

XXXXX XXXXX

# Monitoring progress on Antimicrobial Resistance (AMR) response in the World Health Organization African region: Insights from the Tracking AMR Country Self-Assessment Survey (TrACSS) 2021 results for the human health sector

LAETITIA GAHIMBARE<sup>1</sup>, AMBELE JUDITH MWAMELO<sup>1</sup>, ALI AHMED YAHYA<sup>1</sup>,  
WALTER FULLER<sup>1</sup>, PONNU PADIYARA<sup>2</sup>, PRAVARSHA PRAKASH<sup>2</sup>,  
ANAND BALACHANDRAN<sup>2</sup> and ELIZABETH LINDIWE MAKUBALO<sup>1</sup>

<sup>1</sup>World Health Organization Regional office for Africa, Brazzaville, Congo;

<sup>2</sup>World Health Organization Headquarters, Geneva

DOI: 10.4081/jphia-2024-xxxx

**Abstract.** Antimicrobial resistance (AMR) is a major 21st century global health challenge. The WHO African Region Member States committed to develop and implement multi-sectoral national action plans (NAPs) that address AMR, in line with the Global Action Plan on AMR (GAP). The aim of this paper is to present the progress of AMR response in the WHO African Region based on the annual Tracking AMR Country Self-Assessment Survey (TrACSS), with a focus on human health indicators. This was a secondary data analysis of responses from forty-one countries that participated in the 2021 TrACSS. Of the 41 countries that responded to the 2021 TrACSS, 35(85%) have developed NAPs. Fifteen 15(37%) of countries have functional AMR multisector working groups. 55% (21/41) of countries are collating data nationally on AMR surveillance. Forty nine percent of countries conducted small-scale AMR awareness campaigns and 53% (21/41) covered AMR in some pre- and in-service training for human health workers. While 83% of countries reported having laws and regulations on the prescription and sale of antimicrobials, only 32% (13/41) have national systems for monitoring antimicrobial use. Twenty-three (58%, 23/41) reported having Infection Prevention and Control (IPC) programs at select health facilities. Countries have developed and are implementing AMR NAPs. Gaps still exist across key indicators

monitored through TrACSS. Effective AMR response requires established functional multisectoral governance mechanisms in the One Health approach; political commitment, sustainable funding, and clear monitoring and reporting is critical.

## Introduction

AMR is a major global health threat (1), with misuse and abuse of antimicrobials across human and animal health, plant, and environmental sectors as a major driver of AMR (1-4). Recent estimates show 4.95 million deaths associated with bacterial AMR and 1.27 million deaths attributable (5). The all-age mortality rate attributable to resistance was estimated to be highest in western sub-Saharan Africa, at 27.3 deaths per 100,000 (5). The African region is expected to bear a disproportionate morbidity and mortality burden from drug resistant infections (6,7). Africa accounts for a high burden of infectious disease: available reports show high levels of resistance in microbes responsible for endemic diseases such as Tuberculosis (TB), Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS), and malaria that contribute to the overall disease burden (2,3,8,9). High resistance rates have also been reported for common antibiotics including, ampicillin (23.5%) and amoxicillin (24.5%) for common gram-negative bacteria (3). AMR could result in a cumulative economic cost of \$100 trillion by 2050, with a disproportionate impact on low- and middle-income countries (LMICs) (6,7). Many LMICs, including those in the African region, face challenges that increase the occurrence and spread of AMR, and impede efforts in addressing AMR. These challenges include inadequate Water, Sanitation, and Hygiene (WASH) and Infection Prevention and Control (IPC) measures both at the healthcare and community, weak health systems, limited access to new and quality antibiotics, and poor laboratory and diagnostic (2,3,9). AMR has significant public health and socioeconomic implications, with a potential

---

*Correspondence to:* Dr Laetitia Gahimbare, World Health Organization Regional office for Africa, Brazzaville, Congo  
E-mail: gahimbarel@who.int

*Key words:* antimicrobial resistance, Africa, world health organization, national action plans, tracking AMR country self-assessment survey (TrACSS)

to reverse the healthcare achievements, and ultimately hamper the progress towards attaining Sustainable Development Goals (SDGs) (7).

Cognizant of the urgent need for action, in 2015, the World Health Assembly (WHA) endorsed the Global Action Plan on AMR (GAP) as the main policy framework to guide action towards containing AMR; a plan also endorsed by the Food and Agriculture Organization (FAO) and World Organization for Animal Health (WOAH-former OIE) delegates (4). The GAP outlines strategic five objectives: (i) to improve awareness and understanding of AMR; through effective communication, education and training; (ii) to strengthen the knowledge and evidence base through surveillance and research; (iii) to reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures; (iv) to optimize the use of antimicrobial medicines in human and animal health; (v) and to develop the economic case for sustainable investment for the needs of all countries and to increase investment in new medicines, diagnostic tools, vaccines and other interventions (4). WHO Member States agreed to have a costed national action plan (NAP) on AMR that is consistent with the GAP, in the One Health approach, and to implement relevant policies, strategies and plans to prevent, control, and monitor AMR (2,4,9).

Member States have different capacities, resources, infrastructure and priorities; thus, different starting points and progress levels in addressing AMR (4). The WHO, alongside the FAO, WOA, United Nations Environment Programme (UNEP) and partners such as Africa CDC, provides strategic, technical and implementation support to its Member States<sup>1</sup> to develop NAPs and implement the recommended activities under the GAP (4,9). Studies on AMR in AFRO have reaffirmed the importance of assessing progress to inform national, regional and global stakeholders on effectively addressing AMR (9-11). To monitor country progress, a multi-sectoral, standardized and annual Tracking AMR Country Self-Assessment Survey (TrACSS) has been jointly administered by FAO, WOA, and WHO since the 2016, and recently UNEP (12). Using TrACSS data from the 2021 survey year, this paper aimed to present and discuss the status of AMR response on the human health sector in participating WHO African Region Member States.

