Antimicrobial stewardship: Knowledge, attitudes and practices of healthcare providers in Eastern Uganda

Jimmy Patrick Alunyo
alunyo.j.patrick@gmail.com
Busitema University
Enid Kawala Kagoya
Busitema University
Jennika Virhia
The Open University UK
Koula Charitonos
The Open University UK
Darren Langdridge
The Open University UK
Olivier Biard
The Open University UK
Duncan Banks
The Open University UK
Rachel McMullan
The Open University UK
Peter Olupot-Olupot
Busitema University

Article

Keywords: Antimicrobial Resistance, Antimicrobial Stewardship, Prescribing Practices, Healthcare Providers, Uganda

Posted Date: March 11th, 2025

DOI: https://doi.org/10.21203/rs.3.rs-6066834/v1

Additional Declarations: No competing interests reported.

Abstract

Introduction:

Antimicrobial resistance (AMR) is a growing global health threat exacerbated by inappropriate antimicrobial prescribing practices. In low- and middle-income countries (LMICs) like Uganda, additional challenges for effective antimicrobial stewardship include limited resources and healthcare infrastructure. This study assessed current antimicrobial prescribing practices and evaluated healthcare providers' knowledge, attitudes, and practices related to antimicrobial stewardship (AMS) in Eastern Uganda.

Methods

A cross-sectional study was conducted in healthcare facilities across Eastern Uganda. Data were collected through interviewer administered structured questionnaires.

Results

240 respondents completed questionnaires from four health facilities in Eastern Uganda. Respondents were 51.5% male, median age 33 years [IQR 28–38] with 6 years of medical experience [IQR 4–10]. Clinical Officers constituted 22.5%, Medical Doctors 11.2%, Nurses 40.8%, Pharmacists 4.5%, and other categories accounted for 20.8%. Adherence to national and international guidelines on antibiotic use was suboptimal with a high frequency of broad-spectrum antibiotic prescriptions. 75.4% of the respondents reported the presence of an antibiotic resistance control program within their healthcare facility. Most respondents (83.3%) reported a designated leader for AMS at the facility while 86.7% indicated that Pharmacists lead the programmes at facilities. 92.5% of respondents confirmed that there is a policy in place to guide the appropriate dosage and duration of antibiotic treatments. Overall, 98.8% of respondents believed AMR a significant concern and 62.1% indicated that high workloads negatively affect AMS practices.

Conclusion

The study identifies gaps in antimicrobial prescribing in Eastern Uganda, highlighting the need for improved stewardship programs, training, and policy implementation.

Background

Antimicrobial resistance (AMR) is a global problem of public health importance**[1]**. Antimicrobial resistance develops through genetic mutations and natural selection, accelerated by misuse and overuse of antimicrobials in humans and animals**[2, 3]**. In clinical settings, the recent escalation in AMR

levels is attributed to antibiotic overuse, misuse or both[1, 4, 5]. In low- and middle-income countries (LMICs), treatment of infectious diseases is empirically based on the World Health Organisation (WHO) guidelines, due in part to the inadequacy of laboratories, few qualified health staff and poor community health seeking behaviours. Consequently, hindering the ability to diagnose disease and determine pathogen susceptibility to antimicrobials[6–8]. This often results in poorly targeted treatment with poor clinical outcomes, widespread AMR and increased economic burden of patient care[7, 8]. The pervasive use of antimicrobial agents contributes significantly to the rise of AMR. Healthcare professionals (HCPs) in public health facilities are predominantly responsible for the hospital administration of these agents following evidence-based guidelines as specified in the Uganda clinical guidelines and WHO guidelines[9]. They have a critical role to play in mitigating the effects of AMR but given that AMR is a rapidly evolving challenge, HCP involved in the surveillance and stewardship of AMR need support in expanding their professional practice in these areas. Therefore, evaluating the knowledge, awareness, and practices of HCPs regarding antimicrobial use (AMU), AMR, and antimicrobial stewardship as recommended by the WHO[9] within hospitals is essential for monitoring antibiotic use, ensuring appropriate prescribing practices, and educating healthcare workers and the public about the risks of antibiotic misuse and overuse[10, 11]. Antimicrobial agent misuse is a principal driver of AMR in humans[12]. Inadequate knowledge and awareness about AMU, AMR, and AMS among HPCs results in improper prescribing, dispensing, and administration of antimicrobials, potentially contributing to the emergence of resistant infections. In LMICs, the determinants of AMR are complex and include a lack of diagnostic tools, unrestricted access to antimicrobials, medication shortages, improper agricultural use of antibiotics, poor hygiene and sanitation, weak regulatory frameworks, substandard clinical care, and insufficient AMS[13, 14]. The presence of substandard antimicrobial agents further exacerbates AMR in these regions. In East Africa, almost half of the isolated organisms are resistant to WHO-recommended antibiotics[15]. Monitoring AMR trends in different regions guides policy with antibiotic producing companies[2, 3, 5, 15]. Whereas the homogeneity in the geographical distribution of AMR prompted the WHO to provide an AMR priority list according to location[2, 3, 5], effective and standardised stewardship practices are needed across all locales. Rolling out AMS has the potential to preserve the safety and effectiveness of antimicrobials with good patient outcomes both locally and internationally[16–20].

Antimicrobial Stewardship (AMS) programs are essential for addressing antimicrobial resistance (AMR). They should include leadership commitment, accountability, infection prevention and control expertise, education, training, monitoring, and feedback on AMS outcomes. Implementing hospital AMS programs ensures the rational use of antimicrobials by prescribing the correct dose, duration, and route, while also enhancing healthcare providers' knowledge, attitudes, and practices regarding AMR and antimicrobial use. Hospital AMS programs improve prescribing practices[21]. In May 2015, the WHO launched the Global Action Plan (GAP) on AMR, highlighting the importance of education in combating antimicrobial resistance. The Quadripartite Alliance urges member states to develop National Action Plans and improve infection and AMR surveillance. The GAP promotes a One Health approach to raise awareness about AMU, AMR, and AMS, advocating for proper antimicrobial use[22].

