


REVIEW

Open Access



# A bottom-up, One Health approach to assessing progress in the implementation of a national action plan for combatting antimicrobial resistance: a case study from Uganda

J.P. Waswa<sup>1\*</sup> , Reuben Kiggundu<sup>1</sup>, Hassan Kasujja<sup>1</sup>, Patrick Vudriko<sup>2</sup>, Hakim Sendagire<sup>3</sup>, Henry Kajumbula<sup>3</sup>, Musa Sekamatte<sup>4</sup>, Francis Kakooza<sup>5,6</sup>, Fozo Alombah<sup>7</sup>, Mohan P. Joshi<sup>7</sup>  and Niranjana Konduri<sup>7</sup> 

## Abstract

Antimicrobial resistance (AMR) is one of the greatest threats to public health, and it is spreading across the human health, animal health, and environmental sectors. Sole reliance on desk reviews and national-level stakeholder engagement carries a risk of overestimating the country's health security and AMR capacity. For a genuine evaluation, engaging frontline and last-mile implementers such as health care facilities and workers, farmers, and district local governments ensures a more accurate assessment of existing capabilities and implementation progress. Uganda utilized a bottom-up approach to assess the implementation status of the National Action Plan on AMR (NAP-AMR) to ensure the engagement of key stakeholders at the subnational level, who are often overlooked in NAP-AMR evaluation initiatives. This review revealed poor engagement of subnational stakeholders in the development, validation, dissemination, and implementation of the NAP-AMR as well as various issues at the national level—including gaps in government One Health policy, insufficient funding, and ineffective coordination—that resulted in the inadequate implementation of the NAP-AMR. Addressing these challenges should involve establishing a One Health policy and identifying sustainable funding sources for AMR activities. We recommend the legislation of dedicated policy to formally incorporate the National One Health Platform into government structures at the national and subnational levels. In our experience, a bottom-up approach to evaluating NAP-AMR implementation enhances the effectiveness of the review process and could be utilized by the WHO during the joint external evaluation of health security capacity.

**Keywords** Antimicrobial resistance, National Action Plan, Global Action Plan, One Health, Uganda, Africa

\*Correspondence:

J.P. Waswa

jpwaswa@msh.org

Full list of author information is available at the end of the article



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## Introduction

Antimicrobial resistance (AMR) is predicted to overtake other major causes of morbidity and mortality worldwide, including cancer and diabetes, by 2050 [1]. In 2015, the UN tripartite organizations—the Food and Agriculture Organization (FAO), World Organization for Animal Health (WOAH), and World Health Organization (WHO)—released the Global Action Plan (GAP) on AMR [2], which was later endorsed by the seventy-first session of the United Nations General Assembly as the blueprint for the global AMR response [3]. The GAP outlines the role of tripartite organizations and country governments in AMR containment and urges countries to develop multisectoral national action plans for AMR (NAPs-AMR) that are cognizant of local contexts.

Evaluation has been described as the “systematic assessment of an activity, project, strategy, policy, theme, sector or institutional performance” [4]. On the other hand, monitoring has been described as “a continuing function that uses systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing intervention with indications of the extent of achievement of objectives and progress in the use of allocated funds” [5]. As of November 2023, up to 178 United Nations member countries had developed their NAPs-AMR aligned with the GAP [6]. Over the years since the launch of the GAP, countries including Uganda have been monitoring NAP-AMR implementation through participation in the annual Tracking AMR Country Self-Assessment Survey (TrACSS), with 177 countries submitting data in the 2023 TrACSS [7]. TrACSS aims to provide a framework for countries lacking robust national monitoring and evaluation (M&E) systems for NAPs-AMR. After several years of implementation, some countries have now started undertaking country-led assessments to evaluate their NAPs-AMR, review progress, and identify barriers and opportunities. A popular approach for NAP-AMR evaluation mainly involves national-level stakeholders providing status updates on the implementation of the NAP-AMR with minimal involvement of subnational stakeholders such as frontline practitioners, regional and district officials, and communities. A similar approach has been used for the WHO joint external evaluation (JEE) for countries’ health security capacity [8]. The reliance on centrally based assessment approaches overlooks the valuable insights available at subnational levels, resulting in a significant knowledge gap in NAP-AMR and One Health evaluations.

The inaccurate estimation of capacity for health security and AMR containment remains unexplored, however, lessons can be learned from recent global pandemic preparedness efforts. The COVID-19 pandemic showed

that existing pandemic preparedness capacity assessment methods overestimated the capacity of most countries [9–12], which could partly have been the result of overreliance on desk reviews and national-level stakeholder engagements without the participation of subnational stakeholders. For a genuine evaluation of countries’ health security capacity through the implementation of NAPs-AMR, engaging frontline and last-mile implementers to ensure a more accurate assessment of existing capabilities and implementation progress is crucial. Although this method represents a paradigm shift from the prevailing approach, it provides strong opportunities for more in-depth feedback about existing capacities and gaps to inform better planning and future NAP-AMR development. This paper describes Uganda’s NAP-AMR review methodology—which involves wider stakeholder engagement, including subnational- and community-level evaluations—and presents select findings of this process.

## Results

### Subnational level

#### *Adoption of the NAP-AMR in strategic and operational plans*

Table 1 summarizes key findings from the subnational-level assessment.

*Human health sector* Participants from seven regional referral hospitals (RRHs) and seven district health offices/teams with representation from lower-level health facilities were included in the human health sector assessment. All participants had knowledge of the NAP-AMR, and at least one participated in at least one dissemination event for the NAP-AMR. In all seven RRHs assessed, the NAP-AMR was adequately disseminated. All the RRHs were in possession of copies of the NAP-AMR and were implementing several of its objectives. However, the adoption of NAP-AMR activities directly into individual hospital workplans was not obvious. Health facility medicines and therapeutics committees, antimicrobial stewardship (AMS) subcommittees, and infection prevention and control (IPC) committees were appointed and significantly functional. All the RRHs were established to have implemented NAP-AMR activities, with support from donor and implementing partners. However, lower-level health facilities and district health offices had not adequately adopted the NAP-AMR, and the few lower-level health facilities and districts that had implemented NAP-AMR activities were supported by donor- and implementing partners.

*Veterinary sector* Five of the seven district veterinary offices visited neither had a copy of the NAP-AMR nor had adopted its objectives. The remaining two districts had adopted some of the NAP-AMR objectives, although

**Table 1** Summary of key findings of subnational assessment

Indicator	Findings
Knowledge of national action plan for antimicrobial resistance (NAP-AMR)	<ul style="list-style-type: none"> <li>• <i>Inadequate grassroots knowledge</i>: health care workers (HCWs) from large healthcare facilities (HCFs) and district health teams (DHTs), and other sector stakeholders in decision-making and oversight positions had knowledge of the NAP-AMR; HCWs from Lower-level health facilities and grassroots stakeholders from other sectors such as farmers had no knowledge of the NAP-AMR</li> </ul>
Participation in NAP-AMR development	<ul style="list-style-type: none"> <li>• <i>Inadequate subnational involvement</i>: subnational stakeholders were not involved in the development and validation of the NAP-AMR; only sector decision-makers and overseers were involved in the dissemination of the NAP-AMR</li> </ul>
Access to a copy of the NAP-AMR	<ul style="list-style-type: none"> <li>• <i>Suboptimal access to the NAP-AMR</i>: all but one HCF had a copy of the NAP-AMR; only one district health office had accessed a copy of the NAP-AMR; Only ten participants had accessed a digital copy of the NAP-AMR</li> </ul>
Participation in joint One Health activities	<ul style="list-style-type: none"> <li>• <i>Suboptimal participation in One Health</i>: only four participants had been involved in regional/district joint One Health activities</li> </ul>
NAP-AMR objectives included in work plans	<ul style="list-style-type: none"> <li>• <i>Suboptimal integration of NAP-AMR objectives</i>: all the seven participating regional referral hospitals had functional committees for IPC and AMS implementation; lower-level health facilities had not incorporated NAP-AMR activities in their workplans; One Health bodies established in two districts with donor-supported activities and meetings</li> </ul>
Funding source for AMR activities Achievements	<ul style="list-style-type: none"> <li>• <i>Lack of sustainable funding</i>: All NAP-AMR activities were supported by donor and implementing partners</li> <li>• <i>Suboptimal gains made</i>: NAP-AMR activities included training sessions (such as continuous medical education), and AMR and disease surveillance actions; regular One Health-AMR quarterly meetings in one of the two districts with established One Health bodies</li> </ul>
Barriers and challenges	<ul style="list-style-type: none"> <li>• Lack of funding for NAP-AMR activities</li> <li>• Lack of follow-up activities beyond the launch and early dissemination initiatives</li> <li>• One Health meetings have remained at the district center and have not been disseminated to the lower levels</li> <li>• Lack of access to copies of the NAP-AMR</li> <li>• Lack of involvement of subnational stakeholders in the development and validation of the NAP-AMR</li> </ul>
Recommendations	<ul style="list-style-type: none"> <li>• Integration of One Health/AMR activities into district/regional systems</li> <li>• Decentralization of One Health/AMR bodies</li> <li>• Integration of the national One Health platform into a 'neutral' structure such as Office of the Prime Minister</li> <li>• Develop policies that would facilitate access to secure funding for One Health activities</li> </ul>

they were not necessarily reflected in their work plans. All NAP-AMR activities in these districts were supported by implementing partners. Some of the key achievements from NAP-AMR implementation included improving laboratory space for AMR, participation in AMR activities at the national level, uptake of the transportation system (hub) for laboratory samples, designation of the districts as sentinel sites for AMR surveillance in the animal sector, and participation in One Health and AMR awareness campaigns. Limited funding led to the failure to cascade NAP-AMR activities to levels overseen by the district veterinary office. The five districts that did not adopt the NAP-AMR cited an absence of knowledge about the action plan due to a lack of participation in the development, validation, and dissemination of the NAP-AMR document.

