji, Saudi Arabia, the UK and the US placed a larger emphasis on Domain 7 compared to the previous rendition of their NAP. Cameroon, Malta and Sweden more prominently featured the optimisation of animal feed practices, while Australia placed greater emphasis on restricting the use of antimicrobials as growth promoters and South Korea increased their discussions on enhancing the use of diagnostic tools (all interventions within Domain 4 “Optimise antimicrobial use in human and animal health”). Austria placed a more pronounced emphasis on improving vaccination coverage, while Ireland featured the enhancement of biosecurity (both interventions within Domain 3 “Reduce incidence of infection through effective sanitation, hygiene, and IPC measures”). Tanzania and Spain distinguished themselves for their more prominent coverage pertaining to Domain 9 “Funding”, compared to the previous rendition.

4. Discussion

While previous studies have applied NLP-guided techniques to analyse text from AMR-NAPs systematically and examine the GAP-AMR, this study is the first to utilise these strategies for a chronological comparison of two different NAP versions. In this analysis of 18 countries, observations show that, on average, the frequency of terms related to the domain of Reporting has shown the most substantial increase. Simultaneously, terms associated with reducing the incidence of infection through effective sanitation, hygiene, and IPC measures have demonstrated the most significant increase, when limiting the observation to domains pertaining to implementation (Domains 1 through 5). In contrast, the frequency of terms linked to optimising antimicrobial use in human and animal health has experienced the largest decrease. This is followed by a decline in the frequency of terms associated with international engagement (within Domains 6 through 10, which relate to policy design, monitoring, and evaluation). These findings suggest a prioritisation of certain interventions over others in AMR-NAPs. Additionally, this study reveals diverse emphases on specific interventions among countries, indicating a divergence in focus over the years. Various factors may contribute to the distinct patterns in interventions emphasised in AMR-NAPs across countries.

A prevailing trend discerned from this analysis highlights notable outcomes within domains concerning implementation parameters (Domains 1 through 5). Specifically, terms associated with the mitigation of infection through effective sanitation, hygiene, and IPC measures have demonstrated the

most substantial average increase across the 18 countries included in this study. Notably, nine out of the 18 NAPs exhibited a surge of more than 10% in this domain, suggesting a heightened emphasis on elucidating infection prevention and its nexus with AMR compared to preceding iterations of country NAPs. The countries that saw an increase of more than 10% in the TF of this Domain were, Austria (Ratio = 1.3601), China (Ratio = 2.2588), Fiji (Ratio = 1.7581), Ireland (Ratio = 1.9929), Japan (Ratio = 1.1376), Netherlands (Ratio = 1.5330), Sweden (Ratio = 1.1344), UK (Ratio = 2.1383), and the US (Ratio = 1.7705).

Additionally, domains concerning policy formulation, monitoring, and assessment (Domains 6 through 10) evidenced a general escalation in term prevalence in the latest editions. Noteworthy is the sharp surge in term frequency observed in Domain 8, which was previously absent in 13 out of 18 NAPs from the initial group, and Domain 10, entirely absent in the same group, indicating a notable augmentation in term frequency from group 1 to group 2.

Interpretation of data by Region and Economic Group

This section expounds upon the country and regional variation observed in the data.

On average, OECD countries exhibited notable increases in TF within the domain of One Health Engagement (Domain 7, Ratio = 1.3390). Furthermore, when examining Domains 1 through 5 exclusively, they experienced the most pronounced rise in TF concerning the reduction of infection incidence through effective sanitation, hygiene, and infection prevention and control (IPC) measures (Domain 3, Ratio = 1.2524). Conversely, international engagement (Ratio = 0.6197) demonstrated the most significant decrease in TF. Within Domains 1 through 5, the optimization of antimicrobial use in human and animal health displayed the steepest decline in TF (Ratio = 0.8178). These findings paralleled the aggregated results for G7 countries, which also witnessed TF increases in One Health Engagement (Domain 7, Ratio = 1.3030) and the mitigation of infection incidence through effective sanitation, hygiene, and IPC measures (Domain 3, Ratio = 1.2731). Moreover, G7 countries experienced a notable rise in TF related to reporting (Domain 8, Ratio = 1.3390). It is noteworthy that the domain of Reporting only surfaced in Group 2 or the latest versions of NAPs for 13 out of 18 NAPs in the dataset. The heightened emphasis on infection prevention and control measures may be anticipated, given the advent of the COVID-19 pandemic, which swiftly redirected the focus of high-income countries' public health strategies from non-communicable diseases toward infectious diseases once again. Furthermore, the increased attention to One Health Engagement may be linked to the understanding that COVID-19 possibly originated from zoonotic sources, underscoring the necessity for countries to pursue policies fostering collaboration across human health, animal health, and environmental health sectors.

The contrast between Non-OECD and OECD countries is evident, particularly in domains such as reporting (Domain 8, Group 2/Group 1 Ratio = 4.7399), international engagement (Domain 6; Ratio = 1.4532), and the enhancement of awareness and comprehension of AMR through effective communication, education, and training (Domain 1; Ratio = 1.1476), which exhibited the most significant increases. It is important to highlight that terms associated with reporting demonstrate a notably low term frequency overall, meaning that even minor alterations in their occurrence can manifest as substantial shifts in term frequency. Taking into account the results for LMICs, it is notable that Domains such as international engagement (Domain 6) and funding (Domain 9) saw an increase, as this was not the case for HICs.

It is worth mentioning that in OECD countries, the TF for international engagement (Domain 6; Ratio = 0.6178) experienced a decline, while in Non-OECD countries, the TF for the same domain increased. This shift could be attributed in part to the possibility that Non-OECD countries rely more heavily on international assistance to sustain their public health initiatives. Additionally, previous

research has indicated that NAPs from LMICs have tended to align more closely with the content of the GAP, which places significant emphasis on international engagement, compared to NAPs from high-income countries.

Taking into account the TF-IDF results, the analysis largely mirrored the results from TF, considering that domains such as One Health Engagement (Domain 7) saw an increase in 13 out of 18 countries included in the corpus. Moreover, in 9 out of 18 countries included in the corpus, there was an increase in TF-IDF in an intervention within the domain of reducing incidence of infection through effective sanitation, hygiene, and IPC measures, which indicates that infection prevention and control increased in significance within half of the countries included in the study.

When examining the collective outcomes of NAPs released by African and Middle Eastern countries within the dataset, it is evident that certain domains experienced shifts in TF. For instance, domains such as Funding (Domain 9; Ratio = 1.6546) and enhancing awareness and comprehension of AMR through effective communication, education, and training (Domain 1; Ratio = 1.0943) demonstrated an increase in TF. Conversely, domains like reducing infection incidence through effective sanitation, hygiene, and infection prevention and control measures (Domain 3; Ratio = 0.4484) and advocating for sustainable investments in medicines, diagnostic tools, vaccines, and other interventions (Domain 5; Ratio = 0.4758) witnessed a decrease in TF by more than 50% compared to their previous iterations.

The heightened emphasis on funding aligns with findings from prior studies examining AMR policies in LMICs, particularly in African nations. For instance, a study assessing AMR surveillance systems in Africa before the publication of the GAP revealed that surveillance and related activities were predominantly conducted on a transnational scale. This investigation identified 11 transnational surveillance systems across the continent, supported by both governmental and institutional funding sources. Notable contributors included pharmaceutical companies like Pfizer, GSK, Merck and Co, alongside organisations such as the Bill & Melinda Gates Foundation (BMGF), the World Health Organization, and the Centers for Disease Control and Prevention (CDC)[50].

Subsequent to the implementation of the GAP-AMR, there has been a proliferation of national surveillance networks, indicating a growing recognition among regional countries regarding the significance of national-level surveillance in combating AMR. This trend suggests an increasing momentum in surveillance efforts. Nonetheless, the establishment of a comprehensive surveillance mechanism with an adequate array of parameters necessitates LMICs to enhance their data collection capabilities, a task requiring additional financial resources. The observed rise in TF within the funding domain suggests that while the publication and revision of NAPs have been instrumental in pinpointing areas necessitating improvement, they have also underscored the deficiency in many countries' capacity to address these requirements.

The heightened emphasis on enhancing awareness and understanding of AMR through effective communication, education, and training in the region is consistent with findings from other studies examining human resource capacity development for AMR control in Africa. Aligned with global initiatives such as the GAP and the United Nations General Assembly political declaration, and in collaboration with partners such as the Food and Agriculture Organization, the World Organisation for Animal Health, and others, the World Health Organization Regional Office for Africa (WHO AFRO) initiated a series of activities aimed at building expertise in AMR.

Starting in May 2017, WHO AFRO commenced a program to develop a cadre of experts through AMR training-of-trainers workshops, designed to support the formulation of NAPs. Additionally, WHO AFRO has convened workshops on AMR, bringing together policymakers and technical experts from the health and agricultural sectors to exchange ideas, share experiences, and

[50] Okolie et al., 2022

discuss best practices regarding governance, multisectoral coordination, monitoring, and integrating AMR considerations into plans and budgets[51]. These workshops have served the specific objective of evaluating the progress made by member states in transitioning from NAP development to implementation.

The aggregated findings from NAPs issued by North American countries revealed comparable outcomes. Specifically, domains such as One Health Engagement (Domain 7; Ratio = 1.3911) and the reduction of infection incidence through effective sanitation, hygiene, and IPC measures (Domain 3; Ratio = 1.2238) demonstrated an increase in frequency. Notably, the frequency associated with One Health Engagement surged by over 100% in the NAP from the United States (Domain 7; Ratio = 2.0925).

Conversely, the heightened emphasis on One Health Engagement contrasts with the frequency results for optimising antimicrobial use in human and animal health (Domain 4; Ratio = 0.5016), which experienced a frequency decrease of nearly 50%. While the heightened focus on One Health initiatives is promising, the relative neglect of antimicrobial use in animal health is concerning, particularly regarding the involvement and regulation of the industrial food animal production sector, which falls behind that of European countries.

For example, federal agencies in the United States do not systematically collect or report farm-level antimicrobial use data nationally, despite recommendations for such data collection from the Government Accountability Office. Moreover, individual producers seldom disclose data on their antimicrobial usage[52]. In contrast, the European Parliament has enacted measures to prohibit antimicrobial use for disease prevention, effective January 28, 2022, recognizing unregulated antimicrobial use as a primary driver of resistance[53]. Furthermore, certain EU member states have implemented comprehensive antimicrobial use surveillance systems with regular reporting, such as DANMAP, VETSTAT, and MARAN. Conversely, efforts to establish a similar system in the United States have largely remained unrealized, presenting an area for potential development.

The aggregated findings from NAPs published by East Asian countries revealed trends that departed slightly from other regions. Notably, there was a notable increase in the frequency of optimising antimicrobial use in both human and animal health (Domain 4; Ratio = 1.5996). Following this, there was an increase in the frequency of measures aimed at reducing infection incidence through effective sanitation, hygiene, and IPC measures (Domain 3; Ratio = 1.3716), as well as in the domain of One Health engagement (Domain 7; Ratio = 1.3121). Conversely, there was a decline observed in domains such as international engagement (Domain 6; Ratio = 0.5251) and funding (Domain 9; Ratio = 0.3550).

The optimization of antimicrobial use in human health remains a significant concern in East Asia. This is evident as physician prescription rates continue to be elevated in South Korea compared to the OECD average[54], and antimicrobial purchases without prescription persist in China. Contrary to other regions, however, funding related to AMR is not prominently featured in NAPs from East Asian countries.

Moreover, East Asian countries display comparatively lower investment in AMR-related programs for LMICs, as many countries with multinational global health NGOs are situated in North America or Europe. Consequently, both as donors and recipients, funding may not be prioritised as highly in East Asian countries.

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[51] Fuller et al., 2022
[52] Wallinga et al., 2022
[53] European Commission. 2019. Regulation (EU) 2019/6 of the European Parliament and of the Council of 11 December 2018 on veterinary medicinal products and repealing Directive 2001/82/EC.
[54] OECD iLibrary. (n.d.).

The Effect of COVID-19 on AMR Policy

In general, among the domains addressing interventions against AMR, there was a notable rise in the emphasis on reducing infection incidence through effective sanitation, hygiene, and IPC measures (Domain 3) within NAPs. From the initial years following the publication of the Global Action Plan on Antimicrobial Resistance and the subsequent release of the first editions of NAPs for numerous WHO member states, to the period spanning from 2020 to 2023 when the latest editions of NAPs were issued for specific countries, the advent of the COVID-19 pandemic necessitated significant shifts in priorities concerning public health policies, both at national and global scales.

The progression of AMR within a population hinges on three key factors: emergence, transmission, and the burden of infection at the population level[55]. COVID-19 has the capacity to impact all these elements either directly or indirectly as a result of responses to the pandemic. Various governmental interventions deployed to combat COVID-19 have encompassed measures such as domestic and international travel restrictions, closure of schools, workplaces, and nonessential services, implementation of physical distancing protocols, and widespread adoption of mask-wearing practices.

For example, AMR significantly influenced the treatment approach for COVID-19 patients. Patients diagnosed with COVID-19 may undergo antimicrobial therapy for two primary reasons. Firstly, symptoms of COVID-19 can mimic those of bacterial pneumonia. Diagnostic tools employed to differentiate between viral and bacterial pneumonia may either be ineffective or have prolonged turnaround times, especially when immediate treatment is imperative. For instance, rapid diagnostic tests measuring C-reactive protein—a biomarker typically elevated in bacterial infections but not viral ones—may exhibit elevated levels in COVID-19 patients[56]. Consequently, many hospitalised COVID-19 patients are prescribed empirical antibiotics, often without microbiological confirmation of the diagnosis.

In numerous African countries, despite WHO recommendations, hydroxychloroquine, chloroquine, and azithromycin were being advised for use as of the summer of 2020 and may continue to be used off-label[57]. Similarly, in India, there appears to be ongoing guidance to utilise hydroxychloroquine as a prophylactic measure for healthcare workers[58].

Moreover, LMIC settings face heightened vulnerability to supply chain challenges, where underdeveloped health systems and inadequate quality control of medications present obstacles to accessing antimicrobials[59]. Disparities in the availability of various antimicrobials across all income brackets raise concerns regarding the emergence of AMR due to suboptimal antibiotic utilisation. Apprehensions also arise regarding the origins of antimicrobials accessible during crises, with fragmented systems and diminished regulatory oversight increasing the likelihood of substandard or counterfeit medications becoming prevalent. Such drugs may not only be inappropriate for the given illness but may also possess inadequate antimicrobial concentrations, thereby fostering resistance and posing potential toxicity risks to patients[60].

Finally, within LMIC contexts, where antimicrobial purchasing regulations are already less stringent, the financial repercussions of COVID-19 policies may escalate the reliance on over-the-counter services, including for unregulated antimicrobials, in an effort to mitigate healthcare expenditures. This situation heightens the risk of suboptimal drug doses, abbreviated antimicrobial

[55] Knight et al., 2021
[56] Sproston and Ashworth, 2018
[57] Abena et al., 2020; Belayneh, 2020
[58] Knight et al., 2021
[59] Pokharel et al., 2019
[60] Kelesidis and Falagas, 2015

courses, and increased mortality, either of which could promote resistance. Conversely, the economic aftershocks of this crisis may exacerbate existing challenges for health systems struggling to ensure adequate antimicrobial access[61], thereby amplifying difficulties in delivery. Moreover, individuals thrust into deeper poverty may find accessing medicines increasingly unaffordable[62], potentially leading to heightened mortality rates. Access to medications has been demonstrated to correlate with a greater burden of preventable infections such as community-acquired pneumonia in children under five[63]. The challenge of distinguishing between COVID-19 symptoms and underlying bacterial infections is particularly acute in LMICs due to inadequacies in healthcare services[64].

COVID-19 patients hospitalised in intensive care units face a heightened susceptibility to bacterial infections compared to the general hospitalised population. Among COVID-19 patients experiencing bacterial co-infection, antimicrobial resistance is prevalent in approximately two-thirds of bacterial infections and about one-third of isolates. The findings of this systematic review align with evidence from previous reviews, affirming that bacterial co-infection occurrence among COVID-19 patients is low, warranting cautious antibiotic use unless bacterial infection is strongly suspected. However, in ICU-admitted patients, although co-infections remain rare, the risk of secondary bacterial infections is notably elevated[65].

However, this issue extends beyond LMICs. With a reduction in face-to-face healthcare and a surge in telemedicine in high-income countries, there may be increased instances of antibiotic use in primary care. Moreover, due to fewer opportunities for microbiological sampling, antibiotics may be prescribed more liberally "just in case." Evidence from the UK suggests a potential indication of this trend[66]. During crises such as the COVID-19 pandemic, when healthcare services are strained and less accessible, the reliance on antibiotics as a "quick fix" is expected to rise, mirroring patterns observed in past conflict scenarios. Assuming existing supply chains remain operational, it is anticipated that antibiotic sales will increase as a means to circumvent numerous deficiencies in disrupted health systems.

In this regard, global antimicrobial consumption surged by 11.2% from 714.0 units per 1000 population in March 2019 to 793.9 units per 1000 population in March 2020 ($p<0.001$; Table 1). Specifically, in developed countries, antimicrobial consumption escalated from 1731.5 units per 1000 population in March 2019 to 1918.5 units per 1000 population in March 2020.(12-13)

In both hospital and community settings, disruptions caused by the COVID-19 pandemic have triggered alterations in healthcare-seeking behaviour and access to treatment, potentially resulting in challenges in physically accessing care. In high-income countries, where antibiotics typically require prescriptions for access, this shift could initially lead to a temporary decrease in overall antibiotic usage, consequently reducing the emergence of AMR in the short term.

However, over the long term, individuals delaying treatment may experience adverse outcomes, leading to heightened rates of hospitalisation and necessitating the use of additional or different antibiotics. Notably, in England, there has been a significant reduction—up to 50%—in Accident and Emergency attendance in specific regions (2020), accompanied by a 20% decrease in appointments[67].

While grappling with the challenges posed by SARS-CoV-2, an additional concern during the treatment of COVID-19 patients has been the occurrence of superinfections. Factors contributing to

[61] Laxminarayan et al., 2016
[62] Nayiga et al., 2020
[63] Laxminarayan et al., 2016
[64] Rizvi and Ahammad. 2021
[65] Langford et al., 2023
[66] Armitage and Nellums, 2020
[67] Armitage and Nellums, 2020

superinfections during COVID-19 include compromised immune responses, prolonged hospitalisation, invasive medical procedures, inappropriate antibiotic use or overuse, and corticosteroid therapy. Bacterial superinfections associated with COVID-19 frequently manifest as hospital-acquired pneumonia. Treatment guidelines recommend the use of broad-spectrum antibiotics, such as third-generation cephalosporins (ceftazidime and cefepime), quinolones, and carbapenems, or antibiotics tailored to the specific antibiogram results of the cultured organism. Observing these challenges, countries may have been prompted to bolster their policies concerning infection prevention and control[68].

Commitments in the Global Health fora

The findings of this analysis exhibit similarities with other studies examining commitments outlined in ministerial statements from multinational gatherings, such as those convened by the World Health Organization and the G7. Given the G7's heightened focus on formulating novel financial incentives to expedite the development of new antibiotics[69], it is unsurprising that, on average, G7 countries featured in the dataset displayed the highest term frequency for making an economic case for sustainable investments in medicines, diagnostic tools, vaccines, and other interventions (Domain 5) across both previous and most recent NAPs.

