

Attention to the Tripartite's One Health Measures in National Action Plans on Antimicrobial Resistance

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Short running title:

One Health in National Action Plans on AMR

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Abstract

The WHO, FAO, and OIE (the Tripartite) promote One Health (OH) as the guiding frame for national responses to antimicrobial resistance (AMR). Little is known, however, about how much national action plans (NAPs) on AMR actually rely on the OH measures outlined by the Tripartite. The paper investigates attention to OH through a systematic content analysis of 77 AMR NAPs to discern regional and income patterns in the integration of these OH measures. Our findings suggest that (1) AMR NAPs almost universally address the three key sectors of OH, namely human, animal, and environmental health; (2) AMR NAPs primarily apply OH measures in policies related to human health care, food production, hygiene, and agriculture, whereas the level of attention to OH measures in sanitation, aquaculture, waste management, and water governance is generally low and mainly

present in NAPs from low-income countries; (3) AMR NAPs of low-income and lower-middle-income countries' display greater congruence with OH measures than NAPs from upper-middle-income and high-income countries; and (4) the level of OH attention on paper appears to matter little for the extent of multisectoral collaboration in practice.

Key messages:

- Most NAPs pay attention to all three key sectors of OH (human, animal, and environmental health) but display greater discrepancies when it comes to OH attention within specific policy areas: most NAPs display significantly more attention to the areas of human health care, food production, hygiene, and agriculture than to the areas of sanitation, aquaculture, waste management, and clean water.
- Low-income and lower-middle-income countries are more likely to adhere to the Tripartite's OH guidelines in their NAPs but less likely to translate these guidelines into actual multisectoral OH collaboration in implementation.
- A mixed global governance regime with legally binding provisions combined with NAPs tailored to the specific needs of individual member states could help strengthen OH commitment in both strategic documents as well as policy implementation.

Keywords: One Health, antimicrobial resistance, national action plans, national policy-making, cross-country comparative study.

Introduction

Antimicrobial resistance (AMR) is a slow-burning and complex global health crisis. AMR causes 700,000 human deaths worldwide annually, and it burdens both human and animal healthcare systems with excess costs in the tens of billions of US dollars [1–4]. AMR occurs when microorganisms (such as bacteria and viruses) develop resistance to antimicrobials (such as antibiotics and antiviral drugs). This makes infectious diseases increasingly difficult to treat. Mitigating AMR demands global concerted action such as internationally shared political priorities, strategies, and actions [5–9]. Fighting AMR also requires a One Health (OH) approach, meaning ‘an approach to address a health threat at the human-animal-environment interface based on collaboration, communication, and coordination across all relevant sectors and disciplines’ [10]. Use of antibiotics in human and veterinary medicine, and the presence of antibiotic residues in food products, soil, and wastewater all contribute to increasing resistance [3,11–13].

There is global agreement that OH needs to take center stage in efforts to reduce the emergence and spread of AMR [14]. Since 2016, national progress on AMR policy-making and implementation has been monitored by the Tripartite (the World Health Organization, WHO; the Food and Agriculture Organization of the United Nations, FAO; and the World Organization for Animal Health, OIE) through annual self-assessment surveys among their members [15]. The surveys collect responses from national authorities to a long list of questions about how their respective member states are addressing AMR. In 2019, 162 member states participated in the latest survey [15]. A few of these questions relate to central elements of OH, such as multisectoral collaboration and coordination, but there is less focus on measuring attention to OH in policy designs and overarching strategies. Hence, gauging the reliance of the OH measures outlined by the Tripartite in the NAPs requires additional research. The survey data has limitations that jeopardize conclusions based on them, because the data are based on self-reporting with limited scope for neutral third-party assessments [16].

This paper gauges adherence to the Tripartite's OH measures in national AMR policies and strategies by directly analyzing NAPs that member states have adopted and published. The Tripartite defines OH as 'a collaborative, multidisciplinary, and multisectoral approach that can address urgent, ongoing, or potential health threats at the human-animal-environment interface at subnational, national, global, and regional levels' [10]. We present a systematic content analysis of the NAPs to indicate how much the Tripartite's OH measures are included and prioritized in these national strategies on AMR. The analysis includes 77 AMR NAPs and focuses on

(1) the extent to which the concept of OH is introduced and discussed in the NAPs;

(2) the reliance in the outlined policies on the three overarching sectors of OH, human, animal, and environmental health; and

(3) the attention devoted to what we refer to as 'OH facilitators', eight policy areas highlighted by the Tripartite (human health care, agriculture, aquaculture, food production, waste management, water, sanitation, and hygiene) meant to strengthen the interface and generate synergies between the three sectors.