*Crops, fisheries, environment and water sectors* Information was captured from sector heads for crops, fisheries, water, and environment for seven regional districts. In all the sectors, the NAP-AMR was poorly adopted for implementation, with the heads citing a lack of early access to the NAP-AMR, unawareness of the strategic objectives of the NAP-AMR, and weak alignment of the

priority activities of the NAP-AMR with the mandates of the sectors stemming from a lack of involvement in the drafting and validation of the NAP-AMR.

#### **Level of implementation of NAP strategic objectives**

Table 2 shows the level of implementation of NAP-AMR objectives at the subnational level (See Table 5 for the interpretation of the color codes). All five strategic objectives of the NAP-AMR were inadequately implemented across the assessed sectors at the subnational level. There were no research and innovation activities implemented at the subnational level. However, some activities to promote public awareness about AMR in the human health and veterinary sectors were implemented without systematic planning and sustainable funding. Additionally, some health facilities included in the assessment, especially RRHs, were implementing some IPC, AMS, and AMR surveillance activities, although there was no secure funding for long-term implementation. The seven IPC committees of the RRHs included in the study had work plans incorporating some NAP-AMR-recommended actions for improving IPC, mainly supported by donor- and

**Table 2** Level of implementation of NAP-AMR objectives at the subnational level

Sector/subsectors	Promote public awareness, training, and education	Improve Infection prevention and control	Promote optimal access to and use of antimicrobials	AMR surveillance	Research and innovation
Human health	●	●	●	●	●
Veterinary	●	●	●	●	●
Fish health	●	●	●	●	●
Crop health	●	●	●	●	●
Water and environment	●	●	●	●	●

implementing partners. However, district health offices, lower-level health facilities, and other sectors did not plan or implement IPC activities. Some activities for promoting optimal access and use of antimicrobial medicines were implemented in RRHs and by district veterinary offices, including training and inspection, respectively, despite a lack of dedicated operational and strategic plans and secure funding. Similarly, a few AMR surveillance activities were implemented without secure funding and dedicated local plans by RRHs and district veterinary offices. The performances of the other sectors are shown in Table 2.

**National level**

**Policy design**

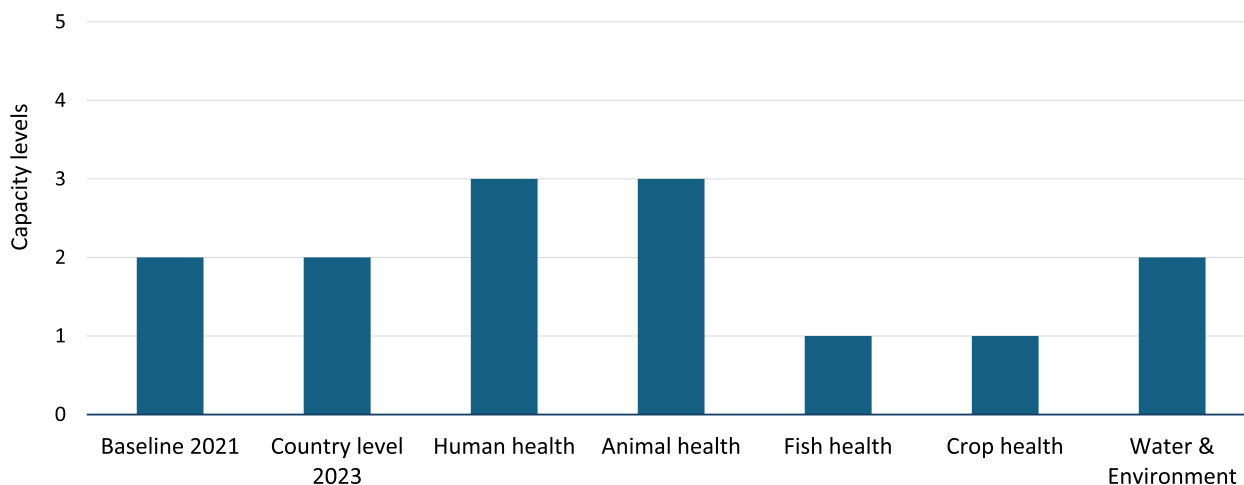
The NAP-AMR was well aligned with the GAP and the WHO’s other guiding documents on the NAPs-AMR [13], with the strategic objectives and actions focused on raising awareness and understanding of the AMR problem and containment options; improving prevention, detection, and control of infectious agents; optimizing the use of antimicrobial medicines; generating knowledge and evidence through surveillance; and research and innovation, including with respect to alternative treatments and approaches to infection management. The NAP-AMR clearly defined the governance structures and mechanisms, information flow, and decision-making. However, clear reporting mechanisms for NAP implementation were lacking, as evidenced by a lack of regular reports and dedicated and designated focal points for data and reporting. Additionally, despite the establishment of governance mechanisms, the absence of a formal government policy or instrument to institutionalize the governance structure weakened its authority, support, funding, and recognition within government ministries, departments, and agencies. The NAP-AMR defines National

Antimicrobial Resistance Sub-Committee (NAMRSC) membership and the participation of various stakeholders in NAMRSC activities. However, there is little guidance for establishing and operationalizing technical working committees (TWCs), resulting in poor representation and participation of some sectors. Finally, the NAP-AMR was silent on mechanisms for securing funding and other resources for long-term and sustained implementation.

**Multisectoral coordination (One Health management)**

Findings on multisectoral coordination (MSC) for AMR were analyzed, and the capacity level was estimated based on the 2019 WHO benchmarks for the International Health Regulations (IHR) capacities tool. The benchmark tool provides a set of actions required for completion to attain one of five capacity levels—level 01 (no capacity): no risk assessment, dedicated plans, and assigned resources (human or financial); level 02 (limited capacity): core capacities at level 2 are in the development stage, with implementation started; level 03 (developed capacity): core capacities at level 3 are in place but are not sustainable; level 04 (demonstrated capacity): core capacities at level 4 are in place at the national and subnational level and are somewhat sustainable through being supported by funding and inclusion in national plans; and level 05 (sustainable capacity): core capacities at level 5 are fully functional and sustainable [14].

Figure 1 shows the capacity levels of the country and sector MSC mechanisms compared with the 2021 baseline. Similar to the findings from the 2021 self-assessment [15], country-level MSC capacity was estimated at level 2 (limited capacity), with significant progress being made toward achieving level 3 (developed capacity). MSC bodies were established with defined terms of reference (TORs), memberships, and focal points, and the country was implementing and monitoring



**Fig. 1** Capacity levels of country and sector MSC mechanisms

the NAP-AMR through meetings. However, the meetings were not regular, and there was inadequate data and information sharing, including M&E indicator progress. Furthermore, there was inadequate coordination between the National One Health Platform (NOHP) and the NAMRSC and its TWCs, as evidenced by a lack of structured meeting schedules, reporting, information flow, and feedback. The data revealed gaps in existing policy to support MSC and One Health management, resulting in a lack of access to government funding and other resources for the NOHP; informal human resources with no clear job descriptions, compensation, or accountability; a lack of institutional targets for the NOHP and NAMRSC; and low adherence to standard operating procedures and guidelines for AMR coordination mechanisms. The ultimate effect of these gaps is the questionable sustainability of NOHP operations beyond donor funding. Due to inadequate policy support for the NOHP, repercussions for the unmet objectives of the NAP-AMR were nonexistent. The participation of individual institutions and stakeholders was not monitored, and the extent of their involvement thus could not be established. Furthermore, MSC structures for NAP-AMR implementation were mainly based at the national level, with a negligible presence at the subnational level.

The human health sector had a designated focal point for AMR activities within the Ministry of Health (MOH). However, the focal point was not institutionalized within MOH structures, and there was inadequate coordination between departments and agencies of the ministry. Similarly, there was a focal point for AMR activities and MSC participation in the veterinary sector. However, no formal appointments have been made, making participation voluntary and erratic. The water and environment

sector participates in some NAMRSC and NOHP activities through focal points have not been formally designated and appointed. Only the public awareness, training, and education (PATE) and AMR surveillance TWCs had representation from all sectors. There was no representation of the fish and crop sectors in the NOHP and NAMRSC.