Significantly, nations like the UK have taken the lead in pioneering and implementing pull incentives, which are reimbursement mechanisms independent of the volume of medication sold. Specifically, the UK has introduced a subscription model for select novel antimicrobials, wherein pharmaceutical companies are remunerated at a predetermined price for the utilisation of their technology. Given the stagnation in novel antimicrobial development largely attributed to profitability concerns, the prioritisation of financial incentive development by high-income countries represents a promising development.

Lastly, although domains related to policy formulation and monitoring and evaluation have witnessed substantial increases in term frequency, it is essential to recognize that, in comparison to intervention-related domains, the term frequency of these areas in NAPs is considerably lower. Therefore, minor fluctuations in the term frequency of these domains may appear significant once again.

Limitations

This study possesses several limitations. Firstly, the corpus comprises NAPs from only 18 countries, potentially limiting the generalizability of the findings. This restriction stems from the study's focus on countries that have published more than one NAP since the release of the GAP-AMR in 2015. Additionally, the study only includes countries that have publicly shared their NAPs on the WHO website, potentially excluding countries that have solely published their plans on individual government websites or in image format, rendering the text unextractable. Future research could adopt a similar methodology to analyse a broader array of countries, with particular attention to variations across economic and geographic regions as more countries update their NAPs.

Secondly, this study employs a dictionary-based approach, making the results sensitive to the set of terms included in the analysis. While the term dictionary is comprehensive across the domains outlined in the GAP-AMR, there is a possibility that certain terms may have been overlooked. Additionally, the methodology does not consider the significance of the location of terms within a

[68] Khaznadar et al., 2021
[69] Tejpar et al., 2021

document. While this study intentionally excluded relatively less policy-relevant sections of each document (e.g., cover/end pages, acknowledgements), it did not assess the relative importance of each term based on its placement within the document.

Thirdly, it is crucial to recognize that NAPs are forward-looking documents and may not fully reflect past or ongoing initiatives to address AMR. The considerable variation in the interventions discussed in AMR-NAPs underscores the need for further examination of the factors influencing countries' emphasis on specific interventions. Moreover, additional studies are warranted to evaluate whether the interventions highlighted in AMR-NAPs are effectively addressing the underlying drivers of AMR within their respective settings.

5. Conclusion

In the years subsequent to the release of the GAP-AMR in 2015, WHO member states have unveiled NAPs delineating the challenges and objectives regarding AMR mitigation within each nation. With most NAPs structured for a duration of three to five years, early adopters of these plans have initiated the release of updated versions.

Thus far, only a limited number of cross-country longitudinal studies have examined the extent of alterations between the most recent and preceding editions of NAPs. To the best of the authors' knowledge, this study represents the inaugural endeavour to employ NLP-guided methodologies on text extracted from AMR-NAPs from WHO member states to assess the level of evolution between previous and current iterations of these plans.

In an effort to address these research gaps, the present study scrutinised the textual content of NAPs from 18 WHO member states, all of which had issued more than one NAP accessible via the WHO Library of AMR national action plans as of October 2023. In total, 36 NAPs (two from each country) and the GAP-AMR were subjected to analysis. Overall, the findings suggest that in the latest iterations of NAPs, countries have heightened their focus on curbing infection rates through effective sanitation, hygiene, and IPC measures, as well as on refining policy design and enhancing monitoring and evaluation frameworks. Moreover, substantial inter-country discrepancies were observed in the assortment of interventions emphasised in the AMR-NAPs.

The increased emphasis on infection prevention and control comes as expected, particularly in light of the recent COVID-19 pandemic, which prompted countries to swiftly realign their public health priorities. Similarly, the amplified attention to monitoring and evaluation and policy design is rational, given that many countries are on their second iteration of AMR-NAPs, necessitating the evaluation of outcomes from the initial plans and refinement of policy strategies based on progress achieved during the previous NAP period. However, there was a decrease in TF pertaining to international engagement, suggesting that AMR strategies have shifted from the pursuit of global coordination to the reinforcement of domestic infection prevention measures.

Moving forward, the findings hold implications for NGOs and international development agencies engaged in AMR aid programs, aiding them in aligning their efforts with individual country objectives. Additionally, policymakers participating in global health forums, such as the World Health Assembly and multi-country frameworks like the G20, stand to benefit from an understanding of evolving country priorities to facilitate consensus-building at the international level. Subsequent studies could replicate the methodology employed herein with a broader array of countries as more WHO member states release updated NAPs. Moreover, future research could employ more sophisticated NLP techniques to assign weights to terms in NAPs, potentially considering factors such as their placement within a document or discerning the positive or negative connotations associated with specific terms.

References

Abbas, S. S., Shorten, T., & Rushton, J. (2021). Meanings and mechanisms of one health partnerships: Insights from a critical review of literature on cross-government collaborations. *Health Policy and Planning*, *37*(3), 385–399. https://doi.org/10.1093/heapol/czab134

Abo, Y.-N., Freyne, B., Kululanga, D., & Bryant, P. A. (2022). The impact of antimicrobial stewardship in children in low- and middle-income countries. *Pediatric Infectious Disease Journal*, *41*(3S). https://doi.org/10.1097/inf.0000000000003317

Anderson, M., Schulze, K., Cassini, A., Plachouras, D., & Mossialos, E. (2019). A governance framework for development and assessment of National Action Plans on antimicrobial resistance. *The Lancet Infectious Diseases*, *19*(11). https://doi.org/10.1016/s1473-3099(19)30415-3

Armitage, R., & Nellums, L. B. (2020). Covid-19 and the consequences of isolating the elderly. *The Lancet Public Health*, *5*(5). https://doi.org/10.1016/s2468-2667(20)30061-x

Basu, S., Copana, R., Morales, R., Anugulruengkitt, S., Puthanakit, T., Maramba-Lazarte, C., Williams, P., Musembi, J., Boga, M., Issack, M., Hokororo, A., Falade, A. G., Trehan, I., Molyneux, E., Arscott-Mills, T., Alemayehu, T., & Bryant, P. A. (2022). Keeping it real: Antibiotic use problems and stewardship solutions in low- and middle-income countries. *Pediatric Infectious Disease Journal*, *41*(3S). https://doi.org/10.1097/inf.0000000000003321

Belayneh, A. (2020). Off-label use of chloroquine and hydroxychloroquine for covid-19 treatment in Africa against who recommendation . *Research and Reports in Tropical Medicine*, *Volume 11*, 61–72. https://doi.org/10.2147/rrtm.s269936

Bloom, G., Merrett, G. B., Wilkinson, A., Lin, V., & Paulin, S. (2017). Antimicrobial resistance and Universal Health Coverage. *BMJ Global Health*, *2*(4). https://doi.org/10.1136/bmjgh-2017-000518

Broom, A., Peterie, M., Kenny, K., Broom, J., Kelly-Hanku, A., Lafferty, L., Treloar, C., & Applegate, T. (2022). Vulnerability and antimicrobial resistance. *Critical Public Health*, *33*(3), 308–317. https://doi.org/10.1080/09581596.2022.2123733

Carelli, D. E., Mitsouli, E. T., Ogne, J. B., & Pierre, J. (2023a). The Best Laid Plans?: International Governance Perspectives in AMR National Action Plans in Europe. *European Journal of Public Health*, *33*(4), 682–686. https://doi.org/10.1093/eurpub/ckad080

Carelli, D. E., Mitsouli, E. T., Ogne, J. B., & Pierre, J. (2023b). The Best Laid Plans?: International Governance Perspectives in AMR National Action Plans in Europe. *European Journal of Public Health*, *33*(4), 682–686. https://doi.org/10.1093/eurpub/ckad080

Cassola, A., Baral, P., Røttingen, J.-A., & Hoffman, S. J. (2022). Evaluating official development assistance-funded granting mechanisms for Global Health and development research that is initiated in high-income countries. *Health Research Policy and Systems*, *20*(1). https://doi.org/10.1186/s12961-022-00859-6

Chalkidou, K., Claxton, K., Silverman, R., & Yadav, P. (2020). Value-based tiered pricing for Universal Health Coverage: An Idea Worth revisiting. *Gates Open Research*, *4*, 16. https://doi.org/10.12688/gatesopenres.13110.1

Charani, E., Mendelson, M., Pallett, S. J., Ahmad, R., Mpundu, M., Mbamalu, O., Bonaconsa, C., Nampoothiri, V., Singh, S., Peiffer-Smadja, N., Anton-Vazquez, V., Moore, L. S.,

Schouten, J., Kostyanev, T., Vlahović-Palčevski, V., Kofteridis, D., Corrêa, J. S., & Holmes, A. H. (2023a). An analysis of existing national action plans for antimicrobial resistance—gaps and opportunities in strategies optimising antibiotic use in human populations. *The Lancet Global Health*, *11*(3). https://doi.org/10.1016/s2214-109x(23)00019-0

Charani, E., Mendelson, M., Pallett, S. J., Ahmad, R., Mpundu, M., Mbamalu, O., Bonaconsa, C., Nampoothiri, V., Singh, S., Peiffer-Smadja, N., Anton-Vazquez, V., Moore, L. S., Schouten, J., Kostyanev, T., Vlahović-Palčevski, V., Kofteridis, D., Corrêa, J. S., & Holmes, A. H. (2023b). An analysis of existing national action plans for antimicrobial resistance—gaps and opportunities in strategies optimising antibiotic use in human populations. *The Lancet Global Health*, *11*(3). https://doi.org/10.1016/s2214-109x(23)00019-0

Choudhury, S., Medina-Lara, A., & Smith, R. (2022). Antimicrobial resistance and the COVID-19 pandemic. *Bulletin of the World Health Organization*, *100*(05). https://doi.org/10.2471/blt.21.287752

Chua, A. Q., Verma, M., Hsu, L. Y., & Legido-Quigley, H. (2021a). An analysis of national action plans on antimicrobial resistance in Southeast Asia using a governance framework approach. *The Lancet Regional Health - Western Pacific*, *7*, 100084. https://doi.org/10.1016/j.lanwpc.2020.100084

Chua, A. Q., Verma, M., Hsu, L. Y., & Legido-Quigley, H. (2021b). An analysis of national action plans on antimicrobial resistance in Southeast Asia using a governance framework approach. *The Lancet Regional Health - Western Pacific*, *7*, 100084. https://doi.org/10.1016/j.lanwpc.2020.100084

Chung The, H., Bodhidatta, L., Pham, D. T., Mason, C. J., Ha Thanh, T., Voong Vinh, P., Turner, P., Hem, S., Dance, D. A., Newton, P. N., Phetsouvanh, R., Davong, V., Thwaites, G. E., Thomson, N. R., Baker, S., & Rabaa, M. A. (2021). Evolutionary histories and antimicrobial resistance in Shigella flexneri and Shigella Sonnei in Southeast Asia. *Communications Biology*, *4*(1). https://doi.org/10.1038/s42003-021-01905-9

Cox, J. A., Vlieghe, E., Mendelson, M., Wertheim, H., Ndegwa, L., Villegas, M. V., Gould, I., & Levy Hara, G. (2017). Antibiotic stewardship in low- and middle-income countries: The same but different? *Clinical Microbiology and Infection*, *23*(11), 812–818. https://doi.org/10.1016/j.cmi.2017.07.010

Danzon, P. M. (2018). Differential pricing of pharmaceuticals: Theory, evidence and emerging issues. *PharmacoEconomics*, *36*(12), 1395–1405. https://doi.org/10.1007/s40273-018-0696-4

Do, P. C., Alemu, Y. A., & Reid, S. A. (2023). An Analysis of Australia's national action plan on antimicrobial resistance using a governance framework. *Journal of Public Health*. https://doi.org/10.1007/s10389-023-02029-6

Docteur, E. (2022). *TOWARDS A NEW VISION FOR SHARED RESPONSIBILITY IN PHARMACEUTICAL PRICING, COVERAGE AND REIMBURSEMENTPolicy approaches building on principles of solidarity, transparency and sustainability*. World Health Organization.

Dolecek, C., Shakoor, S., Basnyat, B., Okwor, T., & Sartorius, B. (2022). Drug-resistant bacterial infections: We need urgent action and investment that focus on the weakest link. *PLOS Biology*, *20*(11). https://doi.org/10.1371/journal.pbio.3001903

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

Ferrinho, P., Viveiros, M., & Fronteira, I. (2023). Antimicrobial resistance, Society and Environment: A Glocal syndemic. *One Health*, *16*, 100512. https://doi.org/10.1016/j.onehlt.2023.100512

The Fleming Fund 2021 annual review. Fleming Fund. (2022, July 11). https://www.flemingfund.org/publications/the-fleming-fund-2021-annual-review/

Foxlee, N. D., Townell, N., Heney, C., McIver, L., & Lau, C. L. (2021). Strategies used for implementing and promoting adherence to antibiotic guidelines in low- and lower-middle-income countries: A systematic review. *Tropical Medicine and Infectious Disease*, *6*(3), 166. https://doi.org/10.3390/tropicalmed6030166

Fuller, W. F., Hamzat, O. T., Aboderin, A. O., Gahimbare, L., Kapona, O., Yahaya, A. A., Kasambara, W., Nikiema, J.-B., Ilboudo, D. W., & Mpundu, M. M. (2022). National action plan on antimicrobial resistance: An evaluation of implementation in the World Health Organization Africa Region. *Journal of Public Health in Africa*, *13*(2). https://doi.org/10.4081/jphia.2022.2000

Gandra, S., Alvarez-Uria, G., Turner, P., Joshi, J., Limmathurotsakul, D., & van Doorn, H. R. (2020). Antimicrobial resistance surveillance in low- and middle-income countries: Progress and challenges in eight South Asian and Southeast Asian countries. *Clinical Microbiology Reviews*, *33*(3). https://doi.org/10.1128/cmr.00048-19

Global antimicrobial resistance and use surveillance system (glass) report 2021. (2022). . World Health Organization.

Godman, B., Egwuenu, A., Wesangula, E., Schellack, N., Kalungia, A. C., Tiroyakgosi, C., Kgatlwane, J., Mwita, J. C., Patrick, O., Niba, L. L., Amu, A. A., Oguntade, R. T., Alabi, M. E., Ncube, N. B., Sefah, I. A., Acolatse, J., Incoom, R., Guantai, A. N., Oluka, M., … Brink, A. J. (2022). Tackling antimicrobial resistance across sub-Saharan africa: Current challenges and implications for the future. *Expert Opinion on Drug Safety*, *21*(8), 1089–1111. https://doi.org/10.1080/14740338.2022.2106368

Goff, D. (2021). BSAC Vanguard Series: The future of antibiotic stewardship—managing access and excess. *Journal of Antimicrobial Chemotherapy*, *77*(4), 863–864. https://doi.org/10.1093/jac/dkab423

Harant, A. (2022). Assessing transparency and accountability of National Action Plans on antimicrobial resistance in 15 African countries. *Antimicrobial Resistance & Infection Control*, *11*(1). https://doi.org/10.1186/s13756-021-01040-4

Harrington, A., Vo, V., Papp, K., Tillett, R. L., Chang, C.-L., Baker, H., Shen, S., Amei, A., Lockett, C., Gerrity, D., & Oh, E. C. (2022). Urban monitoring of antimicrobial resistance during a COVID-19 surge through wastewater surveillance. *Science of The Total Environment*, *853*, 158577. https://doi.org/10.1016/j.scitotenv.2022.158577

Hawkins, O., Scott, A. M., Montgomery, A., Nicholas, B., Mullan, J., van Oijen, A., & Degeling, C. (2022a). Comparing public attitudes, knowledge, beliefs and behaviours towards antibiotics and antimicrobial resistance in Australia, United Kingdom, and Sweden (2010-2021): A systematic review, meta-analysis, and comparative policy analysis. *PLOS ONE*, *17*(1). https://doi.org/10.1371/journal.pone.0261917

Hawkins, O., Scott, A. M., Montgomery, A., Nicholas, B., Mullan, J., van Oijen, A., & Degeling, C. (2022b). Comparing public attitudes, knowledge, beliefs and behaviours towards antibiotics and antimicrobial resistance in Australia, United Kingdom, and Sweden (2010-2021): A systematic review, meta-analysis, and comparative policy analysis. *PLOS ONE*, *17*(1). https://doi.org/10.1371/journal.pone.0261917

Heinzel, M., & Koenig-Archibugi, M. (2023). Soft governance against superbugs: How effective is the international regime on antimicrobial resistance? *The Review of International Organizations*. https://doi.org/10.1007/s11558-023-09510-7

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. https://doi.org/10.1007/s40258-022-00728-x

Holtorf, A.-P., Gialama, F., Wijaya, K. E., & Kaló, Z. (2019). External reference pricing for pharmaceuticals—a survey and literature review to describe best practices for countries with expanding healthcare coverage. *Value in Health Regional Issues*, *19*, 122–131. https://doi.org/10.1016/j.vhri.2019.04.003

Hou, J., Long, X., Wang, X., Li, L., Mao, D., Luo, Y., & Ren, H. (2023). Global trend of antimicrobial resistance in common bacterial pathogens in response to antibiotic consumption. *Journal of Hazardous Materials*, *442*, 130042. https://doi.org/10.1016/j.jhazmat.2022.130042

Iskandar, K., Molinier, L., Hallit, S., Sartelli, M., Catena, F., Coccolini, F., Craig Hardcastle, T., Roques, C., & Salameh, P. (2020). Drivers of antibiotic resistance transmission in low- and middle-income countries from a "one health" perspective—a review. *Antibiotics*, *9*(7), 372. https://doi.org/10.3390/antibiotics9070372

Iskandar, K., Molinier, L., Hallit, S., Sartelli, M., Hardcastle, T. C., Haque, M., Lugova, H., Dhingra, S., Sharma, P., Islam, S., Mohammed, I., Naina Mohamed, I., Hanna, P. A., Hajj, S. E., Jamaluddin, N. A., Salameh, P., & Roques, C. (2021). Surveillance of antimicrobial resistance in low- and middle-income countries: A scattered picture. *Antimicrobial Resistance & Infection Control*, *10*(1). https://doi.org/10.1186/s13756-021-00931-w

Janssen, J., Afari-Asiedu, S., Monnier, A., Abdulai, M. A., Tawiah, T., Wertheim, H., Baltussen, R., & Asante, K. P. (2022). Exploring the economic impact of inappropriate antibiotic use: The case of Upper Respiratory Tract Infections in Ghana. *Antimicrobial Resistance & Infection Control*, *11*(1). https://doi.org/10.1186/s13756-022-01096-w

Jeleff, M., Haddad, C., & Kutalek, R. (2023). Between superimposition and local initiatives: Making sense of 'implementation gaps' as a governance problem of antimicrobial resistance. *SSM - Qualitative Research in Health*, *4*, 100332. https://doi.org/10.1016/j.ssmqr.2023.100332

Jensen, C. S. (2023). Antimicrobial resistance in the Risk Society – a Danish study on how veterinarians and human medical doctors construct risk through blaming. *Health, Risk & Society*, 1–18. https://doi.org/10.1080/13698575.2023.2251542

Kariyawasam, R. M., Julien, D. A., Jelinski, D. C., Larose, S. L., Rennert-May, E., Conly, J. M., Dingle, T. C., Chen, J. Z., Tyrrell, G. J., Ronksley, P. E., & Barkema, H. W. (2022). Antimicrobial resistance (AMR) in COVID-19 patients: A systematic review and meta-analysis (November 2019–June 2021). *Antimicrobial Resistance & Infection Control*, *11*(1). https://doi.org/10.1186/s13756-022-01085-z

