

Institutional Capacity for Effective Control of AMU and AMR through OHA

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Abstract

Antimicrobial resistance (AMR) is a rising global concern, exacerbated by inappropriate antimicrobial use (AMU) in agriculture, which accelerates resistance in pathogens affecting both humans and animals. Addressing AMR requires coordinated strategies, with the One Health Approach (OHA) emphasizing integrated actions across human, animal, and environmental sectors. This study assessed institutional capacity for AMU and AMR control through the OHA in the Kilimanjaro and Mwanza regions of Tanzania. Six districts were purposively selected to capture diverse economic activities, population densities, and AMU practices, while ensuring contextual variation. A qualitative design was employed, using key informant interviews and focus group discussions with stakeholders from health, veterinary, and environmental sectors. Data were coded using both deductive and inductive approaches, with validation through double-coding, peer debriefing, and triangulation of sources. Findings revealed institutional gaps, including weak enforcement of AMU regulations, limited veterinary support, inadequate laboratory capacity, and insufficient intersectoral collaboration. Farmers and officers emphasized the risks of counterfeit drugs, poor-quality products, and misuse of human antimicrobials in livestock production. While limited to two regions, the study's robustness was strengthened by methodological rigor and alignment with regional evidence. Beyond confirming existing challenges, the findings advance global AMR discourse by showing how institutional weaknesses manifest differently across socio-economic and ecological contexts, highlighting the need for context-sensitive operationalization of the OHA. Strengthening institutional capacity, improving veterinary and human health services, and fostering meaningful community engagement are critical to achieving Tanzania's National Action Plan on AMR (2023–2028) and contributing to global AMR control efforts.

Keywords: AMR; AMU; Institution; Institutional capacity; OHA

1. Introduction

Antimicrobial resistance (AMR) poses a significant threat to global public health, with particularly severe implications for low-and middle-income countries like Tanzania (Kiggundu et al., 2023). The World Health Organization has emphasized the critical need for countries to develop and implement National Action Plans (NAPs) to combat AMR through a One Health Approach (OHA), recognizing the interconnectedness of human, animal, and environmental health (Chua et al., 2023). Institutional capacity plays a crucial role in the effective implementation of AMR control strategies. Several researchers have highlighted the importance of strong institutional frameworks for addressing AMR. For instance, Chua et al. (2021) proposed a governance framework for AMR, emphasizing the need for coordinated efforts across sectors and levels of government. Similarly, Munkholm and Rubin (2020)

stressed the importance of institutional capacity in translating global AMR policies into national and local actions (Zimbwe et al., 2024).

In Tanzania, the launch of the National Action Plan on AMR in 2017 marked a significant step towards addressing this challenge (Sindato et al., 2020). However, the implementation of the NAP requires robust institutional capacity across various sectors. Studies from different countries have showed the importance of strong and powerful institutional frameworks to moderate inappropriate AMU and address AMR. Taking an example from Nigeria and Kenya where studies show that gaps in regulatory enforcement and limited resources in veterinary services hinder AMR control efforts (Okeke et al., 2020; Mwangi et al., 2019), this similar challenge could affect AMR control strategies in other countries, including Tanzania. These gaps hinder effective control of AMR by allowing indiscriminate use of antibiotics both in human medicine and agriculture. This not only accelerates resistance but also poses significant health risks as infections become harder or impossible to treat. While different studies have examined AMR prevalence and antimicrobial use patterns in Tanzania, there is limited research on the institutional capacity for AMR control, from a One Health perspective. The development of drug resistance makes common infections difficult to treat thus increasing the risk of disease spread, severe illness, and death both to humans and animals (Wu et al., 2022).

OHA is an integrated and unifying strategy that aims to optimize the health of humans, animals, and ecosystems by recognizing their interconnectedness and interdependence (WHO, 2023). In Tanzania, the adoption of the OHA was initially catalyzed by the Rift Valley Fever (RVF) outbreak of 2006-2007. The destructive effects of this outbreak on human and animal health, as well as the economy, prompted the Prime Minister's Office to take a coordinating role in the response. Then, in October 2015, Tanzania developed its first National One Health Strategic Plan for 2015-2020. This plan was a response to the East African Sectoral Council of Ministers of Health's policy statement urging partner states to adopt a One Health approach (Kitua et al., 2019). The National OH strategic plan made a lot of initiatives to implement a OHA, this includes establishment of the One Health Coordination Desk, development of a multisectoral approach, creation of governance structures, and addressing emerging health challenges.