#### **Implementation of NAP-AMR objectives and tools**

Findings from national-level data collection activities were analyzed, and the level of implementation of the NAP-AMR objectives was estimated. Table 3 shows the consolidated country level for NAP-AMR implementation across sectors (See Table 5 for the interpretation of the color codes). Overall, there was inadequate implementation of NAP-AMR objectives (implementation level 2 across all objectives) despite some improvement from the baseline. The greatest gains in technical capacity were made in the health sector across all five objectives. In the animal sector, substantive gains were only made on the objectives related to PATE and to AMS, with minimal gains made on IPC, AMR surveillance, and research and innovation. In the water and environment sector, some gains were made in AMR surveillance, while no significant gains were made in PATE, IPC, AMS, and research and innovations objectives over the baseline. The fish health sector made some gains in the AMS and IPC, but none for the rest of the strategic objectives, whereas the crop health sector did not register any gains.

#### **Monitoring and evaluation**

The NAP-AMR included an M&E framework based on the operational plan that outlined a structured approach



**Table 3** Consolidated country level for NAP-AMR implementation across sectors

NAP objectives	Country baseline level (2018)	Country 2023 level	Human health	Veterinary	Fish health	Crop health	Water and environment
Promote public awareness, training, and education	●	●	●	●	●	●	●
Improve Infection prevention and control	●	●	●	●	●	●	●
Promote optimal access to and use of antimicrobials	●	●	●	●	●	●	NA
AMR surveillance	●	●	●	●	●	●	●
Research and innovation	●	●	●	●	●	●	●

for guiding implementation and the timely and accurate transmission of information to government and partners to inform performance reviews, policy discussions, and periodic revisions. The framework aimed at establishing a robust, comprehensive, fully integrated, harmonized, and coordinated system to guide NAP-AMR implementation and evaluate impact. The framework detailed the overall goal and specific objectives of the M&E plan, defined key outputs and outcomes, and described the structural matrix and implementation methodology. Within this matrix, input actions and processes were delineated, alongside output, outcome, and impact indicators. Notably, the latter two pertain to population-level indicators, ensuring a comprehensive assessment of the framework's effectiveness.

The assessment revealed numerous gaps in the design and implementation of the M&E framework. Many objectives of the framework were unspecific and vague and could not be accurately measured. Furthermore, priority indicators and targets for each of the strategic objectives were not identified. Sector-specific M&E indicators were also missing. The framework did not include a clear plan, tools, guidelines, and standard operating procedures for data collection, analysis, and submission. Additionally, the framework did not include feedback mechanisms and guidance for report generation, submission, and dissemination. There was no designated focal point for M&E activities and there were no entities assigned clear M&E responsibilities, raising questions about accountability. Sole responsibility for implementing the M&E plan was determined to have been given to the NAMRSC and not to any of its technical working committees. Additionally, the NAP-AMR did not include indicators on governance and coordination, and thus the performances of the NOHP, NAMRSC, and TWCs were neither monitored nor evaluated at any time. Additionally, indicators on funding and financing were not included, making the M&E of resource input and value for money impossible. To foster transparency, implementing partners created a

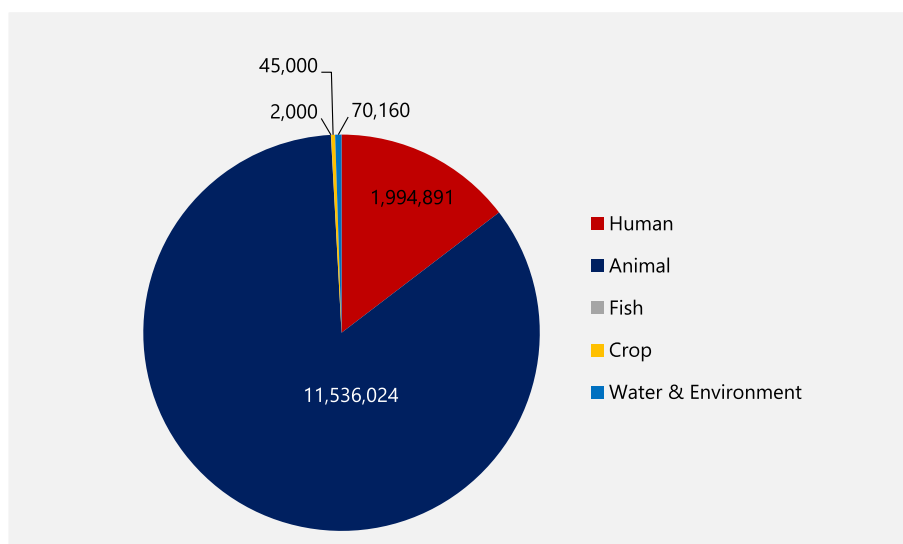
digital platform for data and information sharing, but its use by implementers was limited. Due to these gaps, there was no repository and historical data for M&E activities, and thus, we could not evaluate NAP-AMR implementation based on the M&E framework. Going forward, a TWC for M&E should be created to strengthen real-time tracking of the implementation of the next iteration of the NAP-AMR and operationalize the national intersectoral data-sharing mechanism for consolidating the gains made in AMR interventions.

#### **Funding and resource allocation**

The level of adoption and implementation of the strategic objectives of the NAP-AMR across the different sectors depended mainly on the prioritization of activities by donors and implementing partners. Of the proposed 5-year investment of approximately USD 206 million required to implement the NAP, less than 10% (USD 13.6 million) was directly invested from all sources over a 5-year period (Fig. 2). The animal health sector received the largest investment (USD 11.5 million), followed by the human health sector (USD 1.99 million), across all NAP objectives. Both the fish and crop sectors received negligible direct investment compared to the animal and human health sectors. Generally, the involvement of implementing partners in activities in a given sector was observed to have led to a more positive level of advancement of technical capacity.

#### **Discussion**

In this assessment, we utilized a bottom-up approach to assess NAP-AMR implementation to ensure the engagement of key beneficiaries—e.g., farmers, local governments, and key implementers—that are often neglected in NAP-AMR evaluation exercises. This approach allowed information capture and flow from subnational to national-level efforts, thereby facilitating a context-specific analysis of best practices, gaps, and barriers to NAP-AMR implementation. This approach offers a more



**Fig. 2** Level of investment across sectors in NAP-AMR implementation (in US dollars)

accurate reflection of stakeholders' perspectives and concerns, enhances external validity, and consequently emerges as a preferred method for evaluating implementation outcomes [16, 17]. Current NAP-AMR evaluations are based on top-to-bottom approaches [18–20], which can be problematic and may not reflect true capacity, based on experiences learned from COVID-19 and the use of the Global Health Security Index [9–11]. Among the available methodologies for NAP-AMR evaluation, the bottom-up approach employed in our assessment has not been previously implemented in Uganda.

We utilized locally developed tools to collect information on the status of NAP-AMR implementation at the subnational level. The application of structured tools with predetermined indicators and data collection through individual and group interviews has been the mainstay approach for AMR and One Health assessments in Uganda and elsewhere, such as joint external assessments for IHR [21–23], IPC [24, 25], and AMS [26, 27] capacity. Notably, many subnational stakeholders, especially in the animal health and environment sectors, were not involved in the development, validation, or dissemination of the NAP-AMR. These subnational stakeholders were unaware of the NAP-AMR and had not included NAP-AMR activities in their work plans. Poor stakeholder engagement and coordination, resulting in poor implementation of NAPs-AMR, have been documented in other countries [28–30].

Our assessment revealed significant disparities between the subnational and national levels in the adoption and implementation of the NAP-AMR and its strategic objectives, with suboptimal progress observed at the grassroots level in contrast to the significant gains made

nationally. This discrepancy in performance highlights an emerging trend observed in AMR containment efforts across diverse settings globally [31]. Since 1997, Uganda has been steadfastly implementing a decentralized system for planning, delivering, monitoring, and evaluating healthcare services for its population [32]. This approach remains a cornerstone of Uganda's strategy for achieving universal health coverage, demonstrating the country's ongoing commitment to improving healthcare accessibility and outcomes [33]. This approach has fostered continual engagement and integration of subnational stakeholders into the institutionalized programs of the health system, encompassing critical programs such as nutrition, maternal and child health, medicines management, among others [34, 35]. However, there remains a gap in extending this inclusivity to programs not yet formally institutionalized by the government, such as AMR containment and One Health, highlighting the critical role of institutionalization [36].

At the national level, we identified several strong features of the Uganda NAP-AMR. Overall, the NAP-AMR was well aligned with the GAP and other guiding documents. This is not unique to Uganda's NAP-AMR, as those of other countries have also been found to be aligned with the GAP [37–40], indicating the usefulness of the GAP as a guiding document. Uganda's NAP-AMR had a clear strategic vision and objectives, which implied that it was capable of providing direction with respect to AMR interventions [41]. The NAP-AMR contained interventions to combat AMR across the One Health spectrum, with activities contributing to the five objectives recommended by the WHO [2, 42]. With this standardized NAP-AMR, the suboptimal implementation can be

explained by factors beyond the NAP-AMR itself, such as stakeholder involvement, coordination, and funding and resource allocation.

Currently, annual AMR country assessments such as the Tracking Antimicrobial Resistance Country Self-Assessment Survey (TrACSS), a framework that monitors the implementation of countries' NAPs-AMR, do not include questions related to actual reporting of numbers on funding and resource allocation [7], unlike implementation reports for tuberculosis (TB) and human immunodeficiency virus (HIV) [43, 44]. The lack of reporting on financial indicators, including funding sources, allocations, and funding gaps, leaves countries unable to ascertain the financial landscape associated with AMR containment, hindering effective resource management, impeding effective strategic planning, and compromising NAP-AMR implementation. Drawing lessons from TB and HIV implementation, reporting on financial indicators can help enhance data-driven advocacy based on actual numbers.

