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Knowledge, attitudes, and practices on antibiotic prescribing for acute upper respiratory tract infections among clinicians in health centers in Kigali, Rwanda

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Abstract

Introduction: *antimicrobial resistance (AMR) remains a global threat to public health, with the irrational use of antibiotics acknowledged as a significant force causing the resistance. In Rwanda, AMR-related deaths accounted for 2,400 of the country's 9,800 deaths in 2019, and of the 204 assessed nations, Rwanda has the 34th-highest age-standardized mortality rate linked to AMR. The study's main goal was to assess the level of knowledge, attitude, and practice regarding the prescription of antibiotics for acute upper respiratory tract infections by clinicians.* ***Methods:*** *we conducted a cross-sectional study to assess the knowledge, attitudes, and practices on antibiotics prescribing for acute upper respiratory tract infections among clinicians in health centers in the city of Kigali, Rwanda. Primary data were collected through structured questionnaires.* ***Results:*** *a total of 191 clinicians participated, the findings revealed substantial gaps in clinicians' knowledge, with 61.8% exhibiting poor knowledge of appropriate antibiotic use to treat acute upper respiratory tract infections. Attitudes towards antibiotic prescription were also concerning, as only 32.5% acknowledged the role of irrational prescription of antibiotics in developing resistance. Moreover, the study identified a deficiency in practice, with 38.7% of clinicians never avoiding antibiotic prescriptions for conditions such as the common cold.* ***Conclusion:*** *the insights from this study underline the need for targeted educational interventions and continuous professional development to improve antibiotic prescribing practices and mitigate the threat of antimicrobial resistance. The study findings are useful to policymakers in developing policies and appropriate interventions to promote rational antibiotic prescribing to halt the spread of antibiotic resistance.*

Introduction

Globally, public health is concerned with the spread of antibiotic resistance, and the overuse of antibiotics has been recognized as the primary contributing factor to this resistance. The resistant pathogen unpredictability in developing new mechanisms coupled with their rapid proliferation, makes the health system more vulnerable by not being able to treat common infections [1]. Antimicrobial resistance (AMR) is recognized as a severe public health threat in the developed world but more severe in the economically less developed world because of the fragility of their healthcare financing. The World Bank report concluded that around 700,000 people are dying of AMR-related infections, which is anticipated to escalate to 10 million by 2050. In Rwanda, AMR-related deaths accounted for 2,400 of the country's 9,800 deaths in 2019 and of the 204 assessed nations, Rwanda has the 34th-highest age-standardized mortality rate per 100,000 people linked to AMR [2].

The prescription of antibiotics in primary healthcare settings is considerable, and respiratory tract infections are the most prevalent, whereby in research conducted in primary healthcare, patients who were prescribed antibiotics are more than the WHO's 30% recommendation, with acute upper respiratory tract infections being the most common reason for prescription. In the National Action Plan on Antimicrobial Resistance for 2020-2024, the Rwandan government acknowledged the gravity of antimicrobial resistance as a global health concern that impacts food safety, animal and human health [3]. Researchers looked at antimicrobial susceptibility trends over five years at a tertiary healthcare facility in Kigali from 2009 to 2013 and reported that gram-negative bacteria became less sensitive to Imipenem and Colistin, and MDR-TB strains to isoniazid and rifampicin at 2.1% [4,5].

The knowledge of healthcare providers regarding the rational prescription of antibiotics to treat acute upper respiratory tract infections (AURTIs) has a crucial role in reducing the spread of AMR. Studies reported that gaining knowledge about the diagnosis of AURTIs, distinguishing between

bacterial and viral origins, and being aware of the principles of antibiotic stewardship are all crucial aspects of effective prescribing procedures [6], the attitudes of healthcare providers on the usage of antibiotics found to significantly impact the prescribing practices [7] and clinical decision-making found to have a relationship with the knowledge and attitudes of the clinicians, making it important to have a good knowledge and a positive attitudes towards cautious antibiotic usage and dedication to evidence-based medicine to promote responsible prescribing practices towards preventing the AMR. Prudent prescribing procedures are characterized by following clinical recommendations, carefully choosing antibiotics, considering local resistance patterns, and effectively communicating with patients about the reasons behind antibiotic selections. In addition, the implementation of diagnostic testing, follow-up care, and patient education play a significant role in comprehensive antibiotic stewardship initiatives [8].