## Methods

This study utilised data extracted from the Global TrACSS Database, specifically focusing on the 2021 survey responses. The TrACSS questionnaire has questions for each GAP strategic objective, and includes questions for human, animal and plant health sectors, environment, and food safety. Hence, the key sections cover progress on multi-sectoral working groups on AMR and NAPs, as well as the first four GAP strategic objectives. The 5th objective is not monitored through the TrACSS,

<sup>1</sup>Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Republic of Congo, Cote d'Ivoire, Democratic Republic of the Congo, Eritrea, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau Kenya, Lesotho, Liberia Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, South Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

as it pertains to the global level, hence, was not covered in this paper. TrACSS is designed to be dynamic, allowing for responses to reflect the different levels of implementation that countries are at (13). A five-point rating system (A-E) is used in most questions where countries select one rating that most closely matches the country situation. The rating system reflects a range from no capacity (A), limited (B), developed (C), demonstrated (D), and sustained capacity (E), with which countries should be aiming to reach levels C-E.

Each year, the TrACSS questionnaire and Guidance Note is disseminated to countries; the Ministry of Health receives an access key from WHO; FAO, WOA, and UNEP focal points also collaborate with national officials as they respond to questions on each respective sector to complete and validate of responses prior to submission (13). One official response is submitted per country via the online portal.

For this paper, 2021 TrACSS data for all participating WHO AFRO member states was downloaded; of this, data from the human health sector was extracted for analysis. The data were summarized in frequencies to obtain descriptive statistics through one-way tabulations, where missing information were excluded. Analysis of the data was done using Stata (version 16.0). The detailed key to the indicator progress levels A-E under each strategic objective is in the Annex.

## Results

*Responding countries characteristics.* Characteristics of responding countries, including World Bank income group classification, (14) is shown in Table I.

*Development of national action plans and multisectoral coordination.* Thirty five (85%) of the 41 responding countries have established AMR National Action Plans on AMR (levels C-E). Of those, 15(37%) countries reported their NAPs being implemented (level D) and six 6(15%) i.e., Burkina Faso, Côte d'Ivoire, Kenya, Mozambique, Nigeria, and South Africa have NAPs being implemented and actively monitored through a monitoring and evaluation framework (level E) (Fig. 1). Central African Republic was the only country that reported not having a NAP. The TrACSS 2021 also captured the impact of COVID-19 pandemic on implementation of AMR activities; 98% (n=40) responded having their NAPs development and implementation process affected by COVID-19.

Moreover, 15 (37%) countries have established a functional multisectoral working group with clear terms of reference, regular meetings, and funding (levels C-E). Of those, six countries i.e., DRC, Ethiopia, Ghana, Nigeria, South Sudan and Tanzania have multisector collaboration jointly working on issues including agreements and common objectives (level D); and 4(10%) countries Cabo Verde, Côte d'Ivoire, Malawi, and South Africa are at highest level E with integrated approaches used to implement the NAPs, with relevant data and lessons learned from all sectors used to adapt implementation of the action plan. However, 54% of the countries (n=22) reported having established multi-sectoral working groups which are yet to be functional (level B). In terms of sector involvement, human and animal sectors were mostly reported (98%) as actively involved sectors in NAP development and implementation compared to other sectors such as environment.

Table I. Responding countries characteristics (n=41).

S/N	Country	Region	WBI
1	Algeria	West Africa	LMIC
2	Benin	West Africa	LMIC
3	Botswana	Eastern and Southern Africa	UMIC
4	Burkina Faso	West Africa	LIC
5	Burundi	Central Africa	LIC
6	Cabo Verde	West Africa	LMIC
7	Cameroon	Central Africa	LMIC
8	Central African Republic	Central Africa	LIC
9	Chad	Central Africa	LIC
10	Côte d'Ivoire	West Africa	LMIC
11	Democratic Republic of the Congo (DRC)	Central Africa	LIC
12	Equatorial Guinea	Central Africa	UMIC
13	Eritrea	Eastern and Southern Africa	LIC
14	Ethiopia	Eastern and Southern Africa	LIC
15	Gabon	Central Africa	UMIC
16	Ghana	West Africa	LMIC
17	Guinea	West Africa	LIC
18	Kenya	Eastern and Southern Africa	LMIC
19	Lesotho	Eastern and Southern Africa	LMIC
20	Liberia	West Africa	LIC
21	Madagascar	Eastern and Southern Africa	LIC
22	Malawi	Eastern and Southern Africa	LIC
23	Mali	West Africa	LIC
24	Mauritania	West Africa	LMIC
25	Mauritius	Eastern and Southern Africa	UMIC
26	Mozambique	Eastern and Southern Africa	LIC
27	Namibia	Eastern and Southern Africa	UMIC
28	Niger	West Africa	LIC
29	Nigeria	West Africa	LMIC
30	Rwanda	Eastern and Southern Africa	LIC
31	Senegal	West Africa	LMIC
32	Seychelles	Eastern and Southern Africa	HIC
33	Sierra Leone	West Africa	LIC
34	South Africa	Eastern and Southern Africa	UMIC
35	South Sudan	Eastern and Southern Africa	LIC
36	Swaziland	Eastern and Southern Africa	LMIC
37	Togo	West Africa	LIC
38	Uganda	Eastern and Southern Africa	LIC
39	United Republic of Tanzania	Eastern and Southern Africa	LMIC
40	Zambia	Eastern and Southern Africa	LMIC
41	Zimbabwe	Eastern and Southern Africa	LMIC