Despite the establishment of governance mechanisms, gaps in coordination exist, as evidenced by the continued dominance of the human health sector in One Health and AMR implementation at all levels. This trend aligns with findings observed in similar contexts elsewhere [45]. For example, no public institution was assigned significant government funding to implement NAP-AMR activities. Additionally, the NOHP, the overall coordinating body of the NAP-AMR, is funded by donors and implementing partners, which limits its functionality and threatens its sustainability. However, these challenges have been documented by One Health coordinating bodies in other low- and middle-income countries (LMICs) [38, 46].

It has become increasingly evident that the gaps in existing policies supporting One Health implementation negatively impacted the NOHP, resulting in a lack of access to government funding, human resources, and public accountability. The country has scattered policies, laws, and regulations in place that can indirectly support the implementation of One Health, such as the regulation of antimicrobial consumption and use through the National Drug Policy and National Drug Authority Act; the regulation of medical and dental practices through the National Medical and Dental Practitioners Act; and the regulation of veterinary practice through the Veterinary Surgeons Act [47]. Additionally, the country has strategic and operational policy frameworks that support One Health implementation, such as the national One Health strategic plan, national action plan for health security, and NAP-AMR [41, 48, 49]. These frameworks fail to formally establish the NOHP within

any government institution, resulting in the platform functioning essentially as an informal or ad hoc organization. This has been observed by other researchers in Uganda [50] and in other LMICs in Africa [50, 51]. A dedicated national policy on One Health is needed to formally establish the NOHP as part of government structures to ensure consistent funding and human resources and streamline reporting and accountability to the public. Overall, low public funding for AMR activities has been reported in other LMICs in Africa [38, 52, 53]. The establishment of independent TWCs for financing led to increased public funding for NAP-AMR activities in Burkina Faso [54]—an approach that can be adopted by Uganda and other LMICs.

The lack of MSC structures and mechanisms for AMR implementation at the subnational level hinders the comprehensive benefits of MSC, resulting in a diminished ability to grasp region-specific challenges with precision, implement targeted interventions, and empower facilities and communities to implement AMR containment initiatives. Efforts to expand MSC for health security have been initiated in some districts in Uganda; however, these initiatives were undertaken outside the NAP-AMR framework and did not incorporate AMR containment interventions [55]. MSC for AMR needs to be expanded to subnational levels, and efforts should be streamlined to align with other health security initiatives.

M&E is key in determining the effectiveness of a plan and providing evidence to inform policies. Even though the NAP-AMR had an M&E plan to guide performance reviews, that plan was not adequately implemented, which resulted in difficulty in tracking progress. This challenge has also been documented in other countries [20, 38]. A recent analysis of countries in Southeast Asia showed that robust M&E was essential for obtaining the required funding for implementing NAPs-AMR [40]. Relatedly, the current Ugandan M&E framework is based on a top-to-bottom approach that does not engage last-mile implementers (health workers, community leaders, etc.) or beneficiaries (farmers, patients, the wider community, etc.) in the evaluation process. M&E efforts at the subnational level need to be strengthened to ensure that the intended beneficiaries of the NAP-AMR are engaged and participate in activity implementation.

A notable limitation of our study was the unavailability of data and difficulty in quantifying nonfinancial support provided by various stakeholders and the government. Additionally, the assessment at the subnational level included only seven districts purposely selected, which presented an inherent bias because the perspectives of other districts were missing.



## Recommendations

Overall, we recommend the legislation of dedicated policy to formally incorporate the NOHP into government structures at the national and subnational levels and allow access to consistent government funding and human resources for One Health and AMR containment and foster reporting and accountability of the NOHP to the public. Additionally, establishing a TWC on financing should be considered during future iterations of the NAP-AMR, as doing so would be important in overcoming funding gaps for NAP-AMR activities. Strengthening the M&E function of the NAP-AMR with a designated TWC is also important to avoid overlapping roles and functions among TWCs and ensure the objectivity of ongoing progress evaluations. Finally, we recommend the adoption of a bottom-up approach that recognizes the critical role played by last-mile implementors and beneficiaries and engages them in the development, validation, adoption, and implementation of the NAP-AMR. This approach will provide an alternative to the current practice based on desk reviews undertaken at the top without speaking to the intended beneficiaries, which in our view can provide inaccurate and sometimes misleading estimates of existing capacities.

## Conclusion

Despite the challenges and slow implementation, the NAP-AMR has had a positive impact on national AMR containment efforts in Uganda. However, gaps exist at the subnational level, and these gaps have been previously missed by M&E mechanisms that are solely based at the “top.” The bottom-up approach for assessing capacity and NAP-AMR implementation presents a practical and effective framework for accurately determining implementation status, identifying barriers and opportunities, and optimizing resource allocation and utilization. This approach ensures a comprehensive understanding of ground-level realities, thereby facilitating informed decision-making at the national level, which is critical in resource-limited settings. At the heart of this subnational level are grassroots implementors, who stand as the linchpins of AMR containment and One Health. Neglecting to engage subnational stakeholders can be deceptive, resulting in an overestimation of capacity and overlooking relevant contextual factors. Lessons can be learned from lower levels to inform future AMR containment efforts. Relatedly, this approach could be utilized during JEE assessments conducted by the WHO.

## Methods

### Study design

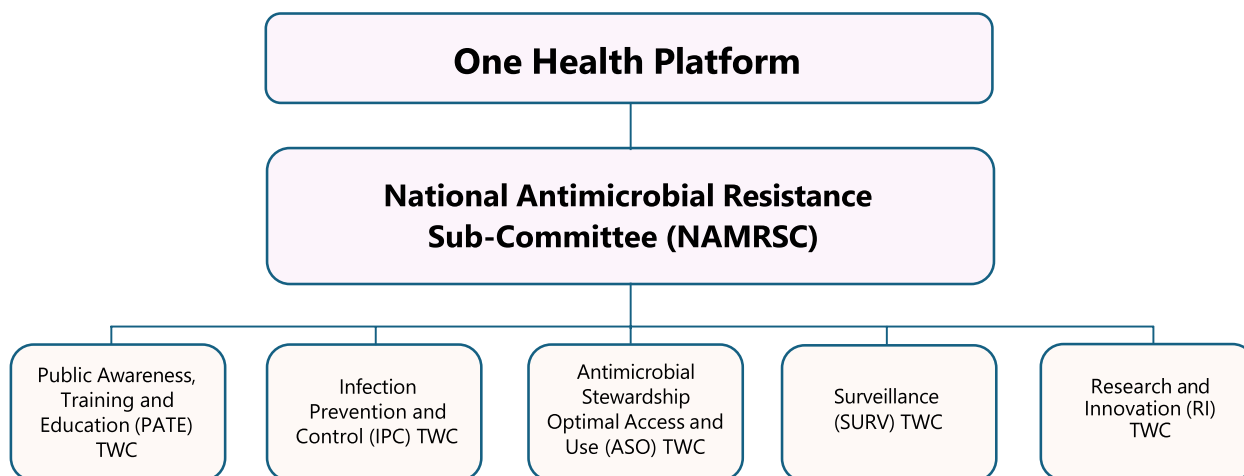
This was a national cross-sectional study to assess progress in the implementation of the Uganda NAP-AMR.

## Setting

Uganda is classified as a LMIC and is located in sub-Saharan Africa with approximately 48,000,000 inhabitants [56]. Uganda is epidemic prone and, like many countries, has not been spared from the threat of AMR [57]. Uganda is a signatory to the IHR and is implementing the GAP through the Uganda NAP-AMR (2018–2023) [41]. The country has participated in assessments of its IHR capacity using the JEE frameworks and self-evaluations [15, 21, 58, 59]. Findings from Uganda's 2017 JEE assessment showed developed capacity for AMR response, with scores of 3 for both IPC and AMS [21]. These findings and a 2015 situation analysis on AMR implementation in the country provided guidance for the development of the NAP-AMR [60]. Subsequently, the country has regularly submitted data to the WHO Global AMR surveillance system [61, 62], with additional data sharing through other forms of publication [59, 63].

### The Uganda National Action Plan on AMR (2018–2023)

Launched in November 2018 as the country's primary strategy for AMR containment, the NAP-AMR adopted a comprehensive One Health approach and included a myriad of interventions spanning five years [41] aimed at achieving five strategic objectives aligned with the GAP [2]. In recognition of the need for political, technical, and financial commitments to sustain implementation [64], the NAP-AMR recommended government oversight and ownership through the existing National One Health Platform (NOHP), a collaboration between the Ministry of Health (MOH), the Ministry of Agriculture Animal Health and Fisheries (MAAIF), the Ministry of Water and Environment (MWE) and the Uganda Wildlife Authority through a Memorandum of Understanding with the objective of coordinating joint efforts to address cross-sector health issues [50]. The NOHP established the NAMRSC as one of its technical committees to provide oversight and overall coordination of NAP-AMR implementation (Fig. 3). The NAMRSC, chaired by an independent AMR expert, includes representation from key line ministries, departments and agencies; national and international organizations; academia; and civil society organizations. The NAMRSC directly coordinates NAP-AMR implementation through five TWCs, one for each of the five strategic objectives of the NAP-AMR, and regular review meetings. The NAP-AMR includes terms of reference (TORs) delineating the membership, roles and responsibilities of the NAMRSC. The NAMRSC established its five multisectoral TWCs, appointed members, and outlined the TORs. National stakeholders engaged in NAP-AMR monitoring and decision-making; some subnational stakeholders supported interventions and reporting. In 2021, the country conducted a multisectoral



**Fig. 3** Organizational structure for One Health multisectoral coordination and NAP implementation [41]

self-assessment of IHR capacities, including AMR implementation, using the JEE-2 tool [15]. However, like most national assessments, this was conducted at the national level, with minimal engagement of subnational stakeholders.