Kelesidis, T., & Falagas, M. E. (2015). Substandard/counterfeit antimicrobial drugs. *Clinical Microbiology Reviews*, *28*(2), 443–464. https://doi.org/10.1128/cmr.00072-14

Kentikelenis, A., Ghaffar, A., McKee, M., Dal Zennaro, L., & Stuckler, D. (2022). Global Financing for Health Policy and Systems Research: A review of funding opportunities. *Health Policy and Planning*, *38*(3), 409–416. https://doi.org/10.1093/heapol/czac109

Khaznadar, O., Khaznadar, F., Petrovic, A., Kuna, L., Loncar, A., Omanovic Kolaric, T., Mihaljevic, V., Tabll, A. A., Smolic, R., & Smolic, M. (2023). Antimicrobial resistance

and antimicrobial stewardship: Before, during and after the COVID-19 pandemic. *Microbiology Research*, *14*(2), 727–740. https://doi.org/10.3390/microbiolres14020052

Khouja, T., Mitsantisuk, K., Tadrous, M., & Suda, K. J. (2022a). Global consumption of antimicrobials: Impact of the WHO global action plan on antimicrobial resistance and 2019 coronavirus pandemic (COVID-19). *Journal of Antimicrobial Chemotherapy*, *77*(5), 1491–1499. https://doi.org/10.1093/jac/dkac028

Khouja, T., Mitsantisuk, K., Tadrous, M., & Suda, K. J. (2022b). Global consumption of antimicrobials: Impact of the WHO global action plan on antimicrobial resistance and 2019 coronavirus pandemic (COVID-19). *Journal of Antimicrobial Chemotherapy*, *77*(5), 1491–1499. https://doi.org/10.1093/jac/dkac028

Knight, G. M., Glover, R. E., McQuaid, C. F., Olaru, I. D., Gallandat, K., Leclerc, Q. J., Fuller, N. M., Willcocks, S. J., Hasan, R., van Kleef, E., & Chandler, C. I. (2021). Antimicrobial resistance and covid-19: Intersections and implications. *eLife*, *10*. https://doi.org/10.7554/elife.64139

Lai, C.-C., Chen, S.-Y., Ko, W.-C., & Hsueh, P.-R. (2021). Increased antimicrobial resistance during the COVID-19 pandemic. *International Journal of Antimicrobial Agents*, *57*(4), 106324. https://doi.org/10.1016/j.ijantimicag.2021.106324

Lam, T. T., Dang, D. A., Tran, H. H., Do, D. V., Le, H., Negin, J., Jan, S., Marks, G. B., Nguyen, T. A., Fox, G. J., & Beardsley, J. (2021). What are the most effective community-based antimicrobial stewardship interventions in low- and middle-income countries? A narrative review. *Journal of Antimicrobial Chemotherapy*, *76*(5), 1117–1129. https://doi.org/10.1093/jac/dkaa556

Langford, B. J., So, M., Simeonova, M., Leung, V., Lo, J., Kan, T., Raybardhan, S., Sapin, M. E., Mponponsuo, K., Farrell, A., Leung, E., Soucy, J.-P. R., Cassini, A., MacFadden, D., Daneman, N., & Bertagnolio, S. (2023). Antimicrobial resistance in patients with COVID-19: A systematic review and meta-analysis. *The Lancet Microbe*, *4*(3). https://doi.org/10.1016/s2666-5247(22)00355-x

Laxminarayan, R., Matsoso, P., Pant, S., Brower, C., Røttingen, J.-A., Klugman, K., & Davies, S. (2016). Access to effective antimicrobials: A Worldwide Challenge. *The Lancet*, *387*(10014), 168–175. https://doi.org/10.1016/s0140-6736(15)00474-2

Leonard, C., Crabb, N., Glover, D., Cooper, S., Bouvy, J., Wobbe, M., & Perkins, M. (2023). Can the UK 'netflix' payment model boost the antibacterial pipeline? *Applied Health Economics and Health Policy*, *21*(3), 365–372. https://doi.org/10.1007/s40258-022-00786-1

Maugeri, A., Barchitta, M., Magnano San Lio, R., & Agodi, A. (2023). Socioeconomic and governance factors disentangle the relationship between temperature and antimicrobial resistance: A 10-year ecological analysis of European countries. *Antibiotics*, *12*(4), 777. https://doi.org/10.3390/antibiotics12040777

Maugeri, A., Barchitta, M., Puglisi, F., & Agodi, A. (2023). Socio-economic, Governance and Health Indicators Shaping Antimicrobial Resistance: An ecological analysis of 30 European countries. *Globalization and Health*, *19*(1). https://doi.org/10.1186/s12992-023-00913-0

Mendelson, M. (2021). BSAC Vanguard Series: Inequality and antibiotic resistance. *Journal of Antimicrobial Chemotherapy*, *77*(2), 277–278. https://doi.org/10.1093/jac/dkab426

Monitoring and evaluation of the Global Action Plan on Antimicrobial Resistance: Framework and recommended indicators. (2015). . World Health Organization.

Munk, P., Brinch, C., Møller, F. D., Petersen, T. N., Hendriksen, R. S., Seyfarth, A. M., Kjeldgaard, J. S., Svendsen, C. A., van Bunnik, B., Berglund, F., Bego, A., Power, P.,

Rees, C., Lambrinidis, D., Neilson, E. H., Gibb, K., Coventry, K., Collignon, P., Cassar, S., … Aarestrup, F. M. (2022). Genomic analysis of sewage from 101 countries reveals Global Landscape of antimicrobial resistance. *Nature Communications*, *13*(1). https://doi.org/10.1038/s41467-022-34312-7

Munkholm, L., & Rubin, O. (2020a). The global governance of antimicrobial resistance: A cross-country study of alignment between the global action plan and national action plans. *Globalization and Health*, *16*(1). https://doi.org/10.1186/s12992-020-00639-3

Munkholm, L., & Rubin, O. (2020b). The global governance of antimicrobial resistance: A cross-country study of alignment between the global action plan and national action plans. *Globalization and Health*, *16*(1). https://doi.org/10.1186/s12992-020-00639-3

Murray, C. J., Ikuta, K. S., Sharara, F., Swetschinski, L., Robles Aguilar, G., Gray, A., Han, C., Bisignano, C., Rao, P., Wool, E., Johnson, S. C., Browne, A. J., Chipeta, M. G., Fell, F., Hackett, S., Haines-Woodhouse, G., Kashef Hamadani, B. H., Kumaran, E. A., McManigal, B., … Naghavi, M. (2022). Global burden of bacterial antimicrobial resistance in 2019: A systematic analysis. *The Lancet*, *399*(10325), 629–655. https://doi.org/10.1016/s0140-6736(21)02724-0

Nayiga, S., Kayendeke, M., Nabirye, C., Willis, L. D., Chandler, C. I., & Staedke, S. G. (2020). Use of antibiotics to treat humans and animals in Uganda: A cross-sectional survey of households and farmers in rural, urban and peri-urban settings. *JAC-Antimicrobial Resistance*, *2*(4). https://doi.org/10.1093/jacamr/dlaa082

Naylor, N. R., Lines, J., Waage, J., Wieland, B., & Knight, G. M. (2020). Quantitatively evaluating the cross-sectoral and one health impact of interventions: A scoping review and case study of antimicrobial resistance. *One Health*, *11*, 100194. https://doi.org/10.1016/j.onehlt.2020.100194

Njage, P. M., van Bunnik, B., Munk, P., Marques, A. R., & Aarestrup, F. M. (2023). Association of Health, nutrition, and socioeconomic variables with global antimicrobial resistance: A modelling study. *The Lancet Planetary Health*, *7*(11). https://doi.org/10.1016/s2542-5196(23)00213-9

OECD iLibrary. (n.d.). *Safe prescribing in primary care*. Health at a Glance 2021 : OECD Indicators | OECD iLibrary. https://www.oecd-ilibrary.org/sites/1fd25a1c-en/index.html?itemId=%2Fcontent%2Fcomponent%2F1fd25a1c-en

Ogyu, A., Chan, O., Littmann, J., Pang, H. H., Lining, X., Liu, P., Matsunaga, N., Ohmagari, N., Fukuda, K., & Wernli, D. (2020). National action to combat AMR: A one-health approach to assess policy priorities in action plans. *BMJ Global Health*, *5*(7). https://doi.org/10.1136/bmjgh-2020-002427

Ohkusa, Y., Sugawara, T., Kawanohara, H., & Kamei, M. (2018). Evaluation of the global action plan on antimicrobial resistance in Japan during its first eighteen months. *Drug Discoveries & Therapeutics*, *12*(3), 182–184. https://doi.org/10.5582/ddt.2018.01011

Okolie, O. J., Igwe, U., Ismail, S. U., Ighodalo, U. L., & Adukwu, E. C. (2022). Systematic review of surveillance systems for AMR in Africa. *Journal of Antimicrobial Chemotherapy*, *78*(1), 31–51. https://doi.org/10.1093/jac/dkac342

Outterson, K., & Rex, J. H. (2023). Global pull incentives for better antibacterials: The UK leads the way. *Applied Health Economics and Health Policy*, *21*(3), 361–364. https://doi.org/10.1007/s40258-023-00793-w

Overton, K., Fortané, N., Broom, A., Raymond, S., Gradmann, C., Orubu, E. S., Podolsky, S. H., Rogers Van Katwyk, S., Zaman, M. H., & Kirchhelle, C. (2021). Waves of attention:

Patterns and themes of international antimicrobial resistance reports, 1945–2020. *BMJ Global Health*, *6*(11). https://doi.org/10.1136/bmjgh-2021-006909

Overview report – member states' one Health National Action Plans against antimicrobial resistance. Public Health. (2022, November 17). https://health.ec.europa.eu/publications/overview-report-member-states-one-health-national-action-plans-against-antimicrobial-resistance_en

Patel, J., & Sridhar, D. (2022a). The pandemic legacy of antimicrobial resistance in the USA. *The Lancet Microbe*, *3*(10). https://doi.org/10.1016/s2666-5247(22)00227-0

Patel, J., & Sridhar, D. (2022b). The pandemic legacy of antimicrobial resistance in the USA. *The Lancet Microbe*, *3*(10). https://doi.org/10.1016/s2666-5247(22)00227-0

Patel, J., Harant, A., Fernandes, G., Mwamelo, A. J., Hein, W., Dekker, D., & Sridhar, D. (2023). Measuring the global response to antimicrobial resistance, 2020–21: A systematic governance analysis of 114 countries. *The Lancet Infectious Diseases*, *23*(6), 706–718. https://doi.org/10.1016/s1473-3099(22)00796-4

Piddock, L. J., Paccaud, J.-P., O'Brien, S., Childs, M., Malpani, R., & Balasegaram, M. (2021). A nonprofit drug development model is part of the antimicrobial resistance (AMR) solution. *Clinical Infectious Diseases*, *74*(10), 1866–1871. https://doi.org/10.1093/cid/ciab887

Pokharel, S., Raut, S., & Adhikari, B. (2019). Tackling antimicrobial resistance in low-income and middle-income countries. *BMJ Global Health*, *4*(6). https://doi.org/10.1136/bmjgh-2019-002104

Poudel, A. N., Zhu, S., Cooper, N., Little, P., Tarrant, C., Hickman, M., & Yao, G. (2023). The economic burden of antibiotic resistance: A systematic review and meta-analysis. *PLOS ONE*, *18*(5). https://doi.org/10.1371/journal.pone.0285170

Preckler, V., & Espín, J. (2022). The role of indication-based pricing in future pricing and reimbursement policies: A systematic review. *Value in Health*, *25*(4), 666–675. https://doi.org/10.1016/j.jval.2021.11.1376

Rehman, S. (2023a). A parallel and silent emerging pandemic: Antimicrobial resistance (AMR) amid covid-19 pandemic. *Journal of Infection and Public Health*, *16*(4), 611–617. https://doi.org/10.1016/j.jiph.2023.02.021

Rehman, S. (2023b). A parallel and silent emerging pandemic: Antimicrobial resistance (AMR) amid covid-19 pandemic. *Journal of Infection and Public Health*, *16*(4), 611–617. https://doi.org/10.1016/j.jiph.2023.02.021

Ren, M., So, A. D., Chandy, S. J., Mpundu, M., Peralta, A. Q., Åkerfeldt, K., Sjöblom, A. K., & Cars, O. (2022). **equitable access to antibiotics:** a core element and shared global responsibility for pandemic preparedness and response. *Journal of Law, Medicine & Ethics*, *50*(S2), 34–39. https://doi.org/10.1017/jme.2022.77

Rizvi, S. G., & Ahammad, S. Z. (2022a). Covid-19 and antimicrobial resistance: A cross-study. *Science of The Total Environment*, *807*, 150873. https://doi.org/10.1016/j.scitotenv.2021.150873

Rizvi, S. G., & Ahammad, S. Z. (2022b). Covid-19 and antimicrobial resistance: A cross-study. *Science of The Total Environment*, *807*, 150873. https://doi.org/10.1016/j.scitotenv.2021.150873

Rubin, O. (2019a). The glocalization of antimicrobial stewardship. *Globalization and Health*, *15*(1). https://doi.org/10.1186/s12992-019-0498-2

Rubin, O. (2019b). The glocalization of antimicrobial stewardship. *Globalization and Health*, *15*(1). https://doi.org/10.1186/s12992-019-0498-2

Shamas, N., Stokle, E., Ashiru-Oredope, D., & Wesangula, E. (2023). Challenges of implementing antimicrobial stewardship tools in low to middle income countries (lmics). *Infection Prevention in Practice*, *5*(4), 100315. https://doi.org/10.1016/j.infpip.2023.100315

Sproston, N. R., & Ashworth, J. J. (2018). Role of C-reactive protein at sites of inflammation and infection. *Frontiers in Immunology*, *9*. https://doi.org/10.3389/fimmu.2018.00754

Spruijt, P., & Petersen, A. C. (2020). Multilevel governance of antimicrobial resistance risks: A literature review. *Journal of Risk Research*, *25*(8), 945–958. https://doi.org/10.1080/13669877.2020.1779784

Sugianli, A. K., Ginting, F., Parwati, I., de Jong, M. D., van Leth, F., & Schultsz, C. (2021). Antimicrobial resistance among uropathogens in the asia-pacific region: A systematic review. *JAC-Antimicrobial Resistance*, *3*(1). https://doi.org/10.1093/jacamr/dlab003

Sun, R., Yao, T., Zhou, X., Harbarth, S., & Lin, L. (2022). Non-biomedical factors affecting antibiotic use in the community: A mixed-methods systematic review and meta-analysis. *Clinical Microbiology and Infection*, *28*(3), 345–354. https://doi.org/10.1016/j.cmi.2021.10.017

Tamvada, J. P., & Chowdhury, R. (2022). The irrationality of rationality in Market Economics: A paradox of incentives perspective. *Business & Society*, *62*(3), 482–487. https://doi.org/10.1177/00076503221101888

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

Tejpar, S., Rogers Van Katwyk, S., Wilson, L., & Hoffman, S. J. (2022). Taking stock of global commitments on antimicrobial resistance. *BMJ Global Health*, *7*(5). https://doi.org/10.1136/bmjgh-2021-008159

Theuretzbacher, U., Baraldi, E., Ciabuschi, F., & Callegari, S. (2023). Challenges and shortcomings of antibacterial discovery projects. *Clinical Microbiology and Infection*, *29*(5), 610–615. https://doi.org/10.1016/j.cmi.2022.11.027

TOWARDS A NEW VISION FOR SHARED RESPONSIBILITY IN PHARMACEUTICAL PRICING, COVERAGE AND REIMBURSEMENT. (n.d.).

Van Dijck, C., Vlieghe, E., & Cox, J. A. (2018). Antibiotic stewardship interventions in hospitals in low-and middle-income countries: A systematic review. *Bulletin of the World Health Organization*, *96*(4), 266–280. https://doi.org/10.2471/blt.17.203448

van Heuvel, L., Caini, S., Dückers, M. L., & Paget, J. (2022). Assessment of the inclusion of vaccination as an intervention to reduce antimicrobial resistance in AMR National Action Plans: A global review. *Globalization and Health*, *18*(1). https://doi.org/10.1186/s12992-022-00878-6

Vogeler, C. S., Hornung, J., Bandelow, N. C., & Möck, M. (2021). Antimicrobial resistance policies in European countries – a comparative analysis of policy integration in the water-food-health nexus. *Journal of Environmental Policy & Planning*, *24*(5), 568–579. https://doi.org/10.1080/1523908x.2021.1956311

Wallinga, D., Smit, L. A., Davis, M. F., Casey, J. A., & Nachman, K. E. (2022). A review of the effectiveness of current US policies on antimicrobial use in meat and poultry production. *Current Environmental Health Reports*, *9*(2), 339–354. https://doi.org/10.1007/s40572-022-00351-x

Wang, Z., Yu, M., & Lin, L. (2023). The emerging antimicrobial resistance crisis during the covid-19 surge in China. *The Lancet Microbe*, *4*(5). https://doi.org/10.1016/s2666-5247(23)00038-1

Willemsen, A., Reid, S., & Assefa, Y. (2022). A review of National Action Plans on antimicrobial resistance: Strengths and weaknesses. *Antimicrobial Resistance & Infection Control*, *11*(1). https://doi.org/10.1186/s13756-022-01130-x

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

World Health Organization. (2021, September). *Comprehensive review of the WHO global action plan on antimicrobial resistance - volume 1: Report*. World Health Organization. https://www.who.int/publications/m/item/comprehensive-review-of-the-who-global-action-plan-on-antimicrobial-resistance

World Health Organization. (n.d.). *Who implementation handbook for national action plans on antimicrobial resistance: Guidance for the human health sector*. World Health Organization. https://www.who.int/publications-detail-redirect/9789240041981

Zay Ya, K., Win, P. T., Bielicki, J., Lambiris, M., & Fink, G. (2023). Association between antimicrobial stewardship programs and antibiotic use globally. *JAMA Network Open*, *6*(2). https://doi.org/10.1001/jamanetworkopen.2022.53806

Özçelik, E. A., Doucet, C., Kang, H., Levy, N., Feldhaus, I., Hashiguchi, T. C., Lerouge, A., & Cecchini, M. (2022). A comparative assessment of action plans on antimicrobial resistance from OECD and G20 countries using natural language processing. *Health Policy*, *126*(6), 522–533. https://doi.org/10.1016/j.healthpol.2022.03.011

Abstract in Korean

키워드 : 항생제 내성, 세계보건기구, 국가 행동 계획, 자연어 처리, 용어 빈도, 용어 빈도 역 문서 빈도
학생 번호 : 2020-20959

항생제 내성(AMR)은 전 세계적인 문제이며, 특히 중저소득국(LMICs)에서 시급한 과제이다. 국가 간 협력적 행동의 필요성에 따라 WHO는 2015년 AMR에 관한 글로벌 행동계획(GAP-AMR)을 결의하고, 세계보건기구(WHO)에 가입한 194개국에 GAP-AMR의 5가지 목표와 그에 상응하는 행동을 국가행동계획(NAP)에 기재할 것을 권고했다. 권고했다. 대부분의 NAP의 이행 기간은 3년에서 5년으로 설정되어 있어, 일부 회원국은 팬데믹 이후 상황을 고려한 최신 버전의 NAP 수립에 착수하고 있다. 이에 본 연구에서는 자연어처리(NLP) 기술을 활용하여 NAP의 전략 목표와 AMR에 대한 개입 방안의 초점이 이전 버전과 얼마나 달라졌는지 정량적으로 분석하였다.