Studies advocate that the most efficient means to tackle the considerable increase of antimicrobial resistance would be to decrease irrational prescription of antibiotics as in most cases of AURTIs as many are caused by viruses. The Food and Agriculture Organization (FAO) report said that the main objectives of Rwanda in fighting antimicrobial resistance are to call for improving awareness and tackling the problem of antimicrobial resistance through effective education, communication, capacity building, and to promote surveillance and research [9]. Despite this increase in antibiotic resistance and irrational use of antibiotics, in primary healthcare settings in Rwanda, knowledge, attitudes, and practices of clinicians have not been assessed. This is particularly important for acute respiratory infections, which ranked among the top ten causes of morbidity in all health facilities and a focus for the health centers as they receive 82.5% of all medical visits [10]. “The primary objective of this study was to assess the knowledge, attitude, and practices about prescribing antibiotics for acute respiratory tract infections amongst clinicians working in the health centers of the City of Kigali.

Methods

Study area: the study was carried out in the health centers located within the City of Kigali, the capital of Rwanda. Rwanda, a landlocked East African nation, characterized by its picturesque landscapes. This study covered all three districts of the City of Kigali. There are 36 health centers, with 16 in Gasabo, 10 in Kicukiro, and 10 in Nyarugenge district. These health centers provide comprehensive primary healthcare services to the general population, where 82.5% of all medical visits occur at health centers [10]. The City of Kigali is located at Rwanda´s geographical heart and has a population of 1.2 million, occupying an area of 730km^2, Gasabo is the largest district by geographical area at 429.3km^2, followed by Kicukiro with 166.7km^2 and Nyarugenge 134km^2.

Study design: we conducted a cross-sectional study from January to March 2024, primary data were collected through structured questionnaires from 191 clinicians who were practicing in health centers in the city of Kigali. The study utilized a quantitative approach.

Study population: the study population were nurses and clinical officers who were authorized to do consultations and who were at the time of this research employed to work in the health centers in the city of Kigali districts. The total number of consulting clinicians in 36 health centers of the districts of Kigali city is estimated to be 378 [11].

Sample and sampling method: the sample size used in this study was calculated based on a formula developed by Cochran [12] a method to determine an appropriately representative sample size for proportions. In this study, a total of 191 clinicians were enrolled. This study covered all three districts of the City of Kigali. There are 36 health centers distributed throughout the entire region, with 16 in Gasabo, 10 in Kicukiro, and 10 in

Nyarugenge district. And all health centers were sampled, at the health center level, clinicians in consultations were invited to participate until the desired number was reached, as the probability proportional to size of the study population was estimated.

Data collection method: the questionnaires were self-administered using a paper-and-pen format during in-person sessions. The questionnaire comprised four parts that include social demographic characteristics to track socio-demographic information, level of knowledge, attitude-related questions, and practices towards the use of antibiotics to treat acute infections affecting the upper respiratory tract. Questions were adapted from similar studies [13-17] that have been used to assess the level of the knowledge on the rational prescription of antibiotics, on weighing the benefits against the harms of antibiotics, and on antibiotic resistance. Questions used in similar studies [7,18-20] were used to assess the attitude related to ignorance, fear, complacency, indifference and responsibility avoidance on the rational prescription of antibiotics, on weighing the benefits against the harms of antibiotics and on antibiotic resistance and the practice related questions used in similar studies [20-23] were used to check the self-reported practices on the antibiotic prescription to treat acute respiratory tract infections, educate patients, influence from patients requests and use of guidelines and treatment protocol.

