

Implementing the global action plan on antimicrobial resistance

First quadripartite biennial report



Food and Agriculture Organization of the United Nations



World Health Organization



World Organisation for Animal Health
Founded as OIE

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Foreword

When medicines used to treat common infections are no longer effective, the social, humanitarian and economic impact is significant. Antimicrobial resistance (AMR) is a global threat to human health, animal health, agriculture and food production, and the environmental ecosystem services. Many of the Sustainable Development Goals (SDG) associated with human health, food security, poverty, terrestrial and aquatic animal life, and the environment in the 2030 Agenda for Sustainable Development cannot be achieved if the global community does not place higher priority on addressing AMR – often referred to as the “silent pandemic”.

The global action plan on AMR (GAP-AMR) adopted in 2015 commits our organizations to produce biennial reports to monitor global and national progress in addressing AMR. An initial report was produced in 2019, which also served as the report of the United Nations Secretary-General to the Seventy-third session of the United Nations General Assembly.

We are pleased to note that despite the coronavirus disease (COVID-19) pandemic, the quadripartite – Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP), World Health Organization (WHO) and World Organisation for Animal Health (WOAH) – undertook significant steps during the period 2020–2021 to implement the GAP-AMR, and developed many innovations to support countries in implementing their AMR national action plans (NAPs). This report outlines various initiatives and activities the quadripartite has undertaken at the global, regional and country levels. It also provides a precise description of the environmental

dimensions of addressing AMR and a clear call for action in this sector.

Countries should be commended because within the short 6-year period since the adoption of the GAP-AMR, 84% of Member States have provided annual information on the implementation of their multisectoral AMR NAPs and activities across all the relevant sectors. The quadripartite’s “tracking AMR country self-assessment survey” (TrACSS) collects and publishes valuable information on NAP implementation, highlights the key challenges faced in each of the relevant sectors, and helps identify opportunities for urgent action in countries. The uneven progress seen in certain critical indicators highlights the need for a more programmatic approach to address AMR in countries, both through sector-specific action and through a joint, collaborative One Health approach.

The quadripartite worked to establish and support various global governance structures in 2020–2021, including the quadripartite Joint Secretariat, the Global Leaders Group on AMR and the AMR Multi-Partner Trust Fund. These structures, with the strong support of key donors and partners, have helped strengthen collaboration, enhance political commitments and mobilize resources, and have delivered impact at the country level.

This report highlights many areas in all sectors where urgent action is needed: greater high-level political engagement in countries to address AMR, a robust governance structure to ensure accountability for NAP implementation and monitoring, the allocation of adequate financial resources, the strengthening of technical capacity, increased awareness and education about AMR among targeted

stakeholders and youth, the enforcement of existing regulations and legislation on the prescription, use and disposal of antimicrobials, and to prevent contamination of food and the environment with antimicrobials and antimicrobial residues.

Having identified the challenges, the quadripartite has developed and continues to develop a wide range of effective guidelines, tools, systems and processes to support the implementation of the GAP-AMR and AMR NAPs. But to increase support to countries, to expedite the implementation of AMR-relevant interventions in the different sectors, and to continue to monitor progress in the GAP-AMR's implementation, strong political engagement and additional financial resources are essential.

It is time to move the global response to AMR from its "early implementation" phase to a "sustained implementation" phase in which all sectors are well resourced and progress is driven by a collaborative and programmatic approach in countries where sustained progress in the GAP-AMR's five interdependent strategic objectives can be seen.

So, as the global community plans for the United Nations General Assembly High-level Meeting on AMR in 2024, this biennial

report from the quadripartite provides the evidence and motivation needed to drive urgent action and ensure that antimicrobials remain effective to treat infections in human health, animal health and plant health, and that environmental pollution from the use and misuse of antimicrobials is mitigated. The quadripartite remains committed and looks forward to enabling the global community to achieve the various goals of the 2030 Agenda for Sustainable Development.

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Abbreviations

AMC	antimicrobial consumption	MDR/RR-TB	multidrug- and rifampicin-resistant tuberculosis
AMR	antimicrobial resistance	NAP	national action plan
AMR MPTF	antimicrobial resistance multi-partner trust fund	NTD	neglected tropical disease
AMS	antimicrobial stewardship	PAHO	Pan American Health Organization
AMU	antimicrobial use	PVS	Performance of Veterinary Services
ANIMUSE	ANImal antiMicrobial USE	QJS	Quadripartite Joint Secretariat on antimicrobial resistance
AST	antimicrobial susceptibility testing	R&D	research and development
ATLASS	Assessment Tool for Laboratories and Antimicrobial resistance Surveillance Systems (FAO)	SADC	Southern African Development Community
AWaRe	access, watch and reserve (classification of antibiotics)	SDG	Sustainable Development Goals
COVID-19	coronavirus disease	SFVP	substandard and falsified veterinary product
ESBL	extended spectrum beta-lactamase	STI	sexually transmitted infection
EU	European Union	TB	tuberculosis
FAO	Food and Agriculture Organization of the United Nations	TrACSS	Tracking AMR Country Self-assessment Survey
GAP-AMR	global action plan on antimicrobial resistance	UMIC	upper-middle-income country
GBAD	Global Burden of Animal Disease	UN	United Nations
GLASS	Global Antimicrobial Resistance and Use Surveillance System	UNEP	United Nations Environment Programme
GLASS-AMC	GLASS antimicrobial consumption	UNICEF	United Nations Children's Fund
HIC	high-income country	VCIA	veterinary critically important antimicrobial agent
IACG	Interagency Coordination Group on Antimicrobial Resistance	VICH	International Cooperation on Harmonisation of Technical Requirements for Registration of Veterinary Medicinal Products
IPC	infection prevention and control	WAAW	World Antimicrobial Awareness Week
LIC	low-income country	WASH	water, sanitation and hygiene
LMIC	low- and middle-income country	WHO	World Health Organization
M&E	monitoring and evaluation	WOAH	World Organisation for Animal Health
		WPRACSS	Western Pacific Regional Antimicrobial Consumption Surveillance System

1

Chapter 1. **Introduction**



What is AMR?

AMR threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi.

AMR is a natural phenomenon that is exacerbated by the misuse and overuse of antimicrobials (1). It occurs when bacteria, viruses, fungi and parasites change over time and no longer respond to medicines, making infections harder to treat and increasing the risk of disease spread, severe illness and death. As a result, the medicines become ineffective and infections persist in the body, increasing the risk of their spreading to others.

Antimicrobials, including antibiotics, antivirals, antifungals and antiparasitics, are medicines used to prevent and treat infections in humans, animals and plants. Microorganisms that develop AMR are sometimes referred to as “superbugs”.

The natural environment is an important reservoir of AMR (2). *Drug-resistant* microbes are in people, animals, food and the environment (in water, soil and air). Pollution contributes to AMR, and contaminated water and soil may be prime localities for AMR development and spread.

AMR, often referred to as a silent pandemic, poses a major threat to human health, animal health, agriculture, food production and ecosystems around the world. The lack of effective medicines against antimicrobial-resistant microorganisms leaves an uncertain future with devastating effects on lives and livelihoods at any stage of life. The cost of AMR for society is extremely high and the global burden is staggering. Recent evidence shows that AMR was associated with nearly 5 million deaths in 2019, of which 1.27 million were directly caused by AMR, with the majority estimated to be in sub-Saharan Africa and Asia (3).

While AMR is prevalent in countries at all economic levels, the risk of it emerging and spreading is particularly high in countries where basic systems to prevent and treat infections are weak, where access to essential and quality-assured medicines and diagnostics is limited, where water and sanitation systems are not optimal, and where legislation and regulatory and enforcement mechanisms need to be enhanced. In addition, countries with the inadequate capacity to establish microbiology laboratory networks and/or national surveillance systems for AMR, antimicrobial use (AMU) and antimicrobial consumption (AMC) lack the data and evidence needed to drive changes in policies.

Furthermore, significant gaps exist in the level of awareness about AMR and its risks among the community, key stakeholders and policy-makers. This may have a profound impact on the spread of AMR. These challenges are particularly evident in low-income countries (LICs) and middle-income countries, and recent studies suggest that the burden of AMR is already unevenly distributed around the globe.

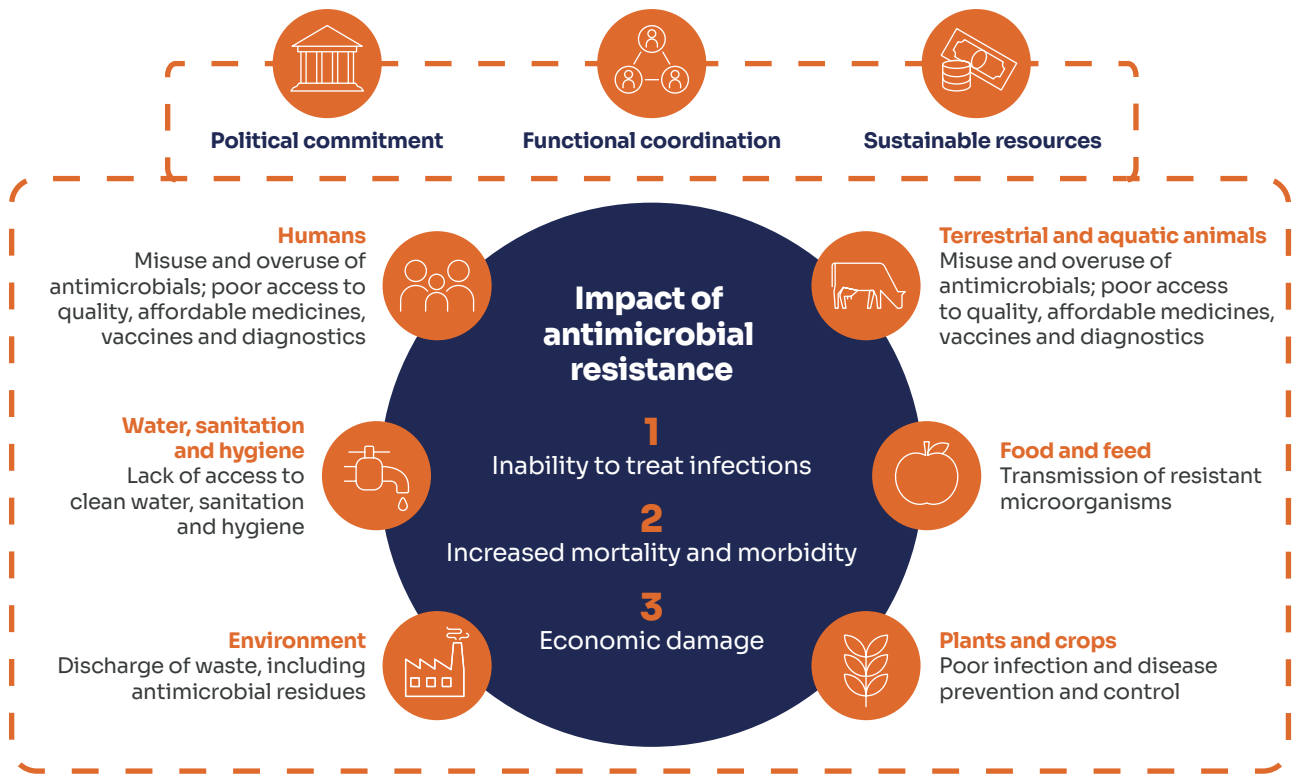
AMR is also a major barrier to protecting animals and ensuring their welfare as well as treating animals, including zoonotic diseases. The emergence of AMR in food and agriculture has implications for food safety, food security and the economic well-being of millions of households engaged in farming, including livestock and aquaculture. This highlights the complexity of the AMR crisis.

The non-prudent and/or excessive use of antimicrobials in human, animal and plant health has accelerated the development and spread of AMR, and undermines the effectiveness of available antimicrobials used in all sectors. Drug-resistant infections in humans have also been traced back to food and animal sources, and a contaminated environment plays a pivotal role by catalysing the development and spread of AMR.

Although the non-prudent and/or excessive use of antimicrobials is one of the driving forces behind AMR (Fig. 1) (4), the issue is multifaceted and the mitigation of this global health and sustainable development challenge requires a holistic One Health approach. Both sector-specific actions and multisectoral collaboration must be strengthened in all sectors, including in human health, animal (terrestrial and aquatic) and plant health, food production and environmental protection, to effectively mitigate the burden of AMR. The delivery of the One Health approach also requires political engagement, coordination and resource allocation.

AMR threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi.

Fig. 1. Drivers and impact of AMR



Source: IACG (5).



The impact of global COVID-19 pandemic on AMR

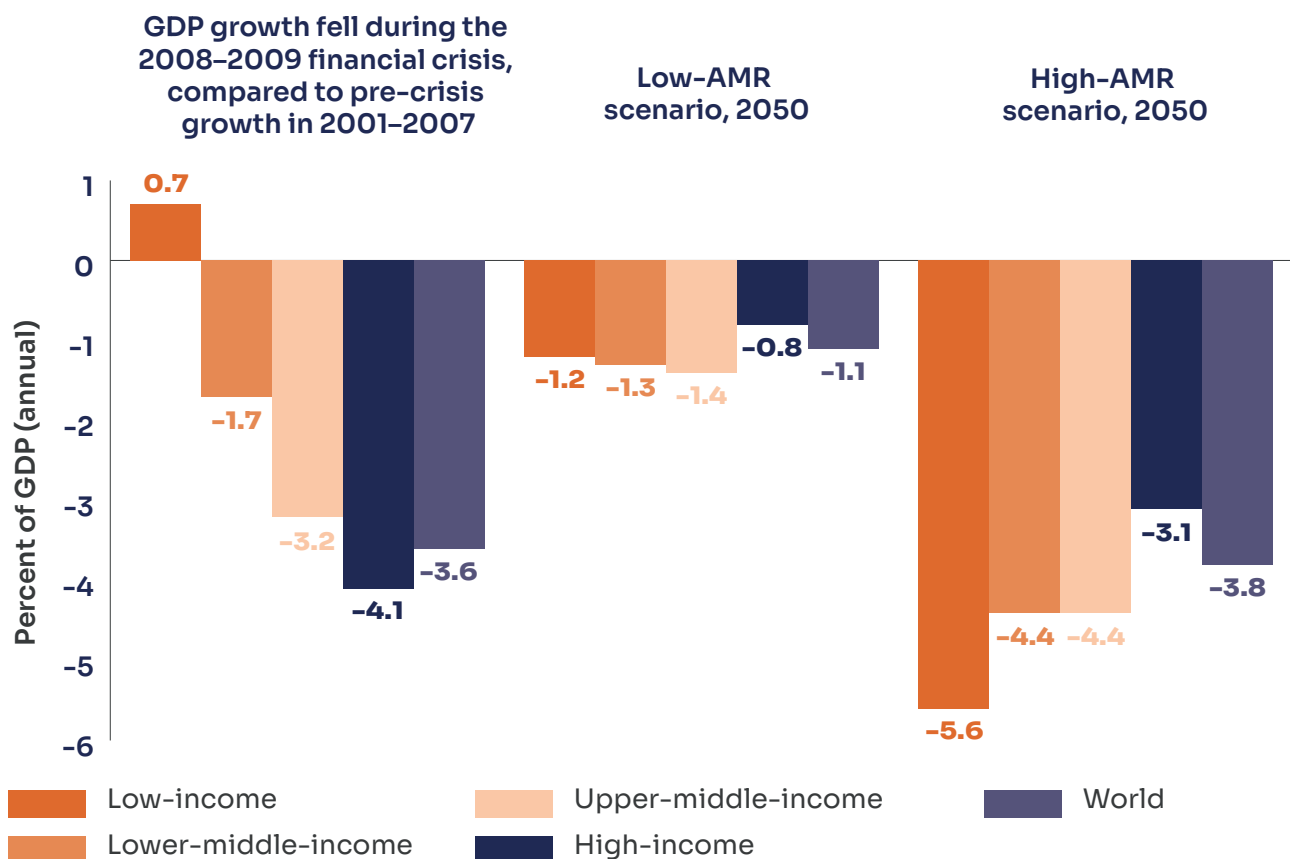
For the last three years, the COVID-19 pandemic, caused by the severe acute respiratory syndrome (SARS-CoV-2) virus, has alerted us to the true implications of a global health emergency. Health care systems in both high- and low-to-middle-income countries were not prepared for an outbreak of this scale. In the future, a multidrug-resistant pathogen, a so-called “superbug”, has the potential to cause a pandemic with even more devastating consequences. AMR affects all infectious diseases and is not limited to one pathogen. Like SARS-CoV-2, resistant pathogens do not respect borders and can rapidly spread within and across countries. Several aspects of modern society, including expected population growth, urbanization, environmental aspects and increased travel of people and goods, further catalyse the spread of pathogens between regions. The very weak pipeline of new and novel antimicrobials to treat resistant infections further complicates any response to AMR. These reasons highlight the urgent need to prevent the further development and spread of AMR.

The COVID-19 pandemic has significantly impacted progress in addressing AMR, as antimicrobial use to treat secondary bacterial infections in COVID-19 patients or even as prophylaxis has risen around the globe during the pandemic (6,7). Owing to quarantine and other restrictions, immunization activities for both human and animals were affected and, consequently, could result in an increase in preventable infections. The pandemic has shown the devastating impact of hard-to-treat infections and the ease with which infections can spread and threaten global health security and the global economy. The pandemic also provided opportunities to strengthen diagnostic and laboratory capacities, strengthen infection prevention and biosecurity measures, and accelerate the awareness of good hygiene habits that can decrease the incidence of infections and optimize antimicrobial use. The lessons learned from the pandemic, including those related to laboratory capacity and surveillance, health care infrastructure, sanitation and hygiene, infection prevention and control measures as well as risk communication, need to be incorporated into ongoing AMR response efforts.

AMR will also continue to put substantial pressure on economies. The World Bank reports that by 2030, if no action is taken, the gross domestic product (GDP) shortfall due to AMR could be 3.4 trillion United States dollars (US\$) per year (8). By 2050, AMR could be responsible for the loss of 3.8% of the world’s annual GDP. Here again, the incremental costs due to AMR will increase existing inequities, including impacts on gender, and further heighten the gap

between developed and developing nations (Fig. 2). The World Bank also estimates that an additional 24 million people may be forced into extreme poverty, including hunger and malnutrition, due to the impact of AMR in just 10 years’ time. In Uganda, for instance, the economy lost 2.6 trillion Ugandan shillings (approximately US\$ 684.6 million) owing to costs associated with productivity loss due to tick-borne diseases in livestock, as a result of widespread acaricide resistance (9).

Fig. 2. Economic costs of AMR^a



GDP - Gross domestic product.

^a “Low-AMR” means low AMR impact; “High-AMR” means high AMR impact.

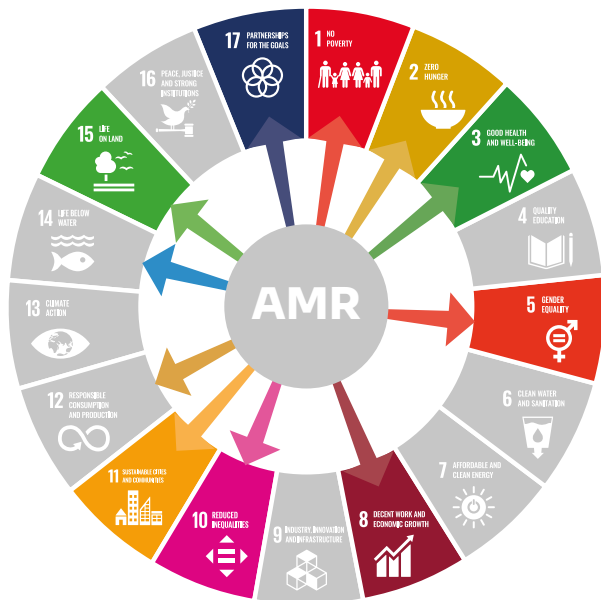
Source: World Bank (10).

Without continued action, the development and spread of AMR will hinder progress in achieving most of the SDGs. In turn, a focus on the SDGs is a way to contribute to AMR mitigation. For example, reducing

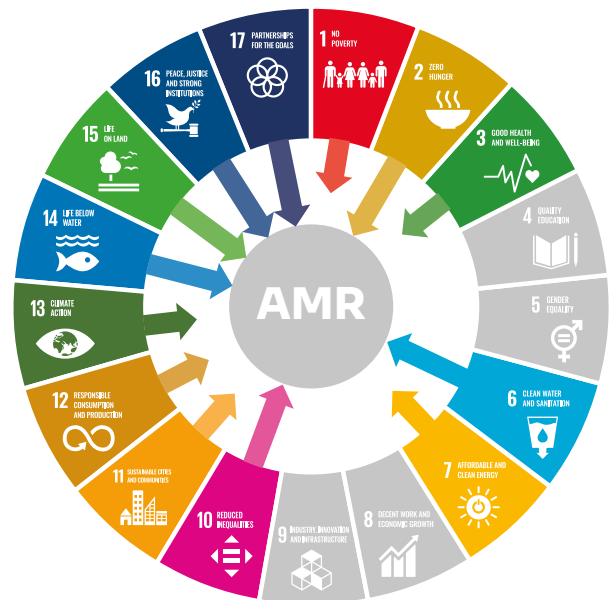
inequalities will help with the access to medicine, which will essentially lower AMR risks. Thus, a multifaceted response is crucial in strengthening the two-way relationship between AMR and the SDGs (Fig. 3).

Fig. 3. The two-way relationship between AMR and the SDGs

The emergence and spread of AMR will impede progress towards the 2030 agenda



Progress made on some SDGs will contribute to containing AMR



Source: World Bank (17).

Recognizing the urgent need to combat AMR at the national, regional and global levels, the global action plan on AMR (GAP-AMR) (12) was adopted in 2015 by all countries through decisions in the World Health Assembly (13), the FAO Governing Conference (14) and the

WOAH (formerly OIE) World Assembly (15). It was further endorsed by heads of state during the United Nations General Assembly in September 2016 (16).

In 2019, the World Health Assembly resolution emphasized the importance of a multisectoral approach to expedite the implementation of the AMR national action plans (NAPs) and mitigate the burden of AMR (17). This resolution was further reinforced by the recommendations of the ad hoc Interagency Coordination Group on AMR (IACG) established by the United Nations.¹

In response, the Food and Agriculture Organization of the United Nations (FAO), World Health Organization (WHO) and World Organisation for Animal Health (WOAH, founded as OIE) signed a memorandum of agreement to work collectively to address AMR at various governance levels and established the Tripartite Joint Secretariat on AMR.

**“ One Health collaboration
to address the threat
of AMR.”**



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¹ The five IACG recommendations are: (i) accelerate progress in countries; (ii) innovate to secure the future; (iii) collaborate for more effective action; (iv) invest for a sustainable response; and (v) strengthen accountability and global governance.

Fig. 4. Quadripartite memorandum of understanding heralds a new era of One Health collaboration to address the threat of AMR

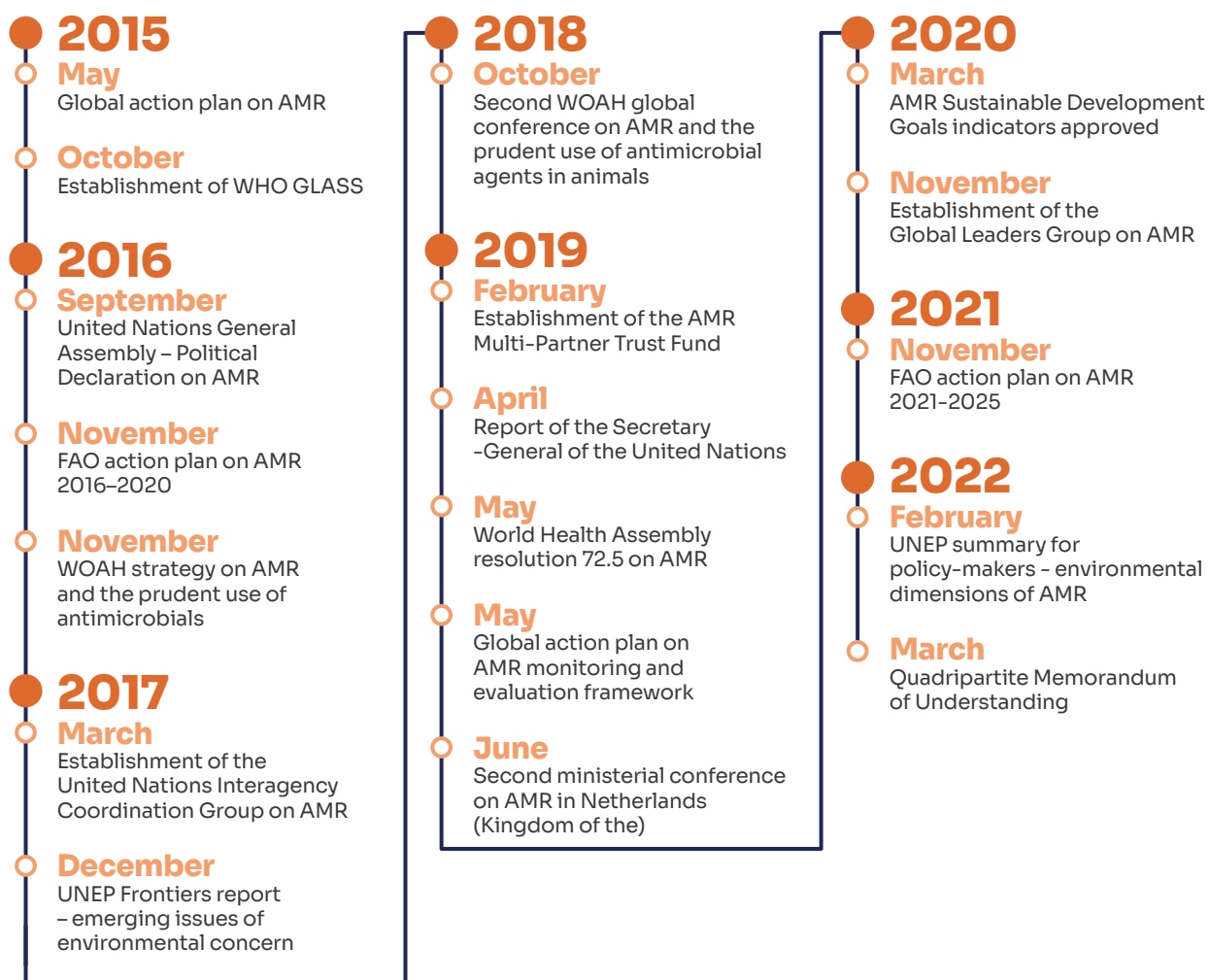


Source: Quadripartite Memorandum of Understanding (MoU) signed for a new era of One Health collaboration [website]. Geneva: World Health Organization; 2022.

The tripartites' aim was to lead and coordinate the global response to AMR across the One Health spectrum in close collaboration with the United Nations (UN) system and other organizations. In 2022, the quadripartite was founded after the United Nations Environment Programme (UNEP) joined the existing Tripartite. The Tripartite Joint Secretariat was then officially renamed to the Quadripartite Joint Secretariat on AMR (QJS).

Addressing the need to safeguard health threats at the animal–human–ecosystems interface, the four organizations signed a memorandum of understanding to strengthen cooperation to sustainably balance and optimize the health of humans, animals, plants and ecosystem interface on 17 March 2022 (Fig. 4). The timeline of key global events since the adoption of GAP-AMR in 2015 can be seen in Fig.5.

Fig. 5. Key global events since the Tripartite organizations' publication of the GAP-AMR, 2015–2022



Source: Quadripartite Monitoring and Evaluation Teams.

The GAP-AMR committed the tripartite to producing biennial reports on national and global progress in addressing AMR. A report was produced by the tripartite monitoring and evaluation teams in 2019 and was incorporated into a report of the United Nations Secretary-General as “Follow-up to the political declaration of the high-level

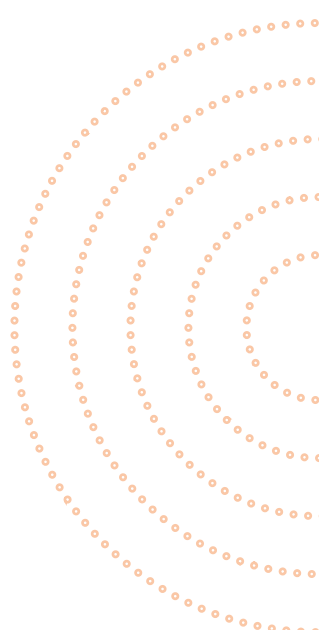
meeting of the General Assembly on AMR” (19). Members of the tripartite monitoring and evaluation teams further developed and published the global monitoring and evaluation (M&E) framework for the GAP-AMR in 2019 (20).

The global M&E framework was designed to facilitate the assessment of GAP-AMR implementation at the national and global levels. It provides a recommended list of indicators, including a selected number of indicators that are measured through the annual tracking AMR country self-assessment survey (TrACSS) that is developed and administered by the quadripartite M&E teams. In addition, these M&E teams provide targeted technical assistance to countries to establish and implement monitoring plans for their AMR NAPs.

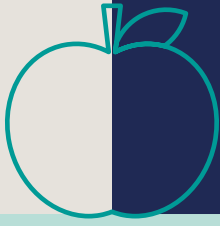
This is the first biennial progress report jointly produced by the quadripartite. The target audience includes policy-makers, technical staff, academics, researchers, members of civil society, private-sector representatives, development partners and donors. This report highlights the implementation of activities based on the recommendations and challenges provided in the 2019 UN Secretary-General report. It also captures progress in the implementation of AMR-relevant activities by countries and by the quadripartite between 2020 and the first quarter of 2022.

This report comprises the following: an introduction (Chapter 1); highlights of the quadripartite's contributions at all levels to the implementation of activities aligned with the GAP-AMR's five strategic objectives (Chapter 2); progress made by countries in implementing their AMR NAPs as measured through the TrACSS² (Chapter 3); actions taken by the newly established global governance and coordination structures (Chapter 4); an overview of the environmental dimensions of AMR (Chapter 5); and emerging issues and opportunities for accelerated action (Chapter 6). A series of country case studies are included in this report to highlight progress made at the national level.

Annex 1 provides a list of resources, including tools, guidelines and reports that support the implementation, monitoring and evaluation of AMR NAPs. Annex 2 gives an update on the status of data collection within the GAP-AMR M&E framework. Annex 3 presents the 2020–2021 TrACSS analysis of the selected indicators described in Chapter 3.



² Given the inclusion of UNEP in the quadripartite, the acronym TrACSS has now changed from “Tripartite AMR Country Self-Assessment Survey” to “Tracking AMR Country Self-Assessment Survey.”



2

Chapter 2.

Global action plan on AMR: implementation by the tripartite in 2020–2021*



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* Activities undertaken by UNEP are not included in this chapter as they officially joined the quadripartite only in 2022. Analysis of data from 2022–2023 will be published in 2024.



Background on the global action plan on AMR

The GAP-AMR is the blueprint to mitigate the burden of AMR by tackling its emergence and spread. The GAP-AMR provides an action framework across five objectives for stakeholders and countries to develop NAPs. Based on the GAP-AMR's five primary objectives (see the “GAP-AMR objectives” text box), this section captures the progress made at various levels of each of the tripartite between 2020 and 2021, reviews the impact, and discusses key risks and opportunities in implementing the GAP-AMR.

GAP-AMR objectives

Objective 1:

Improve awareness and understanding of AMR through effective communication, education and training

Objective 2:

Strengthen the knowledge and evidence base through surveillance and research

Objective 3:

Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures

Objective 4:

Optimize the use of antimicrobial medicines in human and animal health

Objective 5:

Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions

WHO activities to support GAP-AMR objectives

Objective 1:

Improve awareness and understanding of AMR through effective communication, education and training

World Antimicrobial Awareness Week (WAAW) aims to highlight global AMR and encourage best practices among the general public, health workers and policy-makers to prevent the development and spread of drug-resistant infections. Following a tripartite (now quadripartite) stakeholder consultation meeting in May 2020, the scope of WAAW was expanded from “antibiotics” to the broader term “antimicrobials” to increase stakeholder engagement. Dates for celebrating WAAW were also fixed to 18–24 November every year starting in 2020. The overall slogan for all sectors in 2020 (21) was “Antimicrobials: Handle with care”, and the theme for the human health sector was “United to preserve antimicrobials”. In 2021, the WAAW campaign theme (22) of “Spread awareness, stop resistance” called on everyone to be AMR awareness champions. A Go Blue for AMR campaign was also launched

that encouraged individuals to wear blue when participating in WAAW events and urged organizations and communities to light up their offices or monuments in blue. The campaign was a great success with many offices and landmarks lit up in blue.

Regional activities

Countries across all WHO regions reported participating in WAAW campaigns or national activities to raise awareness and an understanding of AMR risks among various stakeholders, including the public, health care workers and policy-makers. WHO regional offices provided countries in their region with diverse WAAW materials, such as videos, digital tools, social media messages and webinars.

To advance greater awareness of AMR among the public, health care workers and policy-makers, the WHO Regional Office for Africa launched the Resist the resistance campaign (23). The campaign provided fact sheets, powerful testimonials, succinct information based on evidence and a short video (24). An excellent example of a country-specific effort was a scientific meeting in Sierra Leone to review the status of AMR drivers, including the use of antibiotics in selected health facilities, human immunodeficiency virus (HIV) drug resistance, health financing

and AMR costs, surgical site infections and infection prevention and control (IPC) strategies for AMR (25). The WHO African Region also joined forces with five other regional bodies to organize week-long events to highlight the need for stronger governance to address AMR as part of WAAW 2021 (26).

Countries in the WHO Region of the Americas continued to participate in WAAW despite the impact of COVID-19 (27). In November 2021, a regional dialogue on the role of the community in the AMR response in the context of COVID-19 took place, which closed with a declaration from all signatory participants recognizing the depth of the AMR problem (28, 29). The Working Together to Fight AMR project, supported and financed by the EU in collaboration with the Pan American Health Organization (PAHO), FAO and WOA, was aimed at implementing the AMR NAPs by working with seven Latin American partner countries – Argentina, Brazil, Chile, Colombia, Paraguay, Peru and Uruguay. One of the main achievements of the four-year programme (2020–2023) was a WAAW campaign at both the regional and national levels that reached more than 98 million people (30). In July 2021, PAHO also published its “Plan of action on AMR: final report”, which indicates the status of the plan’s implementation based on targets set in 2015 (31).

Spread awareness, stop resistance.

In the third progress report on the implementation of AMR NAPs in the WHO South-East Asia Region, all countries in the area reported that the campaign for AMR had been undertaken regularly every year, especially during WAAW (32). WAAW has become a useful forum to engage all stakeholders from the human, agriculture, veterinary and environmental sectors in an educational campaign and to hold joint interagency awareness-raising workshops. Additionally, the region’s 11 countries reported incorporating training materials on AMR into health workers’ pre-service and in-service curricula.

In the WHO European Region, WAAW continues and broadens the scope of European Antibiotic Awareness Day, including many non-European Union (EU) countries. Numerous countries in the region publish local language versions of WAAW materials produced by the WHO Regional Office for Europe. Acknowledging that knowledge alone is not enough to change behaviour, however, the Regional Office published a handbook on using behavioural insight methodologies to guide appropriate, context-specific interventions on AMR,

called “Tailoring AMR Programmes” (33). The WHO Regional Office for Europe has also produced a series of advocacy briefs on AMR and its links to other topics, such as gender (34), food safety (35), immunization (36), COVID-19 (37) and many more.

Over the past two years, the WHO Regional Office for the Eastern Mediterranean supported countries with WAAW materials in English and Arabic, used athletes in the region as AMR champions and organized joint WAAW activities with the WHO Regional Office for Africa and a joint media briefing with FAO and WOAHA on the role of media and AMR (38, 39). The WHO Regional Office for the Eastern Mediterranean also promoted behaviour change interventions in the region, providing support to Egypt and Sudan in using an adapted Tailoring AMR Programme model to develop behaviour

change interventions (40, 41). In order to facilitate the monitoring of progress in the implementation of the NAPs at the national level, the Regional Office developed a regional AMR M&E framework, including 36 core AMR and IPC indicators.

Within the WHO Western Pacific Region, 17 countries (out of 27) held activities to celebrate WAAW 2021, which continued the “Stewards for the future” pledge and campaign that the WHO Regional Office for the Western Pacific launched to broaden engagement across the region (42). In 2020, the Regional Office and countries focused on engaging health professional societies and associations. In 2021, they expanded to engage global and regional patient groups to build coalitions, expand networks and inform and raise awareness in these groups on the societal value of fighting AMR.

Objective 2:

Strengthen the knowledge and evidence base through surveillance and research

Global AMR and AMC surveillance in human health

In 2015, WHO launched the Global AMR and Use Surveillance System (GLASS), which provides a standardized approach to the collection, analysis, interpretation and sharing of national AMR data on selected bacterial pathogens that commonly cause infections in humans. New modules have been developed in GLASS over the years, including a routine surveillance module for antimicrobial consumption (GLASS-AMC) and other surveillance activities in focused surveillance modules and surveys (43).

GLASS works through the three levels of WHO – headquarters and regional and country offices – and is supported by its network of AMR collaborating centres. GLASS also works closely with existing regional AMR networks, such as the Central Asian and European Surveillance of AMR network, the European AMR Surveillance network and the Latin American Network for AMR Surveillance.

The GLASS 2020 report (44) notes that 91 countries and territories have enrolled in GLASS, with 66 countries providing AMR data. The majority of the infections reported were urinary tract infections (79%), followed by bloodstream infections (20%). The variation in the types of data submitted and their completeness and representativeness is still wide, so the results must be interpreted carefully.

The GLASS 2021 report (45) notes that as of April 2021, 107 countries or territories had enrolled in GLASS, with 70 countries submitting data. The 2021 report highlights higher rates of the two AMR SDG 3.d.2 associated indicators – bloodstream infections caused by *Escherichia coli* resistant to third-generation cephalosporins and by methicillin-resistant *Staphylococcus aureus* – in lower-middle-income countries (LMICs) compared to high-income countries (HICs) (46). High rates of resistance to last-resort antibiotics, such as carbapenems, or first-line drugs, such as co-trimoxazole, were also reported. Some countries reported a high level of resistance to first-line empirical treatment in *Neisseria gonorrhoeae*, which warrants further analysis to inform guidelines.