본 연구는 글로벌 AMR 거버넌스의 변천을 조사했다. 변화의 정도는 용어 빈도(TF)와 용어 빈도-역문서 빈도(TF-IDF)를 기반으로 정량화했으며, TF를 통해 전략 목표 등의 상대적 중요성을 정량화하고, TF-IDF를 통해 각국의 NAP에서 더 자주 등장하는 개입을 식별할 수 있도록 했다. 샘플에는 GAP-AMR 채택 이후 팬데믹 이전과 팬데믹 이후 두 개의 NAP를 발표한 18개국이 포함되었다. 문서 내 용어는 GAP-AMR에 명시된 정책 목적 및 개입 방안에 해당하는 5개의 용어 그룹과 정책 설계, 모니터링 및 평가(M&E)를 암시하는 5개의 용어 그룹으로 분류되어 총 10개의 그룹으로 분류되었다.

GAP-AMR에 명시된 5가지 주요 목표 중 ① 효과적인 보건위생 및 IPC 대책 등을 통한 감염병 발생률 감소 및 ② 효과적인 홍보, 교육, 훈련을 통한 AMR에 대한 인식 및 이해 증진과 관련된 용어의 빈도가 증가(각각 △13.62%, △4.34%)했다. 반면, ① AMR 감시 및 기초연구 강화를 통한 지식 및 근거 기반 확대, ② 의약품, 진단 도구, 백신 및 기타 중재책에 대한 지속 가능한 투자를 위한 경제적 인센티브 구축, ③ 인간과 동물의 건강에서 항생제 사용의 최적화와 관련된 용어는 TF가 감소하였다(각각 ▲5.32%, ▲11.12%, ▲19.40%). 또한, 정책 설계 및 M&E 등 용어군에서는 비용효과성 관련 용어가 최신판(주로 팬데믹 이후) NAP에서 처음으로 언급된 반면, 국제 협력 및 공조 관련 용어가 가장 큰 폭으로 감소했다(▲15.4%). 한편, 각 NAP에서 명확하게 빈번하게 등장하는 개입의 분포는 국가 간 편차가 있다는 점에 유의할 필요가 있다.

이 조사 결과를 통해 각국의 초판 NAP와 2판 NAP가 발표된 3년에서 5년 사이에 각국의 AMR 전략의 초점이 글로벌 협력 추구에서 국내 감염 예방 대책 강화로, 식품 생산 관련 개입에서 소비 관련 개입으로 이동했음을 짐작할 수 있다. 원인은 다양하지만, 감염 예방 및 관리 대책 강화와 비용 대비 효과를 중시하는 방향으로 전환된 한 요인으로 코로나19 팬데믹의 영향도 부정할 수 없다. 한편, WHO 등 국제기구 입장에서는 이번 팬데믹이 글로벌 공조에서 국내 정책 강화로의 전환을 가속화시켰을 가능성이 있으며, 이에 따라 회원국들이 보다 글로벌한 접근 방식을 취하도록 동기를 부여하는 메커니즘을 구축하는 것이 시급한 과제임을 강력히 시사하고 있다.

Supplementary Table 1 - List of Domains/Interventions

Term Dictionary for Domain/Intervention	**Terms**	**Terms after stemming**
Domain 1 Sum (Improve AMR awareness and understanding through effective communication, education and training)		
Intervention 1a Sum (Enhance AMR awareness in the public)	Antibiotic awareness, antibiotic awareness week, antibiotic/antimicrobial campaign, awareness campaign, communication, disseminate knowledge, educate/inform general public, educate/inform public, mass media, improve awareness and understanding, improve knowledge and understanding, amr knowledge, public awareness, raising awareness, risk registration, risk communication, social media	"antibiot_awar", "antibiot_awar_campaign", "antibiot_awar_week", "antimicrobi_awar_week", "antibiot_campaign", "antimicrobi_campaign", "awar_campaign", "communic", "dissemin_knowledg", "dissemin", "inform_general_public", "inform_public", "educat_general_public", "educat_public", "mass_media", "improv_awar_and_understand", "improv_awar_understand", "amr_knowledg", "public_awar", "rais_awar", "risk_registr", "risk_communic", "social_media"
Intervention 1b Sum (Integrate AMR in professional education and training)	capacity building, certification, continued education, continuous professional education, curricula, curriculum, higher education, undergraduate, university, postgraduate, training	"capac_build", "certif", "continu_educ", "continu_profession_educ", "curricula", "curriculum", "higher_educ", "undergradu", "univers", "postgradu", "train",
Intervention 1c Sum (Integrate AMR in school education)	child, curricula, curriculum, high school, primary school, secondary school	"child", "high_school", "primari_school", "secondari_school", "curricula", "curriculum",
Domain 2 Sum (Strengthen knowledge and evidence base by bolstering AMR surveillance and research)		
Intervention 2a Sum (Engage global and regional AMR surveillance networks)	caesar, cddep, earsnet, ears vet, esac, esvac, eurosurveillance, gei, glass, global surveillance, regional surveillance	"caesar", "cddep", "earsnet", "ears_net", "ears_vet", "esac", "esvac", "eurosurveil", "gei", "glass", "global_surveil", "region_surveil"
Intervention 2b Sum (Expand laboratory network capacity)	assay laboratory, laboratory capability, laboratory capacity, laboratory network, reference laboratory, referral laboratory	"assay_laboratori", "laboratori_capabl", "laboratori_capac", "laboratori_network", "referenc_laboratori", "referr_laboratori"
Intervention 2c Sum (Promote new data sources in AMR surveillance)	new data sources, metagenomic, molecular testing, susceptibility testing, whole-genome sequencing	"new_data_sourc", "metagenom", "molecular_test", "suscept_test", "whole_genom_sequenc", "genom_sequenc", "whole_genom",

Term Dictionary for Domain/Intervention	Terms	Terms after stemming
Intervention 2d Sum (Other terms associated with strengthening AMR surveillance)	benchmarking, data collection, monitoring framework, data reporting, monitor, evaluate, point prevalence survey, resistance monitoring, risk analysis, risk assessment, risk management, surveillance, sentinel site	"benchmark", "data_collect", "monitor_framework", "data_report", "monitor", "evalu", "point_preval_survey", "point_preval", "preval_survey", "resist_monitor", "risk_analysis", "risk_assess", "risk_manag", "surveil", "sentinel_site"
Domain 3 Sum (Reduce incidence of infection through effective sanitation, hygiene, and IPC measures)		
Intervention 3a Sum (Improve water, hygiene, sanitation, and waste management)	clean water, decolonization, decontamination, hand washing, hazard, hygiene, manure, sanitation, soil, wastewater, water safety, water quality, waste	"clean_water", "decolon", "decontamin", "hand_wash", "hazard", "hygien", "manur", "sanit", "soil", "wastewat", "water_safeti", "water_qualiti", "wast"
Intervention 3b Sum (Improve vaccination coverage)	immunize, vaccine	"immun", "vaccin"
Intervention 3c Sum (Other terms associated with strengthening IPC programs)	disease control, infection prevention control, infection prevention measure, infect prevent policy, ipc, infection prevention program, infection prevention promotion, outbreak control, preventive measure, hai, healthcare acquired infection, health facility acquired infection, superinfection, covid-19, covid, coronavirus disease, pandemic, differentiate, viral infection, biocide usage, pre-covid, post-covid, secondary bacterial infection, nosocomial infection, healthcare associated infection, pull factor, coronavirus, corona virus, secondary infection, co-infection	"diseas_control", "infect_prevent_control", "infect_prevent", "prevent_control", "infect_prevent_measur", "infect_prevent_polici", "ipc", "infect_prevent_program", "infect_prevent_promot", "outbreak_control", "prevent_measur", "hai", "healthcar_associ_infect", "health_facil_acquir_infect", "superinfect", "covid_19", "covid", "coronavirus_diseas", "coronaviru_diseas", "pandem", "differenti", "viral_infect", "biocid_usag", "pre_covid", "post_covid", "secondari_bacteri_infect", "nosocomi_infect", "healthcar_associ_infect", "pull_factor", "coronaviru", "corona_viru", "secondari_infect", "co_infect"
Intervention 3d Sum (Promote food safety and security)	alimentarius commission, codex alimentarius, food hygiene, food safety, food security, food processing, food production, kitchen hygiene	"alimentari_commiss", "codex_alimentari", "food_hygien", "food_safeti", "food_secur", "food_process", "food_product", "kitchen_hygien",
Intervention 3e Sum (Enhance biosecurity)	biosecurity, stockbreeding, vaccine	"biosecur", "stockbreed", "vaccin"
Domain 4 Sum (Optimize antimicrobial use in human and animal health)		

Supplementary Table 1 - List of Domains/Interventions

Term Dictionary for Domain/Intervention	**Terms**	**Terms after stemming**
Intervention 4a Sum (Strengthen antimicrobial stewardship)	access antibiotic/antimicrobial, acute care, antimicrobial stewardship, asp, broad/narrow spectrum antibiotics, clinical guideline, dispensing, dose optimization, elderly care, first-choice antibiotic, general practitioner, gp, hospital care, long term care, nursing home, older patient, prescribing, supply chain, supply mechanism, primary care, primary health care, phc, veterinary oversight, critically important antimicrobial/antibiotic, cia, essential medicine list, eml, delay prescribe, wait see, off patent, older antibiotic, older agent, older class, patient safety, rapid treatment, target medicine, timely treatment, optimize treatment options, accreditation, quality assurance, reaccreditation, quality of care, private sector, private healthcare, private hospital, private laboratory, private practice private veterinarian, private physician, private provider	"access_antibioti", "access_antimicrobi", "acut_care", "antimicrobi_stewardship", "asp", "broad_spectrum_antibioti", "narrow_spectrum_antibioti", "clinic_guidelin", "dispensing", "dose_optim", "elderli_care", "first_choic_antibioti", "general_practition", "gp", "hospit_care", "long_term_care", "nurs_home", "older_patient", "prescrib", "suppli_chain", "suppli_mechan", "primari_care", "primari_health_car", "phc", "veterinari_oversight", "critic_import_antimicrobi", "critic_import_antibioti", "cia", "essenti_medicin_list", "eml", "delay_prescrib", "wait_see", "off_patent", "older_antibioti", "older_agent", "older_class", "patient_safeti", "rapid_treatment", "target_medicin", "time_treatment", "optim_treatment_option", "qualiti_assur", "reaccredit", "qualiti_of_care", "qualiti_care" "privat_sector", "privat_healthcar", "privat_hospit", "privat_laboratori", "privat_practic", "privat_veterinari", "privat_physician", "privat_provid",
Intervention 4b Sum (Limit antimicrobial sale without prescription, counterfeit or substandard antimicrobial sale, online antibiotic sales)	antibiotic/drug sale without prescription, black market, counterfeit antibiotic, falsified drugs, falsified products, false labelling, illegal sale, online pharmacy, online sale, substandard antibiotic	"antibioti_sale_without_prescript", "drug_sale_without_prescript", "black_market", "counterfeit_antibioti", "falsifi_drug", "falsifi_product", "fals_label", "illeg_sale", "onlin_pharmaci", "onlin_sale", "substandard_antibioti"
Intervention 4c Sum (Enhance the use of diagnostic tools)	diagnostic tools, electron health, electron medic, electron prescribe, electron prescript	"diagnost_tool", "electron_health", "electron_medic", "electron_prescrib", "electron_prescript",
Intervention 4d Sum (Monitor antibiotic consumption)	audit, compliance, ddd, dot, defined daily doses, days of therapy, feedback mechanism, prescriber feedback, monitor antibiotic consumption/use, prescriber survey	"audit", "complianc", "ddd", "dot", "defin_daili_dose", "day_of_therapi", "feedback_mechan", "prescrib_feedback", "monitor_antibioti_use", "monitor_antibioti_consumpt", "prescrib_survey"
Intervention 4e Sum (Support new drugs, medicines, technologies)	new antibiotic, new antimicrobial, new medicine, new drug, new therapeutic, new treatment	"new_antibioti", "new_antimicrobi", "new_medicin", "new_drug", "new_therapeut", "new_treatment",
Intervention 4f Sum (Restrict the use of antimicrobials as growth promoters)	growth promotion, growth enhancer, antimicrobial/antibiotic as growth promoter, agp, antimicrobials as growth enhancers	"growth_promot", "growth_enhanc", "antimicrobi_as_growth_promot", "antibioti_as_growth_promot", "agp", "antimicrobi_as_growth_enhanc",
Intervention 4g Sum (Optimize animal feed practices)	animal feed, feed additives, medicated feed, medicated feeding stuff, residue	"anim_feed", "feed_addit", "medic_feed", "medic_feed_stuff", "residu"
Domain 5 Sum (Make an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions)		

Supplementary Table 1 - List of Domains/Interventions

Term Dictionary for Domain/Intervention	**Terms**	**Terms after stemming**
Intervention 5a Sum (Promote R&D for AMR innovations)	grant, development, research, r&d, interdisciplinary collaboration, interdisciplinary platform, knowledge gap, product development, antimicrobial pipeline, discovery pipeline, evidence base	"grant", "develop", "research", "r&d", "interdisciplinari_collabor", "interdisciplinari_platform", "knowledg_gap", "product_develop", "antimicrobi_pipelin", "discoveri_pipelin", "evid_base",
Intervention 5b Sum (Explore new market models)	bulk discount, direct payment, lower price, incentive system, market approval, market authorization, market failure, market gap, market mechanism, market model, incentive, payment system, pay play, pull incentive, push incentive	"bulk_discount", "direct_payment", "lower_price", "incent_system", "market_approv", "market_author", "market_failur", "market_gap", "market_mechan", "market_model", "incent", "payment_system", "pay_play", "pull_incent", "push_incent"
Intervention 5c Sum (Promote PPPs)	public privat, public privat, privat public, ppp	"public_privat", "privat_public", "ppp"
Domain 6 Sum (International engagement)	amr gap, global action plan, oie, fao, unep	"amr_gap", "global_action_plan", "oie", "fao", "unep"
Domain 7 Sum (One Health engagement)	one health, animal health, animal healthcare, plant health, codex alimentarius, food safety, food security, environment, agriculture	"one_health", "anim_health", "anim_healthcar", "plant_health", "food_safeti", "food_secur", "environ", "agricultur",
Domain 8 Sum (Reporting)	ddd, dot, defined daily doses, days of therapy	"defin_daili_dose", "day_of_therapi", "ddd", "dot"
Domain 9 Sum (Funding)	budget, funding, finance, per capita	"budget", "fund", "financ", "per_capita"
Domain 10 Sum (Effectiveness)	cost-effective	"cost_effect"

Supplementary Table 2

Group 1 (Set of previous NAPs)				
File Name	**Number of Pages**	**Word count before stop words**	**Word count after stop words**	**Term Count (total)**
Australia 1	48	11376	7048	604
Austria 1	84	20337	11915	744
Cameroon1	100	9155	5522	458
Canada 1	44	11112	7023	691
China 1	8	2850	1884	169
Fiji1	18	2943	1842	163
France 1	38	6064	3995	281
Ireland1	114	20547	12478	978
Japan 1	69	21990	14084	1447
Korea 1	36	8607	5695	506
Malta 1	43	11721	7230	542
Netherlands 1	15	6277	3591	259
Saudi 1	31	6842	4550	385
Spain 1	36	13058	7536	546
Sweden 1	24	6672	4028	227
Tanzania 1	76	6965	4508	534
UK1	43	11623	7124	647
US1	63	19207	12971	914
Average	49.44444	10963.66667	6834.666667	560.8333333
Standard Deviation	29.38231	5995.949809	3743.469309	323.7901009

Group 2 (Most Recent NAPs)				
File Name	**Pages**	**Word count before stop words**	**Word count after stop words**	**Term Count (total)**
Australia 2	18	4766	2875	263
Austria 2	195	37389	22288	1721
Cameroon 2	97	15433	10240	588
Canada 2	42	11830	7662	661
China 2	9	3574	2396	26
Fiji 2	55	12676	8558	906
France 2	25	8833	5041	305
Ireland 2	122	33280	21377	1874
Japan 2	90	32098	20526	1977
Korea 2	45	12143	8128	778
Malta 2	45	13972	8556	608
Netherlands 2	18	11334	6727	344
Saudi 2	22	5630	3581	313
Spain 2	66	20542	11619	752
Sweden 2	24	7166	4343	302
Tanzania 2	140	23682	16267	1469
UK 2	98	18170	11161	1040
US 2	47	9469	6371	476
Average	64.333333	15665.94444	9873.111111	800.1666667
Standard Deviation	50.259327	10079.97762	6313.573314	591.0068428

Supplementary Table 3 -
TF for Group 1 NAPs

File Name	Word Count	Domain1 (Improve AMR awareness and understanding through effective communication, education and training)	Intervention 1a (Enhance AMR awareness in the public)	Intervention 1b (Integrate AMR in professional education and training)	Intervention 1c (Integrate AMR in school education)
AMRGAP	5068	0.006708760852	0.002367797948	0.004340962904	0.0003946329913
Australia 1	6895	0.002030456853	0.0008701957941	0.001160261059	0.0002900652647
Austria 1 en	11724	0.002900034118	0.0005117707267	0.002388263391	0.0001705902422
Cameroon1	5403	0.00444197668	0.001850823617	0.002406070701	0.0001850823617
Canada 1	6830	0.002928257687	0.0002928257687	0.002635431918	0.0001464128843
China 1	1851	0.01350621286	0.001620745543	0.01026472177	0.001620745543
Fiji1	1787	0.006715165081	0.003357582541	0.003357582541	0.0005595970901
France 1	3932	0.00508646999	0.002543234995	0.002288911495	0.0002543234995
Ireland1	12126	0.003628566716	0.000907141679	0.002638957612	0.0001649348507
Japan 1	13670	0.006949524506	0.002048280907	0.004608632041	0.0004389173372
Korea1	5590	0.01037567084	0.004114490161	0.006082289803	0.0001788908766
Malta 1	7049	0.00539083558	0.0008511845652	0.004255922826	0.0004255922826
Netherlands1	3515	0.003698435277	0.002844950213	0.000853485064	0
Sweden1	3955	0.002781289507	0.001769911504	0.0005056890013	0.0005056890013
Tanzania1	4325	0.0110982659	0.003468208092	0.007630057803	0.001387283237
UK1	6934	0.0064897606	0.003028554947	0.003461205653	0.0005768676089
US1	12714	0.002123643228	0.0008651879818	0.001258455246	0.00007865345289
Saudi1	4550	0.02549450549	0.004835164835	0.02065934066	0.002197802198
Spain1	7536	0.01180997877	0.004246284501	0.007430997877	0.0001326963907
Average 1	6688.111111	0.00708050276	0.002223696576	0.004660348692	0.0005174524512
Standard Deviation 1	3650.365492	0.005793782993	0.001396401612	0.004782485025	0.0006016699364
Average OECD	7951.75	0.005066840674	0.002003569098	0.002942715013	0.0002448367841
Average Non-OECD	24965	0.06664696159	0.01598370919	0.0485736963	0.006376102712
Average G7	8816	0.004715531202	0.00175561692	0.002850527271	0.0002990349566
Average East Asia	7037	0.01027713607	0.002594505537	0.006985214539	0.0007461845856
Average Africa & Middle East	14278	0.04103474807	0.01015419654	0.03069546916	0.003770167796
Average EU	7119.571429	0.005042229994	0.001953496884	0.00290888961	0.0002362608953
Average North America	9772	0.002525950457	0.0005790068752	0.001946943582	0.0001125331686