Data analysis: the study collected primary data using a questionnaire with closed questions to collect information. After data collection, data were cleaned and analyzed using SPSS 29.0.1.0 Descriptive statistics were performed to analyze research variables. Chi-square test and regression analysis were used to examine the association between dependent and independent variables. The level of knowledge was assessed using 9 polar questions where respondents were asked to make judgments on statements concerning the antibiotics use and antibiotic resistance. For the polar questions, 1 point was given to the correct answer and 0 to the incorrect answer. The total number of accurate responses per participant and the percentage of participants who gave a correct answer to each question were determined. The attitude was measured using 10 statement questions, five-point Likert scale was used, where a negative mark indicated disagreement and on the other hand, a positive mark indicated agreement. The sum of the scores in the same unit was summed, and averages were calculated. Practice was assessed by a set of 15 positive and negative practice questions using a five-point Likert scale. Overall practice scores ranged from 15 to 75 and percentages were calculated. The knowledge, attitudes, and practices scores were categorized using Bloom´s cut-off points, which were utilized in similar studies [24,25].

Ethical consideration: before conducting this study, data collection authorization letter was sought from Mount Kenya University, and ethical clearance with reference MKU/ETHICS/23/01/2024(1), has been issued by the Ethical Review Board. Individuals who chose to participate in the study were provided with comprehensive information about the research. Respondents were required to sign a consent form before they could proceed with filling out the questionnaire.

Validity and reliability: in this research, a questionnaire was piloted to 19 nurses in a different district to determine the reliability, and the calculated Cronbach´s Alpha found to be 0.781, which concluded that the internal consistency of this survey was acceptable. We controlled internal validity by avoiding unclear or complicated terms. Also, to ensure content validity, the instrument items were adapted from the questionnaire used in previous similar studies and were reviewed by experienced professionals.

Results

Social demographic characteristics of respondents: in this study, a total of 191 clinicians

were interviewed. Among them, as illustrated in Table 1, 147 (76.96%) were females, and 44 (23.04%) were males. The age group ranging from 35 to 45 years constituted the highest number of respondents, 92 (48.17%). Following that, the second-largest age group consisted of individuals over 45 years, accounting for 31.9% of the respondents. For academic qualification, more than half of the participants totaling 100 (52.36%) had A1 in nursing, and 72 (37.7%), 17 (8.9%), and 2 (1.05%) of the respondents had A2 in nursing, A0 in nursing, and Clinical Officer A0, respectively. In terms of working experience, the data shows that most respondents, accounting for 62 (32.46%), had 11 to 15 years of experience.

Clinicians´ knowledge on antibiotics prescription to treat AURTIs: of the 191 clinicians who participated in this study, a total of 118 (61.8%) had a poor level of knowledge, with scores ranging from 0 to 6. A total of 70 (36.6%) respondents demonstrated a moderate level of knowledge, with scores ranging from 6.1 to 8, while only 3 respondents (1.6%), had a good knowledge level , scoring between 8.1 and 10. More than half of the respondents, specifically 112 (59%), responded that antibiotics are not beneficial in treating colds and flu, 101 (53%) acknowledged the negative consequences and potential dangers linked to the overuse of antibiotics, a majority of 113 respondents (59%) were aware of the ability of antibiotics to trigger drug allergies, 100 (52%), expressed the opinion that antibiotics should not be discontinued once their symptoms have improved and 98.52% acknowledged that resistance occurs when medications become ineffective against bacterial infections. However, more than half of 112 (59%) responded that using only part of a prescribed course of antibiotics does not reduce their effectiveness.

Clinicians´ attitude on antibiotics prescription to treat AURTIs: generally, respondents of this study, 135 (70.7%) demonstrated a positive attitude while 56 (29.3%) had a negative attitude. The positive attitude range was delineated as scores ranging from 30 to 50, whilst scores below 30 reflected negative attitudes. Among the respondents, 32.5% strongly agreed or agreed that antibiotics have an impact on the development of resistance, 29.8% expressed strong agreement or agreement that incorrect medications result in harm, 51.3% reported that patient expectations have an impact on their judgments, while 45.7% confessed to providing antibiotics without adequate time to elucidate their non-essentiality, 56% of clinicians are influenced by worries regarding patient retention, while 43.4% are influenced by issues regarding patient perception. On the other hand, 58.1% of respondents expressed disagreement with the practice of administering antibiotics as a preventive measure against secondary infections, and 56% of respondents indicated that they refrain from giving unnecessary antibiotics even in the absence of accurate patient tracking.

