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Achievements, challenges and enablers of Ghana's National Action Plan on antimicrobial resistance during 2017-2021: a mixed-methods study

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Abstract

Background: Antimicrobial resistance (AMR) is a complex national and global challenge. Many countries have already undertaken or are currently implementing AMR policies and national action plans (NAPs) within the “One Health” framework to ensure appropriate antimicrobial use. NAP implementation is important, as these provide lessons for the next phase of its implementation guidance for other countries.

Objective: This study analysed Ghana's AMR national action plan (2017 - 2022) achievements, challenges, and enablers.

Methods: We employed a mixed-method approach to collect and analyse data. Data were collected through document review (n = 20), in-depth interviews (n = 27), and a questionnaire. The data were thematically and descriptively analysed according to the NAP's five strategic objectives. The level of completion was based on the scoring of 143 NAP activities per stated targets.

Results: The overall completion rate for all activities, per stated deliverables and targets, was 66.21%. Strategic objective three, which focused on reducing the incidence of infection through sanitation, hygiene, infection prevention measures, and biosecurity practices, was the most implemented, with 77% of activities completed. Strategic objective two had the least, with 56.11% of activities completed and was aimed at generating knowledge and evidence from surveillance systems and laboratory services to inform policy and practice. Some identified implementation barriers were lengthy and complex institutional procedures, packed NAP activities, and inadequate funding. However, dedicated AMR champions, mainstreaming NAP activities into implementing institutions' programmes, and continuous dialogue through the multisectoral AMR platform were identified as enablers.

Conclusion: Implementing national plans to curb AMR is a complex process involving multiple sectors and stakeholders with diverse institutional arrangements, interests, and resources. Therefore, aligning NAP activities with existing institutional plans and securing adequate funding for implementation is critical for sustainable gains in AMR prevention and control.

Keywords: Antimicrobial Resistance, Ghana, National Action Plan Implementation, One Health

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INTRODUCTION

Antimicrobial resistance (AMR) is a phenomenon in which microbes – bacteria, viruses, fungi, and

parasites – become resistant to existing medicines, making infections more difficult and expensive to treat [1]. AMR increases healthcare costs [1,2] and is one of the leading causes of death around the world, with the highest burden in low-income settings [3]. Many countries have therefore developed national-level policies, accompanied by National Action Plans (NAPs), for the containment of antimicrobial resistance. In a 2023 study, 108 countries

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were identified as having NAPs, with 39% (n = 42) from high-income countries, 46% (n = 50) from low- and middle-income countries (LMICs), and 15% (n = 16) from least developed countries [4]. In 2017, Ghana developed its first NAP (2017 - 2021) with strategies to ensure the appropriate use of antimicrobials and control the development and spread of antimicrobial resistance across all sectors [5,6]. Ghana's strategic objectives are aligned with the World Health Organisation's (WHO) global action plans [7,8], as the NAP was developed through multisectoral coordination and a 'one health' approach [9], with inputs from government and non-governmental organisations [10]. The government organisations included the quadripartite, i.e., the Ministry of Health (MOH), the Ministry of Food and Agriculture (MOFA), the Ministry of Environment, Science, Technology, and Innovation (MESTI), and the Ministry of Fisheries and Aquaculture Development (MOFAD) of Ghana, while non-governmental organisations comprised development partners and civil society [5,6].

The NAP focused on interventions in areas across all sectors: human, animal, agriculture, and environment, guided by five strategic objectives; Strategic objective 1: Improve awareness and understanding of antimicrobial resistance through effective communication, education, and training, Strategic objective 2: Strengthen knowledge and evidence base through surveillance and research, Strategic objective 3: Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures and good agricultural and biosecurity practices, Strategic objective 4: Optimise the use of antimicrobial agents in humans, aquaculture, plant production and in animal health in the 'one health' approach and Strategic objective 5: Develop the economic case and create an enabling environment for sustainable investment that takes account of the needs of Ghana, and increase investment in new medicines, diagnostic tools, vaccines and other intervention. Covering 143 activities, the NAP details timelines and frequency of implementation, lead implementer and collaborators, and process indicators with deliverables and targets. The lead NAP implementers are the quadripartite - MOH, MOFA, MESTI, and MOFAD of Ghana. Implementation of the NAP activities is coordinated by the AMR national secretariat at the MOH, focal persons from the implementing agencies, and members of the AMR Platform (a multisectoral technical working group).

The evidence generated through the policy cycle, i.e., agenda setting, policy formulation, implementation, and evaluation, is critical and can inform the next steps in the policy revision. Findings from the NAP (2017 - 2021) assessment would be particularly important, serving as lessons for Ghana and other countries. Several studies in Ghana have focused on AMR agenda setting and formulation [10], donor support for AMR policy and NAP development [11], and stakeholders' perspectives on NAP implementation [12] and NAP development and implementation [13]. There is, however, a knowledge gap

in information from the end-term assessment of Ghana's NAP 2017 - 2021. This paper seeks to bridge this gap by analysing Ghana's NAP (2017 - 2021) implementation with a focus on achievements, contextual challenges, and enablers.

MATERIALS AND METHODS

A study of the NAP (2017 - 2021) was conducted using a mixed methods approach. Data were collected between September and November 2022 using document review, in-depth interviews, and questionnaire administration. Ethical approval was sought from the Ghana Health Service Ethics Review Committee (GHS-ERC: 012/10/22), and written and verbal informed consent were obtained from all respondents. The document review was conducted to understand NAP implementation, contextual barriers, and enablers. Our main inclusion criterion was documents that report on NAP implementation in Ghana for the period 2017 - 2021, in recognition of the NAP implementation timeframe. We excluded documents on AMR policy and NAP design processes, as this study focused on evaluating NAP implementation. The documents that were reviewed (n = 20) are noted in Supplementary File 1. A total of thirty-nine (39) participants were contacted; twenty-seven (27) persons were interviewed, and twelve were unavailable for an interview in November 2022. Respondents (Table 1) were purposively selected with input from the national AMR secretariat and AMR implementing focal persons to ensure representation across the 'one health' sectors. The interviews were conducted face-to-face using online communication platforms and lasted 45 minutes on average. Consent was obtained for participation and recording. A semi-structured interview guide was used to collect information. The interviews were transcribed verbatim and anonymised for analysis. Respondents' identities were protected using codes as labels, such as KI 2.

Data saturation was reached after the twenty-fifth interview, with subsequent interviews confirming recurring themes. A structured Google Forms questionnaire was used to assess the implementation of 143 activities under the NAP. Respondents (Table 2) were purposively selected from lead implementing organisations across four ministries, in consultation with each ministry's AMR focal person. This approach ensured the inclusion of individuals with direct involvement and specialised knowledge of implementation activities. To minimise bias, the final list of respondents was agreed upon during an AMR platform meeting on 20 September 2022, ensuring representation of all key implementers. Each organisation (n = 20) provided collective responses to enhance accuracy. The questionnaire captured respondent details and five sections aligned with NAP strategic objectives, including activity status (completed, in progress, or not started), deliverables, timelines, and funding sources. These data formed the basis for evaluating implementation progress.