Supplementary Table 3 -
TF for Group 1 NAPs

File Name	Domain2 (Strengthen knowledge and evidence base by bolstering AMR surveillance and research)	Domain2a (Engage global and regional AMR surveillance networks)	Intervention 2b (Expand laboratory network capacity)	Intervention 2c (Promote new data sources in AMR surveillance)
AMRGAP	0.009471191792	973164957	0.0003946329913	0.0007892659826
Australia 1	0.01232777375	0.0001450326323	0	0.0002900652647
Austria 1 en	0.01270897305	0.0004264756056	0	0.00008529512112
Cameroon1	0.01480658893	0.0007403294466	0.0001850823617	0.0001850823617
Canada 1	0.01434846266	0	0.0001464128843	0
China 1	0.02106969206	0	0	0
Fiji1	0.01734750979	0	0.00167879127	0.00167879127
France 1	0.006358087487	0	0	0.0002543234995
Ireland1	0.01220517895	0.0007422068283	0.00008246742537	0.00008246742537
Japan 1	0.02677395757	0.0001463057791	0.001243599122	0.001097293343
Korea1	0.01824686941	0.001610017889	0	0.0003577817531
Malta 1	0.01063980706	0.001276776848	0.0001418640942	0.0004255922826
Netherlands1	0.007112375533	0.0002844950213	0	0.0002844950213
Sweden1	0.006573957016	0.0007585335019	0	0
Tanzania1	0.02150289017	0.0004624277457	0.001387283237	0.0009248554913
UK1	0.008076146524	0.0002884338044	0	0.0004326507067
US1	0.01470819569	0.00007865345289	0.001022494888	0.002516910492
Saudi1	0.01912087912	0.001318681319	0.0002197802198	0
Spain1	0.0156581741	0.001194267516	0.0001326963907	0
Average 1	0.01442141772	0.0005262576328	0.0003466928829	0.0004786446685
Standard Deviation 1	0.005640145848	0.0005249803695	0.0005594079053	0.0006801032153
Average OECD	0.01292484598	0.0004728685026	0.0002189725592	0.0004501068856
Average Non-OECD	0.1044873671	0.003798215359	0.003612801183	0.003214321406
Average G7	0.01405296999	0.0001026786073	0.0004825013788	0.0008602356083
Average East Asia	0.02203017301	0.0005854412227	0.0004145330407	0.0004850250321
Average Africa & Middle East	0.05543035823	0.002521438511	0.001792145818	0.001109937853
Average EU	0.0101795076	0.0006689650458	0.00005100398717	0.00016173905
Average North America	0.01452832918	0.00003932672644	0.0005844538859	0.001258455246

Supplementary Table 3 -
TF for Group 1 NAPs

File Name	Intervention 2d (Other terms associated with strengthening AMR surveillance)	Domain 3 (Reduce incidence of infection through effective sanitation, hygiene, and IPC measures)	Intervention 3a (Improve water, hygiene, sanitation, and waste management)	Intervention 3b (Improve vaccination coverage)
AMRGAP	0.008089976322	0.01539068666	0.004143646409	0.004735595896
Australia 1	0.01189267585	0.01189267585	0.001015228426	0.00246555475
Austria 1 en	0.01219720232	0.01330603889	0.006653019447	0.0001705902422
Cameroon1	0.01369609476	0.0135110124	0.008328706274	0.001295576532
Canada 1	0.01420204978	0.02093704246	0.002489019034	0.003806734993
China 1	0.02106969206	0.01026472177	0.005402485143	0.001620745543
Fiji1	0.01398992725	0.01231113598	0.005595970901	0.0005595970901
France 1	0.006103763988	0.007629704985	0.0007629704985	0.001525940997
Ireland1	0.01129803728	0.009813623619	0.003216229589	0.0007422068283
Japan 1	0.02428675933	0.01667885881	0.001755669349	0.001682516459
Korea1	0.01627906977	0.009838998211	0.003041144902	0.0005366726297
Malta 1	0.00879557384	0.01418640942	0.00170236913	0.000709320471
Netherlands1	0.006543385491	0.009672830725	0.003698435277	0
Sweden1	0.005815423515	0.009102402023	0.002781289507	0.0007585335019
Tanzania1	0.0187283237	0.01942196532	0.007167630058	0.00323699422
UK1	0.007355062013	0.007643495818	0.0002884338044	0.002451687338
US1	0.01109013686	0.005977662419	0	0.002438257039
Saudi1	0.01758241758	0.01230769231	0.004615384615	0.0008791208791
Spain1	0.01433121019	0.007563694268	0.002653927813	0.001194267516
Average 1	0.01306982253	0.01178110918	0.003398217432	0.001448573168
Standard Deviation 1	0.005204583463	0.004096332491	0.002435862666	0.001061550003
Average OECD	0.01178289803	0.01083808567	0.002362947304	0.001481080191
Average Non-OECD	0.09386202919	0.0820029372	0.03281254612	0.008301354734
Average G7	0.01260755439	0.0117733529	0.001059218537	0.002381027365
Average East Asia	0.02054517372	0.0122608596	0.003399766465	0.001279978211
Average Africa & Middle East	0.05000683604	0.04524067003	0.02011172095	0.00541169163
Average EU	0.009297799517	0.01018210056	0.003066891609	0.0007286942223
Average North America	0.01264609332	0.01345735244	0.001244509517	0.003122496016

Supplementary Table 3 -
TF for Group 1 NAPs

File Name	Intervention 3c (Other terms associated with strengthening IPC programs)	Intervention 3d (Promote food safety and security)	Intervention 3e (Enhance biosecurity)	Domain4 (Optimize antimicrobial use in human and animal health)
AMRGAP	0.004143646409	0.002367797948	0.004735595896	0.01026045777
Australia 1	0.006381435823	0.002030456853	0.002900652647	0.01116751269
Austria 1 en	0.005544182873	0.0009382463323	0.0001705902422	0.009553053565
Cameroon1	0.003701647233	0.0001850823617	0.0009254118083	0.00444197668
Canada 1	0.01200585652	0.002635431918	0.003660322108	0.01361639824
China 1	0.002701242572	0.0005402485143	0.002160994057	0.004321988115
Fiji1	0.005595970901	0.0005595970901	0.00111919418	0.01063234471
France 1	0.002797558494	0.002543234995	0.003814852492	0.00483214649
Ireland1	0.004948045522	0.000907141679	0.0009896091044	0.01748309418
Japan 1	0.01185076811	0.001389904901	0.001463057791	0.006583760059
Korea1	0.00626118068	0	0.0005366726297	0.01037567084
Malta 1	0.01035607888	0.001418640942	0.000709320471	0.01276776848
Netherlands1	0.003982930299	0.001991465149	0	0.006543385491
Sweden1	0.004551201011	0.001011378003	0.001011378003	0.007079646018
Tanzania1	0.008554913295	0.0004624277457	0.00323699422	0.0136416185
UK1	0.004759157773	0.0001442169022	0.002307470436	0.01773867897
US1	0.002200296681	0.001337108699	0.002280950134	0.006921503854
Saudi1	0.005494505495	0.001318681319	0.0008791208791	0.005494505495
Spain1	0.0009288747346	0.002786624204	0.002786624204	0.005705944798
Average 1	0.005700991493	0.001233327089	0.001719623078	0.009383388732
Standard Deviation 1	0.00316607331	0.00087309295	0.00119858432	0.004306938368
Average OECD	0.005517790709	0.00147626747	0.001826848316	0.009800066267
Average Non-OECD	0.03640435837	0.004484677972	0.009031035615	0.05130020198
Average G7	0.006723127514	0.001609979483	0.002705330592	0.009938497524
Average East Asia	0.006937730452	0.0006433844719	0.001386908159	0.007093806338
Average Africa & Middle East	0.01775106602	0.001966191426	0.005041526907	0.02357810067
Average EU	0.00472983883	0.001656675901	0.001354624931	0.009137862717
Average North America	0.007104076598	0.001986270309	0.002970636121	0.01026895105

Supplementary Table 3 -
TF for Group 1 NAPs

File Name	Intervention 4a (Strengthen antimicrobial stewardship)	Intervention 4b (Limit antimicrobial sale without prescription, counterfeit or substandard antimicrobial sale, online antibiotic	Intervention 4c (Enhance the use of diagnostic tools)	Intervention 4d (Monitor antibiotic conption)
AMRGAP	0.003157063931	0	0.002959747435	973164957
Australia 1	0.008556925308	0	0	0.001740391588
Austria 1 en	0.006311838963	0	0	0.0007676560901
Cameroon1	0.001480658893	0	0.0009254118083	0.0007403294466
Canada 1	0.009370424597	0	0.000878477306	0.001171303075
China 1	0.001620745543	0	0.0005402485143	0
Fiji1	0.005595970901	0	0.0005595970901	0.00223838836
France 1	0.003306205493	0	0.0002543234995	0.0002543234995
Ireland1	0.01154543955	0	0.0007422068283	0.003298697015
Japan 1	0.002852962692	0	0.0002194586686	0.001097293343
Korea1	0.006618962433	0	0.0005366726297	0.001073345259
Malta 1	0.009079302029	0	0.000709320471	0.002269825507
Netherlands1	0.005120910384	0	0	0
Sweden1	0.003286978508	0	0	0.002022756005
Tanzania1	0.007167630058	0	0.002312138728	0.0009248554913
UK1	0.0128353043	0	0.0004326507067	0.0008653014133
US1	0.00464055372	0	0.0002359603587	0.00007865345289
Saudi1	0.002637362637	0.002857142857	0	0.002857142857
Spain1	0.005307855626	0.000398089172	0	0.000398089172
Average 1	0.005963112869	0.0001808462238	0.0004636925894	0.001211019532
Standard Deviation 1	0.003302102172	0.00067445158	0.0005639486851	0.0009890082969
Average OECD	0.006646196798	0.00003317409766	0.0002749791665	0.001063984159
Average Non-OECD	0.02758167006	0.002857142857	0.005046716612	0.009030541663
Average G7	0.00660109016	0	0.0004041741079	0.0006933749567
Average East Asia	0.003697556889	0	0.0004321266042	0.0007235462008
Average Africa & Middle East	0.01128565159	0.002857142857	0.003237550537	0.004522327795
Average EU	0.006279790079	0.00005686988171	0.0002436929713	0.001287335327
Average North America	0.007005489159	0	0.0005572188323	0.0006249782638

Supplementary Table 3 -
TF for Group 1 NAPs

File Name	Intervention 4e (Support new drugs, medicines, technologies)	Intervention 4f (Restrict the use of antimicrobials as growth promoters)	Intervention 4g (Optimize animal feed practices)	Domain5 (Make an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions)
AMRGAP	0.002959747435	0.0003946329913	0.000591949487	0.02190213102
Australia 1	0.000435097897	0.0001450326323	0.0002900652647	0.01957940537
Austria 1 en	0.0002558853634	0	0.002217673149	0.006397134084
Cameroon1	0.00111049417	0	0.0001850823617	0.0111049417
Canada 1	0.001317715959	0.000439238653	0.000439238653	0.01815519766
China 1	0.001080497029	0.001080497029	0	0.01458670989
Fiji1	0	0.0005595970901	0.00167879127	0.005595970901
France 1	0.000508646999	0.0002543234995	0.0002543234995	0.01729399797
Ireland1	0.000907141679	0.00008246742537	0.000907141679	0.01162790698
Japan 1	0.001024140454	0	0.001389904901	0.02114118508
Korea1	0.0003577817531	0	0.001788908766	0.01019677996
Malta 1	0	0	0.000709320471	0.006951340616
Netherlands1	0.001137980085	0	0.0002844950213	0.01763869132
Sweden1	0.0005056890013	0.0007585335019	0.0005056890013	0.008343868521
Tanzania1	0.002312138728	0	0.0009248554913	0.0161849711
UK1	0.003461205653	0.0001442169022	0	0.02437265648
US1	0.0008651879818	0.0008651879818	0.0002359603587	0.01738241309
Saudi1	0	0	0	0.007912087912
Spain1	0	0	0	0.01048301486
Average 1	0.0008488668196	0.0002405052619	0.0006561916604	0.01360823742
Standard Deviation 1	0.000884679596	0.0003489160428	0.0006888869669	0.005598750516
Average OECD	0.0008980394021	0.000224083383	0.0006927833578	0.01521768761
Average Non-OECD	0.004503129927	0.001640094119	0.003498049594	0.06233602211
Average G7	0.001435379409	0.0003405934073	0.0004638854825	0.01966909005
Average East Asia	0.0008208064118	0.0003601656762	0.001059604556	0.01530822498
Average Africa & Middle East	0.003422632898	0	0.001109937853	0.03520200071
Average EU	0.0004736204469	0.0001564749181	0.0006969489745	0.01124799348
Average North America	0.00109145197	0.0006522133174	0.0003375995058	0.01776880537

Supplementary Table 3 -
TF for Group 1 NAPs

File Name	Intervention 5a (Promote R&D for AMR innovations)	Intervention 5b (Explore new market models)	Intervention 5c (Promote PPPs)	Intervention 6 (International engagement)
AMRGAP	0.02012628256	0.00138121547	973164957	0.01657458564
Australia 1	0.0192893401	0.0002900652647	0	0.002320522117
Austria 1 en	0.006311838963	0.00008529512112	0	0.0004264756056
Cameroon1	0.0111049417	0	0	0.002406070701
Canada 1	0.017715959	0.0002928257687	0.0001464128843	0.00102489019
China 1	0.01404646137	0.0005402485143	0	0.001080497029
Fiji1	0.005036373811	0	0.0005595970901	0.00111919418
France 1	0.01449643947	0.0007629704985	0.001017293998	0.004323499491
Ireland1	0.01030842817	0	0.0007422068283	0.0005772719776
Japan 1	0.02011704462	0.0007315288954	0.0001463057791	0.001755669349
Korea1	0.009481216458	0	0.0003577817531	0.001431127013
Malta 1	0.005674563768	0.0002837281884	0.0005674563768	0.0009930486594
Netherlands1	0.01621621622	0.0002844950213	0.0005689900427	0.001422475107
Sweden1	0.00809102402	0.0002528445006	0	0.00404551201
Tanzania1	0.01572254335	0	0.0002312138728	0.001387283237
UK1	0.02350735506	0.0004326507067	0.0002884338044	0.0004326507067
US1	0.0150228095	0.001337108699	0.0005505741702	0.001573069058
Saudi1	0.007912087912	0	0	0
Spain1	0.01021762208	0.0002653927813	0	0
Average 1	0.01279290364	0.0003088418867	0.0002875703667	0.001462180913
Standard Deviation 1	0.005368866583	0.0003548186357	0.0003131207444	0.001199540644
Average OECD	0.01423127447	0.0003945981048	0.000318166605	0.001611096885
Average Non-OECD	0.05949697191	0.0008239767027	0.00135826734	0.006986093807
Average G7	0.01817192153	0.0007114169137	0.0004298041272	0.001821955759
Average East Asia	0.01454824082	0.0004239258032	0.0001680291774	0.00142243113
Average Africa & Middle East	0.03473957296	0	0.0002312138728	0.003793353938
Average EU	0.01018801896	0.0002763894445	0.0004137067494	0.001684040407
Average North America	0.01636938425	0.0008149672339	0.0003484935273	0.001298979624

Supplementary Table 3 -
TF for Group 1 NAPs

File Name	Intervention 7 (One Health engagement)	Intervention 8 (Reporting)	Intervention 9 (Funding)	Intervention 10 (Effectiveness)
AMRGAP	0.0136148382	0	0.0009865824783	0
Australia 1	0.01073241479	0	0.00188542422	0
Austria 1 en	0.004435346298	0	0.0008529512112	0
Cameroon1	0.01147510642	0	0.004071811956	0
Canada 1	0.01581259151	0	0.001464128843	0
China 1	0.0037817396	0	0.002160994057	0
Fiji1	0.01231113598	0	0.003357582541	0
France 1	0.01169888098	0	0.001780264496	0
Ireland1	0.01121556985	0.0009896091044	0.001319478806	0
Japan 1	0.008778346745	0.0007315288954	0.0005852231163	0
Korea1	0.01091234347	0.0005366726297	0.002862254025	0
Malta 1	0.01149099163	0.0001418640942	0.001418640942	0
Netherlands1	0.009672830725	0	0.001137980085	0
Sweden1	0.007585335019	0.0002528445006	0.0005056890013	0
Tanzania1	0.01479768786	0	0.0006936416185	0
UK1	0.005912892991	0	0.002740121142	0
US1	0.005977662419	0	0.001337108699	0
Saudi1	0	0	0	0
Spain1	0	0	0	0
Average 1	0.008699493127	0.0001473621791	0.001565183042	0
Standard Deviation 1	0.004548943741	0.00029661353	0.001128206368	0
Average OECD	0.008561184566	0.0002092212608	0.001372551971	0
Average Non-OECD	0.0538566615	0.0001418640942	0.01170267111	0
Average G7	0.009636074928	0.0001463057791	0.001581369259	0
Average East Asia	0.007824143272	0.0004227338417	0.0018694904	0
Average Africa & Middle East	0.02627279428	0	0.004765453575	0
Average EU	0.008014136357	0.0001977596713	0.001002143506	0
Average North America	0.01089512696	0	0.001400618771	0

Supplementary Table 4 -
TF for Group 2 NAPs

File Name	Word Count	Domain1 (Improve AMR awareness and understanding through effective communication, education and training)	Intervention 1a (Enhance AMR awareness in the public)	Intervention 1b (Integrate AMR in professional education and training)	Intervention 1c (Integrate AMR in school education)
AMRGAP	5068	0.006708760852	0.002367797948	0.004340962904	0.0003946329913
Australia 2	2789	0.002151308713	0	0.001792757261	0.0003585514521
Austria 2	21936	0.006564551422	0.0003646973012	0.006199854121	0.000136761488
Cameroon 2	10103	0.0114817381	0.002573493022	0.008908245076	0.0003959220034
Canada 2	7470	0.002008032129	0.001070950469	0.00093708166	0.0001338688086
China 2	2329	0.01288106483	0.002576212967	0.009016745384	0.001717475311
Fiji 2	8270	0.01378476421	0.002176541717	0.01148730351	0.0003627569528
France 2	4938	0.001012555691	0.0004050222762	0.0002025111381	0.0004050222762
Ireland2	20759	0.003468375163	0.001348812563	0.002119562599	0.00009634375452
Japan 2	19816	0.005096891401	0.001917642309	0.002977392006	0.0002523213565
Korea 2	7958	0.01068107565	0.002387534556	0.008293541091	0.000502638854
Malta 2	8340	0.004916067146	0.0008393285372	0.003836930456	0.0003597122302
Netherlands 2	6676	0.002246854404	0.0002995805872	0.001497902936	0.0004493708808
Sweden 2	4261	0.001642806853	0.0007040600798	0.0004693733865	0.0004693733865
Tanzania 2	15989	0.01275877166	0.00481581087	0.007692788792	0.000813058978
UK 2	10891	0.003397300523	0.001652740795	0.001744559728	0
US 2	6236	0.002565747274	0.0006414368185	0.001924310455	0
Saudi 2	3581	0.02066461882	0.002234012846	0.01843060598	0.004747277297
Spain 2	11619	0.01566399862	0.009811515621	0.005680351149	0.0002581977795
Average 2	9664.5	0.007388140145	0.001989966296	0.005178434262	0.0006365918227
Standard Deviation 2	6154.806082	0.005917741043	0.002278289348	0.004787865076	0.001095832092
Average OECD	10445.75	0.004708291487	0.001716999448	0.002819933128	0.0002552041697
Average Non-OECD	48612	0.07648702476	0.01521539996	0.05937261919	0.008396202773
Average G7	9870.2	0.002816105403	0.001137558534	0.001557170998	0.0001582424883
Average East Asia	10034.33333	0.009553010628	0.002293796611	0.006762559494	0.0008241451739
Average Africa & Middle East	29673	0.04490512857	0.009623316737	0.03503163984	0.005956258278
Average EU	11218.42857	0.005073601329	0.001967573852	0.002858069398	0.0003106831137
Average North America	6853	0.002286889701	0.0008561936435	0.001430696058	0.00006693440428