Clinicians´ practices on antibiotics prescription to treat AURTIs: regarding the self-reported practices, among the 191 clinicians, only 25.1% exhibited good practices, achieving scores ranging from 60 to 75. 40.8% of the participants demonstrated moderate practices, receiving scores ranging from 45 to 59, and 34.0% were classified as having poor practices, as their scores were below 44. A total of 85.2 (44.6%) reported that they often avoid prescribing antibiotics for tonsillitis, pharyngitis, common cold, sinusitis, purulent rhinitis, otitis media, and bronchitis. When it comes to denying a patient's request for an antibiotic, 41.3% to deny, while 42.2% reported providing them. On another hand, among all participants, 100 (57.5%) reported that they rarely take time to explain to patients the reason for prescribing antibiotics, 96 (50.3%) reported that they do not explain the risks associated with taking antibiotics, and 110 (57.5%) reported that they do not follow any antibiotic prescription guidelines when prescribing antibiotics for acute upper respiratory tract infections. In addition, a total of 79 (41.3%) reported minding the potential emergence of bacterial resistance to antibiotics when prescribing antibiotics, and 95 (49.7%)

reported taking into consideration the potential adverse effects of the antibiotic treatment. Furthermore, a total of 92 (49.3%) reported that they rarely practice delayed antibiotic prescribing, and 60 (31.4%) reported that in the face of uncertainty whether the AURTIs is of viral or bacterial origin, they depend on diagnostic tests to confirm.

Regression analysis: the study found that the respondents with good knowledge predominantly have moderate practices, while those with moderate knowledge showed a mix of good and moderate practices, and none fall into poor practice. Conversely, respondents with poor knowledge are widely spread across all practice levels, with a substantial number exhibiting poor practices. Roughly 24.7% (p=0.001) of the variance in practice scores is explained by knowledge scores. In addition, the study found, as indicated in Table 2, an association between positive attitudes and good practices, with 47 out of 135 respondents demonstrating both positive attitudes and good practices and most respondents with negative attitudes exhibited poor practices, with attitude scores explain around 48% of the variation in practice scores (R squared = 0.480). This study found an association between higher levels of knowledge and positive attitudes towards antibiotics and their use, as well as a strong link between respondents' attitudes and practices. Among the various factors influencing practice scores, attitude evaluations have the strongest impact, with a substantial standardized coefficient ($\beta = 0.561$, $p < 0.001$), indicating that more positive attitudes are significantly associated with better practices. Knowledge scores also significantly influence practice scores ($\beta = 0.174$, $p = 0.005$), while demographic factors such as age, gender, education level, and administrative position show weaker or non-significant associations. However, years of working experience demonstrate a moderately positive relationship ($\beta = 0.117$, $p = 0.05$), suggesting that practical experience positively influences practices.

Discussion

The study provides important new information about the knowledge, attitudes, and practices of clinicians regarding the prescription of antibiotics for acute upper respiratory tract infections. The data revealed important knowledge gaps, with only 1.6% displaying good knowledge and 61.8% having a poor understanding of antibiotic prescriptions to treat acute infections affecting the respiratory tract. Despite a generally positive attitude toward cautious antibiotic usage, only 25.1% of clinicians had good practices. The study´s findings suggest that a large proportion of clinicians are at risk of prescribing antibiotics inappropriately, potentially contributing to the growing threat of antibiotic resistance, which poses a significant challenge for patient safety and public health. The findings imply as well that although medical professionals are aware of the potential hazards associated with overprescription, misconceptions and practical difficulties continue, which exacerbates the problem of antibiotic resistance. The results of the study align with other studies conducted in low- and middle-income countries, including Palestine, where gaps in understanding were also noted, and the Democratic Republic of Congo [25,26] where medical professionals voiced concerns regarding antibiotic resistance. Contrasting results from research conducted in China, where medical professionals showed more knowledge [27].