Despite the efforts outlined in the OH Strategic Plan to promote OHA, the study by Vianney et al. (2024) indicates little awareness and knowledge on the OHA. The study shows that despite the existence of a One Health Strategic Plan and other supporting documents, there are still challenges in implementing the OHA in Tanzania, particularly in terms of awareness and knowledge at various levels. This indicates that the One Health Strategic Plan (2015-2020) and other initiatives have not significantly facilitated the good practice of knowledge, attitude and practices to the practitioners and community in general. The plan focused on building a functional national One Health platform, establishing and institutionalizing the OHA, and addressing emerging zoonotic diseases through a multisectoral and transdisciplinary approach. Many of the studies show that people know what OHA means but few understand how it operates. The successful implementation of a National Action Plan (NAP) relies heavily on a robust institutional capacity. Institutional capacity refers to the ability of organizations, governments, and stakeholders to effectively plan, implement, monitor, and evaluate policies and programs. A well-established institutional framework ensures proper coordination, resource allocation, policy enforcement, and stakeholder engagement, all of which are crucial for achieving the objectives of a National Action Plan.

This study is aimed at understanding the institutional capacity for AMU and AMR control through a OHA in Tanzania. The outcome of this study will contribute to the growing body of knowledge particularly on implementing OHA strategies in reducing further

development of resistance and mitigation in low and middle-income countries. It will also inform policy decisions for strengthening institutional capacity in Tanzania and similar settings.

2. Methodology

2.1. Study Area

This study applied purposive sampling to select six districts: Moshi Rural, Moshi Urban, and Hai in Kilimanjaro Region, as well as Ilemela, Nyamagana, and Magu in Mwanza Region (Figure 1). The selection of Kilimanjaro and Mwanza for assessing institutional capacity in controlling AMU and AMR was based on their economic, geographical, and demographic differences thus allowing for a comprehensive evaluation of institutional structures and AMU as well as AMR practices across diverse contexts. In terms of economic activities, Kilimanjaro is predominantly agricultural and tourism-based, heavily reliant on crop farming and livestock keeping. In contrast, Mwanza is known for fishing and mining industries associated with unique occupational health risks and distinct antimicrobial use patterns due to waterborne diseases and industrial exposure. These variations significantly influence AMU patterns in both human and animal sectors and they contribute to AMR dynamics (McCubbin *et al.*, 2021). By studying these two regions, this research captures a broad spectrum of AMU and AMR challenges, leading to more comprehensive policy recommendations tailored to different economic and social contexts. Additionally, the findings aim to inform national policies and decision-makers by illustrating how local factors impact AMR control initiatives (IACG, 2018).

While other regions in Tanzania also present geographic, economic, and demographic diversity, the choice of Kilimanjaro and Mwanza was deliberate because these regions uniquely capture contrasting dynamics of antimicrobial use and resistance. Kilimanjaro combines intensive smallholder agriculture, tourism-related livestock activities, and high human–animal interaction due to its peri-urban settlements, while Mwanza represents a hub for large-scale fishing, mining, and cross-border trade across the Lake Victoria Basin. These activities create distinct AMU patterns, such as increased use of veterinary drugs in poultry and aquaculture in Mwanza, and intensive crop-livestock integration in Kilimanjaro. Moreover, Mwanza is among the fastest-growing urban centers in Tanzania, while Kilimanjaro is characterized by high rural population density, offering a comparative perspective on institutional capacities across urbanizing and agrarian settings. This deliberate contrast allows for more nuanced insights that may not be as pronounced if other regions were selected.

The selection of six districts, three from each region, was deliberate to balance regional representation with feasibility of in-depth qualitative inquiry. Within each region, districts were chosen purposively to reflect variation in economic activities, population density, and exposure to AMU practices, such as livestock farming in Kilimanjaro and aquaculture and mining in Mwanza. This ensured that the districts captured a broad range of institutional and community-level dynamics relevant to AMU and AMR control.