#### Bottom-up approach

Bureaucratic top-down approaches to programming have been documented to negatively impact the delivery of HIV care services, with a lack of consideration of health workers and patients leading to declining HIV care [65]. Given that most activities responding to disease outbreaks occur in the community and at local health facilities, ensuring that these levels are included in assessments and capacity building is important. The top-down approach has overestimated capacity, as shown in the literature, and the management of recent epidemic outbreaks has led to inadequate responses [9–12]. A bottom-up approach was adopted, starting with subnational engagement and progressing to the national level as shown in Fig. 4, prioritizing grassroots input, fostering inclusivity, and facilitating a comprehensive understanding of NAP-AMR implementation in the country.

#### Data collection

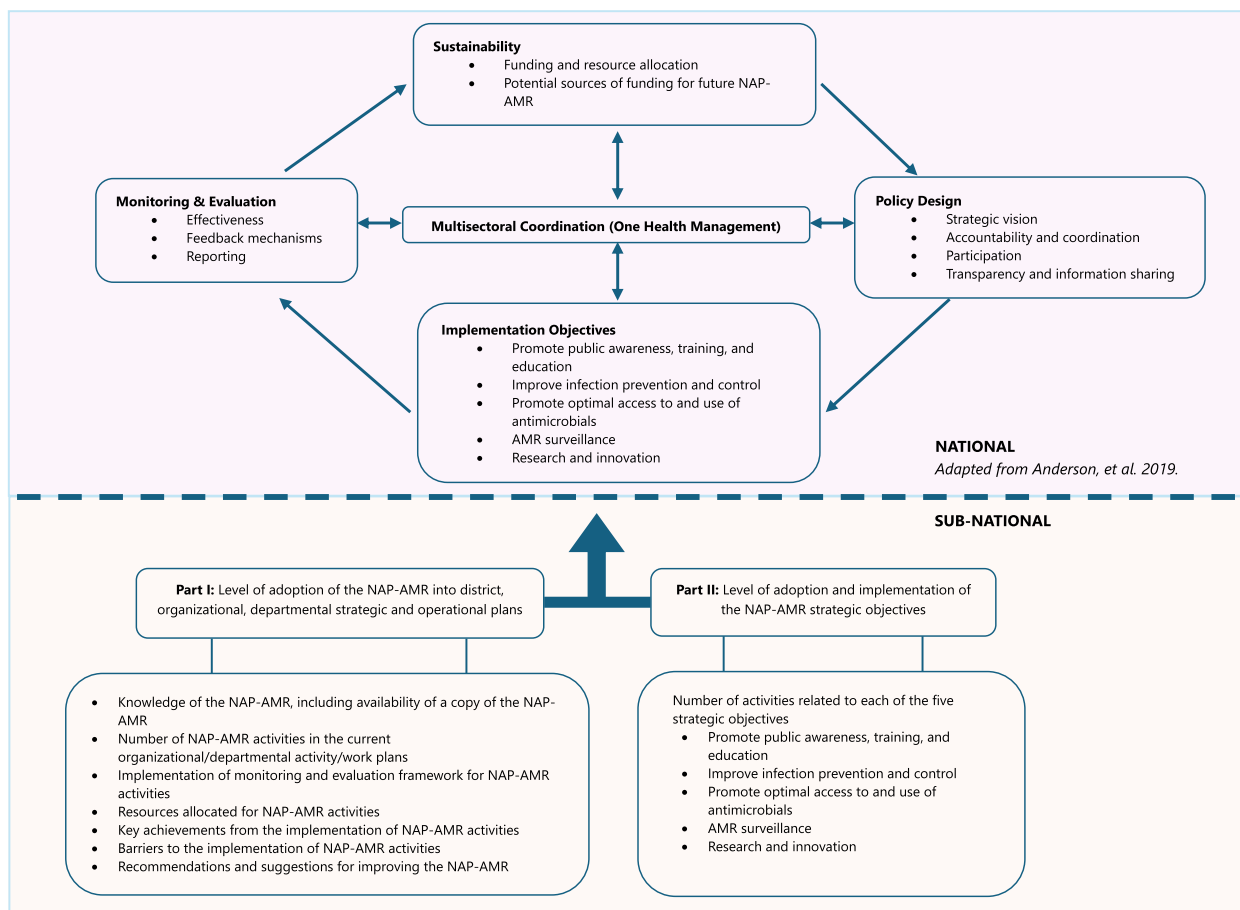
##### Tools

The development of data collection tools was accomplished by technical consultants through a process involving literature review and stakeholder consultations. The tools were developed to collect data on predetermined indicators at the subnational and national levels. The tool for subnational data capture was developed and applied for data collection before the development of the tool for national-level data capture. The subnational tool

consisted of two parts: Part 1, which profiled the adoption of the NAP-AMR in subnational annual activity plans; and Part 2, which evaluated the level of implementation of the five strategic objectives of the NAP-AMR—promote PATE; improve IPC; promote optimal access to and use of antimicrobials (AMS); AMR surveillance; and research and innovation (Fig. 4). The tool for national-level data capture was based on a 2019 governance framework for NAP-AMR development and assessment [66], and evaluated the strength and capacity of the NAP-AMR document (policy design), mechanisms for (MSC)/One Health management, monitoring and evaluation (M&E) capacity, level of implementation of the NAP-AMR strategic objectives, and sustainability capacity, including secure funding for long-term NAP-AMR implementation. A complimentary tool—the 2019 WHO benchmarks for IHR capacities [14]—was utilized to perform a granular assessment of MSC mechanisms, and the capacity level was estimated as guided by the tool. The national tool was designed to incorporate information and feedback from subnational assessments conducted previously to provide a mechanism for feedback from subnational to national-level implementers and developers of the NAP-AMR. The tool assessed the implementation status of activities related to each strategic objective, encompassing both the national and subnational levels.

##### Approaches

On behalf of the NAMSRC, a multisectoral team comprising four AMR experts and three research assistants supported by the US Agency for International Development (USAID)-funded Medicines, Technologies, and Pharmaceutical Services (MTaPS) program applied the developed tools to collect data. Prior to data collection,



**Fig. 4** Framework for the review of NAP-AMR implementation. The national part is adapted from Anderson et al. [66].

comprehensive mapping of stakeholders for data collection and engagement was done by the data collection team in collaboration with the NAMRSC. The data were collected from February to March 2024 at the subnational level and from April to May 2024 at the national level.

The team interviewed individuals and groups of individuals using the data collection tools to gather information on the knowledge, availability, and implementation of the NAP-AMR at various implementation sites. The interviews targeted stakeholders involved in NAP-AMR implementation and decision-making at different levels. The research team conducted physical one-round individual interviews for 24 stakeholders depending on availability and consent. Designated facilitators led the interviews, took notes of responses, and ensured that all pertinent questions were addressed comprehensively. The study population consisted of 8 national and 16 subnational stakeholders, including the NAMRSC, the MOH, the MAAIF, national and regional referral hospitals, national reference laboratories, research

organizations, political offices and local governments, as shown in Table 4. Using purposeful sampling, the team recruited potential participants through physical contact visits and introduction letters from the NOHP.

The research team utilized snowballing to recruit participants for group interviews. Groups of three to ten participants were interviewed through on-site and offsite meetings for subnational- and national-level stakeholders, respectively. A designated facilitator took notes for key responses. The study population comprised grassroots implementers, stakeholders not directly involved in decision-making, implementing partners, private-sector stakeholders, academia, and individuals who preferred group interviews. Figure 5 shows the characteristics of participants involved in group interviews. Up to eight group interviews were conducted at the subnational level, recruiting 45 participants; and ten involving 56 participants were conducted at the national level. A review of existing documentation and direct observations for interventions at implementation sites were performed to facilitate evidence gathering and evaluation of findings