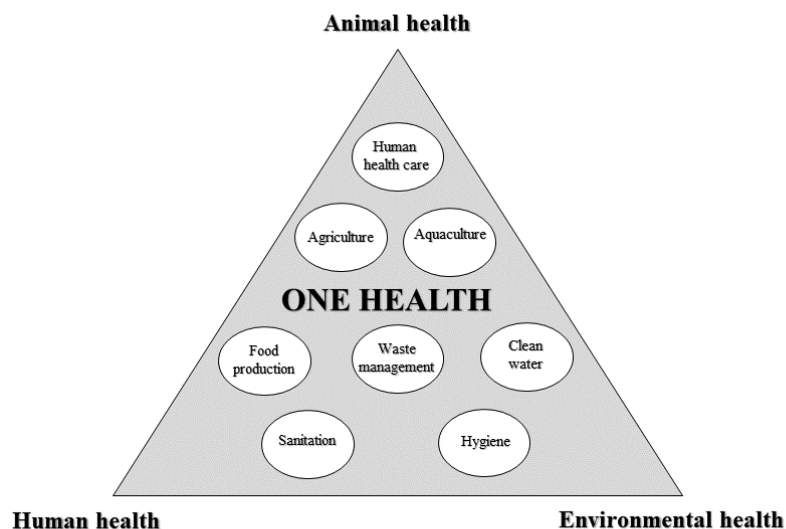
We also analyze OH collaboration in NAPs implementation using the self-assessment surveys from the Global Database for Antimicrobial Resistance Country Self-Assessment. The analysis shows that the Tripartite's OH measures are applied, to a very large extent, in most AMR NAPs, but with substantial variations in emphasis across policy areas *within* most NAPs and *between* NAPs of lower and higher resource member states. There is only a limited relationship between attention given to the Tripartite's OH measures in the NAPs and the member states' own account of the level of OH collaboration in AMR policy development and implementation.

Methods

OH measurement and data collection

We conducted a systematic content analysis using the well-established coding tool of NVivo known as “text search query” (NVivo Pro, version 12). We established a codebook deductively based on the OH measures promoted by the Tripartite and its advisory group, the Interagency Coordination Group (IACG) (see Supplemental material available online) because our research interest is in measuring the extent to which countries translate global guidelines on OH into national policies in the concrete case of AMR. Thus, we assess OH attention based on the parameters set by these international bodies who have taken up the task of coordinating global action on AMR. The Tripartite’s definition of OH outlined above emphasizes collaboration at the human-animal-environment interface, with three key sectors of OH: human health, animal health and environmental health. In the report ‘No Time to Wait’ from 2019, the IACG specifies several elements that shape and facilitate interaction among the three sectors [3]. These include eight policy areas (human health care, agriculture, aquaculture, food production, waste management, water, sanitation, and hygiene) that act as ‘OH facilitators’ as they shape interaction between human, animal, and environmental health (see Figure 1 below). On this basis, we assess a NAP’s attention to the OH elements outlined by the Tripartite by measuring its explicit mentions of the OH concept, its three sectors, and the eight facilitators of interaction.

Figure 1: Sectors and facilitators of One Health



We compiled data on NAPs' attention to OH using a two-step process: automated search queries within the sampled NAP texts, followed by manual screening of the search results and in-depth content coding. The automated process transformed the identified elements of OH (concept, sectors, and facilitators) into text search query items (TSQIs) we then used to code the content of all NAPs. We used the NVivo text search query tool (a full list of search terms is provided in the Supplemental material available online). For each of the three sectors and the eight facilitators, we coded NAPs that addressed these dimensions in their concrete policies packages or strategic plans 1 and NAPs that did not 0. This produced systematic and cross-country comparative data to assess and measure the extent to which individual NAPs pay attention to the OH measures defined by the Tripartite.