The GLASS 2022 report (47) marks the end of the first five years of early implementation, during which the system quickly expanded to cover 72% of the world's population. It summarizes data from 87 countries on AMR in bacteria that cause disease in humans and provides data on AMC in humans from 27 countries. The report reveals very high levels of resistance in bacteria causing life-threatening bloodstream infections, as well as increasing resistance to treatment in several bacteria causing common infections in the community:

- In hospitals, high levels (above 50%) of resistance were reported in bacteria causing bloodstream infections, such as *Klebsiella pneumoniae* and *Acinetobacter* spp. These life-threatening infections require treatment with last-resort antibiotics, such as carbapenems. However, 8% of bloodstream infections caused by *K. pneumoniae* were reported as resistant to carbapenems, increasing the risk of death due to unmanageable infections.

“Several bacteria causing common infections in the community are becoming more resistant to treatment.”

“To mount an effective worldwide response to antimicrobial resistance, we must track and map out this global threat.”

**– Dr Tedros Adhanom Ghebreyesus
WHO Director-General**

- In the community, several common bacterial infections are becoming increasingly resistant to treatments. Over 60% of *Neisseria gonorrhoeae* isolates, causing gonorrhoea, the common sexually transmitted disease, have shown resistance to one of the most used oral antibacterials, ciprofloxacin. Over 20% of *Escherichia coli* isolates, the most common pathogen in urinary tract infections, were resistant to both first-line drugs (ampicillin and co-trimoxazole) and second-line treatments (fluoroquinolones).
- New analyses show that countries with a lower testing coverage, mostly LMICs, were more likely to report significantly higher AMR rates for most bug-drug combinations. This may be (partly) due to the fact that, in many LMICs, a limited number of referral hospitals report to GLASS. The patients in these hospitals are often the sickest, who may have received previous treatment with antibiotics.

GLASS 2022 and SDG 3.d.2 indicators:

- the AMR SDG indicators showed 42% (*Escherichia coli*) and 35% (methicillin-resistant *S. aureus*) median resistance for all countries, but 11% and 6.8%, respectively, when only countries with high testing coverage were considered.

GLASS-AMC surveillance. The new technical GLASS-AMC module provides a common, standardized set of methodologies for measuring and reporting the consumption of antimicrobial medicines in the human health sector at the country, regional and global levels. AMC data are estimates derived from aggregated data sources, ranging from the macro level, such as import and distribution, to the micro level, such as data on prescriptions and insurance reimbursements. Countries enrolled in GLASS-AMC are asked to provide two types of information:

i) national AMC consumption data from the previous year; and ii) data on the level of implementation of their surveillance system. AMC data provide a basis for countries to understand the patterns and volume of national AMR consumption, and support the development of guidelines and policies for the optimal use of antimicrobials, regulations and interventions. Several guidance documents on GLASS-AMC have been published to help countries monitor AMC (48–51).

WHO AMC Target: Consumption of ≥60% of “Access” group antibiotics.

- In the GLASS 2022 report, AMC surveillance data show that 65% of 27 reporting countries met WHO’s target of ensuring that at least 60% of antimicrobials consumed are from the Access group of antibiotics, i.e. antibiotics that, according to the WHO AWaRE classification, are effective in a wide range of common infections and have a relatively low risk of creating resistance.

Neglected tropical diseases

AMR in neglected tropical diseases (NTDs) should not be ignored. For NTDs specifically, the potential emergence of drug resistance is real: many programmes depend heavily on antimicrobials for preventive and curative chemotherapy. Widespread resistance to currently used medicines has the potential, therefore, to jeopardize entire interventions and put at risk global programmes that currently treat millions of marginalized populations. With the goal of raising awareness of global AMR and encouraging best practices among stakeholders and policy-makers to avoid the emergence and spread of AMR in NTDs, a webinar was organized on NTDs and the prevention of AMR, and a report was published (52). The webinar highlights current challenges in managing NTDs due to AMR that include leprosy, yaws, trachoma and visceral leishmaniasis, and the importance of monitoring drug efficacy in preventive chemotherapy medicines with a particular focus on resistance to anthelmintics. Most importantly, the experts called on the need to address NTDs and AMR with a One Health intervention and discussed the feasibility and challenges.

Malaria

Antimalarial drug resistance has repeatedly emerged, threatening the ability to treat malaria and progress towards malaria elimination. In 2020, there were an estimated 241 million malaria cases worldwide (53). The *Global technical strategy for malaria 2016–2030* (54) calls on countries and global malaria partners to monitor the efficacy of antimalarial medicines so the most appropriate treatments can be selected for national policies. WHO has a global database on antimalarial drug efficacy and resistance, and continues to update the data therein. These data are made public through the *Malaria Threats Map* (55), and the *2020 Report on antimalarial drug efficacy, resistance and response: 10 years of surveillance (2010–2019)* (56). Artemisinin-based combination therapies were originally introduced as treatment for *Plasmodium falciparum* in the early 2000s to respond to the emergence of drug resistance impacting monotherapies such as chloroquine and sulfadoxine-pyrimethamine.

The emergence and the spread of multidrug resistance in the Greater Mekong subregion led to the development and launch in 2015 of the *Strategy for malaria elimination in the Greater Mekong subregion (2015–2030)* (57). In 2021, the five subregion countries – Cambodia, Lao People’s Democratic Republic, Myanmar, Thailand and Viet Nam

– reported 65 297 malaria cases, a 16% reduction from 2020. China was the first country in the subregion to be declared malaria free in 2021. In other parts of the world, artemisinin partial resistance is suspected to have emerged in Papua New Guinea. Recent evidence of the independent emergence of artemisinin partial resistance in Africa is of great global concern. WHO will work with countries to develop a strategy to address antimalarial drug resistance to respond to this threat in a coordinated manner. This strategy (58) was launched in 2022.

Sexually transmitted infections

The *Global health sector strategy on sexually transmitted infections 2016–2021* (59) prioritized addressing AMR in *Neisseria gonorrhoeae*. Based on this strategy, about 70 countries are monitoring AMR in *N. gonorrhoeae*. The current *Global health sector strategies on HIV, viral hepatitis and sexually transmitted infections 2022–2030* (60) continue to prioritize AMR in *N. gonorrhoeae* with the aim of reducing the incidence of gonorrhoea by 90%.

Data from 2021 estimated the annual gonorrhoea incidence to be 84 million globally, as reported in the 2021 progress report on HIV, viral hepatitis and sexually transmitted infections (STIs) (61). A high proportion of countries are reporting high

rates of quinolone resistance, and countries are increasingly reporting azithromycin resistance and the emergence of ceftriaxone resistance in *N. gonorrhoeae*. Data on AMR in gonorrhoea are also accessible at the Global Health Observatory (62). In September 2021, *The Lancet Microbe* published the latest results from a retrospective observational study of WHO’s global AMR and use surveillance platform (GASP/GLASS) (63) for *N. gonorrhoeae* isolates from 2017 to 2018. Seventy-three countries contributed data to the biennial report on the status of AMR in gonorrhoea, which confirmed that resistant gonococcal strains are globally widespread (64). Because of the limitation of quality and standardized AMR data in *N. gonorrhoeae* and in order to have accurate and comparable data globally and to detect emerging resistance, gonococcal culture-based AMR monitoring needs to be standardized and linked to clinical and epidemiological data. To address these needs, the Enhanced Gonococcal Antimicrobial Surveillance Programme was initiated (65).

WHO was recently selected to partner with the US Centers for Disease Control and Prevention on a project to expand the Enhanced Gonococcal Antimicrobial Surveillance Programme globally by supporting implementation in 10 additional LMICs that have a high burden of *N. gonorrhoeae* and are at risk of developing

AMR. The project will further strengthen the programme's reach in the two early adopter countries of the methodology (66). In 2020, WHO published four target product profiles for medical treatments, one of which was for the therapy of diagnosed, uncomplicated gonorrhoea, and helped provide further detailed guidance for the research and development (R&D) community on the profile of drugs needed (67).

In 2021, WHO published new guidelines for the management of symptomatic STIs (68). These guidelines aim to raise the quality of care in managing people with symptoms of STIs by providing evidence-based, practical recommendations, especially in resource-limited settings, that would consequently conserve gonorrhoea treatment and delay the development of resistance.

Drug-resistant tuberculosis

Drug-resistant tuberculosis (TB) continues to be a public health threat. WHO uses five categories to classify cases of drug-resistant TB: isoniazid-resistant TB, rifampicin-resistant TB (RR-TB) and multidrug-resistant TB (MDR-TB), plus pre-extensively drug-resistant TB and extensively drug-resistant TB. Globally, the burden of MDR-TB or RR-TB (MDR/RR-TB) is stable. For more than 10 years, the best estimate of the proportion of people

diagnosed with TB for the first time who had MDR/RR-TB has remained at about 3–4% and the best estimate for those previously treated for TB has remained at about 18–21%. Globally, in 2020, 71% (2.1/3.0 million) of the people diagnosed with bacteriologically confirmed pulmonary TB were tested for rifampicin resistance, up from 61% (2.2/3.6 million) in 2019, and 50% (1.7/3.4 million) in 2018. Among them, 132 222 cases of MDR/RR-TB and 25 681 cases of pre-extensively drug-resistant TB or extensively drug-resistant TB were detected, for a combined total of 157 903. Worldwide, 150 359 people with MDR/RR-TB were enrolled in treatment in 2020, down 15% from the total of 177 100 in 2019. This level of enrolment was equivalent to approximately one in three of the people who develop MDR/RR-TB each year. Reversals in progress in the number of people enrolled in treatment mean that the global targets set at the United Nations High-level Meeting appear increasingly out of reach. The cumulative total number of people with MDR/RR-TB who were reported as enrolled in treatment from 2018 to 2020 was 482 683, only 32% of the five-year target (2018–2022) of 1.5 million. Considering children specifically, the cumulative number was 12 219, only 11% of the five-year target of 115 000 (69).

HIV drug resistance

Antiretroviral therapy has been increased: by the end of 2020, 27.5 million people had received this therapy globally. However, HIV drug resistance can compromise the effectiveness of antiretroviral drugs in reducing HIV incidence and HIV-associated morbidity and mortality. To minimize the emergence and transmission of drug-resistant HIV, WHO recommends that antiretroviral therapy and pre-exposure prophylaxis programmes be accompanied by measures to monitor the quality of their delivery and the routine surveillance of HIV drug resistance. According to the 2021 HIV drug resistance report (70), 66 countries implemented surveys of HIV drug resistance between 2004 and 2021. At the end of 2021, 34 countries planned to conduct HIV drug resistance surveys over the next two years. The 2021 report highlights progress in the following areas: “(1) increased uptake of HIV drug resistance surveys from 37 surveys in 23 countries between 2014 and 2016 to 113 surveys in 47 countries between 2017 and 2020; (2) increased response to high levels of pretreatment drug resistance; (3) increase in the number of countries achieving high levels of viral suppression ($\geq 90\%$) from 33% in 2017 to 80% in 2020; (4) designation of an additional five laboratories to support HIV drug resistance genotyping; (5) progress by the global research community in addressing

critical research gaps related to HIV drug resistance; (6) increase in the number of countries with a NAP on HIV drug resistance from 46% (13 of 28) of countries with a high burden of HIV in 2018 to 64% (25 of 39) in 2020; and (7) increased funding support by global donors on HIV drug resistance surveillance and monitoring. Between 2018 and September 2021, the Global Fund funded 42 surveys in 22 countries, and the United States of America (USA) President’s Emergency Plan for AIDS Relief (PEPFAR) supported 44 surveys in 18 countries reporting data to WHO.”

AMR surveillance in WHO regions

The WHO African Region has provided support to countries in the area to strengthen their AMR and AMU surveillance systems over the past two years. WHO has trained staff from various ministries on the use of WHONET software, an essential data tool developed for the management and analysis of microbiology laboratory data with a special focus on the analysis of antimicrobial susceptibility test results. It also promotes collaboration and data sharing across subnational, national and global levels. More specifically, the WHO African Region supported Nigeria in improving surveillance (in 10 sentinel sites) and AMR stewardship (in three selected tertiary hospitals) in response to the GAP-AMR (71).

Another example is the technical assistance provided to the Democratic Republic of the Congo to fill gaps, harmonize practices, acquire and update practical skills in the management and interpretation of microbiology laboratory data, particularly antimicrobial susceptibility testing (AST), and help strengthen the country's AMR surveillance systems. The training programme for more than 30 staff in the human and animal sectors included hands-on exercises related to WHONET installation, data capture, analysis and interpretation. The newly trained national professionals will in turn train about 40 people in the first five provinces of the Democratic Republic of the Congo and, gradually, capacities will be strengthened throughout the country.

Based on a summary of its work on fighting AMR in the Americas, by 2020, PAHO had provided laboratory AMR assessments and recommendations to 22 countries in the region over the previous four years. Additionally, all countries in PAHO have received between one and five AMR capacity-building training sessions to improve the detection of AMR in health care settings over the past three years (72). As of 2020, 19 of 35 countries in the region have participated in the Latin American Network for AMR Surveillance (73, 74). Seven of these countries officially joined GLASS (75). PAHO is also supporting horizontal

cooperation between Argentina and 14 Caribbean member countries to strengthen national and regional AMR surveillance in the Caribbean (76). In 2021, PAHO published its "Protocol for Enhanced Isolate-Level AMR Surveillance in the Americas. Primary Phase: Bloodstream Infections", which provides technical guidance to integrate patient, laboratory and epidemiological data to monitor AMR emergence, trends and effects in the population (77).

Based on the third progress report on the implementation of AMR NAPs in the WHO South-East Asia Region, around 90% of countries in the area report having established a national AMR human surveillance system. Additionally, 90% of countries have an established mechanism for the national laboratory network for humans. However, none of the countries has implemented an AMR early warning system yet.

In the WHO European Region, the main surveillance mechanisms for collecting AMR data are through the European AMR Surveillance network, collecting data from 30 countries, and the Central Asian and European Surveillance of AMR network, collecting data from 19 countries as of 2020 (78, 79). In combination, these two networks provide surveillance data for 49 of the 53 Member States in the WHO European Region but, as of 2020, only 29 of 53 countries are

enrolled in GLASS (80). A joint publication between the European Centre for Disease Prevention and Control and the WHO Regional Office for Europe using 2020 AMR data indicates that AMR is widespread in the WHO European Region, and a north-to-south and west-to-east gradient was observed, with higher AMR percentages in the southern and eastern parts of Europe (81). The WHO Regional Office also promotes Better Labs for Better Health, an intersectoral approach to strengthen health laboratories, including AMR laboratories, to improve health and the early detection of acute public health events (82).

By 2021, all 21 countries in the WHO Eastern Mediterranean Region were enrolled in GLASS. A peer-review analysis of the AMR burden in the region from 2017 to 2019 showed that, in 2019, up to 18 countries in the region reported data to GLASS (83). In 2021, a WHO regional assessment of the capacities of national reference laboratories for AMR found improvement in 14 countries compared to previous regional assessments. The WHO Regional Office for the Eastern Mediterranean has supported the implementation of the One Health surveillance extended spectrum beta-lactamase (ESBL) *Escherichia coli* Tricycle Project in Jordan, Morocco, Pakistan and the Islamic Republic of Iran.

Objective 3:

Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures

Infection prevention and control

Reducing the incidence of infections in health care facilities and in the community through IPC measures, through water, sanitation and hygiene (WASH) measures, and through immunization activities are essential to prevent the emergence and spread of AMR pathogens.

Inadequate IPC measures result in harm to patients as well as health workers due to health-care-associated infections and AMR, and are also an indicator of poor-quality health care delivery. The 2022 report on infection prevention and control (84) highlights that up to 70% of these infections can be prevented by expanding an array of effective IPC interventions. The global report also notes, however, that the percentage of countries with a national IPC programme did not improve from 2017 to 2022. Furthermore, in 2021–2022, only four of 106 assessed countries (3.8%) had all the minimum requirements for IPC in place at the national level. This is reflected in the inadequate implementation of IPC practices

at the point of care, with only 15.2% of health care facilities meeting all of the IPC minimum requirements, according to a WHO survey in 2019.

While progress has been made in some areas, the report notes that HICs are eight times more likely to have more advanced IPC programmes and to have implemented prescribed practices than LICs. This demonstrates, once again, that IPC is also a problem of equity and access to quality health care.

Investing in IPC is one of the most effective and cost-saving interventions available. The global IPC report notes that hand hygiene and environmental hygiene in health care facilities could more than halve the risk of dying as a result of infections with AMR pathogens, and decrease the associated long-term complications and health burden by at least 40%. In the global report, WHO provides key directions and priorities to accelerate efforts and progress on IPC at all levels. In the past two years, a number of new technical guidance documents and training programmes have been developed to assist countries in various aspects of strengthening IPC (85–88).

66 1.8 billion people were using health care facilities that lacked basic water services, and 800 million people were using facilities with no toilets.

Water, sanitation and hygiene. In 2020, WHO and UNICEF published the *Global progress report on water, sanitation and hygiene in health care facilities: fundamentals first* (89). The report provided a striking picture when it was published: 1.8 billion people were using health care facilities that lacked basic water services, and 800 million people were using facilities with no toilets. As also highlighted in World Health Assembly report A74/43 Rev.1 in 2021, (90) updated data from the WHO/UNICEF Joint Monitoring Programme show that major gaps exist globally: one in four facilities have no basic water services, one in 10 have no sanitation services and one in three do not have adequate facilities to clean hands at the point of care. Furthermore, one in three do not segregate waste safely.

In 2020, WHO held a series of Water and Sanitation for Health Facility Improvement Tool training webinars (91), in addition to a global webinar series on IPC in the context of COVID-19 in collaboration with the US Centers for Disease Control and Prevention. Also in 2020, WHO and UNICEF launched the Hand Hygiene for All Global Initiative, aimed at ensuring the implementation of WHO global recommendations on hand hygiene in the context of COVID-19 (92). WHO continues to celebrate its global SAVE LIVES: Clean Your Hands campaign on hand hygiene in health care on 5 May every year.

In 2020, WHO, FAO and WOAHA jointly developed a document entitled “Technical brief on water, sanitation, hygiene and wastewater management to prevent infections and reduce the spread of AMR” (93). This brief provides a summary of the evidence and rationale for WASH and wastewater actions within AMR NAPs and sector-specific policy to combat AMR. It reinforces the fact that wastewater management in all sectors is critical to preventing infections and reducing AMR.

To assist countries in conducting assessments of WASH in health care facilities and in tracking progress, a number of technical tools, guidance documents and portals have been developed (94–96).

Immunization and AMR

Vaccines are powerful tools to prevent infections and therefore have the potential to curb the spread of AMR infections and reduce the use of antimicrobials (97). Vaccines can prevent part of the AMR burden by preventing drug-sensitive and drug-resistant infections, reducing antibiotic use and reducing pathogen transmission and chances of developing resistance genes. Increasing evidence from observational and modelling studies show the impact of vaccines on AMR.

“Vaccines can prevent AMR by reducing infections, and thereby reducing the use of antibiotics.”

WHO released the first-ever report (98) on the pipeline of vaccines currently in development to prevent infections caused by antimicrobial-resistant bacterial pathogens. WHO’s analysis points to the need to accelerate trials for AMR-related vaccines in late-stage development and maximize the use of existing vaccines. The analysis identifies 61 vaccine candidates in various stages of clinical development, including several in the late stages, to address diseases listed on the bacterial priority pathogens list, which WHO has prioritized for R&D. While the

report describes these late-stage candidates as having a high-development feasibility, the report cautions that most will not be available any time soon.

Vaccines are already available against four priority bacterial pathogens: pneumococcal disease (*Streptococcus pneumoniae*), Hib (*Haemophilus influenzae* type b), TB (*Mycobacterium tuberculosis*) and typhoid fever (*Salmonella Typhi*). Current Bacille Calmette–Guérin vaccines against TB do not adequately protect against the disease, and the development of more effective vaccines against TB should be accelerated. The remaining three vaccines are effective, and the number of people receiving them must be increased to contribute to reducing the use of antibiotics and preventing further deaths.

WHO helped develop an action framework (99) intended to guide vaccine stakeholders to maximize the impact of vaccines in preventing AMR. It was the result of a collaboration between WHO, the Wellcome

Trust, the Bill & Melinda Gates Foundation and the Center for Disease Dynamics, Economics & Policy (now called the One Health Trust). The framework was developed through a consensus-building consultative process involving experts from academic institutions, country representatives, leaders of nongovernmental organizations and pharmaceutical industry executives. It supports a strategic vision based on three goals with appropriate objectives (see the “Goals and objectives to maximize the impact of vaccines against AMR” text box) (100).

Vaccination coverage against four priority bacterial pathogens needs to be increased: pneumococcal disease (*Streptococcus pneumoniae*), Hib (*Haemophilus influenzae* type b), TB (*Mycobacterium tuberculosis*) and typhoid fever (*Salmonella Typhi*).

Goals and objectives to maximize the impact of vaccines against AMR

Goal 1. Expand the use of licensed vaccines to maximize impact on AMR

Objective 1. Increase coverage of vaccines with impact on AMR

Objective 2. Update recommendations and normative guidance in both the vaccine and AMR sectors to include the role of vaccines to control AMR

Objective 3. Improve awareness and understanding of the role of vaccines in limiting AMR through effective communication, education, and training

Goal 2. Develop new vaccines that contribute to prevention and control of AMR

Objective 4. Bridge the funding gap for R&D of new vaccines with potential for global AMR impact

Objective 5. Develop regulatory and policy mechanisms to accelerate approval and use of new vaccines that can reduce AMR

Goal 3. Expand and share knowledge of vaccine impact on AMR

Objective 6. Improve methodologies and increase collection and analysis of data to assess vaccine impact on AMR, including antimicrobial use

Objective 7. Develop estimates of vaccine value to avert the full public health and socioeconomic burden of AMR



To articulate the value of vaccines against AMR, WHO is developing a value attribution framework for vaccines against AMR. This semi-quantitative framework aims to apprise vaccine funders, developers, researchers and policy-makers of the potential value of vaccines against AMR. The framework seeks to inform decisions on which vaccines to develop, when to introduce them to country immunization programmes, and how they might best be utilized. The framework considers the value of vaccines for 30 pathogens across five criteria: (i) the vaccine-averted AMR health burden (i.e. the proportion of vaccine-averted deaths due to an infection with a resistant pathogen); (ii) the vaccine-averted AMR economic burden (i.e. the proportion of vaccine-averted economic burden due to an infection with a resistant pathogen); (iii) vaccine-averted antibiotic use (i.e. the proportion of vaccine-averted antibiotic use associated with a pathogen); (iv) the urgency of the AMR threat; and (v) the pathogen impact on equity and social justice.

Activities in WHO regions

As of 2020, 24 of 35 countries in the WHO Region of the Americas had an IPC programme that included mandatory surveillance for health-care-associated infections, and 28 countries had conducted evaluations of IPC capacities using a standardized guide (101). In 2021, PAHO published a policy brief for decision-makers on how the COVID-19 pandemic has fuelled the ongoing AMR crisis, which outlines the need to continue prioritizing the AMR response. It also encourages countries to measure and monitor the impact of the COVID-19 pandemic on AMR epidemiology in the region (102).

Ten countries (90%) in the WHO South-East Asia Region have implemented IPC programmes in their health care settings, according to the third progress report on the implementation of AMR NAPs in the region. Six countries (54%) had a monitoring system for health-care-associated infections and AMR, and all countries in the region report that a sanitation and hygiene programme has been implemented. During the COVID-19 pandemic, the hand washing programme was enforced at all health facilities and hospitals. The region's 11 countries have implemented

pneumococcal conjugate vaccination to prevent pneumococcal infection. This is notable progress compared to the situational analysis in 2018 (54%).

In 2021, the WHO Regional Office for Europe published a document on IPC guidance to action tools (103) to ensure reliable improvements in IPC practices. It contains several aide-memoires, including ones on respiratory and hand hygiene (104), the procurement and use of personal protective equipment (105), and environmental cleaning, waste and linen management (106). The Regional Office also published a five-step roadmap booklet called “Understanding accelerators and overcoming barriers to IPC guideline development or adaptation”, which provides an easy-to-follow approach to accelerate a country’s journey to guideline development (107).

Evidence-based national IPC guidelines are the fundamental building blocks to expand IPC programmes. In the WHO Eastern Mediterranean Region, five additional countries and territories developed their national IPC guidelines for the first time in 2021. The WHO Regional Office for the Eastern Mediterranean conducted nine IPC country missions in 2021 to assess

the capacity of countries to respond to the COVID-19 pandemic and provide recommendations to enhance their national and facility-level IPC programmes. The Regional Office also reviewed and updated national IPC guidance documents in the context of COVID-19 for eight countries in the region. For the Eastern Mediterranean Region, the implementation of IPC against COVID-19 represents a lasting contribution to prevent the spread of AMR, since several countries took important initial steps towards establishing and sustaining IPC programmes (108). The WHO Regional Office for the Eastern Mediterranean delivered five virtual IPC webinars in 2021, targeting 650 health care workers. A series of IPC training courses targeted 1800 health care workers from seven countries in collaboration with the WHO Collaborating Centre in Saudi Arabia. In addition, 54 hospitals in five crisis-affected countries implemented a multimodal intervention strategy to identify gaps in IPC practices, improve the implementation of key behaviours and monitor the improvements of priority IPC indicators to reduce the spread of multidrug-resistant organisms.

Objective 4:

Optimize the use of antimicrobial medicines in human and animal health

Optimizing the use of antimicrobial medicines across human, animal and plant health is a cornerstone of the GAP-AMR. WHO defines antimicrobial stewardship (AMS) as a coherent set of integrated actions that promote the responsible and appropriate use of antimicrobials to help improve patient outcomes across the continuum of care. The responsible and appropriate use of antimicrobials includes prescribing them only when needed, selecting the optimal drug regimen, and optimizing the dosing, route of administration and duration of treatment following proper and accurate diagnosis.

To support countries in their AMS efforts, WHO developed a practical toolkit to assist AMS activities at the health-care-facility-level in LMICs; this has helped advance implementation at the national level as well as within health care facilities and clinical practice (109). However, the effective implementation of AMS activities in health care facilities requires a comprehensive approach, beyond the facilities, at the national policy and programme levels. Hence,

WHO developed a guidance document that aims to provide a set of evidence-based and pragmatic recommendations to drive comprehensive and integrated AMS activities under the purview of a central national coordination unit, national AMR steering or coordinating committees or other equivalent national authorities. The policy guidance (110) complements the GAP-AMR, the WHO practical toolkit for AMS programmes in health care facilities in LMICs and other WHO guidance in surveillance, IPC and WASH. The guidance was developed based on consultations in various WHO regions.

To help build capacity in countries to implement AMS activities, WHO developed three specific online training courses, designed for clinical practitioners, policy-makers, programme managers and health care workers (111-113).

Throughout 2021 and 2022, WHO and the Global Antibiotic Research and Development Partnership, with strategic input from UNICEF and the Clinton Health Access Initiative, developed a new concept for access to generic and newly registered antibiotics: SECURE – the Antibiotic Facility (114). In 2022, the facility was mentioned as an important global health initiative by the ministers of health of both the G7 and the G20. SECURE will move from concept to project and start its implementation phase in 2023.

Activities in WHO regions

Tackling AMR requires a comprehensive set of interventions that include AMS, hospital hygiene, the use of diagnostic tests to support prescribing and mass media campaigns for optimal AMU.

The WHO African Region has worked closely with ministries of health to conduct point prevalence surveys to provide baseline data on antibiotic use in hospitals. These data have served as a starting point for identifying gaps and carrying out the necessary interventions to optimize antibiotic use in these facilities. Specific efforts were conducted in the United Republic of Tanzania, including using the WHO's toolkit for AMS programmes in health care facilities in LMICs to build the capacities of the newly constituted AMS committees in three hospitals on the concept of AMS (115).

With PAHO support, seven countries started collecting information on AMC in 2020 (116). These countries join six others that already recorded their consumption in 2019 and 2020. The data collection and recording tool provided by PAHO is a validated methodology, which also allows data to be exported to the GLASS-AMC module. In 2021, PAHO developed a “Handbook for Communication on the Rational Use of Antimicrobials for the Containment of Resistance” to help communication

and health programme officials develop communication strategies to promote the importance of the appropriate use of antimicrobials among different stakeholders (117).

As reported in the third progress report on the implementation of AMR NAPs in the WHO South-East Asia Region, eight countries in the region have implemented AMS in health care settings. Seven countries (63%) had an official AMR containment policy to control the human use of antimicrobials and AMS. In all countries (100%), a functional national regulatory agency was mandated to control the production, importation, sale and use of medicinal products, including antimicrobials. The regulation of pharmacies pertaining to over-the-counter sale and inappropriate sale of antibiotics and active pharmaceutical ingredients existed in nine countries (81%); the enforcement of the regulations, however, may vary across countries. In 90% of countries, a functioning surveillance system existed for medicine use and sale among humans, including antimicrobials, run by the national regulatory agency. As of April 2022, only six countries in the region have officially enrolled in the WHO GLASS-AMC module.

In 2021, the WHO Regional Office for Europe published a guide on antimicrobial stewardship interventions (118) that describes 10 commonly used stewardship

interventions that promote the optimal use of antimicrobials at health care facilities, along with implementation considerations for these interventions, especially for low-resource settings. The WHO Regional Office for Europe has also supported Member States with an ongoing series of evidence briefs for policy on promoting the appropriate use of antibiotics in health systems and facilities to tackle AMR in Estonia (119), Greece (120) and North Macedonia (121) and on strengthening Romania's health system to address AMR (122). More recently, the Regional Office supported the publication of *Antimicrobials supplied in community pharmacies in eastern Europe and central Asia in the early phases of the COVID-19 pandemic* (123), a report that examines data on the supply of antimicrobial agents from community pharmacies in nine countries. It found an overall increasing trend in the use of azithromycin and, to a lesser extent, hydroxychloroquine during that time.

In 2020, point prevalence surveys were conducted on AMU in seven countries in the WHO Eastern Mediterranean Region. Data collection of hospital-level AMC has started in Jordan, and national AMC data are currently being collected from Bahrain and Tunisia. In 2020, the WHO Regional Office for the Eastern Mediterranean also completed a regional assessment of the national AMS programme for 18 countries using the WHO checklist. The following year, to support countries in implementing national AMS

programmes, in collaboration with WHO headquarters, the WHO Regional Office conducted a regional workshop to introduce the WHO policy on integrated AMS (124). Further to this workshop, two countries in the region (Egypt and Tunisia) developed a National Policy of Integrated Antimicrobial Stewardship Programme. The WHO Regional Office for the Eastern Mediterranean supported 40 clinical pharmacists to participate in a training course provided by the Society of Infectious Diseases Pharmacists from the Low- and Middle-Income Country Antimicrobial Stewardship Certificate Program. This provided them with the fundamental knowledge needed to implement, manage and improve AMS programmes in the health care settings.

The WHO Regional Office for the Western Pacific launched the Western Pacific Regional Antimicrobial Consumption Surveillance System (WPRACSS) in 2020 to help Member States implement and further monitor for AMU at the national level, in hospitals and in the community (125). So far, 14 countries and areas have enrolled in WPRACSS. Seven countries and territories have provided antimicrobial import, manufacturing or sales data, and an additional three countries have provided data on AMC in the hospital or community sector. The first WPRACSS report indicates a wide variation in national AMC in the region, ranging from 4.8 to 50.7 defined daily doses

per 1000 inhabitants. Based on the AWaRe (Access, Watch and Reserve) classification of antibiotics (126), WHO has set a general goal that “Access” antibiotics should comprise 60% of national antibiotic consumption, a target achieved by four countries in the region (Brunei Darussalam, Lao People’s Democratic Republic, Malaysia and Mongolia) that submitted data to WPRACSS.

Essential medicines, AWaRe classification and AMR

Since 1977, WHO has been working with countries to design the package of essential medicines as an integral component of treatment within the continuum of care, developing and disseminating the WHO model list of essential medicines. Achieving universal health coverage requires access to safe, effective, quality and affordable essential medicines, vaccines and health products. WHO published a document in 2020 (127) that aims to support countries in developing their own national essential medicines lists and, through these lists and other medicine policy actions, to progress towards universal health coverage and the goal of ensuring that all people and communities have access to highly effective medicines that are appropriate to their needs, affordable to individuals and health systems, and of assured quality. The core list presents minimum medicine needs for a basic health care system, listing the

most efficacious, safe and cost-effective medicines for priority conditions. Priority conditions are selected on the basis of current and estimated future public health relevance and the potential for safe and cost-effective treatment. The complementary list presents essential medicines for priority diseases for which specialized diagnostic or monitoring facilities and/or specialist medical care and/or specialist training are needed. In case of doubt, medicines may also be listed as complementary on the basis of consistent higher costs or less attractive cost-effectiveness in a variety of settings (128). Antibiotics are included in the model list as first- or second-choice treatments for specific indications.

The AWaRe classification of antibiotics was developed in 2017 as a tool to reduce AMR, and to support antibiotic stewardship and access efforts at all levels. Antibiotics are classified into three groups, Access, Watch and Reserve, taking into account the impact of different antibiotics and antibiotic classes on AMR, that emphasize the importance of their appropriate use (129). The Access group includes antibiotics used as first- or second-line treatment for some of the most common infections and should be affordable, quality-assured and available at all times. The Watch group includes the highest priority critically important antimicrobials for human medicine and veterinary use, and are recommended for specific, limited indications.

The antibiotics in the Reserve group should only be used as a last resort when all other antibiotics have failed. AWaRe is a useful tool for monitoring antibiotic consumption and defining targets; WHO recommends that countries establish a target of at least 60% of Access group antibiotics in their total antibiotic consumption. In 2021, WHO updated the AWaRe classification to include an additional 78 antibiotics not previously classified, bringing the total to 258 classified antibiotics (130). The adoption of the AWaRe classification of antibiotics in the national essential medicines lists is encouraged to help address AMR.

Objective 5:

Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions

WHO leads a number of high-impact research initiatives aimed at informing R&D for the prevention and control of infectious disease and AMR. Of note, WHO published the WHO fungal priority pathogens list (131), the first-ever global effort to systematically prioritize

fungal pathogens, considering their unmet R&D needs and the perceived public health importance. The report was extensively covered by the news media and received over 20 000 download hits within the first month of its publication.

WHO is currently reviewing its bacterial priority pathogens list (132). Since its publication in 2017, the list has been instrumental in informing investments and decisions in new antibiotic R&D. All major private and public antibacterial developers, public-private funded partnerships, such as the Global Antibiotic Research and Development Partnership, and other antibacterial development funding mechanisms, such as CARB-X (133) and the AMR Action Fund (134) use the list to inform their investment decisions. The list also emerged as an important global tool to inform AMR public health prevention and control programmes and interventions, including surveillance, stewardship and IPC programmes. In the update, the list's scope will be broadened to consider the public health importance of pathogens in the list globally. The updated list is expected to be launched in 2023.

To guide R&D efforts and investment and stimulate innovation in drug development, WHO performs pipeline analyses identifying

gaps and unmet needs in the medicines and vaccines landscape. WHO has conducted the antibacterial pipeline analysis annually since 2017. The 2021 publication on antibacterial agents in clinical and preclinical development (135) covers traditional and non-traditional antibacterial agents in development worldwide and evaluates to what extent the present pipeline addresses infections caused by WHO bacterial priority pathogens. Traditional products are also evaluated against the WHO innovation criteria. Based on the antibacterial pipeline analysis, additional peer-reviewed articles have been published (136, 137).

WHO is also launching the development of a global AMR research agenda in human health, and supporting the quadripartite's global AMR One Health research agenda. These efforts will help identify research priorities to help drive research to prevent, diagnose, treat and mitigate AMR in all relevant sectors.

WHO regions have also conducted assessments to evaluate the effectiveness of AMR NAPs. The WHO African Region has conducted in-depth assessments of the implementation of AMR NAPs in specific countries (Burkina Faso (138), Malawi (139)) and larger evaluation of progress in NAP implementation in the African Region (140). In addition, the WHO African Region has

conducted and published a systematic literature review of AMR in the region (141) and has further supported the development and publication of a protocol for a scoping review aimed at mapping the evidence on interventions used to prevent and manage AMR in Africa, guided by the One Health approach (142).

The Structured Operational Research and Training Initiative on tackling AMR (AMR-SORT IT) (143), established in 2019, has supported countries to conduct effective operational research based on their priorities, build research capacity and generate evidence to inform decision-making to tackle the emergence, spread and health impact of AMR. The initiative has supported 74 research studies in 7 countries. Sixty-nine institutions in 30 countries became part of the AMR-SORT IT programme (144).

The Evidence-informed Policy Network (EVIPNet) initiative (145) has also been supporting countries to turn their evidence into high-quality and effective healthcare policies and strengthen their health systems. Using the EVIPNet tools, evidence briefs for policy have been developed to tackle AMR in countries in Europe (146, 147).

FAO activities to support GAP-AMR objectives

Objective 1:

Improve awareness and understanding of AMR through effective communication, education and training

Major global tools and activities

WAAW is a global campaign held in November each year to raise awareness and understanding of AMR and promote best practices among One Health stakeholders to reduce the emergence and spread of drug-resistant pathogens. In 2021, FAO presented its *Action Plan on AMR 2021–2025 (148)* as part of WAAW. On that occasion, the AMR microsite on the FAO website saw an increase in visitors of over 200%. The daily average of 300–400 visitors increased to peaks of 1000. A total of 4000 visitors interacted with the website during WAAW week. According to FAO, some 200 multilingual posts were shared, receiving more than 1500 mentions and reaching 26 million accounts.

In April 2022, FAO launched an e-learning course (149) on AMR in food and agriculture, aimed at a broad range of stakeholders in the agrifood system. The course helps learners understand the impact of AMR on

food safety, food security and the economic well-being of farming households. It also explains the potential role of the agrifood system stakeholders as well as FAO's work to help countries mitigate AMR with other global partners. This online course consists of five lessons that cover: 1) what AMR is and why it is a global public health challenge; 2) AMR in the context of One Health; 3) the role of food and agriculture stakeholders in AMR; 4) how AMR can be contained and its impacts minimized in food and agriculture; and 5) FAO's role and current initiatives in tackling AMR. The course was developed in collaboration with the FAO Reference Centre for AMR in the United Kingdom of Great Britain and Northern Ireland.

In November 2021, FAO organized a virtual expert consultation on the sustainable management of parasites in livestock challenged by the global emergence of resistance. The consultation advised FAO to develop guidelines for the strategic control and management of acaricide and trypanocidal drug resistance and called for strengthened advocacy, awareness and resource mobilization to address this challenge. As part of the follow-up, a community of practice on acaricide resistance management of livestock ticks is being established.

