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Summary

Background Understanding strategic commitments and policy responses to overcome antimicrobial resistance at the national, regional, and global levels is required to evaluate current progress and direct future planning. National action plans (NAPs) are the primary mechanism for guiding national strategy and action for antimicrobial resistance governance. Although several NAPs have been developed, no comprehensive content analysis of these plans exists. Using a governance framework, we aimed to assess all publicly available NAPs on antimicrobial resistance.

Methods We systematically reviewed the contents of NAPs on antimicrobial resistance from 114 countries, applying a governance framework containing 18 domains and 54 indicators in three integral areas: policy design, implementation tools, and monitoring and evaluation. As well as manually searching NAPs and doing online and literature searches that were relevant to specific indicators from repository inception to June 1, 2022, several data sources were used to generate scores, including the Tripartite Antimicrobial Resistance Country Self-Assessment Survey, the Global Antimicrobial Resistance and Use Surveillance System, the Global Antimicrobial Resistance Research and Development Hub, and various WHO datasets. NAPs were included if the country had also submitted the NAP to the Tripartite Antimicrobial Resistance Country Self-Assessment Survey 2020–21, if the NAP was retrievable through a publicly accessible database or website, and if the NAP was either published in English or eligible for machine translation. Three researchers independently reviewed each NAP and were initially blinded to the evaluations of other researchers. They generated a score using a quantification system for each of 54 indicators. The Cochrane protocol for ensuring reliability was followed. The three researchers were then unblinded and met to resolve any disagreements in scoring to reach a consensus agreement. In each case of discrepancy, consensus was reached between the researchers. We developed criteria to standardise the process of quantifying each indicator. We also weighted and collated relevant national data from various sources to generate composite scores concordant with the key governance areas. We transformed these data to a scale of 0 (worst) to 100 (best), ranked countries on the basis of their mean scores, and used descriptive statistics to analyse global and regional trends.

Findings 306 NAPs were identified and 114 were eligible for analysis. Between 2020 and 2021, the mean antimicrobial resistance governance score was 51 (SD 14). Norway had the highest governance score (mean 85 [SD 32]), and the Federated States of Micronesia had the lowest governance score (28 [37]). The highest scoring domain was participation (83 [16]), and the lowest scoring domains were accountability (30 [18]) and feedback mechanism (30 [25]). Domains relating to policy design (55 [13]) and implementation tools (54 [17]) scored similarly, whereas monitoring and evaluation (38 [20]) efforts were lower.

Interpretation International efforts to control antimicrobial resistance varied considerably between countries. Monitoring and evaluation efforts need improving for continuous understanding of national and international progress. International response might not be commensurate with the scale and severity of antimicrobial resistance.

Funding None.

Introduction

Antimicrobial resistance is a substantial challenge for global public health in the 21st century. Research efforts have quantified the magnitude of the health and economic effects of antimicrobial resistance, which suggests that the global response might not be commensurate with its current and predicted burden. Estimates from the Institute for Health Metrics and Evaluation show that 1·27 million deaths (95% uncertainty interval 0·91–1·71) were directly attributable to drug-resistant infections in 2019, with the highest mortality rates in sub-Saharan Africa and south Asia.[1] Even when being optimistic, the cost of a relaxed international response to antimicrobial resistance could result in an annual loss in economic output of 1·1% of global gross domestic product by 2050, with the cost of inaction increasing to 3·8% annually.[2]

To encourage action on antimicrobial resistance, the 68th World Health Assembly endorsed the Global Action Plan (GAP) on antimicrobial resistance in 2015, which focused on five objectives: improving awareness through

Research in context

Evidence before this study

Measuring the global response to antimicrobial resistance at the national, regional, and global levels is one of four priority areas by WHO. Only the Tripartite Antimicrobial Resistance Country Self-Assessment Survey—developed and administered by WHO, the World Organisation for Animal Health, and the Food and Agriculture Organization—provides a multinational review of country progress on antimicrobial resistance. However, these datasets do not measure the breadth of areas implicated in responding to antimicrobial resistance and do not readily facilitate national or regional comparison due to variable scoring methods. Despite identification of the research need in antimicrobial resistance monitoring and evaluation by prominent organisations, such as WHO, the World Bank, and various governments, there is an absence of research comprehensively evaluating the responses to antimicrobial resistance and of studies providing detailed content analyses of national action plans (NAPs) in various countries. We searched Google Scholar, PubMed, MEDLINE, and Web of Science for articles related to antimicrobial resistance, governance, policy responses, and national action plans published between Jan 1, 2000, and June 1, 2022, without any language restrictions. We used the search terms "antimicrobial resistance" OR "antibiotic resistance" OR "drug resistance" OR "drug-resistant infection*" OR "AMR", "govern*" OR "policy" OR "respon*" OR "monitor*" OR "progress", and "national action" OR "national action plan" OR "NAP". Several studies assessed governance of antimicrobial resistance NAPs. However, they were either focused on individual countries, groups of countries, or regions or exclusively assessed only a few specific aspects of antimicrobial resistance governance. To date, no comprehensive global study of antimicrobial resistance governance has been done.

Added value of this study

To our knowledge, this study is the first to comprehensively assess international antimicrobial resistance governance efforts and NAPs and generate quantitative results that can be compared across countries encompassing many countries and regions by use of a governance framework. Findings from this research add value in at least four ways: as a cross-sectional baseline assessment for monitoring future progress at the global, regional, and national levels; as an accountability mechanism, showing shortcomings in national commitments and political action; to guide the development of NAPs or to identify areas for improvement in subsequent NAP versions after the expiry of validity periods; and to encourage debate around the necessary components of optimal antimicrobial resistance governance practices.

Implications of all the available evidence

Our results show substantial variability in the strategic responses to antimicrobial resistance of 114 countries and highlight the need to improve relevant governance and policy responses in all locations. We show, with detailed granularity, specific areas for each country to improve their response to one of the greatest global health threats of the 21st century. These data suggest that the international response, including efforts to monitor and evaluate interventions, might not be commensurate with the scale and severity of antimicrobial resistance. The indication that current policies might not be proportional to the magnitude of antimicrobial resistance is particularly concerning in low-income and middle-income countries, where activities identified in NAPs often lack sustainable domestic financing for operationalisation, instead relying on funds from foreign donors and philanthropies with specific terms. The available evidence also suggests that simply developing a NAP might not necessarily make a country prepared to respond to the threat of antimicrobial resistance. Further research is required to understand whether the quality and comprehensiveness of the contents of NAPs affect national progress by evaluating, for example, the association between NAP implementation and important metrics that are pertinent to antimicrobial resistance.

education and training, increasing intelligence through surveillance and research, preventing infections and improving sanitation, optimising antimicrobial use, and developing the economic case for sustainable investment.[3] 194 WHO member states committed to developing multisectoral national action plans (NAPs) on antimicrobial resistance within 2 years (by the 70th World Health Assembly in 2017), supporting the main objectives of the GAP and guided by a One Health approach—a unifying concept recognising the interdependence of human, animal, and environmental health. 2 years after the implementation of the GAP, 79 (41%) member states had developed a NAP, with a further 50 (26%) in development.[4] In 2020–21, 148 (76%) plans had reportedly been finalised, including some countries operationalising a second version.[5]