**Table 4** Characteristics of participants interviewed individually

No.	Position/title	Organization	Level
1	Director	National Agricultural Research Organization	Subnational
2	Senior Research Technician	National Agricultural Research Organization	Subnational
3	Farm Manager	National Agricultural Research Organization	Subnational
4	Assistant District Veterinary Officer	National Agricultural Research Organization	Subnational
5	AMR focal person	District Local Government	Subnational
6	Senior Environmental Officer	District Local Government	Subnational
7	District Veterinary Officer	District Local Government	Subnational
8	District Veterinary Officer	District Local Government	Subnational
9	District Veterinary Officer	District Local Government	Subnational
10	District Production Officer	District Local Government	Subnational
11	District Veterinary Officer	District Local Government	Subnational
12	Principal Agricultural Officer	District Local Government	Subnational
13	Pediatrician	Regional Referral Hospital	Subnational
14	District Health Officer	District Local Government	Subnational
15	Pharmacist	Regional Referral Hospital	Subnational
16	District Health Officer	District Local Government	Subnational
17	Microbiologist/Chair NAMRSC	NAMRSC/Makerere University	National
18	Clinical Pharmacist/ASO TWC	Ministry of Health	National
19	Microbiologist/AMR surveillance TWC	Uganda National Health Laboratory and Diagnostic Services	National
20	Medical Laboratory Technologist	National Referral Hospital	National
21	Commissioner	Office of the President	National
22	AMR focal person	Ministry of Agriculture Animal Health and Fisheries	National
23	Director	Ministry of Agriculture Animal Health and Fisheries	National
24	Senior Inspector	Ministry of Agriculture Animal Health and Fisheries	National

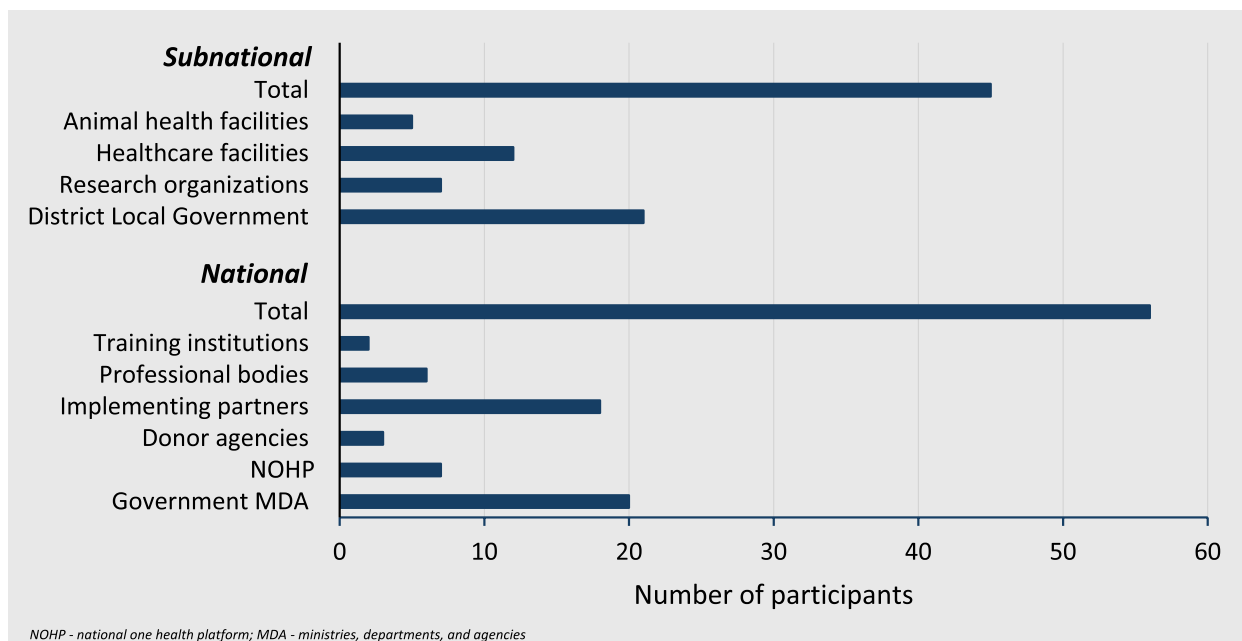
NAMRSC National Antimicrobial Resistance Sub-Committee, ASO TWC Antimicrobial Stewardship Optimal Access and Use Technical Working Committee

and feedback from the interviews. Available strategic and operational plans, policy documents, meeting minutes, and reports were reviewed.

#### **Subnational assessment**

The NAP-AMR included interventions for implementation at the subnational level, including health care facilities, animal health facilities; research organizations, and district local governments coordinated by the TWCs through district and regional government structures. The NAP-AMR identified implementation sites and assigned roles to the district and regional government coordinators, such as district health and veterinary teams. However, it lacked clear roles for grassroots stakeholders such as healthcare workers and farmers. To gain a more comprehensive understanding of NAP-AMR implementation, data were collected from participants from district health, fisheries, agriculture, environment, and veterinary

offices; health care facilities; regional agriculture research and development institutes; farms; academic and health training institutions; water treatment plants; and border entry points. Information was captured through individual and group interviews, desk reviews, and observations, guided by the data collection tool. Key indicators included knowledge, awareness, and availability of the NAP-AMR; integration of NAP-AMR-related objectives, policies, and activities into work plans; resources allocated for NAP-AMR activities; key achievements; implementation, monitoring and reporting challenges; and recommendations for NAP-AMR development and implementation. The findings were utilized to refine the tool for national-level assessment, enhancing its effectiveness and precision. Information was collected from 7 of 135 districts purposively selected due to their status as regional hubs for health-related activities for human, animal, crop, and environmental health.



**Fig. 5** Characteristics of participants involved in group interviews

**Table 5** Performance levels of NAP-AMR adoption and implementation

Performance level	Observation	Color code
Level 1	No NAP-AMR activities implemented	●
Level 2	Implementation started with some achievements and others commenced	●
Level 3	Systematic inclusion of NAP-AMR activities in operational/strategic plans but sustainability has not been ensured such as secure funding sources	●
Level 4	Sustained implementation measured by inclusion of NAP-AMR activities in operational/strategic plans with secure funding sources	●
Level 5	Systematic NAP-AMR implementation including planning; secure long-term funding sources; and regular monitoring, reporting, and evaluation.	●

**National assessment**

Five areas were assessed—specifically, policy design, implementation objectives and tools, monitoring and evaluation, sustainability (funding and resource allocation), and multisectoral coordination (One Health)—as shown in Fig. 4. Information was captured from national-level stakeholders from government ministries, departments, and agencies; professional bodies; donors and implementing partners; and civil society organizations through individual and group interviews, observations, and desk reviews.

**Data analysis**

Using a deductive thematic analysis approach, the research team analyzed the key interview notes to

identify themes related to the predetermined indicators for the level of adoption and implementation of the strategic objectives of the NAP-AMR at the subnational and national levels. Subsequently, the team developed a grading system to evaluate performance. This grading system categorized the level of NAP-AMR adoption and implementation into five performance tiers: starting from Level 1, where no NAP-AMR activities have been initiated, to Level 5, characterized by systematic NAP-AMR implementation inclusive of planning, secure long-term funding sources, and regular monitoring, reporting, and evaluation mechanisms. Color codes were assigned to represent each performance level as shown in Table 5.



## Abbreviations

AMR	Antimicrobial resistance
AMS	Antimicrobial stewardship
GAP	Global action plan
IHR	International Health Regulations
IPC	Infection prevention and control
JEE	Joint external evaluation
LMICs	Low- and middle-income countries
M&E	Monitoring and evaluation
MSC	Multisectoral coordination
NAMRSC	National antimicrobial resistance subcommittee
NAP	National action plan
NOHP	National one health platform
PATE	Public awareness, training, and education
RRH	Regional referral hospital
WHO	World Health Organization

## Authors' contributions

R.K. conceived the idea for this study, while J.P.W., M.P.J. and N.K. provided administrative support. J.P.W., H.K. (Hassan Kasujja), P.V., and H.S. designed data collection tools. J.P.W., H.K. (Hassan Kasujja), P.V., H.S., H.K. (Henry Kajumbula), and M.S. led the data collection and report writing. M.P.J., F.K. and N.K. provided critical input to the report that informed the manuscript. J.P.W. and R.K. wrote the first draft of the manuscript. All reviewers reviewed subsequent drafts of the manuscript and provided critical input. All authors have read and approved the final manuscript.

## Funding

This paper was made possible by the generous support of the American people through the US Agency for International Development (USAID) contract no. 7200AA18C00074.

## Availability of data and materials

Data are available upon reasonable request.

## Declarations

### Ethics approval and consent to participate

The Uganda Government granted permission to the USAID Medicines, Technologies, and Pharmaceutical Services (MTaPS) program for long-term technical assistance in multisectoral coordination of antimicrobial resistance, infection prevention and control and antimicrobial stewardship. In line with Uganda's National Action Plan on Antimicrobial Resistance, this includes permission for the review of the plan to establish implementation status, identify barriers to implementation, and make actionable recommendations. This study is part of the USAID MtaPS program's routine technical assistance to inform priorities for AMR containment. The officials in various ministries, departments and agencies, and facilities and sites provided their respective approval and clearance. There was no direct patient contact, and all the data were anonymized when appropriate.

### Competing interests

The authors declare that they have no competing interests.

### Author details

<sup>1</sup>USAID Medicines, Technologies, and Pharmaceutical Services Program, Management Sciences for Health, Kampala, Uganda. <sup>2</sup>College of Veterinary Medicine, Animal Resources and Biosecurity, Makerere University, Kampala, Uganda. <sup>3</sup>Department of Microbiology, College of Health Sciences, Makerere University, Kampala, Uganda. <sup>4</sup>National One Health Platform, Ministry of Health, Kampala, Uganda. <sup>5</sup>Global Health Security Department, Infectious Diseases Institute, Makerere University, Kampala, Uganda. <sup>6</sup>Centers for Antimicrobial Optimization Network, Infectious Diseases Institute, Makerere University, Kampala, Uganda. <sup>7</sup>USAID Medicines, Technologies, and Pharmaceutical Services Program, Management Sciences for Health, Arlington, VA, USA.