In July 2021, the FAO communications division organized a knowledge-sharing session on the impact of storytelling. These stories are used to demonstrate FAO's expertise on its various channels, such as the website, social media, publications and podcasts.

FAO held a series of monthly webinars to update participants on specific scientific and technical topics related to AMR. The webinars were co-organized by the FAO AMR working group and relevant FAO technical networks. Areas addressed in the webinars included microbiology, epidemiology, environmental or behavioural science, and plant and animal production and health, which were designed to increase the knowledge of AMR risks and mitigating measures in the agri-food sectors.

Regional and country-level activities

In October 2021, an FAO mission in Ghana addressed the issue of refining and implementing evidence-based solutions developed by the AMR behaviour change community of practice. The aim of the mission was to identify and overcome behavioural barriers to footbath use among Farmer Field School participants in Kade and Dormaa, Ghana. Two interventions were designed jointly with participants and implemented on home farms: 1) a poster intervention that serves as a reminder to use the footbath; and 2) an intervention to use a common household item (a 500ml

water bottle of any brand) to assist in diluting disinfectant, as recommended by the brand. While still in the piloting phase, these interventions appear to be useful to remind people entering the farm or poultry house to use the footbath; help farmers educate visitors, staff and management on biosecurity measures; reduce production costs by curbing the waste of disinfectant; and change the mindset that disinfectant is a costly intervention.

In Africa, together with the African Union, FAO and the other quadripartite developed and published a joint continental AMR communications and advocacy strategy in 2021. The strategy aims to help countries and regional institutions communicate on AMR in a harmonized manner, address limited awareness of AMR and support governments' engagement on the issue. A total of 267 journalists, animal health professionals and representatives of pastoralist farmers' associations were trained on AMR and AMU to strengthen their knowledge, attitudes and practices and to better communicate on AMR.

Further, FAO signed a letter of agreement with Johns Hopkins University/ReACT in December 2021 for "Seeding and Scaling One Health Awareness and Action on AMR," an initiative to reinforce ongoing communication activities to foster policy dialogue and youth engagement on AMR in Africa, Asia and Latin America.

Objective 2:

Strengthen the knowledge and evidence base through surveillance and research

Major global tools and activities

The FAO Assessment Tool for Laboratories and AMR Surveillance Systems (ATLASS), available in four languages, assesses and defines targets to improve national AMR surveillance systems in the food and agricultural sectors. It is composed of surveillance and laboratory modules. Each module includes two standardized

questionnaires, which are completed by assessors. ATLASS aims to collect descriptive data and score the performance of national AMR surveillance-linked activities by mapping laboratory analytical capabilities and networks, and assessing activities on data collection and analysis, governance, communication and sustainability (Fig. 6). Based on the ATLASS assessment, a Progressive Improvement Pathway stage is assigned for each laboratory; each “pillar” (governance, epidemiology unit, laboratory network, communication and sustainability) and the national AMR surveillance system as a whole are assessed. These results help assessors provide recommendations to prioritize actions for improvement.

Fig. 6. ATLASS approach to assess and improve national AMR surveillance systems



Source: Food and Agriculture Organization of the United Nations.

ATLASS assessment missions are carried out by trained assessors. The recommended approach at the country level is for external assessors to carry out the first assessment mission to have baseline information, with follow-up assessments carried out by national assessors, or, as for laboratory self-assessments, by ATLASS focal points. FAO is also building a worldwide community of assessors to serve as a technical resource towards harmonized regional and global surveillance efforts. The organization works

with WOA and WHO to coordinate country-level assessments across sectors using a One Health approach.

International FAO AMR Monitoring (InFARM) platform. FAO is committed to developing the building blocks that will catalyse national efforts to regularly generate, share and analyse reliable and comparable AMR data in food and agriculture and AMU data in plants and crops. During the second half of 2021, FAO completed a requirements

analysis to inform the development of an IT solution for the InFARM platform. FAO has been developing a prototype of the platform since early 2022 and inviting countries to participate in the pilot testing using their own data. InFARM's initial scope will be to host AMR data in priority bacterial species of interest for public health and animal health, and indicator bacteria from animals and food, according to international standards and Codex Alimentarius (the “Food Code”) and WOAHA recommendations. This data platform will support national, regional and global surveillance efforts, providing countries with a mechanism to host and analyse AMR data from terrestrial and aquatic animals and food, and will complement the integration of data from other sectors (led by WOAHA and WHO) under a global platform, initially called the “Tripartite Integrated System for Surveillance of AMR and Use”.

Because research is a critical element in the fight against AMR, FAO and the other quadripartite have fostered and supported the process of developing a One Health Priority Research Agenda on AMR. This work aims to catalyse scientific interest among researchers and donors, and to provide direction for investment in One Health AMR research, including identifying research areas to better prevent, control and respond to AMR, with a focus on five pillars: 1) transmission; 2) integrated surveillance; 3) interventions; 4) behavioural insights and change; and 5) policy and economics. The project started in 2021 with a global

survey to identify key gaps. The survey results were analysed and, together with a grey literature review, served as the basis for the consolidation and prioritization exercise on gap research areas using a Delphi panel process with 150 global experts invited to contribute. Nearly 100 experts from around the world with backgrounds in surveillance, microbiology, animal health, human health, environmental health, crop science, epidemiology, genomics, pharmacy, artificial intelligence, ecology, public health, behavioural science, law, political science, psychology, behavioural economics, gender, communication, human rights, anthropology and sociology participated. The results of this exercise are expected in early 2023.



FAO tool for a situation analysis of AMR risks in the food and agriculture sectors (version 2)

In 2017, the first FAO activities on AMR for the Latin American and Caribbean region revealed a lack of related information from the food and agriculture sectors. To address this situation, between 2019 and 2021, the FAO Regional Office for Latin America and the Caribbean developed the “FAO Tool for a Situation Analysis of AMR risks in the Food and Agriculture Sectors (version 2)” based on the One Health approach.

The tool’s objective at the national level is to provide a qualitative and systematic assessment of the risks and gaps of AMR from animal production systems (terrestrial and aquatic species), for animal health and human health, respectively. The tool consists of three instruments: a survey to collect data; a methodological procedure to analyse the information collected; and instructions to prepare a national roadmap for the containment of AMR.

The roadmap includes guidance to prioritize needs and sectoral actions consistent with the characteristics of the institutional systems in the countries and their NAPs. The tool is available in Spanish and English and has been implemented in 10 countries in the region as well as in two countries in Africa.

Regional and country-level activities

Missions using ATLASS either as an externally or self-administered assessment tool for the overall national AMR surveillance system for food and agriculture and/or for laboratories were conducted in 28 countries in 2021 and 2022 with support from various sources, including the ACT project, an EU-funded project in Latin America and the Caribbean, the Fleming Fund, the Russian Federation, and the US Agency for International Development. The FAO Regional Office for Asia and the Pacific recently summarized and presented findings on the countries assessed in South-East Asia to identify cross-cutting needs and regional priorities for action. Overall, the tool has been used in approximately 45 countries.

FAO supported the development of the Codex Alimentarius standards on the

integrated monitoring and surveillance of foodborne AMR, which were adopted in 2021. As a follow-up, FAO is now leading the Antimicrobial Codex Texts (ACT) project (150) funded by the Republic of Korea, which focuses on the practical implementation of these guidelines and the revised Code of Practice to Minimize and Contain Foodborne AMR, with a focus on six countries as proof of concept (the Plurinational State of Bolivia, Cambodia, Colombia, Mongolia, Nepal and Pakistan). Compliance with and the application of Codex general principles and recommendations for integrated surveillance are also being mainstreamed through the implementation of all currently active AMR projects developing practical guidelines and national strategies for the monitoring and surveillance of AMR and AMU in food and agriculture. For example, the FAO Regional Office for Asia and the Pacific and WOAH

have developed guidelines that follow WOA and Codex standards for AMR monitoring and surveillance in healthy animals and food and in bacterial pathogens from terrestrial and aquatic animals, and guidelines for monitoring AMU at the farm level.

As part of the EU-funded ACT project in Latin America, FAO in collaboration with the Phyto and Zoosanitary Regulation and Control Agency of Ecuador as the host of the Codex Coordinating Committee for Latin America and the Caribbean supported the containment and reduction of foodborne AMR through a series of virtual seminars to socialize and promote the application of Codex Alimentarius standards for the strengthening of national food safety systems.

In the Asia and the Pacific region, FAO continues to support the development of regional guidelines for the monitoring and surveillance of AMR, AMU and antimicrobial residues. The proposed series includes: 1) Monitoring and surveillance of AMR in bacteria from healthy food animals intended for consumption, 2) Monitoring and surveillance of AMR in bacterial pathogens from diseased livestock and poultry, 3) Monitoring and surveillance of AMR in bacterial pathogens from aquaculture, 4) Monitoring and surveillance of AMR in farm animal environments, 5) Monitoring AMU at the farm level, 6) Monitoring and surveillance of antimicrobial residues in food of animal origin.

A regionally customized broth microdilution plate for gram-negative aquatic pathogens (AS1AQ) was also developed and finalized in 2022 for the Asia and the Pacific region, in collaboration with global and regional

experts on aquaculture AST. This builds upon the FAO regional office's recent success in AMR surveillance of *Escherichia coli* and *Salmonella* spp. (ASSEC A and B), *Enterococcus* spp. (ASEN) and *Campylobacter* spp. (ASCAM) in 2019. The final format is now in the manufacturer's library and the regional mechanism for coordinated procurement is under discussion. A call for expressions of interest to participate in the multicentre testing of gram-negative aquatic pathogens has also been developed for implementation.

A multicentre retrospective study on antimicrobial susceptibility profiles of *Campylobacter* and *Enterococcus* spp. using the regionally customized broth microdilution plates was also launched in Asia and the Pacific in 2022. This initiative brings together research institutions and expertise in the region to provide retrospective data on these two fastidious organisms, and creates a network and platform for future exchange and subsequent capacity-building initiatives. This will use the regionally customized plates designed for these two species.

The FAO Regional Office for Asia and the Pacific also updated a series of regional AMR data management templates for the monitoring and surveillance of AMR in bacteria from healthy food animals (Volume 1), diseased livestock and poultry (Volume 2) and diseased aquatic animals (Volume 3). FAO and WHONET developers also revised the long-standing software and adapted it for food and agriculture use. Additionally, the FAO regional office received 12 673 antimicrobial susceptibility test results from eight countries using the regional AMR data management Volume 1

template following a call for submissions of current AMR data generated by countries in 2021. FAO's Emergency Centre for Transboundary Animal Diseases at the Regional Office collated these submissions, de-identified them and transferred them to the Chulalongkorn University/FAO Reference Centre for AMR for blind analysis in 2022. Although the data from the region present limitations, a general picture of the AMR situation in the animal sector and schemes of national AMR surveillance could be drawn. The results highlighted the high prevalence of AMR among zoonotic and commensal bacteria from food animals in the participating countries.

In September 2021 and March 2022, in its Europe and Central Asia region, FAO supported Armenia and Tajikistan with laboratory training for national experts on international standards for AST. In addition, laboratory reagents and equipment were procured, and samples collected from the field and analysed to produce baseline AMR surveillance data in food producing animals and food.

FAO is providing ongoing support to facilitate the participation of laboratories in external quality assurance/proficiency testing to improve laboratory capacities to isolate and identify bacterial species relevant for AMR surveillance along the value chain of food products of animal origin. Support also continues for AST in Asia and in Africa through the FAO Reference Centres for AMR in Denmark, Thailand and the United Kingdom.

In East Africa, an AMR/AMU technical advisory group was established with the engagement of 10 countries. An AMR monitoring and surveillance guideline for bacteria from healthy food producing animals was also developed for those countries. In Sierra Leone, an AMR surveillance and AMU monitoring strategy was elaborated, while a national AMR surveillance strategy and a protocol for broiler and layer poultry surveillance were developed in Zimbabwe.



FAO reference centres for AMR

FAO has eight reference centres for AMR that support the organization's work to combat AMR in food and agriculture. The main objectives of the reference centres are aligned with the strategic objectives of the *FAO Action Plan on AMR 2021–2025*. As distinguished centres of excellence, these entities secure FAO's Reference Centre for AMR designation by demonstrating key AMR capacities and showing a track record of active engagement in specific fields of expertise. These institutions also commit a portion of their own resources to carry out AMR work in collaboration and coordination with FAO. The centres retain their status for four years, after which renewal is possible depending on the activities undertaken and the value and strength of the collaboration. Reference centres are currently located in the following institutions:

- National Food Institute, Technical University of Denmark, Denmark
- French Agency for Food, Environmental and Occupational Health and Safety, France
- Department of Veterinary Medicine, Freie Universität Berlin, Germany
- Integral Unit of Services, Diagnosis and Verification, National Service for Agrifood Health, Safety and Quality, Secretariat of Agriculture and Rural Development, Mexico
- Pasteur Institute of Dakar, Senegal
- Department of Veterinary Public Health, Faculty of Veterinary Science, Chulalongkorn University, Thailand
- Department for Environment, Food and Rural Affairs (Defra) agencies: Veterinary Medicines Directorate; Centre for Environment, Fisheries and Aquaculture Science; Animal and Plant Health Agency, United Kingdom
- Infectious Diseases Institute of Ohio State University, United States of America (USA)

Objective 3:

Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures

Major global tools and activities

FAO is working closely with feed sector stakeholders to promote animal nutrition practices that reduce AMU identified in the 2021 FAO paper on animal nutrition strategies and options to reduce the use of antimicrobials in animal production (151).

Regional and country-level activities

In August 2021, FAO deployed a six-week poultry Farmer Field School refresher course for facilitators and master trainers with a focus on AMR. It was the first online course delivered through the Farmer Field School, with participation from two countries in Africa (Zambia and Zimbabwe). Overall, 756 farmers were trained in Farmer Field School approaches to apply good practices, increase knowledge and attitudes, support better farm management, improve animal health, decrease mortality and improve production. More than 350 professionals were also trained in clinical service provision, farm biosafety and biosecurity and IPC in the food and agriculture sectors.

In Asia and the Pacific, a regional survey on bacterial pathogens in major livestock and aquatic animals was conducted in 2021 in collaboration with the Federation of Asian Veterinary Associations to identify common antimicrobial agents used for the treatment of prioritized bacterial pathogens in swine, poultry, cattle and aquatic animals

in the region. This received an additional 1300 responses from field veterinarians, laboratory personnel, animal health workers and other stakeholders. This work's findings will help prioritize efforts to address gaps in clinical breakpoints and develop treatment guidelines and in-field interventions. Under the same collaboration a WAAW design challenge was successfully launched and carried out in November 2021. A total of 19 entries from seven countries (Bhutan, India, Indonesia, Malaysia, Nepal, Philippines and Thailand) were received from various professional disciplines (veterinary science, engineering, architecture/design, agriculture, farming and business). FAO also provided capacity-building for farmers to develop good practices in animal health management and biosecurity control, including for prudent and effective AMU in aquaculture in India, Indonesia and Viet Nam.

Through the 2020 poultry housing design competition, a collaboration between FAO and the Federation of Asian Veterinary Associations generated several small-scale poultry housing designs that highlighted the importance of farm biosecurity and reinforced good animal husbandry practices. During the second round of this collaboration in 2021, a pig housing design contest that considered biosecurity was carried out.

A stakeholder mapping and review of studies and initiatives assessing the implementation of IPC by field actors (i.e. professionals involved in prescribing, selling and administering antimicrobials) as well as studies aimed at improving their IPC implementation were also carried out by the FAO Regional Office for Asia and the Pacific with support from the French Agricultural Research Centre for International

Development, CIRAD. These are part of an overarching plan to create a virtual library of evidence-based resources to promote and improve good practices in AMS and to reduce the need for AMU. Significant effort was also made to promote the responsible use of antimicrobials in beekeeping.

In Asia and the Pacific region, FAO is developing a tool to assess the implementation of IPC in food and agriculture, including water, hygiene, sanitation and wastewater management (Agri-WASH).

Objective 4:

Optimize the use of antimicrobial medicines in human and animal health

Major global tools and activities

FAO is collaborating with HealthyLivestock, a network funded by the EU, to promote good practices at the farm production level to reduce the need for antimicrobials and encourage prudent use.

FAO guidelines for the responsible and prudent use of antimicrobials 2020–2021

FAO has developed the following guidelines:

- (i) Responsible use of antimicrobials in beekeeping (152);
- (ii) HOW TO USE antibiotics effectively and responsibly in DAIRY PRODUCTION – for the sake of human and animal health (153);
- (iii) HOW TO USE antibiotics effectively and responsibly in PIG PRODUCTION – for the sake of human and animal health (154);
- (iv) Slowing down superbugs – Legislation and antimicrobial resistance (155); and
- (v) Tackling antimicrobial use and resistance in dairy cattle – Lessons learned in Sweden (156).

Regional and country-level activities

In 2021, a set of surveys on the knowledge, attitude and practices associated with AMU patterns was conducted in the Africa, Asia and the Pacific, and Europe and Central Asia regions. The results of the survey in Lao People's Democratic Republic were published in August 2021, resulting in a better understanding of the drivers and motivations

of using antibiotics in the country's livestock industry. The results also contributed to shaping the country's AMR communications and advocacy campaign.

In Latin America and the Caribbean, in collaboration with WHO and WOA, FAO is working to strengthen the animal feed industry's engagement in the fight against AMR through a project funded by the EU.

In 2022, FAO convened a roundtable discussion with the public and private sectors at the Regional FeedLatina Meeting, in Mexico City, Mexico on policy guidelines for the containment of AMR in the production and use of medicated feed.

In the Asia and the Pacific region, surveys assessing pig farms' state of adherence to recommended practices on the prudent use of antimicrobials were conducted between September and December 2020 in Cambodia, Indonesia and Viet Nam. Support is being provided to India, Indonesia and Viet Nam to mitigate AMR risk associated with aquaculture, through an improved understanding of AMR and related use challenges.

A workshop on developing national veterinary antimicrobial therapy guidelines in South-East Asia was held in January and March 2022 to boost regional collaboration on the development of antimicrobial treatment guidelines. Subsequently, two South-East Asia communities of practice on antimicrobial treatment guidelines (for poultry and swine) were established in September 2022, gathering national and international experts. The sharing of relevant resources, expertise and experience is now facilitated within both communities and their members will also receive technical support on how to develop evidence-based and practical guidelines.

In 2021, a subcommittee on AMS was formed under the committee on pharmaceutical stewardship as part of the FAO–Federation of Asian Veterinary Associations collaboration. This subcommittee will lead the Federation of Asian Veterinary Associations' work

to promote AMS among its member organizations in Asia and Oceania.

In Africa, seven guidelines were developed in 2020 on the prudent use of antimicrobials and stewardship in poultry, the pig value chain, sheep, goats and cattle in Ethiopia, Nigeria and Senegal. More than 200 veterinarians, paraveterinarians, biologists, health workers, medical doctors and pharmacists were trained in the proper use of antimicrobial drugs for the treatment of disease.

Objective 5:

Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions

Tackling AMU and resistance in dairy cattle

Lessons learned in Sweden

In 2020, FAO collaborated with the Swedish dairy sector to produce a case study that describes the sector's long-term efforts to keep animals healthy, thereby putting Swedish dairy farms in top position with regard to the low use of antibiotics combined with high productivity. Key has been a bottom-up approach, allowing farmers' views and conditions to be considered before introducing interventions for limiting the emergence and spread of antibiotic resistance (157).

Tackling AMR in food producing animals

Lessons learned in the United Kingdom

In collaboration with the United Kingdom, FAO produced a series of case studies describing how the United Kingdom

managed to halve the sale of antimicrobials in the country's livestock industry thanks to a multisectoral collaborative approach between the UK Department for Environment, Food and Rural Affairs and farmers, producers and veterinarians (158).

Strengthening antimicrobial governance in the food and agriculture sectors

In 2019, FAO launched the **Progressive Management Pathway for AMR (FAO-PMP-AMR)** that focuses on building management capacity through a bottom-up approach with strong stakeholder involvement.

The FAO-PMP-AMR helps Member States put their NAPs into action. The progressive approach enables specific sectors to make step-by-step improvements towards the sustainable use of antimicrobials and the management of AMR. These improvements can start as small-scale initiatives, evolve into broader actions in priority sectors and eventually develop into fully-fledged efforts. The FAO-PMP-AMR provides guidelines, standards and references to help with the planning and implementation of each activity, and has been undertaken in 28 countries.

FAO Assessment methodology for AMR-relevant legislation in the food and agriculture sectors (159) was developed in 2020 to identify the key regulatory issues within the food and agriculture sectors that directly contribute to AMR. The methodology can help regulators identify gaps and weaknesses in their sectoral legislation and governance structures, improving their capacity to better address AMR through legislation.

FAO also maintains **AMR-LEX**, the global repository of AMR-relevant legislation and policies mapped and assessed in 19 African countries, generating over 300 pieces of legislation that are available on FAO's website (160).

WOAH activities to support GAP-AMR objectives

Objective 1:

Improve awareness and understanding of AMR through effective communication, education and training

Communication

WOAH (founded as OIE) pursued its primary communication goal: to encourage the responsible use of antimicrobials in animals by engaging all the relevant stakeholders in the implementation of WOA standards. The We Need You campaign was expanded to include a social media guide and toolkit with visuals to support digital communications at the national level for WAAW 2020 (161). A webinar on raising awareness and changing behaviours to tackle AMR (162) in the animal health sector was delivered in advance of WAAW, targeting national focal points of communication, veterinary products and aquatic animals to improve countries' capacities in behaviour change and communication to tackle AMR. An assessment conducted in March 2021 reveals that 83% of the respondent countries were familiar with the campaign (54 of 65 participating countries), while 78% (51 of 65 participating countries) used the dedicated website.

In November 2020, the International Veterinary Students' Association hosted its first global AMR Youth Summit, supported through the participation of staff from WOA. The event welcomed 3500 students in the human, animal and plant health and pharmacy fields representing 127 countries.

The quadripartite played a leading role at the global, regional and country levels in mobilizing support for WAAW under the theme "Spread awareness, stop resistance" (163), where participants were encouraged to spread awareness of what AMR is, share stories about its consequences, and demonstrate how the actions of individuals, families, professionals and communities affect its spread.

The year 2021 marked a turning point in WOA's approach to AMR communication. Building on the successful We Need You communication campaign, WOA reframed its AMR narrative, targeting specialists (animal health professionals, feed suppliers, pharmaceutical industry representatives and farmers) and broader audiences (decision-makers, general public, animal/pet owners and young people). An updated AMR web portal (164) and new toolkit address gaps identified in 2021 and highlight the animal health sector's role as part of a multisectoral approach to AMR.

National focal point training for veterinary products

In 2020–2021, WOAHA delivered the sixth cycle of focal point training seminars to national focal points for veterinary products in 147 countries in five WOAHA regions: Africa, Americas, Asia and the Pacific, Europe and the Middle East. The sixth cycle seminar series introduced such topics as veterinary product quality, substandard and falsified veterinary products (SFVPs), pharmacovigilance and antiparasitic resistance. One month of Performance of Veterinary Services (PVS) e-training (six modules) on veterinary products was

delivered in advance of the seminar series to serve as an introduction to veterinary products and AMR. Sharing experiences and lessons was an important component of the series.

The seventh cycle of national focal point training seminars was introduced with two-day virtual sessions delivered in Africa (February 2022) and Asia and the Pacific regions (April 2022). The seventh cycle seminar series seeks to tailor training content to regional needs to strengthen the capability to implement WOAHA standards and guidelines.

Communication activities in southern Africa

WOAHA contributed to the drafting of the Africa AMR Communications and Advocacy Strategy and provided annual technical and financial support to some Southern African Development Community (SADC) countries in 2020–2021 to undertake national WAAW activities in Botswana, Lesotho, Madagascar, Mauritius, the United Republic of Tanzania and Zimbabwe, who implemented a range of awareness activities (school competitions, teaching materials, radio and TV messages).

Further, WOAHA facilitated the participation of SADC research and public-sector organizations in Africa WAAW 2021, including the Agricultural Research Council–Onderstepoort Veterinary Institute (South Africa), Southern African Centre for Infectious Disease Surveillance (SACIDS) Foundation for One Health (United Republic of Tanzania), Thermo Fisher Scientific (South Africa) and Avimune (South Africa).

(Please see Bibliography for communication materials from the Asia and the Pacific region)

Objective 2:

Strengthen the knowledge and evidence base through surveillance and research

AMU monitoring in animals (terrestrial and aquatic)

Overall findings of the sixth data collection round of antimicrobial agents intended for use in animals

A total of 157 reports were submitted during the sixth round of data collection (2020). Of these, 126 reports (80%) included quantitative data for at least one reported year within the time frame of 2018 to 2020. A total of 70 reports (out of 126; 56%) conveyed antimicrobial quantities with the highest details (WOAH Reporting Option 3), which means a 5% increase from the fifth report, in many cases, helped by the assistance of the Excel calculation tool developed by WOAH to overcome technical barriers. In all, 35 participant countries (out of 126; 28%) reported making their national reports publicly available, the vast majority (30 of 35; 86%) being European countries. Among the 24 participant countries that provided information on the barriers faced in reporting quantities of antimicrobials intended for use in animals, the lack of a regulatory framework, human resource constraints and circumstances that prevent the data collection, including the COVID-19 pandemic, were primarily reported.

In 2020, the use of antimicrobial agents in animals for growth promotion was no longer a practice in almost three quarters of the participant countries (108 of 157; 69%), regardless of the presence or absence of legislation/regulatory provisions on their use. However, the use of growth promoters was reported by a quarter of the participant countries contributing to this sixth round of data collection (40 of 157; 26%), with 68% of those concentrated in two regions: the Americas, and Asia and the Pacific. Twenty-seven countries provided data on which antimicrobial agents were used as growth promoters. Flavomycin, not used in humans according to the WHO “List of critically important antimicrobials for human medicine” (the CIA list), was the most frequently listed antimicrobial agent (n=18 countries). Bacitracin and tylosin were reported to be used by 15 countries. While the former is not classified as critically important for use in humans, the latter is. Colistin, considered a highest priority critically important antimicrobial for use in humans, was reported to be used by six countries. The number of those reporting the use of colistin as a growth promoter was reduced by half over the four years leading up to 2020, confirming the progressive implementation of WOAH’s recommendations to prohibit its use as a growth promoter.

Focused analyses for 2018

The sixth report (165) published in 2022, presents analyses with a special focus on the antimicrobial quantities announced as used in 2018 by 109 participant countries. According to the sales and import data provided, WOAAH estimates that 69 455 tonnes of antimicrobial agents intended for use in animals were used in 2018. Acknowledging the different data sources, data cover was on average 91% of the total amount of antimicrobials present in the field (as estimated by each country). WOAAH estimates that the adjusted total amount could be 76 704 tonnes. Overall, tetracyclines remain the most used antimicrobial agent in animal health globally (40.5% of the total amount), followed by penicillins (14.1% of the total amount). Both are part of the veterinary critically important antimicrobial agent (VCIA) classes in WOAAH's list (166), while they are not part of the highest priority critically important antimicrobial agents for human health according to WHO. The rest of the total amount (45%) is split between 21 other reported classes of antimicrobials. It is important to note that macrolides represent less than 9% of the total amount.

The analysis of antimicrobial agents normalized by estimated animal biomass was performed on data provided by 106 participant countries (77% higher than the initial analysis in 2014). This is considered to represent 72% of the total animal biomass around the globe (29% higher than in 2014), encompassing terrestrial and aquatic food producing animals, with companion animals excluded from the analyses. Bovine species account for 43% of the total coverage, followed by swine (20%) and poultry (18%). Aquatic animals account for 7% of the total coverage, being almost two thirds represented by farmed fish. Taking this into consideration, WOAAH estimates that, in 2018, 86.69 mg to 95.74 mg of antimicrobial agents were used per kg of animal biomass, depending on how coverage estimates were adjusted among the 106 countries.

69 455

**tonnes of antimicrobials
intended for use in animals
were used in 2018 as per
WOAH estimates**

Improved AMU data quality

WOAH conducted seminars (in Indonesia, Malaysia and Pakistan in 2020) to help countries improve their capacity to obtain quality data for the annual AMU databases survey. The seminars discussed each country's AMU supply chain and devised recommendations on how to improve data gathering at various points along the supply chain. While import data are readily available from customs offices, understanding the distribution of antimicrobials down the supply chains and how they reach the specific target species remains a significant question.

During the WOAHA virtual workshop for veterinary education establishments in India in June 2021, a half-day seminar was included on using these education establishments to combat AMR. Recommendations related to AMR for the Veterinary Council of India, veterinary education establishments, veterinary services and WOAHA were developed during the workshop, among others.

Trends (2016–2018)

An analysis of these data over time was applied to 72 participant countries that consistently provided quantitative data from 2016 to 2018, using the normalized amount of milligrams of antimicrobials used per kilogram of estimated animal biomass. Collected data, representing 65% of the global animal biomass, show an overall decrease of 27% in mg/kg at the global level, moving from 120 mg/kg in 2016 to 88 mg/kg in 2018 (Fig. 7). This decreasing trend was apparent across all WOAHA regions and confirms the trend already reported in the fifth report, suggesting a continuous overall global reduction in the utilization of antimicrobial agents for intended use in animals. When examining this trend by antimicrobial class, a reduction is observed in tetracyclines (21%, the most used antimicrobial class in animal health and classified by WOAHA as a VCIA), in macrolides (43%, a VCIA within the WOAHA list, and a high priority in the CIA list) as well as in polypeptides (62%, a highly important antimicrobial agent within the WOAHA list, and split into two categories within the

CIA list: bacitracin – important, and colistin – high priority).

Tetracyclines remain the most used antimicrobial class globally in animal health and, while some antimicrobial classes considered as critically important for use in humans are still used, they represent a small part of the global picture. Sixty-nine percent of the participant countries reported not using antimicrobial agents for growth promotion, and notable progress was made in phasing out the use of some of the highest priority critically important antimicrobial classes, such as colistin. When assessed per kilogram of estimated animal biomass, AMU in food producing animals continued its global reduction over the period. All participant countries made important progress, although further engagement is needed to attain the sustainable use of the common good that are antimicrobial agents. The participant countries' commitment to providing information on the use of antimicrobials, since the initial data collection round in 2015, represents a remarkable achievement.

ANIMUSE: the new AMU database IT system

In 2020, WOAHA initiated the process of building an interactive automated system for members to report the use of antimicrobial agents in animals and receive support in calculating the amount of active ingredients. Accessible online, ANImal antiMicrobial USE (ANIMUSE) helps members with their calculations, reducing errors and improving the quality of data. ANIMUSE simplifies the reporting process, enables faster reporting and analysis, and encourages members to use their own data to get valuable

insights and graphically present important information. In 2022, WOAHA completed the development of change management procedures and materials to support ANIMUSE's uptake. The organization started training its members in the new system's adoption and use in 2022, enabling them to submit data and navigate the system. This system embraces the modifications to the list of aquatic animal species presented in the WOAHA *Aquatic Animal Health Strategy 2021–2025 (167)* that will enable the gathering of detailed information on AMU for aquaculture.

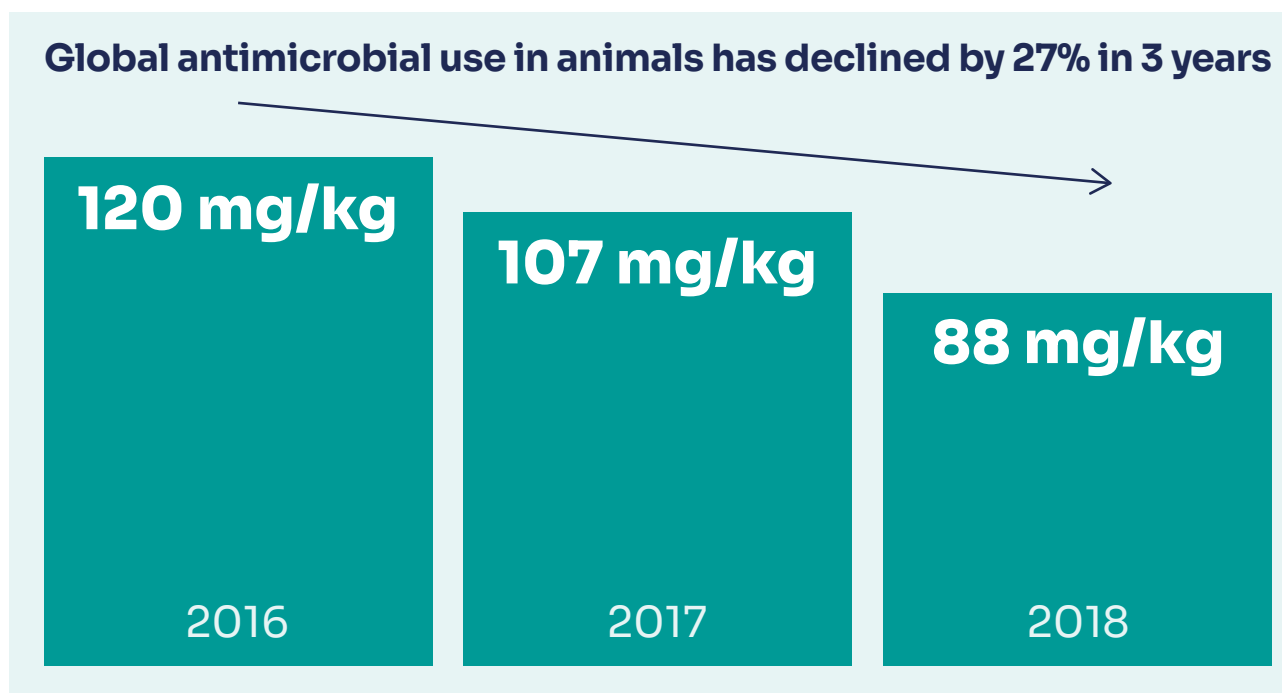
AMR NAPs – Americas

In liaison with FAO and PAHO/WHO, WOAHA is implementing the Working Together to Fight AMR project, funded by the EU. The strategic objective of the four-year project initiated in 2019 is to contribute to tackling AMR through the implementation of One Health AMR NAPs in Argentina, Brazil, Chile, Colombia, Paraguay, Peru and Uruguay. Progress in 2020–2021 included reviews (“landscape analyses”) of the AMR NAPs and regional digital communication campaigns and seminars for WAAW. Training tools on AMR are being developed for delivery through the WOAHA Training Portal to help strengthen the capacity of veterinary professionals in AMR-related topics.

In 2021, WOAHA convened and activated a subregional (Americas) network of stakeholders involved in AMR, including the private sector, academic and research institutions and media outlets. A series of webinars on public–private partnerships served as a platform to share experiences on AMR and strengthen this network.



Fig. 7. Trends in global quantities of antimicrobial agents intended for use in animals based on data reported by 72 countries, adjusted by animal biomass (mg/kg), 2016–2018



Source: WOAHA (168, fig. 39).

AMU monitoring at the field level. A process was initiated to identify member countries that have existing activities on AMU field-level monitoring. Of the 17 Asian and 18 African countries surveyed in 2022, 11 Asian and five African countries were conducting or planning AMU monitoring at the field level. WOAHA continued its development of joint WOAHA/FAO regional guidelines for monitoring AMU at the farm level for Asia and

the Pacific. The guidelines, when published in 2023, will provide methodological assistance to countries in Asia undertaking AMU monitoring at the field level. In 2020, WOAHA started collaborating with the UK Fleming Fund (169) on AMU monitoring for Fleming Fund grant recipient countries to strengthen the support to member countries in collecting field-level AMU data.

Antiparasitic resistance. In 2019, WOAHA created an Electronic Expert Group on antiparasitic resistance. This group published a document in December 2021 on the responsible and prudent use of anthelmintic chemicals to help control anthelmintic resistance in grazing livestock species (170). This publication provides some foundation for the development of a standard in the future. As part of its work, the Electronic Expert Group will complete a mapping and prioritization exercise and define a roadmap of actions for WOAHA to undertake to address antiparasitic resistance.

Objective 3:

Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures

As a standard-setting organization for animal health, including zoonoses, WOAHA has developed a wide range of international standards on antimicrobial agents, in particular on responsible and prudent use as well as on the surveillance of AMU and AMR. These standards are regularly reviewed and updated through the transparent process of expert advice and member consultation before presentation for adoption to the WOAHA World Assembly of Delegates each

year. WOAHA has developed international standards related to biosecurity in poultry production (Chapter 6.5 (171) of the terrestrial animal health code) and in aquaculture establishments (Chapter 4.1 (172) of the aquatic animal health code). These standards' objective is to prevent the introduction and dissemination of infectious agents in the poultry value chain and in aquaculture. In addition, WOAHA has also supported countries in developing biosecurity guidelines aligned with its standard (see case study 4). To prevent animal disease occurrence and the need for AMU, WOAHA also encourages countries to conduct vaccination campaigns. In 2021, WOAHA supported the delivery of more than 8 million doses of vaccines against *Peste des petits ruminants* and the production of 100 000 doses of vaccines against theileriosis (see case study 3). As part of its efforts to help members implement standards, including those related to biosecurity, and strengthen veterinary services, WOAHA developed the PVS pathway.

To have an overview of the uptake of the international standards including the ones related to AMR and AMU, WOAHA has initiated the observatory programme. The indicators used to monitor the implementation of standards related to AMR and AMU are published on WOAHA website (173).

WOAH PVS

As a consequence of the COVID-19 pandemic, all PVS missions planned for 2020 were postponed, except for three missions that occurred prior to global lockdowns.

To resume missions, an adapted delivery model was developed to meet members' needs. WOAHA has continued to expand PVS activities through hybrid and blended approaches consisting of face-to-face and virtual engagement (Table 1).