Data analysis

In this study, our conceptual framework (Figure 1) is based on the AMR policy’s five strategic objectives as stipulated in the National AMR policy and the accompanying implementation plan for 2017 to 2021 [5, 6], and on contextual factors that serve as barriers and enablers to implementation. We also explained the factors that influenced AMR policy interventions and their impact during the period (2017-2021), as per the deliverables, as well as the key influences on implementation processes from contexts and actors. We conceptualised context as comprising micro (individual interests and preferences),

meso (organisational practices and structures), and macro (national, international, and economic influences) [16]. Policy actors, such as groups, institutions, and individuals, implemented the AMR policy interventions through multistakeholder collaboration within the human, plant, animal, and environmental sectors [6,10]. Thematic content analysis and descriptive analysis were used for analysing the qualitative and quantitative data, respectively [17]. Data from the document reviews and interview transcripts were thoroughly read. The data were manually coded by AK and JAB (independent of the AMR secretariat or implementing agencies) and mapped to our analytical framework: the five

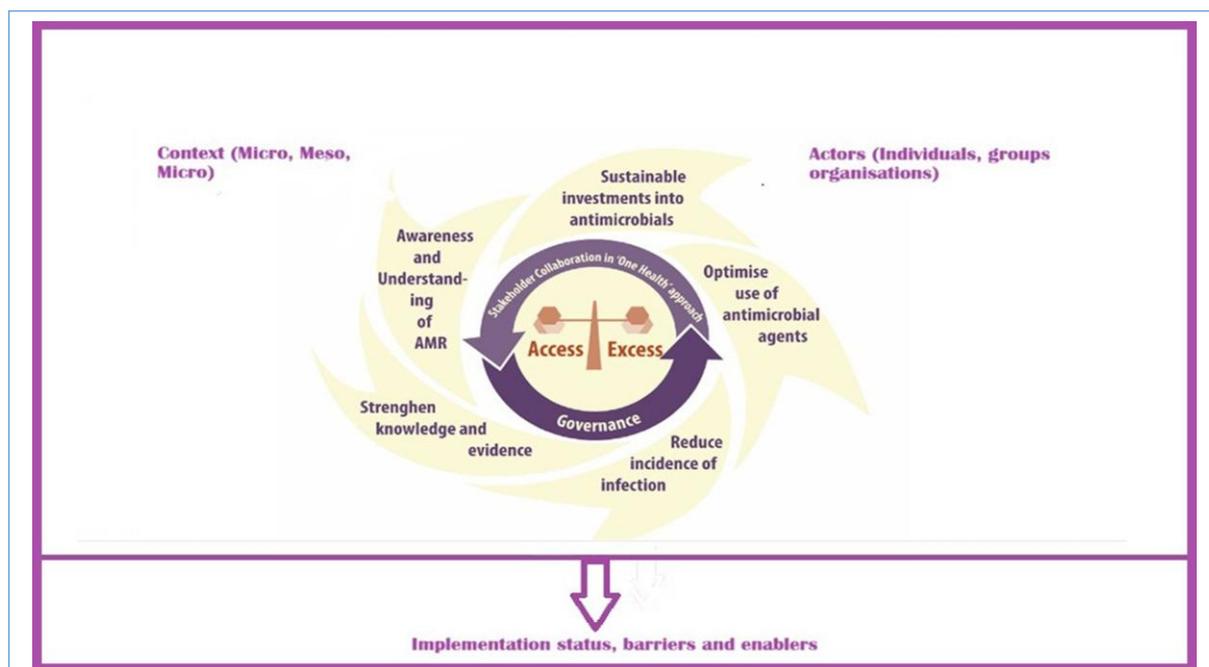


Figure 1. Conceptual framework drawing on AMR policy framework [5]

Table 1. A listing of interview respondents’ organisations

Grouping	Representative	Number
AMR Platform Technical Working Group (TWG)	Surveillance TWG	1
	Advocacy TWG	1
	Infection Prevention Control TWG	1
	Policy TWG	1
Ministries and agencies	Ministry of Health	2
	Ghana Health Service	2
	Food and Drugs Authority	1
	Ministry of Food and Agriculture (Veterinary Service Directorate)	3
	Ministry of Environment, Science, Technology, and Innovation (Environmental Protection Agency, Council for Scientific and Industrial Research)	4
Development Partners	World Health Organization (WHO) Ghana Office	3
	Food and Agriculture Organization (FAO) Ghana Office	2
Academia / Research Institutions	University of Health and Allied Sciences	1
	University of Development Studies	1
	Kintampo Health Research	1
Civil societies and associations	Ashanti Fish Farmers Association	1
	Pharmaceutical Society of Ghana	1
	Health Keepers	1

strategic objectives, the NAP implementation plan, policy actors, and contextual factors that serve as barriers and enablers to implementation. The emerging results were collated in tabular format for discussion by all authors. The emerging themes were further grouped and interpreted based on our analytical framework. Data from the questionnaire were quantified and scored based on the NAP objectives, deliverables, and targets by ENO. The NAP level of completion computation is detailed in Supplementary File 2. Data from different sources were then triangulated to reduce recall bias and ensure data consistency and convergence. The resulting findings were presented to the AMR platform members, i.e., the multisectoral technical working group, on 25 November 2022 for validation. Thirty-four AMR platform members attended the validation meeting. AK and JAB documented feedback, leading to reordering NAP enablers and adding Ghana-specific AMR research references. The private sector was highlighted as a potential domestic funding source for activities such as awareness creation.

RESULTS

The overall completion rate for all NAP activities was 66.21%. Figure 2 shows disaggregated completion rates for each strategic objective. Details of activities and their respective completion levels refer to the supplementary file 3.

Strategic objective one: Awareness creation

There were four interventions and eight activities targeted at awareness creation. At the end of 2021, there was a 68% level of completion for all these activities' deliverables and targets. The main AMR awareness creation activity was the celebration of World Antimicrobial Awareness Week (WAAW). During WAAW, NAP implementing agencies

such as MOH, MOFA, MESTI, and MOFAD, the Veterinary Service Department (VSD), together with the WHO, Ghana Coalition of NGOs in Health (GCNH), universities, and health professional bodies, advocated for the rational use of antimicrobial agents. Awareness creation activities were mainly funded by the government of Ghana, health professional bodies, GCHH, and development partners, including the WHO, the Fleming Fund, the Food and Agriculture Organisation (FAO), and the Wellcome Trust.

'We did some audio-visuals in the form of cartoons on antibiotic use and misuse and converted them to the common local languages to educate the general public' – KI-9 (Representative from FDA)

Other venues for awareness creation and education on AMR identified included Food Safety Week, International Infection Prevention Week, World Patient Safety Day, community engagements, and health professional bodies' Annual General Meetings. Additionally, the AMR platform members and development partners trained media practitioners to report on AMR issues. Table 3 summarises examples of the training. Farmer Field Schools (FFS), a participatory approach to learning, was implemented to create awareness. The FFS curriculum was developed, and facilitators and farmers were trained in Dormaa, Bono Region, by the FAO and other AMR platform members in 2019 [18]. However, as noted by one respondent, most of the awareness creation focused on health and the livestock sector, and less was done in the environment sector.

Strategic objective two: Knowledge and evidence generation

There were ten interventions and 32 activities under strategic objective two. At the end of 2021, there was a

Table 2. Organisation representatives responding to the questionnaire

Ministries	Representatives
Ministry of Health and agencies	Ghana Health Service
	Food and Drugs Authority
	Pharmacy directorate
	Korle-bu Teaching Hospital
	Pharmacy Council
Ministry of Food and Agriculture	Veterinary Services Directorate (VSD)
Ministry of Environment, Science, Technology & Innovation	Environmental Protection Agency (EPA)
Ministry of Trade and Industry	Council for Scientific and Industrial Research (CSIR)
	Ghana Standards Authority
Academia /Research Institution	University of Ghana
	Kintampo Health Research
	Kwame Nkrumah University of Science and Technology
Developmental Partners	WHO- Ghana Office
	FAO- Ghana Office
	Fleming Fund- Ghana Office
Civil Society Organizations	Ghana Coalition of NGOs in Health
	Professional Association and groups
	Laboratory Professional Association
	Society of Private Medical and Dental Association
	Christian Health Association of Ghana (CHAG)

56.11% level of completion for all these activities' deliverables and targets. Data show that there were inadequate national structures for human and non-human surveillance. However, Ghana shared data through the Global Antimicrobial Resistance and Use Surveillance System (GLASS). The AMR platform subgroup on surveillance has been very active and coordinated reporting to GLASS since Ghana enrolled in 2019 [19]. Additionally, the Extended-Spectrum Beta-Lactamase (ESBL) E. coli Tricycle project - a simplified and integrated multisectoral surveillance system for bacterial resistance in humans, the food chain, and the environment was implemented in synergy with GLASS [20].