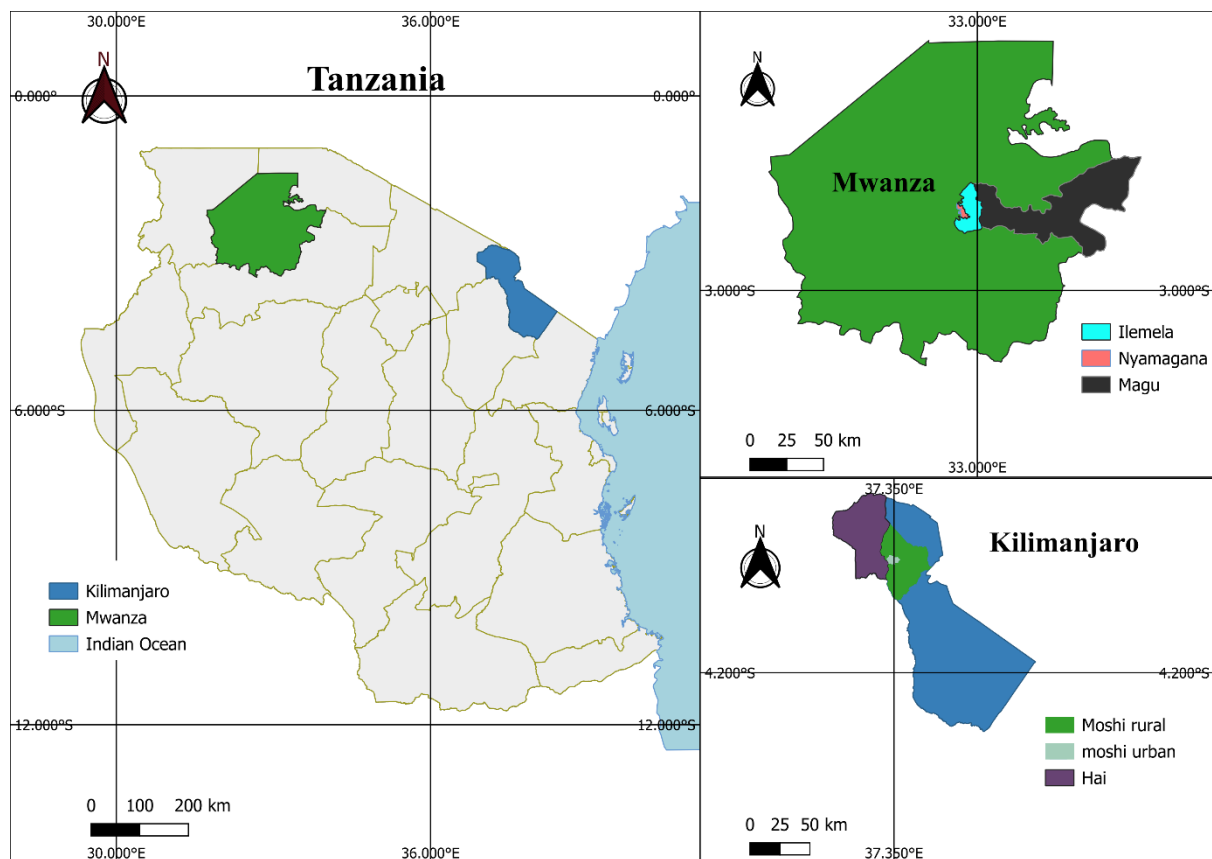


Figure 1: A map of Tanzania showing the study area

2.2. Research Design and Setting

The study was designed to assess the institutional capacity areas for effective AMU and AMR control through OHA by examining various sectors, that is health, animal, and environment. A qualitative research design was used to assess the institutional capacity on controlling AMU and AMR. Data were collected through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs), with participants purposively selected to represent key stakeholder groups, including broiler farmers, veterinarians/animal health practitioners, human health practitioners, and environmental officers. For each focus group, 9 to 11 participants were included, and were selected based on their expertise, daily engagement with AMU, and their willingness to share insights. Experts included human health and animal health officers, pharmacists, Agro-vet dealers and environment officers. KIIs helped to gain expert-level insights, and FGDs facilitated discussions on shared experiences and perceptions thus providing a broad understanding of the challenges and solutions. Sessions lasted between 30 to 45 minutes and were guided by checklist of questions intended to gather information regarding AMU and AMR aspects. Additionally, a literature review was used to examine existing literature by providing valuable insights to enhance the quality and depth of this study.

In this study, the OHA was operationalized by examining institutional capacity across the three interconnected sectors of human health, animal health, and the environment using measurable indicators such as staffing and technical expertise, adequacy and enforcement of AMU regulations, quality of veterinary services and laboratory facilities, and the extent of intersectoral collaboration. These indicators directly linked the study's objective to observable outcomes thus enabling the analysis to assess not only the presence of institutional structures but also their functionality and effectiveness in addressing AMR.

The decision to include 9–11 participants per FGD was guided by qualitative research standards, which recommend groups of this size to ensure active participation, manageable discussions, and generation of diverse perspectives within the allocated time (Bachtar et al., 2024). The purposive selection of participants followed clear criteria: (i) direct involvement in antimicrobial use either in human, animal, or environmental health sectors, (ii) professional expertise and daily engagement with AMU or AMR-related practices, and (iii) willingness to share experiences and insights. This approach ensured that the FGDs captured a broad and representative range of perspectives relevant to the One Health framework.

The purposive sampling technique also accounted for diversity by including participants across different stakeholder categories, namely, farmers, veterinarians, human health practitioners, pharmacists, agro-vet dealers, and environmental officers. Participant diversity was therefore embedded in the design to capture cross-sectoral perspectives. Data collection was continued until thematic saturation was reached, meaning that no new themes were emerging from additional interviews or discussions. This approach ensured that both breadth and depth of perspectives were achieved thus strengthening the robustness of the study findings.