To simplify the comparison, we constructed an additive index of facilitators by adding the scores across each NAP for the eight facilitators. The resulting indicator scores NAPs between 0 (no policies relating to any of the facilitators) to 8 (policies relating to all the eight facilitators). This enabled cross-country comparison that could be thematic (identifying the sectors and facilitators most addressed); regional (uncovering regional patterns in policies addressing the sectors and facilitators);

and across income groups (revealing income patterns in the OH policy areas addressed). Because multisectoral and multidisciplinary collaboration is a core aspect of OH, according to the Tripartite, we then analyzed the level of OH collaboration, using data on NAPs implementation from the Tripartite's Global Database for Antimicrobial Resistance Country Self-Assessment. We draw primarily on the question about the multi-sectoral approach to addressing AMR that asks member states to report progress along a five-point scale [15]. This allowed us to assess the strength of the relationship between OH attention in the NAPs and the reported OH collaborative effort of member states, scoring each NAP between 1 (no multisectoral coordination) and 5 (strong multisectoral coordination).

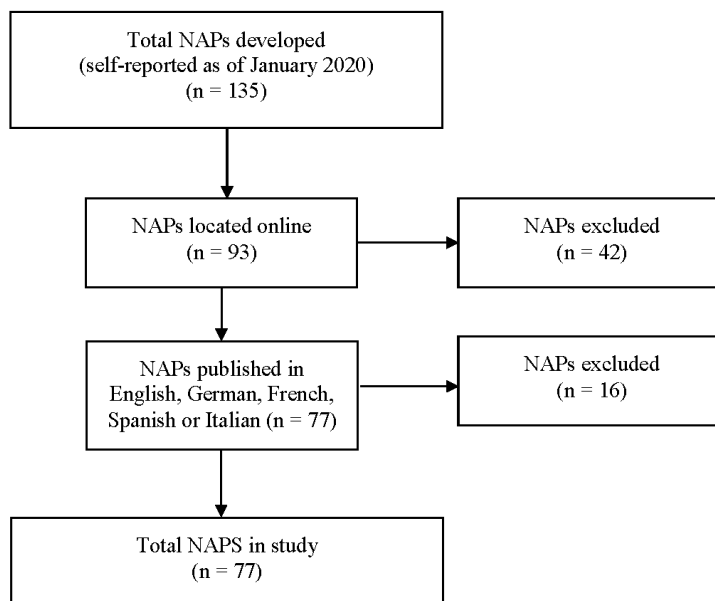
We used World Bank categories to divide countries into four income groups: low-income countries (LICs), lower-middle-income countries (LMICs), upper-middle-income countries (UMICs) and high-income countries (HICs) [18]. We applied the WHO's regional categories to study regional patterns: the African Region (AFRO), the South-East Asia Region (SEARO), the Western Pacific Region (WPRO), the Region of the Americas (PAHO), the Eastern Mediterranean Region (EMRO), and the European Region (EURO) [19]. All statistical tests in our study (independent samples t-test and Pearson correlation coefficients) are based on 95 % confidence levels ($p < 0.05$). The full dataset is provided in the Supplemental material available online).

Sampling

Our point of departure was the 135 NAPs developed as of January 2020 [20]. Of these, we obtained 93 NAPs by searching the WHO archive [21] and the latest self-reporting questionnaire to the Tripartite available through the Global Database for Antimicrobial Resistance Country Self-Assessment [15]. For linguistic reasons, we included only NAPs written in English, German, French, Spanish, and Italian (excluding 16 NAPs), as we were able to code those NAPs in their original

language. The resulting sample includes 77 NAPs: 11 from AFRO, 11 from SEARO, 12 from WPRO, nine from PAHO, 13 from EMRO, and 21 from EURO. In terms of income groups, the sample includes nine NAPs from LICs, 20 from LMICs, 20 from UMICs, and 28 from HICs. Figure 2 shows the selection process:

Figure 2: Diagram of NAPs selected for analysis



Findings

The findings of our content analysis are structured according to the four dimensions identified previously: (1) attention to the OH concept; (2) policies explicitly addressing the three overarching sectors; (3) reliance on the eight facilitative policy areas that strengthen the interface between the three sectors; and (4) the level of OH collaboration in AMR policy development and implementation.