Table 1. Type of PVS missions by country, mode of delivery and date

No.	Type of PVS mission	Country	Mode of delivery	Year
1	PVS gap analysis missions	Kazakhstan	Virtual	August 2021
		Kenya	Field	April 2022
2	PVS strategic planning workshops	Malaysia	Field	2020
		Nigeria	Field	2020
3	PVS sustainable laboratory missions	Liberia	Virtual	March 2021
		Nigeria	Virtual	November 2021
		Sierra Leone	Virtual	March 2022
4	International Health Regulations/PVS National Bridging Workshops and follow-up surveys	Cameroon	Field	August 2021
		Côte d'Ivoire	Field	March 2021
		Ethiopia	Field	August 2021
		Gambia	Field	February 2021
		Guinea	Field	November 2021
		Kazakhstan	Field	March 2021
		Kenya	Virtual	November 2021
		Mali	Field	February 2020
		Uganda	Field	February 2022
		United Republic of Tanzania	Field	January 2022

Table 1. Type of PVS missions by country, mode of delivery and date (continued)

No.	Type of PVS mission	Country	Mode of delivery	Year
5	Veterinary Legislation Support Programme – identification missions	Togo	Virtual	June 2021
		Pakistan	Virtual	March 2022
6	Veterinary Legislation Support Programme – agreement preparatory phases	Georgia	Virtual	2021
		Kazakhstan	Virtual	
		Uzbekistan	Virtual	
7	Veterinary Legislation Support Programme – agreement implementation phases	Botswana	Field	2019–2021
		Mozambique	Field	2019–2020
		Senegal	Field	January 2022–2023
		Zimbabwe	Field	2019–2022

Source: WOA (table developed for this report).

Training in biosecurity in Kenya

To ensure well-trained veterinarians and veterinary paraprofessionals are at the forefront of the fight against AMR and the implementation of AMR NAPs, WOA supported the training of 30 veterinary paraprofessional instructors in October 2021. The training focused on the link between the implementation of farm biosecurity measures and the reduced emergence and spread of AMR and on how to share this information during the course of their work. WOA aims to build a pool of competent veterinary paraprofessional instructors as trainers to continue the dissemination and implementation of farm biosecurity measures.

In December 2021, a training session for county (public- and private-sector) veterinarians took place, in recognition of their critical roles in regulating and supervising the use of antimicrobials and in providing professional advice to farmers and animal keepers.

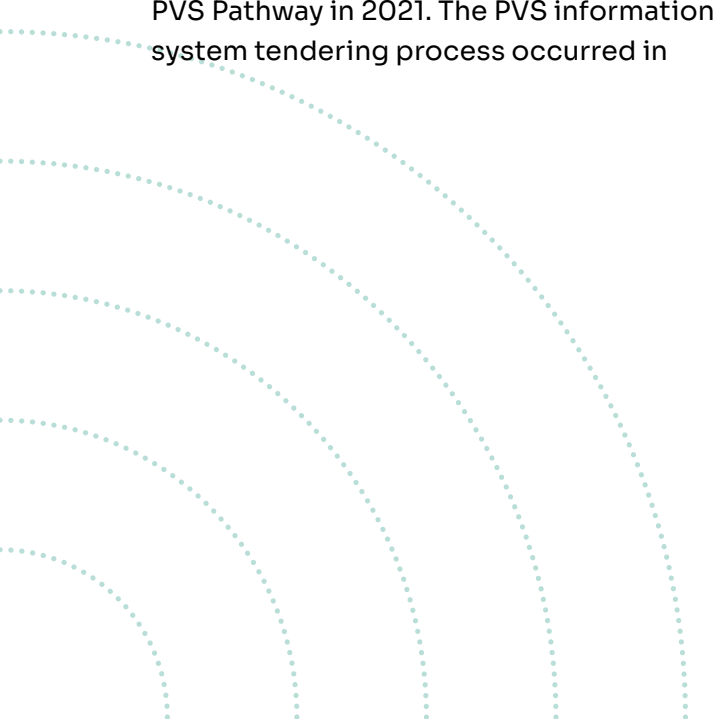
The AMR Multi-Partner Trust Fund (AMR MPTF) supported the FAO, WHO and WOA (Veterinary Legislation Support Programme) to develop the One Health assessment tool for AMR-relevant legislation in 2021, which is intended to identify national AMR-relevant legal gaps and options for legal reform across all One Health sectors (notably the human health, food safety, animal health, plant health and environmental sectors); this tool was piloted in 2022 and will be published in 2023.

Two pilot veterinary paraprofessional curriculum assessment missions took place in Senegal and Togo in 2021, which identified gaps in the curricula. One pilot veterinary paraprofessional curriculum development mission took place in Senegal in March 2022, which provided curriculum updates for the gaps identified. A virtual subregional workforce development workshop in Asia Pacific took place from June to July 2021. All workshops highlighted the veterinary paraprofessional competencies document, which includes appropriate use of veterinary medicinal products.

WOAH developed the technical specifications for the digitalization of the PVS Pathway in 2021. The PVS information system tendering process occurred in

2022 and the system's development will begin in early 2023. The information system will allow insights on One Health through dynamic dashboards and key PVS Pathway performance indicators, and will improve PVS evaluation mission processes as well as reports, information and documentation accessibility for WOA Members, partners and experts. The digitalization of the PVS Pathway aims to bring new insights, services, access, functionalities and methodologies of delivering capacity-building services to WOA Members.

WOAH is developing its competency-based training framework and companion e-catalogue of e-modules for a broad learning community (while face-to-face training remains fully valid, but for a more targeted audience, such as the delegates and focal points). The responsible use of antimicrobials is central to this framework with competency packages dedicated to AMU and AMR. A regional needs assessment to establish a list of AMR-related e-modules, both for terrestrial and aquatic animals, was undertaken to identify learning needs in WOA members. A call for tender was developed based on this list, selecting four e-modules relating to stewardship on AMR, to be launched in 2022.



Objective 4:

Optimize the use of antimicrobial medicines in human and animal health

SFVPs

In line with the sixth recommendation of the second WOAHA Global Conference on AMR and Prudent Use of Antimicrobial Agents in Animals in 2018, WOAHA is developing a global information and alert system of SFVPs. It aims to receive notifications of SFVPs from its network and subsequently alert all members to facilitate their identification and eventual removal from circulation. This intervention seeks to create a digital platform for the veterinary domain, similar to that of WHO for substandard and falsified medical products in human health. This platform will allow members to analyse the trends related to SFVP quantities on their territories, develop new policies and assess how their

implementation affects the presence of SFVP in their countries.

In 2021, WOAHA launched a pilot study with 14 WOAHA members representing all geographical regions. This pilot allows the collection of information on the country situation related to veterinary product quality, and member feedback on an Excel-based data collection tool. All 14 members have an authority to register and authorize veterinary products, and all but one have an authority for the surveillance of veterinary product quality. Very few members have cooperated or coordinated with another country to manage an incident of suspected SFVP (three members) or have a traceability system in place (four members), suggesting opportunities for targeted capacity-building. Seven participating members submitted Immediate Notification Forms alerting WOAHA of potential SFVPs, and four confirmed they were not aware of incidents. To date, 38 incidents – the discovery of (a) SFVP(s) at one time and place – were reported, affecting a total of 59 products. Table 2 shows the classification of the 38 incidents.

Table 2. Classification of products notified as part of the WOAHA global information and alert system pilot for substandard and falsified veterinary products

Classification (number of incidents)	Number of suspect products	Number of confirmed products
Substandard (23)	19	18
Falsified (9)	0	11
Unregistered/unlicensed (0)	0	0
Unknown (6)	10	1

Source: WOAHA (table developed for this report)

These SFVPs were mostly found at the distributor level (31 products), or in authorized (eleven products) and unauthorized (nine products) retail stores selling veterinary products. Other places of discovery can include border control areas and manufacturing sites. The main context for substandard or falsified product identification was through routine inspection and surveillance (35 products) and unusual packaging (15 products). The pilot will be expanded to 40 participants in 2022–2023 and will adopt digital tools (i.e. surveys) to better understand members' needs to develop the SFVP system specifications.

Pilot evidence on the collection and analysis of the in-country situations related to veterinary product quality will be drawn upon to progress on: 1) the creation of regional laboratory networks (laboratory hubs for each region) to increase the percentage of suspected SFVP testing in countries with no laboratory capacity; 2) the prioritization of developing and implementing veterinary product quality post-marketing surveillance at the regional and national levels so SFVPs are detected and removed from circulation; and 3) the extension of data collection at the field level, specifically the identification of SFVPs at the end of the supply chain of veterinary products.

AMR in aquaculture

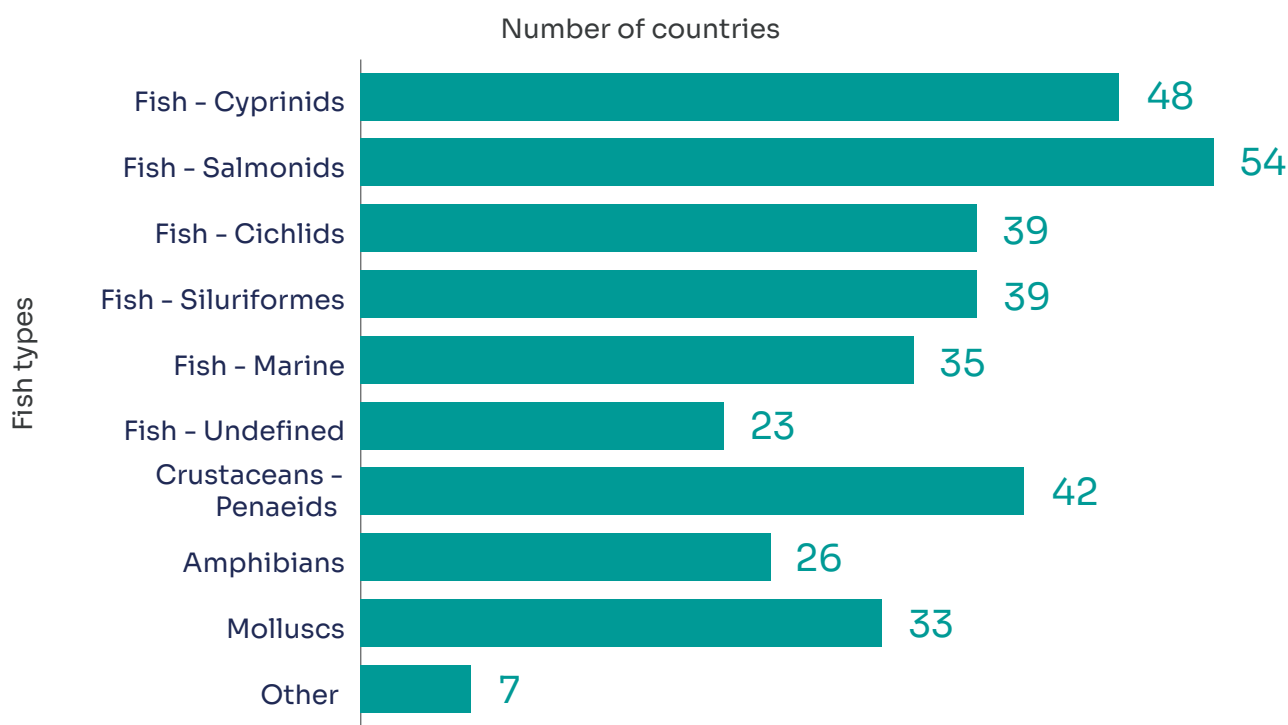
The WOAHA list of antimicrobial agents of veterinary importance was enhanced with the addition of an aquatic animal annex in 2021. A technical reference document listing antimicrobial agents of veterinary importance for aquatic species (174) was developed, which includes an updated list of 26 antibiotics authorized for use in fish and crustacean aquaculture (in at least one country), a list of 23 major bacterial pathogens and diseases for fish and five for crustaceans, and a table with the 12 classes of antibiotics used to treat fish infections and four for crustacean infections.

The WOAHA template for collecting AMU data on aquatic animals was also refined. The four major groups (fish, crustaceans, amphibians and molluscs) included in aquatic food producing animals were disaggregated into various subcategories (fish: cyprinids, salmonids, cichlids, siluriformes, marine, undefined; crustaceans: penaeids; amphibians; molluscs). The ornamental fish category was included with the non-food producing animal species. These subcategories were incorporated in the seventh round of global data collection (September 2021).

According to the preliminary results obtained (September 2021 and May 2022), 62 countries used the new subcategories for aquatic food producing animals and 24 countries used the new aquatic category

within the non-food producing animal species. These categories/subcategories allow trend analyses of AMU within aquaculture qualitatively where quantities for each subcategory are reported (Fig. 8).

Fig. 8. Number of countries reporting AMU data in aquaculture using the new subcategories



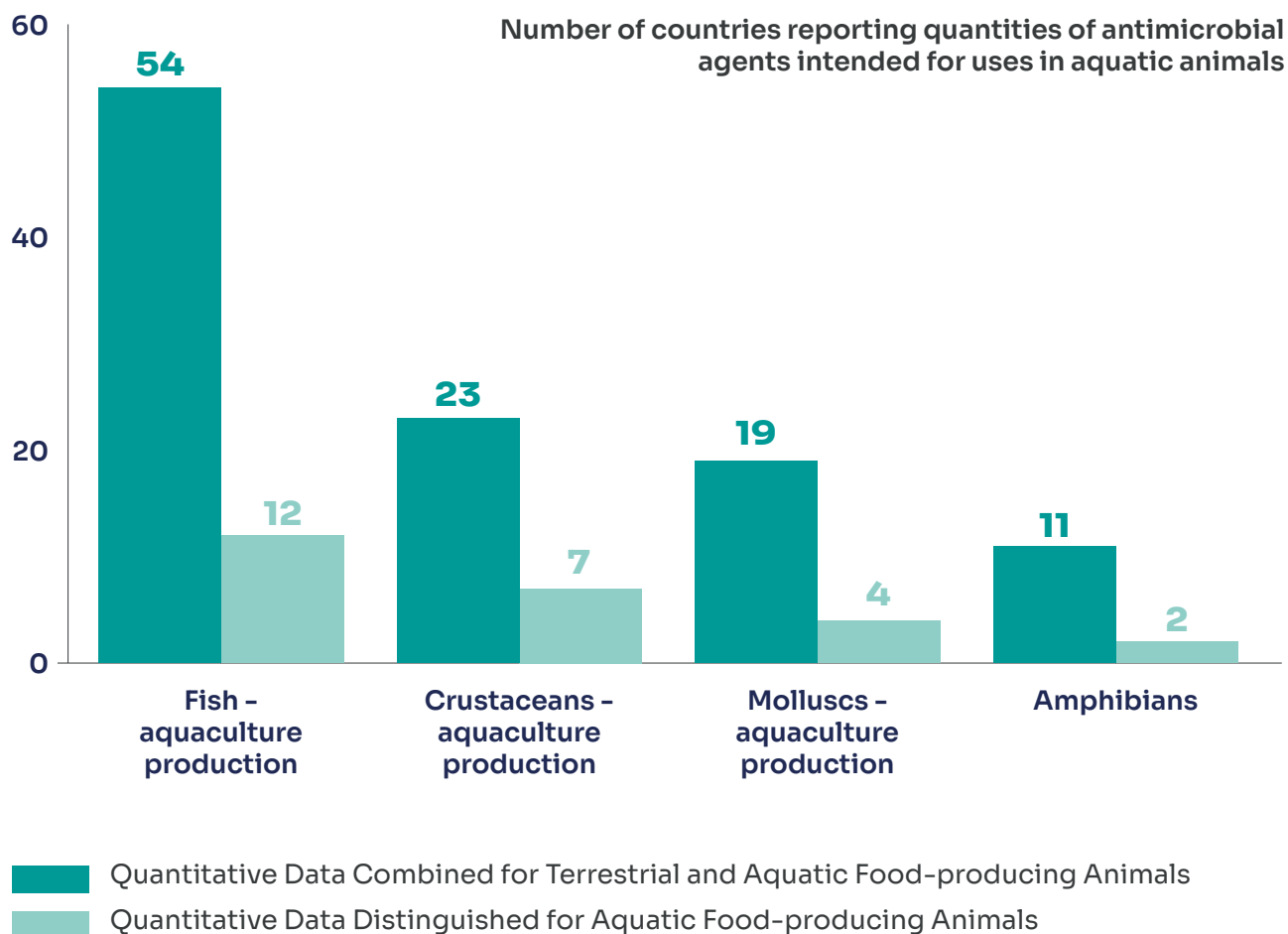
Source: WOA AMU database.



In AMU data reported for 2018 in the sixth edition (2022) of the annual report on antimicrobial agents intended for use in animals, 68 of the 109 countries that provided quantitative data for food producing animals included aquatic food producing animals.

Of those 68 countries, 13 were able to report quantitative data under the aquatic food producing animals group separately from other animal groups. Fig. 9 highlights the animals included in aquaculture covered by these 13 countries.

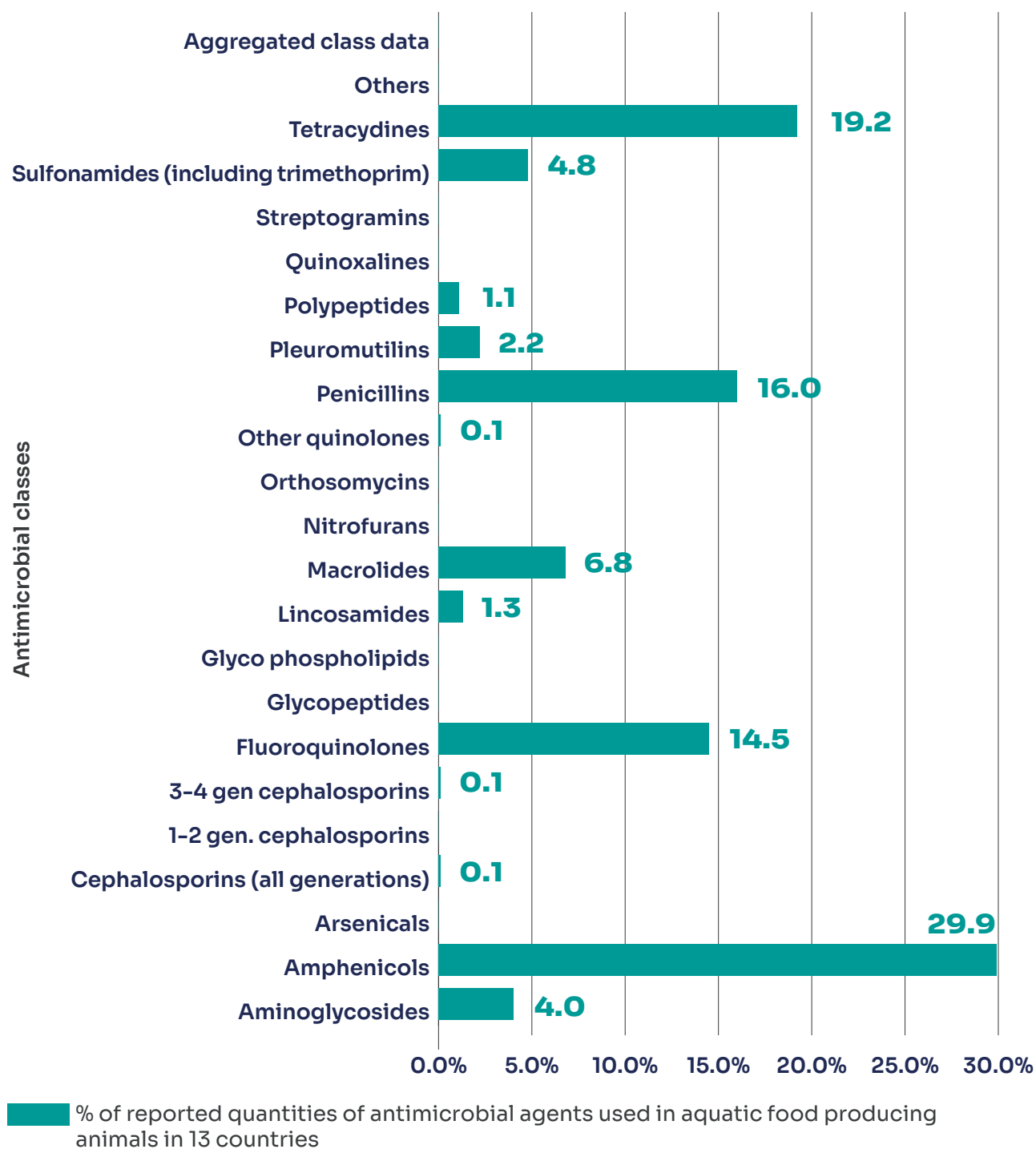
Fig. 9. Animals included in aquaculture covered in the quantitative data reported by 68 countries in 2018



Source: WOAH (168, fig. 23).

Of the 13 countries reporting quantitative data under the aquatic food producing animals group, amphenicols were most commonly reported (Fig. 10).

Fig. 10. Proportion of antimicrobial classes by aquatic food producing animals as reported by 13 countries in 2018



Source: WOA (168, fig.24).

Regional engagement – southern Africa

WOAH participated in the SADC task force on diseases in aquatic animals. Meetings on these animals were attended with members of the SADC Secretariat and FAO covering Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe. They were organized in response to outbreaks of a WOAHL-listed disease (epizootic ulcerative syndrome, a fungal disease) in two countries in the region.

Support was provided to promote AMU data collection in aquatic animals, by working closely with the SADC Aquatic Animal Health subcommittee, in which WOAHL has observer status. The WOAHL Sub-Regional Representation for Southern Africa also contributed to the SADC and African Union – Inter-African Bureau for Animal Resources project that aims to map and collect data on the use of antimicrobials in aquaculture within the SADC region.

WOAHL Working Group on AMR

The WOAHL list of antimicrobial agents of veterinary importance was adopted by the WOAHL International Committee at its Seventy-fifth General Session in May 2007 (Resolution No. XXVIII) (175). The list was further updated in May 2013, May 2015 and May 2018. The list's subdivision by animal species follows recommendations by the participants in the second WOAHL Global Conference on AMR and Prudent Use of Antimicrobial Agents in Animals in 2018 (Marrakesh, Morocco), and the work conducted by the WOAHL ad hoc Group on AMR. Members of the working group and external experts prepared the first list for poultry species in October 2020. The second list focused on swine and was completed in 2022. The document's purpose is to guide members on the development of national treatment guidelines, providing advice on prevention and best practice management, risk management and risk prioritization to minimize and contain AMR.

Chapters 6.10 (176) of the WOAHL Terrestrial Animal Health Code (TAHC) and 6.2 (177) of the Aquatic Animal Health Code (AAHC) provide guidance for the responsible and prudent use of antimicrobial agents in veterinary medicine, with the aim of protecting both animal and human health as well as the environment. They define the respective responsibilities of the competent authority and stakeholders such as the veterinary pharmaceutical industry, veterinarians, animal feed manufacturers, distributors and food animal producers who are involved in the authorization, production, control, importation, exportation, distribution and use of veterinary medicinal products containing antimicrobial agents.

The AMR working group is revising chapter 6.10 of the TAHC. The revised draft was submitted to the Terrestrial Animal Health Standards Codes (TAHSC) Commission for consideration in August 2022 and subsequently disseminated to the members for feedback. It is expected that two to three cycles of feedback will be conducted with members over the next couple of years before submission for endorsement at the WOAHL General Session.

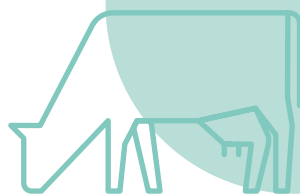
Objective 5:

Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions

WOAH work on research

The Global AMR R&D Hub (178) was launched in May 2018 following a call from G20 leaders to address challenges and improve coordination and collaboration in global R&D using a One Health approach. This

global partnership consists of 17 countries, the European Commission and two philanthropic foundations, and is steered by a board of members. By launching the animal component of its dynamic dashboard, the Global AMR R&D Hub supports the improvement of coordination and collaboration in tackling global AMR using a One Health approach. In 2021, the Hub used the WOAH priority vaccine lists (2015: chicken, swine, fish (179); 2018: cattle, sheep, goats (180)) to conduct an analysis of public and philanthropic funding supporting animal health vaccine development. The overall aim of the report produced is to help identify the potential gaps and opportunities of funding R&D relevant to animal health vaccines.



WOAH partnership with HealthforAnimals

HealthforAnimals (187) is a non-profit, nongovernmental organization representing companies and industry associations advancing animal health and animal health products. HealthforAnimals brings together member countries committed to supporting food security and sustainable economic growth, raising living standards through healthy animals and safe food, maintaining financial stability and contributing to growth in world trade. A memorandum of understanding between WOA and

HealthforAnimals supports the exchange of views and collaboration on key policy priorities, including AMR, animal health and welfare, the economic burden of animal diseases, the harmonization of legislation on veterinary drugs and biologicals including vaccines, and the funding of veterinary research. A manual on pharmacovigilance with practical guidance on how to set up a pharmacovigilance system for veterinary medicinal products was prepared in collaboration with HealthforAnimals and introduced to the Focal Points of Veterinary Products worldwide for feedback.

Good governance and capacity-building

The regulation of veterinary medicinal products represents a key element in controlling the misuse of antimicrobial agents. WOA is a key collaborator in the sub-Saharan Africa Veterinary Regulatory Harmonization project led by the UK Veterinary Medicines Directorate and funded by the Bill & Melinda Gates Foundation. Within the southern African region, WOA contributed to the published analysis of the implementation of regional guidelines for veterinary drug regulation in the national legal framework of SADC member states.

In Botswana, WOA offered the authorities facilitation and technical support to classify and schedule veterinary medicinal drugs to be enacted in legislation. The Botswana Medicinal Regulatory Authority engaged WOA to implement guidelines for the pharmacovigilance of veterinary medicines.

International Cooperation on Harmonisation of Technical Requirements for Registration of Veterinary Medicinal Products

The International Cooperation on Harmonisation of Technical Requirements for Registration of Veterinary Medicinal Products (VICH) seeks to harmonize

technical requirements for veterinary product registration. An associate member of VICH, WOA helps member countries take VICH guidelines into consideration. WOA considers that the international harmonization of technical requirements for the pre- and post-marketing authorization of veterinary medicinal products is a necessity for animal health, public health,

the protection of the environment and the facilitation of international trade, and that VICH is one of the tools needed to achieve these aims.

The VICH Outreach Forum, a VICH/WOAH initiative, provides a basis for wider international harmonization of technical requirements for the marketing authorization of veterinary medicinal products. WOAH co-chairs the Outreach Forum in collaboration with the chair of the VICH Steering Committee and provides WOAH members

with information on efforts to harmonize requirements. The VICH Outreach Forum meets regularly alongside the Steering Committee meeting. The fourteenth and fifteenth VICH Outreach Forums and fortieth and forty-first VICH Steering Committee meetings were held in November 2021 and 2022, (182) respectively. The Steering Committee developed a set of training materials on VICH guidelines. The primary audience for these training materials (183) are VICH Outreach Forum member countries.

Strengthening public–private collaboration: CAMEVET in the Americas

WOAH acts as the Secretariat of the American Committee for Veterinary Medicines (CAMEVET). The committee involves the national focal points for veterinary products as well as the veterinary medicines and biologicals national industry associations from WOAH members in the Americas. One of CAMEVET's primary objectives is to harmonize the technical regulations on the registration and control of veterinary products through public–private collaboration. CAMEVET has been an active partner in the diffusion of WOAH-led activities to relevant stakeholders, and has participated in training aimed to improve antimicrobial usage data collection. In 2020 and 2021, annual seminars were held during which WOAH staff made technical presentations designed to increase the involvement of the veterinary medicines industry and their counterparts from veterinary services.

Global burden of animal diseases

The economic loss due to the misuse and overuse of antimicrobials and the subsequent development of AMR and its impact on livelihoods is a difficult problem to tackle. A key factor in this challenge is the lack of a systematic approach to estimate what these losses are. The development of methods to define the economic burden of antimicrobials in terms of the expenditure on AMU and the costs of AMR in livestock will contribute

significantly to the ability to assess the burden of AMR on animal health.

The Global Burden of Animal Diseases (184) (GBADs) programme, with funding from the UK Fleming Fund, is working to develop such a model. GBADs is a systematic approach for the assessment of the economic burden of animal diseases and health issues. The approach will provide estimates of the net loss of production and the impacts on expenditure and trade in addition to

identifying the causes, risks, and where in the economy the burden occurs.

A methodology is being developed within the GBADs programme that can be used to define the economic impact of AMU and AMR based on: 1) the cost of antimicrobials and alternative technologies; 2) the impact of AMU and AMR on production; 3) the wider impact on the economy; and 4) the negative externalities on public and environmental health. The methods will be tested with existing country and sector case studies to ensure the integration of AMU/AMR into the attribution of economic impact. The outputs of the project will be integrated into the GBADs Knowledge Engine and presented through the GBADs dashboards. This embedding into the GBADs programme's informatic products will promote improved access and standardisation of credible information for decision-makers to better understand the economic impact of AMU/AMR, explore the cost-effectiveness of alternative mitigations strategies, and develop policies and programme to tackle AMU/AMR.

Secretariat for Registration of Diagnostic

Kits. WOAHA established a procedure for the validation and registration of diagnostic test kits for infectious animal diseases in 2003 via Resolution XXIX (1), to support WOAHA members' needs to gain global access to high-quality, validated diagnostic kits. Within the current scope of the Secretariat for Registration of Diagnostic Kits, the main outputs in 2020 and 2021 included:

- six new diagnostic test kit applications were reviewed by WOAHA's panel of experts;
- five diagnostic test kit renewals were reviewed by WOAHA's panel of experts;
- two diagnostic test kits underwent test application for extension of their use for new species targets/new sample matrices and were approved by WOAHA's panel of experts; the Biological Standards Commission approved one test kit for proposal for resolution at the ninetieth WOAHA General Session in May 2023; and
- the Biological Standards Commission approved two new test kit applications for proposal for resolution at the WOAHA General Session in May 2023.

RESEARCH – STAR-IDAZ: alternatives to antimicrobials (185).

WOAH co-hosts the STAR-IDAZ (186) International Research Consortium on Animal Health Secretariat. The consortium has 28 partners in 19 countries, including both public and private research funders and international donors. STAR-IDAZ aims to improve the coordination of research activities on the major infectious diseases of livestock and zoonoses to accelerate the delivery of improved control methods. One of the consortium's priorities is to speed up the development of alternatives to antibiotics. To do this, a working group was set up to identify research gaps and define research roadmaps to help research funders determine the specific challenges to be addressed by opening

a call for research proposals on the topic. Over 60 experts from 15 countries participated in several workshops to identify key areas of research and develop roadmaps for alternatives to antibiotics in livestock production. The roadmaps will be published on the STAR-IDAZ website (187), together with recommendations on key priority research areas. The STAR-IDAZ “alternative to antibiotics” report has been published in 2022.

WOAH AMR strategy results framework.

WOAH formulated its first AMR strategy in 2016 to guide the implementation of AMR work in the organization. An M&E framework was developed to track the strategy's implementation, which is providing the organization with information for evidence-based decision-making.

Kenya's AMR NAP and M&E plan development

The Government of Kenya developed its AMR NAP M&E plan in 2021 to guide monitoring and evaluation actions. Specifically, the M&E plan aims to improve the efficiency and accountability of NAP implementation, better coordinate activities, measure performance, improve decision-making and guide public-sector funding, resource mobilization and reporting commitments. The country had initially established an M&E technical working group to spearhead the implementation of M&E activities, consisting of the National Antimicrobial Stewardship Interagency Committee and the County Antimicrobial Stewardship Interagency Committee. Key lessons from this initiative are that countries should develop their AMR NAPs and M&E plans concurrently, strengthen capacity-building on M&E for AMR Secretariat, ensure resourcing for M&E units within the AMR Secretariat, and anchor the M&E system within the existing government M&E process for buy-in, uptake and sustainability.

Case study 1:

Building a multisectoral response to AMR: the experience of Colombia



I. Situation of AMR in Colombia

The use of antimicrobials in human, animal and environmental health is associated with the emergence, evolution and spread of bacteria resistant to such drugs. Like other countries, Colombia has developed a series of strategies aligned with the actions proposed in the GAP-AMR and with the guidelines recommended by PAHO, WOA, FAO to address AMR from a One Health perspective.

II. Country actions: sector-specific actions and a multisectoral approach

Human health:

Colombia's National Institute of Health has carried out laboratory surveillance of AMR for *N. gonorrhoeae* since 1987, and subsequently for *S. pneumoniae*, *Haemophilus influenzae* and *Neisseria meningitidis*. In 1994, surveillance was extended to acute diarrhoeal disease and foodborne illness, thus making it possible to determine resistance profiles in enteropathogens. In 2010, following the establishment of the national subsystem for the surveillance of health-care-associated infections, surveillance was initiated for device-associated infections, the use of antibiotics and AMR. The present surveillance network comprises 379 hospitals in 21 departments of Colombia and is part of the Latin American and Caribbean Network for AMR Surveillance and GLASS.

Surveillance has facilitated the identification of AMR markers to support decision-making in public health, such as determinants of resistance, which have been identified in human and animal isolates, foods and the environment, as well as useful data to develop national guidelines and alerts in human medicine and other sectors.

Progress has also been made in implementing IPC programmes, AMS and multimodal hand hygiene strategies in hospitals providing secondary and tertiary levels of care. There has also been progress in capacity-building, updating and developing guidelines for priority national events, including the development of a multimodal strategy to contain carbapenemase-producing Enterobacteriaceae.

Animal health:

The Colombian Agricultural Institute initiated AMR-related actions in 2002. In 2007, together with the Colombian Agricultural Research Corporation, it implemented the Colombian Integrated Surveillance Program for AMR in the poultry chain, which served as a benchmark for other countries in the region.

To date, 18 sampling schemes have been developed in the livestock sector and a National Surveillance Programme for Agricultural AMR is in the process of being implemented. This programme envisages joint controls in the food and agricultural sectors, in addition to other actions under public-private partnerships covering such topics as awareness of AMU and evidence-based decision-making. The Colombian Agricultural Institute is also part of the global surveillance system on the use of antimicrobials in animals led by WOA. H.

Among the main findings was the identification of epidemiologically important determinants of AMR that had also been reported in human health, such as the *mcr-1* and *optrA* genes. These data subsequently served as input for research articles, epidemiological alerts and guidelines for the appropriate use of antimicrobials at the intersectoral level.

Joint review of data from various sectors is critical for effective AMR NAP monitoring and implementation.

Food safety:

The National Food and Drug Surveillance Institute, in accordance with Law 1122 of 2007, develops pathogen control programmes, controls meat and meat products intended for human consumption, and oversees the surveillance and control of residues in food under the National Plan for the Surveillance and Control of Residues of Veterinary Drugs and Chemical Contaminants of Food of Animal Origin. In addition, it implements national guidelines and those of the Codex Alimentarius regarding general principles of food hygiene and the assessment of general risks to human health posed by foodborne antimicrobial-resistant microorganisms. It also develops codes of practice to minimize and contain AMR.

Environment:

Since 2021, Colombia's Ministry of the Environment and Sustainable Development has engaged in the intersectoral effort through the strategic plan to monitor emerging pollutants (antimicrobials) in the country by 2022 and thus strengthen this aspect of the AMR NAP.

Regulatory and legal frameworks are needed to coordinate across the sectors.

Multisectoral approach:

In line with WHO resolution WHA68.7, Colombia initiated multisectoral efforts to develop an AMR NAP in 2015, forming working groups involving the main sectors of interest, led by the Ministry of Health and Social Protection with input from the Ministry of Agriculture and Rural Development, the National Institute of Health, the National Food and Drug Surveillance Institute, the Colombian Agricultural Institute, the Colombian Agricultural Research Corporation and PAHO/WHO. As a result of this initiative, the AMR NAP was implemented in 2018 as an intersectoral strategic plan to address AMR in human and animal health, enhance phytosanitary control and reduce impact on the environment. A range of sectors have been mobilized and an intersectoral steering body was formed to implement this plan.

To follow through on the plan under the tripartite Working Together to Fight AMR project (FAO, PAHO/WHO and WOA) funded by the EU, the intersectoral technical steering body was consolidated as a forum for joint work and ongoing exchanges between the various institutions involved, thus enabling the stakeholders to combine the progress made in each sector and make technical decisions to implement the project and the AMR NAP.

III. Successful results of multisectoral and cross-sectoral work

- In 2016, the first detection of the *mcr-1* gene resistant to colistin, was handled in an intersectoral manner (by the National Institute of Health, National Food and Drug Surveillance Institute, Colombian Agricultural Institute and Colombian Agricultural Research Corporation). The gene was identified in isolates of human origin, in food and in the livestock sector. Accordingly, it was decided to intensify surveillance and the control of transmission of gram-negative bacterial strains resistant to colistin in Colombia; moreover, the use of these antimicrobials as growth promoters in animal species producing food for human consumption was prohibited.
- The national Codex Alimentarius Commission, which brings together stakeholders from the public sector, industry and academia, has promoted the implementation of guidelines and codes of practice to monitor and contain foodborne AMR as well as support Colombia's implementation of the Codex Alimentarius with regard to its approach to AMR.

- As part of the Working Together to Fight AMR project, an integrated AMR surveillance pilot plan was developed using molecular diagnosis of *Salmonella* spp. with input from the intersectoral body. This exercise revealed the main strengths and gaps of the future development of a national intersectoral surveillance plan for AMR. The pilot also helped prioritize a set of data variables to be collected and analysed, through the implementation of a standardized WHONET One Health tool.
- Colombia joined GLASS in 2021, providing data on AMU (2018–2020) and AMR (data from 2022).
- In 2022, based on a joint analysis by the National Institute of Health, the National Food and Drug Surveillance Institute and the Colombian Agricultural Institute on the emergence of mechanisms of resistance to linezolid and phenicols in humans, animals and food, a government epidemiological alert was issued that called on the timely detection and containment of the spread of these resistance mechanisms.
- Operational research capacities to address AMR in Colombia were strengthened through the development of seven projects on topics of interest to the NAP.

IV. Lessons learned

- Collaborative work across all sectors is important to consolidate the intersectoral body, which facilitated exchanges, stakeholder recognition and the visibility of AMR NAP implementation progress.
- Regulatory and legal frameworks are needed to coordinate the sectors represented in the intersectoral body.
- It is important to combine data from various sectors to monitor, follow up and develop the priority activities envisaged by the AMR NAP.
- It is necessary to develop short-, medium- and long-term intersectoral operational plans (food, human and animal health) to provide a clear roadmap of each sector's goals.

V. Future opportunities and critical needs

In light of the above, the priorities of the country are to:

- secure the intersectoral body's official status through a legal framework to ensure that the AMR NAP is funded on a sustainable basis;
- endorse the review and update of the AMR NAP in accordance with the country context and the One Health approach;
- develop a roadmap to implement an integrated AMR surveillance system that facilitates the intersectoral use and analysis of data;
- promote the implementation of community-targeted communication strategies to raise awareness of the use of antimicrobials; and
- conduct operational and management capacity-building initiatives to support the NAP implementation processes.