2.3. Data Collection and Analysis

The data from KIIs and FGDs were systematically coded. Initially, the data collection process involved recording discussions while adhering to research ethics, with the researcher also taking notes. The recorded discussions were later reviewed, and voice notes were carefully transcribed. This transcription process enabled data coding to the predetermined themes that were based on the key areas. Delve helped to identify recurring themes and patterns across the responses. The key predetermined themes include (i) human resources staffing levels and expertise, adequacy and enforcement of AMU regulations, (ii) poultry health care: the impact of inadequate facilities and poor-quality products, (iii) impact of ineffective treatments and institutional weaknesses, (iv) intersectoral collaboration among sectors, and (vii) misuse of human antibiotic in poultry farming.

The coding process combined both deductive and inductive approaches. Predetermined themes were informed by the study objectives and existing AMR/OHA frameworks, while inductive coding allowed new insights to emerge directly from participant narratives. To ensure consistency, the transcripts were coded independently by two researchers and later compared to resolve discrepancies thus enhancing reliability. Coding validity was further supported by peer debriefing sessions with colleagues familiar with AMR and qualitative methods by ensuring that the themes accurately reflected the data. Each theme was analyzed in detail, and findings were linked to relevant research and literature. The coded data were thoroughly interpreted to draw insightful conclusions regarding the institutional capacity areas necessary for the effective control of AMU and AMR within the framework of the OHA. Results from this analysis were systematically presented, incorporating direct quotations from participants to enhance transparency and accuracy in the reporting of findings. It is important to note that while the FGDs allowed for a diversity of perspectives, no clear group consensus was reached; therefore, the analysis presents individual views to reflect the range of experiences shared.

As with most qualitative studies, potential researcher bias in data interpretation was a concern. To mitigate this, multiple strategies were employed: triangulation of data sources (KIIs, FGDs, and literature review), use of verbatim quotations to retain participants' authentic voices, and cross-checking interpretations with secondary literature. These measures strengthened the credibility and trustworthiness of the findings. This comprehensive approach ensured that the entire data collection and analysis process

maintained a high standard of accuracy and reliability thus contributing to the overall clarity and depth of the research.

In addition to the primary data from KIIs and FGDs, a targeted literature review was undertaken to provide contextual understanding of AMU and AMR in Tanzania and to triangulate the study's findings with existing evidence. It is important to clarify that this literature review was not a standalone data collection method but a supplementary step to enrich interpretation and ensure alignment with broader research and policy discussions, distinct from the background literature review presented in the introduction.

3. Results and Discussion

To strengthen the analysis, each theme was not only illustrated with participants' quotations but also systematically linked to existing literature on AMU and AMR. This approach ensured that the findings were contextualized within broader national and international evidence thus enhancing both credibility and applicability.

3.1. Institutional Capacities and their Implications on AMU and AMR

3.1.1. Staffing Level and Technical Expertise

Institutional support plays a crucial role in the success of poultry farming, yet a significant gap was identified, which often leaves farmers to rely on non-governmental or informal resources for guidance. This made farmers feel neglected by the government. The lack of veterinarians visiting farms was a key issue. Some farmers mentioned that lack of veterinarians made them to rely on their own experience or advice from unqualified sources thus ended up in frustration of having to manage without government involvement. For example, a farmer in the FGD in Newland Village pointed out that,

"The government does not provide any support; farmers must purchase medication on their own and rely on the advice of someone with experience rather than government-appointed doctors." (A Farmer in Newland, Nov, 13th 2023).

Another farmer remarked:

"The government must recognize that farmers face significant challenges due to lack of veterinary visits. Farmers are left to manage on their own, relying on personal capital to purchase poultry and materials, while the government takes taxes without providing support or assistance. There is no guidance or veterinary care offered to them. The government needs to acknowledge the needs of farmers and ensure they receive proper visits and access to necessary medicines. (KII, Moshi, Nov, 14th 2023).

Participants urged the government to recognize and support its farmers including access to veterinary services and reliable diagnostic tools. The dual role of some government officials as private suppliers of veterinary medicines and civil servants was seen as a conflict of interest that further limited farmers' access to unbiased veterinary guidance. These observations are consistent with findings from a study by Frumence et al. (2021), which noted that farmers often lack direct support from veterinary professionals thus hindering effective animal health management. The research indicates a significant neglect of poultry farmers by the government, leading to feelings of abandonment and reliance on unqualified sources for veterinary advice. This lack of institutional support imposes financial burdens on farmers. They must purchase medications independently and manage operations without professional guidance. These challenges may deter new entrants into poultry farming and threaten food security. These gaps in staffing and technical expertise directly affect the quality of poultry health care because inadequate veterinary visits leave farmers vulnerable to ineffective treatments and poor-quality products.