1) Attention to the OH concept

Starting with the OH concept, seven of 77 NAPs have OH in their title (the NAPs of Denmark, Luxembourg, Malta, Philippines, South Africa, Zambia, and Zimbabwe). A content analysis of the attention to the OH concept reveals that the majority of NAPs in our sample explicitly mention the OH concept in their introduction (64 out of 77 NAPs), very often with reference to central documents published by the Tripartite. As an example, France's NAP describes its governing approach as 'an intersectoral and interministerial approach based on the "One Health" concept as advocated by the World Health Organization (WHO) and the World Organization for animal health (OIE)' [22]. Similarly, almost all NAPs mention the OH concept in their outline of specific policies and activities (59 out of 77 NAPs). 10 NAPs in our sample do not mention the OH concept at all: Burkina Faso, Cambodia, China, Colombia, Czech Republic, Iran, Mongolia, Serbia, Spain, and Turkmenistan. Importantly, the lack of mentions of the OH concept itself does not necessarily mean that the OH measures are missing in a given NAP. For example, the NAPs of Burkina Faso and Iran do define policies and activities related to the three sectors of human, animal, and environmental health. As such, OH is very much present in these two NAPs, although they do not mention the concept by name. In sum, we find that almost all NAPs in our sample mention the OH concept, and if not the concept then the three key sectors emphasized by the Tripartite, as will be further elaborated in the next section.

2) Policies relating to the three sectors of OH

Most NAPs contain policies related to the three central sectors of the OH approach. All 77 NAPs in our sample mention actions on human and animal health. Sixty-six of the 77 NAPs include policies that address environmental health. The few NAPs that do not present policies or actions regarding environmental health are regionally and economically diverse: Bhutan, Cambodia, Czech Republic,

Denmark, Korea, Macedonia, Mongolia, New Zealand, Saudi Arabia, Sri Lanka, and Turkmenistan. Several NAPs that refer to environmental health in their policy actions only do so cursorily. For example, Oman’s NAP specifies environmental health only one time as part of establishing a national surveillance system to share antimicrobial resistance data across human, animal, and environmental sectors [23]. Similarly, Nepal’s NAP mentions environmental health very briefly as part of its surveillance program and in its outline of research needs [24]. Hence, attention to the three sectors is generally high, but the analysis also suggests that the environmental sector receives less attention than human and animal health in AMR NAPs.

3) Policies relating to the eight facilitators of OH

Analyzing how much AMR NAPs address the facilitators of interaction between the OH sectors reveals a high degree of variation (see Table 1). Attention to the eight facilitators of interaction clusters into two distinct groups that are significantly different from each other. Attention to human health care, food production, hygiene, and agriculture in the NAPs is significantly higher than attention to aquaculture, waste management, sanitation, and clean water ($t(616) = 10.05$; $p < 0.000$).

Table 1: Percentage of NAPs with policies addressing each of the eight facilitators

Facilitators	%	Share
Human health care	100.0	77/77
Food production	96.1	74/77
Hygiene	89.6	69/77
Agriculture	88.3	68/77
Aquaculture	64.9	50/77
Waste management	63.6	49/77
Sanitation	61.0	47/77
Clean water	59.7	46/77

Comparing the World Bank's four categories of country income, LIC NAPs tend to focus most and HIC NAPs least on OH facilitators. Table 2 illustrates differences across income and regional groups using the index of facilitators described previously. On average, NAPs include policies that address about six facilitators (mean index score = 6.2). The HIC group has the lowest average (mean score = 5.6), and the LIC group has the highest average (mean score = 7.4). This difference between HICs and LICs is statistically significant ($t(32) = 3.79$; $p < 0.001$).

Unpacking the additive index into eight individual facilitators reveals further income group disparities. For example, all nine LIC NAPs include AMR policies on sanitation compared to fewer than half of HIC NAPs (11 out of 28 NAPs). Similarly, the vast majority of LIC NAPs (eight of nine NAPs) include waste management policies compared to fewer than half of HIC NAPs (12 out of 28 NAPs). The additive index for the eight facilitators also indicates differences across the WHO's six regions. NAPs in the AFRO region tend to address all facilitators (mean score of 7.6) and this regional attention to OH facilitators is significantly higher than in the two lowest scoring regions EURO and WPRO (with mean scores of 5.6 and 5.3, respectively) ($t(43) = 4.71$; $p < 0.000$). Disaggregating the additive measure also reveals interesting patterns where sanitation, aquaculture, and waste management exhibit differences across regions. In particular, NAPs in the EURO region rarely focus on these facilitators, while nearly all NAPs in the AFRO region focus on these facilitators: only eight out of 21 EURO NAPs mention sanitation in their outline of policies compared to ten out of 11 AFRO NAPs. An example of attention to sanitation is the NAP of Zimbabwe that presents concrete policies and activities on sanitation as part of all its strategic objectives (except on surveillance), including the holding of 'field days to promote good hygiene practices and sanitary measures' for human and animal health managers at community level under the NAP's strategic objective one (raising awareness and understanding of AMR) and the improvement of sanitation facilities for the population under the NAP's strategic objective three (infection prevention and control and biosecurity) [25].