'Surveillance is a little bit challenging because we don't have well-laid-down structures, so data collection is based on individual initiative. For example, one needs to knock on the doors of colleagues for data before we structure it to fit the GLASS requirement- KI-1 (Representative from UGMS)

The Environmental Protection Agency (EPA) monitors institutions such as the pharmaceutical industry to ensure compliance with EPA standards in terms of the production of pharmaceuticals, plant antimicrobials, waste management, and compliance with microbial levels in air and water. Key findings for other interventions, such as a surveillance system for antimicrobial consumption, standard operating procedures, and a surveillance database, are summarised in Table 3.

Strategic objective three: Reduce the incidence of infection

There were 7 interventions and 27 activities targeted at reducing infection incidence. At the end of 2021, there was a 77% level of completion for all these activities' deliverables and targets. Infection Prevention and Control (IPC) is implemented and mainstreamed in the health sector, and this is less advanced in the non-human sectors. The MOH and its agencies, such as the Ghana Health Service (GHS), have developed guidelines and job aids on IPC and the Water, Sanitation, and Hygiene (WASH) Programme, and have trained healthcare workers (Table 3).

'IPC-WASH activities are more skewed towards the public health service, so we are trying to pull in the private sector in collaboration with the Ghana Health Service focal point on IPC-WASH' - KI-18 (Representative from WHO).

In terms of waste management, the Environmental Protection Agency (EPA) and the Food and Drugs Authority (FDA) ensure compliance with the standard disposal of effluent from the pharmaceutical and food processing industries. Farmers were trained on biosecurity to reduce infection and antimicrobial use on their farms. Biosafety guidelines for poultry have been developed, but have yet to be implemented.

'The EPA has developed an environmental guideline for the poultry sector, and this includes biosecurity measures within the farms and the management of the poultry waste' - KI-17 (Representative from EPA).

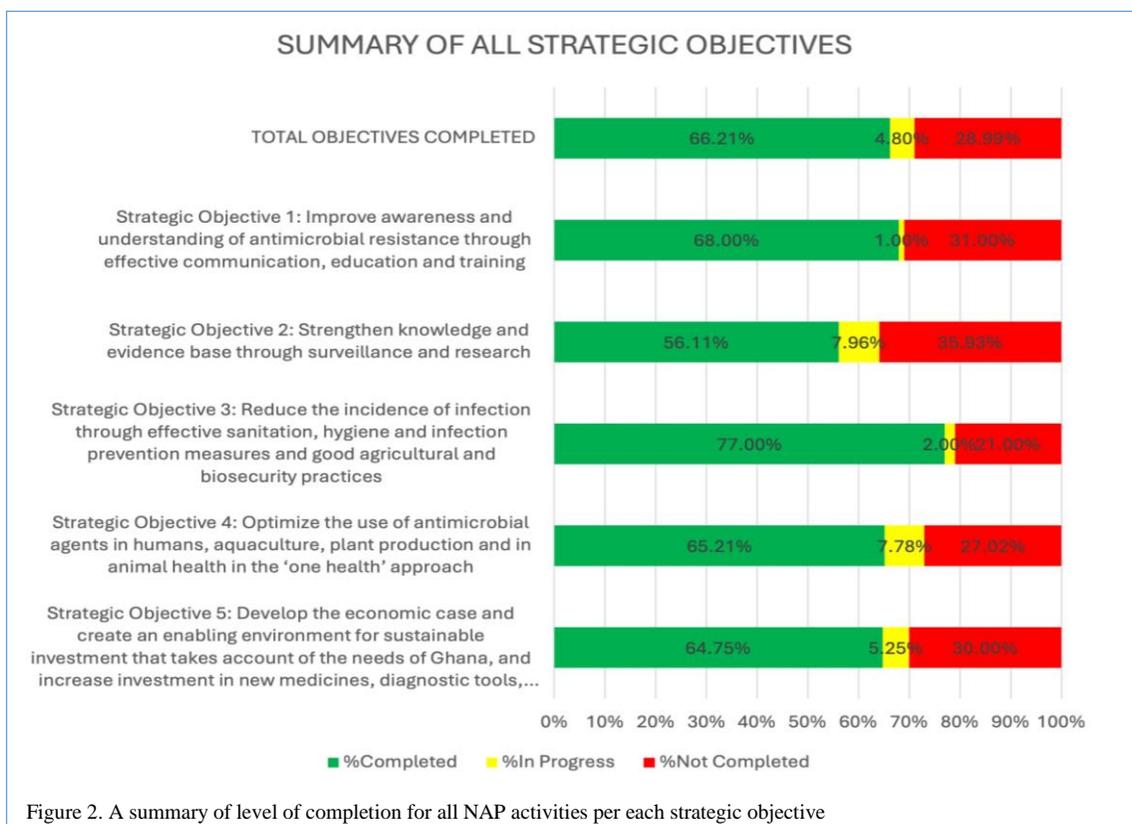


Figure 2. A summary of level of completion for all NAP activities per each strategic objective

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Strategic objective four: optimise use of antimicrobial agents

There were 14 interventions and 36 activities targeted at optimising the use of antimicrobial agents in humans, aquaculture, plant production, and animal health in the ‘one health’ approach. At the end of 2021, there was a 65.21% level of completion for all these activities’ deliverables and targets. In terms of the promotion of AMR stewardship, there is evidence that AMR stewardship is incorporated into curricula to educate healthcare students. For example, the University of Ghana, School of Pharmacy, teaches students AMR stewardship. Optimising the use of antimicrobials in the STG by using the WHO access, watch, reserve (AWaRe) classification of antimicrobials is important, but not implemented.

‘Stewardship and optimising the use of antimicrobials are important for the Standard Treatment Guidelines (STG).

Antimicrobials are classified under Access Watch and Reserve, and this has been done to protect antimicrobial agents, but this has yet to be incorporated in the STGs.’ - KI-18 (Representative from WHO).

Some activities are mainstreamed into the day-to-day operations of state institutions (Table 3).

Strategic objective five: Develop economic cases and create enabling environment for sustainable investment

There were 18 interventions and 40 activities aimed at developing the economic case and creating an enabling environment for sustainable investment that takes account of the needs of Ghana and increases investment in new medicines, diagnostic tools, vaccines, and other interventions. At the end of 2021, there was a 64.75% level of completion for all these activities’ deliverables and

Table 3. Summary findings of activities implementation

Strategic Objectives Interventions	Findings
Strategic Objectives One-Awareness creation trainings	In November 2019, the FAO organized media training in Accra. The WHO also funded media training in the Ashanti and Brong Ahafo regions in 2020. The Pharmaceutical Society of Ghana has constantly engaged the media and other stakeholders on AMR during the WAAW. <i>‘Every year, we train the media to create awareness so that in their reporting for AMR activities, at least they will have a basic understanding of what it is to be able to report well.’ - KI-24 (Representative from FAO)</i>
Strategic Objective Two: Knowledge and evidence generation interventions	In terms of surveillance systems for antimicrobial consumption, the Ministry of Health pharmacy directorate collated data from health facilities; however, there were no tools for analysis to inform policy. There are reference laboratories for humans and non-humans, but with inadequate logistics. Ten Standard Operating Procedures (SOPs) with reporting and feedback mechanisms for laboratory work were developed by the AMR Platform surveillance technical working group. A framework for sampling live birds, standard operating procedures, and terms of reference has been developed for animal health surveillance. The national surveillance database is not set up; nevertheless, researchers shared and disseminated findings at the AMR Platform meetings. However, there is limited evidence of how these disseminated findings informed practice and policy.
Strategic Objective Three: Infection Prevention and Control trainings	In 2019, a total of 34,000 personnel across 170 healthcare facilities were trained, and 107 post-training monitoring sessions were carried out. Infection Prevention and Control training was more focused on the health public sector, especially during the COVID-19 pandemic.
Strategic Objective Four: Optimizing the use of antimicrobial agents	The FDA enforces advertisement restrictions as prescribed in the Public Health Act 2012 (Act 851), and as a result, antimicrobial agents cannot be advertised in print and on electronic media. In terms of promoting the responsible use of antimicrobials in veterinary, fisheries, and agricultural practices, local consumption of antimicrobial agents used in animals was collected using the World Organization for Animal Health (WOAH) template. However, a standard treatment guideline for the veterinary sector is yet to be developed and implemented. A standard guideline for antimicrobial residues in veterinary, plant production, and aquaculture was not developed. To promote the safe disposal of microbiologically sensitive matter and waste, the EPA and FDA established a mechanism for the retrieval and disposal of unwholesome and unused antimicrobial agents. The FDA also supervises the safe disposal of expired and unwholesome antimicrobials in the form of raw materials and finished products.
Strategic Objective Five: Interventions aimed at strengthening governance and stakeholder collaboration	The set-up of an inter-ministerial committee and AMR Platform was implemented. As part of governance structures, technical working groups have been formed to champion various activities and strategic objectives of the NAP implementation. District and regional committees were not formed.