3.1.2. Poultry Health Care: The Impact of Inadequate Facilities and Poor-Quality Products

The respondents identified challenges on poultry health care facilities. For instance, a Human Health Officer noted some gaps in laboratory resources, particularly the lack of facilities for performing culture sensitivity tests that could guide precise antimicrobial prescriptions:

"There are no laboratories that conduct culture and sensitivity tests, and if you look closely, from doctor's view, saying, if this was available, it would resolve approximately 80% of the issue... but it is still lacking at the local government level." (A Health officer, Moshi, Nov 14th 2023)

This observation is corroborated by findings from a study by Ndaki *et al.* (2021), which reported that the lack of laboratory facilities for conducting culture and sensitivity tests hinders effective antimicrobial use and it contributes to the spread of AMR.

Moreover, the issue of counterfeit veterinary medicine raises serious concerns about regulatory weaknesses and the safety of poultry farming. Despite farmers' efforts to verify expiry dates, tampered products still circulate due to inadequate quality control and enforcement.

One farmer from Buswelu, Mwanza, shared a concerning observation:

"At times, the medicine we purchase is discovered to be counterfeit, with altered expiry dates and fraudulent stamps. Despite checking the expiry date and confirming its validity, we later find that the product has been tampered with and sold without proper quality control..." (A Farmer, Mwanza, Nov 17th 2023)

This statement resonates with the findings of a study conducted by Fuller *et al.* (2023), which found that there is still a challenge in quality of medication provided.

Additionally, the respondent also mentioned how the effectiveness of some medications has decreased over time, particularly those sourced from local manufacturers, compared to international brands. One of the respondents had the following to say, based on experience:

"As farmers, we carefully monitor disease treatment and recognize when a particular medicine becomes ineffective. For example, despite local factories producing medicine, we find that their quality still doesn't match that of foreign brands from countries like India and the Netherlands, which are more effective in treating our chickens." (KII, Moshi, Nov 14th 2023)

A similar issue was highlighted by Monk *et al.* (2024) which found that AMR is exacerbated by the increased use of less effective antimicrobials in developing regions, as well as the reliance on lower-quality local pharmaceutical products. This report also acknowledged the role of counterfeit and substandard drugs in the spread of AMR thus supporting the concerns raised by the farmers in this study. Additionally, a forecast report on the global burden of bacterial antimicrobial resistance by Naghavi *et al.* (2024) estimated that AMR is expected to claim more than 36 million lives since 1990 up to 2050, with a death toll set to rise dramatically in future years. Generally, the above challenges not only lead to financial losses but also they compromise animal health thus contributing to ineffective treatment and potential AMR risks. Strengthening regulatory oversight and improving supply chain transparency are crucial to addressing this challenge.

On the other hand, farmers also face a significant challenge due to inconsistent quality in feed and medications, which directly impacts poultry health and leads to financial strain. During the FGDs in Buswelu, a farmer highlighted that:

"Sometimes you buy feeds, and chickens grow well; sometimes it's disappointing because the feed quality has been compromised somewhere." (A farmer, Mwanza, Nov 17th 2023)

This affects both animal well-being and farmers' finances. This observation is consistent with the findings of a study by Mdegela *et al.* (2021), which reported an increased antimicrobial

use in livestock, aquaculture, and crop production in Tanzania, where the use of antimicrobial in broiler production was identified as a driver of AMR. This calls for sector collaboration aiming at, not only implementing sustainable practices that reduce over-reliance on antimicrobials, but also ensuring standards on animal feed. Adopting the OHA and ensuring resource allocation will help to reduce further development of resistance. The challenges identified in poultry health care are compounded by broader systemic issues, particularly the inadequacy of regulatory frameworks that should safeguard the drug quality and service delivery.

3.1.3. Adequacy of Regulatory Frameworks

The study revealed a shared consensus that institutional efforts, including government policies and regulations, are insufficient in tackling AMR from the grassroots level. Participants emphasized the importance of strengthening coordination between various actors, including human health officers, community leaders, and policymakers. One of the environmental officers emphasized the necessity for comprehensive regulations and community involvement in addressing AMR.