Uganda has identified several factors contributing to AMR with microorganisms exhibiting resistance to commonly used antimicrobials in the healthcare system**[23]**. Studies have highlighted inappropriate antibiotic prescribing patterns in public sector hospitals as a significant issue**[23]**. The health systems in sub-Saharan Africa (SSA) are illustrative of the challenges that many developing countries face**[24, 25]**: they are fragmented and with little priority settings coming from within the subcontinent.

This study aimed to assess the current antimicrobial prescribing practices in healthcare facilities and evaluate healthcare providers' knowledge, attitudes, and practices related to antimicrobial stewardship in Eastern Uganda. The findings presented herein represent one component of a larger study that aims to examine forms of professional practice that are needed to improve practices associated with AMR surveillance and stewardship.

Materials and methods

Study Settings

This study was conducted in healthcare facilities across Eastern Uganda, namely, Mbale RRH, Soroti RRH, Atutur District Hospital and Ngora District Hospital. Facilities were selected based on their locations, namely urban (Soroti and Mbale RRH) and rural areas (Atutur and Ngora), and regional versus district-level health facilities. The workforce size are fairly typical in these settings, with more women than men at all levels of service delivery (at 54% females and 46% males)**[26]**. Eastern Uganda was selected because of limited data on AMR stewardships.

Study design

This was a descriptive cross-sectional study using a quantitative approach to data collection, a structured questionnaire administered to HCPs.

Study Population

The study included physicians, nurses, pharmacists, laboratory personnel and clinical officers involved in antibiotic prescribing across the four healthcare facilities ranging from primary health centres to tertiary hospitals in Eastern Uganda. **See Table 1**.

Sampling strategy

Table 1: Multistage Sampling procedure

Stage	Details
Sampling Approach	Multistage sampling approach starting at district and hospital levels
District Selection	Purposive selection of four districts across Eastern Uganda: Mbale, Soroti, Atutur, and Ngora
Hospital Selection	Purposive selection of four high-volume hospitals within selected districts
Allocation of Sample Size	Proportionate allocation based on the catchment population served by each facility
Sample Size Allocation	Ninety-six participants from Mbale and Soroti RRHs; twenty-four participants from Ngora and Atutur Hospitals
Participant Selection	Simple random sampling from available cadres at each hospital
Participant Refusals	No participants refused to participate in the study

To recruit the 240 participants included in this study, a multistage sampling approach was employed, starting at the district and hospital levels. We purposively selected four districts across Eastern Uganda: Mbale, Soroti, Atutur, and Ngora and selected four high-volume hospitals within these districts. We utilized proportionate allocation techniques, basing our calculations on the catchment population served by each facility to determine the required sample size for each facility. From these calculations, we selected ninety-six participants from Mbale and Soroti RRHs and twenty-four participants from Ngora and Atutur Hospitals, respectively. We employed simple random sampling to select our participants from the list of all available cadres (Pharamcist, doctors, clinical officers, nurses, and others involved in prescribing) at each hospital. Considerable flexibility was offered regarding participation opportunities and no participants refused to participate in the study.

Data Collection

A semi-structured questionnaire designed in electronic format Kobo Toolbox administered bu trained research assistants were used to capture primary data on Antimicrobial Prescribing Practices and Knowledge, Attitudes, and Practices (KAP) and had the following sections: the participant's socio-demographic variables, attitudes and practices, and knowledge sections (see Supplementary Materials for full questionnaire). To ensure the completeness of our data, all questions were made mandatory and skip logic was applied where necessary.

The tools were created in English, as our target respondents were healthcare professionals (HCPs) who were proficient in the language. Trained research assistants then collected the data in English. A comprehensive document review was conducted to inform and shape the development of questions related to current antimicrobial practices. This review provided critical insights into existing guidelines, protocols, and standard practices, ensuring that the questions were relevant, accurate, and reflective of the latest developments in antimicrobial management. We conducted a reliability test to assess the

reliability of our twelve-item knowledge scale. Results showed an average interitem covariance of 0.023 and a scale reliability coefficient (Cronbach's alpha) of 0.724. See the results. **See Table 2.**

Table 2: Reliability test for knowledge items

Variables	Statistic
Average interitem covariance	0.023
Number of items in the scale	12
Scale reliability coefficient	0.724

Data Analysis

The data analysis was conducted using STATA® version 17 software. We computed frequencies, proportions, median and interquartile ranges and the results are summarised below.

Results

Participants

A total of 240 participants were included in the study as follows: Atutur 24 (10.0%), MRRH 96 (40.0%), Ngora 24 (10.0%), and Soroti RRH 96 (40.0%) participants, most from urban locations (84.2%), with a smaller proportion from rural areas (15.8%). The gender distribution was relatively balanced, with 116 females (48.5%) and 124 males (51.5%). The median age of participants was 33 years, with an interquartile range (IQR) of 28 to 38 years. The median years of experience in their respective fields was 6 years, with an IQR of 4 to 10 years with the groups comprising nurses (40.8%), clinical officers (22.5%), other specified positions (20.8%), medical doctors (11.2%), and pharmacists (4.5%), as shown in **Table 3**.