Received: 1 March 2024 Revised: 27 June 2024 Accepted: 16 July 2024  
Published online: 28 August 2024

## References

- O'Neal P. Antimicrobial resistance: Tackling a crisis for the wealth and health of nations. *Rev Antimicrob Resist.* 2014;1:1–16.
- World Health Organization (WHO). Global action plan on antimicrobial resistance. 2015. [https://www.amcra.be/swfiles/files/WHO%20actieplan\\_90.pdf](https://www.amcra.be/swfiles/files/WHO%20actieplan_90.pdf). Accessed 31 Aug 2023.
- United Nations. Political declaration of the high-level meeting of the general assembly on antimicrobial resistance. New York: Seventy-first session of the United Nations General Assembly; 2016 Sep. Report No.: A/RES/71/3.
- United Nations Evaluation Group. Norms and Standards for Evaluation (2016). <https://www.unevaluation.org/document/detail/1914>. Accessed 31 Aug 2023.
- Organisation for Economic Co-operation and Development. Glossary of key terms in evaluation and results based management. Eval. Dev. Program. 2010. [https://www.oecd-ilibrary.org/development/glossary-of-key-terms-in-evaluation-and-results-based-management-for-sustainable-development-second-edition\\_632da462-en-fr-es](https://www.oecd-ilibrary.org/development/glossary-of-key-terms-in-evaluation-and-results-based-management-for-sustainable-development-second-edition_632da462-en-fr-es). Accessed 31 Aug 2023.
- World Health Organization (WHO). Antimicrobial resistance. <https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance>. Accessed 11 Mar 2024.
- FAO, UNEP, WHO, WOA. Tracking AMR Country Self Assessment Survey - TrACSS (7.0) 2023. [https://www.who.int/publications/m/item/tracking-amr-country-self-assessment-survey-tracss-\(7.0\)-2023](https://www.who.int/publications/m/item/tracking-amr-country-self-assessment-survey-tracss-(7.0)-2023). Accessed 31 Aug 2023.
- Bell E, Tappero JW, Ijaz K, Bartee M, Fernandez J, Burris H, et al. Joint external evaluation—development and scale-up of global multisectoral health capacity evaluation process. *Emerg Infect Dis.* 2017;23:533. <https://doi.org/10.3201/eid2313.170949>.
- Abbey EJ, Khalifa BAA, Oduwole MO, Ayeh SK, Nudotor RD, Salia EL, et al. The global health security index is not predictive of coronavirus pandemic responses among organization for economic cooperation and development countries. *PLoS One.* 2020;15:e0239398. <https://doi.org/10.1371/journal.pone.0239398>.
- Aitken T, Chin KL, Liew D, Ofori-Asenso R. Rethinking pandemic preparation: Global Health Security Index (GHSI) is predictive of COVID-19 burden, but in the opposite direction. *J Infect.* 2020;81:318–56.
- Haider N, Yavlinsky A, Chang YM, Hasan MN, Benfield C, Osman AY, et al. The global health security index and joint external evaluation score for health preparedness are not correlated with countries' covid-19 detection response time and mortality outcome. *Epidemiol Infect.* 2020;148:e210. <https://doi.org/10.1017/S0950268820002046>.
- Sirleaf EJ, Clark H. Report of the independent panel for pandemic preparedness and response: making COVID-19 the last pandemic. *Lancet.* 2021;398:101–3.
- World Health Organization (WHO). Technical guidance and resources for NAP on AMR Implementation. <https://www.who.int/teams/surveillance-prevention-control-AMR/technical-guidance-and-resources-for-nap-amr-implementation>. Accessed 7 Jan 2024.
- World Health Organization (WHO). WHO benchmarks for International Health Regulations (IHR) capacities. <https://iris.who.int/bitstream/handle/10665/311158/9789241515429-eng.pdf?sequence=1>. Accessed 31 Aug 2023.
- Republic of Uganda. Report on the 2021 Uganda multi-sectoral self-assessment and operational planning. <https://www.health.go.ug/cause/report-on-the-2021-uganda-multi-sectoral-self-assessment-and-operational-planning/>. Accessed 31 Aug 2023.
- Chen HT. The bottom-up approach to integrative validity: a new perspective for program evaluation. *Eval Program Plann.* 2010;33:205–14. <https://doi.org/10.1016/j.evalprogplan.2009.10.002>.
- Chen HT, Garbe P. Assessing program outcomes from the bottom-up approach: an innovative perspective to outcome evaluation. *New Dir Eval.* 2011;130:93–106. <https://doi.org/10.1002/ev.368>.
- Hein W, Aglanu LM, Mensah-Sekyerere M, Harant A, Brinkel J, Lamshöft M, et al. Fighting antimicrobial resistance: development and implementation of the Ghanaian National Action Plan (2017–2021). *Antibiotics.* 2022;11(5):613. <https://doi.org/10.3390/antibiotics11050613>.
- Wesangula EN, Githii S, Ndegwa L. Implementing the national action plan on antimicrobial resistance in Kenya: global expectations, national realities. *Int J Infect Dis.* 2020;101:41. <https://doi.org/10.1016/j.ijid.2020.09.140>.
- Ahmed SM, Naher N, Tune SNBK, Islam BZ. The implementation of national action plan (NAP) on antimicrobial resistance (AMR) in