"There should be adequate regulations that will guide issues pertaining to AMR. But also, there is a need for the government to ensure presence of organs that would regulate the cooperation of local people, that is to say meaningful community engagement." (A Environmental officer, Mwanza, Nov 16th 2023)

Also, on the side of community involvement, a human health officer stated that:

"The community's lack of awareness leads to increased economic strain. Patients may use medication multiple times without improvement and only seek hospital care later, starting treatment from scratch and incurring higher costs. What could have been a five-thousand-shilling treatment ends up costing between thirty to seventy thousand shillings. To address this, there is a need for more healthcare professionals to visit rural areas, as medication use is higher there compared to urban centres." (A human health officer, Mwanza, Nov 16th 2023)

The findings highlight critical gaps in regulatory frameworks and community involvement in tackling AMR. While policies exist, weak enforcement and poor coordination among sectors hinder effective control. An environmental officer emphasized the need for comprehensive regulations and structured community participation, suggesting that government oversight should extend to grassroots engagement. Meanwhile, a human health officer stressed the economic burden of AMR due to public misuse of antibiotics, particularly in rural areas where healthcare access is limited. To address this challenge, it is essential to increase healthcare professionals in underserved regions, strengthen regulatory enforcement, and enhance public awareness campaigns. For effective AMR control, there should be a multi-sectoral approach integrating policy reform, enforcement, and education. While regulatory frameworks exist, their effectiveness is largely dependent on enforcement mechanisms, which remain weak and inconsistent across regions.

3.1.4. Enforcement of Policy, Regulations and Guidelines on AMR

The study revealed that a critical challenge in addressing AMR lies in the institutional gaps that undermine effective control measures. A significant concern was the lack of specific regulations or guidelines tailored to AMR, with many respondents underscoring the need for stronger policy frameworks and enforcement. Commenting on this assertion, a human health officer pointed out the challenge of lack of adequate enforcement as follows:

Illegal pharmacies are generally not available, but there are regulations that must be followed in daily business. Occasionally, during inspections, some pharmacies are

found not to comply with these regulations. When this happens, the authorities may close the pharmacy...” (A Human health officer, Mwanza, Nov 16th 2023)

Additionally, another human health officer raised concerns about the inadequacy enforcement of existing guidelines, especially in the private sector and pharmacies. A significant gap in training and monitoring, which hindered the effective implementation of AMR prevention measures was pointed out as follows:

"Right now, there is a big problem. I will first deal with the issue of the Accredited Drug Dispensing Outlet or famously known as Duka la Dawa Muhimu (DLDM). After that, I will return to the pharmacy side. We are focused on increasing sales, but we do not pay attention to whether the person has received the correct medication and at the right time." (A Human health officer, Mwanza, Nov 16th 2023)

This view aligns with the propositions in the NAP-AMR, 2023-2028 that Tanzania faces significant institutional challenges due to the lack of clear regulations and regulatory bodies for AMR oversight (URT, 2022). The findings reveal significant gaps in the enforcement of AMR regulations in Tanzania, especially in the private sector and pharmacies. Farmers, environment and health officers emphasized the need for stronger regulatory frameworks and community inclusion to address the AMR challenges effectively. While regulations exist, inadequate enforcement allows non-compliant pharmacies to operate until inspections uncover violations. These enforcement challenges cannot be addressed by one sector alone thus underscoring the importance of intersectoral collaboration in tackling AMR.

3.2. Intersectoral Collaboration among Sectors

Participants also acknowledged the value of the OHA but pointed out operational challenges in collaboration. The lack of inter-sectoral collaboration among human health, animal health, and environmental sectors, limits the effectiveness of AMR control efforts. One participant highlighted as follows:

"We are trying to sustain and ensure that multisectoral conflict is improved as well as the ways of collaboration, communication and coordination. We are trying to improve by engaging other professionals to share knowledge and perspectives... because it's not a single unit that can eradicate this challenge." (Environment officer, Moshi, Nov 13th 2023)

The participants highlighted operational challenge, particularly in inter-sectoral collaboration. The limited coordination between the sectors weakens the effectiveness of AMR control efforts. This aligns with global recommendations that stress the need for a multisectoral approach to AMR control. Without strong collaboration, interventions remain fragmented thus reducing their overall impact. Strengthening these partnerships is essential for developing holistic and sustainable AMR control strategies.

3.3. Misuse of Intended Human Antimicrobial in Poultry Farming

One of the significant challenges identified was the misuse of antimicrobial in farming, particularly the use of human medications to treat animals. A human health official noted:

"I have seen that some people are using human hospital medications to treat chickens.... but I am not sure if those animal medications themselves cause resistance for us; we still need research on that." (A Human health officer, Mwanza, Nov 16th 2023)

The findings show the misuse of antimicrobial in farming. According to Barasa (2024), the inappropriate use of antimicrobials in animals is a significant contributor to AMR, especially in low-resource settings where regulations are not adequately enforced. This advocates for better regulation and education to prevent the misuse of human medications in animal husbandry.