Table 3: Participants' demographic characteristics

Variables	Freq.	Percentages
Health Facility Name		
Atutur	24	10.00
Mbale RRH	96	40.00
Ngora	24	10.00
Soroti RRH	96	40.00
Location		
Rural	38	15.8
Urban	202	84.2
Gender		
Female	116	48.5
Male	124	51.5
Age median [p25, p75]	33[28, 38]	-
Years of experience median [p25, p75]	6[4, 10]	-
Position in this hospital		
Clinical Officer	54	22.5
Medical doctor	27	11.2
Nurse	98	40.8
Others specify	50	20.8
Pharmacist	11	4.5

Prescribing practices

Table 4: Reported antibiotic prescribing practices in healthcare facilities in Eastern Uganda, presents the results for antibiotic prescribing practices in Eastern Uganda. Most of the hospitals included in this study had AMS measures in place, with 75.4% having an antibiotic resistance controlling program, 83.3% having a designated AMR leader, and 86.7% having a pharmacist dedicated to improving antimicrobial use. Additionally, 92.5% had policies requiring documentation of antibiotic prescription durations. Of the 240 participants, 90.4% reported their hospitals had specific treatment guidelines based on national standards, 88.8% said the hospitals provided them with access to evidence-based medicine resources, and 76.7% said the hospitals were sharing antibiotic consumption data with them (prescribers). However, only 56.3% consistently use culture results for therapy decisions. **See Table 4.**

Table 4: Reported antibiotic prescribing practices in healthcare facilities in Eastern Uganda

Variable	Response %(n)		
	I Don't Know	No	Yes
The existence of an antibiotic resistance program	18.8(45)	5.8(14)	75.4(181)
Existence of AMR program leader	12.9(31)	3.8(9)	83.3(200)
Availability of an antimicrobial stewardship pharmacist	8.3(20)	5.0(12)	86.7(208)
The existence of an antibiotic documentation policy	5.4(13)	2.1(5)	92.5(222)
The hospital had specific treatment guideline	7.5(18)	2.1(5)	90.4(217)
Availability of evidence to be accessed by staff	3.3(8)	7.9(19)	88.8(213)
Availability of antibiotic consumption reports	14.6(35)	8.8(21)	76.7(184)

AMS attitudes and practices

Figure 1, presents the results of the possible mechanisms the hospitals used to maintain interdisciplinary communications on AMS. Overall, the most common method was the use of an AMS committee, utilised by 58.6% of the hospitals. Meetings were the second most common method, (38.5%) with monthly reports the least common (2.9%).

When disaggregated by facility level, meetings were the most common method used by General Hospitals (Atutur and Ngora 70.8%), followed by committees (20.8%), and monthly reports (8.3%). At the RRH level (Mbale and Soroti), committees were the most common method for maintaining interdisciplinary communications (68.1%), followed by meetings (30.3%), and monthly (1.6%).

Participants were asked to identify the roles that were part of the antibiotic resistance controlling committee in their hospital (Figure 2).

Figure 2, presents the perceptions of respondents on the kind of cadres who form the antibiotic resistance controlling committees in the four hospitals. Pharmacists (42.5%) and clinical officers (30.8%) were most frequently reported by participants as being part of the antibiotic resistance committees whereas hospital management representatives (14.2%), infection control representatives (4.2%) nurses (3.3%) and others were less frequently reported as being part of these committees by respondents.

Table 5 presents the results of attitudes and practices regarding AMS. When asked about instances of uncertainty regarding the best antimicrobial therapy choice during practice, 52.9% of participants reported feeling this way sometimes, with 33.3% rarely feeling uncertain, and only 2.1% never feeling

uncertain. Regarding challenges related to inadequate funding for AMR stewardship activities, 37.5% sometimes experience this issue, compared to only 5.4% who never do.

Concerning essential antimicrobial agents at the facility, 48.3% sometimes experience stockouts. Most HCPs reported rarely receiving feedback on their antibiotic prescribing practices from management, with only 2.5% always receiving feedback. **See Table 5.**

Table 5: Attitudes and practices regarding AMR stewardship

Variable	Response %(n)				
	Always	Never	Often	Rarely	Sometimes
Uncertainty on antimicrobial choice	4.6(11)	2.1(5)	7.1(17)	33.3(80)	52.9(127)
Inadequate funding for AMS activities	10.4(25)	5.4(13)	27.9(67)	18.8(45)	37.5(90)
Shortages or stockouts of essential antimicrobial agents	8.8(21)	0	30.0(72)	12.9(31)	48.3(116)
Frequency of feedback on antimicrobial prescribing practice	2.5(6)	12.1(29)	7.1(17)	40.8(98)	37.5(90)

Figure 3, presents a graphical depiction of the level of confidence of the cadres we interviewed, regarding antibiotics prescribing. Among the clinical officers, the level of confidence was high, followed by the pharmacist, and nurses compared to the same among medical doctors and other cadres.

Table 6 presents healthcare professionals' perceptions of antimicrobial stewardship (AMS). Nearly all respondents (98.8%) identified antimicrobial resistance (AMR) as a critical issue in their practice settings, yet only 26.3% believed there was adequate community hospital support for AMS. Adherence to AMS protocols in hospitals was reported as intermediate (50.8%) to low (33.3%), while confidence in antimicrobial prescribing guidelines varied, with 42.9% of healthcare professionals expressing moderate confidence and 28.7% reporting high confidence. Workload was a significant barrier to AMS implementation, with 68.3% agreeing that current work demands negatively impacted their ability to practice AMS effectively. Regarding the establishment of AMS committees to strengthen stewardship efforts, 68.3% of respondents agreed, and 26.7% strongly agreed. The majority (67.9%) believed that regular audits and feedback could improve adherence to AMS guidelines, with 22.5% strongly supporting this view. Perceptions of government support were mixed, with 66.7% rating current policies as moderately (35%) to highly effective (31.7%) in supporting AMS efforts. Notably, 51.7% expressed confidence that implementing AMS programs could reduce antimicrobial resistance. **See Table 6.**

Table 6: Showing the healthcare professionals' attitudes and practices towards AMR.