*Improving awareness and understanding on AMR.* Most common response 20(49%) showed countries had small scale AMR awareness raising activities and campaigns across relevant stakeholders (level C). Eight (20%) countries: Burkina Faso, Eritrea, Ethiopia, Ghana, Kenya, Liberia, Tanzania, and Zimbabwe have government supported, nationwide AMR campaigns (level D); Nigeria was the only country that responded to being at the highest level with targeted, nationwide government-supported activities with monitoring in place

(level E). However, 3(7%) countries: Equatorial Guinea, Niger, and South Sudan reported no significant awareness-raising activities (Fig. 1).

Similar patterns were observed in training and professional education on AMR in human health, where 21(53%) of the countries were at level C with AMR covered in some pre- and in-service training for human health workers. Burkina Faso, Ethiopia, and Kenya (n=3, 8%) cover AMR in pre-service training for all relevant cadres nationwide (level D) (Fig. 1).

Annex: Table I.I. Reported country progress for human health indicators (NAPs, Multisectoral Coordination and 4 Strategic objectives).

Progress level (A-E)	Reported Indicators for human health	TrACSS 2021 Results		
	Definition	N	%	No response
<b>National Action Plans and Multisectoral Coordination</b>				
<b>Multisector and One Health coordination</b>				
		41	100	N/A
A	No formal multi-sectoral governance or coordination mechanism on AMR exists	4	10	
B	Multi-sectoral working group(s) or coordination committee on AMR established with Government leadership	22	54	
C	Multi-sectoral working group(s) is (are) functional, with clear terms of reference, regular meetings, and funding for working group(s) with activities and reporting/accountability arrangements defined	5	12	
D	Joint working on issues including agreement on common objectives	6	15	
E	Integrated approaches used to implement the NAP with relevant data and lessons learned from all sectors used to adapt implementation of the NAP	4	10	
<b>National Action Plan (NAP) development</b>				
		41	100	N/A
A	No national AMR NAP	1	2	
B	National AMR NAP under development	5	12	
C	National AMR NAP developed	14	34	
D	National AMR NAP being implemented	15	37	
E	National AMR NAP being implemented and actively monitored through a monitoring and evaluation framework	6	15	
<b>Strategic Objective 1</b>				
<b>Raising awareness and understanding of AMR risks and response</b>				
		41	100	N/A
A	No significant awareness-raising activities on relevant aspects of risks of AMR	3	7	
B	Some activities in parts of the country to raise awareness about risks of AMR and actions that can be taken to address it	9	22	
C	Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders	20	49	
D	Nationwide, government-supported AMR awareness campaign targeting all or the majority of priority stakeholder groups, based on stakeholder analysis, utilizing targeted messaging accordingly within sectors	8	20	
E	Targeted, nationwide government-supported activities regularly implemented to change behavior of key stakeholders within sectors, with monitoring undertaken over the last 2-5 years	1	2	
<b>Training and professional education on AMR in the human health sector</b>				
		40	100	1
A	No training for human health workers on AMR	2	5	
B	Ad hoc AMR training courses in some human health related disciplines.	14	35	
C	AMR is covered in 1) some pre-service training and in 2) some in-service training or other continuing professional development (CPD) for human health workers	21	53	
D	AMR is covered in pre-service training for all relevant cadres. In-service training or other CPD covering AMR is available for all types of human health workers nationwide	3	8	
E	AMR is systematically and formally incorporated in pre-service training curricula for all relevant human health cadres. In-service training or other CPD on AMR is taken up by relevant groups for human health nationwide, in public and private sectors	0	0	

Annex: Table I.I. Continued.

Progress level (A-E)	Reported Indicators for human health Definition	TrACSS 2021 Results		
		N	%	No response
Strategic Objective 2				
National monitoring system for consumption and rational use of antimicrobials in human health				
A	No national plan or system for monitoring use of antimicrobials	41	100	N/A
B	System designed for surveillance of antimicrobial use, that includes monitoring national level sales or consumption of antibiotics in health services	18	44	
C	Total sales of antimicrobials are monitored at national level and/or some monitoring of antibiotic use at sub-national level	10	24	
D	Prescribing practices and appropriate antibiotic use are monitored in a national sample of healthcare settings	6	15	
E	On a regular basis (every year/two years) data is collected and reported on: a) Antimicrobial sales or consumption at national level for human use; and b) Antibiotic prescribing and appropriate/rational use, in a representative sample of health facilities	5	12	
		2	5	
National surveillance system for AMR (AMR) in humans				
A	No capacity for generating data (antibiotic susceptibility testing and accompanying clinical and epidemiological data) and reporting on antibiotic resistance	39	100	2
B	AMR data is collated locally for common bacterial infections in hospitalized and community patients* , but data collection may not use a standardized approach and lacks national coordination and/or quality management	4	10	
C	AMR data are collated nationally for common bacterial infections in hospitalized and community patients, but national coordination and standardization are lacking	14	36	
D	There is a standardized national AMR surveillance system collecting data on common bacterial infections in hospitalized and community patients, with established network of surveillance sites, designated national reference laboratory for AMR	8	21	
E	The national AMR surveillance system links AMR surveillance with antimicrobial consumption and/or use data for human health	12	31	
		1	3	
National AMR Laboratory network in human health				
A	Information not available	40	100	1
B	The National Reference Laboratory (NRL) and/or the National Regulatory Authority (NRA) has not agreed and approved national guidelines for AST (e.g CLSI or EUCAST), bacterial isolation and identification protocols	6	15	
C	The NRL and/or NRA have issued national guidelines, based on international standards for AST(e.g CLSI or EUCAST), bacterial isolation and identification for use within the bacteriology laboratory network	11	28	
D	The NRL and/or NRA have issued national guidelines for AST(e.g CLSI or EUCAST), bacterial isolation and identification for use within the bacteriology laboratory network and National Reference Laboratory participates in an international external quality assurance	5	12	
E	The National Reference Laboratory supports the bacteriology laboratory network in identification of pathogens and AMR through a systematic approach to cascade training and supportive supervision and it has established a National External Quality Assurance program provided to the national bacteriology laboratory network	7	18	
		11	28	