Case study 2:

Developing the AMR NAP in El Salvador: the experience of the human health sector

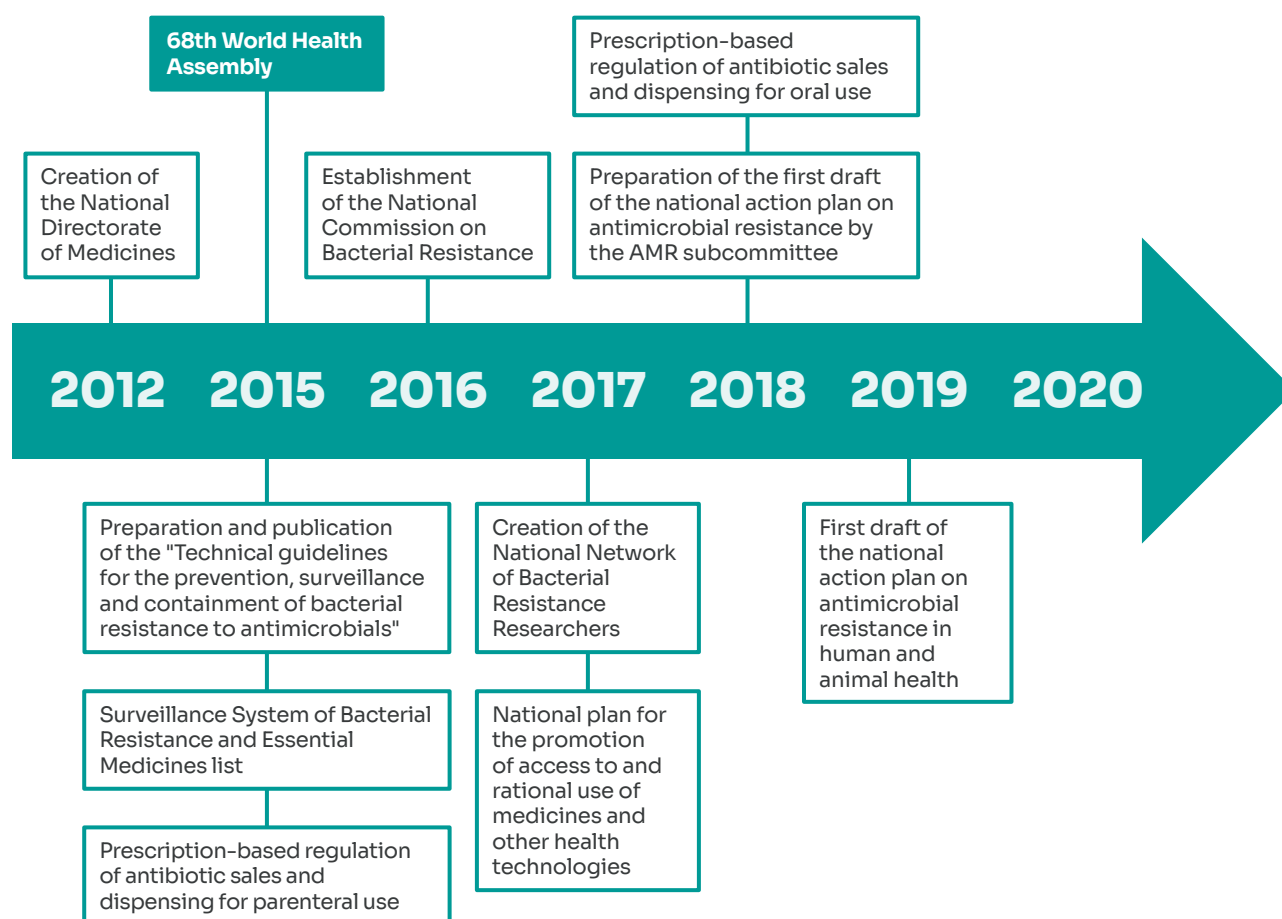


I. Context

Since the adoption of the AMR resolution at the Sixty-eighth World Health Assembly (13) in Geneva in 2015, the Government of El Salvador, in line with the recommendations, took initial steps in 2015 to control the use of non-orally administered antimicrobials. It did so through measures applicable to dispensing pharmacies throughout the country, issued by the National Directorate of Medicines – the country’s national regulatory agency – and by creating a system for the epidemiological surveillance of microorganisms in hospital settings. This system collected information on susceptibility and resistance to antimicrobials that forms part of the national institutional Essential Medicines list (188), and included data from 17 hospitals in the national network through the Ministry of Health (National Public Health Laboratory, Directorate of Technologies and Office of Infectious Diseases).

At the same time, by way of legal support and in an ongoing effort to control AMR, El Salvador continues to update its regulatory documentation and develop national agreements. The National Commission on Bacterial Resistance was formed in 2016 by ministerial agreement; the Ministry of Health takes the lead role, and governmental and nongovernmental institutions, civil society and international cooperation bodies directly or indirectly involved with human and animal health are represented.

Fig. 11. Timeline of AMR control activities in El Salvador, 2012–2020



Source: Government of El Salvador.

II. Country actions

Efforts to develop a national AMR plan began in 2017 when a commission was formed and PAHO/WHO provided assistance based on other countries' experience in the region. As shown in Fig. 11, the first draft of the AMR NAP was developed in 2019 prior to launching the authorization process.

In the period 2020–2021, the COVID-19 pandemic affected health programmes and scaled back previous efforts to consolidate the AMR NAP. Self-medication among the general population, hastily developed recommendations and clinical guidelines, and the use of biomedical devices in seriously ill patients all contributed to an increase in

the use of antimicrobials in hospital settings. Reports became more frequent of hospital-acquired infections driven by changes in the resistance profiles of known microorganisms, including enzymatic mechanisms caused by metallo- β -lactamase.

In response to this aggravated situation, El Salvador requested support from the WHO/PAHO country office in El Salvador to reactivate the National Commission on Bacterial Resistance and resume the development and implementation of the AMR NAP.

In the national context, the Ministry of Health faced a number of COVID-19-related challenges, and multisectoral collaboration was affected by social restrictions imposed under sanitary measures. However, delegates from all the institutions and agencies sitting on the National Commission were subsequently convened, and their participation ensured in the programmed activities. Given their status as representatives of the various bodies on the Commission set up by the Ministry, AMR was treated as a priority issue.

III. Results

Following the reactivation of the National Commission, activities began with the introduction of the periodic evaluation tool of the WHO Policy Guidance on Integrated Antimicrobial Stewardship Activities, to be applied at the national level, with subsequent focus on the indicators and objectives to be developed in the context of the roadmap for updating the AMR NAP.

Once the NAP was updated, follow-up meetings were scheduled for 2021 to develop an implementation and execution plan for 2022. These meetings were attended by all delegates of the Commission. It is noteworthy that during the process of developing the AMR NAP, with support from the WHO/PAHO regional and country offices, opportunities were identified to continue strengthening and creating regulatory instruments for IPC at all health care levels, updating the national Essential Medicines list and strengthening surveillance of health-care-associated infections.

Likewise, efforts to establish AMS programmes were made in close collaboration with IPC programmes in six hospitals of the national Integrated Health

System. Both programmes relied on the self-administration of evaluation mechanisms adapted from existing tools developed by WHO, the US Centers for Disease Control and Prevention, the European Centre for Disease Prevention and Control and PAHO/WHO, to establish the baseline of capacity in place and prepare the implementation of the programmes in El Salvador.

Alongside universities and centres for training human and animal health professionals in the public and private sectors, the National Academic Committee for the Containment of AMR was created and accredited, ensuring that the topic of AMR is included in study curricula of health specialists in a wide range of health and related disciplines.

In January 2022, El Salvador adopted the WHO AWaRe classification of antibiotics in its national Essential Medicines list in coordination with the national regulatory agency.

IV. Lessons learned

The main challenges identified when AMR activities resumed during the pandemic included incorporating AMR control and IPC strengthening activities into COVID-19 control and management initiatives, optimizing the use of antimicrobials and updating the epidemiological surveillance of resistant microorganisms, as well as exploring areas of coordination and joint work among members of the Commission and other strategic partners.

A major achievement of the Ministry of Health in AMR containment to date has been the development and official launch of the AMR NAP for the period 2022 to 2024, adapted to the needs of the country and clearly stipulating the role of each stakeholder

institution and organization. The NAP contains a mechanism to follow up, monitor and evaluate activities on a semi-annual basis to ensure compliance and identify any barriers to performance.

Another notable achievement has been the updating of technical guidelines of the National Commissions, of IPC, epidemiological surveillance and AMS, which has a direct impact on improving patient care and AMR prevention and containment in the human health sector.

Several key lessons emerged that could guide other countries developing an AMR NAP, including the need to ensure legal support to provide sustainability and continuity to a multisectoral national/regional AMR commission or committee directly or indirectly involved in human, animal and environmental health through a One Health lens. It is also necessary to establish links with strategic partners, such as international organizations, civil society organizations, providers and educators in the areas of private and public health, in order to strengthen the NAP's impact and ensure compliance with it.

Another experience to keep in mind is the need for an initial situation analysis to establish a baseline, and the importance of working comprehensively and continuously in all AMR-related activities, from AMR surveillance to IPC and AMS, among other strategies, to maximize the impact of the AMR response.

V. Future opportunities

Areas to improve AMR activities include:

- developing strategies at the local and national levels in health facilities to promote the sustainability and continuity of the plan and its execution;
- following up on the adoption of effective complementary strategies, such as AMS programmes, and continuously strengthening IPC programmes and epidemiological surveillance; and
- encouraging related institutions' medium-term involvement, such as the Ministry of the Environment, the National Administration of Aqueducts and Sewers, the Central American Integration System, FAO, WOAHA and others, in expanding the holistic One Health vision.

The national Integrated Health System with strong AMS, IPC and surveillance programmes has maximized the AMR response.

The COVID-19 pandemic has shown the importance of the Salvadorian national Integrated Health System's coordinated work, as reflected in the achievements and progress made in fighting AMR in the past few years.

3

Chapter 3.

AMR national action plan implementation 2020–2021*



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* A report with data from 2022–2023
will be published in 2024.

Background on the annual tracking AMR country self-assessment survey (TrACSS)

Since the adoption of the GAP-AMR in 2015, countries have substantially stepped up their response to AMR by developing and implementing AMR NAPs. To measure progress on the implementation of the NAPs, the TrACSS³ has been administered annually since 2016 (Fig. 12) and is well received by stakeholders. The TrACSS closely aligns with the five GAP-AMR objectives and governance.

The indicators are assessed on a five-point scale from A to E, with C serving as a threshold for nationwide implementation on most indicators. Countries should aim to reach levels C–E on all indicators. Responses from the surveys are published in a quadripartite open-access database (189). The TrACSS has the same limitations as any self-assessment survey, including the potential for reporting bias and varying national data-collection standards, which may affect data quality.

The TrACSS supports the global M&E framework that was developed and published in 2019 (190). This framework was designed to facilitate GAP-AMR assessment at the national and global levels. It provides a recommended list of indicators, including a selected number of TrACSS indicators.

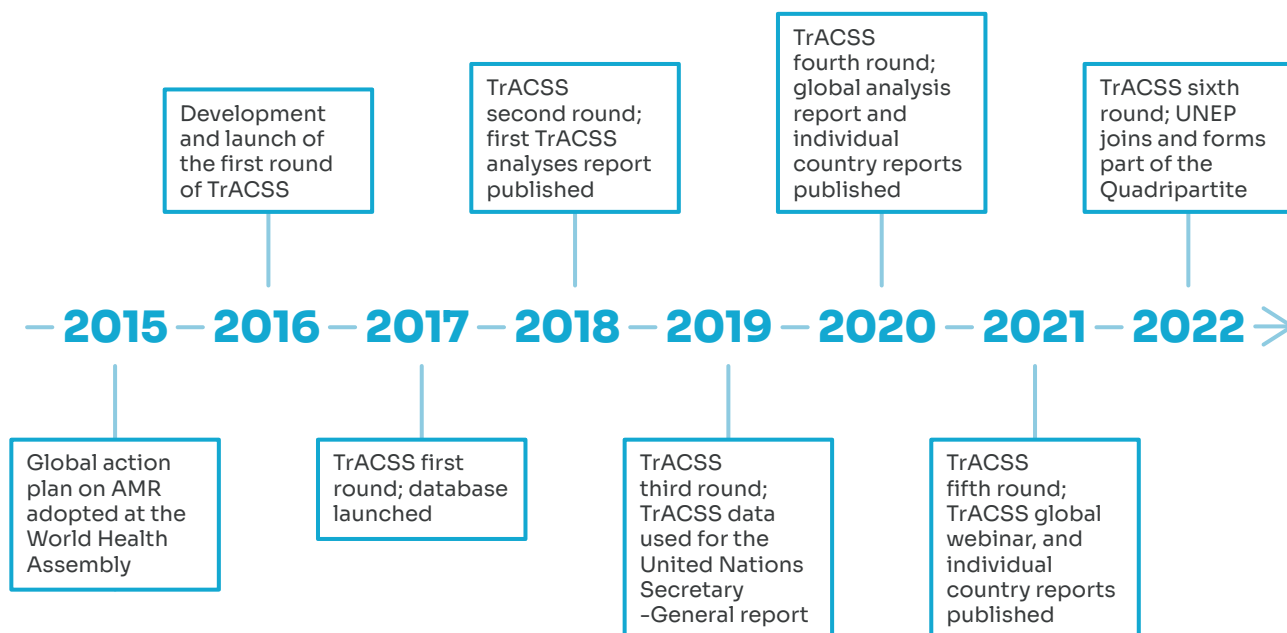
The TrACSS⁴ results have been reported for six consecutive years since its development in 2016. This chapter captures countries' assessment of their progress in implementing their AMR NAP, and provides an analysis of their responses against the four World Bank income group classifications for countries.

The indicators are assessed on a five-point scale from A to E, with C serving as a threshold for nationwide implementation on most indicators.

3 Given the inclusion of UNEP in the quadripartite, the acronym TrACSS has now changed from “Tripartite AMR country self-assessment survey” to “Tracking AMR country self-assessment survey.”

4 The TrACSS questionnaire in 2022 was extensively reviewed and revised. The revised version separates the terrestrial and aquatic questions and includes more environment-related questions, subsequent to UNEP joining the tripartite partners to formally become the *quadripartite*.

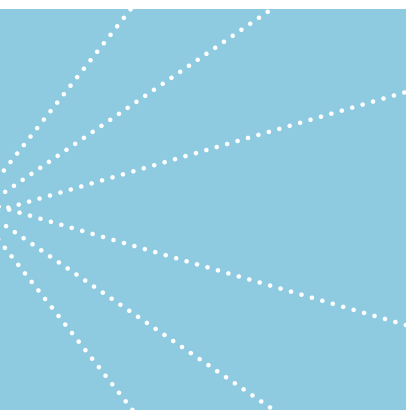
Fig. 12. Timeline and development of the TrACSS



Source: FAO, WHO, WOH.

Countries participating in the TrACSS

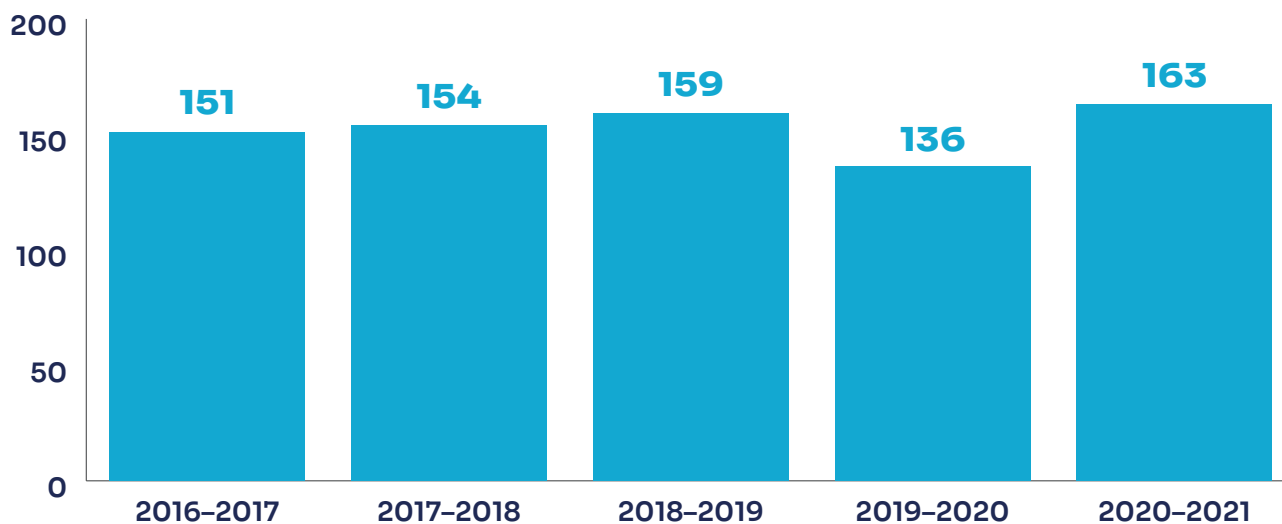
An analysis of the TrACSS over the past 5 years shows an overall increasing trend in the number of countries participating in the survey. In 2020–2021, a record number of 163 countries reported their progress (Fig.13), representing over 90% of the global population.⁵



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5 The survey was sent to 194 WHO Member States. FAO, WHO and WOH country membership can differ. Based on precedent and for consistency, WHO Member States are used in the rest of this report.

Fig. 13. TrACSS country response rate, 2016–2021



Source: Global results of Tripartite AMR country self-assessment survey (TrACSS) 2021 – human health [webinar]. Geneva: World Health Organization; 2021.

The global analysis report on the 2019–2020 TrACSS concluded that the level of achievement on the majority of TrACSS indicators significantly differed among World Bank income groups (191). Additionally, studies show that the impact of AMR on economic growth will be more pronounced in LICs compared to higher-income countries, and the economic inequality gap will widen (192).

It is therefore important to monitor and evaluate the progress on AMR NAP implementation by economic status. In the current report, countries are classified according to 2021 World Bank income group, which means that the TrACSS results are summarized and compared for HICs, upper-middle-income countries (UMICs), LMICs and LICs (Table 3). The individual TrACSS reports of all participating countries are available online (193).

Table 3. Number of participating countries and percentage in the 2020–2021 TrACSS, by World Bank country income group ($n = 163$)

World Bank country income group	Number of countries	Percentage (%)
High income	49	30
Upper middle income	43	26
Lower middle income	46	28
Low income	25	15
Total	163	100

Source: FAO, WHO, WOA. H.

Data analysis framework to measure national progress on AMR

Key One Health indicators aligned with progress on NAP implementation activities were selected for comparison between income groups and to enable five-year trend analyses. These indicators captured progress made in the human health, animal health, food and agriculture, and environmental sectors (see Annex 3 for the full list of indicators analysed in the current report).

Unless mentioned otherwise, the selected indicators were coded into binary variables representing levels A–B (having no nationwide implementation) and levels C–E (having reached nationwide implementation). Owing to the smaller sample size, a global test of independence (Fisher’s exact test) was performed to verify if there was a significant relationship between level of achievement

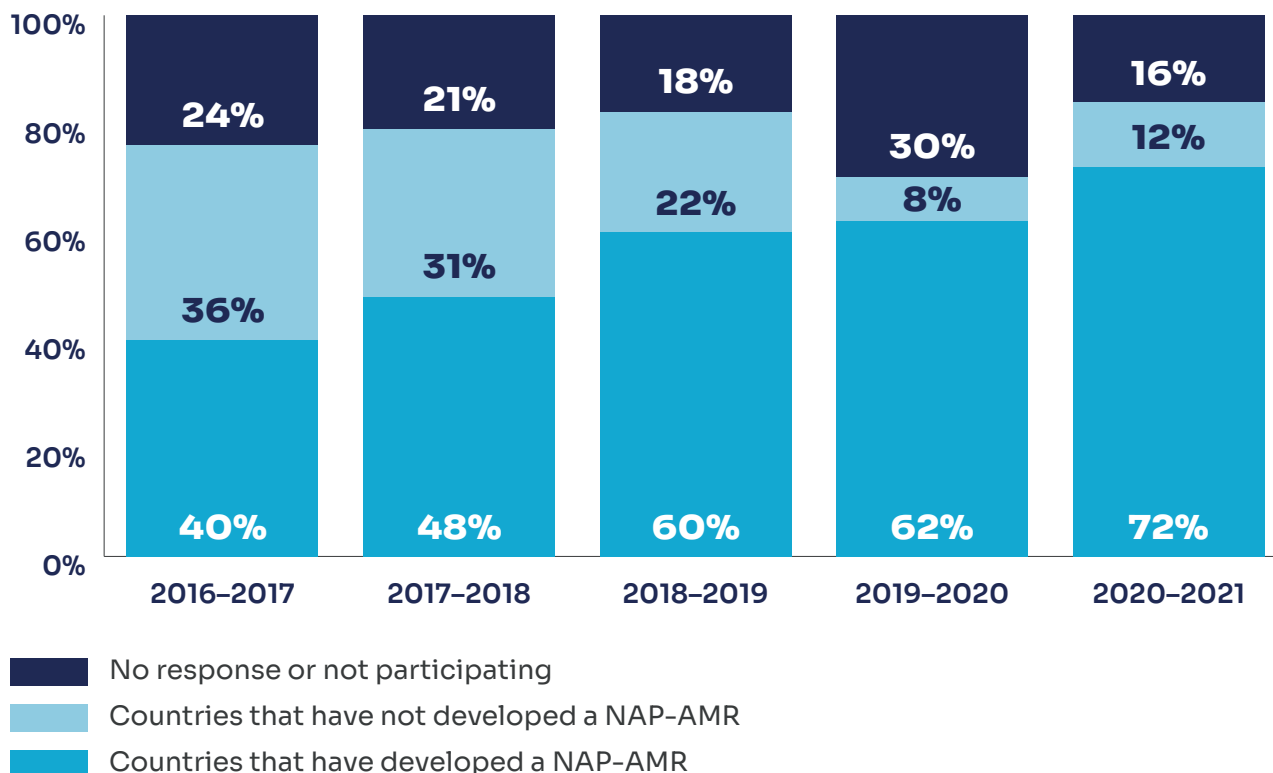
and World Bank income group. Fisher’s exact test was chosen instead of the Chi-squared test because more than 20% of cells had expected frequencies of less than 5. The significance level was set to $P < 0.05$.

Trends in AMR One Health indicators

AMR NAPs. The proportion of countries that have developed an AMR NAP has significantly increased. Almost three quarters (72.2%) of countries, a total of 140, developed an AMR NAP in 2020–2021, compared to 39.7% of countries (numbering 77) in 2016–2017 (Fig. 14).

Strong progress in the development of multisectoral AMR national action plans worldwide.

Fig. 14. Proportion of countries that have or have not developed an AMR NAP, 2016–2021



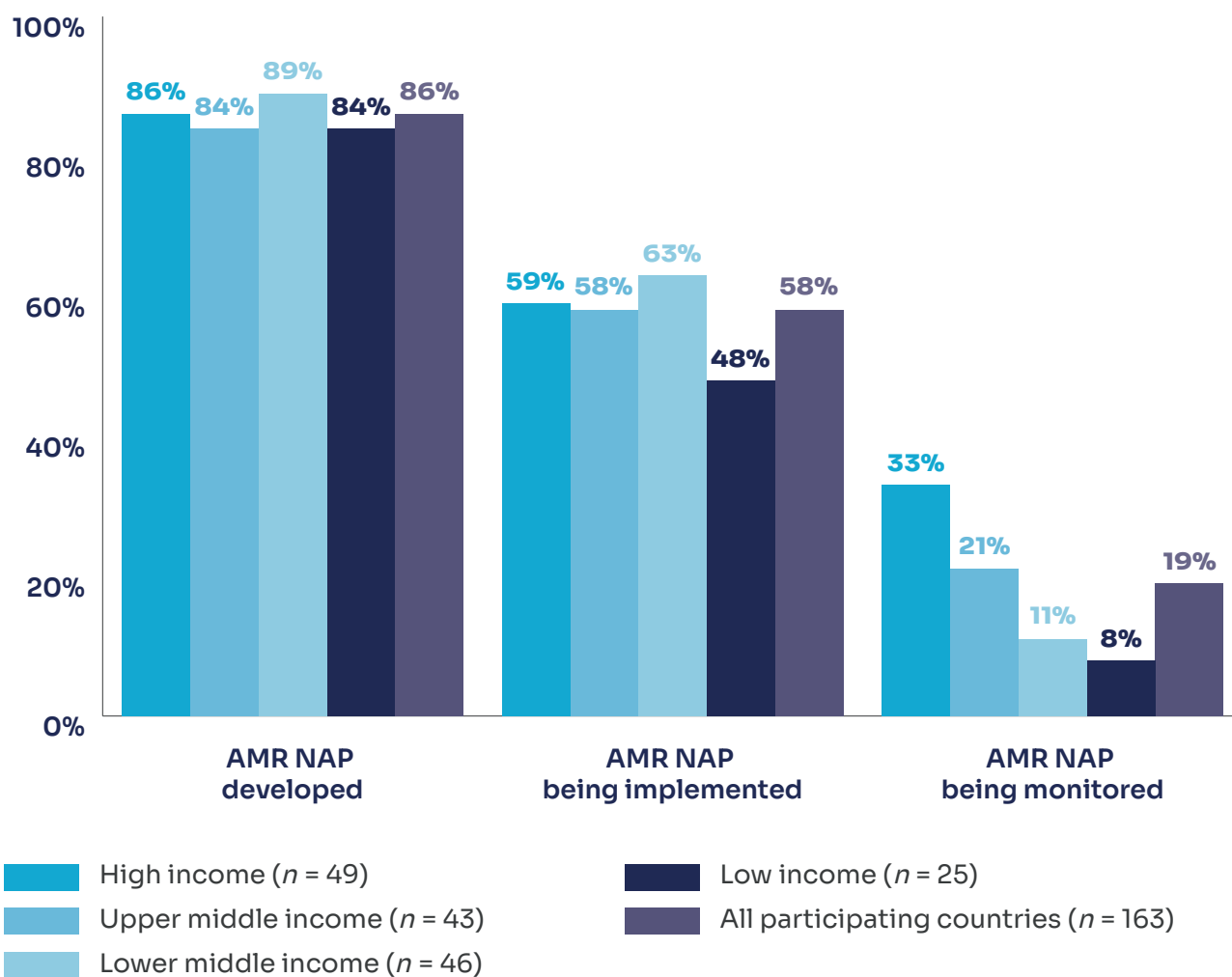
Proportions shown out of the 194 WHO Member States (captured in question 5.1 of the 2020–2021 TrACSS). Countries that did not participate in the TrACSS or respond to this indicator are depicted in grey.

Source: World Health Organization, tracking AMR country self-assessment survey (TrACSS) data, 2016–2021.

Despite countries' progress in developing AMR NAPs across all income levels, few countries are reporting the implementation of their plans, and even fewer are actively monitoring and evaluating their implementation. A significant difference ($p = 0.03$) was found between income group and the monitoring and evaluation of the NAP (level E). Whereas one third of HICs

reported actively monitoring the progress of their action plans, this was less the case for the other income groups (Fig. 15). Given that few countries are actively monitoring the progress made, countries need to be supported in establishing their M&E framework for the sustainability of their AMR NAP.

Fig. 15. Proportion of countries reporting on AMR NAP development (left), implementation (middle) and monitoring and evaluation (right), by World Bank country income group in 2021



Proportions shown of the 163 participating countries in 2020–2021. Data based on responses collected during the 2020–2021 TrACSS (captured in question 5.1).

Source: World Health Organization, tracking AMR country self-assessment survey (TrACSS) data, 2020–2021.

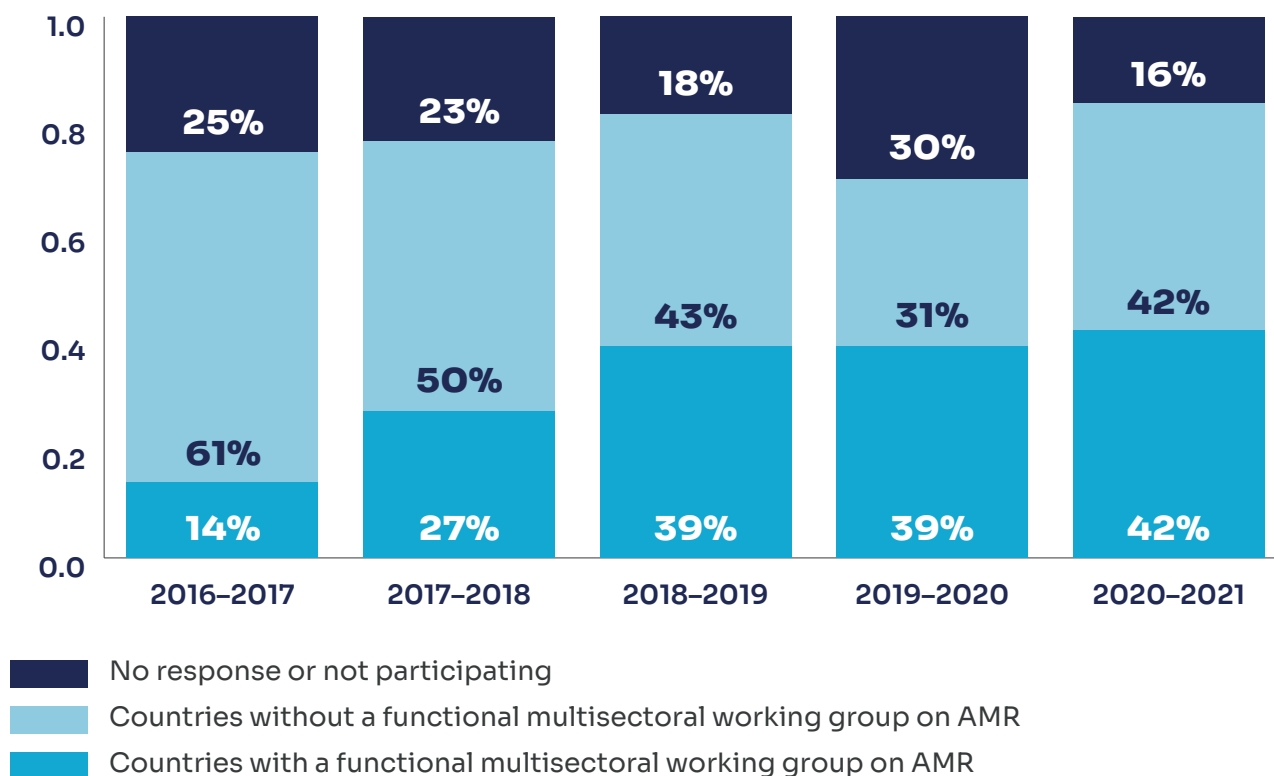
Multisectoral working groups on AMR.

As a multisectoral challenge, AMR requires a One Health approach with all sectors’ robust engagement. Between 2016 and 2021, the proportion of countries that reported having a functional multisectoral working group increased. Almost half (42.3%) of all countries reported having a functional working group

in 2020–2021 compared to a significantly lower proportion of countries (14.4%) in 2016–2017 (Fig. 16).

Country income levels impact the implementation and monitoring of AMR NAPs.

Fig. 16. Proportion of countries with or without a functional multisectoral working group on AMR, 2016–2021



Proportions shown out of the 194 WHO Member States (captured in question 4.1 of the TrACSS). Countries that did not participate in the TrACSS or respond to this indicator are depicted in grey.

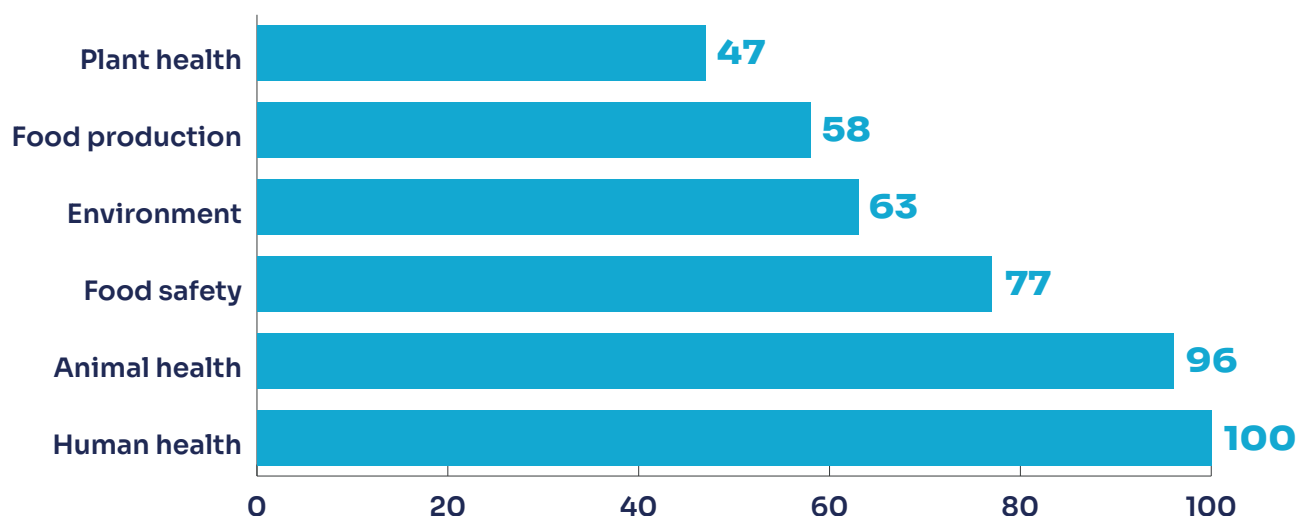
Source: World Health Organization, tracking AMR country self-assessment survey (TrACSS) data, 2016–2021.

The existence of a multisectoral governance structure on AMR is one of the indicators in which the largest differences between income groups and achievement levels have been observed ($P < 0.01$). Less than one third (28.0%) of LICs reported having a functional governance or coordination mechanism addressing AMR, while the proportion was higher for LMICs (45.7%), UMICs (46.5%) and HICs (69.4%).

In 2020–2021, all 163 participating countries reported that their AMR NAP involved the human health sector (Fig. 17). The vast majority (96.3%) reported having both human and animal health sectors actively involved in the implementation of their AMR NAP.

Ensuring that the AMR multisectoral coordination mechanism is functional is a critical priority.

Fig. 17. Proportion of countries responding “yes” to sector involvement (question 4.2 of the TrACSS), 2020–2021



Source: World Health Organization, tracking AMR country self-assessment survey (TrACSS) data, 2020–2021.

Compared to 2017–2018, the trend regarding the participation of other sectors increased, specifically:

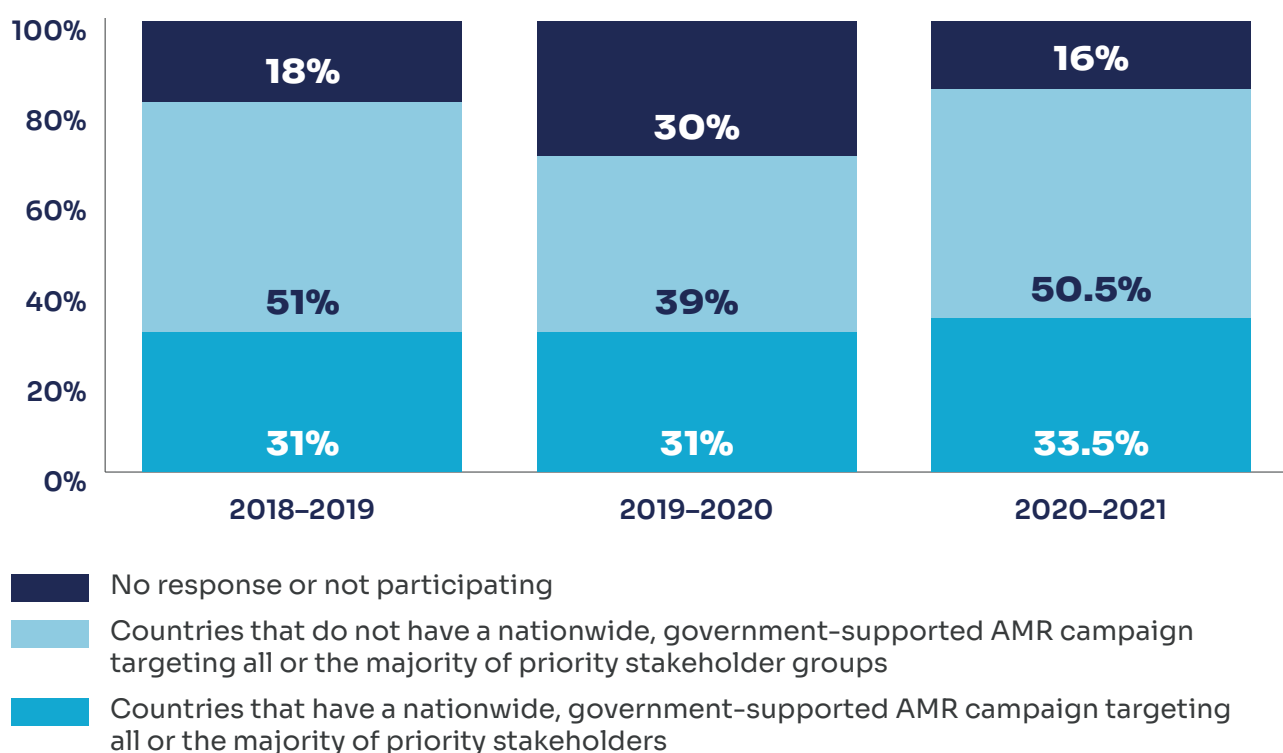
- The food safety sector increased from 70.8% (109 of 154) in 2017–2018 to 77.3% (126 of 163) in 2020–2021.
- The environmental sector increased from 48.7% (75 of 154) in 2017–2018 to 63.2% (103 of 163) in 2020–2021.
- The plant health sector increased from 40.3% (62 of 154) in 2017–2018 to 47.2% (77 of 163) in 2020–2021.
- Food production remained similar overall from 58.4% (90 of 154) in 2017–2018 to 58.3% (95 of 163) in 2020–2021.

The increasing involvement of various sectors in the multisectoral coordination mechanism to address AMR over the years reflects stronger synergy and collaboration in tackling AMR.