Table 2: Mean scores of the additive index of facilitators across income and regional groups and mean scores of One Health self-reported collaboration

	<i>Additive Index Score</i>		<i>One Health Collaboration Score</i>	
	Mean	N	Mean	N
Income groups				
HIC	5.6	28	4.3	27
UMIC	6.3	20	3.4	20
LMIC	6.5	20	2.8	20
LIC	7.4	9	2.7	9
<i>Total</i>	<i>6.2</i>	<i>77</i>	<i>3.5</i>	<i>76</i>
Regional groups				
AFRO	7.6	11	2.7	11
PAHO	6.7	9	3.3	8
EMRO	6.6	13	3.2	13
SEARO	6.4	11	2.9	11
EURO	5.6	21	4.3	21
WPRO	5.3	12	3.6	12
<i>Total</i>	<i>6.2</i>	<i>77</i>	<i>3.5</i>	<i>76</i>

4) The level of OH collaboration in NAPs development and implementation

The Tripartite’s self-assessment survey measures OH collaboration using a the five-point scale of ascending collaborative efforts outlined previously. In the latest survey from 2019, only three of the member states in our sample reported no formal multi-sectoral governance or coordination mechanism on AMR (Mongolia, Indonesia, and Oman). Twenty-five member states reported the highest value, indicating they use integrated cross-sectoral approaches to implement their NAPs. Table 2 also portrays income and regional patterns based on the self-reported data on OH collaboration. The 77 NAPs we selected for analysis is a perfect subset of the 162 member states that participated in the latest self-assessment survey from 2019, with the exception of Barbados, that did not respond to the latest survey despite having adopted and made public a NAP on AMR.

As shown in Table 2 there are clear patterns across income groups and regions. EURO reports a mean OH collaboration score of 4.3, statistically different from the two lowest scoring regions of AFRO with a mean of 2.7 ($t(30) = 4.03$; $p < 0.000$) and SEARO with a mean of 2.9 ($t(30) = -3.2$; $p < 0.003$). In terms of income groups, a clear pattern also appears, of increasing OH collaboration as one moves from LICs to HICs. HICs with a mean of 4.3 is significantly different from all the other income groups combined ($t(74) = 4.81$; $p < 0.000$). The importance of income is supported by a bivariate correlation between income per capita and reported OH collaboration, that shows a significant medium effect of income per capita on the extent of OH collaboration: the richer the member state, the greater the extent of reported OH collaboration ($r = 0.5$; $n = 73$; $p < 0.000$). When comparing NAPs' attention to OH with the member states' self-reported multisectoral collaboration in AMR policy development and implementation, we found no significant empirical correlation between OH attention in the NAPs and the extent of the reported collaborative efforts in implementation ($r = -0.41$; $n = 76$; $p = 0.728$). Thus, the emphasis placed on the Tripartite's OH measures in the formal NAP documents does not appear to have an effect on the reported collaborative arrangements in actual implementation (and *vice-versa*).

Discussion

Our analysis of the 77 NAPs shows that most member states include OH as an important theme. More than 85 percent of NAPs in our sample present policies and actions addressing all three sectors (human, animal and environmental health) indicating that the multisectoral focus promoted by the Tripartite is widely applied. The analysis also suggests that environmental health receives less attention than human and animal health in AMR NAPs. This is consistent with the common finding

in the OH literature that the environmental health dimension tends to be overlooked in OH approaches [26–28]. The analysis further shows different levels of attention to the OH facilitators. Policies directed at monitoring and optimizing the use of antimicrobials in human health care, agricultural sectors, and in food production receive more attention than policies directed at waste management, water, sanitation, and antimicrobial use in aquaculture. This disparity is particularly evident for HICs in EURO and WPRO.