Variable	Total (n)	Percent (%)
Believe antimicrobial resistance is a significant concern in your practice setting	237	98.8
There is sufficient community awareness and support for antimicrobial stewardship efforts in your hospital	63	26.3
The hospital's level of adherence to antimicrobial stewardship protocols		
Very High	2	0.8
High	23	9.6
Intermediate	122	50.8
Low	80	33.3
Very low	13	5.4
Healthcare worker's levels of confidence in the knowledge of antimicrobial prescribing as per the guidelines		
Very High	14	5.8
High	69	28.7
Intermediate	103	42.9
Low	49	20.4
Very Low	5	2.1
The impact of the current workload on healthcare workers' ability to practice antimicrobial stewardship effectively		
Strongly Agree	16	6.7
Agree	149	62.1
Neutral	60	25.0
Disagree	12	5.0
Strongly Disagree	3	1.3
Establishing antimicrobial stewardship committees within healthcare facilities would enhance antimicrobial stewardship efforts.		
Strongly Agree	64	26.7
Agree	164	68.3
Neutral	8	3.3

Disagree	2	0.8
Strongly disagree	2	0.8
Regular audits and feedback on antimicrobial prescribing adherence practices would help improve antimicrobial stewardship guidelines		
Strongly Agree	54	22.5
Agree	163	67.9
Neutral	8	3.3
Disagree	1	0.4
Strongly Disagree	14	5.8
Willing to actively engage in antimicrobial stewardship initiatives in your facility	240	100.0
Believe government policies and regulations are in support of antimicrobial stewardship efforts in Eastern Uganda		
Extremely effective	6	2.5
Very Effective	76	31.7
Moderately Effective	84	35.0
Slightly effective	48	20.0
Not all effective	26	10.8
Collaboration with other healthcare facilities or organizations would facilitate the implementation of antimicrobial stewardship	240	100.0
Implementing antimicrobial stewardship programs in Eastern Uganda will lead to a reduction in antimicrobial resistance		
Extremely Confident	20	8.3
Very Confident	124	51.7
Moderately Confident	57	23.8
Somewhat Confident	32	13.3
Not Confident	7	2.9

Knowledge of AMR and stewardship practices

Table 7 presents the level of knowledge of AMR and stewardship principles among HCPs. Out of the twelve knowledge questions, nearly all respondents correctly defined AMR (99.2%) and understood

stewardship's role (99.6%). Key practices like tailoring therapy based on cultures (95.0%) and avoiding broad-spectrum antibiotics as first-line (65.8%) were recognized. Awareness of stewardship goals (88.8%) and the link between agricultural antibiotic misuse and AMR (87.9%) was high. Yet, confidence in stewardship knowledge was lower (28.3%), suggesting a need for improved education and training. Overall, 98% were knowledgeable in AMR practices and only 2% had limited knowledge. **See Table 7**

Table 7: Showing the healthcare workers' level of Knowledge of AMR practices.

Knowledge item	CORRECT	FALSE	TRUE
Antimicrobial resistance (AMR) is the ability of microorganisms to withstand the effect of an antibiotic	TRUE	0.8(2)	99.2(238)
Antimicrobial stewardship is a program to promote the appropriate use of antimicrobials	TRUE	0.4(1)	99.6(239)
A core principle of antimicrobial stewardship is to tailor antibiotic therapy based on culture results	TRUE	5.0(12)	95.0(228)
De-escalation of antibiotic therapy based on culture results is a key component of antimicrobial stewardship	TRUE	6.3(15)	93.8(225)
Antimicrobial stewardship is a program that aims to reduce the incidence of antibiotic-resistant infections, improve patient outcomes, and decrease health cost	TRUE	11.3(27)	88.8(213)
Empirical antibiotic therapy should be reassessed within 48-72 hours based on culture results and clinical response	TRUE	7.1(17)	92.9(223)
Broad-spectrum antibiotics should be used as the first line of treatment for any infection	TRUE	34.2(82)	65.8(158)
Have you participated in any continuing education programs or workshops related to antimicrobial stewardship in the past year	TRUE	40.4(97)	59.6(143)
The misuse of antibiotics in agriculture can contribute to the development of AMR in humans	TRUE	12.1(29)	87.9(211)
Are you aware of the current local or national guidelines for antimicrobial use in your hospital setting	TRUE	34.6(83)	65.4(157)
Do you always use culture, and sensitivity results to guide antibiotic therapy	TRUE	43.8(105)	56.3(135)
Confident in your knowledge of antimicrobial stewardship principles?	TRUE	28.3(68)	71.7(172)

Discussion

There is limited data reporting AMS knowledge, attitudes and practices in Eastern Uganda, with this study providing novel insights that have the potential to inform policy and practice. The assessment of antimicrobial prescription practices and the evaluation of AMS-related KAP among HCPs in Eastern

Uganda are critical steps in combating AMR. This study has identified current strengths and gaps on AMS activities at four health facilities in Eastern Uganda. In addition, the study highlights general targeted interventions, need for training, and systemic support needed to improve antimicrobial use and safeguard the efficacy of antibiotics in Eastern Uganda. In this context, we found health workers possessed a high level of basic knowledge regarding AMS but which did not correspond to the actual practice as some HCPs were found to lack confidence in antibiotic prescription practices. However, while there may be some limitations with our measure of knowledge (lack of a standardised tool and only 70 validity rating), we think it likely that the high level of knowledge we found in this study might be explained by the high-capacity building on AMR and the existence of the Uganda Clinical Guidelines (UCG) for the management of infections in health facilities. The 98% level of knowledge found in our study is higher than the 75% by Mudenda and others in Zambia**[21]**.