3.4. Impact of Ineffective Treatments and Institutional Weaknesses

The negative impact of AMU and AMR on community health is further exacerbated by institutional gaps in regulation, farmer training, and access to veterinary services. Participants pointed out that a lack of proper guidance from veterinary experts and insufficient monitoring of antibiotic use create an environment where misuse and overuse thrive. For example, a farmer pointed out that:

"You might leave ten sick chickens and, within a few hours, you find that fifty are now affected. When prescribed medication, you must complete the full course once you start administering it. However, despite giving the treatment, the chicken may still die in your hands—and farmers described this as discouraging. In our area, typhoid has become a serious issue, largely driven by poor hygiene, unsafe water, and overcrowded poultry houses." (A farmer, Moshi, Nov 14th 2023)

On the same note, human health officer expressed concerns over the economic burden of AMR, stating that resistant infections require more expensive treatments and prolonged hospital stays, impacting both individuals and the healthcare system. A health officer remarked:

"The economic loss in the community is significant because what used to cost 5,000 shillings to treat a disease will no longer be enough. It will now cost you more than 10,000 shillings because you will need to add another medication since the first one didn't work. You will have to buy twice the amount of medication, at different prices, and the treatment duration will also increase, meaning you will spend more on the medication and the time spent being ill. This will have a significant economic impact on you personally." (A Human health officer, Mwanza, Nov 16th 2023)

Similarly, AMR is linked to poverty and health risks within the community. To be specific, the economic impacts of AMR were emphasized, particularly the costs associated with treating resistant infections, such as Pelvic Inflammatory Disease (PID), which requires a broad spectrum, and it is more expensive. Additionally, the societal impacts of AMR were linked to reduced workforce productivity due to long-term illnesses. An environmental officer described the socioeconomic consequences as detrimental, affecting food safety, increasing healthcare costs, and posing risks to farmers who depend on livestock and crop yields. Thus, he said:

"This is due to the interaction of the chemicals we use... for example, if someone has used amoxicillin, taken half the dose, and it helped, but then stopped, the consequences he/she will face are that first, that medicine will create resistance in his/her body..." (A Environmental officer, Moshi, Nov 13th 2023)

A key informant from a pharmaceutical company added that:

".... when someone faces this issue, the treatment becomes very costly, and at the end of the day, it forces them to incur high expenses and significant resources to manage the treatment." (KII, Mwanza, Nov 17th 2023)

This proposition was further supported by the concern that the community also faces challenges, with some individuals resorting to traditional medicine, which is not always effective in treating infections. It thus prolongs health issues. The key informant from the pharmaceutical company continued as follows:

"So, when you stop using medication and resort to traditional medicine, at the end of the day, it's not that the person will get better; instead, they continue to worsen the problem." (KII, Mwanza, Nov 17th 2023)

These drawbacks illustrate the long-term economic consequences of improper antimicrobial use, leading to more severe health issues and increased healthcare costs. These findings highlight the increased costs associated with treating resistant infections. A study by Mdegela

et al., (2021) found that AMR leads to higher healthcare costs due to the need for more expensive drugs and longer treatment duration. The increased cost of medication, longer treatment duration, and reduced workforce productivity due to illness exacerbate financial strain, particularly for low-income communities. Some individuals turn to traditional medicine, which may not effectively treat infections rather worsening their health condition. AMR is also seen as a potential threat to community health because untreated or ineffectively treated infections often lead to more widespread health issues and economic strain on communities. A health officer stated as follows:

"Socially, it will affect the next generation, and you may find that there is no progress because many of us will be sick in the future, as resistance has already developed. This person will not recover, and in the end, the nation will lose. If we look more closely, people may continue to suffer without receiving appropriate treatment." (A Human health officer, Moshi, Nov 13th 2023)

This excerpt emphasizes the broader implications of AMR on community health and development. A study by Frumence *et al.*, (2021) highlighted that AMR poses a significant threat to community health and socioeconomic development because it leads to increased morbidity and mortality, reduced productivity, and higher healthcare costs. The findings underscore the serious threat AMR poses to our communities' health and socioeconomic development. Ineffectively treated infections contribute to increased illness, reduced productivity, and long-term health risks, thus hindering the national progress in socioeconomic development. As resistance spreads, future generations may face greater health challenges, leading to higher healthcare costs and economic strain.

4. Conclusions, Policy Implications and Recommendations

4.1. Conclusions

This study is unique not only for its integration of the OHA but also for its inclusion of diverse perspectives from both grassroot practitioners (farmers) and meso-level stakeholders (officers). This study highlights the challenges and institutional gaps affecting the control of AMU and AMR in Tanzania. The findings emphasize that weak enforcement of regulation and guidelines, inadequate government support for farmers, poor access to human health services, veterinary services, and limited awareness of AMR, contribute to the growing resistance problem. The presence of substandard and counterfeit medications, along with inconsistent feed quality, further exacerbates the situation, making AMR a pressing issue in both human and animal health.

