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RESEARCH

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Prescription patterns of antibiotics and associated factors among outpatients diagnosed with respiratory tract infections in Jinja city, Uganda, June 2022–May 2023

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Abstract

Background Most respiratory tract infections (RTIs) are viral and do not require antibiotics, yet their inappropriate prescription is common in low-income settings due to factors like inadequate diagnostic facilities. This misuse contributes to antibiotic resistance. We determined antibiotic prescription patterns and associated factors among outpatients with RTIs in Jinja City, Uganda.

Methods We conducted a retrospective observational study that involved data abstraction of all patient records with a diagnosis of RTIs from the outpatient registers for the period of June 1, 2022, to May 31, 2023. An interviewer-administered questionnaire capturing data on prescribing practices and factors influencing antibiotic prescription was administered to drug prescribers in the health facilities where data were abstracted and who had prescribed from June 1, 2022, to May 31, 2023. We used modified Poisson regression analysis to identify factors associated with antibiotic prescription.

Results Out of 1,669 patient records reviewed, the overall antibiotic prescription rate for respiratory tract infections (RTIs) was 79.8%. For specific RTIs, rates were 71.4% for acute bronchitis, 93.3% for acute otitis media, and 74.4% for acute upper respiratory tract infections (URTIs). Factors significantly associated with antibiotic prescription included access to Uganda Clinical Guidelines (Adjusted prevalence ratio [aPR] = 0.61, 95% CI = 0.01–0.91) and Integrated Management of Childhood Illness guidelines (aPR = 0.14, 95% CI = 0.12–0.87, $P = 0.002$), which reduced the likelihood of prescription. Prescribers without training on antibiotic use were more likely to prescribe antibiotics (aPR = 3.55, 95% CI = 1.92–3.98). Patients with common cold (aPR = 0.06, 95% CI = 0.04–0.20) and cough (aPR = 0.11, 95% CI = 0.09–0.91) were less likely to receive antibiotics compared to those with pneumonia.

Conclusion The study reveals a high rate of inappropriate antibiotic prescription for RTIs, highlighting challenges in adherence to treatment guidelines. This practice not only wastes national resources but also could contribute to the growing threat of antibiotic resistance. Targeted interventions, such as enforcing adherence to prescription guidelines, could improve prescription practices and reduce antibiotic misuse in this low-income setting.

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Keywords Respiratory tract infections, Antibiotic prescriptions, Drug resistance, Prescription drug misuse, Uganda

Introduction

Approximately 30–50% of the global antibiotics consumed are prescribed inappropriately [1–4]. The antibiotics prescribed for respiratory tract infections unnecessarily constitute 40–80% in low- and middle-income countries (LMICs) [5–7], Studies in Uganda have also revealed a high prevalence of prescription of antibiotics for respiratory tract infections (RTIs) (40–80%) which indicates a high level of inappropriate prescription of antibiotics [8, 9].

According to Uganda clinical guidelines 2016, the causes of respiratory tract diseases are mostly viral and do not require antibiotics [10]. Inappropriate prescription of antibiotics is the main driver of antimicrobial resistance (AMR) [11], Antimicrobial resistance threatens infection control leading to longer hospital stays, need for more expensive medicines, death, financial challenges to those impacted and undermines the achievements in various areas of modern medicine [12, 13]. Bacterial AMR was responsible for 1.27 million death in 2019 and this was predicted to rise to 10 million per year by 2050 [13].

Globally, upper respiratory tract infections (URTIs) constituted 42.8% of all causes of global burden of disease in 2019 [14]. In Uganda, RTIs accounted for 29.8% of out-patient department attendance during the financial year 2019/2020 and were the second highest after malaria [15]. That makes RTIs important infections in the context of public health.

Both the World Health organization (WHO) and Uganda Ministry of Health (MoH) recognize the high burden of inappropriate use of antibiotics and its significant contribution to AMR. Surveillance of antibiotic use and research on patterns of antibiotic use forms part of the strategic objectives for the WHO's Global Action Plan on AMR and the Uganda's AMR National Action Plan 2018–2023 [16, 17]. In a recent national study that included Jinja Regional Referral Hospital (Jinja RRH), a broader range of AMR priority pathogens was recovered from Jinja RRH [18]. This finding suggests an increased risk of AMR spread and potential issues with inappropriate antibiotic use in Jinja City. However, the specific patterns of antibiotic prescription and associated factors among patients with RTIs in Jinja City have not been studied. Given that RTIs are prevalent and account for a significant proportion of antibiotic consumption [14, 15, 19], this study aimed to determine the prescription patterns of antibiotics and associated factors among patients with RTIs in Jinja City, in order to inform strategies for the Ministry of Health and local leaders to promote appropriate antibiotic use.