Supplementary Table 4 -
TF for Group 2 NAPs

File Name	Domain2 (Strengthen knowledge and evidence base by bolstering AMR surveillance and research)	Domain2a (Engage global and regional AMR surveillance networks)	Intervention 2b (Expand laboratory network capacity)	Intervention 2c (Promote new data sources in AMR surveillance)
AMRGAP	0.009471191792	0.0001973164957	0.0003946329913	0.0007892659826
Australia 2	0.01326640373	0.0007171029043	0	0.0007171029043
Austria 2	0.01262764406	0.0004558716265	0	0.0004102844639
Cameroon 2	0.0122735821	0	0	0
Canada 2	0.01070950469	0	0	0.0002677376171
China 2	0.02533276084	0	0	0
Fiji 2	0.01124546554	0.0003627569528	0.0002418379686	0.0001209189843
France 2	0.01336573512	0.001215066829	0	0.0008100445525
Ireland2	0.009393516065	0.001011609422	0	0.0002890312635
Japan 2	0.02210335083	0.0002523213565	0.00116067824	0.0009588211546
Korea 2	0.01658708218	0.001382256848	0	0.000251319427
Malta 2	0.01103117506	0.0008393285372	0.0001199040767	0.000479616307
Netherlands 2	0.00209706411	0	0	0
Sweden 2	0.005867167332	0.0004693733865	0	0
Tanzania 2	0.01638626556	0.0005003439865	0.0007505159797	0.0005628869848
UK 2	0.0124873749	0.0005509135984	0.0003672757323	0.00009181893306
US 2	0.01186658114	0.0006414368185	0.0008017960231	0.001763951251
Saudi 2	0.02485339291	0.0005585032114	0.001396258028	0
Spain 2	0.0142869438	0.00172131853	0.0000860659265	0
Average 2	0.01365450055	0.000593233556	0.0002735739986	0.0003735296579
Standard Deviation 2	0.005896798574	0.0004945561556	0.000445292618	0.0004631398247
Average OECD	0.01205486399	0.0007014392767	0.0002013179935	0.0004633426306
Average Non-OECD	0.101122642	0.002260932688	0.002508516054	0.001163422276
Average G7	0.01410650933	0.0005319477204	0.000465949999	0.0007784747016
Average East Asia	0.02134106462	0.0005448594016	0.0003868927466	0.0004033801939
Average Africa & Middle East	0.05351324057	0.001058847198	0.002146774008	0.0005628869848
Average EU	0.00980989222	0.0008160811902	0.00002942428618	0.0002841395124
Average North America	0.01128804291	0.0003207184092	0.0004008980115	0.001015844434

Supplementary Table 4 -
TF for Group 2 NAPs

File Name	Intervention 2d (Other terms associated with strengthening AMR surveillance)	Domain 3 (Reduce incidence of infection through effective sanitation, hygiene, and IPC measures)	Intervention 3a (Improve water, hygiene, sanitation, and waste management)	Intervention 3b (Improve vaccination coverage)
AMRGAP	0.008089976322	0.01539068666	0.004143646409	0.004735595896
Australia 2	0.01183219792	0.01003944066	0.001075654356	0.0007171029043
Austria 2	0.01176148796	0.01809810357	0.01094091904	0.0003191101386
Cameroon 2	0.0122735821	0.001286746511	0.0004949025042	0.0006928635059
Canada 2	0.01044176707	0.02235609103	0.002275769746	0.003078982597
China 2	0.02533276084	0.0231859167	0.006869901245	0.001717475311
Fiji 2	0.01051995163	0.02164449819	0.004594921403	0.001451027811
France 2	0.01134062373	0.006682867558	0.0002025111381	0
Ireland2	0.008092875379	0.01955778217	0.002697625126	0.001252468809
Japan 2	0.01973153008	0.01897456601	0.001513928139	0.001110213969
Korea 2	0.01495350591	0.008293541091	0.001005277708	0.0001256597135
Malta 2	0.009592326139	0.01294964029	0.001438848921	0.0008393285372
Netherlands 2	0.00209706411	0.01482923907	0.002995805872	0.0007489514679
Sweden 2	0.005397793945	0.0103262145	0.003754987092	0.001173433466
Tanzania 2	0.01457251861	0.01313402965	0.004565638877	0.001751203953
UK 2	0.01147736663	0.01634377009	0.003030024791	0.006427325314
US 2	0.008659397049	0.0105837075	0.001924310455	0.003046824888
Saudi 2	0.02289863167	0.00586428372	0.003071767663	0.0005585032114
Spain 2	0.01247955934	0.006799208193	0.002237714089	0.000172131853
Average 2	0.01241416334	0.01338609147	0.003038361565	0.001399033747
Standard Deviation 2	0.005678486549	0.006384491821	0.00257090196	0.001531271299
Average OECD	0.01068876409	0.01357371095	0.002804543963	0.001514350427
Average Non-OECD	0.09518977099	0.07806511505	0.02103598061	0.00701040233
Average G7	0.01233013691	0.01498820044	0.001789308854	0.002732669354
Average East Asia	0.02000593227	0.01681800793	0.003129702364	0.0009844496644
Average Africa & Middle East	0.04974473238	0.02028505988	0.008132309044	0.00300257067
Average EU	0.008680247231	0.01274900791	0.003466915897	0.0006436320388
Average North America	0.009550582059	0.01646989927	0.002100040101	0.003062903742

Supplementary Table 4 -
TF for Group 2 NAPs

File Name	Intervention 3c (Other terms associated with strengthening IPC programs)	Intervention 3d (Promote food safety and security)	Intervention 3e (Enhance biosecurity)	Domain4 (Optimize antimicrobial use in human and animal health)
AMRGAP	0.004143646409	0.002367797948	0.004735595896	0.01026045777
Australia 2	0.003944065973	0.004302617426	0.003226963069	0.008605234851
Austria 2	0.004741064916	0.002097009482	0.001002917578	0.006883661561
Cameroon 2	0	0.00009898050084	0.0007918440067	0.005344947045
Canada 2	0.01352074967	0.003480589023	0.00374832664	0.007095046854
China 2	0.01202232718	0.002576212967	0.002146844139	0.005581794762
Fiji 2	0.01475211608	0.00084643289	0.001813784764	0.005683192261
France 2	0.005872823005	0.0006075334143	0	0.007290400972
Ireland2	0.0137771569	0.001830531336	0.002408593863	0.01069415675
Japan 2	0.01468510295	0.001665320953	0.00156439241	0.009234961647
Korea 2	0.006408645388	0.000753958281	0.0001256597135	0.01922593616
Malta 2	0.009592326139	0.001079136691	0.0009592326139	0.01175059952
Netherlands 2	0.01003594967	0.001048532055	0.0007489514679	0.001048532055
Sweden 2	0.004224360479	0.001173433466	0.00140812016	0.007744660878
Tanzania 2	0.005503783851	0.001313402965	0.002251547939	0.005441240853
UK 2	0.005600954917	0.001285465063	0.006335506381	0.0111100909
US 2	0.004490057729	0.001122514432	0.003688261706	0.003207184092
Saudi 2	0.0008377548171	0.001396258028	0.0005585032114	0.006143535325
Spain 2	0.003356571133	0.001032791118	0.000516395559	0.004045098545
Average 2	0.007409211711	0.001539484449	0.001849769179	0.007562793058
Standard Deviation 2	0.004729522085	0.001031379218	0.001600064348	0.004009532568
Average OECD	0.007554791893	0.001700024671	0.002064507379	0.008015413773
Average Non-OECD	0.04270830807	0.007310424041	0.008521756675	0.03994530977
Average G7	0.008833937653	0.001632284577	0.003067297428	0.007587536893
Average East Asia	0.01103869184	0.001665164067	0.001278965421	0.01134756419
Average Africa & Middle East	0.006341538668	0.002808641494	0.003601895157	0.01692972322
Average EU	0.007371464606	0.001266995366	0.001006315892	0.007065301469
Average North America	0.009005403697	0.002301551728	0.003718294173	0.005151115473

Supplementary Table 4 -
TF for Group 2 NAPs

File Name	Intervention 4a (Strengthen antimicrobial stewardship)	Intervention 4b (Limit antimicrobial sale without prescription, counterfeit or substandard antimicrobial sale, online antibiotic sales)	Intervention 4c (Enhance the use of diagnostic tools)	Intervention 4d (Monitor antibiotic conption)
AMRGAP	0.003157063931	0	0.002959747435	0.0001973164957
Australia 2	0.006812477591	0	0.0003585514521	0.001075654356
Austria 2	0.004421954778	0	0.00009117432531	0.0005014587892
Cameroon 2	0.00356329803	0	0	0.0003959220034
Canada 2	0.004953145917	0	0	0.0005354752343
China 2	0.0008587376556	0.0004293688278	0.0004293688278	0
Fiji 2	0.002176541717	0	0	0.002176541717
France 2	0.005872823005	0	0	0.001215066829
Ireland2	0.008719109784	0	0.0004817187726	0.0006744062816
Japan 2	0.006560355268	0	0.0001513928139	0.000857892612
Korea 2	0.01294295049	0	0.001759235989	0.001382256848
Malta 2	0.007673860911	0	0.0005995203837	0.002278177458
Netherlands 2	0.001048532055	0	0	0
Sweden 2	0.003754987092	0.0002346866933	0	0.001877493546
Tanzania 2	0.002189004941	0	0.0001250859966	0.0006254299831
UK 2	0.00688641998	0.0007345514645	0.001101827197	0.0007345514645
US 2	0.001603592046	0	0.0004810776139	0
Saudi 2	0.002792516057	0.003351019268	0	0.002513264451
Spain 2	0.002840175574	0.001204922971	0	0.001032791118
Average 2	0.004759471272	0.0003308082903	0.000309941854	0.0009931323718
Standard Deviation 2	0.003131737544	0.0008221333992	0.0004704498726	0.0007837498248
Average OECD	0.005534710298	0.0001811800941	0.0003687481803	0.0008239205899
Average Non-OECD	0.01925395931	0.003780388096	0.001153975208	0.007989335613
Average G7	0.005175267243	0.0001469102929	0.0003468595249	0.0006685972279
Average East Asia	0.006787347805	0.0001431229426	0.0007799992102	0.0007467164868
Average Africa & Middle East	0.008544819028	0.003351019268	0.0001250859966	0.003534616438
Average EU	0.004904491886	0.0002056585235	0.0001674876402	0.001082770575
Average North America	0.003278368982	0	0.0002405388069	0.0002677376171

Supplementary Table 4 -
TF for Group 2 NAPs

File Name	Intervention 4e (Support new drugs, medicines, technologies)	Intervention 4f (Restrict the use of antimicrobials as growth promoters)	Intervention 4g (Optimize animal feed practices)	Domain5 (Make an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions)
AMRGAP	0.002959747435	0.0003946329913	0.000591949487	0.02190213102
Australia 2	0.0003585514521	0	0	0.02258874148
Austria 2	0.0002735229759	0	0.001595550693	0.007157184537
Cameroon 2	0	0	0.001385727012	0.001979610017
Canada 2	0.001338688086	0.0002677376171	0	0.01726907631
China 2	0.001717475311	0.0004293688278	0.001717475311	0.01760412194
Fiji 2	0.0001209189843	0.0004836759371	0.0007255139057	0.008222490931
France 2	0	0	0.0002025111381	0.003442689348
Ireland2	0.0003853750181	0	0.0004335468953	0.01112770365
Japan 2	0.0008074283407	0	0.000857892612	0.01766249495
Korea 2	0.0001256597135	0	0.003015833124	0.01256597135
Malta 2	0	0	0.001199040767	0.006954436451
Netherlands 2	0	0	0	0.008088675854
Sweden 2	0.0002346866933	0.0007040600798	0.0009387467731	0.01337714152
Tanzania 2	0.0001250859966	0	0.002376633936	0.008068046782
UK 2	0.001377283996	0	0.0002754567992	0.01854742448
US 2	0.0008017960231	0.0001603592046	0.0001603592046	0.01860166774
Saudi 2	0	0	0.0008377548171	0.006702038537
Spain 2	0	0.000172131853	0	0.007918065238
Average 2	0.0004259151439	0.0001231851955	0.0008734468327	0.01154875451
Standard Deviation 2	0.0005488647661	0.0002125317715	0.0008758426265	0.005947926947
Average OECD	0.0004752493582	0.0001086907295	0.0006233247699	0.0131955697
Average Non-OECD	0.001963480292	0.0009130447649	0.008242145749	0.04953074466
Average G7	0.0008650392891	0.00008561936435	0.0002992439508	0.01510467056
Average East Asia	0.0008835211218	0.0001431229426	0.001863733682	0.01594419608
Average Africa & Middle East	0.0001250859966	0	0.004600115765	0.01674969534
Average EU	0.0001276549553	0.0001251702761	0.0006241994667	0.008295128084
Average North America	0.001070242054	0.0002140484109	0.00008017960231	0.01793537202

Supplementary Table 4 -
TF for Group 2 NAPs

File Name	Intervention 5a (Promote R&D for AMR innovations)	Intervention 5b (Explore new market models)	Intervention 5c (Promote PPPs)	Intervention 6 (International engagement)
AMRGAP	0.02012628256	0.00138121547	0.0001973164957	0.01657458564
Australia 2	0.02151308713	0	0.0007171029043	0.001075654356
Austria 2	0.006792487236	0.0001823486506	0.00009117432531	0.001048504741
Cameroon 2	0.001286746511	0	0.0003959220034	0.001781649015
Canada 2	0.01593038822	0.001338688086	0	0.0006693440428
China 2	0.01760412194	0	0	0
Fiji 2	0.007859733978	0	0.0002418379686	0.006045949214
France 2	0.003442689348	0	0	0
Ireland2	0.01064598487	0	0.0002408593863	0.0004335468953
Japan 2	0.01574485264	0.001412999596	0.0003027856278	0.001110213969
Korea 2	0.01244031164	0.0001256597135	0	0.001130937421
Malta 2	0.00551558753	0.0002398081535	0.0007194244604	0.001199040767
Netherlands 2	0.007189934092	0	0.0004493708808	0.0001497902936
Sweden 2	0.01314245482	0.0002346866933	0	0.003520300399
Tanzania 2	0.006942272813	0.00006254299831	0.0007505159797	0.00112577397
UK 2	0.01652740795	0.001469102929	0.0002754567992	0.001560921862
US 2	0.0174791533	0.0004810776139	0.0003207184092	0.001282873637
Saudi 2	0.006702038537	0	0	0
Spain 2	0.007831999311	0.0000860659265	0	0
Average 2	0.0108106251	0.0003129433534	0.0002502871525	0.001229694477
Standard Deviation 2	0.005678813875	0.0005195300553	0.0002680443792	0.001477584177
Average OECD	0.01239006255	0.0004442191007	0.0001997890277	0.0009985073014
Average Non-OECD	0.04591050131	0.0003023511518	0.002107700412	0.01015241297
Average G7	0.01382489829	0.000940373645	0.0001797921672	0.0009246707021
Average East Asia	0.01526309541	0.0005128864366	0.0001009285426	0.0007470504633
Average Africa & Middle East	0.01493105786	0.00006254299831	0.001146437983	0.002907422985
Average EU	0.007794448173	0.0001061299177	0.0002144041504	0.0009073118709
Average North America	0.01670477076	0.0009098828498	0.0001603592046	0.0009761088399

Supplementary Table 4 -
TF for Group 2 NAPs

File Name	Intervention 7 (One Health engagement)	Intervention 8 (Reporting)	Intervention 9 (Funding)	Intervention 10 (Effectiveness)
AMRGAP	0.0136148382	0	0.0009865824783	0
Australia 2	0.01972032987	0	0.001792757261	0
Austria 2	0.007932166302	0	0.002279358133	0
Cameroon 2	0.006136791052	0	0.001880629516	0
Canada 2	0.01780455154	0.0001338688086	0.0008032128514	0
China 2	0.01030485187	0	0.0004293688278	0
Fiji 2	0.01983071342	0	0.002660217654	0
France 2	0.01235317942	0.001012555691	0	0
Ireland2	0.01854617274	0.000192687509	0.002553109495	0
Japan 2	0.009184497376	0.000504642713	0.0008074283407	0
Korea 2	0.01130937421	0.001005277708	0.000753958281	0
Malta 2	0.01019184652	0.0003597122302	0.001199040767	0
Netherlands 2	0.005542240863	0	0.007189934092	0
Sweden 2	0.01173433466	0	0.0004693733865	0
Tanzania 2	0.01163299769	0.0003127149916	0.006004127838	0
UK 2	0.01092645303	0	0.002662749059	0
US 2	0.01250801796	0	0.0008017960231	0
Saudi 2	0	0	0	0
Spain 2	0	0	0	0
Average 2	0.0108699177	0.0001956366473	0.00179372564	0
Standard Deviation 2	0.005797544674	0.0003328860336	0.001982466384	0
Average OECD	0.01146344317	0.0002374193691	0.001676139743	0
Average Non-OECD	0.05809720055	0.0006724272218	0.0121733846	0
Average G7	0.01255533987	0.0003302134424	0.001015037255	0
Average East Asia	0.01026624115	0.000503306807	0.0006635851498	0
Average Africa & Middle East	0.01776978874	0.0003127149916	0.007884757354	0
Average EU	0.009471420074	0.0002235650614	0.001955830839	0
Average North America	0.01515628475	0.00006693440428	0.0008025044372	0

Supplementary Table 5 - TF for Group 1/TF for Group 2

File Name	Word Count	Domain1 (Improve AMR awareness and understanding through effective communication, education and training)	Intervention 1a (Enhance AMR awareness in the public)	Intervention 1b (Integrate AMR in professional education and training)	Intervention 1c (Integrate AMR in school education)
AMRGAP	1	1	1	1	1
Australia	0.4044960116	1.059519541	0	1.545132664	1.236106131
Austria	1.871033777	2.26361179	0.7126185266	2.59596749	0.8016958425
Cameroon	1.8698871	2.584826289	1.39045828	3.702403703	2.139166584
Canada	1.093704246	0.6857429719	3.65729585	0.3555704299	0.9143239625
China	1.25823879	0.9537140404	1.589523401	0.8784208266	1.059682267
Fiji	4.627867935	2.052781137	0.6482466747	3.421301894	0.6482466747
France	1.25584944	0.1990684488	0.159254759	0.08847486612	1.59254759
Ireland	1.711941283	0.9558526641	1.486881922	0.8031817525	0.5841321836
Japan	1.449597659	0.7334158468	0.9362203703	0.6460468052	0.5748721572
Korea	1.423613596	1.029434705	0.5802747031	1.363555726	2.809751194
Malta	1.183146546	0.9119304556	0.9860711431	0.9015507594	0.8452038369
Netherlands	1.899288762	0.6075148638	0.1053025764	1.75504294	New in 2nd Ver
Sweden	1.077370417	0.5906637366	0.3977939451	0.9281858719	0.9281858719
Tanzania	3.696878613	1.149618488	1.388558801	1.008221561	0.5860800133
UK	1.570666282	0.5234862629	0.5457192702	0.5040323815	0
US	0.4904829322	1.208181883	0.7413843373	1.529105196	0
Saudi	0.787032967	0.8105518589	0.4620344749	0.8921197573	2.16001117
Spain	1.541799363	1.326335883	2.310611929	0.7644129689	1.945778466
Average	1.44502683	1.043448523	0.8948911096	1.111168843	1.230242163
Standard Deviation	1.032457211	0.6254656403	0.8906644526	0.9985612513	0.780700002
T test	0.007389773632	0.3494052704	0.3023802901	0.2325677076	0.2270837302
Average OECD	1.313641651	0.9292361433	0.8569704182	0.9582759848	1.042344069
Average Non-OECD	1.947206089	1.147644588	0.9519317309	1.222320386	1.316823638
Average G7	1.11957804	0.5971979153	0.6479537311	0.5462747238	0.5291772242
Average East Asia	1.425939084	0.9295401524	0.8840977898	0.9681248094	1.104478958
Average Africa & Middle East	2.078232245	1.094319587	0.9477181868	1.141264193	1.579839042
Average EU	1.575716837	1.006221718	1.007206036	0.9825293434	1.315000154
Average North America	0.7012893983	0.9053580978	1.478727939	0.7348420729	0.5947971172