Additionally, the study has underscored the lack of intersectoral collaboration among human health, animal health, and environmental sectors, which limits the effectiveness of AMR control efforts. The OHA is crucial in addressing AMR, but its implementation is hindered by poor coordination, inadequate funding, and weak regulatory frameworks. Strengthening institutional capacity and promoting multi-sectoral cooperation is vital for AMR control.

While this study provides important insights into institutional gaps affecting AMU and AMR control, its findings should be interpreted with caution. The purposive selection of two regions—Kilimanjaro and Mwanza—allowed for in-depth analysis of contrasting contexts but may limit the generalizability of the results to other regions in Tanzania. Additionally, as with most qualitative research, there is a potential for researcher bias during data interpretation. These risks were mitigated through triangulation of data sources (KIIs, FGDs, and literature review), double-coding of transcripts, and the use of direct quotations to preserve participants' voices. Despite these limitations, the consistency of the findings with regional and global literature on AMR enhances their robustness and credibility.

Furthermore, the economic burden of AMR including higher treatment costs, cost of production, and financial strain on both farmers and the healthcare system emphasizes the urgency of integrating AMR control into national policies. Targeted interventions, such as enhanced regulation, improved human health services, veterinary services, and stronger enforcement of antibiotic use policies are essential for controlling and combating AMR. Beyond confirming challenges already noted in regional and international literature, this study advances the global discourse on AMR control by demonstrating how institutional weaknesses manifest differently across socio-economic and ecological contexts within low- and middle-income countries. By integrating farmers' lived experiences with meso-level institutional perspectives, the study highlights the practical implications of weak veterinary support, poor regulatory enforcement, and cross-sectoral fragmentation on the ground. These findings underscore the need for global AMR strategies to move beyond broad policy frameworks and incorporate localized, context-sensitive approaches that account for diverse institutional realities. In this way, the study contributes to refining the operationalization of the OHA, showing how global principles can be adapted and tested in specific national and sub-national settings.

4.2. Policy Implications and Recommendations

The robustness of the findings is supported by convergence with regional studies on AMR governance and antimicrobial use, which reinforces the validity of the institutional gaps identified in this study.

Strengthening Regulatory Frameworks and Enforcement: The government should establish and enforce clear and binding regulations on antibiotic use in both human and animal health sectors. Stricter control over antimicrobial sales and prescriptions should be implemented to prevent the misuse of antimicrobial in farming. Regular inspections of pharmacies and veterinary facilities should be conducted to ensure compliance with AMR regulations.

Improving Veterinary Services, Human Health Services and Institutional Support: The availability of qualified veterinary professionals should be increased, particularly in rural areas. The government must invest in training human health practitioners, farmers and veterinary practitioners on responsible antimicrobial use. Diagnostic capacity should be improved to ensure accurate disease detection and appropriate antibiotic administration.

Enhancing Multi-Sectoral Collaboration through the One Health Approach: The government should facilitate joint initiatives between ministries, local authorities, healthcare providers, and agricultural bodies to foster intersectoral collaboration. Multi-sectoral working groups should be established to share knowledge, develop integrated solutions, and improve communication across sectors. Resources should be allocated efficiently to support collaborative AMR management strategies.

Addressing the Economic Burden of AMR: AMR control measures should be integrated into national policies and funding structures to reduce the economic burden on healthcare and agriculture. The government should prioritize community-level AMR education and awareness campaigns to encourage responsible antimicrobial use. Investment in alternative disease prevention strategies, such as biosecurity measures, vaccination programs, and improved farming practices, can help to reduce reliance on antibiotics.

Generally, to ensure effective implementation of AMR control, the government should establish systems for monitoring and evaluating AMR interventions. Regular audits

and assessments of AMR management efforts should be conducted to identify areas of improvement and ensure that policies are adapted based on evolving trends in AMR.

Ethical Statement: This study took into consideration all ethical issues by following all procedures required in data collection and processes. This included obtaining the relevant authority's consent and the willingness of respondents to participate in the research by providing relevant data to meet the study objectives. Moreover, a research permit was obtained from the Vice Chancellor's office at Sokoine University of Agriculture and from the Kilimanjaro Municipal Council and Mwanza Municipal Council to access the study area. Furthermore, other ethical considerations, such as protective measures for respondents, the freedom to withdraw, secrecy, and confidentiality, were maintained throughout each aspect and stage of data collection, processes, and analysis. All findings will be submitted to Sokoine University of Agriculture (SUA) and the National Institute of Medical Research (NIMR) for ethical review and approval of the study.

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