Monitoring the antimicrobial resistance burden and global antimicrobial resistance response is one of four strategic priorities on antimicrobial resistance established by WHO.[6] Although the burden of antimicrobial resistance has been quantified and recognised by several countries, few comprehensive measures of global progress on antimicrobial resistance exist. Efforts to evaluate the contents of antimicrobial resistance NAPs have been limited to either individual countries,[7,8] specific regions,[9–11] specific countries with similar economic context,[12] or a few specific thematic areas.[13–15]

Of these studies, several have operationalised a governance framework, developed through systematic review and expert consultation, allowing for detailed assessment of NAPs on antimicrobial resistance at the

country level.[16] Comprehensive analyses of NAPs for other health priorities exist more abundantly than NAPs for antimicrobial resistance in the literature, such as those for national cancer control plans.[17–20] Because of the urgency of the antimicrobial resistance crisis and the compounding effects it has on health and the economy, monitoring and evaluating the strategic responses from countries is a clear and pressing priority. As attempts to characterise the effects of the COVID-19 pandemic on drug-resistant infections occur,[21] a baseline assessment could also enable characterisation of the effects of COVID-19 on antimicrobial resistance governance efforts in future studies.

This study aimed to operationalise and apply a governance framework for a global characterisation of all publicly available antimicrobial resistance NAPs.

Methods

Search strategy and selection criteria

For this systematic governance analysis, five repositories were searched from database inception to June 1, 2022, to identify antimicrobial resistance NAPs: WHO, FDI World Dental Federation, European Centre for Disease Prevention and Control, Food and Agriculture Organization of the UN, and Action on Antibiotic Resistance (appendix pp 48–60). Additional manual searching with Google and government websites provided two additional NAPs that were included (appendix pp 62–65). Searches included a combination of the terms "antimicrobial resistance", "antibiotic resistance", "AMR", "national", "action", "plan", "NAP", "strategy", and "policy" alongside individual country names. Since 2009, WHO has acknowledged the interchangeable use of the terms, "policy", "strategy", and "plan".[22] Only the most recent publicly available version of the plan was eligible for inclusion. We used Google Neural Machine Translation software to convert the contents of 41 native language NAPs to English, except Armenian for which translation was not possible.

See Online for appendix

Inclusion criteria for assessment were country inclusion in the WHO Tripartite Antimicrobial Resistance Country Self-Assessment Survey (TrACSS) 2020–21,[23] retrieval through a publicly accessible database or website, and either published in English or eligible for machine translation. Furthermore, documents had to be NAPs on antimicrobial resistance, not any other type of document. Duplicates were manually removed by two researchers (JP and AH). The full list of countries and their analysed plans are detailed in the appendix (pp 49–61). TrACSS provides an annual understanding of international efforts to monitor and evaluate progress on managing antimicrobial resistance internationally.[23] Reliance on data only from TrACSS would provide insights that are not necessarily concordant with important antimicrobial resistance governance areas, which is why we did detailed content analysis of 114 NAPs.

Governance framework and indicator quantification

We used a governance framework devised by Anderson and colleagues[16] designed to assess antimicrobial resistance NAPs, which consists of 53 indicators pertaining to 18 domains around three main areas that are relevant to global health governance in a cyclical design: policy design, implementation tools, and monitoring and evaluation (appendix pp 3–5).

Although the framework was designed to facilitate the universal application of a binary assessment system to score each of 53 indicators, we identified issues with the appropriateness of this method. First, the proposed binary system risks generating superficial insights that do not include the multisectoral complexities of antimicrobial resistance. Second, because of the weight of each score, the ability to formulate meaningful comparisons between countries is restricted and could lead to misleading conclusions. Of the few initiatives that exist to track country progress on antimicrobial resistance, progress is typically evaluated at a more granular level than binary assessment allows, enabling detailed insights to be captured in a graded scoring system.

Considering these limitations with the suggested method, two researchers (JP and AH) reviewed various data sources and compared them with the framework to identify relevant commonalities. We then developed a system of assigning a numerical score for each indicator, applying the binary scoring system to only 12 indicators (appendix pp 6–47). We separated an indicator pertaining to accountability into two components (ie, PD4.2 and PD4.3) for more detailed assessment, increasing the total number of indicators to 54. To facilitate a comprehensive assessment of often multisectoral country activities on antimicrobial resistance, we also curated 26 composite indicator scores combined with insights drawn from manually screening NAPs, TrACSS, the Global Antimicrobial Resistance and Use Surveillance System (GLASS), the Global Antimicrobial Resistance Research and Development Hub, the WHO 2018 South-East Asia Region Situational Analysis, and the WHO 2020 Immunization Dashboard (appendix pp 6–47). Some indicators could not be scored with databases or the scientific literature, such as PD5.2, PD5.3, PD6.2, and ME4.2. In these cases, an online search was done with words that were specific to the indicator (eg, to locate publicly available progress reports for individual countries). Google Neural Machine Translation software was used to locate relevant information available in native languages.

Data extraction and analysis

Three researchers (JP, AH, and GF) were masked to the evaluations of other researchers and independently reviewed each NAP, generating a score using a quantification system developed by the authors for each of the 54 indicators. The research team consolidated all country scores into a single Microsoft Excel

	Indicator	Mean (SD)	Highest scoring country (score)	Lowest scoring country (score)	Rank	Source
Policy design		54·5 (13·2)	UK (84·7)	Mongolia (28·4)	1	
Domain 1	Strategic vision	58·4 (22·1)	France and the USA (96·9)	Cuba (17·2)	7	
PD1.1	Has national situational analysis been done to establish the prevalence and incidence of antimicrobial resistance organisms?				26	GLASS and TrACSS
PD1.2	What is the status on NAP development or implementation?				10	TrACSS
PD1.3	Are the NAP objectives specific, measurable, and time-bound?				15	NAPs
PD1.4	Are quantitative targets for antimicrobial resistance or antimicrobial use outlined in the NAP?				38	NAPs
Domain 2	Coordination	62·9 (26·3)	Various (100·0)	Libya and Poland (8·3)	4	
PD2.1	Is coordination between sectors and between different levels of each sector considered?				17	TrACSS
PD2.2	Is there a ministry or intersectoral committee responsible for coordination and implementation?				20	TrACSS
Domain 3	Participation	82·6 (16·1)	Various (100·0)	Mongolia (22·2)	1	
PD3.1	Was substantial stakeholder participation facilitated throughout the development of the NAP?				9	TrACSS
PD3.2	Are the activities in the NAP inclusive of all One Health sectors?				8	TrACSS
PD3.3	Was there support from a technical advisory group or subject matter experts during development of the NAP?				3	NAPs
Domain 4	Accountability	30·3 (17·6)	Peru and Switzerland (83·3)	Various (0·0)	17	
PD4.1	Is there a ministry, intersectoral committee, or both responsible for NAP coordination and implementation that is accountable to the government?				31	TrACSS
PD4.2	Is a responsible person nominated in each sector?				35	NAPs
PD4.3	Do agreements exist regarding what happens if objectives are not met?				53	NAPs
Domain 5	Transparency	60·9 (19·0)	Burkina Faso, Denmark, and Peru (83·3)	Various (25·0)	6	
PD5.1	Is the complete NAP publicly available?				1	NAPs
PD5.2	Are all progress reports publicly available?				21	NAPs
PD5.3	Is all funding information publicly available?				33	NAPs
PD5.4	Are all antimicrobial resistance and antimicrobial use surveillance data publicly available?				37	GLASS
Domain 6	Sustainability	43·3 (16·8)	Australia, Denmark, Germany, and UK (75·0)	Oman (8·3)	9	
PD6.1	Is there a written mandate or voluntary agreement from all relevant sectors to implement the NAP?				14	TrACSS
PD6.2	Are there dedicated budgets in place to implement specific activities in the NAP?				40	NAPs
PD6.3	Is there an assessment of future budget requirements for different activities listed in the NAP?				54	NAPs
PD6.4	Is there ongoing technical support during implementation, monitoring, and evaluation of the NAP?				18	TrACSS
Domain 7	Equity	34·2 (37·8)	Various (100·0)	Various (0·0)	15	
PD7.1	Does the NAP encourage responsible use of and equitable access to existing essential antimicrobials?				41	NAPs