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targets. Concerning research into antimicrobial use and resistance, the Structured Operational Research and Training Initiative (SORT IT) promoted operational research in all sectors with researchers based at the Council for Scientific and Industrial Research (CSIR)–Water Research Institute; Kintampo Health Research Centre; Environmental Protection Agency; Institute of Statistical, Social, and Economic Research, and the FDA. Researchers shared findings with the AMR platform. The FDA enforces laws regulating the sourcing and distribution of AM agents as well as standards for antimicrobial manufacturing in the country. The FDA also supports local pharmaceutical manufacturers with tailored training and technical know-how. However, economic action plans and investment models for the long-term drug development of

potential agents, including herbal sources, have not been developed.

‘The AMR platform may not have made an economic case to the Government, but sourced additional funding to support in-country NAP activities implementation’ - KI-19 (Representative from WHO).

Interventions aimed at strengthening governance and stakeholder collaboration are summarised in Table 3.

Key barriers and enablers to the NAP implementation

We assessed contextual barriers and enablers at the Macro (national), Meso (institutional/organisational), and Micro (facility/individual) levels. Tables 4 and 5 summarise contextual barriers and enablers to the NAP implementation, respectively.

Table 4. Contextual Barriers to the NAP Implementation

Contextual Level	Barrier Description
Micro	Inadequate commitment and dedication at the inter-ministerial level; only 2 of 10 planned meetings were held, slowing decision-making.
Meso	Lengthy and complex institutional processes and procedures are causing delays in AMR activity implementation. Suboptimal collaboration between academic institutions and implementing ministries/agencies. Simultaneous handling of multiple activities by the same institutions, leading to divided attention and incomplete tasks, exacerbated by the COVID-19 focus. Stakeholders are unaware of their roles in implementing NAP activities (e.g., Society of Private Medical and Dental Association). Limited input from the environment sector in NAP design, resulting in fewer activities for the sector.
Macro	Inadequate funding from the government and stakeholders; most activities are donor-funded despite budget allocations. <i>‘I think one of the biggest challenges was funding. So far, most of the activities that have been implemented are donor-funded. The NAP has a budget for each recommended activity, but as a country, we have not sustainably made the necessary investment towards implementation- KI-1 (Representative from UGMS)</i> NAP activities and targets are not adequately phased for implementation. Complex objectives packed with timelines difficult to follow and monitor. For example, <i>‘To improve the manufacturing, supply, and distribution of antimicrobial agents, including research and development’</i> Complex objectives (e.g., combining R&D and access) need to be unpacked into separate goals in future policies.

Table 5. Contextual Enablers to the NAP Implementation

Contextual Level	Enablers Description
Micro	Dedicated AMR champions and implementing units are driving AMR discourse and advocacy. <i>‘We still have AMR champions passionate and committed to the implementation of AMR activities, and I think this is very important for us as a country,’ KI 2 (Representative from CSO)</i>
Meso	Individual initiatives for research grants, e.g., Structured Operational Research and Training Initiative (SORT IT). Availability of some institutional funding for NAP implementation.
Macro	Institutional support through venues and technical expertise to facilitate NAP implementation. Financial and technical support from Development Partners and the government. Continuous national dialogue and sharing of research findings through the AMR Platform.

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DISCUSSION

We analysed Ghana's NAP (2017 - 2021) implementation based on five strategic objectives and 143 corresponding activities, highlighting end-term achievements, barriers, and enablers. The overall level of completion for all activities, per the stated deliverables and targets, was 66.21%. Strategic objective three, which focused on reducing the incidence of infection, was most implemented, with 77% of activities completed. The increased attention to infection control in the human sector during COVID-19 [21,22] and the institutionalisation of IPC activities in hospitals [21,23,24] contributed to the high level of completion. Strategic objective two, aimed at strengthening knowledge and evidence base through surveillance and research, was the least implemented, with 56.11% of activities completed. Completion of NAP strategic objective two has not improved much after the mid-term assessment [14]. Similarly, an evaluation of Jordan's NAP implementation (2018 - 2022) reported a comparable outcome, with surveillance-related activities achieving a 56% completion rate [25]. Achieving surveillance and research objectives was more challenging in low- and middle-income countries (LMICs) with inadequate qualified human resources and infrastructure [8], and this was also the case in Ghana.

Although the NAP deliverables and targets were mapped to budgets, funding was not always available to implement the stated activities. Inadequate funding is also highlighted in a study assessing NAP implementation in 15 countries. Funding allocation was absent in 14 countries [26]. In Kenya, for instance, the national government's budget for NAP implementation remains unclear, including what has been allocated and disbursed [27]. Inadequate funding for monitoring NAP implementation limits low- and middle-income countries' ability to establish infrastructure, human resources, surveillance systems, legislative frameworks, and public awareness campaigns for combating AMR [8, 13]. Ghana has, over the years, benefited from donor support, especially within the health sector [28] and also other sectors for AMR policy implementation [12]. The NAP was implemented through multisectoral coordination and collaboration, with progress and findings being shared at the AMR platform meetings. Inclusiveness through multisectoral engagement and involvement is an important attribute of policy implementation [29]. A functional governance structure, such as the AMR secretariat, was essential for NAP implementation. This finding aligns with evidence from Tanzania's NAP implementation [30]. Similarly, a study across 20 African countries emphasised the critical role of effective governance structures in supporting NAP implementation [31]. Additionally, certain individuals supported the AMR agenda and sustained its presence on the national agenda [10] by implementing some AMR activities using their institutional resources. Their efforts towards curbing AMR were successful because they were also able to garner financial support through grants. Mainstreaming AMR activities promotes

sustainability as they become embedded in the day-to-day operations of these institutions. Though some stakeholders argued that the NAP activities are packed and not phased out for implementation, there was less attention and fewer activities focused on the environment sector. This is similar to findings from Bangladesh [32], and AMR action plans from five countries (China, Japan, Norway, the UK, and the USA) [33] and Latin America [34].

Our assessment of the NAP (2017 - 2021) suggests four main policy implications and recommendations. One, having the government and other stakeholders commit to AMR by allocating funds, is critical for sustaining NAP implementation. Therefore, the government and other stakeholders must identify adequate funding sources to support the implementation of the next NAP. For the next NAP, we recommend aligning phased implementation with available resources, leveraging public-private partnerships, and exploring domestic funding opportunities. Two, creating broader inclusion of the NAP interventions, such as focusing on increasing affordable access to antimicrobials and diagnostics, is important. Additionally, consumer involvement in the design and implementation of the next NAP can further promote inclusion and ownership. Three, mainstreaming NAP activities into the day-to-day operations of implementing agencies such as the FDA, GHS, EPA, and FAO should be promoted to sustain AMR activities. To promote the mainstreaming of NAP activities, these institutions should allocate and disburse funds for implementation and incorporate these activities into their monitoring and evaluation frameworks. For surveillance activities, priority should be given to developing human capacity, as it underpins effective laboratory operations and data management. Subsequently, strengthen laboratory logistics—equipment, reagents, and quality assurance systems—and enhance data systems to ensure timely reporting and cross-sector integration. Finally, all four sectors (human, food, animal, and environmental) must receive equal attention and support in terms of budgetary allocation and disbursement, as well as stated interventions and activities for the next NAP implementation. The stated intervention and activities should be explicitly directed to institutions and sectors.