Awareness of AMR. Since the 2018–2019 edition of the TrACSS, countries are asked to report whether they have a nationwide, government-supported AMR awareness campaign targeting all or the majority of priority stakeholder groups. The proportion of countries with a national awareness campaign has remained at about one third of all countries and has not increased since 2018–2019 (Fig. 18). Half of all countries (50.5%; 98 of 194) reported that no or limited nationwide AMR awareness campaigns were conducted in 2020–2021. The remaining countries did not respond to this indicator or participate in the survey.

More countries need to organize and conduct nationwide AMR awareness campaigns.

Fig. 18. Proportion of countries that have or do not have a nationwide, government-supported AMR campaign targeting all or the majority of priority stakeholder groups, 2018–2021



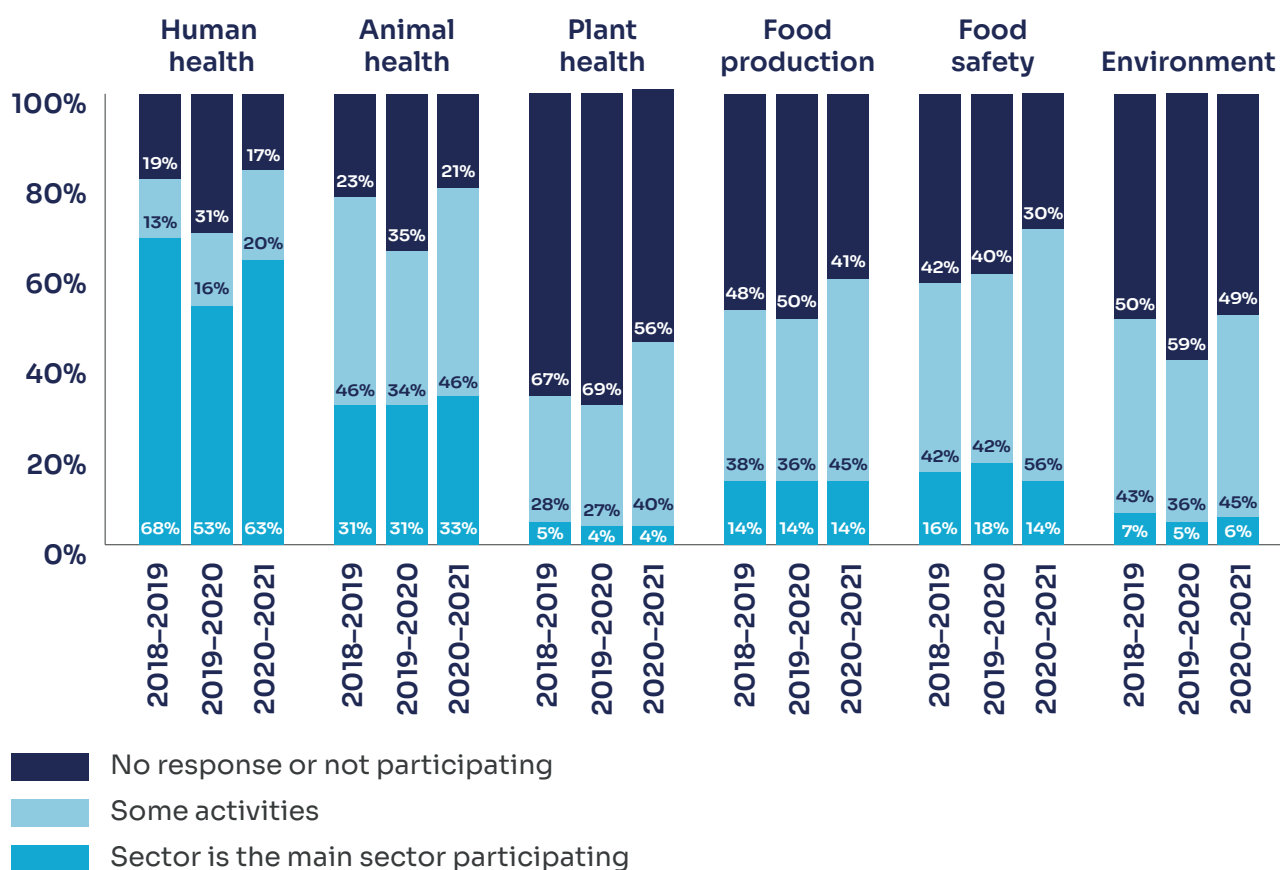
Proportions shown out of the 194 WHO Member States (captured in question 6.1 of the TrACSS). Countries that did not participate in the TrACSS or respond to this indicator are depicted in grey.

Source: World Health Organization, tracking AMR country self-assessment survey (TrACSS) data, 2018–2021.

The classification of countries by their income level revealed a significant relationship between levels of achievement in promoting awareness and income groups ($P < 0.001$). The higher a country's income level, the greater its probability of having a nationwide, government-supported AMR awareness campaign targeting all or the majority of priority stakeholder groups; 65.3% of HICs, 39.5% of UMICs, 23.9% of LMICs, and 20.0% of LICs reported reaching this level of achievement. More countries reported having a limited or small-scale awareness campaign directed at some but not all stakeholders (levels C–E): 95.9% of HICs, 83.7% of UMICs, 89.1% of LMICs, and 68.0% of LICs ($P < 0.01$).

The human and animal health sectors are predominantly targeted in awareness campaigns in the majority of countries (63% and 33%, respectively, of all countries in 2020–2021). The food safety and food production sectors are the main targets in some countries (>14% of all countries in 2020–2021). However, awareness-raising activities for the environment and plant health sectors received less focus (<6% of all countries in 2020–2021) and should be engaged further in nationwide AMR awareness campaigns (Fig. 19), especially given the evolving evidence in these sectors.

Fig. 19. Proportion of countries that had a sector as the main focus of their awareness campaign or had some activities targeting a certain sector, 2018–2021



Proportions shown out of the 194 WHO Member States (captured in question 6.1 of the TrACSS). Countries that did not participate in the TrACSS or respond to this indicator are depicted in grey.

Source: World Health Organization, tracking AMR country self-assessment survey (TrACSS) data, 2018–2021.

AMR NAP implementation in the human health sector

Training and professional education on AMR.

In total, 78.5% of the participating countries (128 of 163) reported that they offered at least some training and professional education on AMR in the human health sector (levels C–E of indicator 6.2). Almost all HICs (95.9%) covered AMR in some pre- and in-service training, whereas this was less the case in UMICs (76.7%), LMICs (76.1%) and LICs (52.0%), with these differences being

statistically significant ($P < 0.001$). Although most HICs are already incorporating AMR in educational curricula for human health care workers, a greater effort needs to be made in the remaining countries. Additionally, all countries should work towards systematically including AMR in the curricula for health care trainees and workers.

National surveillance for AMR in humans.

Most countries (72.3%; 118 of 163) in 2020–2021 reported having a national surveillance system for AMR in humans. Less than half (44.0%) of LICs reported having surveillance

activities for common bacterial infections and a national reference laboratory that participates in external quality checks (levels C–E of indicator 7.4). The proportion of countries with national surveillance systems increased the higher the income group (65.2% for LMICs, 74.4% for UMICs, and 91.8% for HICs). The level of achievement was significantly associated with the income group ($P<0.001$).

Infection prevention in human health

care. Globally, around a third of responding countries (34.4%; 56 of 163) reported the nationwide implementation of their national IPC programmes. However, more than half (69.4%) of all HICs reported that they have a national IPC programme as outlined in the WHO guidelines on the core components of IPC and that IPC plans and guidelines are implemented nationwide (levels D–E). This level of achievement was significantly higher compared to one fifth (between 17.4% and 20.9%) in the other economic groups. The level of achievement was highly associated with the income group ($P<0.001$).

AMU optimization in humans. Levels C–E indicate that guidelines for the appropriate use of antimicrobials are available and implemented in some health care facilities. In total, 70.6% (115 of 163) countries reported having reached this level of achievement in 2020–2021. A total of 95.9% of HICs, 67.4% of UMICs, 65.2% of LMICs and 36.0% of LICs reported reaching levels C–E. Income group and the reported level of achievement were statistically associated ($P<0.001$).

National monitoring system for AMC and AMU. Less than 40% of LICs (32.0%) and LMICs (39.1%) reported having a national monitoring system for AMC in human health (levels C–E). A significantly higher proportion of UMICs (51.2%) and HICs (83.7%) reported

having such a system in place ($P<0.001$). This remains an area in which additional global support is needed to help these countries develop a system to monitor AMC.

AWaRe adoption in the national Essential Medicines list. AWaRe classifies antibiotics in three groups (Access, WAtch and REserve) to guide stewardship activities. In total, about one third (36.2%; 59 of 163) of all participating countries reported having adopted the AWaRe classification in their national Essential Medicines list. No association was found between the level of achievement and the World Bank income group ($P=0.82$).

Legislation on AMU. Regulations are one of the crucial ways to preserve antimicrobial effectiveness. About 90% (148 of 163) of participating countries reported having laws or regulations on the prescription and sale of antimicrobials for human use. HICs (98.0%) and UMICs (97.7%) were more likely to have a regulation in place compared to LMICs (80.4%) and LICs (84.0%).

AMR NAP implementation in the animal health sector

Training and professional education on AMR.

Of the 163 participating countries, about half (52.1%; 85 countries) reported offering at least some training and professional education on AMR in the veterinary sector in 2020–2021 (levels C–E of indicator 6.3). Almost two thirds (63.3%) of HICs, 55.8% of UMICs, 43.5% of LMICs and 40.0% of LICs reached this level of achievement, therefore showing it increases with a country's World Bank income level ($P<0.001$).

Progress on strengthening veterinary services. Levels D–E indicate that countries regularly monitor the performance of

their veterinary services, whereas level C indicates that a plan to strengthen capacity gaps is under way. Nationwide implementation is therefore indicated by levels D–E; less than one third (29.4%; 48 of 163 countries) reported having reached that level of achievement in 2020–2021. This remains an area in which additional global support is needed to increase investment and awareness of the importance of strengthening national veterinary services, and to develop adequate systems to monitor the performance of veterinary services.

National surveillance for AMR in terrestrial and aquatic animals. Under half (42.9%; 70 of 163 countries) reported having a national surveillance system for AMR in animals. The majority (69.4%) of HICs reported having reached this level of achievement in 2020–2021, whereas this was less the case in UMICs (37.2%), LMICs (37.0%) and LICs (12.0%). Income level was directly proportional to the level of achievement ($P < 0.001$). An effort should be made to implement an integrated surveillance system for AMR in the animal health sector in all countries, independent of income group. However, more support is needed for LICs and LMICs. Less than half (46.6%; 76 of 163 countries) reported having established or started the implementation of such a system. This was not associated with the World Bank income group.

Infection prevention in animal health.

Levels C–E indicate that countries have a national plan to ensure good production practices in line with international standards and that national agreed guidance for food production practices was developed and adapted for implementation at the local farm and food production level. One fifth (20.0%) of LICs reported having achieved this in

2020–2021, compared to higher proportions for LMICs (32.6%), UMICs (44.2%) and HICs (61.2%) ($P < 0.01$).

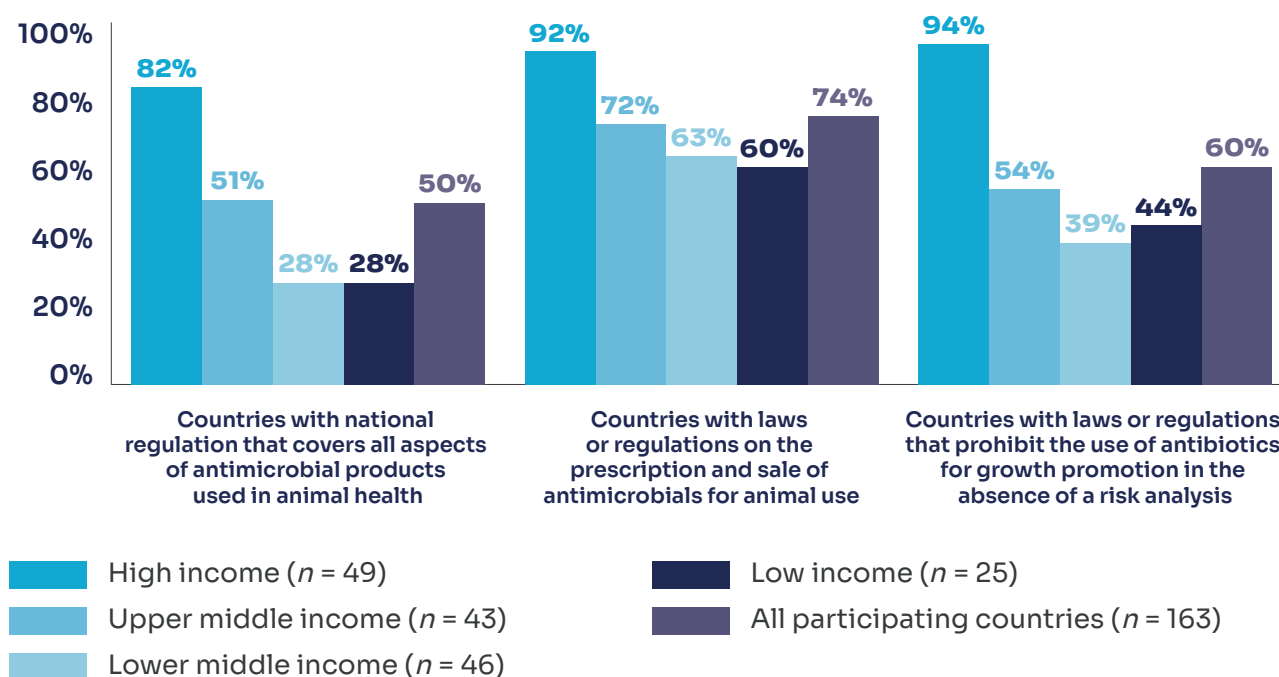
National monitoring system for AMU.⁶

Whereas the majority of HICs (83.7%) reported having a national monitoring system for antimicrobials intended for use in animals, a lower proportion of UMICs (39.5%), LMICs (50.0%) and LICs (40.0%) reported having reached this level of achievement. This was significantly associated with the income group ($P < 0.001$).

AMU optimization in animals. Less than one third of LICs (28.0%) and LMICs (28.3%) reported having national legislation that covers all aspects of the national manufacture, import, marketing authorization, control of safety, quality and efficacy, and distribution of antimicrobial products used in animal health (Fig. 20). More than half of UMICs (51.2%) and HICs (81.6%) reported having such legislation. Similar trends were observed for the proportion of countries that reported having laws or regulations on the prescription and sale of antimicrobials for animal use, and the prohibition of antibiotic use for growth promotion in the absence of a risk analysis. It is therefore important to provide global support to help the two lower-income groups develop and enforce national legislation to optimize the use of antimicrobials in terrestrial and aquatic animals.

6 A summary of WOA's antimicrobial usage data is described in Chapter 2.

Fig. 20. Proportion of countries with national laws or regulations on optimizing antimicrobial use in animals, by World Bank country income group in 2021



Source: World Health Organization, tracking AMR country self-assessment survey (TrACSS) data, 2021.

AMR NAP implementation in the agriculture and food sectors

Training and professional education on AMR. Two fifths (40.8%) of HICs reported providing training and professional education on AMR to the farming, food production, food safety and environmental sectors, compared to 23.3% of UMICs, 15.2% of LMICs and 16.0% of LICs.

National surveillance for AMR in food of animal and plant origin. About one third (31.9%; 52 of 163 countries) reported having a national surveillance system for AMR in food. The level of achievement was significantly associated with the World Bank income group ($P < 0.001$); 65.3% of HICs reported having such a surveillance system, compared

to 25.6% of UMICs, 17.4% of LMICs and 4.0% of LICs. This remains an area where global support is needed for countries in the lower-income groups.

Infection prevention in the food sector. Levels D–E indicate that a country has achieved the nationwide implementation of a plan to ensure good management and hygiene practices and that national guidance is published and disseminated. About one fifth (20.9%) of all countries reported having achieved nationwide implementation by 2020–2021. The level of achievement was significantly associated with the World Bank income group ($P < 0.001$) with 42.9% of HICs, 18.6% of UMICs, 8.7% of LMICs and 4.0% of LICs reporting nationwide implementation.

AMU optimization in crops. Less than half of all participating countries (36.8%; 60 of 163 countries) reported having national

legislation that covers all aspects of the national manufacture, import, marketing authorization, control of safety, quality and efficacy, and distribution of antimicrobial products used in plant production (levels C–E). A higher proportion of countries (67.5%; 110 of 163) reported having legislation on the marketing of pesticides, including antimicrobial pesticides in plant production. Both indicators were significantly associated with the World Bank income group.

National monitoring system for AMU in crops. A total of 33.7% (55 of 163 countries) had a monitoring system for antimicrobial-pesticide use in plant production, including bactericides and fungicides (levels C–D). The proportion of countries that reported having such a system increased with World Bank income status ($P < 0.001$), with over half of all HICs (63.3%) reporting the existence of a monitoring system, compared to lower proportions among UMICs (32.6%), LMICs (10.9%) and LICs (20.0%).

AMR NAP implementation in the environmental sector

Integrated multisectoral surveillance system including AMR and AMU in the environment. Less than 16% (26 of 163 countries) reported having established or started the implementation of an integrated multisectoral surveillance system that includes AMR, AMC and AMU in the environmental sector. This proportion was higher for LICs (32.0%) compared to LMICs (17.4%), UMICs (14.0%) and HICs (8.2%).

Risk assessment of AMR spread in the environment. The proportion of countries that reported having performed a national assessment of the risk of AMR spread in the environment was not associated with the World Bank income group. Less than one

third (25.8%; 42 of 163 countries) reported having performed such an assessment as of 2020–2021.

National legislation to prevent contamination of the environment. Less than half (43.6%; 71 of 163 countries) of all participating countries reported having legislation and/or regulations to prevent the contamination of the environment with antimicrobials. The level of achievement was not statistically associated with the World Bank income group.

Challenges and opportunities for the implementation of the NAPs

Countries have reported progress in developing and implementing their AMR NAP in the last five years. Analyses show that implementation is uneven; some specific indicators have progressed whereas others have stagnated. The implementation of AMR NAPs is disproportionately impacted by income levels. Helping countries develop an M&E framework should be a priority as only a few reported having a functional M&E plan, although such a plan is essential to revise and improve the implementation of their AMR NAP.

The challenges and opportunities are common across all sectors. Key areas for improvement include:

- **Prioritizing support for LICs.** A significant difference was observed between the level of achievement of nearly all the indicators analysed and the World Bank income group. LICs should be provided with both technical and financial support to accelerate the implementation of sector-specific interventions.

- **Strengthening collaboration across sectors.** Despite the observed increase in the proportion of countries that reported having a functional multisectoral working group on AMR, greater alignment and improved collaboration are required between and across sectors.
- **Strengthening the monitoring system on AMU.** Most countries reported having laws and regulations in place on the use of antimicrobials in all sectors. However, the presence or absence of legislation does not necessarily reflect optimal use practices. The national systems to monitor AMU in relevant sectors should be strengthened.
- **Increasing the adoption of the AWaRe classification in national Essential Medicines lists.** As of 2020–2021, 36% of the countries reported having included the AWaRe classification in their national Essential Medicines list. Using the AWaRe classification allows countries to adequately monitor AMC and AMU.
- **Increasing awareness through education and training in all sectors.** Whereas the majority of countries offer training to human health care workers, this is less the case in the other sectors. A similar trend is observed regarding awareness campaigns, where the human and animal health sectors are the main areas of focus in most countries. Further inclusion of the plant health, food safety and environmental sectors is necessary to promote knowledge and awareness across the One Health spectrum.
- **Increasing the focus on good hygiene practices, biosecurity and IPC measures.** The IPC minimum requirements should be strengthened in all human health care facilities. Improving WASH in health care

facilities and the community will further prevent the development and spread of AMR in the environment. Good health, management and hygiene practices in farms will promote animal health and ensure food safety.

Universal challenges to be addressed

Four common themes can be identified from the opportunities and challenges described above, namely:

- catalyse political commitment, engagement and accountability to accelerate action addressing AMR;
- establish and sustain a functional multisectoral coordination group with the legal mandate to oversee the implementation and monitoring of the multisectoral AMR NAP, and review data to revise policies and activities;
- develop a prioritized and costed multisectoral AMR NAP with an M&E framework; and
- allocate sustainable and adequate resources (human and financial) to develop, implement and monitor priority interventions.

Governance and coordination at the global, regional and national levels play a pivotal role in overcoming these challenges and seizing opportunities. Global-coordinated governance groups are currently working together to strengthen the political commitment to tackle AMR and provide necessary resources to meet the GAP-AMR and AMR NAP objectives, as was called for in the IACG report. The activities and progress made by these governance initiatives are described in the next chapter.

Case study 3:

Vaccine alternatives for the responsible use of antibiotics in Zimbabwe



I. Situation of AMR in Zimbabwe

The misuse and overuse of antimicrobial drugs in human and veterinary practices has placed our future at risk by increasing the resistance of pathogens to antimicrobials. The quadripartite bundled its efforts on a project in Zimbabwe, making good progress to reduce AMR in the livestock sector. The Zimbabwe Department of Veterinary Services reported that 65% of cattle mortality in the country is attributed to theileriosis, in addition to other tick-borne diseases. In order to simultaneously reduce cattle mortality and antibiotic use in the cattle production sector, an alternative solution was needed. Theileriosis vaccines are one such solution.

II. Country actions: tick collection and vaccine production

Infected tick vectors, *Rhipicephalus appendiculatus*, also called “brown ear tick”, transmit the *Theileria parva* infection (theileriosis) to domestic cattle during feeding. This tick species is therefore vital to the production of vaccines against theileriosis. In June 2022, thanks to support from the quadripartite AMR MPTF, Zimbabwe collected reference tick nymphs from the country’s national parks for the production of 100 000 doses of vaccines. The project’s aims were to produce a viable vaccine by conducting vaccine trials among a target population of cattle in

Theileriosis vaccine stored in liquid nitrogen.

©Zimbabwe Department of Veterinary Services 2022.

2022. An initial 20 000 doses were produced and prioritized for distribution to disease hotspots and an additional 92 000 doses were produced by the end of 2022. The impact of the vaccine on disease reduction will be measured and monitored over the next two years.

Subsequent to the successful vaccine quality and efficacy testing conducted at the Central Veterinary Laboratory, the official launch of the Theileriosis (BOLVAC) pilot vaccination trials started in late 2022, in Makoni District, Manicaland Province, Zimbabwe (high-risk area). This pilot field vaccination will enable a longitudinal assessment of the performance of the vaccine under field conditions and its impact in reducing the occurrence of theileriosis and cattle deaths. The vaccine is expected to give a lifelong immunity for vaccinated cattle.

In addition, technical officers from the Zimbabwe Department of Veterinary Services' Division of Veterinary Technical Services (DVTS) Parasitology Section received *Theileria* immunofluorescence antibody test training to detect an animal's exposure to *Theileria* parasites and assess their response to the vaccine. The training further empowered the Division to carry out critical quality controls along the theileriosis vaccine production chain. WOHAI supports every aspect of vaccine development and deployment by contributing cattle and rabbits for vaccine trials, conducting laboratory and field trials using the new vaccine, supporting the registration of the vaccine with the Medicines Control Authority and training field staff to implement mass vaccinations.

III. Results of the intervention

- 70 000 ticks collected
- Reduced dependency on antibiotics such as tetracycline
- 112 000 doses of theileriosis vaccine produced
- Commencement of pilot vaccination trails in high-risk areas

IV. Lessons learned and future opportunities

Theileriosis vaccine (BOLVAC) production is a major breakthrough for Zimbabwe, allowing it to produce vaccines against three of the four major tick-borne diseases prevalent in the country. With this production capacity, Zimbabwe is now ready to roll out its *Integrated Tick and Tick-Borne Disease Control Strategy 2022–2030 (194)*.

112 000

doses of theileriosis
vaccine produced

Case study 4:

Developing and disseminating poultry, pig and dairy value chain biosecurity guidelines in Kenya



I. Context

Kenya has an animal population of 18.8 million cattle, 26.7 million goats, 18.9 million sheep, 3.2 million camels, 44.6 million poultry, 1.9 million donkeys and 0.5 million pigs. The country's livestock sector is primed to grow exponentially over the next three decades and anchor the country's food sufficiency amid a rapid rise in the human population. The high burden of diseases in animals associated with poor husbandry practices, the paucity of herd health programmes and low vaccination coverage levels have been identified in a situation analysis report as contributing to the emergence and spread of AMR in livestock.

Antimicrobials are used the most in three value chains: dairy cattle, poultry and pigs. Kenya and partners are investing in interventions that improve animal husbandry in these value chains to reduce AMU in animals intended for food. The biosecurity guidelines were developed within the context of the Kenyan AMR MPTF Preventive Approaches to Containment of AMR project. This project aims to improve veterinarians' and paraveterinarians' knowledge of AMR and promote investments in farm biosecurity to reduce the risk of introducing, establishing and spreading animal diseases and infections to, from and within an animal population.

II. Country actions

In 2021, in collaboration with FAO, WOAHA began drafting the biosecurity guidelines for the poultry, pig and dairy cattle value chains. The drafting, review and validation of the guidelines involved veterinarians from the public and private sectors in Kenya able to contribute valuable practical working experience. A total of 50 experts reviewed and validated the biosecurity guidelines. In November and December 2021, 15 counties trained their public- and private-sector veterinarians on the newly developed and validated farm biosecurity guidelines.

III. Results and lessons learned

The biosecurity guidelines that will guide the management of animal farming in Kenya were the key deliverable. They include an introduction; definitions of key words; the scope and objectives; the major routes, factors for introduction and transmission of infectious diseases in each production system; farm management practices; and information on the importance of documentation, training and facility standards as well as waste management. The guidelines were successfully completed within six months due to effective collaboration between WOAHA and FAO, on the one hand, and between WOAHA/FAO and the public and private sectors, on the other.

IV. Opportunities and critical needs

The training of key stakeholders in the animal health sector continues and will cover all counties in Kenya. The guidelines have been adopted by the USAID Transformational Strategies for Farm Output Risk Mitigation (TRANSFORM) project under CARGILL, a project funded by the US Agency for International Development that aims to enhance farm biosecurity, hygiene and animal nutrition, and improve farming practices in the dairy as well as the poultry sector. It seeks to prevent emerging zoonoses and transboundary animal diseases, mitigate AMR and reduce AMU. Manuals for farmers were developed and are used during training.

Biosecurity guidelines for the poultry, pig and dairy cattle value chains produced to enhance farm hygiene and reduce antimicrobial use.

The farm biosecurity guidelines are used by the Kenya Veterinary Association Self Employed Veterinarians' Branch for professional development on the role of private veterinarians and veterinary paraprofessionals in enhancing farm hygiene and reducing AMU. A critical mass of well-trained veterinary professionals and farmers in farm biosecurity will contribute to optimizing the use of antimicrobials in the animal sector.

4

Chapter 4.

Global governance structures and coordination



Quadripartite Joint Secretariat (QJS) on AMR

The QJS⁷ (previously called the Tripartite Joint Secretariat on AMR - TJS) coordinates and oversees the cooperation between FAO, UNEP, WHO and WOA, drawing on their core mandates to support the achievement of a shared vision and goals for the global response against AMR across the One Health spectrum. This is being done through the provision of secretariat services for global governance structures, global advocacy and high-level political engagement.

History and major achievements of the QJS between 2020 and 2022

In 2019, the TJS was established to support cooperation between FAO, WHO and WOA in their efforts to lead and coordinate the global response to AMR. Following the IACG recommendation in 2019 that were endorsed by the Secretary-General of the United Nations, the TJS set up the Global Leaders Group on AMR in November 2020. Throughout 2021 and 2022, the Secretariat worked on establishing the AMR Multi-Stakeholder Partnership Platform⁸, which aims to bring government, international organizations, civil society and the private sector together to advance a multi-stakeholder response to AMR. Other agencies within the UN system as well as international financial institutions, regional economic communities, private-sector entities, academic and research institutions, and civil society organizations all play a critical role in curbing AMR through funding initiatives, technical support,

implementation, advocacy, and research and innovation.

In March 2022, the United Nations Environment Programme (UNEP) formally joined the tripartite which then officially became the QJS on AMR. The QJS team comprises liaison officers from each organization and other Secretariat staff. It carries out the Secretariat's day-to-day technical and coordination functions (Fig. 21) under the leadership of its director. Overall operational direction and functioning are performed by the Secretariat through effective communication and the flow of information and coordination among the four organizations. The QJS meets biweekly to discuss the implementation of their joint workplan and review progress. The four organizations have also worked together on awareness-raising and capacity-building activities and are responsible for hosting WAAW, which is now held annually on 18–24 November.

A critical area supported by the QJS is the strengthening of legislation and regulations on AMU in all relevant sectors. Legislation and regulation play an important role in AMR One Health governance and form a foundation for the effective implementation of the actions identified in NAPs. The quadripartite joined forces in this area and developed a report covering all international standards and best practices related to AMU (195). In response to country demand, the quadripartite also developed a One Health legislative assessment tool for AMR. This tool is being implemented in four countries and will be launched publicly in mid-2023.

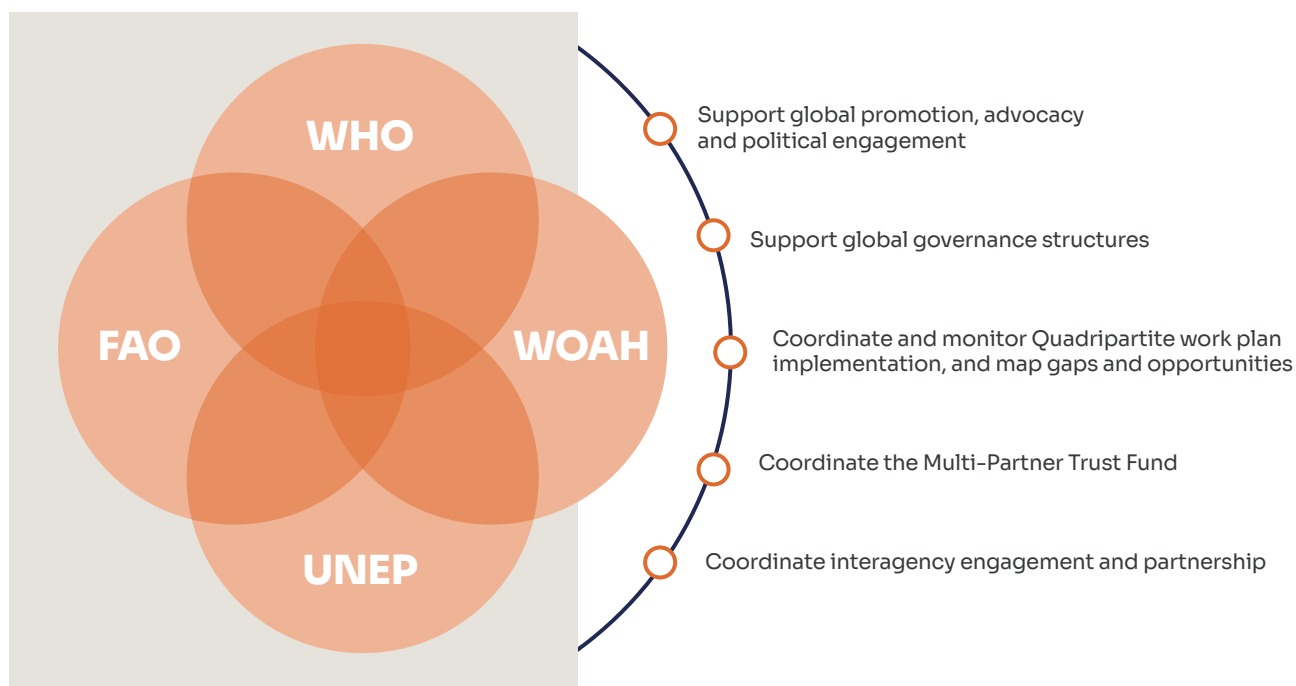
7 The Tripartite Joint Secretariat on AMR became the Quadripartite Joint Secretariat (QJS) on AMR on 17 March 2022 when the tripartite became the quadripartite with UNEP formalizing long-standing working relationships.

8 Launched in November 2022

The quadripartite is also working towards convening a first Human and Veterinary Medicines Regulatory Authorities Summit to Preserve Antimicrobials in May 2023. The Summit will bring Heads of Human Medicines Regulatory Authorities and Heads of Veterinary Medicines Regulatory Authorities together with key actors to discuss coordinated and sustainable approaches, as well as how to curb the misuse or overuse of antibiotics to safeguard their efficacy for both human and animal health. The Summit will underscore the appropriate

use of regulatory instruments, enforcement measures, and smart solutions to phase out over-the-counter and online sales of unprescribed antibiotics used in the human and animal health sectors. Additionally, the Summit is expected to discuss and agree on the establishment of a collaborative mechanism, that will support the ongoing engagement of human and animal health regulators with a view to ensuring continuous harmonization, sharing of best practices and coordinated actions.

Fig. 21. Key functions of the QJS



Source: Getahun H. Update on AMR global coordination and governance structures. AMR global coordination. quadripartite (FAO/UNEP/WHO/WOA) Joint Secretariat on AMR. Geneva: World Health Organization; 2022.

Global leaders accelerating political action on AMR

The AMR global governance structure continues to play a prominent role towards helping to overcome the critical challenges in the effective implementation of the GAP and AMR NAP namely the need for political commitment, financing, and coordination and at national and global levels. The establishment of the Global Leaders Group on AMR (GLG) in November 2020, has resulted in highlighting the urgency and increased visibility of AMR on the global agenda. The group includes heads of

government, government ministers, and leaders from the private sector and civil society 9. The GLG was co-chaired by Sheikh Hasina, Prime Minister of Bangladesh, and Mia Amor Mottley, Prime Minister of Barbados during the period covered by this report. Prime Minister Hasina completed her term in November 2022, and Christopher Fearn, Deputy Prime Minister and Minister of Health of Malta, is currently serving as vice-chair. These leaders have joined forces to advocate for urgent global action to combat AMR across all sectors to preserve antimicrobials and mitigate social and economic impact of drug resistant infections.

Co-Chairs 2020-2022



H.E. Sheikh Hasina
Prime Minister
Bangladesh



H.E. Mia Amor Mottley
Prime Minister
Barbados

Source: Global Leaders Group on AMR website.

The Global Leaders Group developed an action plan focusing on six priority areas: 1) political action; 2) transforming systems; 3) surveillance; 4) financing; 5) R&D; and 6) environmental dimensions. A total of 18 deliverables were agreed upon in May

2021 to monitor the progress made by and through the Global Leaders Group on these six areas (196). By March 2022, a total of 11 deliverables were completed, including the development of a communication and engagement strategy and the publication

9 A list of all current members can be found here: <https://www.amrleaders.org/members>

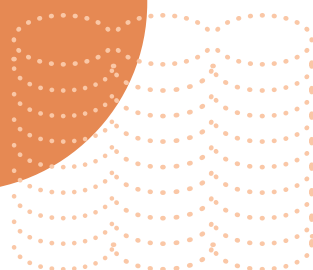
of three information notes. In addition, three statements and “calls to action” were released. The Global Leaders Group website includes the latest news, events and resources (197).

Financing the One Health AMR response through the AMR MPTF

Inadequate financing is one of the most-mentioned challenges in implementing the objectives of the GAP-AMR and AMR NAPs. In 2019, the UN Secretary-General’s report highlighted the need to increase investments to drive One Health AMR action. In response to this report, FAO, WHO and WOAHA created the AMR MPTF in 2019, with UNEP joining the fund as a co-signatory in mid-2021.

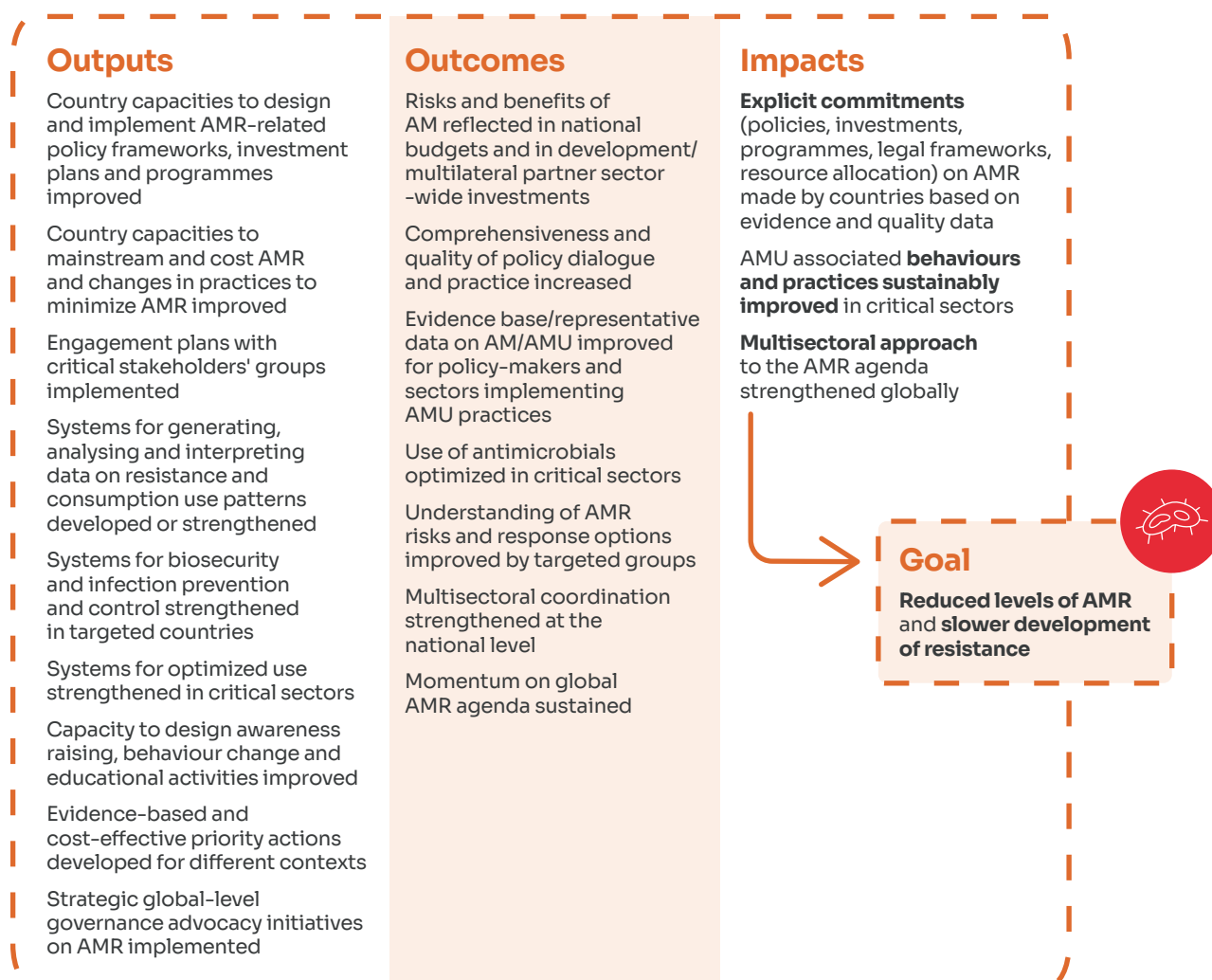
The fund is administered by the United Nations Development Programme, and its main goal is to achieve reduced levels of AMR and slow the development of resistance (Fig. 22). It supports national governments in implementing their One Health NAPs as well as the quadripartite global initiatives. The current donors are: Sweden, the United Kingdom/Fleming Fund, the Netherlands (Kingdom of the) and Germany. The European Commission’s Directorate-General for Health and Food Safety (DG SANTE) has also contributed to the AMR MPTF. This funding initiative sets an important milestone for combating AMR globally. The current duration of the fund runs until 2030, in line with the 2030 Agenda for Sustainable Development. With its country and global programmes, the AMR MPTF aims to contribute to six¹⁰ of the 17 SDGs.