Annex: Table I.I. Continued.

Progress level (A-E)	Reported Indicators for human health	TrACSS 2021 Results		
	Definition	N	%	No response
Strategic Objective 3				
Infection Prevention and Control (IPC) in human health care				
A	No national IPC programme or operational plan is available	40	100	1
B	A national IPC programme or operational plan is available. National IPC and water, sanitation and hygiene (WASH) and environmental health standards exist but are not fully implemented	5	12	
C	A national IPC programme and operational plan are available and national guidelines for health care IPC are available and disseminated. Selected health facilities are implementing the guidelines, with monitoring and feedback in place	12	30	
D	A national IPC programme and operational plan are available and national guidelines for health care IPC are available and disseminated. Selected health facilities are implementing the guidelines, with monitoring and feedback in place	16	40	
E	National IPC programme available according to the WHO IPC core components guidelines* and IPC plans and guidelines implemented nationwide. All health care facilities have a functional built environment (including water and sanitation), and necessary materials and equipment to perform IPC, per national standards	6	15	
	IPC programmes are in place and functioning at national and health facility levels according to the WHO IPC core components guidelines. Compliance and effectiveness are regularly evaluated and published. Plans and guidance are updated in response to monitoring	1	3	
Strategic Objective 4				
Optimizing antimicrobial use in human health				
A	No/weak national policies for appropriate use	40	100	1
B	National policies for antimicrobial governance developed for the community and health care settings	14	35	
C	Practices to assure appropriate antimicrobial use being implemented in some healthcare facilities and guidelines for appropriate use of antimicrobials available	7	18	
D	Guidelines and other practices to enable appropriate use are implemented in most health facilities nationwide. Monitoring and surveillance results are used to inform action and to update treatment guidelines and essential medicines lists	15	37	
E	Guidelines on optimizing antibiotic use are implemented for all major syndromes and data on use is systematically fed back to prescribers	4	10	
Adoption of AwaRe categorization				
A	Country has no knowledge or information about the AWARe classification of antibiotics	0	0	
B	Country has knowledge about the AWARe classification of antibiotics and country has intention to adopt it in the next few years	40	100	1
C	Country has adopted the AWARe classification of antibiotics in their National Essential Medicines List	4	10	
D	Country is monitoring its antibiotic consumption based on the AWARe classification of antibiotics	20	50	
E	Country has incorporated AWARe classification of antibiotics into its antimicrobial stewardship strategies	11	28	
		3	8	
		2	5	

*Strengthening knowledge and evidence base through surveillance.* Twenty-one countries reported collating data nationally for AMR surveillance in human health (levels C-E). Of those, twelve (31%) countries: Côte d'Ivoire, Ethiopia, Eswatini,

Table I.II. Additional select indicators reported for human health sector.

Indicator	Yes, n (%)	Otherwise, n (%)
COVID-19 Impact on NAP development	40 (98)	1 (2)
Country has laws or regulations on prescription and sale of antimicrobials for human use	34 (83)	7 (17)
Sectors involved in NAP development and implementation-human health	41 (100)	0 (0)
Sectors involved in NAP development and implementation-animal Health (terrestrial and aquatic)	40 (98)	1 (2)
Sectors involved in NAP development and implementation-plant health	25 (61)	16 (39)
Sectors involved in NAP development and implementation-food production	21 (51)	20 (49)
Sectors involved in NAP development and implementation-food safety	28 (68)	13 (32)
Sectors involved in NAP development and implementation-environment	36 (88)	5 (12)
Country using relevant AMC/AMU and(or) AMR data to amend national strategy and(or) inform decision making, at least annually? (Human health)	15 (37)	25 (63)