We also found a high rate of inappropriate antibiotic prescribing practices within these settings which we think could be linked to the lack of proper diagnostics facilities in hospitals, more especially at the health sub-district level in Uganda. For instance, two out of the four facilities included in this study could not perform microbiological culturing and antimicrobial susceptibility testing. This finding is consistent with what Antoine and colleagues found in their multicentric community-based cohort study among paediatric outpatients, where inappropriate prescriptions were found to be high**[27]**.

Additionally, while a basic level of knowledge of antimicrobial resistance (AMR) was high among our participants, we found that significant gaps existed in the consistent application of stewardship principles. For instance, only 56.3% of healthcare professionals consistently used culture results to guide their therapy decisions and only 28.3% felt confident in their knowledge of antimicrobial stewardship (AMS), possibly due to the lack of culture and sensitivity diagnostic facilities. Furthermore, we found a high frequency of inappropriate antibiotic prescriptions, particularly resulting from the use of broad-spectrum antibiotics possibly driven by factors such as access to diagnostic tools that prevent the opportunity to use narrow-spectrum antibiotics requiring culture and sensitivity results. The findings support the call by Nuwematsiko and colleagues, who also found a high prevalence of inappropriate practices in Central Uganda **[28]**, for improved diagnostic support and adherence to guidelines.

Many HCPs indicated that heavy workloads negatively affect their ability to engage in AMS practices, with 62.1% of participants in our study stating that current workloads were a barrier to effective stewardship. The impact of workload on the quality of care is well-documented. Overburdened healthcare providers may prioritize immediate patient relief over optimal prescribing practices, leading to the misuse of antibiotics. Our study agrees with what Han found on workload and how it negatively affects HCPs' ability to perform other duties [29]. This underscores the need not only for enhanced training but also for systemic changes aimed at reducing workload and providing more support to HCPs. Moreover, when we tested the healthcare professional level of knowledge, the knowledge score was high, however, but the use of culture and sensitivity to guide therapy and participation in continuous education programs were low at 56.3% and 59.6% respectively.

Strengths and limitations

This was the first study to our knowledge investigating the current antibiotic stewardship practices in Eastern Uganda. The study achieved a high response rate from participants, which enhanced the reliability and generalizability of the findings. Additionally, by focusing on real-world practices and challenges faced by healthcare providers, the study provides practical insights that can inform policy and intervention strategies to improve AMS in similar settings. However, our study also had limitations. Firstly, the study was only descriptive, and we did not explore any form of association, although it provided an exploratory picture of AMS in Eastern Uganda. Secondly, our study relied heavily on self-reported data from healthcare providers, which may be subject to response bias, as participants might overestimate their knowledge or adherence to AMS practices. Thirdly, the study also primarily focused on public health facilities, potentially overlooking AMS practices in private healthcare settings, which may differ significantly. We also did not include data on patient outcomes, which would have provided a more comprehensive understanding of the impact of AMS practices on health outcomes. And, lastly, while the knowledge scale utilised in this study proved to be reliable, the questions were all positively worded with only True/False response options which may have biased the results. That said, our findings are broadly in line with other similar studies **[10]**.

Conclusion

This study provides valuable data on the current situation regarding AMR/AMS knowledge, attitudes and practices in Eastern Uganda. It highlights the need for targeted strategies to improve antimicrobial prescribing practices and enhance the knowledge, attitudes, and practices of healthcare providers. Strengthening these areas is crucial for combating antimicrobial resistance (AMR) in Eastern Uganda and ensuring the future efficacy of antibiotics more widely.

Recommendations

Based on our findings from this exploratory study on AMS in our setting, we suggest that health facilities should consider the value of implementing (and evaluating) regular training programs for healthcare providers on antimicrobial stewardship and AMR with a need to develop and disseminate clear, context-specific guidelines for antibiotic prescribing.

There is also an apparent need to improve access to diagnostic tools and resources necessary for appropriate antimicrobial prescribing and to establish robust monitoring and evaluation systems to track antibiotic prescribing patterns and adherence to guidelines.

Finally, there is a pressing need for more detailed and extensive research focused on AMS practices in this region if we are to make further progress in tackling AMR.

Abbreviations

AMR
Antimicrobial Resistance
AMS
Antimicrobial Stewardship
HCPs
Healthcare Providers
LMICs
Low-and Middle-Income Countries
WHO
World Health Organization
RRH
Regional Referral Hospital
KAP
Knowledge, Attitudes, and Practices
MRRH
Mbale Regional Referral Hospital
UNCST
Uganda National Council for Science and Technology
UCG
Uganda Clinical Guidelines

Declarations

Ethics approval and consent to participate

This study was approved by the Research Ethical Committee (REC) of Mbale Regional Referral Hospital (MRRH-2023-357) and the Uganda National Council for Science and Technology (UNCST). Administrative clearances were sought from the office of the director of MRRH, Soroti RRH, and in charge offices of Ngora Hospital and Atutur General Hospitals. Informed consent was sought from all the participants verbally and in writing. Participation in the study was voluntary, and all participants were assured that they were free to withdraw at any point and without consequence. All methods were carried out in accordance with relevant guidelines and regulations in the Declaration of Helsinki.

Consent for publication

The Mbale Clinical Research Institute (MCRI, www.mcri.ac.ug), a research entity affiliated with the Uganda National Health Research Organization, approved the publication of this manuscript.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Competing interests

"The authors declare no conflicts of interest."

Funding

This work was supported by The Open University's Open Societal Challenges programme and Mbale Clinical Research Institute (MCRI), Eastern Uganda.

Authors' contributions

The primary author contributed to this study by conceptualizing the Research design and drafting the initial manuscript. All the coauthors provided expertise in critically revising the manuscript for intellectual content. The last Author supervised the overall review, provided guidance throughout the manuscript drafting, and critically reviewed and revised the manuscript for important intellectual content. All authors have read and approved the final version of the manuscript.