The current donors of the MPTF for AMR are Sweden, the United Kingdom/Fleming Fund, Kingdom of the Netherlands and Germany.



¹⁰ The six SDGs are no poverty (SDG 1); zero hunger (SDG 2); good health and well-being (SDG 3); decent work and economic growth (SDG 8); reduced inequalities (SDG 10); and partnership for the goals (SDG 17).

Fig. 22. AMR MPTF results matrix



Source: AMR Multi-Partner Trust Fund: countering AMR with a One Health approach [website]. New York: United Nations MPTF Office Partners Gateway; 2019.

AMR MPTF project progress at the country level between 2020 and 2022

At the country level, the AMR MPTF provided US\$ 10 million to 10 LICs and LMICs to support the implementation of AMR NAPs across the One Health spectrum. The fund is intended to have a

catalytic effect and strengthen joint work between the quadripartite and the national governments. In 2021, the MPTF launched country programmes in eight countries: Cambodia, Ethiopia, Ghana, Indonesia, Kenya, Morocco, Tajikistan and Zimbabwe. Country programmes in Peru and Senegal were approved in 2021, and implementation started in early 2022 (Fig. 23).

Fig. 23. Summary of thematic areas supported by AMR MPTF country grants

	Cambodia	Ethiopia	Ghana	Indonesia	Kenya	Morocco	Peru	Senegal	Tajikistan	Zimbabwe
NAP implementation review	✓	✓	✓			✓			✓	
M&E strengthening for the AMR NAP	✓	✓	✓	✓		✓				
Multisectoral governance strengthening	✓	✓	✓			✓			✓	
AMR regulatory frameworks and legislation	✓					✓	✓			✓
Cost-benefit analysis			✓			✓				
Integrated surveillance		✓	✓			✓				
Infection prevention		✓	✓		✓	✓	✓	✓	✓	
Stewardship	✓	✓	✓	✓	✓		✓	✓	✓	✓
Communication, awareness and advocacy	✓		✓		✓	✓	✓		✓	✓
KAP studies		✓		✓		✓				✓
Lead implementing partner	WHO	FAO	WHO	WHO	WOAH	FAO	FAO	FAO	WHO	WHO
Project start	Oct 2020	May 2021	May 2021	Oct 2020	Dec 2020	Dec 2020	Jan 2022	Jan 2022	Aug 2021	May 2021

Source: FAO, UNEP, WHO, WOA. H.

Key achievements in fostering One Health coordination

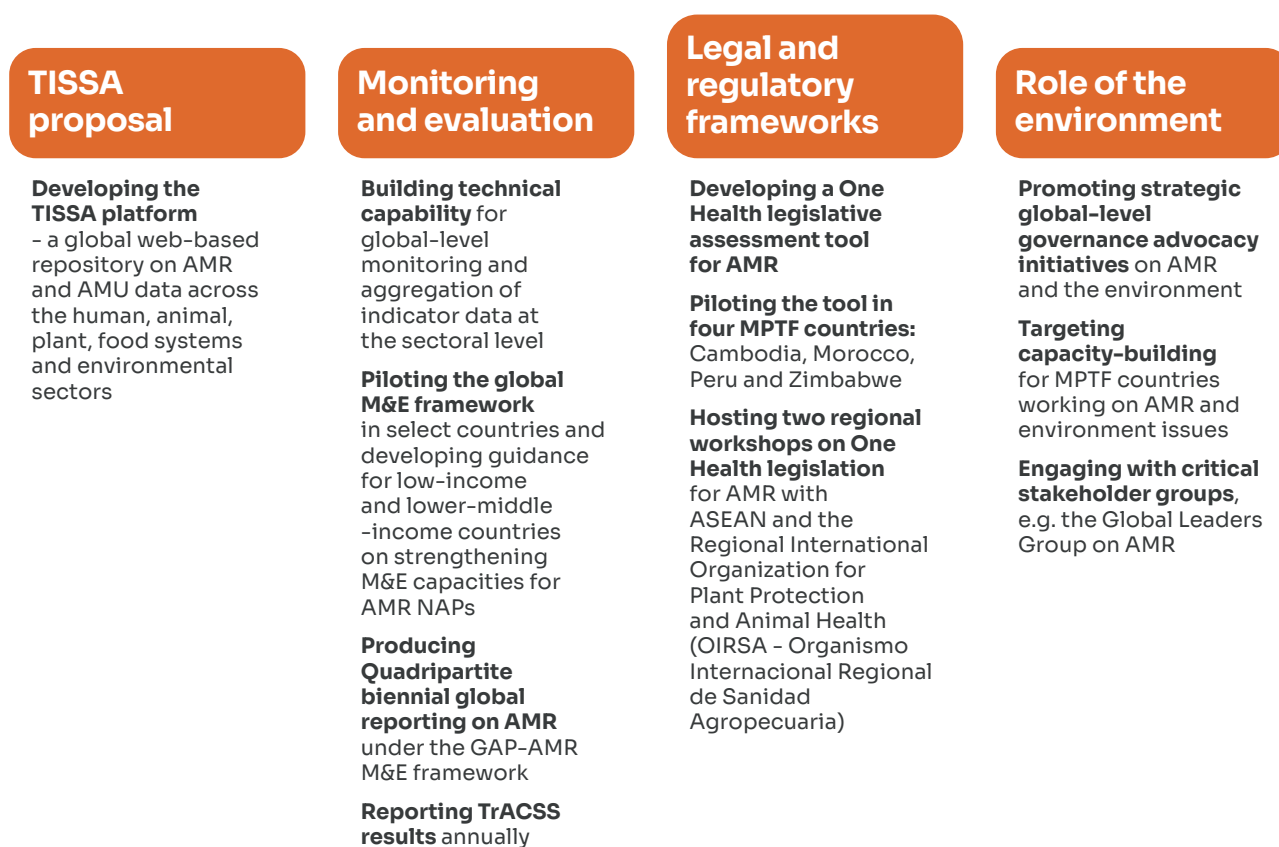
- Enhanced quadripartite One Health collaboration at the country level;
- Established and strengthened multisectoral collaboration and coordination between national ministries;
- National collaboration strengthened among government, civil society, academic and private-sector stakeholders; and
- Stronger understanding of the importance of addressing AMR through a One Health approach among relevant stakeholders.

Four AMR MPTF projects to address global challenges

The quadripartite received AMR MPTF funding to support global initiatives in four

priority areas: 1) integrated surveillance; 2) global monitoring and evaluation; 3) legal and regulatory frameworks; and 4) the role of the environment in AMR. These projects are described in Fig. 24.

Fig. 24. Overview of AMR MPTF global initiatives



Source: AMR Multi-Partner Trust Fund: combatting the rising global threat of AMR through a One Health approach. FAO, UNEP, WHO, WOHAI, 2022.

Opportunities for expansion: future directions of the AMR MPTF

The AMR MPTF has established a foundation and effective ways of working at the global, regional and country levels. Over the coming years, the AMR MPTF will expand to more countries. Moreover, the fund will evaluate the country and global programmes to revisit their work plans and adjust them where required. Given the recent establishment of the quadripartite, countries are currently exploring how they can effectively engage UNEP and the ministries of environment in their work on AMR. Several first-round country projects will conclude in 2023. It will be essential to see how activities can be sustained and to what extent the AMR MPTF country projects are able to catalyse domestic and other external financing for AMR. To this end, the QJS commissioned a strategic review of the MPTF with the view to assess progress in line with its vision and direction (consistent with the Theory of Change), suitability of Fund strategy and indicators of success, and the *modus operandi* - to ensure efficient and effective operations (coordination, country, and global programmes). The strategic review will also proffer recommendations for increased resourcing and growth as well as the longer-term sustainability of AMR MPTF projects. An update on the fund's latest activities can be found in its most recent annual report (198).

Collective political leadership and action to address AMR

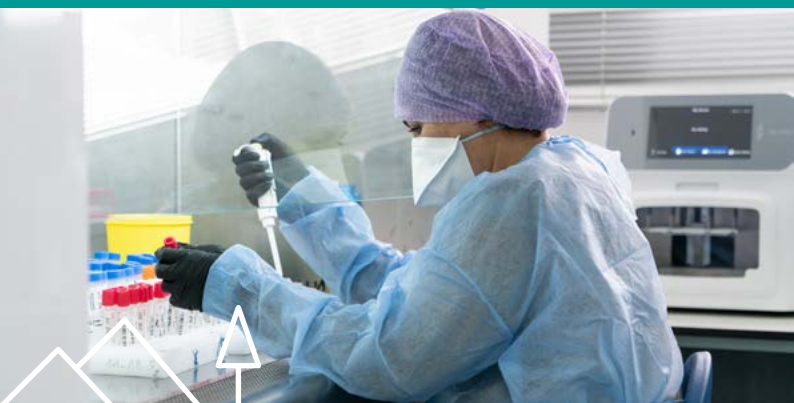
The intergovernmental community, including the G7 and G20, has recognized AMR as a priority that requires global coordination, and has agreed to support the quadripartite in achieving GAP-AMR objectives. During the Forty-seventh G7 summit, held in Cornwall, England in 2021, the G7 leaders promoted the global task force to tackle AMR with clear leadership, bold science-based actions and a One Health approach. In 2020, during the Saudi Arabia G20 Presidency, the G20 leaders confirmed that AMR will be a policy priority in their commitment to improving the global health architecture. In 2021, the G20 leaders at the summit hosted by the Italian G20 Presidency in Rome emphasized the quadripartite's technical leadership and coordinating role in fighting AMR.

Leaders of South-East Asian nations developed the *ASEAN Strategic Framework to Combat AMR through the One Health Approach 2019–2030 (199)* through the comprehensive multisectoral and multidisciplinary engagement and participation of all governments and stakeholders. Similarly, in Africa in 2020, at the Thirty-third Ordinary Session of the Assembly of the African Union, African heads of state and government endorsed the African Common Position on AMR Control. The European Commission is committed to making the EU a best-practice region, boosting research, development and innovation, and shaping the global agenda.

Recognizing the urgency to tackle AMR globally, in 2021, the United Nations General Assembly Seventy-fifth session hosted the High-level Interactive Dialogue on AMR with the contribution of the quadripartite to: 1) strengthen political commitment; 2) take stock of progress; 3) recommit to actions; and 4) build back better from COVID-19. In 2024, the United Nations General Assembly (200) will host the High-level Meeting on AMR to review the progress and follow up on political leadership and action on AMR, and highlight challenges and opportunities for accelerated action. The QJS has developed a Road Map that will guide the engagement of the Secretariat and partners to leverage opportunities for advocacy and socializing the UNGA 2024 HLM on AMR with various stakeholders including member states.



Case study 5: Establishing the first One Health governance mechanism to tackle AMR in Morocco



I. Context

The quadripartite supported the AMR MPTF grant for Morocco and this two-year project was endowed with up to US\$ 1 million, aimed to advance the implementation of the national multisectoral plan for the prevention and control of AMR in Morocco through the One Health approach.

The project's development phase demonstrated the excellent dynamic that already existed between key partners working in the One Health field. Building on this existing collaboration between technical teams, the organizations partnered with three government departments, the ministries of health, agriculture and environment, to raise awareness of AMR and advocate for a multisectoral partnership at a strategic level.

II. Country actions

For the first time in Morocco, the AMR MPTF project enabled the establishment of a One Health governance system for AMR, bringing together key stakeholders to address common issues. This mechanism consisted of:

- the High-Level Steering Committee, with ministers from the three ministries and FAO, WOA and WHO representatives;
- the Technical Coordination Committee, composed of FAO, WOA and WHO technical officers and the focal points of the three ministries; and

- a national scientific project coordinator recruited specifically for the project, whose role was to bring all partners together and facilitate the project's implementation.

The project's official launch was a crucial step to sensitize, mobilize and engage high-level decision-makers on AMR. It was attended by the Minister of Health of Morocco and the Government's Secretaries General for Agriculture and Environment as well as representatives from FAO, WOH and WHO. Their active participation demonstrated their strategic vision and commitment to work together to address AMR.

III. Results and lessons learned

In addition, a national workshop on the progressive approach to AMR management (the Progressive Management Pathway for AMR) was organized under FAO's coordination with the participation of the Technical Coordination Committee. The approach consists of a progressive self-assessment of the implementation status of AMR NAPs. While the workshop focused on the food and agricultural sectors, it also demonstrated the methodology and assessment tools that can be tailored to other sectors to achieve sustainable AMU and AMS.

Other activities included a scientific webinar on current AMR data in Morocco, aimed at human health, animal health and environmental professionals.

IV. Future opportunities

Since the adoption of this collaborative approach, several structural activities are under way: the establishment of an integrated AMR surveillance system, work on regulatory aspects to institutionalize AMR programmes, the assessment of laboratory capacity based on an accreditation system and a communication plan to raise awareness of AMR. Each of these topics will be addressed through a One Health approach.

The governance mechanisms adopted for this project enabled a solid and lasting common ground for reflection and exchange, strengthening the structural capacities of the three ministries dealing with AMR in Morocco.

Strengthening collaboration between the human health, agriculture and environment sectors.

5

Chapter 5.

Environmental dimensions of AMR: strengthening the One Health response



The tripartite partnership for One Health, bringing together FAO, WHO and WOA, formally became the quadripartite when UNEP joined the partnership in March 2022. The establishment of the quadripartite formally marked a new beginning in combating AMR at the national and global levels and has resulted in a strong call to strengthen environmental action within the One Health response to AMR.

Environmental dimensions of AMR

The use of antimicrobials in humans, animals and plants contributes significantly to antimicrobial residues, antimicrobial-resistant microorganisms and antimicrobial-resistant genes in the environment. Pollution in various environmental media (e.g. water, sewage, soil and air), often caused by human activity, can promote the development and spread of AMR in the environment.

The improper disposal of unused or expired antimicrobials is one source of antimicrobial residues in the environment. Sectors that produce and use antimicrobials are points in the system where conditions favour the

emergence and selection of antimicrobial-resistant microorganisms and where the exposure of humans, animals and plants to resistant microbes occurs (201). A large proportion (60–90%) of antimicrobials used in human medicine, terrestrial animal production, aquaculture and intensive crop production are released directly into the environment in the form of active antimicrobial residues or as partially degraded and active metabolites (202–204). Effluents and/or waste from health care systems, municipalities, pharmaceutical manufacturing, and plant and food animal production (terrestrial and aquatic) can be contaminated with antimicrobial residues and resistant microorganisms. Point sources of pollution containing antimicrobial residues from waste streams disrupt soil microbial composition and affect biodiversity and ecosystem services (205, 206). Environmental media serve as vehicles for spreading antimicrobial-resistant microorganisms between and among humans, animals and plants. The interplay between the drivers of resistance and the environment is complex and warrants further attention and research (207).

The development and spread of AMR in the environment can lead to potential adverse effects in human, animal or plant health as well as soil biodiversity loss (208). The accumulation of antimicrobial residues and resistant microorganisms may further drive the development and spread of AMR in the environment. Strengthening appropriate waste management principles and water

quality standards, and accentuating good manufacturing practices and good hygiene and management practices are potential solutions. Human, animal and plant health can all benefit from such intervention and prevention strategies. Fig. 25 shows a variety of environmental AMR pollution sources and areas for prevention and waste management actions.



Fig. 25. Type of environmental AMR pollution sources and areas for prevention and treatment action



Source: UNEP (212, fig. 3)

Identify and target priority AMR-relevant pollutants

Environmental risk assessments can help prioritize actions to address AMR in the environment. Specific actions include developing legislation, codes of good practice and policy guidance to reduce and minimize releases of AMR-relevant pollutants into the environment. Risk assessments at point sources of AMR pollution in the environment provide opportunities to analyse, intervene and evaluate waste management practices. Conducting a risk assessment helps identify the risks and evaluate the hazards to human, animal, plant and ecosystem health. These assessments can also generate evidence to intensify control measures, such as limiting antimicrobial residue concentrations allowed in environmental sampling, so that resistance is not likely to develop or spread.

Asking for and conducting a risk assessment are also part of awareness raising and knowledge promotion. Risk assessments allow a deeper understanding of the environmental risks and hazards of AMR and the adverse effects of exposure to antimicrobials. Measures to prevent the development and spread of AMR in the environment should be considered in AMR NAPs that have not already taken these aspects into account.

Pollution and waste risk management policies and regulations are better informed following risk assessments, especially as these policies should aim to minimize selection pressure from antimicrobial residues as well as the spread of resistant microorganisms, incorporating risk management processes based on standards and acceptable safety limits with legal requirements. Risk management practices can also aid quality control in each key area in the manufacturing, production and delivery of antimicrobials, food and health care.

Point sources of AMR contamination in the environment

Antimicrobial residues, resistant microorganisms and other drivers of AMR can spread into the environment via effluents and/or waste from various point sources. Economic sectors such as pharmaceutical manufacturing, agrifood systems and health care delivery services which manufacture and use antimicrobials are main sources and drivers of AMR and environmental contamination. Municipal effluents and waste also contribute to the development and spread of AMR in the environment.

Human wastewater discharges are a point source that must be considered in the implementation of risk management practices. Important challenges to addressing human sewage treatment quality exist, including the lack of basic toilets and the inadequate management of wastewater and sludge collected in sewer

networks and non-networked facilities such as septic tanks. The release of antimicrobial compounds and resistant microorganisms in the environment via municipal waste streams increases markedly in areas with poor sanitation, sewage and effluent waste management. In health care facilities, waste can contain up to 10 times higher concentrations of antimicrobials and resistant microorganisms despite smaller volumes than in community sources (208). An analysis and risk assessment of the quality of wastewater treatment should include an examination of the standards for log-fold reductions in indicator bacteria.

Wastewater discharges from pharmaceutical manufacturing, either as active pharmaceutical ingredients or from finished products, are an important point source that contributes to the spread and development of AMR in the environment. Solid waste from the pharmaceutical manufacturing industry can also be a source of environmental contamination. The management of solid clinical waste from health facilities, including the disposal of medicines and antimicrobial agents (unused, leftover product and also product containers) for human and animal use, are also points to be considered for potential intervention.

Addressing liquid and/or solid waste discharges from intensive terrestrial and aquatic animal production through policy and regulation can help prevent further environmental pollution from the drivers of AMR. All the stakeholders within this economic value chain, including slaughterhouses (abattoirs), traditional markets and food processing plants and the run-off and solid waste they discharge, could be more carefully considered for interventions and the implementation of risk management practices as they pertain to AMR development and spread.

There are challenges to adequately address the disposal of food, plant or animal products contaminated with antimicrobial residues that exceed the maximum residue limits, the highest allowed or recommended standard for concentration of antimicrobial residues in a food product. Overspray, drift and leaching following pesticide and fertilizer applications are other concerns, as intensive crop production with the use of antimicrobials, biocides and heavy metals directly impacts the environment through soil and watersheds. Risk assessments, policies and regulations that address AMR development and spread can reduce the deleterious effects emanating from this sector. Also important to consider is the application of liquid and solid waste from intensive terrestrial animal production (e.g. manure) as fertilizer, which must be managed prior to use in crop production.

Non-point sources that contribute to the spread and development of AMR in the environment

Apart from the point sources that directly release antimicrobial residues and resistant microorganisms into the environment, other factors also play a role in the development and spread of AMR. For example, transnational and intercontinental transport and the movement of food, goods, live animals and people are a potential source of AMR spread. Inspections (e.g. through customs agencies) to assess the presence of resistant microorganisms or antimicrobial residues in food products could be intervention points.

As climate change shows, increased flooding from severe weather events causes unique challenges for municipalities' drinking-water safety, wastewater treatment plants and combined sewer overflows during heavy storm run-off. Failures in these systems can have health consequences, as antimicrobial-resistant microorganisms are abundant in non-treated community effluent. Ensuring the sufficient capacity of urban wastewater management systems is further complicated by population growth and rapid urbanization. Countries heavily affected by climate change and/or the rapid growth of urban populations should be provided support to develop and maintain sustainable sewer systems and wastewater treatment facilities.

Despite growing recognition of pollution's role in the spread of AMR, the environmental sector can be better represented in national AMR-related planning and implementation. Although countries have developed them, AMR NAPs sometimes lack input from environmental ministries, soil scientists, water engineers and environmental scientists.

An opportunity exists through the quadripartite to steer global momentum to incorporate the environmental dimensions of the spread and development of AMR at the national level to enhance actions for a One Health response.

Environmental surveillance

To mitigate discharges of antimicrobials into the environment, it is important to integrate environmental monitoring data in existing AMR surveillance and pollution data into environmental monitoring data. Monitoring sites for AMR environmental surveillance include transmission routes, such as water, soil, air, plants, food, wildlife, as well as wastewater. Environmental surveillance helps track spatial and temporal patterns of resistance, and survey risk factors that can contribute to the development and spread of AMR. It can also be used to assess AMR-related environmental exposure in humans and animals and characterize AMR in human populations (209).

A comprehensive approach to the environmental surveillance of AMR uses and combines culture techniques, metagenomics, antimicrobial residues and physicochemical samples. However, key One Health issues should be addressed using appropriate surveillance methods, which determine optimal sampling strategies while considering multiple transmission routes, environmental surveillance links to existing monitoring systems, and adaptability to regional, national and subnational conditions. These local applications will aid global comparisons.

A minimum strategy reduces environmental surveillance to sampling hotspots, such as sewage, wastewater effluent, water, sediment and soil. The focus is on sampling for pathogens resistant to critically important antimicrobials. The minimum strategy can use spatial and temporal environmental data sources, such as temperature, pH, chemical and nutrient variables (210).

UNEP and the environmental dimensions of AMR

In 2017, through its Executive Director, UNEP was requested by the UN Environment Assembly to produce a report on the

environmental impacts of AMR, the causes for the development and spread of resistance in the environment, and to include the gaps in understanding of those impacts and causes, in collaboration with FAO, WHO, WOA, the Strategic Approach to International Chemicals Management and IACG (211).

To fulfil this request, in April 2021, the Knowledge and Risk Unit in UNEP's Chemicals and Health Branch conducted a virtual consultation with international experts, key stakeholders and partner UN organizations. The experts and stakeholders discussed the report's scope and topics as well as scientific knowledge gaps. The topics for inclusion were the evolution and development of AMR, its transmission and spread in the environment, and the challenges and solutions to address it.

The clear messages from the consultation were that the environmental dimensions of AMR matter, and environmental pollution that contributes to the development and spread of AMR can be reduced. The various factors affecting AMR transmission and spread in the environment should reflect the targeted drivers, value chains and solutions to address AMR's environmental dimensions. The global action against and response to environmental AMR need to consider its ecological complexities.

The virtual consultation, succeeding follow-ups with stakeholders and discussions with lead experts fed into the publication's development process. It was entitled "Environmental Dimensions of AMR: Summary for Policymakers" and was launched on the sidelines of the UN Environment Assembly (UNEA-5.2) in February 2022.

International cooperation to address AMR in the environment

quadripartite cooperation is essential to address AMR and particularly the environmental dimensions of AMR. Cooperation leverages the organizations' different mandates, financing mechanisms, technical and human resources, programme management and political influence. When the quadripartite collaborates on adding value to country action, the coordinated approach reduces the risk of working in silos and duplicating activities, and brings together multisector stakeholders locally and internationally.

Because of the links that exist between many of the SDGs and addressing AMR, and in view of the One Health lens, the inclusion of addressing AMR in the UN

Sustainable Development Cooperation Framework is urgently needed. Under the One Health approach and with quadripartite support, strengthening activities related to addressing AMR in overall country systems is an important step. Reflecting on the COVID-19 pandemic reveals that boosting integrated AMR surveillance, improving biosecurity, increasing laboratory capacity especially on environmental monitoring as well as ensuring WASH and IPC measures contribute to pandemic and emerging infectious disease preparedness. Unsustainable consumption and production patterns have driven the triple planetary crises of climate change, biodiversity loss, and pollution and waste. The challenges of AMR cannot be addressed separately from these triple crises (212).

The projects under the AMR MPTF are examples of cooperation among the four agencies. Implemented by the quadripartite, increasing the global understanding of the environmental dimensions of AMR been the objective of the AMR MPTF project on strengthening capacity and actions on the environment within AMR NAPs, sector policy and global partnerships as part of a multi-organization cross-sectoral One

Health approach. Under this project, the AMR MPTF envisions improving strategic global-level governance, increasing country capacity to implement NAPs and stakeholder engagement as it relates to the environmental dimensions of AMR.

The AMR MPTF environment project uses various methods to achieve strategic objectives. The project hosted several webinars to highlight the environmental dimensions of AMR through advocacy, awareness raising and offering technical solutions for the prevention and control of AMR in the environment (213). In January 2021, the South Centre, FAO and UNEP hosted a webinar on “advancing the One Health response to AMR” which included a presentation on priority areas for management of AMR in the environment (214).

In addition to expanding public awareness through webinars, governance and policy documents and assessment tools as well as country-specific capacity-building activities are being developed. A tool adapting FAO’s Progressive Management Pathway for AMR to the environmental dimensions of AMR and a rapid assessment tool for AMR in the environment have benefited from MPTF funding. Accompanying these is a Strategic Framework document on quadripartite collaboration (215). Country capacity improvement activities on environmental AMR are also planned.



UNEP project aims to boost understanding of the environmental dimensions of AMR in India

In 2021, UNEP supported the development of a report entitled *Priorities for the Environmental Dimension of AMR (AMR) in India* by the Indian Council of Medical Research–National Institute of Cholera and Enteric Diseases. The report acknowledged the importance of the environmental sector in AMR; antimicrobial-resistant microorganisms from pharmaceutical manufacturing effluent, biomedical waste, manure and animal waste from food animal production, crop production, household sewage and slaughterhouse waste were recognized as contaminants in aquatic environments, waterways and soil. It also identified mechanisms for human exposure to resistant microorganisms, such as contaminated drinking water and food.

India has adopted the principles underlying the GAP-AMR, published in 2015. Although mention of the environment in it is limited, the GAP-AMR has strengthened various aspects of the work in India, such as awareness, knowledge generation, infection prevention, AMU optimization, AMR initiative financing and Indian governance mechanisms to address this challenge. These improvements in animal and human health are directed by the AMR NAP in India, led by the Ministry of Health and Family Welfare, with the participation of national institutions from several sectors, including the Ministry of Environment, Forest and Climate Change.

Although the participation of the environmental sector in India is limited, mechanisms are in place that could strengthen environmental AMR control, such as the Swachh Bharat Mission initiated in 2014 to achieve universal sanitation coverage, the 2016 Biomedical Waste Management Rules, and the 2020 guidelines on pharmaceutical discharge.

Challenges and research needs for the environmental dimensions of AMR

Although there is sufficient information for action to address environmental AMR, knowledge gaps remain. An understanding of infection emergence and spread from environmental sources (Fig. 26) and the relative importance of each pollution source in causing global and regional exposure is currently needed.

A greater level of understanding is also needed of chemical and biological pollutants, the concentrations that contribute to the selection, co-selection and maintenance of AMR, and their relation to the identification and characterization of the risk to microbial biodiversity and ecosystem health. Further research and the consolidation of current literature on the potential environmental origin of resistant genes in microorganisms can

reveal information to improve actions that mitigate the emergence of novel resistance mechanisms. Additionally, the environment is a natural reservoir of medicinal compounds. Protecting ecosystem health

can lead to the discovery of novel infection treatments. Furthermore, investments are needed in technological, social, economic, gender and behavioural interventions to address AMR in the environment.

Fig. 26. AMR and the environment



Source: UNEP (216).

Case study 6: Cambodia steps up efforts to tackle AMR through the One Health approach



I. Context

The AMR MPTF is helping the Government of Cambodia improve governance and coordination mechanisms to tackle AMR through the One Health approach. The project, implemented by FAO, WOAHA and WHO, focuses on supporting joint and coordinated multisectoral action against AMR at the global, regional and national levels. The fund finances catalytic coordinated policy advice, technical assistance and capacity-strengthening programmes requested by the members of the quadripartite to support Cambodia.

II. Country actions: sector-specific actions and a multisectoral approach

The project in Cambodia will help establish a high-level inter-ministerial coordination committee on AMR to strengthen the coordination and monitoring of the country's *Multisectoral Action Plan on AMR 2019–2023 (217)*. To achieve this goal, in collaboration with FAO, WOAHA and WHO, the Government of Cambodia organized a consultation meeting with key stakeholders from across the One Health spectrum in October 2021 to gather input on the foundation of the coordination committee on AMR. The meeting outcome were draft terms of reference for the coordination committee with cross-sectoral input.

III. Results: strengthened multisectoral collaboration

A literature review on AMR in the animal health sector and a review of the guidelines for the prudent use of antimicrobials are also under way. This initiative will help policy-makers make policy dialogue and practice more comprehensive and qualitative, optimize the use of antimicrobials in critical sectors, and improve target groups' understanding of AMR risks and their response options.

IV. Lessons learned and critical needs

Cambodia endorsed the *Multisectoral Action Plan on AMR* in December 2019. However, the action plan's implementation was not optimal. Therefore, FAO, WOAHA and WHO provided technical expertise on coordination mechanisms, AMS and effective communication strategies to help initiate and support intersectoral coordination to implement the plan.

Enhancing coordination, revising guidelines on prudent use of antimicrobials, and raising awareness about AMR risks and response.



6

Chapter 6.

Areas for accelerated action



Sections of this report highlight the progress made globally to implement the GAP-AMR's strategic objectives. At the country level, the implementation of NAPs has been slow, inconsistent, and ad-hoc.

It is noteworthy that FAO, WHO and WOAHA have developed a number of global tools, data systems and processes over 2020-2021 to help countries implement their AMR NAPs as well as drive actions to implement the GAP-AMR. The COVID-19 pandemic has also pushed the quadripartite to develop innovative tools and remote training and e-learning modules to assist countries.

To address the gaps identified in this report, urgent action is needed at the multisectoral level and in sector-specific areas (human health, animal health, agriculture and food production, and the environment) as follows:

Multisectoral action

1. **Enhanced multisectoral governance of AMR NAPs:** Recent data from the TrACSS show that the multisectoral AMR coordination committees are not functional in more than 50% of countries. A robust national multisectoral governance mechanism is needed with dedicated leadership, a clear mandate based on a legislative framework or decision, adequate financial and technical resources, the active participation of all relevant sectors and stakeholders, and accountability for closely monitoring the implementation of AMR NAPs and reporting to the highest levels of government. The governance mechanism needs to be flexible to support and engage with subnational government structures.
2. **Sustainable financing to implement activities in all sectors:** Data from the TrACSS show that the vast majority of countries have not allocated sufficient financial resources to effectively implement their multisectoral NAPs. Both global and country-level investment cases to address AMR are urgently needed to support the allocation of financial resources, both from domestic and external sources. In addition, the multisectoral AMR coordination committees need to develop strong advocacy strategies to seize domestic and global financing opportunities to sustain One Health approaches in countries, including through the Pandemic Fund, the Global Fund and expanding the AMR MPTF and other broader bilateral and multilateral development financing mechanisms.
3. **Leave no one behind: addressing inequities in AMR NAP implementation in all sectors:** The inclusion of gender, equity, disability and rights perspectives in the development, implementation and monitoring of interventions in AMR NAPs is essential to address inequities. To leave no one behind is the central, transformative promise of the 2030 Agenda for Sustainable Development and its SDGs. Aligned with this principle, planned AMR NAP activities need to be designed to also address the inequities many people and vulnerable populations like migrants and refugees face, including discrimination and exclusion based on gender, economic status or disability.

Human health sector

- 1. Developing a specific human health sector strategy to address resistant bacterial infections.** A recent study estimating the global burden of resistant bacterial infections found that, in 2019, 1.27 million deaths were directly attributable to bacterial resistance, more than the number of HIV/AIDS or malaria-related deaths that occurred in the same year (864 000 and 643 000 deaths, respectively). A total of 72% of these deaths were linked to six leading resistant bacterial pathogens. Although in 2015 the World Health Assembly endorsed the GAP-AMR, WHO urgently needs to develop strategic and operational priorities to mitigate bacterial resistance in human health. This strategy will complement the existing FAO and WOAHA strategies for addressing AMR in agriculture and animal health.
- 2. Strengthening AMR and AMC surveillance reporting and data representativeness:** AMR rates and trends are difficult to interpret in most LMICs due to insufficient testing coverage and weak laboratory capacity. WHO is launching a two-pronged approach aimed at short-term evidence generation and long-term capacity-building for routine surveillance. This entails: 1) the introduction of nationally representative AMR prevalence surveys involving intermittent, strategic sampling of a population subset to generate AMR baseline and trend data for policy development and the monitoring of interventions; and 2) an increase in the number of quality-assured laboratories reporting representative AMR data at all

levels of the health system. Likewise, the systematic collection of AMC data needs to be prioritized to inform action at both the national and global levels.

- 3. Enhancing clinical bacteriology laboratories and diagnostic stewardship:** Laboratory capacity and resources to diagnose bacterial disease and test for drug resistance are weak in most LMICs and lead to the overuse and misuse of antibiotics. Furthermore, a significant proportion of surveillance sites do not participate in an external quality assurance programme. These worrisome findings are confirmed by the TrACSS. In addition, several factors lead to poor diagnostic stewardship, causing the overuse of Watch group and Reserve group drugs listed in the AWaRe classification. This calls for an urgent global effort to strengthen microbiology lab capacities and the diagnostic routines of health care providers linked with universal health coverage (insurance coverage of lab tests) and primary health care (adequate referral mechanisms to quality-assured labs and the future introduction of point-of-care tests). WHO is launching a global AMR diagnostic initiative with four building blocks, which addresses all aspects of laboratory strengthening, including a global lab network to deliver technical assistance and external quality assurance; strategic and operational guidance; periodic assessments of global microbiology capacity; and the responsible introduction of new lab tools at all levels of the health system.

4. Establishing a “people-centred approach” to addressing AMR in the human health sector through a package of “core” interventions linked to primary health care and health emergency preparedness and response strategies. The barriers people face in accessing relevant interventions to prevent, diagnose and treat resistant infections, along with critical health system gaps, both impact effective responses to AMR at the community, national and global levels. Therefore, human health sector-specific interventions are being developed based on a people-centred approach that promotes greater participation of the community, and equitable access to infection prevention measures, to quality health care services, to quality and timely diagnosis, and to quality-assured and appropriate treatment and care for all segments of the population. To support this approach and guide countries, a “core” package of interventions for the human health sector, with practical steps to achieve them at the national, community, primary care, and secondary/tertiary facility levels are being developed. These core interventions are aligned with the primary health care strategies and health emergency preparedness and response strategies.

Animal health sector

1. AMU. Countries should start to use AMU data for decision making as they will have continuous access to their data through ANIMUSE. Despite the tremendous efforts made by members to decrease the use of highest priority critically

important antimicrobials for growth promotion, efforts still need to be done to phase out the use of those molecules for growth promotion. Moreover, following the recommendations from WOAHA’s antimicrobial list of veterinary importance and using it to inform the development of national guidelines for responsible use of antimicrobials is crucial to strengthen awareness on responsible use of antimicrobials and therefore contribute to reduce misuse.

2. Aquaculture. AST relevant to aquatic animals is crucial to establish monitoring and surveillance programmes on AMR in aquatic environments associated with aquaculture. AMR trends could eventually be compared with AMU trends and comparative data would support evidence-based policies. Having appropriate standardized methodologies and building Member’s capacity to apply such methodologies is a current need to be addressed.

WOAH Aquatic Animal Health Strategy considers providing guidance on AMR and updating relevant Standards. Updates may include expanding the current standards on AST for terrestrial animal indicators to include those related to aquatic animals. Establishing channels to determine Members’ needs in this subject is necessary to generate these updates.

3. Companion animals. WOAHA will further extend the scope of its AMR Strategy and relevant Standards to non-food producing animals with a particular focus on companion animals, recognizing that antimicrobials are used to treat, prevent and control infectious diseases in these

species and that risk of transfer of AMR between companion animals and humans and vice versa has been observed in a growing number of countries.

Countries where companion animals are commonly kept should extend initiatives to promote responsible antimicrobial use amongst animal health care providers and the public. Furthermore, these countries should consider including these species in their AMU and AMR surveillance programmes and national action plans where possible due to the potential risk of emergence and transfer of AMR between companion animals and humans and vice versa at community and veterinary practice levels.

4. **Substandard and falsified veterinary products.** Build a global information and alert system of SFVPs, whose purpose is to make countries aware of the circulation and to tackle the presence of substandard and falsified products at country, regional and global level.
5. **Enhance awareness of members for consenting, developing and performing joint actions with customs and law enforcement.** Encourage countries to share their in-country situation and resources allocated in terms of the detection, confirmation and elimination of substandard and falsified veterinary products with other international organisations involved in customs and law enforcement, such as the World Customs Organisation and Interpol.

6. **Strengthen collaboration across countries on surveillance and reporting.** Countries share with others their situation in terms of monitoring, surveillance, traceability systems and laboratory capacity and strengthen collaborations across countries on surveillance and reporting.