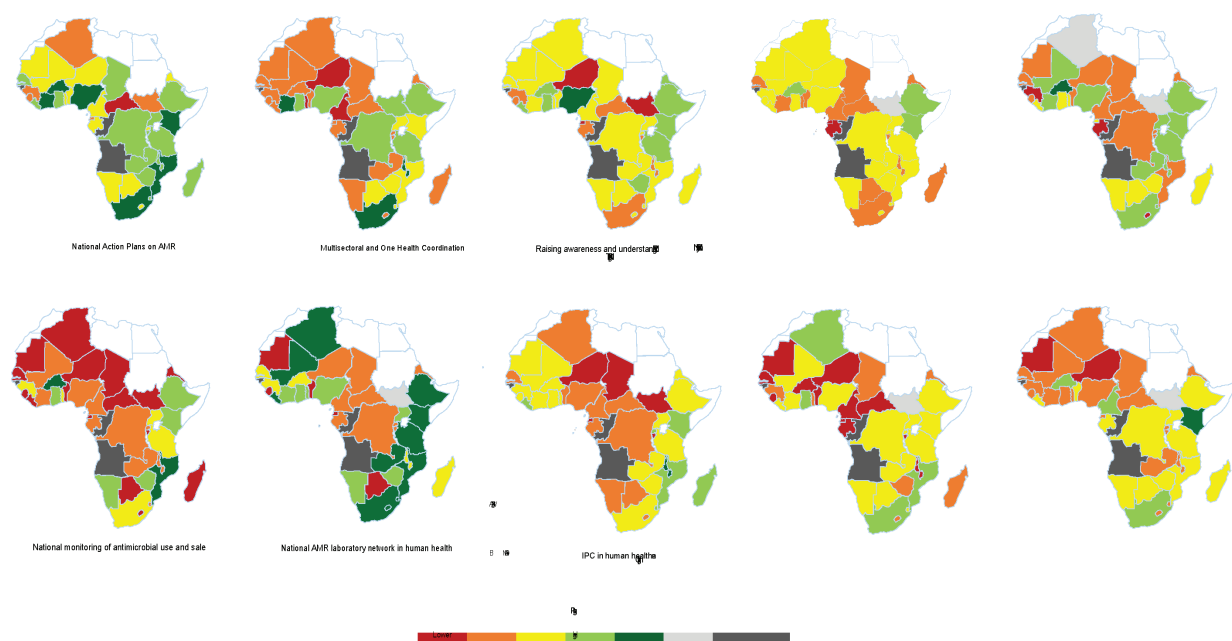


Figure 1. Graphical representation of country progress based on the 2021 TrACSS results for human health.

Kenya, Malawi, Mali, Mauritius, Nigeria, Tanzania, Uganda, South Africa, and Zambia, have standardized national AMR surveillance system with established network of surveillance sites, designated national reference laboratory, and a national coordinating centre producing reports (level D). Burkina Faso was at the level E with national surveillance systems linking AMR surveillance with antimicrobial consumption (level E) (Fig. 1). Only 37% (n=15) of countries report using relevant antimicrobial consumption (AMC)/ Antimicrobial use (AMU) and AMR data to inform and amend national strategy for decision making in human health. Moreover, twenty-three (58%, n=23) countries reported having National Regulatory Authority or a National Reference Laboratory with guidelines and capacity for bacterial isolation and identification, and antibiotics susceptibility testing (AST) (levels C-E).

While 83% (n=85) of countries reported having laws and regulations on the prescription and sale of antimicrobials for

human health, only 13 (32%) countries have national monitoring systems for use and/or total sale of antimicrobials (level C-E). Of those, 5 (12%) i.e., Ethiopia, Ghana, Kenya and Namibia, and Zimbabwe, were at level D with prescribing practices and appropriate antibiotic monitored in national sample of healthcare settings; and Burkina Faso and Mozambique (n=2, 5%) were the only two countries at the highest level E with regular data collection and reporting on antimicrobial sales, prescribing, and use at national level (Fig. 1). However, most countries (n=18, 44%) reported having no plan or national system systems for monitoring use (level A).

*Reducing the incidence of infection through effective sanitation, hygiene, and infection prevention measures.* Twenty-three countries (58%) reported having IPC programs and guidelines implemented in at least select facilities (levels C-E). Of those, six (15%) countries-Eswatini, Kenya, Liberia,

Madagascar, Mozambique, and Rwanda have national IPC programs according to the WHO IPC core components guidelines and built-in environments (level D). Only Malawi reported nationwide implementation of IPC programs that are functioning in line with the WHO IPC core components, as well as compliance and regular monitoring mechanisms in place (Level E) (Fig. 1).

*Optimizing antimicrobial use in human health.* Almost half of the countries (47%, n=19) have policies to guide implementation of practices for appropriate antimicrobial use in some health facilities (levels C-E). Of those, four (10%) countries: Algeria, Ghana, Mozambique, and South Africa have nationwide implementation of guidelines for appropriate use and are using surveillance results to inform their national Essential Medicines List (EML) (level D) (Fig. 1). Moreover, 16(41%) countries have adapted the WHO AWaRe (Access, Watch, Reserve) classification of antibiotics into their EML (levels C-E) and 49% (n=20) reported knowledge about the AWaRe classification (level B) and plans to adopt it in the next few years.

## Discussion

A One Health approach is central to addressing AMR and requires coordinated multisectoral action, especially considering the available evidence on the complex nature of AMR (4,11,15). This paper found that WHO African countries have developed AMR NAPs as is highlighted by the 85% of countries reporting this. NAPs guide and provide context-specific AMR response, in line with the GAP (4). Results show that while 15 countries are implementing their NAPs, only Burkina Faso, Côte d'Ivoire, Kenya, Mozambique, Nigeria, and South Africa are implementing and actively monitoring their NAPs through a monitoring and evaluation framework. Global trends in the 2019-20 TrACSS report highlighted significant gaps between number of countries with NAPs developed vs. those that have funding and are implementing these NAPs with monitoring systems in place (16). The challenge of funding gaps in the implementation of NAPs especially in LMICs, is highlighted in myriad studies, where NAPs also lack costing and budgeting, defined funding structures, and commitment (2,9,10,17). Budgeted and costed prioritized operational plans (17) with monitoring and evaluation in place, are needed to inform decision makers and enable effective and sustainable AMR NAP implementation (15,17). Multisectoral coordination, wilful political commitment with designated local resources and sustainability plans remains critical to moving NAPs from policy to action.