Acknowledgements

We thank the healthcare providers and institutions in Eastern Uganda who participated in this study.

References

1. Waters, A., *AMR is a shared global problem.* Vet Rec, 2018. **183**(14): p. 429.
2. Seale, A.C., et al., *AMR Surveillance in low and middle-income settings - A roadmap for participation in the Global Antimicrobial Surveillance System (GLASS).* Wellcome Open Res, 2017. **2**: p. 92.
3. Rezasoltani, S., et al., *Antimicrobial Resistance as a Hidden Menace Lurking Behind the COVID-19 Outbreak: The Global Impacts of Too Much Hygiene on AMR.* Front Microbiol, 2020. **11**: p. 590683.
4. Mpagi, J.L., *Sustaining AMR-Awareness in post National Conference Era: A Case study of Busitema University*. 2019; Available from: https://cdn.southampton.ac.uk/assets/imported/transforms/content-block/UsefulDownloads_Download/D265FE3DCD0B4D7F8EE351376CD9DD23/J%20Mpagi%20-%20AMR-Awareness%20Presentation.pdf.
5. Stewart Williams, J. and S. Wall, *The AMR emergency: multi-sector collaboration and collective global policy action is needed now.* Glob Health Action, 2019. **12**(sup1): p. 1855831.
6. Tan, B., H. Davies, and C. members of the Paediatric Investigators' Collaborative Network on Infections in, *Dexamethasone and antibiotics for the empirical treatment of bacterial meningitis in Canadian children: A survey of paediatric infectious diseases specialists.* Paediatr Child Health, 2002. **7**(6): p. 390-7.
7. Heinz, W.J., et al., *Diagnosis and empirical treatment of fever of unknown origin (FUO) in adult neutropenic patients: guidelines of the Infectious Diseases Working Party (AGIHO) of the German Society of Hematology and Medical Oncology (DGHO).* Ann Hematol, 2017. **96**(11): p. 1775–1792.

8. de Louvois, J., R. Dagan, and I. Tessin, *A comparison of ceftazidime and aminoglycoside based regimens as empirical treatment in 1316 cases of suspected sepsis in the newborn. European Society for Paediatric Infectious Diseases–Neonatal Sepsis Study Group.* Eur J Pediatr, 1992. **151**(12): p. 876 – 84.
9. *The WHO AWaRe (Access, Watch, Reserve) antibiotic book. ISBN 978-92-4-006238-2 (electronic version).* Available from: https://www.who.int/publications/i/item/9789240062382. 2022, 1-679.
10. Mudenda, S., et al., *Antimicrobial stewardship: knowledge, attitudes and practices regarding antimicrobial use and resistance among non-healthcare students at the University of Zambia.* JAC-Antimicrobial Resistance, 2023. **5**(6) p. 1–10.
11. Singh, S., et al., *How do aged-care staff feel about antimicrobial stewardship? A systematic review of staff attitudes in long-term residential aged-care.* Antimicrobial Resistance & Infection Control, 2022. **11**(1): p. 92.
12. WHO. *Antimicrobial resistance*. 2023; Available from: https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance.
13. Do, N.T.T., et al., *Community-based antibiotic access and use in six low-income and middle-income countries: a mixed-method approach.* Lancet Glob Health, 2021. **9**(5): p. e610-e619.
14. Matee, M., et al., *Mapping and gap analysis on antimicrobial resistance surveillance systems in Kenya, Tanzania, Uganda and Zambia.* Bulletin of the National Research Centre, 2023. **47**(12) p. 1–8.
15. Katawera, V., *Antibiotic Resistance in Uganda: Situation Analysis and Recommendations*. Uganda National Academy of Sciences 2015: ISBN: 978-9970-424-10-8, Kampala, Uganda.
16. Rodriguez, G.D., et al., *Implementation of a Collaborated Antimicrobial Stewardship Program and Outpatient Parenteral Antimicrobial Therapy (OPAT) Unit-driven Monoclonal Antibody Therapy Program for COVID-19 at a NYC Hospital.* Int J Infect Dis, 2022: **118** p. 214–219.
17. Fajt, V.R., et al., *A call to action for veterinarians and partners in animal health to collect antimicrobial use data for the purposes of supporting medical decision-making and antimicrobial stewardship.* J Am Vet Med Assoc, 2022: **260**(8) p. 853–859.
18. Lau, T.M.M., et al., *A systematic review investigating the use of microbiology outcome measures in randomized controlled trials evaluating antimicrobial stewardship interventions published between 2011 and 2021.* JAC Antimicrob Resist, 2022. **4**(1): p. dlac013.
19. Hardefeldt, L.Y., et al., *Antimicrobial stewardship in companion animal practice: an implementation trial in 135 general practice veterinary clinics.* JAC Antimicrob Resist, 2022. **4**(1): p. dlac015.
20. Adegbite, B.R., et al., *Knowledge and perception on antimicrobial resistance and antibiotics prescribing attitude among physicians and nurses in Lambarene region, Gabon: a call for setting-up an antimicrobial stewardship program.* Antimicrob Resist Infect Control, 2022. **11**(1): p. 44.
21. Mudenda, S., et al., *Knowledge, awareness and practices of healthcare workers regarding antimicrobial use, resistance and stewardship in Zambia: a multi-facility cross-sectional study.* JAC Antimicrob Resist, 2024. **6**(3): p. dlae076.