Policy development and implementation of AMR is ongoing, and Ghana is currently implementing AMR interventions led by the FAO, WHO, and the World Health Organisation for Animal Health under the Multi-Partner Trust Fund. The 2-year project was officially launched in February 2022 [35]. We propose four main items for consideration in the design of the next NAP: (1) non-completed activities should be prioritised, (2) AMR policy and NAP should also focus on increasing affordable access to safe and quality antimicrobials, diagnostics, and vaccines, (3) AMR stakeholders must rank and prioritise the most critical activities for implementation because the ranking of NAP activities will be useful in the next steps and (4) adequate funding sources must be identified to support the implementation of the next NAP.

We acknowledge four main study limitations. First, the study focused largely on NAP-listed activities, though some AMR activities outside the NAP may be relevant to the overall national efforts towards AMR. Second, recall bias among respondents about the difficulties in tracing activities, their deliverables, and targets. Third, the potential for social desirability bias in self-reported data from implementing agencies and the influence of the AMR Secretariat's facilitative role. Fourth, potential consensus bias during the validation session with AMR Platform members, development partners, the AMR secretariat, and focal persons. Collectively, these biases suggest that the observed completion rate should be interpreted with caution, as it may not fully reflect the true extent of implementation across all stakeholders. To address these concerns, we employed several mitigation strategies beyond triangulation. First, respondents were purposively selected for their direct involvement in implementation activities, ensuring informed, contextually grounded responses. Second, questionnaires were completed collectively by organisational teams rather than individuals, reducing personal bias. Third, the final list of participants was validated by AMR platform members to ensure inclusivity and minimise selection bias. These measures were designed to enhance the credibility and reliability of the findings. Consequently, the findings reflect Ghana's unique policy and health system context and may have limited generalizability to other settings.

Conclusion

Ghana implemented close to two-thirds of its NAP (2017-2021) activities. The main contextual factor challenging implementation was funding sustainability, whilst multisectoral coordination by the AMR coordinating group and a venue for information sharing were enablers. Having the government and stakeholders committed to achieving the goals of AMR containment by allocating funds is important for sustaining the gains made through the NAP. Governmental organisations, AMR focal persons, and champions in various institutions should also continue mainstreaming NAP activities into institutional and national programmes for sustainable impact. The next NAP must continue with unfinished activities and focus on improving access to diagnostics to inform definitive therapy of infections, and on governance measures that enable value-for-money implementation.

DECLARATIONS

Ethical consideration

The research was performed under the ethical standards of the Ghana Health Service Ethics Review Committee. Informed consent, both written and verbal, was obtained from all participants. The ethical approval number is GHS-ERC-012/10/22.

Consent to publish

All authors agreed on the content of the final paper.

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United Nations Development Programme, Ghana

Competing Interest

The authors declare no conflict of interest

Author contribution

AK, BA, SY, BAA, JA, MGL, KOB, and IAK conceptualised the study. AK, JAB, and ENO collected the data. AK, ENO, JAB, SY, BAA, JA, MGL, KOB, and IAK analysed and interpreted the data. AK, JAB, and ENO drafted the manuscript. AK, ENO, JAB, SY, BAA, JA, MGL, KOB, IAK, and BA critically revised the manuscript. All authors read and approved the final version of the manuscript.

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Availability of data

Data is available upon request to the corresponding author

REFERENCES

1. UNDP (2018) Multisectoral responses to antimicrobial resistance. United Nations Development Programme, One United Nations Plaza, New York, NY 10017, USA.
2. World Health Organization (2021) Ghana 2021 TrACSS Country Report on the Implementation of National Action Plan on Antimicrobial Resistance (AMR). Available at: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/tracss/tracss-2021-ghana.pdf?sfvrsn=b08c842f_5&download=true
3. Murray CJL, et al. (2022) Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *Lancet* 399:629–655
4. Charani E, et al. (2023) An analysis of existing national action plans for antimicrobial resistance—gaps and opportunities in strategies optimising antibiotic use in human populations. *Lancet Glob Health* 11:e466–e474
5. Ministry of Health (2017) Policy on Antimicrobial Use and Resistance. Ministry of Health, Accra, Ghana
6. Ministry of Health (2017) Ghana National Action Plan for Antimicrobial Use and Resistance. Ministry of Health, Accra, Ghana
7. World Health Organization (2015) Global action plan on antimicrobial resistance
8. Willemsen A, Reid S, Assefa Y (2022) A review of national action plans on antimicrobial resistance: strengths and weaknesses. *Antimicrob Resist Infect Control* 11:90
9. Adisasmito WB, et al. (2022) One Health: A new definition for a sustainable and healthy future. *PLoS Pathog* 18:e1010537

10. Koduah A, et al. (2021) Antimicrobial resistance national level dialogue and action in Ghana: setting and sustaining the agenda and outcomes. *One Health Outlook* 3:18
11. Donkor ES, et al. (2024) A systematic review on antimicrobial resistance in Ghana from a One Health perspective. *Antibiotics* 13:662
12. Opintan JA (2018) Leveraging donor support to develop a national antimicrobial resistance policy and action plan: Ghana's success story. *Afr J Lab Med* 7:825
13. Jimah T, Ogunseitan O (2020) National Action Plan on Antimicrobial Resistance: stakeholder analysis of implementation in Ghana. *J Glob Health Rep* 4:e2020067
14. Hein W, et al. (2022) Fighting antimicrobial resistance: development and implementation of the Ghanaian national action plan (2017–2021). *Antibiotics* 11:613
15. Yin RK (2009) *Case study research: design and methods*. Sage Publications, Thousand Oaks, CA
16. Mirzoev T, et al. (2017) Contextual influences on the role of evidence in health policy development: what can we learn from six policies in India and Nigeria? *Evidence Policy* 13:59–79
17. Gale NK, et al. (2013) Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol* 13:117
18. Afakye K, et al. (2020) The impacts of animal health service providers on antimicrobial use attitudes and practices: an examination of poultry layer farmers in Ghana and Kenya. *Antibiotics* 9:554
19. World Health Organization (2020) Global antimicrobial resistance surveillance system (GLASS) report: early implementation
20. World Health Organization (2021) Global antimicrobial resistance and use surveillance system (GLASS) report: 2021
21. Ashinyo ME, et al. (2021) Infection prevention and control compliance among exposed healthcare workers in COVID-19 treatment centers in Ghana: a descriptive cross-sectional study. *PLoS One* 16:e0248282
22. Ashinyo ME, et al. (2020) Healthcare workers exposure risk assessment: a survey among frontline workers in designated COVID-19 treatment centers in Ghana. *J Prim Care Community Health* 11:2150132720969483
23. Amponsah OKO, et al. (2022) Antimicrobial stewardship capacity and infection prevention and control assessment of three health facilities in the Ashanti Region of Ghana. *JAC-Antimicrob Resist* 4:dlac034
24. Hayeh PA, Esena RK (2013) Infection prevention and control practices among health workers at Ridge regional hospital in Accra Ghana. *Int J Health Sci Res* 3:47–55
25. Momani S, et al. (2025) Evaluating Jordan's antimicrobial resistance national action plan (2018–2022) implementation: progress and recommendations. *BMC Public Health* 25:2718
26. Harant A (2022) Assessing transparency and accountability of national action plans on antimicrobial resistance in 15 African countries. *Antimicrob Resist Infect Control* 11:1–15
27. World Health Organization (2022) Kenya National Action Plan on Antimicrobial Resistance: Review of Progress in the Human Health Sector. WHO, Geneva
28. Koduah A, Agyepong IA, van Dijk H (2016) 'The one with the purse makes policy': Power, problem definition, framing and maternal health policies and programmes evolution in national level institutionalised policy making processes in Ghana. *Soc Sci Med* 167:79–87
29. Koduah A, et al. (2023) Implementation of Medicines Pricing Policies in Ghana: The interplay of policy content, actors' participation, and context. *Int J Health Policy Manag* 12:1–12
30. Frumence G, et al. (2021) The governance and implementation of the National Action Plan on Antimicrobial Resistance in Tanzania: a qualitative study. *Antibiotics* 10:273
31. Fuller WL, et al. (2022) National action plan on antimicrobial resistance: An evaluation of implementation in the World Health Organization Africa region. *J Public Health Afr* 13
32. Ahmed SM, et al. (2022) The implementation of National Action Plan (NAP) on Antimicrobial Resistance (AMR) in Bangladesh: Challenges and lessons learned from a cross-sectional qualitative study. *Antibiotics* 11:690
33. Ogyu A, et al. (2020) National action to combat AMR: a One-Health approach to assess policy priorities in action plans. *BMJ Glob Health* 5:e002427
34. Avello P, et al. (2024) National action plans on antimicrobial resistance in Latin America: an analysis via a governance framework. *Health Policy Plan* 39:188–197
35. Ministry of Finance (2022) Mid year Fiscal Policy Review: 2022 Budget Statement and Economic Policy. P.R. Office, Accra, Ghana