(Figure 1 continues on next page)

(version 16.68) spreadsheet and mapped these against the framework indicators and domains. We followed the Cochrane protocol for ensuring reliability;[24] the researchers were then unmasked and met to resolve any disagreements in scoring to reach a consensus agreement. In each case of discrepancy, consensus was reached between the researchers. We then used descriptive analyses in Microsoft Excel to characterise the spatial trends.

Overall country scores were established by calculating the mean average of all governance areas. Composite scores for each governance area were generated by calculating the mean value of each domain. To aggregate indicator scores for domains and governance areas, we transformed values

	Indicator	Mean (SD)	Highest scoring country (score)	Lowest scoring country (score)	Rank	Source
Implementation tools		54 (16·9)	Norway (92·1)	Federated States of Micronesia (16)	2	
Domain 1	Surveillance	56·7 (25·4)	Iceland, Norway, and Sweden (100·0)	Libya (0·0)	8	
IT1.1	Is there a national surveillance system for resistant organisms for all sectors?				32	TrACSS
IT1.2	Is there a national surveillance system for antimicrobial use in animals and humans?				24	TrACSS
IT1.3	Is there adequate laboratory capacity supported by regular external quality assessments?				12	TrACSS
Domain 2	Antimicrobial stewardship	60·9 (22·0)	Norway (100·0)	Federated States of Micronesia and Sierra Leone (11·7)	5	
IT2.1	Are there stewardship programmes in all human and animal health sectors?				28	TrACSS
IT2.2	Are rapid diagnostic tools widely available and in regular use?				25	TrACSS
IT2.3	Do national guidelines regarding the indication and interpretation of rapid diagnostic tools exist?				29	TrACSS
IT2.4	Are there national guidelines on antimicrobial use and rapid diagnostic tools for both animal and human health?				16	TrACSS
IT2.5	Are there incentives or penalties in animal and human health to reduce inappropriate use of antibiotics?				4	TrACSS
Domain 3	Infection prevention and control	73·0 (16·8)	Belgium (100·0)	Cameroon, Libya, and Poland (35·4)	2	
IT3.1	Are there IPC policies for all sectors?				23	TrACSS
IT3.2	Are there up-to-date national guidelines for IPC for all sectors?				11	TrACSS
IT3.3	Are immunisation programmes used to prevent infections in all human and animal health sectors?				6	WHO
IT3.4	Are financial and non-financial incentives or penalties for IPC policies used in all sectors?				7	TrACSS
Domain 4	Education	31·8 (15·6)	Greece (69·4)	Montenegro (2·8)	16	
IT4.1	Are there certifications or programmes to ensure a basic education for professionals to provide a necessary understanding for strategies to address antimicrobial resistance?				32	TrACSS
IT4.2	Are there continuing education programmes for professionals to increase knowledge and sustain efforts on antimicrobial resistance?				24	TrACSS
IT4.3	Is there a strategy that aims to deliver the sustainable supply of workforce required to establish antimicrobial stewardship and IPC policies?				12	TrACSS
Domain 5	Public awareness	40·0 (27·0)	Netherlands and Norway (97·6)	Papua New Guinea (4·8)	12	
IT5.1	Are there multimodal public awareness campaigns and educational programmes related to antimicrobial resistance?				22	TrACSS
IT5.2	Are the public awareness campaigns continual?				27	TrACSS
IT5.3	Do the public awareness campaigns consider aspects of behavioural and social science?				51	TrACSS
Domain 6	Medicines regulation	65·2 (21·2)	Various (100·0)	Cambodia, Cameroon, Egypt, and Federated States of Micronesia (0·0)	3	
IT6.1	Are there regulations to ensure appropriate use of antimicrobials in human health?				2	TrACSS
IT6.2	Are there regulations to ensure appropriate use of antimicrobials in animal health?				5	TrACSS
IT6.3	Is there an authority to monitor and enforce legislation on antimicrobial use in human and animal health sectors?				50	TrACSS

(Figure 1 continues on next page)

onto a scale from 0 (worst) to 100 (best), an approach commonly adopted to curate composite indices.[25] As each indicator and domain had equal significance in the antimicrobial resistance governance framework, we decided that the aggregation of scores at all levels (ie, indicators, domains, and governance areas) should be scaled as variables of equal weight, guiding our approach to provide equally weighted arithmetic mean values and their SDs. Assigning individual weights heterogeneously could be useful for future studies, but the development of an unbiased framework would be resource intensive because of the broadness of the data sources required. We

	Indicator	Mean (SD)	Highest scoring country (score)	Lowest scoring country (score)	Rank	Source
Domain 7	Research and development and market access to novel products	36·4 (33·9)	Various (100·0)	Various (0·0)	14	
IT7.1	Is encouraging research and development and facilitating market access to novel agents in human and animal health a priority in the NAP?				34	NAPs
IT7.2	Does the NAP consider how the country can contribute to research and development of novel agents at both a national and international level?				44	NAPs
IT7.3	Is there a dedicated national budget for the research and development of novel agents?				42	Global Antimicrobial Resistance Research and Development Hub
Monitoring and evaluation		38·0 (20·2)	Australia (88·9)	Ukraine (0·0)	3	
Domain 1	Reporting	42·6 (27·2)	Denmark (100·0)	Various (0·0)	10	
ME1.1	Are annual antimicrobial resistance NAPs progress reports published?				48	NAPs
ME1.2	Are annual surveillance reports containing data regarding the incidence of resistant organisms and antimicrobial use published?				46	TrACSS
ME1.3	Is there collaboration with and systematic data transmission to international surveillance systems?				13	GLASS
Domain 2	Feedback mechanisms	30·3 (24·9)	Belgium (91·7)	Various (0·0)	18	
ME2.1	Are there feedback mechanisms that receive and provide data at both regional and organisational levels?				47	TrACSS
ME2.2	Are there regular deadlines to review the progress of actions within the NAP, and arrangements to feed back at both regional and organisational levels?				45	TrACSS
Domain 3	Effectiveness	41·7 (38·2)	Various (100·0)	Various (0·0)	11	
ME3.1	Have there been efforts to evaluate the effectiveness of specific policies or interventions?				19	NAPs
ME3.2	Have efforts been made to evaluate the cost-effectiveness of specific policies or interventions?				49	NAPs
Domain 4	Antimicrobial resistance research	35·5 (31·9)	Various (100·0)	Various (0·0)	13	
ME4.1	Is research to understand the drivers and effect of antimicrobial resistance and potential policies identified as a priority in the NAP?				39	WHO and NAPs
ME4.2	Is there a dedicated national budget for antimicrobial resistance research?				43	NAPs