22. WHO. *Quadripartite call to action for One Health for a safer world*. 2023; Available from: https://www.who.int/news/item/27-03-2023-quadripartite-call-to-action-for-one-health-for-a-safer-world.
23. Mayito, J., et al., *Characterization of Antibiotic Resistance in Select Tertiary Hospitals in Uganda: An Evaluation of 2020 to 2023 Routine Surveillance Data.* Trop Med Infect Dis, 2024. **9**(4) p. 1–19.
24. Cluver, L., et al., *Poverty, AIDS and child health: Identifying highest-risk children in South Africa.* South African medical journal = Suid-Afrikaanse tydskrif vir geneeskunde, 2013. **103**(12): p. 910-5.
25. Muula, A.S., *My Africa. Poverty, health, disease, and medical journalism.* Croatian medical journal, 2009. **50**(6): p. 598-9.
26. *Human Resources for Health Audit Report 2017/18. Ministry of Health (Department of Human Resource Management), Republic of Uganda. 2018.* Available from: http://library.health.go.ug/human-resources-health/human-resources-health-audit-report-201718.
27. Ardillon, A., et al., *Inappropriate antibiotic prescribing and its determinants among outpatient children in 3 low- and middle-income countries: A multicentric community-based cohort study.* PLoS Med, 2023. **20**(6): p. e1004211.
28. Nuwematsiko, N., et al. *High prevalence of inappropriate antibiotic prescriptions in selected health care facilities in Uganda*. Research Square 2024. Available from: https://www.researchsquare.com/article/rs-4442318/v1.
29. Han, M. and X. Zhang, *Impact of medical professionals on Carbapenem-resistant Pseudomonas aeruginosa: moderating effect of workload based on the panel data in China.* BMC Health Serv Res, 2020. **20**(1): p. 670.

Supplementary Material

The Supplementary Materials file is not available with this version.

Figures

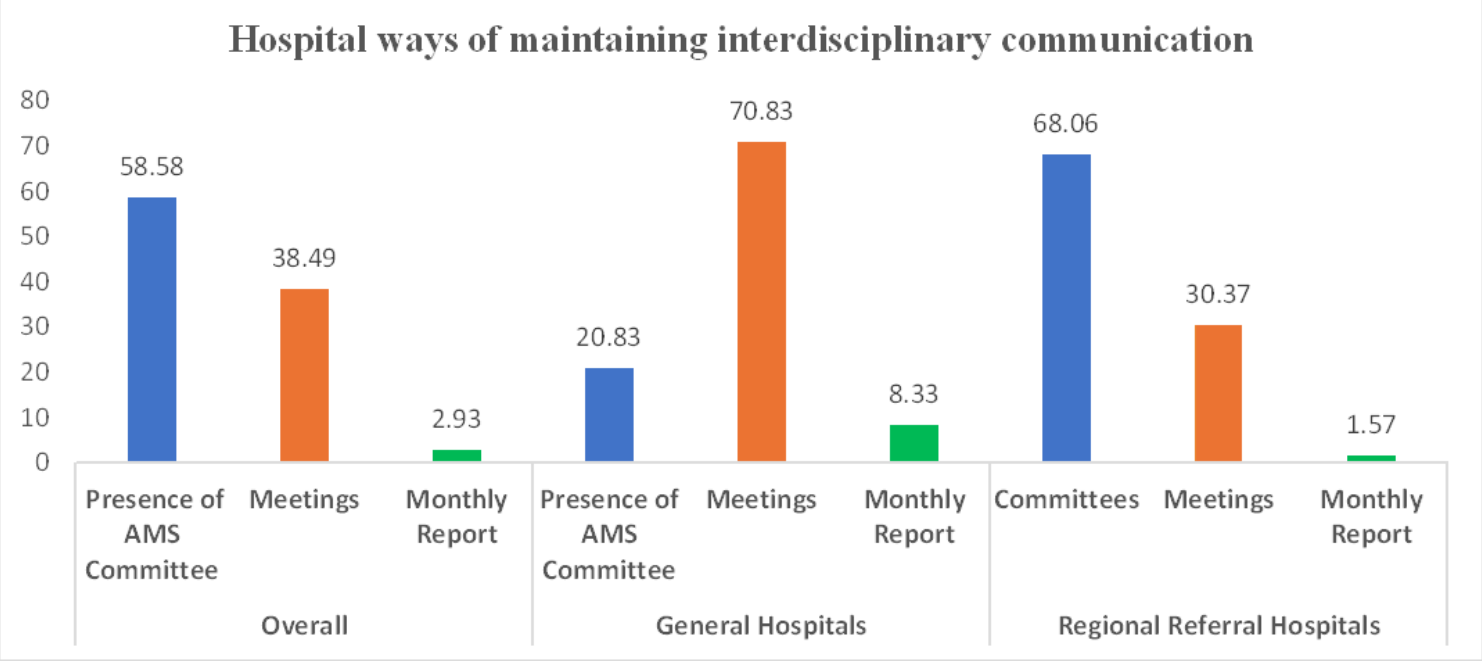

Figure 1

Reported methods used by hospitals to maintain interdisciplinary communication.