Supplementary Table 5 - TF for Group 1/TF for Group 2

File Name	Domain2 (Strengthen knowledge and evidence base by bolstering AMR surveillance and research)	Domain2a (Engage global and regional AMR surveillance networks)	Intervention 2b (Expand laboratory network capacity)	Intervention 2c (Promote new data sources in AMR surveillance)	Intervention 2d (Other terms associated with strengthening AMR surveillance)
AMRGAP	1	0	1	1	1
Australia	1.076139455	4.944424525	New in 2nd Ver	2.472212262	0.994914691
Austria	0.9936006638	1.06892779	New in 2nd Ver	4.810175055	0.9642775168
Cameroon	0.8289270514	0	0	0	0.8961373528
Canada	0.7463869082	New in 2nd Ver	0	New in 2nd Ver	0.7352295781
China	1.202331803	New in 2nd Ver	New in 2nd Ver	New in 2nd Ver	1.202331803
Fiji	0.6482466747	New in 2nd Ver	0.1440548166	0.0720274083	0.7519661427
France	2.102162819	New in 2nd Ver	New in 2nd Ver	3.18509518	1.857972188
Ireland	0.7696336203	1.362975095	0	3.504793102	0.7163080792
Japan	0.8255541142	1.724616472	0.9333218552	0.8738056789	0.8124398077
Korea	0.9090371509	0.858535087	New in 2nd Ver	0.7024377984	0.9185725057
Malta	1.036783373	0.6573807621	0.8452038369	1.126938449	1.090585596
Netherlands	0.2948472139	0	New in 2nd Ver	0	0.3204861021
Sweden	0.8924864153	0.6187905812	New in 2nd Ver	New in 2nd Ver	0.9281858719
Tanzania	0.7620494466	1.081993871	0.5409969354	0.6086215523	0.7781005305
UK	1.546204599	1.910017446	New in 2nd Ver	0.2122241606	1.560471769
US	0.8068006023	8.15522771	0.7841565106	0.7008398813	0.7808196744
Saudi	1.299803882	0.423531602	6.35297403	New in 2nd Ver	1.302359676
Spain	0.9124271904	1.441317382	0.6485928221	New in 2nd Ver	0.8707959186
Average	0.946820959	1.127268317	0.7890960908	0.7803903031	0.9498341167
Standard Deviation	0.3883559835	2.211175096	1.908749593	1.566385097	0.344944506
T test	0.2090027685	0.2860927214	0.2658509367	0.1824799572	0.2093373237
Average OECD	0.9326891798	1.483370689	0.9193754424	1.029405782	0.9071422044
Average Non-OECD	0.9677977805	0.5952618465	0.6943410186	0.3619495779	1.014145675
Average G7	1.003809824	5.180706425	0.9656967203	0.904955217	0.9779959323
Average East Asia	0.9687197919	0.9306816474	0.9333218552	0.8316688154	0.9737533763
Average Africa & Middle East	0.9654139407	0.4199377432	1.197879093	0.5071337853	0.9947586433
Average EU	0.9636902496	1.219916041	0.5769016857	1.756777429	0.9335808128
Average North America	0.7769677281	8.15522771	0.685936087	0.8072153833	0.7552199575

Supplementary Table 5 - TF for Group 1/TF for Group 2

File Name	Domain 3 (Reduce incidence of infection through effective sanitation, hygiene, and IPC measures)	Intervention 3a (Improve water, hygiene, sanitation, and waste management)	Intervention 3b (Improve vaccination coverage)	Intervention 3c (Other terms associated with strengthening IPC programs)	Intervention 3d (Promote food safety and security)
AMRGAP	1	1	1	1	1
Australia	0.8441700408	1.059519541	0.2908485015	0.6180530656	2.119039082
Austria	1.360142092	1.644504292	1.870623632	0.8551422319	2.235030833
Cameroon	0.09523686847	0.05942129401	0.534791646	0	0.534791646
Canada	1.067776935	0.9143239625	0.8088250438	1.126179515	1.320690168
China	2.258796411	1.27161872	1.059682267	4.450665522	4.768570202
Fiji	1.758123557	0.8211124547	2.592986699	2.636203144	1.512575574
France	0.8759011746	0.2654245984	0	2.099267278	0.2388821385
Ireland	1.992921568	0.8387539047	1.687492975	2.784363409	2.01791118
Japan	1.137641743	0.8623082358	0.6598532587	1.239168872	1.198154601
Korea	0.8429253581	0.330558964	0.2341459328	1.023552221	New in 2nd Ver
Malta	0.9128201439	0.8452038369	1.183285372	0.9262507802	0.7606834532
Netherlands	1.533081627	0.8100198184	New in 2nd Ver	2.519740221	0.526512882
Sweden	1.134449399	1.350088541	1.546976453	0.9281858719	1.16023234
Tanzania	0.6762461692	0.6369802626	0.5409969354	0.643347707	2.840233911
UK	2.138258524	10.50509595	2.621592572	1.176879436	8.913414746
US	1.770542858	New in 2nd Ver	1.249591343	2.038806928	0.8395087349
Saudi	0.4764730522	0.6655496602	0.635297403	0.1524713767	1.058829005
Spain	0.8989268938	0.8431706687	0.1441317382	3.61358858	0.3706244698
Average	1.136233547	0.8941045197	0.9658012297	1.299635637	1.248236954
Standard Deviation	0.593012096	2.379441645	0.8025359076	1.20795908	2.12100237
T test	0.1512633997	0.2758663202	0.4360331647	0.05562877474	0.1303983865
Average OECD	1.252408531	1.186883837	1.022463494	1.369169708	1.151569553
Average Non-OECD	0.9519794988	0.6410956509	0.8444889484	1.173164697	1.630088958
Average G7	1.273061342	1.689272602	1.147684984	1.313962532	1.013854272
Average East Asia	1.371682613	0.920563926	0.7691143929	1.591109933	2.588132197
Average Africa & Middle East	0.4483810665	0.4043566965	0.5548303331	0.3572483287	1.42846798
Average EU	1.25209998	1.130433135	0.8832676575	1.558502281	0.7647816725
Average North America	1.223858804	1.687443987	0.9809151802	1.267638879	1.158730369

Supplementary Table 5 - TF for Group 1/TF for Group 2

File Name	Intervention 3e (Enhance biosecurity)	Domain4 (Optimize antimicrobial use in human and animal health)	Intervention 4a (Strengthen antimicrobial stewardship)	Intervention 4b (Limit antimicrobial sale without prescription, counterfeit or substandard antimicrobial sale,	Intervention 4c (Enhance the use of diagnostic tools)
AMRGAP	1	1	1	New in 2nd Ver	1
Australia	1.112495518	0.7705596662	0.7961361523	New in 2nd Ver	New in 2nd Ver
Austria	5.879102845	0.7205718584	0.7005810515	New in 2nd Ver	New in 2nd Ver
Cameroon	0.8556666337	1.203281204	2.406562407	New in 2nd Ver	0
Canada	1.024042838	0.5210663442	0.5285935408	New in 2nd Ver	0
China	0.9934521254	1.291487763	0.5298411335	New in 2nd Ver	0.7947617003
Fiji	1.620616687	0.5345191879	0.3889480048	New in 2nd Ver	0
France	0	1.508729296	1.776303081	New in 2nd Ver	0
Ireland	2.433884098	0.6116855885	0.755199466	New in 2nd Ver	0.6490357596
Japan	1.069262212	1.402688064	2.299488629	New in 2nd Ver	0.6898465886
Korea	0.2341459328	1.852982468	1.955434952	New in 2nd Ver	3.278043059
Malta	1.352326139	0.9203330669	0.8452038369	New in 2nd Ver	0.8452038369
Netherlands	New in 2nd Ver	0.160243051	0.2047550097	New in 2nd Ver	New in 2nd Ver
Sweden	1.392278808	1.093933349	1.142382612	New in 2nd Ver	New in 2nd Ver
Tanzania	0.6955674884	0.3988706219	0.3054014958	New in 2nd Ver	0.05409969354
UK	2.745650078	0.6263200838	0.5365217544	New in 2nd Ver	2.546689927
US	1.616984805	0.4633652108	0.3455604962	New in 2nd Ver	2.038806928
Saudi	0.635297403	1.118123429	1.058829005	1.172856744	New in 2nd Ver
Spain	0.1853122349	0.7089270381	0.5350890782	3.026766503	New in 2nd Ver
Average	1.075682923	0.8059767397	0.7981521357	1.829224206	0.6684209777
Standard Deviation	1.362687183	0.4450506026	0.6931720568	1.310912162	1.117609237
T test	0.3663019543	0.04663209495	0.06712155749	0.01623771175	0.1859510655
Average OECD	1.13009239	0.817893834	0.8327635288	5.461492755	1.341004066
Average Non-OECD	0.9436079136	0.7786579434	0.69807083	1.323135834	0.2286586105
Average G7	1.133797635	0.7634490903	0.7840019024	New in 2nd Ver	0.8581933334
Average East Asia	0.9221702334	1.599643922	1.835630393	New in 2nd Ver	1.805024737
Average Africa & Middle East	0.7144452908	0.7180274383	0.7571400695	1.172856744	0.03863599817
Average EU	0.7428741851	0.7731897149	0.7809961517	3.616299477	0.6872895815
Average North America	1.251682812	0.5016204137	0.4679714588	New in 2nd Ver	0.4316774541

Supplementary Table 5 - TF for Group 1/TF for Group 2

File Name	Intervention 4d (Monitor antibiotic conption)	Intervention 4e (Support new drugs, medicines, technologies)	Intervention 4f (Restrict the use of antimicrobials as growth promoters)	Intervention 4g (Optimize animal feed practices)	Domain5 (Make an economic case for sustainable investments in medicines, diagnostic tools, vaccines and other interventions)
AMRGAP	0	1	1	1	1
Australia	0.6180530656	0.8240707542	0	0	1.153699056
Austria	0.6532336494	1.06892779	New in 2nd Ver	0.7194706278	1.118811087
Cameroon	0.534791646	0	New in 2nd Ver	7.487083045	0.178263882
Canada	0.4571619813	1.015915514	0.6095493083	0	0.9511918642
China	New in 2nd Ver	1.589523401	0.3973808502	New in 2nd Ver	1.20686036
Fiji	0.9723700121	New in 2nd Ver	0.8643288996	0.4321644498	1.469359129
France	4.77764277	0	0	0.7962737951	0.1990684488
Ireland	0.2044462643	0.4248234063	0	0.4779263321	0.9569825136
Japan	0.7818261338	0.7883961013	New in 2nd Ver	0.6172311582	0.8354543461
Korea	1.28780263	0.3512188992	New in 2nd Ver	1.685850716	1.232347015
Malta	1.003679556	New in 2nd Ver	New in 2nd Ver	1.690407674	1.000445358
Netherlands	New in 2nd Ver	0	New in 2nd Ver	0	0.4585757359
Sweden	0.9281858719	0.4640929359	0.9281858719	1.856371744	1.603230142
Tanzania	0.6762461692	0.05409969354	New in 2nd Ver	2.569735443	0.4984900333
UK	0.8488966425	0.3979203012	0	New in 2nd Ver	0.760993144
US	0	0.9267304216	0.1853460843	0.6796023092	1.070143003
Saudi	0.8796425579	New in 2nd Ver	New in 2nd Ver	New in 2nd Ver	0.8470632039
Spain	2.594371288	New in 2nd Ver	New in 2nd Ver	New in 2nd Ver	0.7553232865
Average	0.8200795657	0.5017455437	0.5121933489	1.331084933	0.8486590992
Standard Deviation	1.137496029	0.4865048897	0.3844675136	1.929462425	0.3907344876
T test	0.1080734934	0.01430436669	0.02012618059	0.1288362625	0.05727422382
Average OECD	0.7743729854	0.5292076907	0.485045915	0.8997398147	0.8671205533
Average Non-OECD	0.8847017058	0.4360256808	0.5567026639	2.356211805	0.7945766024
Average G7	0.9642650365	0.6026554955	0.2513829173	0.6450815171	0.7679394687
Average East Asia	1.032023229	1.076406214	0.3973808502	1.758895498	1.041544405
Average Africa & Middle East	0.7815922679	0.0365467172	New in 2nd Ver	4.144480479	0.4758165729
Average EU	0.8410944312	0.2695300766	0.7999382753	0.8956171679	0.737476253
Average North America	0.4283950861	0.9805672475	0.3281877342	0.2374991697	1.009374105

Supplementary Table 5 - TF for Group 1/TF for Group 2

File Name	Intervention 5a (Promote R&D for AMR innovations)	Intervention 5b (Explore new market models)	Intervention 5c (Promote PPPs)	Intervention 6 (International engagement)	Intervention 7 (One Health engagement)
AMRGAP	1	1	0	1	1
Australia	1.115283727	0	New in 2nd Ver	0.4635397992	1.83745506
Austria	1.076150275	2.13785558	New in 2nd Ver	2.458533917	1.788398418
Cameroon	0.1158715233	New in 2nd Ver	New in 2nd Ver	0.7404807407	0.534791646
Canada	0.8992111697	4.571619813	0	0.6530885447	1.125973028
China	1.253278066	0	New in 2nd Ver	0	2.724897258
Fiji	1.560593847	New in 2nd Ver	0.4321644498	5.402055623	1.610794768
France	0.2374851669	0	0	0	1.055928293
Ireland	1.032745701	New in 2nd Ver	0.3245178798	0.7510270932	1.65360949
Japan	0.7826623114	1.931570448	2.069539766	0.6323593729	1.046267326
Korea	1.312100793	New in 2nd Ver	0	0.7902425232	1.036383637
Malta	0.9719844125	0.8452038369	1.267805755	1.207434053	0.886942298
Netherlands	0.443379269	0	0.7897693229	0.1053025764	0.572969901
Sweden	1.624325276	0.9281858719	New in 2nd Ver	0.8701742549	1.546976453
Tanzania	0.4415489693	New in 2nd Ver	3.245981612	0.8114954031	0.7861361717
UK	0.7030739064	3.39558657	0.9550087228	3.607810731	1.847903057
US	1.163507618	0.3597894578	0.582516265	0.815522771	2.092459741
Saudi	0.8470632039	New in 2nd Ver	New in 2nd Ver	New in 2nd Ver	New in 2nd Ver
Spain	0.7665187898	0.3242964111	New in 2nd Ver	New in 2nd Ver	New in 2nd Ver
Average	0.8450485836	1.01328015	0.8703509871	0.8410002251	1.249488624
Standard Deviation	0.4179581777	1.508612388	1.004879795	1.443797928	0.6015265818
T test	0.06041651384	0.4866585307	0.3447630184	0.2854165143	0.02252822867
Average OECD	0.8706221337	1.12575072	0.6279383964	0.619768625	1.339001989
Average Non-OECD	0.7716443347	0.3669413841	1.551756676	1.453231698	1.078737503
Average G7	0.7607835126	1.321832004	0.4183118678	0.5075154528	1.302951665
Average East Asia	1.049136841	1.209849537	0.6006608147	0.5251927124	1.312123359
Average Africa & Middle East	0.4297996949	New in 2nd Ver	4.958344277	0.7664518081	0.6763570158
Average EU	0.7650602347	0.38398687	0.5182515168	0.5387708436	1.181839147
Average North America	1.020488645	1.116465561	0.4601497361	0.7514427646	1.391106758

Supplementary Table 5 - TF for Group 1/TF for Group 2			
File Name	**Intervention 8 (Reporting)**	**Intervention 9 (Funding)**	**Intervention 10 (Effectiveness)**
AMRGAP	New in 2nd Ver	1	New in 2nd Ver
Australia	New in 2nd Ver	0.9508508702	New in 2nd Ver
Austria	New in 2nd Ver	2.672319475	New in 2nd Ver
Cameroon	New in 2nd Ver	0.4618655125	New in 2nd Ver
Canada	New in 2nd Ver	0.5485943775	New in 2nd Ver
China	New in 2nd Ver	0.1986904251	New in 2nd Ver
Fiji	New in 2nd Ver	0.7923014913	New in 2nd Ver
France	New in 2nd Ver	0	New in 2nd Ver
Ireland	0.1947107279	1.934937858	New in 2nd Ver
Japan	0.6898465886	1.379693177	New in 2nd Ver
Korea	1.873167463	0.2634141744	New in 2nd Ver
Malta	2.535611511	0.8452038369	New in 2nd Ver
Netherlands	New in 2nd Ver	6.318154584	New in 2nd Ver
Sweden	0	0.9281858719	New in 2nd Ver
Tanzania	New in 2nd Ver	8.655950966	New in 2nd Ver
UK	New in 2nd Ver	0.9717632618	New in 2nd Ver
US	New in 2nd Ver	0.5996490963	New in 2nd Ver
Saudi	New in 2nd Ver	New in 2nd Ver	New in 2nd Ver
Spain	New in 2nd Ver	New in 2nd Ver	New in 2nd Ver
Average	1.327590623	1.146016531	New in 2nd Ver
Standard Deviation	1.100908811	2.3850699	New in 2nd Ver
T test	0.2846145779	0.3342562244	New in 2nd Ver
Average OECD	1.134776495	1.221184902	New in 2nd Ver
Average Non-OECD	4.739939486	1.040222739	New in 2nd Ver
Average G7	2.257008879	0.6418723829	New in 2nd Ver
Average East Asia	1.190599752	0.354955099	New in 2nd Ver
Average Africa & Middle East	New in 2nd Ver	1.654565978	New in 2nd Ver
Average EU	1.130488638	1.951647471	New in 2nd Ver
Average North America	New in 2nd Ver	0.5729642168	New in 2nd Ver