Figure 1: **Summary of indicators and scores of domains and governance areas, 2020–21**
Ranking based on mean global scores are provided for three governance areas, 18 domains, and 54 indicators. All sectors=human, animal, and environmental sectors. GLASS=Global Antimicrobial Resistance and Use Surveillance System. IPC=infection prevention and control. IT=implementation tools. ME=monitoring and evaluation. NAP=national action plan. Novel agents=novel antimicrobials, diagnostics, vaccines, and alternative treatments. PD=policy design. TrACSS=Tripartite Antimicrobial Resistance Country Self-Assessment Survey 2020–21. Various=five or more countries had the same score.

discourage overinterpretation of the absolute value of scores, and encourage readers to appraise the national and regional scores in relative and comparative terms and as a barometer for areas of strengths and weaknesses.

We created world heat maps for each domain, governance area, and overall antimicrobial resistance governance to show the extent of antimicrobial resistance governance efforts by world region and in several prominent geopolitical blocs.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

Of the 306 NAPs identified through systematic literature searches, after removal of 161 duplicates, 145 were screened by title and 31 (21%) were excluded on the basis that the plan was not the most recent version (n=24), an incorrect type (n=6), or not translatable (n=1). 114 NAPs were eligible for content analysis (appendix p 48). The research team reviewed 114 NAPs and analysed indicators for 114 countries, which provided 6156 scores on the basis of 15 732 input datapoints in the TrACSS between 2020 and 2021. As well as manually searching NAPs, five data sources were used to generate scores (figure 1): TrACSS, the Global Antimicrobial Resistance and Use Surveillance System (GLASS), the Global Antimicrobial Resistance Research and Development Hub, the WHO 2018 South-East Asia Region Situational Analysis, and the WHO 2020 Immunization Dashboard (appendix p 5).

Antimicrobial resistance governance scores were normally distributed. In this cross-sectional analysis, our results show that overall country governance scores of

		Policy design										Implementation tools							Monitoring and evaluation			
	Governance score	Policy design	Implementation tools	Monitoring and evaluation	Strategic vision	Coordination	Participation	Accountability	Transparency	Sustainability	Equity	Surveillance	Antimicrobial stewardship	Infection prevention and control	Education	Public awareness	Medicines regulation	Research and development for novel products	Reporting	Feedback mechanism	Effectiveness	Antimicrobial resistance research
Norway	85	76	92	87	72	100	100	50	88	50	100	100	100	81	64	98	100	100	83	67	100	100
USA	84	83	85	83	97	96	94	50	88	72	100	86	81	96	64	90	75	100	83	50	100	100
UK	83	85	80	88	95	100	100	50	88	75	100	99	70	94	42	58	100	100	96	50	100	100
Sweden	78	69	87	76	72	96	94	50	88	47	0	100	91	73	56	93	100	100	83	17	100	100
Denmark	76	85	75	57	94	100	100	67	100	75	0	83	83	81	64	93	83	33	100	58	0	50
Germany	76	74	79	69	39	100	100	50	88	75	100	96	80	77	47	56	100	100	92	33	50	88
Japan	75	67	84	71	93	96	89	50	63	45	0	81	83	96	44	93	92	100	92	33	100	50
Australia	75	76	70	89	60	100	100	50	88	75	50	75	57	94	42	56	67	100	83	75	100	100
Switzerland	75	79	71	74	72	100	94	83	88	74	0	80	74	75	42	56	83	83	96	50	100	38
France	74	73	82	55	97	92	72	50	88	39	100	86	93	92	61	79	83	67	83	33	50	38
Malaysia	73	66	85	60	70	96	94	50	63	47	50	99	99	92	64	95	83	50	83	83	50	13
South Korea	73	72	73	71	91	100	100	50	63	50	50	83	92	96	28	63	67	67	54	75	100	63
Thailand	72	72	69	80	89	100	100	50	63	50	50	92	78	94	42	88	75	0	83	83	50	100
Netherlands	71	63	88	48	41	96	94	50	88	47	0	92	91	98	47	98	83	100	79	33	0	63
Philippines	71	76	68	71	81	96	83	50	75	69	100	64	79	85	28	54	67	83	38	75	100	88
Spain	71	61	82	64	67	69	83	56	75	37	0	93	93	88	47	90	75	83	67	50	100	38
Austria	70	64	86	43	64	100	100	50	63	50	0	95	88	88	61	95	92	83	92	42	0	13
Ireland	69	77	62	72	88	77	89	39	88	67	100	87	53	96	42	14	67	67	83	50	100	50
Singapore	66	58	68	79	45	96	89	50	63	45	0	85	76	85	25	58	50	83	92	17	100	100
Greece	65	63	74	46	33	96	89	50	75	70	0	83	88	88	69	56	83	33	58	58	0	63
Italy	65	66	66	59	95	63	94	28	88	43	0	74	83	81	42	54	75	33	96	58	50	13
China	64	61	80	27	86	100	83	33	50	46	0	82	90	79	28	83	92	100	42	33	0	25
Belgium	63	62	68	51	38	100	100	50	75	50	0	84	73	100	47	26	100	33	83	92	0	13
Latvia	63	52	72	62	59	35	83	17	75	46	0	84	74	92	42	51	75	83	38	33	100	88
Peru	61	80	46	57	88	92	78	83	100	65	0	23	38	75	33	12	67	67	54	0	100	75
Croatia	60	65	65	38	91	73	78	39	63	63	0	67	90	88	22	14	67	83	50	33	0	63
Tanzania	59	70	55	45	79	69	83	39	75	62	100	59	80	71	31	56	67	0	33	42	50	63
Zimbabwe	59	62	62	45	52	63	100	28	63	69	50	36	65	83	33	58	67	83	33	42	50	63
Canada	58	47	65	63	31	40	94	17	88	26	0	61	71	73	39	26	92	83	71	75	0	100
Ghana	57	71	46	57	81	77	89	39	75	67	50	38	43	65	22	49	33	67	38	0	100	100
Portugal	57	49	73	36	30	77	89	39	50	42	0	90	90	92	47	56	83	33	63	67	0	0
Saudi Arabia	57	73	47	46	64	96	89	50	75	70	100	46	39	83	28	61	67	0	38	25	50	75
Slovenia	57	55	67	35	51	54	89	28	63	62	0	89	79	79	42	17	83	67	17	8	50	75
Mozambique	57	61	55	54	59	63	100	44	50	44	100	60	82	92	28	29	67	0	42	67	100	13
Iran	57	53	64	44	88	54	78	28	50	35	0	87	68	96	53	17	67	50	46	67	50	13
Finland	56	54	65	38	39	81	100	39	50	47	0	93	90	83	47	19	100	0	58	58	0	25
Iceland	56	54	66	32	44	96	94	33	50	47	0	100	85	69	19	58	83	33	67	33	0	13
Uganda	56	66	53	39	83	50	78	28	75	58	100	61	62	56	25	14	67	83	33	0	50	75
Estonia	56	50	61	56	72	44	67	17	50	54	0	77	87	63	64	19	67	33	38	33	100	63
Liberia	56	62	57	38	75	44	100	17	75	54	50	29	64	92	22	58	67	50	33	8	50	63
Bahrain	55	67	50	41	70	77	94	39	63	69	50	42	36	79	19	54	67	50	38	17	50	63
Mexico	55	50	63	44	80	58	89	11	38	40	0	64	71	88	11	54	75	67	4	67	100	25
Malawi	55	77	39	44	77	96	94	50	75	72	100	40	27	75	6	20	33	67	33	25	50	75
Russia	55	53	64	33	68	96	56	50	38	45	0	63	64	81	31	88	67	50	46	67	0	13
Nigeria	55	66	52	36	87	77	94	39	63	44	50	54	42	54	47	88	33	50	50	25	50	13