There are three obvious explanations for these differences across income and regional categories. First of all, lack of attention to some of the facilitators might simply be due to absence of the implicated activities in specific member states. The issue of antimicrobial use in aquaculture, for example, might not be relevant for nations with a negligible aquacultural industry. However, several of the NAPs that lack actions on aquaculture have been developed by member states with substantial aquacultural industries (including China, the United States, Canada, France, New Zealand, Germany, and Ireland) [29] meaning that it would be natural to consider AMR policies on aquaculture in the AMR NAPs produced by those countries. Secondly, differences in attention to OH facilitators can be ascribed the member states' overall state of health (including infectious disease burdens) combined with already existing policies and activities. The NAP, after all, is a strategic document highlighting future national actions for curbing AMR, over and above activities that already exist. From that perspective, HIC NAPs would rarely need to address water, sanitation, and waste management because effective national policies already exist. Indeed, these countries' NAPs tend to leave out those areas. Sanitation is primarily of relevance as an underserved policy area for LICs and LMICs. Some of the HIC NAPs that do address sanitation refer only to interventions in 'low-income, rural and remote settings' [30] or as part of external aid activities in LICs and LMICs [31,32]. Also, several member states do refer to other national policy documents in their NAPs to emphasize that many activities relevant for mitigation of AMR are carried out as part of already existing policy programmes

(for example, the NAP of Norway includes an appendix with references to central policies that make up the ‘national systems for monitoring antibiotic resistance’ [33]). Finally, the high level of OH attention in NAPs from LICs and LMICs is also likely a result of the Tripartite having acted as adviser and, in some cases, facilitator of the process with developing NAPs in LIC and LMIC settings. Further studies need to be conducted, however, to account for the noticeably higher attention to OH in NAPs from LICs and LMICs.

Comparing attention in NAPs to the Tripartite’s OH measures with the member states’ self-reported multisectoral collaboration suggests a discrepancy between high levels of OH attention in the NAPs and lower levels of reported OH collaboration. This could indicate *isomorphic mimicry*, meaning that policy documents might reflect best practices without those practices being implemented as designed [34–36]. Previous studies have shown that mimicking behavior is particularly pronounced in LICs and LMICs as these countries often experience lack of resources, expertise and basic infrastructure, or are faced with conflicting political concerns, such as limited access to effective medicines and health care [37–39]. Our analysis shows that LICs and LMICs are more likely to adhere to the Tripartite’s OH guidelines in their NAPs but less likely to report on OH collaboration in implementation. Hence, our results are consistent with isomorphic mimicry having influence on some countries’ degree of attention to OH in their NAPs. Paying attention in AMR NAPs to the OH measures outlined by the Tripartite is arguably just a first step toward actual OH policy-making. While several tools and metrics have been advanced to help regulate national AMR initiatives based on the OH approach (see for example, [40]), more research is required at the national level to chart and explain implementation difficulties. One way to strengthen global AMR stewardship is to establish a mixed global governance regime with legally binding provisions combined with NAPs tailored to the specific needs and capacities of individual member states [6,7,9,40]. For example, member states could be legally bound to regularly report on OH initiatives

on AMR and to facilitate third-party verification processes. This would not only strengthen OH commitment in both strategic documents and policy implementation, but also form an important first step towards an international legal framework for mitigating AMR following an OH perspective.

Conclusion

This study has explored the extent to which policies and strategies in AMR NAPs focus on OH measures outlined by the Tripartite. We emphasize that a full-fledged OH approach needs to go beyond a focus of attention to a specific set of sectors and facilitators in a strategic policy document to also address mechanisms for learning, systemic organization, interdisciplinarity, integration of practices, knowledge, and so forth. Ideally, OH should function as an “injunction to join up areas of expertise and practice, which have for too long existed in separate silos” [41]. Gaining an overview of adherence to OH guidelines promoted by the Tripartite across many NAPs provides a useful account of OH attention across policy areas, discerning regional and income patterns. The findings could be a first step in a mixed methods or nested approach as a case selection tool to identify interesting individual NAPs or regional patterns that merit more in-depth qualitative analysis. Thus, the findings presented need not be the end-goal. We have shown how the findings can be triangulated with other indicators, in this case with self-reported data on OH collaboration, to reveal new insights. This exercise has helped us to identify a discrepancy between attention to OH measures in the policy document and then in OH collaboration. This suggests some characteristics of isomorphic mimicry in the NAPs. Future studies are needed to understand why some countries are more successful in applying OH when mitigating AMR. As more NAPs are moving to the phase of implementation, this study’s findings can inspire similar types of cross-country studies to provide a more comprehensive and multifaceted perspective on the degree of “OH-ness” [42] in the field of global AMR stewardship.

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