For the practices toward antibiotic prescriptions for acute upper respiratory tract infections, Althagafi and Othman (2022) found that the majority were willing to prescribe antibiotics for conditions like purulent discharge and to prevent complications, suggesting a tendency toward overprescription [28]. This contrasts with a study conducted by Maraqa *et al*. [25], which reported that 96.5% of clinicians indicated that guidelines influenced their selection of prescribed antibiotics. Most of them stated that they did not feel pressured by patients or family members to prescribe antibiotics (90.5%) and did not prescribe

antibiotics to prevent secondary infections (59.8%). On the association between higher levels of knowledge and positive attitudes towards antibiotics and their use, the study conducted in Yerevan, Arminia which found a significant association between the percent scores of attitudes and practice, while that study did not find any significant relationship between the scores of practices and knowledge [29]. The study found that younger clinicians are more likely to follow current antibiotic guidelines due to recent training emphasizing evidence-based practices [30]. Higher education levels enhance critical thinking and guideline adherence [31]. Additionally, female clinicians often show more conservative prescribing behaviors, possibly due to increased risk awareness [32].

While the study adds useful information to the global understanding of antibiotic stewardship, it also emphasizes the necessity of customized treatments that take local situations into account. To enhance antibiotic prescribing practices, the study highlights the significance of addressing attitudes as well as knowledge. Positive attitudes have a significant relationship with better practices, which implies that educational programs that promote a greater understanding of antibiotic resistance and its dangers can impact the practices. Furthermore, the fact that years of experience are associated with improved practices suggests that on-the-job training and ongoing professional development may be critical to improving antibiotic use in clinical settings. This emphasizes how important it is for Rwanda to implement targeted training initiatives and strictly enforce prescription guidelines to reduce the danger of antibiotic resistance.

Notwithstanding the study's insightful conclusions, several issues remain unresolved. Subsequent studies should investigate the underlying reasons for the knowledge gaps that have been found, whether they are due to systemic issues like patient pressure or time limits, or to initial or continuing medical training. Research may also look at the efficiency of initiatives, like the enforcement of guidelines or awareness campaigns, in lowering overprescription. Additionally, longitudinal studies would be helpful in evaluating how knowledge, attitudes, and practices develop over time and in figuring out whether improvements in clinician behavior can be sustained.

Limitations: this study focused on clinicians practicing in public health facilities, it did not capture those in private settings, counting 3.4% of medical visits occurred in primary health care settings (MoH, 2018). In addition, as this study relied on respondents' self-report and did not evaluate actual practice by watching healthcare professionals' clinical performance or using a simulated client method, the study cannot assume that these findings reflected the existence of a routine behavioral response. The diverse sample size of 191 practitioners sampled from all health centers located in the city of Kigali is one of the study's strengths; it enhances the generalizability of the findings among Kigali's health centers. Furthermore, the study analyzed various facets of antibiotic prescribing, such as knowledge, attitudes, and practices, to provide a comprehensive understanding. However, disadvantages include the reliance on self-reported data, which may result in reporting bias. Furthermore, the study's cross-sectional design limits the capacity to draw causal conclusions about knowledge, attitudes, and actions. Geographic and institutional restrictions also suggest that the findings may not be representative of clinicians working in all health centers in Rwanda, particularly those working in rural or private settings.

Conclusion

The study aimed to investigate the knowledge, attitude, and practice of primary healthcare clinicians in the city of Kigali, regarding the prescription of antibiotics for acute upper respiratory infections. A notable gap in the knowledge, attitudes, and practices of primary

healthcare providers in Kigali when it comes to prescribing antibiotics for acute upper respiratory tract infections (AURTIs). Demographic variables, such as gender, age, and educational qualification, have an impact on knowledge levels. Generally, younger, more educated, and female respondents showed higher performance. The findings suggest that the knowledge and attitude of clinicians towards antibiotic prescription significantly influence their practice of prescribing antibiotics to treat acute upper respiratory tract infections. These results are statistically significant and provide important information for improving the appropriate use of antibiotics in the treatment of these infections. These results provide important insights for healthcare providers and policymakers to improve public knowledge and practices regarding antibiotics prescription for acute upper respiratory tract infections. Overall, the findings of this study could inform interventions to improve the rational use of antibiotics and reduce the emergence of antibiotic resistance. The results suggest that improving the knowledge and attitude of clinicians working in health centers in the city of Kigali can lead to improved antibiotic prescription practices to treat acute upper respiratory tract infections.