Methods

Study design, setting and study population

This was a quantitative retrospective observational study in which patient data were collected retrospectively while prescribers were interviewed by a questionnaire in 11 public health facilities. The health facilities included Jinja Regional Referral hospital ($n=1$), Health centers IVs ($n=4$), and Health centers IIIs ($n=6$) in Jinja City, Uganda. Data were collected from June1, 2022 to May 31, 2023. The public health system in Jinja City consisted of 26 public health facilities, including Jinja Regional Referral Hospital, 13 Health Center IIs, 8 Health Center IIIs, and 4 Health Center IVs. Uganda's health care system consists of a hierarchy health facility service levels starting with village health team (VHTs) at community village level as the lowest to the health center II at parish level, health center III at sub county level, health center IV at county level and general hospital at district level, RRH at regional level and National Referral Hospital (NRH) at national level as the highest. The volume, complexity of services and specialties increases across the hierarchy such that the lower levels refer patients to the next higher levels. Uganda Clinical guidelines (UCG) and Integrated Management for Childhood Illnesses (IMCI) are the standard treatment guidelines used in Uganda.

Inclusion and exclusion criteria

We included outpatient records of individuals diagnosed with RTIs from public health facilities in Jinja City between June 1, 2022, and May 31, 2023 and health workers at these health facilities who prescribed for more than six months (130 working days) during the same period. Exclusion criteria comprised records with missing entries for age, sex, and diagnosis. Additionally, we excluded records from Health Center IIs because they have few prescribers who are majorly nurses. Records of RTI patients with other infectious comorbidities were also excluded.

Sample size determination and sampling procedure

To determine the prevalence of antibiotic prescription, the appropriateness of antibiotic prescriptions, and patient factors associated with antibiotic prescriptions, we aimed to retrospectively abstract 1,790 patient records from outpatient registers. This target was set to ensure a sample size above the WHO-recommended minimum of 600, allowing for over 100 records from each of the 11 public health facilities after data cleaning, as per WHO/INRUD guidelines for assessing prescribing quality [20]. Given the potential for data inaccuracies and incompleteness, this larger sample size was intended to guarantee that, after addressing inconsistencies such as missing data, we would still meet the requirement of at least 100 records per facility and an overall minimum of 1,100 records.

To account for varying patient loads across different facilities and avoid over- or under-sampling at individual sites, we calculated the sample size for each health facility based on the average rate of outpatients with RTIs during the study period:

$$Facility\ sample\ size = \frac{total\ number\ of\ RTI\ out\ patients\ for\ the\ facility}{total\ number\ of\ RTI\ outpatients\ for\ all\ facilities\ in\ the\ study.} \times study\ sample\ size$$

The total number of patients diagnosed with RTIs was obtained from the health facility out-patient monthly Health Management Information System (HMIS) 105 report. This report summarizes monthly outpatient data for each disease condition diagnosed at the health facilities.

To identify health system factors associated with antibiotic prescription, we aimed to interview all available health workers at the 11 public health facilities who had prescribed antibiotics during the study period (June 1, 2022, to May 31, 2023). Health facility heads or in-charges provided lists of all prescribers, and we used attendance registers to count the number of days each prescriber had worked. Only those who had prescribed for at least six months (130 working days) were considered for interviews. This approach was taken to enable the linkage of prescription data to the prescribers' activities during the study period, ensuring that the prescribers interviewed were those most likely responsible for the prescriptions analyzed in the patient records.

Due to limited logistics, we could not include all 26 public health facilities in Jinja City. Thus, we purposively selected 11 public health facilities to ensure a sufficient number of prescribers for the interviews. Jinja Regional Referral Hospital (RRH) was selected for being the only public RRH in Jinja City with the highest number of prescribers. All four health center IVs were included for their high number of prescribers. Six out of eight health center IIIs in Jinja City were selected by simple random sampling.

At each health facility, patient records were selected from outpatient registers using systematic random sampling. The sampling interval (K) was calculated using the formula K=N/n, where K is the sampling interval, *N* is the total number of patient records available at a given health facility, and *n* is the health facility sample size.

Study variables

The dependent variable in this study was the rate of antibiotic prescription for respiratory tract infections (RTIs), Additionally, we assessed the antibiotics prescribed based on the AWaRe grouping, which categorizes antibiotics into Access, Watch, and Reserve groups.