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Supplementary

Supplementary File 1

Documents reviewed

We reviewed documents (n=20): Tripartite AMR country self-assessment survey (TrACSS) 2020 reports, Global Antimicrobial Resistance and Use Surveillance System (GLASS) report (1-3), Resource mobilisation for antimicrobial resistance: Getting AMR into plans and budgets of government and development partner (2018), Ghana AMR national action plan Mid-Term Review (4), WHO country support to MOH AMR governance mechanism technical report (5), Legislation relevant for antimicrobial use and antimicrobial resistance in Ghana report (6) and minutes of Ghana's AMR Platform meeting (2017-2021). The documents were sourced from the AMR secretariat, the WHO website and country office, and the AMR platform (multisectoral technical working group).

1. World Health Organization. Ghana 2021 TrACSS Country Report on the Implementation of National Action Plan on Antimicrobial Resistance (AMR). https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/tracss/tracss-2021-ghana.pdf?sfvrsn=b08c842f_5&download=true2021.
2. World Health Organization. Global antimicrobial resistance and use surveillance system (GLASS) report: 2021. 2021.
3. World Health Organization. Global antimicrobial resistance surveillance system (GLASS) report: early implementation 2020. 2020.
4. Ministry of Health. Ghana AMR National Action Plan (NAP) Mid-Year Review In: Directorate P, editor. Accra Ghana2020.
5. Ministry of Health. Technical Report -WHO Country Support to MOH AMR governance mechanism In: Directorate P, editor. Accra, Ghana2020.
6. George A. Sarpong. Legislation relevant for antimicrobial use and antimicrobial resistance (AMU/AMR) in Ghana. Accra Ghana: Food and Agriculture Organization of the United Nations; 2018.

Supplementary File 2

Computation of NAP level of completion

To quantify the objectives and sub-objectives, we relied on the benchmarks set for each strategic objective in the NAP. From the NAP, specified targets were set for each objective and these targets formed the basis for the subsequent percentage computation. The inclusion of specific, measurable targets allowed us to assess the level of progress. These benchmarks set the criteria for the level of activity completion.

For quantifiable objectives, we utilised the following formula:

$$POA = (\sum A_i) / B \times 100$$

Where:

POA (Percentage of Achievement) represents the calculated percentage of achievement.

$\sum A_i$ represents the sum of percentages for each activity related to the objective.

B denotes the benchmark set for the objective in the National Action Plan.

For non-quantifiable objectives, where specific benchmarks were not available, we adopted an alternative approach:

$$POA = (C / T) \times 100$$

Where:

POA (Percentage of Achievement) represents the calculated percentage of achievement.

C represents the number of completed activities.

T stands for the total number of activities related to the non-quantifiable objective.

This formula allowed us to estimate progress for objectives that lacked specific, measurable targets. To provide a comprehensive overview of the status of the NAP, we computed averages of the percentages associated with activities that were completed, in progress, and yet to be completed within each strategic objective. These averages offered a consolidated view of progress across different stages of the NAP implementation.

Supplementary file 3

Supplementary Table 1. Percentage of completion for strategic objective 1 interventions and activities based on deliverables and targets.

Strategic Objective 1 Interventions	Activities	% of completion
Collaboration with all stakeholders to promote the responsible use of AM agents.	Engage CSOs and the media (as AMR media partners) to educate the public on responsible use of antimicrobials in the spirit of 'One Health'	95%
	Develop Information, Education, and Communication (IE & C) materials for targeted groups in a stratified public education campaign	90%
	Educate the public to promote the responsible use of antimicrobials among the general population.	100%
	Review the public education campaign for optimized impact	30%
	Engage professional associations to educate professionals to promote the responsible use of antimicrobials at all levels of practice in all affected sectors (human, animal, plant, environment, etc.)	50%
There shall be continuous education to promote the responsible use of antimicrobials in animal husbandry, aquaculture, and crop production with emphasis on the dangers of antimicrobial misuse		
The Ministry of Health (MOH) and its agencies, in collaboration with educational institutions, shall incorporate information on antimicrobials into their curricula	Develop the content framework on the responsible use of antimicrobials for consideration in the curriculum of training institutions. (This is to serve as the basis for the content on the syllabus)	100%
	Develop the content framework on responsible use of antimicrobials in non-human settings, for consideration in the curriculum of training institutions. (This is to serve as the basis for the content on the syllabus)	0%
	Incorporate content on responsible use of antimicrobials into the curriculum of training institutions for professionals in all affected sectors (human, animal, plant, environment, etc.)	80%
The Ministries of Food and Agriculture, Fisheries, and Aquaculture Development shall collaborate with the relevant educational institutions to develop and include in their curricula the concept of AMU and AMR		

Supplementary Table 2. Percentage of completion for strategic objective 2 interventions and activities based on deliverables and targets.

Strategic Objective 2 Interventions	Activities	% of completion
Monitoring systems for AM use and surveillance to inform	Establish a structure for the national surveillance system for human health – which includes the national reference laboratory (would also cover Healthcare Associated Infection [HCAI])	80%
	Establish a structure for the national surveillance systems for non-human health which includes animal, plant, and environment (would also cover a national reference laboratory)	50%
	Develop national guidelines for the surveillance systems – including guidelines for passive and active surveillance	100%
	Develop unified protocols and SOPs including standardized diagnostics and methodology for sensitivity testing	28.60%
	Train sentinel sites on the use of guidelines, protocols, and SOPs	40%
	Rollout implementation: starting with laboratories that would meet requirements in human and animal sectors	40%
	National laboratories' policies for food, agriculture, fisheries, and environment	Assess the current capacity of laboratories for conducting culture and sensitivity testing
Develop unified protocols and SOPs		50%
Train core clinical care and laboratory staff on standardized protocols, SOPs, systems, etc.		75%
There shall be a data management system to yield quality surveillance data that can be shared regionally and globally to drive future actions in managing AMR	Undertake wide stakeholder consultation on end-user needs, requirements, feasibilities, constraints, SOPs, use or adapt international available data management systems, etc.	66.60%
	Define system specification, scope, and feature-set and definition of future development and management.	66.60%
	Develop a national surveillance database, management tools, analytical tools, applications/software	50%
There shall be established national monitoring systems for antimicrobial use and surveillance of antimicrobial resistance to inform policy	Establish a system for the national surveillance of antimicrobial use in human health	100%
	Establish a system for the national surveillance of antimicrobial use in non-human health	100%
	Establish and resource a desk at the Ministry of Health for the collation of antimicrobial resistance and consumption data.	0%
There shall be a data management system to yield quality surveillance data that can be shared regionally and globally to drive future actions in managing AMR.	Undertake wide stakeholder consultation on end-user needs requirements, feasibilities constraints, etc. for the development of a data management system for antimicrobial consumption in human and animal health	100%
	Define system specification, scope, and feature-set and definition of future development and management	0%
	Develop a national surveillance database, management tools, analytical tools, and applications/software for antimicrobial consumption in human and animal health. Deliverables would include communication and reporting modules, access, and security modules, etc.	80%
	Establish a structure for the national surveillance system for human health – including a national reference laboratory (this would also cover healthcare-associated infection [HCAI] and the organisms that cause HCAs)	70%
Government and other stakeholders shall provide resources to improve the quality of laboratory diagnostic services to inform the selection and prescribing of antimicrobials	Establish a structure for the national surveillance systems for non-human health – including a national reference laboratory	70%
	Quantification and costing of laboratory commodities and tests	100%
	Encourage local production of antimicrobial susceptibility testing disk. (Develop a sustainable business case for the local production of susceptibility disks, engage the business community, and engage Ministry of Trade and Industry for incentives and enabling environment)	0%
	Implement the national laboratory policy implementation plans for human health	25%
	Upgrade district laboratories with the capacity to perform culture and sensitivity testing based on comprehensive needs assessment	50%
The National laboratory policy shall be implemented in all healthcare facilities. District hospital laboratories shall be strengthened to provide culture and sensitivity testing services	Train laboratory personnel as part of the laboratory upgrade programme	90%