Australia		*Austria*		*Cameroon*		*Canada*		*China*	
Intervention 4f	4.110267069	**Intervention 3b**	13.2473401	**Intervention 4g**	4.546365875	**Domain 7**	0.9308982981	**Domain 7**	2.121387527
Intervention 1a	3.92473418	**Intervention 3e**	3.558986892	**Intervention 4b**	4.399708911	**Intervention 4e**	0.8802490473	**Intervention 3b**	1.988800806
Intervention 5b	3.767744813	**Domain 9**	2.911898366	**Intervention 5b**	4.399708911	**Intervention 3e**	0.8779203461	**Intervention 3c**	1.399526493
Intervention 4b	3.767744813	**Intervention 1b**	2.54711807	**Intervention 2c**	4.399708911	**Intervention 3d**	0.7918311743	**Intervention 5a**	1.247875016
Intervention 4g	3.767744813	**Domain 7**	2.029940672	**Intervention 4f**	4.399708911	**Intervention 5a**	0.768208755	**Intervention 2d**	1.244691661
Intervention 2b	3.767744813	**Domain 6**	1.853639006	**Intervention 2b**	4.399708911	**Intervention 3c**	0.7662882332	**Intervention 4g**	1.237476057
Intervention 3b	3.767744813	**Intervention 3a**	1.765370482	**Domain 8**	4.399708911	**Intervention 3a**	0.6328057667	**Intervention 3a**	1.163041407
Domain 8	3.767744813	**Intervention 3d**	1.66086055	**Domain 10**	4.399708911	**Intervention 2d**	0.6325764893	**Intervention 3d**	1.14908491
Domain 10	3.767744813	**Intervention 2c**	1.61001788	**Intervention 3d**	3.996402261	**Domain 6**	0.5944539021	**Intervention 3e**	1.060693763
Intervention 4e	3.596483685	**Intervention 1a**	1.247690807	**Intervention 4a**	3.939739343	**Intervention 5b**	0.5721618808	**Intervention 4e**	1.031230048
Intervention 1b	3.510853121	**Intervention 4f**	1.186328964	**Intervention 2a**	3.771179066	**Intervention 5c**	0.4904244692	**Intervention 1a**	0.9519046595
Intervention 2a	3.440114829	**Intervention 2b**	1.186328964	**Intervention 4d**	3.497204519	**Intervention 1a**	0.4740769869	**Intervention 1b**	0.9519046595
Intervention 1c	3.296776712	**Domain 8**	1.186328964	**Intervention 1a**	3.222009051	**Intervention 4g**	0.4540967308	**Intervention 5c**	0.8839114695
Intervention 4c	3.202583091	**Domain 10**	1.186328964	**Intervention 1c**	3.177567547	**Intervention 2b**	0.4458404266	**Intervention 5b**	0.8839114695
Intervention 4d	3.115635134	**Intervention 5c**	1.186328964	**Intervention 3c**	3.060667068	**Intervention 1c**	0.4458404266	**Intervention 1c**	0.8839114695
Intervention 2c	2.960370925	**Intervention 4b**	1.186328964	**Intervention 1b**	2.8283843	**Intervention 4a**	0.4434121018	**Domain 8**	0.8839114695
Intervention 3a	2.613113338	**Intervention 2a**	1.186328964	**Intervention 4e**	2.639825347	**Intervention 4d**	0.4427443125	**Domain 10**	0.8839114695
Intervention 3d	2.608438717	**Intervention 5a**	1.179005946	**Intervention 4c**	2.444282728	**Intervention 4f**	0.4401245237	**Domain 6**	0.8839114695
Intervention 4a	2.602718456	**Intervention 5b**	1.107240366	**Intervention 5c**	1.955426183	**Domain 9**	0.4086870577	**Intervention 4c**	0.8839114695
Intervention 3c	2.364452102	**Intervention 2d**	1.053592856	**Domain 6**	1.857654873	**Intervention 2c**	0.4086870577	**Intervention 2b**	0.8839114695
Intervention 5a	2.237888698	**Intervention 4e**	1.016853398	**Intervention 3e**	1.047549741	**Intervention 4b**	0.4086870577	**Intervention 2c**	0.8839114695
Intervention 5c	1.883872407	**Intervention 3c**	1.009791916	**Intervention 2d**	1.005031545	**Domain 8**	0.4086870577	**Intervention 4d**	0.8839114695
Domain 7	1.536843279	**Intervention 4d**	0.9556538877	**Intervention 3a**	0.8813519453	**Domain 10**	0.4086870577	**Intervention 4b**	0.8839114695
Domain 9	1.440608311	**Intervention 4c**	0.9490631713	**Intervention 5a**	0.7171094181	**Intervention 2a**	0.4086870577	**Intervention 2a**	0.8839114695
Domain 6	1.412904305	**Intervention 1c**	0.9321156146	**Domain 9**	0.6376389726	**Intervention 1b**	0.3955036042	**Intervention 4a**	0.8511740077
Intervention 2d	1.375226857	**Intervention 4a**	0.9074909597	**Domain 7**	0.4306593378	**Intervention 3b**	0.297226951	**Intervention 4f**	0.7576384024
Intervention 3e	1.113197331	**Intervention 4g**	0.8386118539	**Intervention 3b**	0.305535341	**Intervention 4c**	0.2919193269	**Domain 9**	0.7071291756

Fiji		*France*		*Ireland*		*Japan*		*Korea*	
Domain 7	1.898007865	**Domain 8**	1.68644453	**Intervention 3e**	2.024813979	**Domain 7**	0.9219197405	**Intervention 4c**	1.257244171
Intervention 3e	1.097114373	**Intervention 2d**	1.432926725	**Domain 7**	1.841691268	**Intervention 3c**	0.8481517111	**Intervention 4g**	1.173427893
Domain 6	1.060543894	**Intervention 4d**	1.090226767	**Domain 9**	1.508684926	**Intervention 3e**	0.786810813	**Domain 8**	1.10008865
Intervention 1b	1.022048653	**Intervention 2c**	1.070758432	**Intervention 3c**	1.257766801	**Intervention 4a**	0.7438938596	**Intervention 4a**	1.053257567
Intervention 3b	0.7899223485	**Intervention 2a**	0.9993745362	**Intervention 3b**	1.212722811	**Domain 9**	0.7293077055	**Intervention 5a**	1.029153972
Intervention 5a	0.7465729513	**Domain 7**	0.9887428922	**Intervention 5a**	1.003234404	**Intervention 3d**	0.7204377469	**Intervention 1b**	0.9918259572
Intervention 2d	0.6527830519	**Intervention 3c**	0.9115916378	**Intervention 3d**	0.7166762399	**Intervention 2d**	0.6992454682	**Domain 7**	0.8381627807
Domain 9	0.6112494363	**Intervention 4a**	0.904196009	**Intervention 2d**	0.6632021123	**Intervention 2b**	0.6914398054	**Intervention 4d**	0.8283020421
Intervention 3c	0.539273911	**Intervention 3b**	0.7495309022	**Intervention 1b**	0.609307768	**Intervention 5a**	0.6800367501	**Intervention 1c**	0.782285262
Intervention 4d	0.444331321	**Intervention 4f**	0.7495309022	**Intervention 3a**	0.5973112353	**Intervention 2c**	0.6457411976	**Intervention 2d**	0.7560746734
Intervention 3a	0.4436158117	**Domain 10**	0.7495309022	**Intervention 4a**	0.4848442536	**Intervention 5b**	0.6325628058	**Intervention 3c**	0.7411123535
Intervention 4c	0.3872168375	**Intervention 2b**	0.7495309022	**Domain 6**	0.465839556	**Intervention 1a**	0.6310811271	**Domain 6**	0.7040567358
Intervention 4f	0.3761534993	**Intervention 1c**	0.7495309022	**Intervention 2a**	0.4234905054	**Intervention 5c**	0.6199115497	**Intervention 3d**	0.7040567358
Intervention 4a	0.3291343119	**Intervention 4e**	0.7495309022	**Intervention 1a**	0.4035615405	**Intervention 1b**	0.5768621365	**Intervention 2a**	0.6484733093
Domain 8	0.3291343119	**Intervention 4c**	0.7495309022	**Intervention 4c**	0.3932411836	**Domain 8**	0.5722260458	**Domain 10**	0.5867139465
Domain 10	0.3291343119	**Intervention 4b**	0.7495309022	**Intervention 4g**	0.3811414549	**Intervention 4e**	0.5722260458	**Intervention 2b**	0.5867139465
Intervention 4b	0.3291343119	**Intervention 4g**	0.7495309022	**Intervention 5c**	0.3420500236	**Domain 6**	0.5372566764	**Intervention 4e**	0.5867139465
Intervention 5b	0.3291343119	**Intervention 3a**	0.6959929806	**Intervention 4e**	0.3314273521	**Intervention 1c**	0.5372566764	**Intervention 4f**	0.5867139465
Intervention 2b	0.3148241244	**Intervention 5b**	0.661350796	**Intervention 2c**	0.3049131639	**Intervention 4d**	0.5338127233	**Intervention 4b**	0.5867139465
Intervention 2c	0.3047539925	**Intervention 1a**	0.604460405	**Domain 8**	0.2540943033	**Intervention 3a**	0.5220307787	**Intervention 5b**	0.5867139465
Intervention 1a	0.3032473435	**Intervention 1b**	0.4849905838	**Intervention 1c**	0.2470361282	**Intervention 4g**	0.5207257017	**Intervention 1a**	0.5229406915
Intervention 1c	0.2977881869	**Intervention 3d**	0.4849905838	**Intervention 4d**	0.2055174512	**Intervention 2a**	0.4782174812	**Intervention 2c**	0.5133747032
Intervention 2a	0.2948494877	**Intervention 5c**	0.3747654511	**Intervention 4f**	0.1814959309	**Intervention 4c**	0.4649336623	**Intervention 5c**	0.4400354599
Intervention 4e	0.2879925229	**Domain 9**	0.3331248454	**Intervention 2b**	0.1814959309	**Intervention 4b**	0.4132743664	**Intervention 3b**	0.391142631
Intervention 3d	0.2846567022	**Intervention 5a**	0.2998123609	**Domain 10**	0.1588089395	**Intervention 3b**	0.4132743664	**Intervention 3a**	0.3694124848
Intervention 4g	0.2425200193	**Domain 6**	0.1972449743	**Intervention 4b**	0.1588089395	**Intervention 4f**	0.4132743664	**Intervention 3e**	0.3520283679
Intervention 5c	0.2194228746	**Intervention 3e**	0.1499061804	**Intervention 5b**	0.1588089395	**Domain 10**	0.4132743664	**Domain 9**	0.2761006807

New in 2nd = Term did not appear in Group 1 NAPs

Malta		*Netherlands*		*Saudi*		*Spain*		*Sweden*	
Intervention 4g	1.448964064	**Domain 9**	3.437274442	**Domain 7**	2.096845627	**Domain 9**	1.127395312	**Intervention 5a**	1.532007595
Intervention 3e	1.33750529	**Intervention 3c**	1.015391435	**Intervention 2b**	1.957055918	**Intervention 1a**	1.115577751	**Intervention 4g**	1.478508917
Intervention 2d	1.120956814	**Intervention 3d**	0.8483017051	**Intervention 1c**	1.761350327	**Intervention 3b**	0.9565778404	**Domain 7**	1.460623729
Domain 8	1.114587741	**Intervention 3e**	0.835448649	**Intervention 4g**	1.643926972	**Intervention 1b**	0.9394960933	**Intervention 3e**	1.293695302
Domain 6	1.070004232	**Intervention 3a**	0.477399228	**Intervention 2d**	1.200620822	**Intervention 5a**	0.9113851865	**Domain 9**	1.155085091
Intervention 5c	1.070004232	**Domain 7**	0.4699398651	**Intervention 5b**	1.174233551	**Intervention 3c**	0.9068179683	**Intervention 3a**	1.050077356
Intervention 5a	1.005500431	**Intervention 1b**	0.4177243245	**Intervention 4b**	1.174233551	**Intervention 2a**	0.9040947912	**Intervention 4d**	0.9784250186
Intervention 2c	0.9907446591	**Intervention 5a**	0.3873443736	**Domain 6**	1.174233551	**Intervention 3a**	0.9001683498	**Intervention 4a**	0.9687810444
Intervention 4d	0.9659760426	**Intervention 5c**	0.3759518921	**Domain 10**	1.174233551	**Intervention 3d**	0.8966418855	**Intervention 2d**	0.9529452004
Domain 7	0.9630038086	**Domain 6**	0.2784828828	**Intervention 3b**	1.174233551	**Intervention 4d**	0.8966418855	**Intervention 4f**	0.9240680731
Intervention 3c	0.9491973024	**Intervention 1c**	0.2506345947	**Intervention 4c**	1.174233551	**Intervention 2d**	0.8850164382	**Intervention 1b**	0.9240680731
Intervention 1b	0.9426227757	**Domain 10**	0.2312682425	**Intervention 4f**	1.174233551	**Intervention 5c**	0.8768630204	**Intervention 4b**	0.9240680731
Domain 9	0.8916701932	**Intervention 4a**	0.2169672611	**Intervention 2c**	1.174233551	**Domain 10**	0.8768630204	**Intervention 2c**	0.9240680731
Intervention 4c	0.8916701932	**Intervention 2d**	0.2126596561	**Intervention 4e**	1.174233551	**Intervention 2c**	0.8768630204	**Intervention 5b**	0.9240680731
Intervention 3d	0.8916701932	**Domain 8**	0.05781706063	**Intervention 5c**	1.174233551	**Intervention 4e**	0.8768630204	**Intervention 1c**	0.9240680731
Domain 10	0.8916701932	**Intervention 3b**	0.05781706063	**Intervention 4a**	1.154983821	**Intervention 4g**	0.8768630204	**Intervention 2a**	0.9240680731
Intervention 3b	0.8916701932	**Intervention 1a**	0.04850992156	**Intervention 3d**	1.017669078	**Intervention 4b**	0.8768630204	**Intervention 4c**	0.9240680731
Intervention 1c	0.8916701932	**Intervention 4c**	0.0462536485	**Intervention 4d**	0.9073622895	**Intervention 4c**	0.8768630204	**Intervention 2b**	0.9240680731
Intervention 2b	0.8916701932	**Intervention 4g**	0.0462536485	**Intervention 2a**	0.8979433038	**Intervention 2b**	0.872822177	**Intervention 3d**	0.9240680731
Intervention 4e	0.8916701932	**Intervention 2b**	0.03854470709	**Intervention 5a**	0.8611046041	**Intervention 5b**	0.8652103557	**Intervention 3b**	0.9240680731
Intervention 4f	0.8916701932	**Intervention 4f**	0.03854470709	**Intervention 1b**	0.8387382508	**Intervention 4a**	0.8460958969	**Domain 10**	0.9240680731
Intervention 4b	0.8916701932	**Intervention 2c**	0.03303832036	**Intervention 3a**	0.8072855664	**Intervention 4f**	0.7724745656	**Domain 8**	0.9240680731
Intervention 5b	0.8916701932	**Intervention 4e**	0.02890853032	**Intervention 1a**	0.8006137848	**Intervention 1c**	0.7515968746	**Intervention 5c**	0.9240680731
Intervention 1a	0.8916701932	**Intervention 4b**	0.02102438568	**Intervention 3e**	0.7828223674	**Domain 8**	0.7202803382	**Intervention 3c**	0.902578118
Intervention 4a	0.883013201	**Intervention 4d**	0.02102438568	**Intervention 3c**	0.7226052622	**Domain 6**	0.671068638	**Intervention 1a**	0.8580632108
Intervention 3a	0.8141336546	**Intervention 2a**	0.01927235354	**Domain 9**	0.6709906006	**Domain 7**	0.5434623555	**Domain 6**	0.8213938428
Intervention 2a	0.7978101728	**Intervention 5b**	0.01541788283	**Domain 8**	0.6523519728	**Intervention 3e**	0.3618799767	**Intervention 4e**	0.7920583484

New in 2nd = Term did not appear in Group 1 NAPs

Tanzania		*UK*		*US*		*Average*	
Domain 9	5.450719134	**Intervention 3d**	17.12246186	**Domain 7**	1.649650475	**Intervention 3d**	2.011370056
Intervention 4g	1.703349729	**Intervention 4b**	16.98528259	**Intervention 3e**	0.9129261043	**Intervention 4b**	1.946306578
Intervention 1a	1.230541138	**Intervention 3a**	11.19545584	**Intervention 5a**	0.8512257179	**Intervention 3b**	1.898242387
Intervention 3d	1.117397422	**Domain 10**	6.17646639	**Intervention 2d**	0.592621689	**Intervention 4g**	1.531576763
Intervention 4f	1.090143827	**Intervention 4g**	6.176466388	**Domain 9**	0.5522639396	**Intervention 3a**	1.437041448
Intervention 4b	1.090143827	**Intervention 3b**	5.927006031	**Intervention 5c**	0.4385625403	**Domain 10**	1.357497003
Intervention 2a	1.090143827	**Intervention 5b**	4.829412323	**Domain 6**	0.4193754291	**Domain 9**	1.336831004
Domain 10	1.090143827	**Domain 6**	3.731818613	**Intervention 2b**	0.3901166783	**Domain 7**	1.297150458
Intervention 5c	1.090143827	**Intervention 3c**	3.4025405	**Intervention 1b**	0.3883105825	**Intervention 5b**	1.279822768
Intervention 5b	1.035636635	**Intervention 3e**	2.840023724	**Intervention 4e**	0.363686009	**Intervention 3c**	1.215827099
Intervention 1b	1.001753787	**Intervention 4c**	1.975668678	**Intervention 2c**	0.3607530573	**Intervention 3e**	1.173036838
Domain 8	0.9538758485	**Domain 7**	1.860421338	**Intervention 3b**	0.310648466	**Intervention 2b**	1.120289278
Intervention 2c	0.8993686571	**Intervention 2d**	1.73746749	**Intervention 3c**	0.3084608008	**Intervention 1b**	1.105159431
Intervention 4d	0.8370747242	**Intervention 5c**	1.646390563	**Intervention 3a**	0.2867524302	**Domain 8**	1.066541065
Intervention 2d	0.7816690626	**Intervention 4d**	1.317112452	**Intervention 2a**	0.2854607526	**Intervention 2c**	1.056659072
Intervention 3c	0.778674162	**Domain 9**	1.21312989	**Intervention 4g**	0.2824076964	**Intervention 2a**	1.026671764
Intervention 4a	0.771595306	**Intervention 1c**	0.8231952817	**Intervention 3d**	0.2690151665	**Domain 6**	1.019282694
Domain 7	0.7665073782	**Intervention 4a**	0.7487694073	**Intervention 4c**	0.2600777855	**Intervention 4f**	1.015316942
Intervention 2b	0.7631006788	**Intervention 5a**	0.7393606708	**Intervention 4a**	0.2413956233	**Intervention 4d**	1.006886357
Intervention 3b	0.7631006788	**Intervention 1a**	0.6585562259	**Intervention 1c**	0.2192812701	**Intervention 1a**	1.005721553
Intervention 3e	0.6813398918	**Intervention 2c**	0.6585562232	**Intervention 1a**	0.2137489445	**Intervention 4a**	1.005081246
Intervention 3a	0.6514274087	**Intervention 1b**	0.5213570122	**Intervention 4d**	0.2029980075	**Intervention 1c**	0.9772947467
Intervention 1c	0.6193999016	**Intervention 4e**	0.2772868318	**Intervention 5b**	0.2018225703	**Intervention 4c**	0.9735091592
Domain 6	0.6132059026	**Intervention 4f**	0	**Domain 10**	0.1863890796	**Intervention 2d**	0.944406034
Intervention 5a	0.4898747576	**Domain 8**	0	**Domain 8**	0.1863890796	**Intervention 5a**	0.9270389782
Intervention 4e	0.461214696	**Intervention 2a**	New in 2nd	**Intervention 4b**	0.1863890796	**Intervention 4e**	0.9199140819
Intervention 4c	0.3504033729	**Intervention 2b**	New in 2nd	**Intervention 4f**	0.1833335209	**Intervention 5c**	0.8884648083

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