Most of the countries with developed NAP have national AMR multisectoral coordination groups that are seldom functional. Studies have found that in many LMICs, institutions are often fragmented and such cross-sectoral activities require resources that most lack (10,15). Establishing meaningful multisectoral governance structures is key to not only increasing political will, ownership, and awareness, but also in operationalization of NAPs (10,15,17). Tanzania, for instance, which reported functioning multisectoral coordination, has a clearly established governance structure where development

and operationalization of the NAP is done by One Health ministries and partners, and a functional Multi-Sectoral Coordinating Committee (MCC) serves to coordinate, facilitate and oversee implementation (10). Multisectoral coordination bodies should be functional with routine meetings, clear terms of reference, funding and reporting (15,17). Capacity building on core skills of coordination, management and leadership is also recommended. Of concern is that funding availability remains a challenge, even in countries with established governance structures for NAP operationalization, especially amidst competing priorities. AMR initiatives can be linked with other strategies, frameworks, and priority areas, including International Health Regulations (IHR), the Integrated Disease Surveillance and Response (IDSR), Universal Health Coverage (UHC), Primary Health Care (PHC) and Sustainable Development Goals (SDGs), to leverage opportunities within existing programs for coordination, funding and resource allocation (4,15). This will facilitate government and stakeholder buy in, better engagement, collaboration across sectors for sustainability (4,11,15). In response to the COVID-19 pandemic, countries shifted priorities to respond to the pandemic, hence many witnessed the impacts of COVID-19 on their NAP development and implementation processes. There is an opportunity for lesson learning on preparedness and agility, and leveraging integration of AMR response into the cross-sectoral coordination mechanisms including collaborative works established for strengthening health systems and resource mobilization (15,18).

Awareness campaigns and educational programs are tools for communicating risks associated with AMR and ultimately influencing behavioural change (4,19). This paper found that most countries have small-scale AMR awareness raising campaigns. More investment is needed for implementing targeted, nationwide government-supported AMR campaigns. Global initiatives such as the World Antimicrobial Awareness Week (WAAW) have stirred action at national levels aimed at raising awareness among key stakeholders including policy makers and the general public (17,20). Effective awareness raising campaigns should also involve socio-anthropological and culturally relevant messaging that align with the targeted populations (19,20). For instance, Nigeria which is the only country that reported highest (level E) for this indicator, has been implementing the Dr. Ameyo Stella Adadevoh Health Trust (DRASA) AMR School Program in collaboration with the government, WHO and other partners, for educating school children on reducing AMR and good hygiene practices. DRASA has successfully produced over 300 student ambassadors who cascade awareness on AMR, health and hygiene to peers and their communities. Such is a best practice of clearly defined and evaluated strategies for raising awareness and, in the long term, bringing behaviour change from an early age (19). Most countries have some in-service and pre-service training or other Continuing Professional Development (CPD) on AMR. Focus should be placed in systematically incorporating training curricula for all relevant human health cadres nationwide (21).

Surveillance on the emergence and spread of AMR and monitoring antimicrobial use is important for generating evidence that can be used to design interventions for addressing AMR (8,22,23). Results show ongoing



data collation activities for AMR surveillance; however, data collation methods used are not standardized and lack coordination and quality management. Challenges include shortages in human resources trained on AMR surveillance, inadequate resources, weak laboratory infrastructures and supply chains for microbiology laboratories (22). Laboratories need to be supported on quality management systems to ensure accurate AMR data; strengthening of sentinel surveillance to generate accurate, reliable, and quality data is equally important (22,23). This is especially relevant for low-resource settings which face gaps in the development and operation of National Reference Laboratories and quality management. Hence, efforts should also include continuous training for performance of AMR testing, interpretation and reporting of results (23). Only Burkina Faso, Cabo Verde, Ethiopia, Ghana, Guinea, Kenya, Mozambique, Namibia, South Africa, Togo, Uganda, Zimbabwe, United Republic of Tanzania have national monitoring systems for antimicrobial use and sale. This is in line with literature which shows that most African countries, and LMICs, lack policies, regulations for antimicrobial use, and where present, such structures are not enforced (24,25). Antimicrobial use data and platforms such as the WHO platform Global Antimicrobial Resistance and Use Surveillance System (GLASS) can be utilized to inform stewardship to address misuse and ensure access to effective antimicrobials (8,24). Technical support and sustainable financing should be leveraged to increase surveillance and monitoring capacities to generate reliable AMR data (8). While leveraging support from Quadripartite and relevant stakeholders is essential, local financing and maintained commitments remain essential to building resilient One Health surveillance systems for AMR.

IPC measures, such as effective WASH, access to running water and vaccines, are important in minimizing the spread of infections caused by resistant pathogens, as well as curbing hospital-acquired infections (4,11,24). The COVID-19 pandemic served as a reminder on the need for resilient IPC programs globally, sustainable human and financial resources for diagnostics, and defined frameworks for action (18). However, of concern is that only seven countries reported nationwide implementation of IPC program with compliance to WHO Core components for IPC, highlighting IPC as an intervention needing strengthening and scaling up capacity for nationwide implementation. Elton *et al* found that while 25% of countries in sub-Saharan Africa reported that they conducted training on AMR in IPC capacity, most of them (95%) did not have a fully functional WASH or environmental health standards in place across all healthcare facilities (11). More focus should be placed on countries that either reported having no IPC program in place, or those which IPC programs that are not fully implemented.