(Figure 2 continues on next page)

					Policy design							Implementation tools							Monitoring and evaluation			
	Governance score	Policy design	Implementation tools	Monitoring and evaluation	Strategic vision	Coordination	Participation	Accountability	Transparency	Sustainability	Equity	Surveillance	Antimicrobial stewardship	Infection prevention and control	Education	Public awareness	Medicines regulation	R esearch and development for novel products	Reporting	Feedback mechanism	Effectiveness	Antimicrobial resistance research
Morocco	54	61	56	36	36	77	94	39	75	69	0	51	87	58	56	26	92	0	54	67	0	13
Burkina Faso	54	63	54	35	67	44	100	17	100	54	0	48	61	75	47	51	67	17	63	0	0	63
Zambia	54	55	57	42	58	31	78	17	75	42	100	52	73	77	33	17	83	50	33	25	50	63
Myanmar	53	62	49	44	60	81	100	39	63	47	50	42	42	85	28	56	33	50	58	25	50	38
Jordan	53	65	49	37	90	40	94	33	75	51	50	62	56	65	28	54	67	0	42	42	0	63
Indonesia	53	53	61	29	69	40	89	17	63	24	100	62	61	90	25	49	83	50	38	50	0	25
Timor-Leste	52	56	51	49	55	63	78	28	75	39	50	53	35	73	19	61	67	50	50	33	100	13
Ethiopia	51	52	60	25	35	77	89	39	50	42	50	70	73	88	53	56	67	0	38	42	0	13
North Korea	51	50	55	44	50	77	89	39	38	42	0	47	66	79	39	19	67	50	33	83	50	13
India	51	48	52	53	60	54	67	28	50	32	50	44	52	60	39	14	67	83	38	8	100	75
Sri Lanka	51	52	51	44	54	44	94	17	63	28	100	57	59	73	25	17	67	50	50	0	100	25
Kenya	51	47	61	30	66	50	61	28	50	28	50	73	82	85	42	56	67	0	38	17	50	13
Laos	50	50	53	43	81	40	72	17	50	20	100	32	83	71	22	19	67	50	38	0	100	38
Colombia	49	52	55	25	40	100	94	33	38	49	0	62	60	90	42	49	67	0	13	83	0	13
Slovakia	49	46	62	19	84	54	72	11	38	33	0	54	90	65	47	58	67	33	0	33	50	0
Madagascar	49	55	44	44	50	44	100	17	75	54	0	26	46	85	6	17	67	50	33	25	50	75
Serbia	48	54	55	18	78	58	89	28	50	40	0	40	60	73	31	54	67	50	0	17	50	13
Iraq	48	69	37	27	59	92	89	50	75	68	50	49	48	73	8	14	50	0	38	42	0	25
Cuba	48	49	62	11	17	100	100	33	38	50	0	68	66	94	47	58	83	0	17	25	0	0
Lithuania	47	36	62	36	22	40	50	17	63	23	50	82	78	69	64	58	67	0	71	42	0	13
Eswatini	47	49	54	24	76	63	100	11	25	44	0	51	75	75	39	17	67	33	0	33	50	25
Czech Republic	47	37	64	27	33	40	89	17	38	24	0	93	80	83	28	19	92	33	58	33	0	0
Luxembourg	47	55	46	31	37	96	83	50	50	44	50	28	78	50	22	51	67	0	42	17	50	13
North Macedonia	46	47	56	19	64	54	72	28	50	33	0	75	59	65	25	88	75	0	50	8	0	0
Chile	46	51	53	14	32	96	89	33	50	45	0	55	64	90	19	49	75	0	17	25	0	13
Georgia	45	53	41	40	27	73	78	39	63	63	0	49	40	52	33	46	33	33	33	67	50	13
Brazil	45	54	46	21	28	44	94	17	88	53	50	45	41	83	25	19	67	33	54	0	0	13
Namibia	45	41	47	47	46	31	83	0	50	19	100	61	49	79	42	24	67	0	33	50	100	13
Poland	45	45	47	38	70	8	33	17	88	38	0	63	82	35	19	12	67	33	67	8	50	13
Lebanon	45	52	41	36	73	50	56	28	63	52	0	35	66	54	25	19	67	0	33	50	50	13
Rwanda	45	53	48	17	64	44	100	0	50	54	50	17	38	94	44	31	67	33	0	0	0	75
Cyprus	44	36	60	19	33	40	83	17	38	23	0	93	77	54	8	51	92	33	58	0	0	0
Egypt	44	57	32	44	75	44	72	17	88	47	0	43	38	63	25	7	0	33	50	8	50	63
South Africa	43	52	42	25	33	88	67	50	63	35	50	56	56	65	22	15	67	0	50	25	0	13
Sudan	43	55	32	44	71	31	67	17	75	40	100	24	46	54	8	44	33	0	42	25	50	63
Ecuador	43	44	49	24	80	44	100	0	25	29	0	57	58	77	25	21	75	17	4	50	50	0
Nepal	43	45	49	21	28	54	83	28	63	36	0	51	60	60	25	17	67	50	38	25	0	13
Türkiye	43	40	53	22	55	17	83	17	50	21	0	64	44	77	28	56	67	33	13	17	50	13
United Arab Emirates	43	48	42	32	52	54	72	28	63	33	0	49	37	92	22	17	67	0	54	0	50	13
Bhutan	42	47	43	28	84	50	67	11	50	30	0	50	69	67	8	12	67	0	33	0	50	25
Papua New Guinea	42	61	26	40	70	54	72	44	63	58	50	35	29	38	6	5	67	0	0	17	100	63
Pakistan	41	51	34	38	79	50	67	28	63	30	0	42	52	58	19	10	33	0	50	33	50	13
Argentina	40	35	54	16	25	44	61	17	50	28	0	66	83	65	25	19	67	33	38	17	0	0
Eritrea	40	53	33	28	64	44	100	0	50	54	50	33	20	58	8	58	33	17	0	0	50	75
Cambodia	39	53	32	26	75	44	89	17	50	26	100	32	37	52	36	10	0	50	38	0	50	13