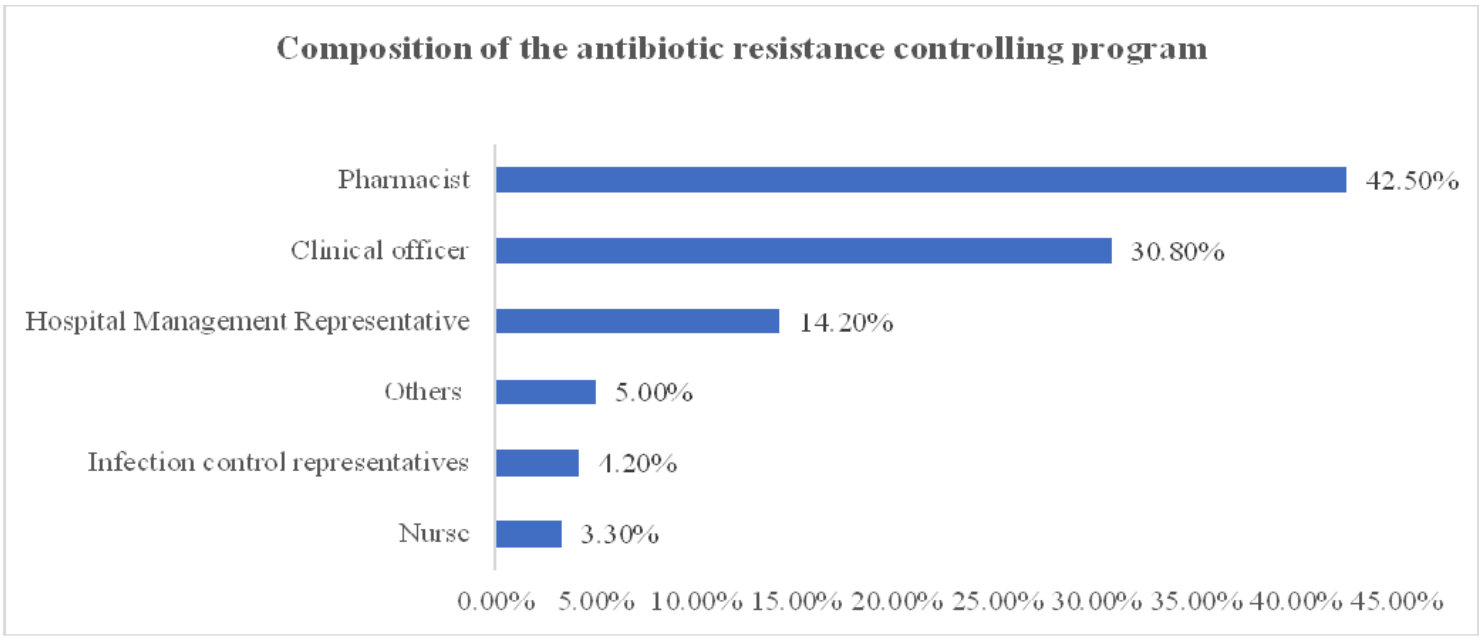

Figure 2

Showing the composition of the antibiotic's resistance-controlling program.

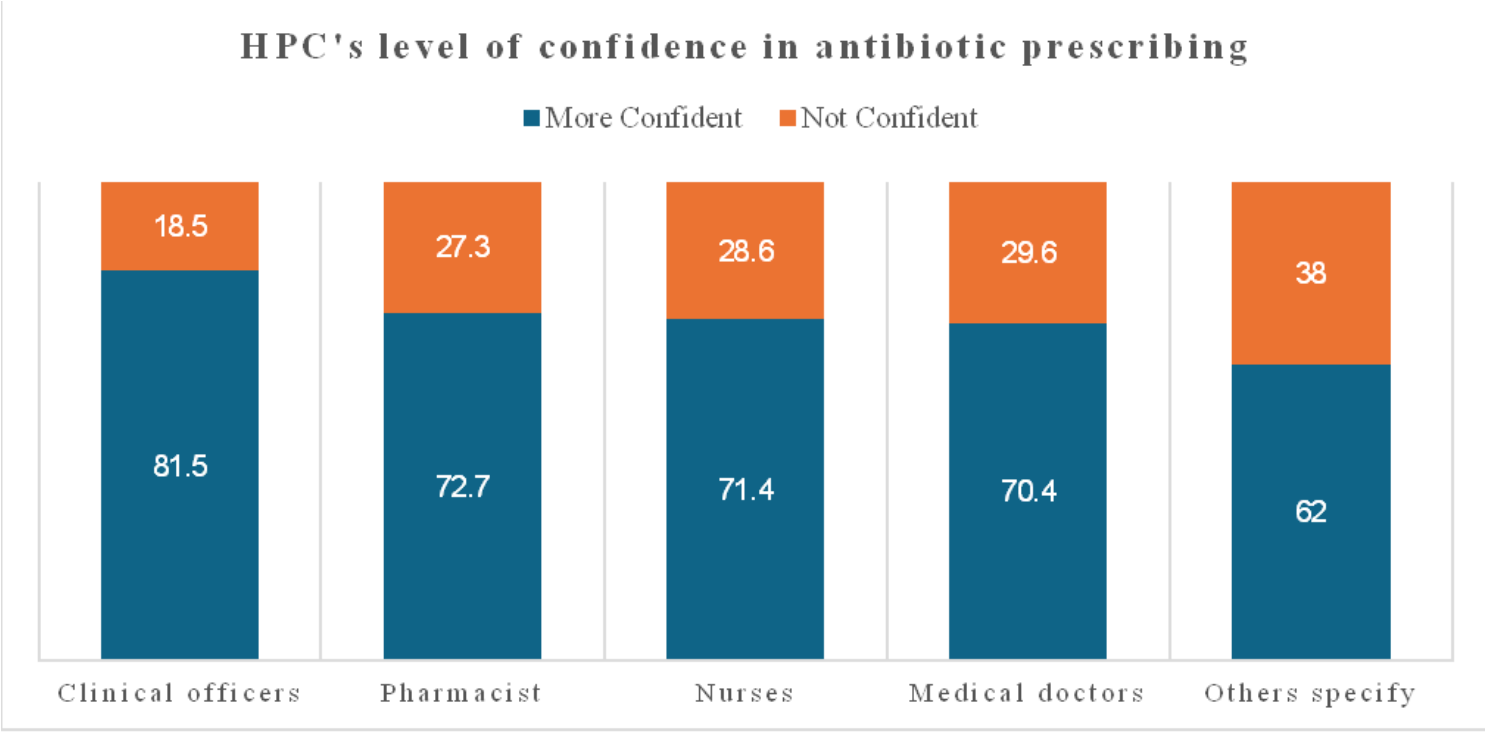

Figure 3

Showing the HCP's level of confidence in antibiotic prescribing.