Almost half of the countries reported having guidelines and are implementing practices for appropriate use of antimicrobials. Stewardship guidelines and interventions are needed in ensuring availability to quality-assured antibiotics and restricting unregulated and under the counter access (26-28). Context-specific approaches to stewardship interventions that prioritize an understanding of structural, socio-cultural and economic factors that influence suboptimal antimicrobial

use ought to be implemented (27,28). While countries have responded having regulations on prescription and sale of antimicrobials for human use, studies have shown that many LMICs face challenges in enforcement of these regulations, further exacerbated by the excessive availability of counterfeit medicines (10,11). WHO report on substandard and falsified medical products (29) also revealed of thr 42% reports from AFRO Region, antibiotics accounted for 16.9% of substandard and falsified medicines. Furthermore, due to inadequate antimicrobial stewardship programmes, increased use of antibiotics in the management of COVID-19 has been observed, which could contribute to emergence of AMR (18). Hence, systems and practices that promote enforcement should have clear deterrent measures for non-abidance to the regulations. Data generated from surveillance and monitoring should be disseminated to inform stewardship interventions, including those on prescribing practices (8,27,28).

## Conclusion

The WHO African Region Member States have developed national action plans to guide local action towards containing AMR, in the One Health approach as reported in the TrACSS results. However, major gaps exist between NAP development and implementation; hence, solidifying the need to accelerate the implementation of NAPs, with a keen focus on supporting countries on the key elements for sustainable implementation. Multisectoral coordination mechanisms and technical working groups are critical to ensuring integrated cross-sectoral approaches, leadership, and accountability for NAP implementation at all levels. The importance of an operational plan that is costed and budgeted with prioritized activities cannot be understated. As countries mobilize resources and identify funding gaps, there is an opportunity to leverage domestic funding sources for implementation while ensuring monitoring and evaluation frameworks and reporting mechanisms; NAPs can also be linked to budgets of major national priorities for continuous funding. Across the four strategic objectives, this paper discusses priority areas for financial and human resources, building technical capacity, and scaling up recommended interventions, that are essential, while taking into account country-specific needs, local priorities and resources. Sharing experiences and best practices stories should be encouraged for cross-country learning and collective regional action and coordination on curbing the AMR threat. In the COVID-19 context, countries ought to leverage not only the lessons learnt, but also established mechanisms, and linkages of AMR initiatives with respective COVID-19 response plans. As WHO African Region Member States continue to increase momentum in their NAP implementation, strong political commitment, governance and coordination, and sustainable financing across all relevant sectors and stakeholders remain critical to effectively address AMR.

## Limitations

Responses to the TrACSS are based on self-assessment which has potential for overstating or understating implementation progress, strengths and weaknesses at national level.

Regardless, the TrACSS is a consistent source of data and a robust multisectoral tool for monitoring country implementation of AMR NAPs.

### Acknowledgement

The authors would like to thank World Health Organization member states for their participation in the TrACSS 2021 round. The views and opinions in this article are those of the authors and do not reflect affiliated institutions.

### Funding

The authors did not receive financial support for this article.

### Data availability

The relevant data used for this article is publicly available on the Global Database for the Tracking Antimicrobial Resistance (AMR) Country Self-assessment Survey (TrACSS).

### Authors contribution

Conceptualization, analysis and interpretation, manuscript draft: LG and AJM; Critical revision, review, and editing: AAY, WF, PAP, PP, AB, ELM. All authors contributed to finalization of the article for publication.

### Potential conflict of interest

The authors declare no conflict of interests with respect of this article.

### Informed consent

This article did not utilize data from individual persons.

Accepted: 00, XXXX 0000; submitted: 00, XXXX 0000.