Food and agricultural sectors

1. **Strengthening surveillance at the country level.** Some of the major challenges facing the food and agricultural sectors' response to AMR are weak surveillance and monitoring systems, the poor quality of surveillance data, a lack of harmonization of the available AMR and AMU data, and limited capacities at the country level to collect, analyse and act upon data on AMR and AMU. Capacity building for establishing AMR surveillance systems, and the development and implementation of the International FAO AMR Monitoring (InFARM) data platform are being prioritized to help FAO members improve the generation and use of AMR data in the food and agricultural sectors.
2. **Enhancing AMR advocacy, awareness, leadership and key stakeholder engagement.** Overall, the response to AMR in the food and agricultural sectors requires more and better evidence as well as more informed and more widely implemented interventions to reduce the need for antimicrobials; increased resources; strengthened capacities; and stronger governance to ensure effective stakeholder engagement and sustained commitment and action,

based on a One Health approach, particularly at the country level. This calls for stronger and more broad-based engagement (advocacy, collaboration and partnerships) with stakeholders at all levels of the private and public sectors and the scientific and development community, and among governments and member countries, civil society and regional blocs, among others. The AMR Multi-Stakeholder Partnership Platform, currently under establishment, is the quadripartite response to this need.

- 3. Strengthening legal and regulatory capacities to enforce compliance at the national level.** The AMR response is constrained by weak legal and regulatory frameworks, including the inability to enforce compliance at the national level. FAO, along with the quadripartite are working on a One Health legislative assessment tool for AMR, which will support countries undertaking a deep assessment of their legal preparedness to support AMR management.
- 4. Supporting operational research and innovative solutions for AMR in agrifood systems.** Within the food and agricultural sectors broadly, more attention is needed on operational research and innovative solutions to respond to AMR more effectively within agrifood systems, aquatic and terrestrial animal health, and plant protection and production. FAO has developed and improved tools and guidelines to support countries' capacities, yet more innovative solutions need to be developed under a collaborative approach through the FAO AMR Reference Centre network, and through partnerships with research institutions and academia.

- 5. Supporting stronger One Health coordination in the food and agricultural sectors.** Sustained efforts are needed to establish multisectoral coordination mechanisms, and strengthen and sustain the coordination of efforts in the food production (plants and animals) and food safety sectors, while taking into consideration their environmental aspects for better AMR action.
- 6. Reducing the need to use antimicrobials in the food and agricultural sectors.** Countries have called for reducing AMU in the food and agricultural sectors by building national capacities to apply good production and management practices, ensure AMS, use alternatives to antimicrobials and implement their NAPs. FAO responded by developing the RENOFARM initiative that aims to reduce the need for antimicrobials on farms. This initiative will engage the entire production chain in a collective effort to strengthen capacities at the primary production level, with extensive use of science and innovative technologies and strengthened public-private partnerships under the One Health approach.

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Annexes



Annex 1. Indicator data: global M&E framework

Table A1.1 Human health indicator data – WHO

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Goal: Reduced levels and slower development of resistance			
II. Patterns and trends in resistance in human health	Prevalence of bloodstream infections caused by methicillin-resistant <i>Staphylococcus aureus</i>	SDG 3.d.2 and GLASS WHO Global Health Observatory – AMR – SDG Indicators (1)	No global aggregate Proportion of patients with non-susceptible infections: 0.0–81.8% (LMICs) 1.7–48.9% (HICs) 59 countries reporting
	Prevalence of bloodstream infections caused by ESBL in <i>Escherichia coli</i>	SDG 3.d.2 and GLASS WHO Global Health Observatory – AMR – SDG Indicators (2)	No global aggregate Proportion of patients with non-susceptible infections: 20.3–93.1% (LMICs) 5.5–57.2% (HICs) 63 countries reporting

Table A1.1 Human health indicator data – WHO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
IV. Patterns and trends in resistance in HIV, TB and malaria	Percentage of new bacteriologically confirmed pulmonary TB cases associated with multidrug- and rifampicin-resistant <i>Mycobacterium tuberculosis</i>	WHO Global tuberculosis report (3) WHO Global Health Observatory – Drug-resistant TB (4)	Data available by country Globally, 167 141 cases notified of MDR/RR-TB in 2021
	Percentage of malaria patients displaying treatment failure after antimalarial treatment during surveillance in selected sentinel sites	WHO Global Malaria Programme WHO Malaria Threats Map-Treatment Failure (5)	No global aggregate Location specific treatment failure of antimalarials
	Percentage of individuals tested positive for HIV starting antiretroviral therapy with detected HIV antiretroviral drug resistance (prevalence of pretreatment HIV drug resistance)	WHO Global HIV Programme HIV drug resistance report 2021 (6)	No global aggregate
	Percentage of individuals tested positive for HIV on antiretroviral therapy with virological failure and detected HIV antiretroviral drug resistance (prevalence of acquired HIV drug resistance)	WHO Global HIV Programme HIV drug resistance report 2021	No global aggregate

Table A1.1 Human health indicator data – WHO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outcome 1: Improved awareness of AMR and behaviour change among policy-makers, farmers, veterinary and health workers, the food industry and the general public			
1.1 Awareness of key groups	Percentage of stakeholders (e.g. human and animal health workers, prescribers, farmers, food processing workers) who have knowledge of AMR and the implications for AMU and infection prevention (metrics to be developed)	Methodology to be developed	Not applicable
Outcome 3: Reduced incidence of infection in health facilities, farms and communities as well as reduced environmental contamination, due to effective prevention			
3.1 Quality of care	Incidence of surgical site infections – inpatient surgical procedures		Not applicable
3.2 Immunization coverage	Percentage of the target population that has received the last recommended dose of the basic series for each of the following vaccines: i) pneumococcal conjugate vaccine, final dose	WHO Immunization Data/ WHO Global Health Observatory WHO Immunization Data – pneumococcal conjugate vaccine (7)	51%
	ii) rotavirus vaccine, last dose	WHO Immunization Data/ WHO Global Health Observatory WHO Immunization Data – rotavirus vaccine (8)	49%

Table A1.1 Human health indicator data – WHO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
	iii) measles-containing vaccine, either alone or in a measles–rubella or measles–mumps– rubella combination, second dose	WHO Immunization Data/ WHO Global Health Observatory WHO Immunization Data – measles containing vaccine, second dose (9)	71%
	iv) <i>Haemophilus influenzae</i> type b containing vaccine (Hib)	WHO Immunization Data/ WHO Global Health Observatory WHO Immunization Data – Hib3 (10)	71%
3.3 Access to safe water	Proportion of population using safely managed drinking-water services	SDG 6.1 WHO Global Health Observatory –safely managed drinking-water services (11)	74%
3.4 Access to sanitation	Proportion of population using safely managed sanitation services	SDG 6.2 WHO Global Health Observatory – safely managed sanitation services (12)	54%

Table A1.1 Human health indicator data – WHO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outcome 4: Optimized use of antimicrobials in human and animal health; phased out animal use for growth promotion			
4.1 Use of antimicrobials in humans	<p>Total human consumption of antibiotics for systemic use (Anatomical Therapeutic Chemical classification code J01) in defined daily doses per 1000 population (or inhabitants)</p> <p>Proportion of access antibiotics for systemic use, relative to total antibiotic consumption in defined daily doses</p> <p>Relative proportion of AWaRe (Access, WAtch and REserve) antibiotics for paediatric formulations</p> <p>Percentage of adult and paediatric hospital patients receiving an antibiotic according to AWaRe categories</p>	GLASS	Not applicable
4.2 Access to antibiotics	Percentage of health facilities that have a core set of relevant antibiotics available and affordable on a sustainable basis	SDG indicator 3.b.3, with Access antibiotics disaggregated	Not applicable
4.7 Optimized AMU and regulation	Legislation or regulation that requires antimicrobials for human use to be dispensed only with a prescription from an authorized health worker	TrACSS (13) 2021 TrACSS, Q5.4.1	148 countries with legislation

Table A1.1 Human health indicator data – WHO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outputs for outcome 1: Improved awareness of AMR and behaviour change among policy-makers, farmers, veterinary and health workers, the food industry and the general public			
1.a Targeted awareness raising	Nationwide, government-supported AMR awareness campaign targeting priority stakeholder groups based on stakeholder analysis	TrACSS 2021 TrACSS, Q6.1 (levels D–E)	65 countries
2.a Data on AMR and AMU in humans	Countries that report to GLASS on: a: AMR in humans	GLASS WHO Global Health Observatory, GLASS GLASS 2022 report (14)	107 enrolled, 70 submitted data as of April 2021
	Countries that report to GLASS on: b: AMU in humans	GLASS-AMC GLASS 2022 report	19 countries reported 2020 data
2.h Use of AMR surveillance data	National bodies that review information from national AMR surveillance programmes, and make and implement recommendations accordingly		103 countries

Table A1.1 Human health indicator data – WHO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outputs for outcome 3: Reduced incidence of infection in health facilities, farms and communities as well as reduced environmental contamination, due to effective prevention			
3.e Hand hygiene in health care	Percentage of acute tertiary health care facilities monitoring the hand hygiene compliance of health workers according to the WHO direct observation method or similar	WHO Hand Hygiene Self Assessment Framework, and the WHO Infection Prevention and Control Assessment Framework Global report on infection prevention and control (15)	29 of 58 (50%) countries monitored hand hygiene compliance
3.f Basic water services in health care facilities	Percentage of health care facilities in which the main source of water is from an improved source, located on premises	WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (16) Data by country (17)	4 of 5 (78%) health care facilities globally had basic water services
3.g Basic sanitation services in health care facilities	Proportion of health care facilities with improved and usable sanitation facilities, with at least one toilet dedicated for staff, at least one sex-separated toilet with menstrual hygiene facilities and at least one toilet accessible for users with limited mobility	WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene Data by country	No global aggregate 41 countries provided data – not enough to calculate global/regional coverage

Table A1.2 Animal health indicator data – WOAHA

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outcome 4: Optimized use of antimicrobials in human and animal health; phased out animal use for growth promotion			
4.4 Use in growth promotion	Percentage of veterinary antimicrobials authorized/ used for non-veterinary medical purposes (e.g. for growth promotion); number of countries reporting use of antimicrobials for growth promotion	WOAH AMU database (18)	30% (39/130 countries) in 2015; 38% (55/146 countries) in 2016; 28% (43/155 countries) in 2017; 24% (36/153 countries) in 2018; 26% (41/160 countries) in 2019; 25% (40/157 countries) in 2020
4.5 Levels and trends in sales/ imports/use of antimicrobials in food producing animals	a: Total volume of sales/ imports (or use), in mg/kg biomass, in food producing animals	WOAH AMU database	136.23 mg/kg (83 countries) in 2016; 116.11 mg/kg (93 countries) in 2017; 95.74 mg/kg (106 countries) in 2018
	b: Percentage of total sales/imports (or use) classified as WHO highest priority critically important antimicrobial agents	WOAH AMU database	11% (83 countries) in 2016; 12% (93 countries) in 2017; 7% (106 countries) in 2018

Table A1.2 Animal health indicator data – WOAAH (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outcome 5: Increased R&D on new medicines, diagnostics, vaccines and other interventions related to priority pathogens			
5.1 Global R&D pipeline	c: Number of new vaccines registered according to prioritization (WOAH reports on the prioritization of diseases for which vaccines could reduce AMU in pigs, poultry and fish, 2015, and in cattle, sheep and goats, 2018)	Health for Animals (19)	No data
Outputs for outcome 1: Improved awareness of AMR and behaviour change among policy-makers, farmers, veterinary and health workers, the food industry and the general public			
1.a Targeted awareness raising	Nationwide, government-supported AMR awareness campaign targeting priority stakeholder groups in the following sector: b) animal health	TrACSS	37/136 countries in 2019–2020; 40/163 countries in 2020–2021
1.b Strengthen veterinary services	a: Countries that in the last five years have had a WOAAH PVS pathway activity (e.g. evaluation, gap analysis, follow-up legislation or laboratory mission)	WOAH PVS pathway (20)	87/180 countries in 2016; 87/181 countries in 2017; 87/182 countries in 2018; 86/182 countries in 2019; 76/182 countries in 2020; 67/182 countries in 2021
	b: Number of PVS pathway missions globally	WOAH PVS pathway	30 in 2016; 25 in 2017; 30 in 2018; 36 in 2019; 3 in 2020; 8 in 2021

Table A1.2 Animal health indicator data – WOA (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outputs for outcome 2: Strengthened knowledge and evidence base used for policy and practical decisions			
2.b Data on AMU in animals	Countries that report information on total quantities of antimicrobial agents sold for/imported for/used in food producing animals	WOAH AMU database	84/130 countries in 2015; 101/146 countries in 2016; 110/155 countries in 2017; 114/153 countries in 2018; 133/160 countries in 2019; 126/157 countries in 2020
2.c Data reporting on AMU in animals	Countries that regularly report data on AMU in animals to the WOA database, broken down by group of animal and administration route	WOAH AMU database	In 2015 (option 1=52; option 2=4; option 3=29); in 2016 (option 1=53; option 2=9; option 3=40); in 2017 (option 1= 46; option 2=25; option 3=40); in 2018 (option 1= 53; option 2=18; option 3=44); in 2019 (option 1= 53; option 2=13; option 3=68); in 2020 (option 1=46; option 2=10; option 3=70)
2.i Authority and capability of veterinary services to manage AMU and AMR	Countries that achieve level III or more on PVS Critical Competency II-9 (the authority and capability of veterinary services to manage AMU and AMR, and to undertake surveillance and control of the development and spread of AMR pathogens in animal production and in food products of animal origin, via a One Health approach)	WOAH PVS pathway	0/4 countries in 2018; 1/15 countries in 2019; no PVS assessment done in 2020; no PVS assessment done in 2021

Table A1.2 Animal health indicator data – WOAHA (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outputs for outcome 3: Reduced incidence of infection in health facilities, farms and communities as well as reduced environmental contamination, due to effective prevention			
3.b Access to strengthened veterinary services	Level of access to veterinary advice and care within a country (e.g. number of qualified veterinarians and/or veterinary paraprofessionals per animal population)	WOAH PVS pathway/ TrACSS	1/4 in 2018; 8/15 in 2019; no assessment done in 2020; no assessment done in 2021
3.d Infection prevention at the national level	Countries that implement minimum requirements for infection prevention (e.g. husbandry and biosecurity) for food animal production, in accordance with WOAHA standards	WOAH PVS pathway	5/11 countries in 2016; 4/10 countries in 2017; 6/10 countries in 2018; 6/16 countries in 2019; no assessment done in 2020; no assessment done in 2021
Outputs for outcome 4: Optimized use of antimicrobials in human and animal health; phased out animal use for growth promotion			
4.c Optimized use	Countries that have laws or regulations that prohibit the use of antibiotics for growth promotion in the absence of a risk analysis	TrACSS	75/136 countries in 2019–2020; 82/163 countries in 2020–2021

Table A1.3 Food and agriculture indicator data – FAO

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Goal: Reduced levels and slower development of resistance			
III. Patterns and trends in resistance for indicator <i>Escherichia coli</i> from priority food producing species	Resistance in commensal <i>Escherichia coli</i> from key food producing animals, as follows: a: Percentage of <i>Escherichia coli</i> isolates showing resistance to third-generation cephalosporins (i.e. presumptive ESBL-producing <i>Escherichia coli</i>) b: Patterns of resistance in <i>Escherichia coli</i> to a defined panel of antimicrobials	FAO platform	No data
Outcome I: Improved awareness of AMR and behaviour change among policy-makers, farmers, veterinary and health workers, the food industry and the general public			
1.1 Awareness of key groups	Percentage of stakeholders (e.g. human and animal health workers, prescribers, farmers, food processing workers) who have knowledge of AMR and the implications for AMU and infection prevention (metrics to be developed)	KAP surveys	Not applicable

Table A1.3 Food and agriculture indicator data – FAO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outcome 4: Optimized use of antimicrobials in human and animal health; phased out animal use for growth promotion			
4.6 Levels and trends in sales/ use of pesticides for the purpose of controlling bacterial or fungal disease in plant production	<p>a: Total amount of pesticide (active substance) intended to repel, destroy or control bacterial or fungal disease (tonnes)</p> <p>b: Percentage of the above total composed of each of the following antimicrobial classes:</p> <p>aminoglycosides; tetracyclines; triazoles; oxolinic acid</p>	FAOSTAT (27)	No data
Outcome 5: Increased R&D on new medicines, diagnostics, vaccines and other interventions related to priority pathogens			
Outputs for outcome 1: Improved awareness of AMR and behaviour change among policy-makers, farmers, veterinary and health workers, the food industry and the general public			
1.a Targeted awareness raising	<p>Nationwide, government-supported AMR awareness campaign targeting priority stakeholder groups in the following sectors:</p> <p>c: plant health d: food production e: food safety</p>	TrACSS, AMR PMP	87/159 countries in 2019; 82/136 countries in 2020; 94/163 countries in 2021

Table A1.3 Food and agriculture indicator data – FAO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outputs for outcome 2: Strengthened knowledge and evidence base used for policy and practical decisions			
2.d Data on AMU in plants	Countries that have systems to collect and report information on the quantity of pesticides used to control bacteria or fungal diseases in plant production	TrACSS	90/136 countries in 2020; 10/163 countries in 2021
2.e Food and agriculture AMR laboratory network	Percentage of laboratories included in the national AMR surveillance system in the food and agricultural sectors with capacity to perform AST and/or bacterial isolation and identification according to international standards	ATLASS	No data
2.f AMR surveillance data in animals and food	Countries that collect and report AMR surveillance data for:	TrACSS, AMR PMP	57/159 countries in 2019; 58/136 countries in 2020; 65/163 countries in 2021
	a: food producing animals (terrestrial and aquatic)		
	b: food (of animal and plant origin)		
2.g Prevalence of ESBL-producing indicator <i>Escherichia coli</i> in animals	Countries that measure the prevalence of ESBL-producing indicator commensal <i>Escherichia coli</i> in key food producing species (terrestrial), in accordance with the WOHAI terrestrial animal health code and the WOHAI “Manual of Diagnostic Tests and Vaccines for Terrestrial Animals” (Terrestrial Manual)	TrACSS	No data

Table A1.3 Food and agriculture indicator data – FAO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
2.h Use of AMR surveillance data	National bodies that review information from national AMR surveillance programmes, and make and implement recommendations accordingly	TrACSS	34/136 countries in 2020; 34/163 countries in 2021
Outputs for outcome 3: Reduced incidence of infection in health facilities, farms and communities as well as reduced environmental contamination, due to effective prevention			
3.a Regulation for antimicrobial waste	Countries that have a regulatory framework for the discharge of antimicrobials and waste potentially contaminated with antimicrobials into the environment	TrACSS	No data
3.c Food safety standards	Countries that have adopted food safety standards consistent with the Codex Alimentarius	Survey on the use of Codex standards	No data
3.d Infection prevention at the national level	Countries that implement minimum requirements for infection prevention (e.g. husbandry and biosecurity) for food animal production, in accordance with WOAHP standards	TrACSS, AMR PMP	56/159 countries in 2019; 52/136 countries in 2020; 67/163 countries in 2021

Table A1.3 Food and agriculture indicator data – FAO (continued)

Measurement	Indicator name	Source of data	Indicator value 2020–2021 (global)
Outputs for outcome 4: Optimized use of antimicrobials in human and animal health; phased out animal use for growth promotion			
4.a Regulatory framework for veterinary medicinal products	Countries that have a regulatory framework for veterinary medicinal products (including medicated feed) that covers all stages of the cycle (manufacture, supply, sale, use, disposal) and that meets other requirements in the WOA and Codex standards	FAOLEX (22), TrACSS	No data
4.b Regulatory framework for non-medicinal Antimicrobials	Countries that have a regulatory framework for pesticides that considers all stages of the antimicrobial life cycle (production, supply, sale, use, disposal) and that meets other requirements in the reference international standards	FAOLEX, TrACSS	No data
4.c Optimized use	Countries that have laws or regulations that prohibit the use of antibiotics for growth promotion in the absence of a risk analysis	TrACSS	No data

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Annex 2.

Analysis of 2020–2021 TrACSS indicators

Table A2.1. Indicators used to assess and benchmark the current state of AMR NAPs

Indicators	Multisectoral (One Health) approach
4.1	Country has functional multisectoral governance or coordination mechanisms on AMR
4.2	(sector-specific)
5.1	Country progress on the development of an AMR NAP
5.1	(stratified analysis of the progress; i. development; ii. implementation; iii. M&E)
6.1	Country progress in raising awareness and raising the level of understanding of AMR risks and exposure
6.1	Country has a nationwide, government-supported AMR awareness campaign targeting all or the majority of priority stakeholder groups
6.1.1	(sector-specific)
Indicators	Human health
6.2	Country offers training and professional education on AMR in the human health sector
7.4	Country has a national surveillance system for AMR in humans
8.1	Country has a national IPC programme in human health care that is implemented across the country
9.1	Country has practices, guidelines and/or policies to optimize antimicrobial use in human health
5.4a	Country has laws or regulations on the prescription and sale of antimicrobials for human use
7.1	Country has a national monitoring system for the consumption and rational use of antimicrobials in human health
9.1.1	Country has adopted the AWaRe classification of antibiotics in the national Essential Medicines list

Table A2.1. Indicators used to assess and benchmark the current state of AMR NAPs (continued)

Indicators	Animal health
6.3	Country provides training and professional education on AMR in the veterinary sector
6.5	Country is currently implementing or has implemented its plan to strengthen capacity gaps in veterinary services
7.5a	Country has a national surveillance system for AMR in animals (terrestrial and aquatic)
7.6.1	Country has established or started the implementation of an integrated surveillance system for AMR in the animal health sector (terrestrial and aquatic)
8.2	Country has good health, management and hygiene practices to reduce the use of antimicrobials and minimize the development and transmission of AMR in animal production (terrestrial and aquatic)
9.2	Country has national legislation that covers all aspects of national manufacture, import, marketing authorization, control of safety, quality and efficacy, and distribution of antimicrobial products used in animal health (terrestrial and aquatic)
5.4b	Country has laws or regulations on the prescription and sale of antimicrobials for animal use
5.4c	Country has laws or regulations that prohibits the use of antibiotics for growth promotion in the absence of a risk analysis
7.2	Country has a national monitoring system for antimicrobials intended for use in animals

Table A2.1. Indicators used to assess and benchmark the current state of AMR NAPs (continued)

Indicators	Food and agriculture
6.4	Country organizes training and professional education on AMR to the farming (animal and plant), food production, food safety and environmental sectors
7.5c	Country has a national surveillance system for AMR in food (animal and plant origin)
7.7a	Country has integrated their laboratories for AMR surveillance in the animal health and food safety sectors
8.3	Country has good management of hygiene practices to reduce the development and transmission of AMR in food processing
9.3	Country has national legislation that covers all aspects of national manufacture, import, marketing authorization, control of safety, quality and efficacy, and distribution of pesticides, including antimicrobial pesticides used in plant production
5.4d	Country has legislation on the marketing of pesticides, including antimicrobial pesticides, such as bactericides and fungicides used in plant production
7.3	Country has a national monitoring system for antimicrobial-pesticide use in plant production, including bactericides and fungicides
Indicators	Environmental health
7.6.1	Country established or started the implementation of an integrated multisectoral surveillance system including AMR and AMC/AMU in the environmental sector
10a.	Country performed a national assessment of the risk of AMR spread in the environment
10b.	Country has legislation and/or regulations to prevent contamination of the environment with antimicrobials

Table A2.2. Responses on TrACSS indicators on One Health by World Bank country income classification and Fisher's exact test of independence on the association between TrACSS indicator levels of achievement and World Bank income groups, based on 2020–2021 TrACSS responses

Levels	High income	Upper middle income	Lower middle income	Low income	P value
Country has functional multisectoral governance or coordination mechanisms on AMR (4.1) ^a					
No	15 (30.6%)	23 (53.5%)	25 (54.3%)	18 (72.0%)	
Yes	34 (69.4%)	20 (46.5%)	21 (45.7%)	7 (28.0%)	0.00476 b
Country progress on the development of an AMR NAP (5.1)					
<i>Country developed an AMR NAP ^a</i>					
No	7 (14.3%)	7 (16.3%)	5 (10.9%)	4 (16.0%)	
Yes	42 (85.7%)	36 (83.7%)	41 (89.1%)	21 (84.0%)	0.883
<i>Country is implementing the AMR NAP ^b</i>					
No	20 (40.8%)	18 (41.9%)	17 (37.0%)	13 (52.0%)	
Yes	29 (59.2%)	25 (58.1%)	29 (63.0%)	12 (48.0%)	0.679
<i>Country is implementing the AMR NAP and is actively monitoring progress through an M&E framework ^c</i>					
No	33 (67.3%)	34 (79.1%)	41 (89.1%)	23 (92.0%)	
Yes	16 (32.7%)	9 (20.9%)	5 (10.9%)	2 (8.0%)	0.026
Country progress in raising awareness and raising the level of understanding of AMR risks and exposure (6.1)					
<i>Country has a limited or small-scale awareness campaign targeting some but not all stakeholders ^a</i>					
No	2 (4.1%)	7 (16.3%)	5 (10.9%)	8 (32.0%)	
Yes	47 (95.9%)	36 (83.7%)	41 (89.1%)	17 (68.0%)	0.009
<i>Country has a nationwide, government-supported AMR awareness campaign targeting all or the majority of priority stakeholder groups ^b</i>					
No	17 (34.7%)	26 (60.5%)	35 (76.1%)	20 (80.0%)	
Yes	32 (65.3%)	17 (39.5%)	11 (23.9%)	5 (20.0%)	P<0.001

a Comparison between TrACSS levels A–B vs C–E; b Comparison between TrACSS levels A–C vs D–E; c Comparison between TrACSS levels A–D vs E.

Table A2.3. Responses on TrACSS indicators on human health by World Bank country income classification and Fisher’s exact test of independence on the association between TrACSS indicator levels of achievement and World Bank income groups, based on the 2020–2021 TrACSS responses

Levels	High income	Upper middle income	Lower middle income	Low income	P value
Country offers training and professional education on AMR in the human health sector (6.2) ^a					
No	2 (4.1%)	9 (20.9%)	11 (23.9%)	11 (44.0%)	
Yes	47 (95.9%)	33 (76.7%)	35 (76.1%)	13 (52.0%)	
Not applicable	0	1 (2.3%)	0	1 (4.0%)	<0.001
Country has a national surveillance system for AMR in humans (7.4) ^a					
No	3 (6.1%)	10 (23.3%)	15 (32.6%)	13 (52.0%)	
Yes	45 (91.8%)	32 (74.4%)	30 (65.2%)	11 (44.0%)	
Not applicable	1 (2.0%)	1 (2.3%)	1 (2.2%)	1 (4.0%)	<0.001
Country has a national IPC programme in human health care that is implemented across the country (8.1) ^b					
No	15 (30.6%)	34 (79.1%)	37 (80.4%)	20 (80.0%)	
Yes	34 (69.4%)	9 (20.9%)	8 (17.4%)	5 (20.0%)	
Not applicable	0	0	1 (2.2%)	0	<0.001
Country has practices, guidelines and/or policies to optimize AMU in human health (9.1) ^b					
No	2 (4.1%)	13 (30.2%)	16 (34.8%)	15 (60.0%)	
Yes	47 (95.9%)	29 (67.4%)	30 (65.2%)	9 (36.0%)	
Not applicable	0	1 (2.3%)	0	1 (4.0%)	<0.001
Country has a national monitoring system for the consumption and rational use of antimicrobials in human health (7.1) ^a					
No	8 (16.3%)	21 (48.8%)	28 (60.9%)	17 (68.0%)	
Yes	41 (83.7%)	22 (51.2%)	18 (39.1%)	8 (32.0%)	
Not applicable	0	0	0	0	<0.001

Table A2.3. Responses on TrACSS indicators on human health by World Bank country income classification and Fisher's exact test of independence on the association between TrACSS indicator levels of achievement and World Bank income groups, based on the 2020–2021 TrACSS responses (**continued**)

Levels	High income	Upper middle income	Lower middle income	Low income	<i>P</i> value
Country has laws or regulations on the prescription and sale of antimicrobials for human use (5.4a) ^c					
No	1 (2.0%)	1 (2.3%)	8 (17.4%)	3 (12.0%)	
Yes	48 (98.0%)	42 (97.7%)	37 (80.4%)	21 (84.0%)	
Not applicable	0	0	1 (2.2%)	1 (4.0%)	0.009
Country has adopted the AWaRe classification of antibiotics in the national Essential Medicines list (9.1.1) ^a					
No	30 (61.2%)	27 (62.8%)	29 (63.0%)	16 (64.0%)	
Yes	19 (38.8%)	15 (34.9%)	17 (37.0%)	8 (32.0%)	
Not applicable	0	1 (2.3%)	0	1 (4.0%)	0.8236

a Comparison between TrACSS levels A–B vs C–E; b Comparison between TrACSS levels A–C vs D–E; c Comparison between TrACSS classes Yes vs No.

Table A2.4. Responses on TrACSS indicators on animal health by World Bank country income classification and Fisher's exact test of independence on the association between TrACSS indicator levels of achievement and World Bank income groups, based on 2020–2021 TrACSS responses

Levels	High income	Upper middle income	Lower middle income	Low income	P value
Country provides training and professional education on AMR in the veterinary sector (6.3) ^a					
No	17 (34.7%)	19 (44.2%)	26 (56.5%)	15 (60.0%)	
Yes	31 (63.3%)	24 (55.8%)	20 (43.5%)	10 (40.0%)	
Not applicable	1 (2.0%)	0	0	0	<0.001
Country is currently implementing or has implemented its plan to strengthen capacity gaps in veterinary services (6.5) ^b					
No	23 (46.9%)	31 (72.1%)	37 (80.4%)	22 (88.0%)	
Yes	25 (51.0%)	11 (25.6%)	9 (19.6%)	3 (12.0%)	
Not applicable	1 (2.0%)	1 (2.3%)	0	0	0.001
Country has a national surveillance system for AMR in animals (terrestrial and aquatic) (7.5a) ^b					
No	14 (28.6%)	27 (62.8%)	29 (63.0%)	22 (88.0%)	
Yes	34 (69.4%)	16 (37.2%)	17 (37.0%)	3 (12.0%)	
Not applicable	1 (2.0%)	0	0	0	<0.001
Country has established or started the implementation of an integrated surveillance system for AMR in the animal health sector (terrestrial and aquatic) (7.6.1) ^c					
No	14 (28.6%)	15 (34.9%)	20 (43.5%)	11 (44.0%)	
Yes	23 (46.9%)	21 (48.8%)	21 (45.7%)	11 (44.0%)	
Not applicable	12 (24.5%)	7 (16.3%)	5 (10.9%)	3 (12.0%)	0.576
Country has good health, management and hygiene practices to reduce the use of antimicrobials and minimize the development and transmission of AMR in animal production (terrestrial and aquatic) (8.2) ^a					
No	18 (36.7%)	22 (51.2%)	31 (67.4%)	19 (76.0%)	
Yes	30 (61.2%)	19 (44.2%)	15 (32.6%)	5 (20.0%)	
Not applicable	1 (2.0%)	2 (4.7%)	0	1 (4.0%)	0.003

Table A2.4. Responses on TrACSS indicators on animal health by World Bank country income classification and Fisher's exact test of independence on the association between TrACSS indicator levels of achievement and World Bank income groups, based on 2020–2021 TrACSS responses (continued)

Levels	High income	Upper middle income	Lower middle income	Low income	P value
Country has national legislation that covers all aspects of national manufacture, import, marketing authorization, control of safety, quality and efficacy, and distribution of antimicrobial products used in animal health (terrestrial and aquatic) (9.2) ^a					
No	8 (16.3%)	19 (44.2%)	33 (71.7%)	18 (72.0%)	
Yes	40 (81.6%)	22 (51.2%)	13 (28.3%)	7 (28.0%)	
Not applicable	1 (2.0%)	2 (4.7%)	0	0	<0.001
Country has a national monitoring system for antimicrobials intended for use in animals (7.2) ^c					
No	4 (8.2%)	21 (48.8%)	18 (39.1%)	12 (48.0%)	
Yes	41 (83.7%)	17 (39.5%)	23 (50.0%)	10 (40.0%)	
Not applicable	4 (8.2%)	5 (11.6%)	5 (10.9%)	3 (12.0%)	<0.001
Country has laws or regulations on the prescription and sale of antimicrobials for animal use (5.4b) ^c					
No	4 (8.2%)	11 (25.6%)	14 (30.4%)	8 (32.0%)	
Yes	45 (91.8%)	31 (72.1%)	29 (63.0%)	15 (60.0%)	
Not applicable	0	1 (2.3%)	3 (6.5%)	2 (8.0%)	0.007
Country has laws or regulations that prohibits the use of antibiotics for growth promotion in the absence of a risk analysis (5.4c) ^c					
No	3 (6.1%)	18 (41.9%)	21 (45.7%)	12 (48.0%)	
Yes	46 (93.9%)	23 (53.5%)	18 (39.1%)	11 (44.0%)	
Not applicable	0	2 (4.7%)	7 (15.2%)	2 (8.0%)	<0.001

a Comparison between TrACSS levels A–B vs C–E; b Comparison between TrACSS levels A–C vs D–E; c Comparison between TrACSS classes Yes vs No.

Table A2.5. Responses on TrACSS indicators on agriculture and food by World Bank country income classification and Fisher’s exact test of independence on the association between TrACSS indicator levels of achievement and World Bank income groups, based on 2020–2021 TrACSS responses

Levels	High income	Upper middle income	Lower middle income	Low income	P value
Country organizes training and professional education on AMR to the farming (animal and plant), food production, food safety and environmental sectors (6.4) ^a					
No	28 (57.1%)	32 (74.4%)	37 (80.4%)	21 (84.0%)	
Yes	20 (40.8%)	10 (23.3%)	7 (15.2%)	4 (16.0%)	
Not applicable	1 (2.0%)	1 (2.3%)	2 (4.3%)	0	0.058
Country has a national surveillance system for AMR in food (animal and plant origin) (7.5c) ^b					
No	16 (32.7%)	30 (69.8%)	38 (82.6%)	24 (96.0%)	
Yes	32 (65.3%)	11 (25.6%)	8 (17.4%)	1 (4.0%)	
Not applicable	1 (2.0%)	2 (4.7%)	0	0	<0.001
Country has integrated their laboratories for AMR surveillance in the animal health and food safety sectors (7.7a) ^a					
No	15 (30.6%)	27 (62.8%)	26 (56.5%)	15 (60.0%)	
Yes	34 (69.4%)	16 (37.2%)	19 (41.3%)	9 (36.0%)	
Not applicable	0	0	1 (2.2%)	1 (4.0%)	0.005
Country has good management of hygiene practices to reduce the development and transmission of AMR in food processing (8.3) ^b					
No	27 (55.1%)	32 (74.4%)	42 (91.3%)	23 (92.0%)	
Yes	21 (42.9%)	8 (18.6%)	4 (8.7%)	1 (4.0%)	
Not applicable	1 (2.0%)	3 (7.0%)	0	1 (4.0%)	<0.001
Country has national legislation that covers all aspects of national manufacture, import, marketing authorization, control of safety, quality and efficacy, and distribution of pesticides, including antimicrobial pesticides used in plant production (9.3) ^a					
No	16 (32.7%)	24 (55.8%)	34 (73.9%)	20 (80.0%)	
Yes	30 (61.2%)	15 (34.9%)	11 (23.9%)	4 (16.0%)	
Not applicable	3 (6.1%)	4 (9.3%)	1 (2.2%)	1 (4.0%)	<0.001

Table A2.5. Responses on TrACSS indicators on agriculture and food by World Bank country income classification and Fisher's exact test of independence on the association between TrACSS indicator levels of achievement and World Bank income groups, based on 2020–2021 TrACSS responses (**continued**)

Levels	High income	Upper middle income	Lower middle income	Low income	<i>P</i> value
Country has a national monitoring system for antimicrobial-pesticide use in plant production, including bactericides and fungicides (7.3) ^a					
No	15 (30.6%)	26 (60.5%)	39 (84.8%)	19 (76.0%)	
Yes	31 (63.3%)	14 (32.6%)	5 (10.9%)	5 (20.0%)	
Not applicable	3 (6.1%)	3 (7.0%)	2 (4.3%)	1 (4.0%)	<0.001
Country has legislation on the marketing of pesticides, including antimicrobial pesticides, such as bactericides and fungicides used in plant production (5.4d) ^c					
No	4 (8.2%)	7 (16.3%)	10 (21.7%)	9 (36.0%)	
Yes	41 (83.7%)	27 (62.8%)	28 (60.9%)	14 (56.0%)	
Not applicable	4 (8.2%)	9 (20.9%)	8 (17.4%)	2 (8.0%)	0.034

a Comparison between TrACSS levels A–B vs C–E; b Comparison between TrACSS levels A–C vs D–E; c Comparison between TrACSS classes Yes vs No.

Table A2.6. Responses on TrACSS indicators on the environment by World Bank country income classification and Fisher’s exact test of independence on the association between TrACSS indicator levels of achievement and World Bank income groups, based on the 2020–2021 TrACSS responses (n=163)

Levels	High income	Upper middle income	Lower middle income	Low income	P value
Country established or started the implementation of an integrated multisectoral surveillance system including AMR and AMC/AMU in the environmental sector (7.6.1) ^a					
No	26 (53.1%)	23 (53.5%)	29 (63.0%)	13 (52.0%)	
Yes	4 (8.2%)	6 (14.0%)	8 (17.4%)	8 (32.0%)	
Not applicable	19 (38.8%)	14 (32.6%)	9 (19.6%)	4 (16.0%)	0.013
Country performed a national assessment of the risk of AMR spread in the environment (10a)*					
No	28 (57.1%)	34 (79.1%)	36 (78.3%)	18 (72.0%)	
Yes	18 (36.7%)	8 (18.6%)	9 (19.6%)	7 (28.0%)	
Not applicable	3 (6.1%)	1 (2.3%)	1 (2.2%)	0	0.214
Country has legislation and/or regulations to prevent contamination of the environment with antimicrobials (10b) ^a					
No	18 (36.7%)	23 (53.5%)	27 (58.7%)	13 (52.0%)	
Yes	26 (53.1%)	17 (39.5%)	17 (37.0%)	11 (44.0%)	
Not applicable	5 (10.2%)	3 (7.0%)	2 (4.3%)	1 (4.0%)	0.462

^a Comparison between TrACSS classes Yes vs No.

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<https://www.who.int/health-topics/antimicrobial-resistance>