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		Policy design										Implementation tools							Monitoring and evaluation			
	Governance score	Policy design	Implementation tools	Monitoring and evaluation	Strategic vision	Coordination	Participation	Accountability	Transparency	Sustainability	Equity	Surveillance	Antimicrobial stewardship	Infection prevention and control	Education	Public awareness	Medicines regulation	Research and development for novel products	Reporting	Feedback mechanism	Effectiveness	Antimicrobial resistance research
Tunisia	39	40	42	29	57	31	67	17	63	15	0	44	46	56	28	14	67	33	33	17	50	13
Bangladesh	39	49	38	19	37	50	72	44	63	31	50	25	44	75	25	14	67	0	50	0	0	13
Oman	39	31	53	20	26	27	50	17	50	8	50	45	60	94	25	51	75	0	42	17	0	13
Malta	38	39	43	23	34	46	56	28	63	25	0	69	51	67	25	44	33	0	58	17	0	0
Cameroon	38	55	19	50	67	17	78	17	88	44	50	4	13	35	17	14	0	50	50	25	50	75
Montenegro	38	59	30	11	48	92	72	33	75	64	0	30	41	42	3	14	67	0	33	0	0	0
Tajikistan	38	57	35	3	49	96	89	50	38	45	50	22	41	54	25	26	67	0	0	0	0	13
Nicaragua	38	40	45	13	48	44	100	0	25	29	50	49	53	77	22	19	75	0	8	33	0	13
Brunei	37	40	43	15	19	58	72	28	50	35	0	62	79	42	22	10	67	0	38	0	0	13
Viet Nam	36	31	47	22	32	31	33	0	50	15	100	82	55	88	6	10	67	0	13	17	50	13
Paraguay	36	40	42	12	32	44	89	17	38	26	50	40	51	58	36	17	33	50	4	33	0	13
Afghanistan	35	42	27	38	23	31	61	17	75	38	50	18	20	48	6	12	33	50	33	8	50	63
Uruguay	34	30	48	9	18	35	83	17	25	21	0	35	47	81	39	54	67	0	4	33	0	0
Costa Rica	34	32	46	8	34	35	78	0	25	19	50	52	64	65	39	17	67	0	4	17	0	13
Mauritius	33	39	32	22	77	23	61	17	50	9	0	26	35	56	19	10	67	0	33	0	50	0
Maldives	33	50	24	17	52	65	72	39	50	32	50	1	15	44	6	17	33	50	33	0	0	25
Fiji	32	38	34	14	20	69	72	22	38	34	0	1	37	50	25	49	67	0	0	0	50	13
Mongolia	31	28	39	17	47	27	22	0	50	10	50	31	48	75	22	11	67	0	25	25	0	13
Libya	31	46	20	25	72	8	56	17	63	35	50	0	26	35	28	10	33	0	33	0	50	13
Turkmenistan	31	44	24	16	45	73	67	39	25	35	50	25	25	48	17	14	33	0	0	8	50	13
Ukraine	29	30	39	0	22	31	72	17	38	16	0	27	50	77	11	17	67	0	0	0	0	0
Sierra Leone	29	40	24	14	33	40	94	17	38	26	50	18	12	58	33	13	33	0	0	0	50	13
Barbados	28	34	32	5	49	40	72	0	25	20	50	31	20	40	22	14	33	67	0	8	0	13
Federated States of Micronesia	28	42	16	29	66	25	100	0	25	29	50	19	12	38	31	7	0	0	0	17	100	13

Figure 2: **Antimicrobial resistance governance ranked by aggregate scores on three governance areas and 18 domains by country, 2020–21**
Countries are ranked in descending order by their overall antimicrobial resistance governance score from highest (Norway, 85) to lowest (Federated States of Micronesia, 28) in 2020–21. Scores are reported on a scale of 0 (worst [red]) to 100 (best [teal]).

antimicrobial resistance NAPs ranged from 85 (SD 32) in Norway to 28 (37) in Federated States of Micronesia, with a mean overall score of 51 (SD 14; figure 2).

Although the areas pertaining to policy design and implementation tools scored similarly, with mean values of 55 (SD 14) for policy design and 54 (17) for implementation tools, monitoring and evaluation scored lower at 38 (20; appendix p 89). The geospatial variation is presented in world heat maps (figure 3). The domains with the lowest mean scores of 30 were accountability (SD 18) and feedback mechanism (SD 25), followed by education, which scored 32 (SD 16). Participation was the highest scoring domain across all countries (83 [SD 16]), followed by infection prevention and control (73 [17]) and coordination (63 [26]). Education was the lowest scoring domain of all implementation tools, highlighting that basic and continuous education for health-care workers has not been robustly established in most countries (figure 4).

We generated an additional composite score for financing that was not part of the antimicrobial resistance governance framework on the basis of five budget-related indicators (appendix p 68) that scored 30 (SD 16) across all countries, joining the lowest scoring domains of accountability and feedback mechanism. We disaggregated data to provide scores relevant to WHO regions and World Bank income groups (appendix p 67). The European region had the highest overall governance score (57 [SD 15]) and the Eastern Mediterranean region had the lowest overall governance score (46 [8]), followed by the region of the Americas (47 [14]). Wide variation in country scores were seen in the European region