- Bangladesh: challenges and lessons learned from a cross-sectional qualitative study. *Antibiotics*. 2022;11(5):690. <https://doi.org/10.3390/antibiotics11050690>.
21. World Health Organization (WHO). Joint external evaluation of IHR core capacities of the Republic of Uganda. 2017. <https://iris.who.int/bitstream/handle/10665/259164/WHO-WHE-CPI-REP-2017.49-eng.pdf?sequence=1>. Accessed 31 Aug 2023.
  22. Republic of Uganda. The joint external evaluation self-assessment, Uganda, 14th–28th May, 2021. 2021. Accessed 7 Jan 2024.
  23. World Health Organization (WHO). Joint external evaluation of IHR core capacities of the Republic of Kenya. 2017. <https://www.who.int/publications/i/item/WHO-WHE-CPI-REP-2017.44>. Accessed 7 Jan 2024.
  24. Opollo MS, Otim TC, Kizito W, Thekkur P, Kumar AMV, Kitutu FE, et al. Infection prevention and control at Iira university hospital, Uganda: more needs to be done. *Trop Med Infect Dis*. 2021;6(2):69. <https://doi.org/10.3390/tropicalmed6020069>.
  25. Harun MGD, Anwar MMU, Sumon SA, Hassan MZ, Haque T, Mah-E-Muneer S, et al. Infection prevention and control in tertiary care hospitals of Bangladesh: results from WHO infection prevention and control assessment framework (IPCAF). *Antimicrob Resist Infect Control*. 2022;11:125. <https://doi.org/10.1186/s13756-022-01161-4>.
  26. Ashiru-Oredope D, Garraghan F, Olaoye O, Krockow EM, Matuluko A, Nambatya W, et al. Development and implementation of an antimicrobial stewardship checklist in Sub-Saharan Africa: a co-creation/consensus approach. *Healthcare*. 2022;10(9):1706. <https://doi.org/10.3390/healthcare10091706>.
  27. Kiggundu R, Waswa JP, Nakambale HN, Kakooza F, Kassuja H, Murungi M, et al. Development and evaluation of a continuous quality improvement programme for antimicrobial stewardship in six hospitals in Uganda. *BMJ Open Qual*. 2023;12:e002293. <https://doi.org/10.1136/bmjopen-2023-002293>.
  28. Acharya KP, Subramanya SH, Lopes BS. Combatting antimicrobial resistance in Nepal: The need for precision surveillance programmes and multi-sectoral partnership. *JAC Antimicrob Resist*. 2019;1:dlz066.
  29. Ecumenical Pharmaceutical Network. Moving beyond antimicrobial resistance (AMR) national action plans development to implementation. [https://www.reactgroup.org/wp-content/uploads/2017/10/RAN\\_Conference-2017-Report.pdf](https://www.reactgroup.org/wp-content/uploads/2017/10/RAN_Conference-2017-Report.pdf). Accessed 31 Aug 2023.
  30. Sommanustweechai A, Tangcharoensathien V, Malathum K, Sumpradit N, Kiatying-Angsulee N, Janejai N, et al. Implementing national strategies on antimicrobial resistance in Thailand: potential challenges and solutions. *Public Health*. 2018;157:142–6. <https://doi.org/10.1016/j.puhe.2018.01.005>.
  31. WHO, FAO, WOA, UNEP. Implementing the global action plan on antimicrobial resistance: first quadripartite biennial report. 2023. <https://www.who.int/publications/i/item/9789240074668>. Accessed 30 Mar 2024.
  32. Tashobya CK, Ogora VA, Kiwanuka SN, Mutebi A, Musila T, Byakika S, et al. Decentralisation and the Uganda health system: what can we learn from past experiences to facilitate the achievement of Universal Health Coverage. 2018. <https://speed.musph.ac.ug/wp-content/uploads/2019/03/Chapter-6.pdf>. Accessed 7 May 2023.
  33. Odokonyero T, Mwesigye F, Adong A, Mbowo S. Universal Health Coverage in Uganda: The critical health infrastructure, healthcare coverage and equity. 2017. <https://speed.musph.ac.ug/wp-content/uploads/2020/05/UHC-in-Uganda-Critical-health-infrastructure-Healthcare-coverage-and-equity.pdf>. Accessed 7 May 2024.
  34. Republic of Uganda Ministry of Health (MOH). Nutrition annual performance report FY 2022/23. <http://library.health.go.ug/file-download/download/public/1689>. Accessed 7 May 2024.
  35. Republic of Uganda Ministry of Health (MOH). Annual health sector performance report, Financial Year 2022/2023. <https://www.kamuli.go.ug/sites/files/Annual%20Health%20Sector%20Performance%20Report%20FY%2020222023.pdf>. Accessed 7 May 2024.
  36. De J, Sosa A, Byarugaba DK, Amabile-Cuevas CF, Hsueh PR, Kariuki S, et al. Antimicrobial resistance in developing countries. New York: Springer; 2010.
  37. Harant A. Assessing transparency and accountability of national action plans on antimicrobial resistance in 15 African countries. *Antimicrob Resist Infect Control*. 2022;11:15. <https://doi.org/10.1186/s13756-021-01040-4>.
  38. Frumence G, Mboera LEG, Sindato C, Katale BZ, Kimera S, Metta E, et al. The governance and implementation of the national action plan on antimicrobial resistance in Tanzania: A qualitative study. *Antibiotics*. 2021;10:273. <https://doi.org/10.3390/antibiotics10030273>.
  39. Nair M, Zeegers MP, Varghese GM, Burza S. India's national action plan on antimicrobial resistance: a critical perspective. *J Glob Antimicrob Resist*. 2021;27:236–8. <https://doi.org/10.1016/j.jgar.2021.10.007>.
  40. Chua AQ, Verma M, Hsu LY, Legido-Quigley H. An analysis of national action plans on antimicrobial resistance in Southeast Asia using a governance framework approach. *Lancet Reg. Heal. West. Pacific*. 2021;7:100084.
  41. Government of Uganda. Antimicrobial resistance national action plan 2018–2023. 2018. <https://www.who.int/publications/m/item/uganda-antimicrobial-resistance-national-action-plan-2018-2023>. Accessed 30 Sep 2023.
  42. World Health Organization. WHO implementation handbook for national action plans on antimicrobial resistance: guidance for the human health sector. 2022. <https://iris.who.int/bitstream/handle/10665/352204/9789240041981-eng.pdf?sequence=1>. Accessed 31 Aug 2023.
  43. World Health Organization (WHO). Global tuberculosis report 2022. 2022. <https://iris.who.int/bitstream/handle/10665/363752/9789240061729-eng.pdf?sequence=1>. Accessed 30 Jan 2024.
  44. United Nations Development Programme (UNDP). HIV and health annual report 2021–2022. 2023. <https://www.undp.org/sites/g/files/zskgke326/files/2023-03/UNDP-HIV-and-Health-Annual-Report-2021-2022.pdf>. Accessed 30 Jan 2024.
  45. Humboldt-Dachroeden S, Rubin O, Sylvester Frid-Nielsen S. The state of One Health research across disciplines and sectors – a bibliometric analysis. *One Health*. 2020;10:100146.
  46. Acharya KP, Karki S, Shrestha K, Kaphle K. One health approach in Nepal: Scope, opportunities and challenges. *One Health*. 2019;8:100101. <https://doi.org/10.1016/j.onehlt.2019.100101>.
  47. Food and Agriculture Organization (FAO). One Health legal framework. 2020. <https://openknowledge.fao.org/server/api/core/bitstreams/fd55b0af-faa6-4c75-a428-c8e968141bf9/content>. Accessed 31 Jan 2024.
  48. Republic of Uganda Ministry of Health (MOH). National Action Plan for Health Security 2019–2023. 2019. [https://opm.go.ug/wpfd\\_file/national-action-plan-for-health-security-2019-2023/](https://opm.go.ug/wpfd_file/national-action-plan-for-health-security-2019-2023/). Accessed 7 Aug 2023.
  49. Republic of Uganda. Uganda One Health Strategic Plan 2018–2022. 2018. <https://www.health.go.ug/wp-content/uploads/2019/11/Uganda-OHSP-Final-Launched-15-02-2018-1.pdf>. Accessed 31 Jan 2024.
  50. Buregyeya E, Atusingwize E, Nsamba P, Musoke D, Naigaga I, Kabasa JD, et al. Operationalizing the one health approach in Uganda: challenges and opportunities. *J Epidemiol Glob Health*. 2020;10:250–7.
  51. Alimi Y, Wabacha J. Strengthening coordination and collaboration of one health approach for zoonotic diseases in Africa. *One Health Outlook*. 2023;5:1–5. <https://doi.org/10.1186/s42522-023-00082-5>.
  52. Fuller WL, Hamzat OT, Aboderin AO, Gahimbare L, Kapona O, Yahaya AA, et al. National action plan on antimicrobial resistance: an evaluation of implementation in the World Health Organization Africa region. *J Public Health Africa*. 2022;13(2):2000. <https://doi.org/10.4081/jphia.2022.2000>.
  53. Ndiokubwayo JB, Yahaya AA, Desta AT, Ki-Zerbo G, Odei EA, Keita B, et al. Antimicrobial resistance in the African region: issues, challenges and actions proposed. *African Heal Monit*. 2013;16:27–30.
  54. World Health Organization. Burkina Faso national action plan on antimicrobial resistance: review of progress in the human health sector. 2021. <https://iris.who.int/bitstream/handle/10665/351442/9789240040410-eng.pdf?sequence=1>. Accessed 31 Aug 2023.
  55. Bakiika H, Obuku EA, Bukirwa J, Nakiire L, Robert A, Nabatanzi M, et al. Contribution of the one health approach to strengthening health security in Uganda: a case study. *BMC Public Health*. 2023;23(1):1498. <https://doi.org/10.1186/s12889-023-15670-3>.
  56. Worldometer. Uganda Population. 2023. <https://www.worldometers.info/world-population/uganda-population/>. Accessed 31 Aug 2023.
  57. Mayega RW, Musenero M, Nabukenya I, Kiguli J, Bazeyo W. A descriptive overview of the burden, distribution and characteristics of epidemics in Uganda. *East Afr J Public Health*. 2013;10:397–402.
  58. Kwesiga P. 2nd joint external evaluation for IHR begins in Uganda. <https://opm.go.ug/2nd-joint-external-evaluation-for-ihp-begins-in-uganda/>. Accessed 7 Jan 2024.
  59. Kayiwa J, Kasule J-N, Ario A-R, Sendagire S, Homsy J, Lubwama B, et al. Conducting the joint external evaluation in Uganda: the process and

- lessons learned. *Heal Secur.* 2019;17:174–80. <https://doi.org/10.1089/hs.2018.0137>.
60. Mpairwe Y, Wamala S. Antibiotic resistance in Uganda: situation analysis and recommendations. 2015. [https://onehealthtrust.org/wp-content/uploads/2017/06/uganda\\_antibiotic\\_resistance\\_situation\\_reportgarp\\_uganda\\_0-1.pdf](https://onehealthtrust.org/wp-content/uploads/2017/06/uganda_antibiotic_resistance_situation_reportgarp_uganda_0-1.pdf). Accessed 30 Aug 2023.
  61. World Health Organization (WHO). Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report: 2021. 2021. <https://iris.who.int/bitstream/handle/10665/341666/9789240027336-eng.pdf?sequence=1>. Accessed 15 Aug 2023.
  62. World Health Organization (WHO). Global antimicrobial resistance and use surveillance system (GLASS) report: 2022. 2022. <https://iris.who.int/bitstream/handle/10665/364996/9789240062702-eng.pdf?sequence=1>. Accessed 30 Sep 2023.
  63. Nabatanzi M, Bakiika H, Nabukenya I, Lamorde M, Bukirwa J, Achan MI, et al. Building national health security through a rapid self-assessment and annual operational plan in Uganda, May to September 2021. *Heal Secur.* 2023;21:130–40. <https://doi.org/10.1089/hs.2022.0107>.
  64. Inter-Agency Coordination Group (IACG). Future global governance for antimicrobial resistance. 2018. [https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/iacg-future-global-governance-for-amr-120718.pdf?sfvrsn=da903992\\_6](https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/iacg-future-global-governance-for-amr-120718.pdf?sfvrsn=da903992_6). Accessed 6 May 2024.
  65. Sturmberg JP, O'Halloran DM, Martin CM. People at the centre of complex adaptive health systems reform. *Med J Aust.* 2010;193:474–8. <https://doi.org/10.5694/j.1326-5377.2010.tb04004.x>.
  66. Anderson M, Schulze K, Cassini A, Plachouras D, Mossialos E. A governance framework for development and assessment of national action plans on antimicrobial resistance. *Lancet Infect Dis.* 2019;19:e371–84. [https://doi.org/10.1016/S1473-3099\(19\)30415-3](https://doi.org/10.1016/S1473-3099(19)30415-3).

### Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.