Supplementary Table 2. Cont

Strategic Objective 2 Interventions	Activities	% of completion
Government through the Ministries of Food and Agriculture and Fisheries and Aquaculture Development shall develop National laboratory policies for the food, agriculture, fisheries, and environment sectors. All the laboratories in these sectors shall be strengthened to enable them to work on AMU and AMR	Develop national laboratory policy and implementation plans for the food, agriculture, fisheries, and environment sectors	90%
	Engage relevant stakeholders toward the development of national laboratory policies for these sectors	90%
	Implement national laboratory policy for the food, agriculture, fisheries, and environment sectors	50%
National monitoring system for AMR use and surveillance	Organise annual dissemination workshops for data on AMR surveillance and consumption	20%
	Follow through evidence-based advocacy activities	17%
	Organise a forum on evidence-based policy implementation based on data on the AMR surveillance and its implications for the AMR policy implementation process	100%
The government and other stakeholders shall provide resources to improve the quality of laboratory diagnostic services to inform the selection and prescribing of antimicrobials	Collate incidence data on infectious diseases of common occurrence in Ghana to inform the review of clinical	50%
	Update Standard Treatment Guidelines and Essential Medicines List based on emergent surveillance data on AMR and AMC, generated from Ghana in the light of the best evidence and the rigor of the national medicines selection process.	50%
	Develop and launch diagnostic, prescribing, and treatment aids based on the national medicines selection process, STGs, and evidence from surveillance	50%
	Train on the use of updated Standard Treatment Guidelines with a focus on infectious disease management, based on surveillance data and monitor for adherence	50%

Supplementary Table 3. Percentage of completion for strategic objective 3 interventions and activities based on deliverables and targets.

Strategic Objective 3 Interventions	Activities	% of completion
Ministry of Health Infection Prevention and Control policies to be implemented in all healthcare facilities	Implement MOH IPC policies in all health facilities	100%
	Conduct a baseline study on Healthcare-Associated Infections	90%
	Advocate and create awareness on Healthcare-Associated Infections [to be added training activities of human and animal health professionals]	60%
	Assessment of implementation of the IPC policy (including the development of tools for assessment)	100%
	Advocate for and facilitate the provision of potable water in 50% of health facilities.	100%
	Advocate for inclusion of infection prevention and control practices into the curriculum of health training institutions	100%
	Provide adequate toilet and hand washing facilities in hospitals and communities.	100%
	Provide PPEs in health facilities	100%
	Conduct supportive supervision for IPC	100%
	Enforce the use of items for IPC– coloured bin liners, sharp boxes, disposable paper napkins	80%
	Develop guidelines for the management of referred patients with infectious conditions from one point to the other [surveillance should be part of management]	80%
	Implement International Health Regulation guidelines for containment of outbreaks of bacterial infection of public health interest in health facilities	80%
	Train and sensitise health workers and the general public on the containment of outbreaks	100%
The Ministries of Food and Agriculture, Fisheries and Aquaculture Development shall develop for agencies in these sectors guidelines and SOPs on Infection Prevention and Control, and ensure their implementation at all levels	Develop IPC policies for non-human sectors	50%
	Implement IPC policies in non-human sectors	50%
	Assess the implementation of the IPC policy (non-human sectors)	50%
	Develop SOPs for ensuring proper infection prevention and control on farms etc.	100%
Develop and train farmers on guidelines for containment of outbreaks of infections on farms etc		100%
Implement the waste management policy of the Ministry of Health in all healthcare settings	Phase, prioritize, cost, and implement the waste management policy in health facilities	0%
	Assess the implementation of the waste management policy	0%
	Educate the public on hand hygiene, environmental cleaning, and waste management	60%
Guidelines and SOPs on Waste management shall be developed for each of the agencies of the food, agriculture, and fisheries sectors; the necessary measures shall be put in place for their implementation	Develop guidelines and SOPs on waste management in other sectors	100%
	Train affected implementing entities on new guidelines for waste management	60%
	Provide resources for the implementation of SOPs and guidelines	60%
Vaccination in animal husbandry	Conduct regular sensitization campaigns on the vaccination of animals	60%
Promotion of resilience of plants through soil fertility	Train farmers on soil fertility management and other measures to promote the resilience of plants	100%
Promotion of vector control	Train farmers on vector control on farms	100%

Supplementary Table 4. Percentage of completion for strategic objective 4 interventions and activities based on deliverables and targets.

Strategic Objective 4 Interventions	Activities	% of completion
AMR Stewardship promotion	Train and re-train core clinical care providers on the responsible use of antimicrobials in all sectors	100%
	Develop indicators for monitoring antimicrobial use and resistance across all affected sectors	60%
	Monitor antimicrobial use in all health facilities for human health	100%
	Advocate for regular post-market surveillance of antimicrobials in circulation	70%
	Enforce the use of the Dangerous drug book/appropriate software and record keeping at both wholesale and retail outlets of antibiotics	40%
	Advocate for and support periodic testing of herbal preparations with the claim of anti-infective properties for the presence of orthodox antibiotic substances. Use of such data to engage producers of herbal preparations.	60%
	Disseminate standards and practice guidelines for pharmaceutical care (SPGPC) for human health	50%
	Train core clinical care providers on the SPGPC	50%
	Educate herbal practitioners on the responsible use of medicines including antimicrobials	80%
	Promote responsible use of herbal products with antimicrobial properties	80%
	Advocate for increased coverage of national health insurance in line with WHO reserved watch list	0%
	Develop and disseminate standards for care for veterinary practice	100%
	Develop criteria and guidelines for the use of national surveillance data for the selection of antimicrobials	50%
	Update the national medicines selection process to include data from national surveillance of antimicrobial use and resistance. Utilize antimicrobial consumption and resistance data for selection at the national level	100%
Prescribing and dispensing of AM to be informed by laboratory results	Adapt the WHO classification list of Antimicrobials for Ghana and ensure optimized prescribing and dispensing based on Laboratory results	50%
	Develop an institutional formulary list for prescribing and dispensing of antimicrobials in health facilities	100%
	Procure and supply relevant 'rapid' diagnostic kits to aid diagnosis at lower levels under a 2-year pilot management framework, and review for health system integration after 2 years	0%
Restriction of advertisement of AM	Advocate for enforcement of the law on the advertisement of restricted drugs	100%
	Collaborate with law enforcement agencies and lorry station owners, drivers' unions, chiefs, and market queens to enforce the ban on the sale of drugs in unauthorized places	80%
Sale and promotion of AM following the Public Health Act 2012 (Act 851)	Public education and sensitization on the dangers of sourcing antimicrobials from unauthorized sources	70%
Functional Drugs and Therapeutic Committees (DTC) for AM stewardship	Develop antimicrobial stewardship training manual for health facilities	70%
	Train DTC members on the antimicrobial stewardship concept	80%