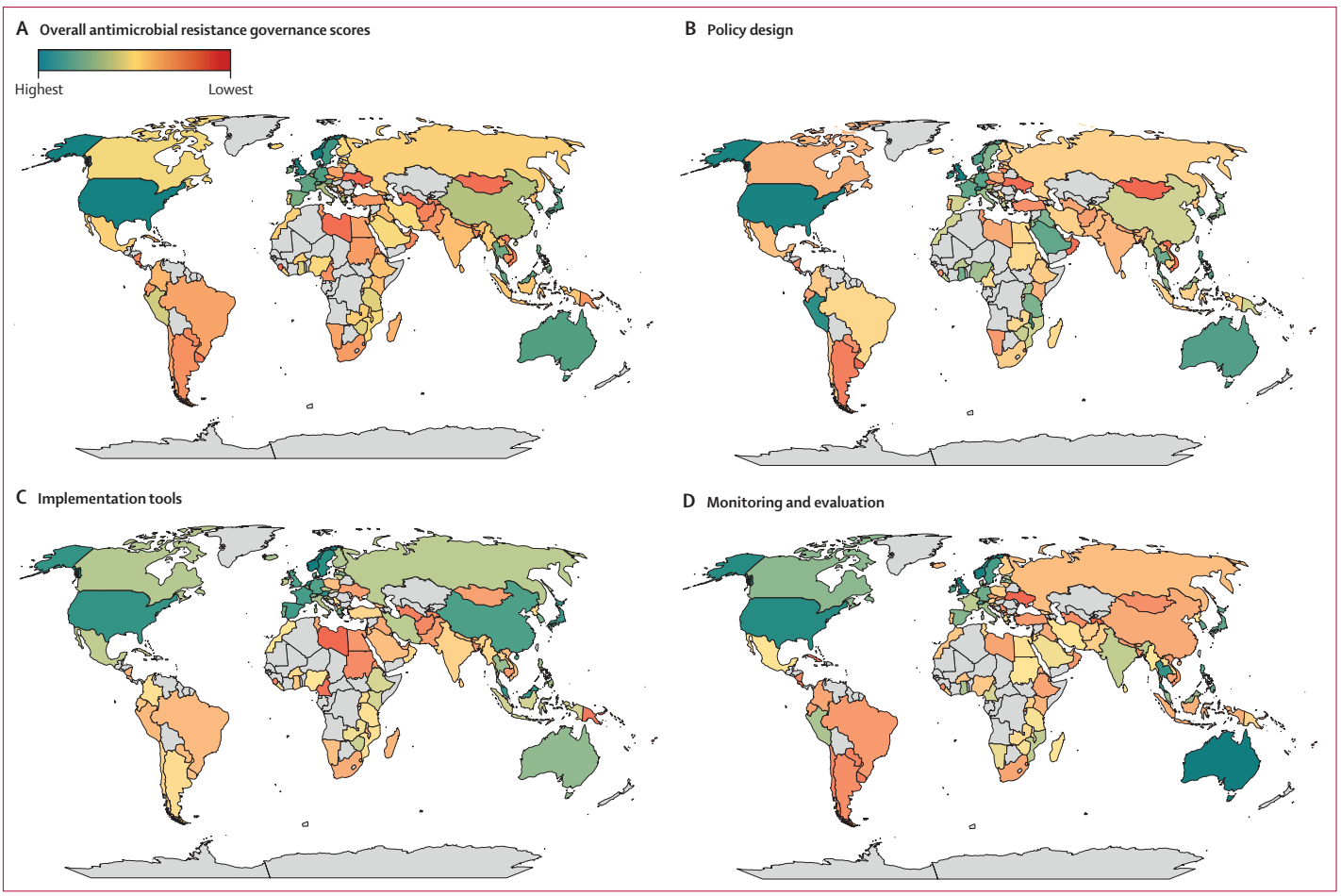

Figure 3: **Map of scores by country, 2020–21**
(A) Overall antimicrobial resistance governance scores. (B) Aggregate policy design scores. (C) Aggregate implementation tools scores. (D) Aggregate monitoring and evaluation scores. Colour scales are based on the distribution of scores for each map, where the highest scoring locations are in teal and the lowest scoring locations are in red. Locations excluded from this Article are in grey.

(eg, Norway 85 [32] and Ukraine 29 [36]), the Western Pacific region (eg, Japan 75 [34] and the Federated States of Micronesia 28 [37]), and the region of the Americas (eg, the USA 84 [28] and Barbados 28 [34]). Of the 20 countries with the highest overall governance scores, 17 were high-income countries and 11 were from the European region. Most of the lowest scoring 20 countries were upper-middle-income countries (n=8) and lower-middle-income countries (n=7); seven were island countries.

Substantial differences were found in the equity domain, which assessed whether NAPs encouraged responsible use of antimicrobials and facilitated access to antimicrobials. High scores were found in the African region (55 [SD 35]), low-income countries (48 [38]), and lower-middle-income countries (54 [38]). The European region (19 [36]) and the region of the Americas (23 [32]) scored lower, as did upper-middle-income countries (23 [29]) and high-income countries (25 [39]). The European region scored highest on surveillance (74 [24]), which could be indicative of more well established laboratory capacity and higher-quality data collection systems compared with the African (43 [19]) and Eastern Mediterranean (42 [20]) regions.

Across all indicators (figure 1), sustainability indicator PD6.3, which considered whether countries had assessed future budget requirements for different activities listed in the NAPs, was the lowest scoring (1 [SD 9]), with only Austria scoring positively. The accountability indicator PD4.3, about whether agreements existed regarding repercussions if objectives were not met, scored 4 (18). Only four NAPs mentioned a formal follow-up review.

Discussion

This Article is the first to comprehensively examine the international response to antimicrobial resistance. Most countries varied widely in their strategic policy design, capacity to implement tools to reduce the burden of antimicrobial resistance, and efforts to monitor and evaluate these interventions. Amid an increase in the recognition of antimicrobial resistance as an urgent health and economic crisis from political and multilateral

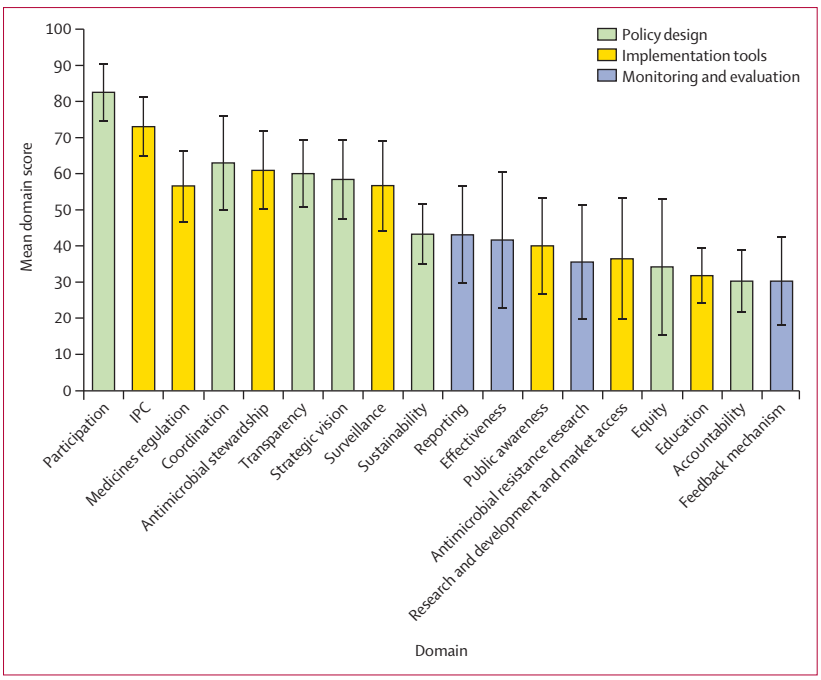

Figure 4: **Mean global domain score**
Arranged by descending mean global domain score. Black bars represent SD. IPC=infection prevention and control.

systems,[28] disparities were found in national efforts to govern antimicrobial resistance in 2020–21. Scores differed across geographical and economic spectra, ranging from 85 in Norway to 28 in the Federated States of Micronesia, and across domains that are crucially relevant to antimicrobial resistance and global health governance. Comprehensive and systematic examinations of these efforts at different levels of granularity should be a key part of important baseline assessments to monitor and evaluate global progress on overcoming antimicrobial resistance and facilitate cross-country and cross-regional learning with opportunities for continual improvement and adjustment.