What is known about this topic

- *Antimicrobial resistance is globally recognized as a global threat to public health, with Rwanda having the 34th highest age-standardized mortality rate per 100,000 population associated with AMR across 204 countries;*
- *Irrational use of antibiotics was recognized as a major contributor to this resistance phenomenon;*
- *In Rwandan primary healthcare, patients who were prescribed antibiotics are more than the WHO's 30% recommendation, with acute upper respiratory tract infections being the most common reason for prescription.*

What this study adds

- *There is a notable gap in knowledge regarding antibiotics prescription to treat acute upper respiratory infection among clinicians practicing in the health centers in the City of Kigali, Rwanda;*
- *There is a positive relationship between knowledge, attitude, and practice towards antibiotics prescription to treat acute upper respiratory infection among clinicians practicing in the health centers in the City of Kigali, Rwanda.*

Competing interests

The authors declare no competing interests.

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Authors' contributions

All the authors have read and agreed on the final manuscript.

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Tables

Table 1: social demographic characteristics of health care workers

Table 2: prediction of respondents' knowledge, attitudes, and demographic characteristics on practices

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Table 1: social demographic characteristics of health care workers		
Variable	**Frequency (n)**	**Percent (%)**
Gender		
Female	147	76.96
Male	44	23.04
Total		100
Age	191	
<25 years	2	1.05
25-34 years	36	18.85
35-45 years	92	48.17
>45 years	61	31.94
Total		100
Education qualification	191	
A2 in nursing	72	37.70
A1 in nursing	100	52.36
A0 in nursing	17	8.90
Clinical officer A0	2	1.05
Total		100
Respondents possess an administrative position	191	
Yes	18	9.42
No	173	90.58
Total		100
Working experience	191	
Five years or less	27	14.14
5-10 years	61	31.94
11-15 years	62	32.46
16-20 years	31	16.23
>20 years	10	5.24
Total		100
Training on antimicrobial resistance	191	
Yes	100	52.4
No	91	47.6
Total	191	100

Table 2: prediction of respondents' knowledge, attitudes, and demographic characteristics on practices

Coefficients

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.	95.0% confidence interval for B	
		B	Std. Error	Beta			Lower bound	Upper Bound
1	(Constant)	-0.543	0.389		-1.397	0.164	-1.310	0.224
	The gender of the participant	-0.035	0.096	-0.019	-0.361	0.719	-.224	0.155
	The age of the participant	-0.025	0.073	-0.024	-0.346	0.730	-0.169	0.119
	Education level of the participant	0.077	0.067	0.067	1.151	0.251	-0.055	0.209
	The participant possesses an administrative position	0.196	0.140	0.075	1.399	0.164	-0.080	0.472
	Years of working experience of the participant	0.084	0.044	0.117	1.901	0.05	-0.003	0.171
	The participant received the training on antimicrobial resistance	0.109	0.093	0.073	1.168	0.244	-0.075	0.293
	knowledge scores	0.255	0.090	0.174	2.829	0.005	0.077	0.434
	Attitude scores	0.941	0.107	0.561	8.777	0.000	0.730	1.153

a. **Dependent variable: practice scores**

Model summary

Model	R	R-square	Adjusted R-squared	Std error of the estimate	Change statistics				
					R-squared change	F Change	df1	df2	Sig. F Change
1	0.731[a]	0.535	0.514	0.534	0.535	26.136	8	182	0.000

B = unstandardized coefficient, Std. Error = standard error, Beta = standardized coefficient, t = t-value, Sig. = significance, R = multiple correlation coefficient, R-square = coefficient of determination, adjusted R-square = adjusted coefficient of determination, Std. error of the estimate = standard error of the estimate, F change = F-statistic for R square change, df1 = degrees of freedom 1, df2 = degrees of freedom 2, Sig. F change = significance of F change, [a] = dependent variable: practice scores