Supplementary Table 4. Cont

Strategic Objective 4 Interventions	Activities	% of completion
<p>The Ministries of Food and Agriculture, Fisheries and Aquaculture Development, and related agencies shall promote the responsible use of antimicrobials at all veterinary fisheries and agricultural practice settings. There shall be instituted, monitoring mechanisms for the use of antimicrobials in veterinary, fisheries, and agricultural practice settings. The roles of veterinary services and PPRSD in animal and plant health respectively, and in antimicrobial use shall be promoted to assure public safety. The standard treatment guidelines and SOPs for animal and plant health shall be developed, disseminated, and implemented. There shall be standards set for antimicrobial residue in veterinary, plant production, and aquaculture. The quality of veterinary and plant pathology laboratory services shall be strengthened to inform the selection and prescribing of antimicrobials. Guidelines and standards for biomedical wastes and effluents from health facilities, animal production, and aquaculture units will be developed and enforced. EPA and FDA shall establish mechanisms for retrieval and disposal of unwholesome and unused antimicrobials from the general public and institutions</p>	Monitor/provide supportive visits to the DTCs in the facilities on antimicrobial stewardship	50%
	Conduct annual DTC peer review on antimicrobial stewardship	50%
	Hold inter-sectoral meetings on responsible antibiotic use in non-health setting	100%
	Develop training scheme and train veterinary personnel on the responsible use of antibiotics in veterinary and aquaculture	85%
	Develop monitoring tools for antibiotic use in veterinary and	80%
	Monitor the use of antibiotics in veterinary and aquaculture.	50%
	Quarterly monitoring reports are to be shared with appropriate offices and with the AMR stakeholder platform	
	Develop a communication kit and educate the public on the existence and role of veterinary services via campaigns on radio, TV, print media, web, and social media	50%
	Implement and monitor adherence to standards, treatment guidelines, benchmarks, SOPs, protocols, lists of medicines, etc. for antimicrobial use in veterinary and aquaculture	30%
	Set up a technical working group to define standards, treatment guidelines, benchmarks, SOPs, protocols, lists of medicines, etc. for antimicrobial use in veterinary and aquaculture.	0%
	Upgrade veterinary laboratories with the capacity to perform culture and sensitivity testing based on comprehensive needs assessment	80%
	Setup a technical committee with clear TORs to develop guidelines for biomedical waste and effluents for all sectors	100%
	Explore and institute possibilities of incentives to encourage the return of unused and unwholesome antimicrobial agents	50%
Educate the public on the need to return unused and unwholesome antimicrobial agents	50%	
Identify and set up collection points for receiving unused and unwholesome antimicrobial agents	80%	

Supplementary Table 5. Percentage of completion for strategic objective 5 interventions and activities based on deliverables and targets.

Strategic Objective 5 Interventions	Activities	% of completion
All stakeholders conduct research into AM use and resistance	Research Agenda	100%
	Research into costs of hospital-acquired infections.	100%
	Research to identify antimicrobial resistance in specific zoonotic diseases	100%
	Research in new point-of-care diagnostic tools and methods	100%
	AMR Prevalence Studies	100%
Basic and operational research in antimicrobial use and resistance and development of new antimicrobial agents, vaccines and diagnostics shall be encouraged	Research- Economics	0%
	Operational Research Training	100%
	Operational Research Kit	80%
A platform to share research findings	Web-based repository	20%
	National AMR Conference	0%
Sourcing, distribution, and supply of AM following regulatory instruments	Advocate for stringent enforcement of regulation on antimicrobials	40%
All manufacturing companies shall have technical requirements	Enforce minimum standards for the manufacture of antimicrobial agents of acceptable quality amongst local manufacturers in Ghana, based on current international standards and GMP	80%
	Implement Good Manufacturing Practice roadmap for local manufacture of antimicrobials in country	50%
The Ministry of Health shall facilitate the establishment of a national bioequivalence Centre to support the manufacture of quality generic antimicrobials	Advocate and implement a national bioequivalence centre strategy in a PPP mode	15%
	The FDA shall support local industries manufacturing antimicrobials to meet quality specifications in accordance with Public Health Act 2012 (Act 851, 2012).	Advocate for the active implementation of the FDA roadmap for local manufacturers in support of the local manufacture of antimicrobials of acceptable quality
The government through the Ministry of Health, Food, and Agriculture, Ministry of Environment Science and Technology shall strengthen collaboration between academia and industry for the development of new antimicrobial agents	Develop a policy framework governing the research between stakeholders including academia and industry.	20%
	The government shall provide incentives and financial support for local industries to produce affordable but quality antimicrobials including industries with the capacity to develop APIs for the pharmaceutical sector Innovation for new antimicrobial agents shall be encouraged including those from herbal sources	Create an incentive package to encourage the local manufacture of antimicrobials of acceptable quality
Set up a fund to support local manufacture of antimicrobials (based on transparent criteria informed by a demonstrable commitment to quality)		50%
Scan the research repositories of existing research institutions for existing research on medicinal agents of potential antimicrobial value		60%
Assess the economic viability of investment in such medicinal agents		0%
Develop a clear action plan and investment model for long-term drug development of potential agents		0%
Explore the development of potential antimicrobial medicinal agents in-country (in collaboration with academia, research institutions, and centres)		20%
Support specific research into local medicinal plants with antimicrobial activity as well as the development of such agents		80%
Collaborate with implementers of key Acts of government to regulate the supply, storage, and distribution of antimicrobials in formal and informal markets		80%
Supply of antimicrobial agents shall be strictly according to laid down regulations (Public Health Act, Health Professions Regulatory Bodies Act, HeFRA), etc.		
The FDA, EPA and other relevant institutions shall enhance post-market surveillance and pharmacovigilance on antimicrobial agents	Conduct post-market surveillance (PMS) of antimicrobial agents	100%
	Engage the private, public, and mission sectors on stricter management model for the results of post-market surveillance	100%

Supplementary Table 5. Cont

Strategic Objective 5 Interventions	Activities	% of completion
<p>There shall be established Ministerial Commission comprising the Ministries of Health, Food and Agriculture, Fisheries and Aquaculture Development, Interior, Defense, Local Government and Rural Development, Environment, Science, Technology and Innovation and others to lead efforts to contain the AMR threat.</p> <p>The Ministerial Commission will be advised on technical issues by a team of experts drawn from relevant fields of expertise</p> <p>Implementation of the Policy will take place at the district level by District Committees on AMR. The District AMR Committees shall be supervised by Regional Committees on AMR.</p> <p>The Ministry of Health shall coordinate a functional multi-stakeholder platform to drive antimicrobial resistance issues in the country</p> <p>MOH promotes collaboration via the AMR secretariat</p> <p>Monitoring and evaluation framework for the AMR policy</p>	Collaborate with FDA to collate pharmacovigilance data on antimicrobial treatments	80%
	Institute special courts for regulatory offences	0%
	Set-up of an inter-ministerial commission on AMR from relevant ministries	100%
	Convene meetings of the inter-ministerial commission bi-annually	50%
	Develop policy briefs and technical briefs for the ministerial commission on key AMR issues as needed	80%
	Engage district and regional structures on the implementation of AMR policy covering intent, roles and responsibilities, interactions, etc.	0%
	Setup/identify and strengthen a secretariat within the Ministry of Health to coordinate AMR issues in the country	100%
	Engage national coordinators with clear TORs for the implementation of the NAP on AMR for the various sectors in Ghana	80%
	Convene quarterly AMR platform meetings	100%
	Develop a monitoring and evaluation framework as part of the NAP development process	100%
Conduct a data mapping exercise to support the monitoring and evaluation framework and identify cost-effective (efficient) means to monitor and evaluate 50 implementations of the NAP	20%	
Monitor implementation of the AMR NAP in Ghana half-yearly	50%	
Conduct annual multi-stakeholder project implementation review meetings for the AMR policy and NAP	100%	

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