Despite 148 countries reporting to have developed an NAP as of October, 2021,[5] our systematic literature searches located only 115 NAPs (including the NAP that couldn't be translated) in the public domain. We recognise that the remaining 33 NAPs might have been developed but are available for internal use only; however, public accessibility of plans is important for good transparency and accountability practices.[9] Although the establishment of an NAP is a highly encouraged development, our content analysis showed that the objectives within these NAPs plan to overcome elements with highly variable priority. Although financing the implementation of NAPs remains crucial, the proposed activities within the plans should seek to manage all challenges.

Analysis of the three broad governance areas suggests that countries' intentions about coordinating their national response to antimicrobial resistance were principally focused on designing and implementing antimicrobial resistance policies. Subsequent efforts to systematically monitor and evaluate the effectiveness and cost-effectiveness of these policies were relatively poor, providing little potential for countries to improve their strategic policy design and implementation. At the structural level, the antimicrobial resistance governance framework was conceptualised through a cyclical design to represent a dynamic and ongoing ability for repeat assessments, in which each component is interdependent, meaning deficiencies in any one area can diminish progress in others (appendix p 88).[16] Therefore, countries should aim to improve activities relevant to all three areas and should avoid disproportionately prioritising resources in one area and neglecting others.

Many countries did not provide information evidencing implemented activities from their NAPs. This finding is consistent with other reports in the literature, which found that countries typically successfully designed progressive policies and identified the necessary implementation mechanisms, but lacked tangible implementation and often did not show sustained action.[29,30] This process diminishes accountability, a concept that was confirmed by regional studies.[9,10,31] Only 27 countries had at least one publicly available progress report and, of those, 17 had multiple progress reports that were published at regular intervals. Countries should improve their methods for evaluating NAP objectives transparently and establish protocols for unmet commitments to improve accountability.

Implementation and evaluation of NAP activities require sustainable financing with dedicated budgets. Low-income and middle-income countries might not be able to acquire sufficient financing independently and without dedicated packages from foreign donors and philanthropies, necessitating renewed international collaboration and public–private partnerships. Our findings about financing are similar to findings from other studies, which found that budgetary support for antimicrobial resistance activities is generally low and is a major challenge to NAP implementation.[32]

Differences in the equity domain are indicative of a longstanding problem of insufficient access to medicines, which is particularly prevalent in lower-middle-income countries and could explain why they are mentioned more frequently in NAPs from low-income countries and lower-middle-income countries. Higher-income regions focused on this aspect less, despite their capabilities to increase access to medicines in lower-income regions.

The assertion that the global response to antimicrobial resistance is favourable because of the development of as many as 148 NAPs is ill-conceived and inappropriate. The role of the NAP could be argued to be relatively inconsequential, as tangible action after the implementation of a plan establishes the most meaningful effects. We believe a well considered, well costed NAP

with multisectoral relevance provides an important basis to direct priority setting and policy making.

This study has some limitations. Because TrACSS responses are generated by self-assessment survey and are not independently verified, our reliance on this dataset to generate scores for some indicators might have led to self-response bias that could have produced more favourable country scenarios than reality by over-estimating strengths or under-reporting weaknesses. Validating each of the 5358 datapoints would be resource intensive, involving a broad range of multilingual sources and experts. However, TrACSS is the only available dataset for insights into country progress on antimicrobial resistance. To improve the reliability of results, we produced several composite indicators synthesising multiple responses to represent an indicator or domain. The use of other data sources (eg, interviews with multiple stakeholders) could invite heterogeneity and might introduce bias.

Although systematic processes were used to ensure that our literature and database searches were comprehensive and rigorous, we acknowledge the potential that publicly accessible documents relevant to our study were not included. Despite our best efforts to ensure systematic methods of searching, reporting on the status of an activity differs between countries and is not universally standardised, which might have inadvertently led to omissions. NAPs were retrievable from at least seven countries and territories that were not included in this analysis, as their absence from TrACSS 2020–21 prevented inclusion.

In this Article, we provided composite scores using equally weighted arithmetic mean values to increase accessibility in the interpretation of results and to allow the scoring system to be understood by a wide range of stakeholders. This approach fulfilled our aim to identify areas of strengths and weaknesses across countries and regions. We acknowledge that some composite scores consisted of varying numbers of constituent variables, which might have led to unintended weighting. However, for transparency, the method for obtaining each value has been described in the appendix (pp 6–48). We also provide an international dashboard (a spreadsheet of scores for all indicators and countries) of the 54 antimicrobial resistance governance indicators across 114 countries, allowing policy makers to view and evaluate the dataset at the most granular level and locate data that might not have been included because of statistical methods. This analysis is a timely opportunity to cross-sectionally evaluate existing NAPs with a broad range of themes, as either the validity periods of many NAPs are expiring or countries are developing their first NAPs.

Although a systematic weighting exercise (eg, participatory approaches from expert consultations or further statistical analysis)[26,27] was beyond the scope of this study, developing an antimicrobial resistance governance index might be useful for continual monitoring and evaluation of antimicrobial resistance response efforts in future studies.

For some indicators, we assigned a score of 0 if data could not be found. This process might have undervalued the genuinely progressive efforts made by some countries. However, as transparency and accountability are crucial components of global governance and global health governance, we believe that no public access to crucial information should negatively reflect on the governance score of a country.

By use of a governance framework, this study analysed the contents of NAPs from 114 countries and combined these findings with data from various sources to generate country scores reflecting the strength of antimicrobial resistance governance strategies at the global, regional, and national levels. The results are intended to assist policy makers to design, implement, monitor, and evaluate antimicrobial resistance NAPs across the One Health spectrum and to facilitate objective assessments to increase accountability and encourage debate about financing, prioritisation, and monitoring and evaluation efforts.[16] Our study is the first comprehensive, global application of this framework and shows crucial deficits in publicly available information that is relevant to antimicrobial resistance policy. We grouped scores thematically at three layers of granularity (ie, governance areas, domains, and indicators) to present more detailed findings for policy makers to identify policy priorities. Areas that require improvement were identified, including financing, accountability, and feedback mechanisms; education; and equitable access to antimicrobials as global public goods. These areas in particular should be enhanced to improve policy formulation and effective implementation.

Although 194 member states committed to the objective of having multisectoral NAPs by the 2017 World Health Assembly,[3] plans for 72 member states could not be located through our systematic searches in 2022, highlighting the urgent need for these countries and territories to publish, finalise, or initiate development of NAPs. For the remaining member states, as the validity period of their NAPs end, our analysis provides an opportunity for learning across countries and regions to improve subsequent iterations of NAPs.

Contributors

All authors contributed to the study conceptualisation and design. JP, AH, and GF contributed to data analysis and interpretation. All authors were able to access all data in this study and JP and AH verified all data. JP and AH drafted the Article, which was reviewed and revised by all authors. JP drafted the appendix, which was reviewed and revised by AH. JP and AH created all figures. All authors read and approved the final version of the manuscript and had final responsibility for the decision to submit for publication.

Declaration of interests

AJM is a consultant to the WHO Regional Office for Africa. All other authors declare no competing interests.

Data sharing

All NAPs used in the analysis (including translated versions of NAPs in languages other than English), all indicator data points informing the

scores for all countries, and relevant data extracted from databases informing revelant scores are available on request to the corresponding author. Data sources are listed in the Article and the appendix. Aggregate results by country are available for each domain in figure 1.

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