### References

- World Health Organisation. Antimicrobial resistance. Fact Sheet [Internet]. 2021 [cited 2021 Nov 23]. Available from: <https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance>.
- Iwu-Jaja CJ, Jaca A, Festus Jaja I, Jordan P and Bhengu P: Preventing and managing antimicrobial resistance in the African region: A scoping review protocol. 2021 Jul 14 [cited 2021 Nov 24]; Available from: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0254737>.
- World Health Organization: Regional Office for Africa. Antimicrobial resistance in the WHO African Region: A systematic literature review [Internet]. World Health Organization. Regional Office for Africa; 2021 [cited 2022 Apr 14]. x, 51 p. Available from: <https://apps.who.int/iris/handle/10665/349223>.
- World Health Organization. Global Action Plan on Antimicrobial Resistance [Internet]. 2015. Available from: [https://apps.who.int/iris/bitstream/handle/10665/193736/9789241509763\\_eng.pdf?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/193736/9789241509763_eng.pdf?sequence=1).
- Antimicrobial Resistance Collaborators: Global burden of bacterial antimicrobial resistance in 2019: A systematic analysis. *Lancet* 399: 629-955, 2022.
- Drug-Resistant Infections: A Threat to our economic future [Internet]. World Bank. [cited 2022 Nov 3]. Available from: <https://www.worldbank.org/en/topic/health/publication/drug-resistant-infections-a-threat-to-our-economic-future>.
- O'Neill J: Tackling Drug-resistant infections globally: Final report and recommendations [Internet]. 2016 May. Available from: [https://amr-review.org/sites/default/files/160518\\_Final%20paper\\_with%20cover.pdf](https://amr-review.org/sites/default/files/160518_Final%20paper_with%20cover.pdf).
- Ndihokubwayo JB, Yahaya AA, Tamer Desta A and Ki-Zerbo G: Antimicrobial resistance in the African Region: Issues, challenges and actions proposed: 27-30, 2013.
- Essack SY, Desta AT, Abotsi RE and Agoba EE: Antimicrobial resistance in the WHO African region: Current status and roadmap for action. *J Public Health (Oxf)* 39: 8-13, 2017.
- Frumence G, Mboera LEG, Sindato C, Katale BZ and Kimera S: The governance and implementation of the national action plan on antimicrobial resistance in Tanzania: A qualitative study. *Antibiotics* 10: 273, 2021.
- Elton L, Thomason MJ, Tembo J, Velavan TP, Pallerla SR, Arruda LB, Vairo F, Montaldo C, Ntoumi F, Abdel Hamid MM, *et al*: Antimicrobial resistance preparedness in sub-Saharan African countries. *Antimicrob Resist Infect Control* 9: 145, 2020.
- Monitoring and evaluation of the global action plan on antimicrobial resistance [Internet]. [cited 2022 Apr 15]. Available from: <https://www.who.int/publications-detail-redirect/monitoring-and-evaluation-of-the-global-action-plan-on-antimicrobial-resistance>.
- World Health Organisation. Tripartite AMR Country Self-Assessment Survey (TrACSS): Guidance note to accompany TrACSS 2020-21 (5.0) [Internet]. 2021. Available from: [https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/tracss/2020-2021/tracss-year-five-guidance-note-2021-english.pdf?sfvrsn=d447af3b\\_36](https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/tracss/2020-2021/tracss-year-five-guidance-note-2021-english.pdf?sfvrsn=d447af3b_36).
- World Bank Group. World Bank Country and Lending Groups [Internet]. 2021. Available from: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>.
- Joshi MP, Hafner T, Twesigye G, Ndiaye A, Kiggundu R, Mekonnen N, Kusu N, Berthé S, Lusaya EP, Acho A, *et al*: Strengthening multisectoral coordination on antimicrobial resistance: A landscape analysis of efforts in 11 countries. *J Pharm Policy Pract* 14: 27, 2021.
- World Health Organization. Monitoring global progress on antimicrobial resistance: Tripartite AMR country self-assessment survey (TrACSS) 2019-2020 [Internet]. 2021. Available from: [https://www.who.int/publications/i/item/monitoring-global-progress-on-antimicrobial-resistance-tripartite-amr-country-self-assessment-survey-\(tracss\)-2019-2020](https://www.who.int/publications/i/item/monitoring-global-progress-on-antimicrobial-resistance-tripartite-amr-country-self-assessment-survey-(tracss)-2019-2020).
- WHO implementation handbook for national action plans on antimicrobial resistance: Guidance for the human health sector [Internet]. [cited 2022 Nov 9]. Available from: <https://www.who.int/publications-detail-redirect/9789240041981>.
- Adebisi YA, Alaran AJ, Okereke M, Oke GI, Amos OA, Olaoye OC, Oladunjoye I, Olanrewaju AY, Ukor NA and Lucero-Prisno DE III: COVID-19 and antimicrobial resistance: A review. *Infect Dis (Auckl)* 14: 11786337211033870, 2021.
- Mathew P, Sivaraman S and Chandy S: Communication strategies for improving public awareness on appropriate antibiotic use: Bridging a vital gap for action on antibiotic resistance. *J Family Med Prim Care* 8: 1867-1871, 2019.
- Huttner B, Saam M, Moja L, Mah K, Sprenger M, Harbarth S and Magrini N: How to improve antibiotic awareness campaigns: Findings of a WHO global survey. *BMJ Glob Health* 4: e001239, 2019.
- Muloi D, Fèvre Eric M, Bettridge J, Rono R, Ong'are D, Hassell JM, Karani MK, Muinde P, van Bunnik B, Street A, *et al*: A cross-sectional survey of practices and knowledge among antibiotic retailers in Nairobi, Kenya. *J Glob Health* 9: 010412, 2019.
- Kariuki S, Keddy KH, Antonio M and Okeke IN: Antimicrobial resistance surveillance in Africa: Successes, gaps and a roadmap for the future. *Afr J Lab Med* 7: 924, 2018.
- World Health Organization. Global antimicrobial resistance surveillance system (GLASS) report: Early implementation 2020 [Internet]. Geneva: World Health Organization; 2020 [cited 2021 Dec 11]. Available from: <https://apps.who.int/iris/handle/10665/332081>.
- Harbarth S, Balkhy HH, Goossens H, Jarlier V, Kluytmans J and Laxminarayan R: Antimicrobial resistance: One world, one fight! *Antimicrob Resist Infect Control* 4: 49, 2015.
- Iwu CD and Patrick SM: An insight into the implementation of the global action plan on antimicrobial resistance in the WHO African region: A roadmap for action. *Int J Antimicrobial Agents* 58: 106411, 2021.

26. Gelban H and Delahoy M: Policies to address antibiotic resistance in low- and middle-income countries. Center Disease Dynamic, Economics & Policy [Internet]. 2014; Available from: [https://cddep.org/wp-content/uploads/2017/06/abrinlmics\\_cddep\\_gelband\\_and\\_delahoy\\_9-14.pdf](https://cddep.org/wp-content/uploads/2017/06/abrinlmics_cddep_gelband_and_delahoy_9-14.pdf).
27. Charani E, McKee M, Ahmad R, Balasegaram M, Bonaconsa C, Merrett GB, Busse R, Carter V, Castro-Sanchez E, Franklin BD, *et al*: Optimising antimicrobial use in humans-review of current evidence and an interdisciplinary consensus on key priorities for research. *Lancet Reg Health Eur* 7: 100161, 2021.
28. Mzumara GW, Mambiya M and Iroh Tam PY: Antimicrobial stewardship interventions in least developed and low-income countries: A systematic review protocol. *BMJ Open* 11: e047312, 2021.
29. World Health Organization: WHO global surveillance and monitoring system for substandard and falsified medical products [Internet]. World Health Organization; 2017 [cited 2022 Nov 15]. pp64. Available from: <https://apps.who.int/iris/handle/10665/326708>.