The independent variables in this study included patient-related factors, such as age and sex, as well as RTI-specific factors, such as the type of RTI, including acute bronchitis, acute otitis media, and acute upper respiratory tract infections (URTIs. The study also considered healthcare facility-related factors, such as the service level of the health facility and the availability of clinical guidelines. Furthermore, prescribers' training on antibiotic use was examined as a potential factor influencing antibiotic prescription practices.

Data management and analysis

The patient records and interview responses were collected into predesigned templates in Kobo collect software, downloaded as excel sheets. The resultant excel sheet was exported into Stata software version 14.0 (StataCorp, College Station, Texas, USA) for analysis.

To assess the appropriateness of antibiotic prescription for RTIs, we compared the prevalence of antibiotic prescription for individual and generalized RTIs against optimal values recommended by the World Health Organization (WHO) and the European standards. For example, the optimal values for antibiotic prescription include less than 20% for acute tonsillitis, <20% for acute otitis media, less than 20% for acute upper respiratory tract infections (ARTIs), <30% for acute bronchitis, and 90–100% for pneumonia [21]. Rates above the optimal values were to indicate inappropriate prescribing of antibiotics for RTIs. We calculated the index for percentage encounter with antibiotics by a method described by [22]. Index score of antibiotic prescription=WHO/INRUD Optimal value of antibiotic prescription/Observed value.

The rate of appropriate prescribing=observed indices/optimal indices) X 100 [22]. The optimal indices for all WHO/INRUD prescribing indicators is 1. The rate of inappropriate prescription=100- rate of appropriate prescribing. To ensure a comprehensive evaluation, we used both WHO and European standards. The WHO standard provides a general morbidity cut-off of 30% encounter with antibiotics [23] suitable for predominantly viral RTIs, while the European standard offers specific cut-offs for different RTIs, allowing for a more detailed assessment [21].

Factors associated with antibiotic prescription were determined using modified Poisson regression analysis. Initially, a bivariate analysis was conducted to assess the association between each individual variable and antibiotic prescribing, with results presented as crude prevalence ratios and 95% confidence intervals. Subsequently, a multivariate analysis was performed, including all factors with a *p*-value<0.05. The type of RTI diagnosis was

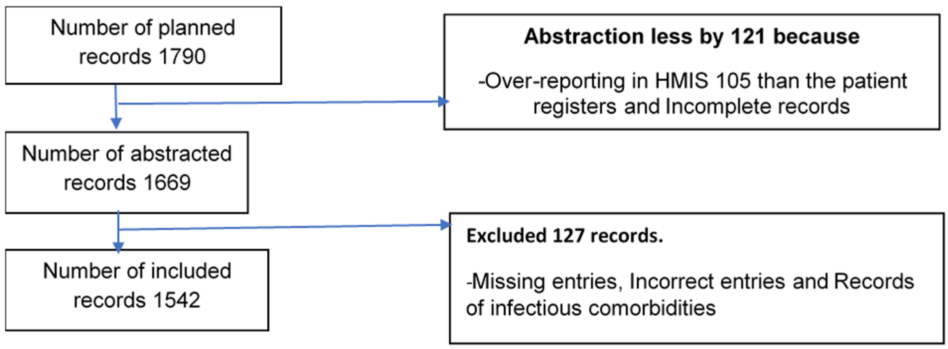

Fig. 1 Flow chart showing included and excluded outpatient records, Jinja City, Uganda, June 1, 2022 to May 31, 2023

Table 1 Socio-demographic characteristics of outpatients with respiratory tract infections, Jinja City, Uganda, June 1, 2022 to May 31, 2023

Variable	Frequencies (*N* = 1,542)	Percentages (%)
Health facility		
HCIIIs	674	43.7
HCIVs	692	44.9
Referral Hospital	176	11.4
Sex		
Male	694	45.0
Female	848	55.0
Age (years)		
0–5	449	29.1
6–18	394	25.6
19–30	346	22.4
31–64	323	21.0
≥ 65	30	1.9

Table 2 Social-demographic characteristics of prescribers interviewed using a questionnaire, *n* = 30

Variable	Frequencies (*n* = 30)	Percentages (%)
Facility Service level		
Health Center III	13	43.33
Health Center IV	11	33.67
Regional Referral Hospital	6	20.00
Gender		
Male	18	60
Female	12	40
Professional Category		
Medical Doctor	1	3.3
Clinical Officer (CO)	17	56.7
Nursing Officer (NO)	2	6.7
Assistant nursing officer (ANO)	7	23.3
Certificate nurse	3	10.0

included in the multivariate analysis irrespective of its *p*-value in the bivariate analysis, as it is a known confounder for antibiotic prescription in patients with RTIs [24]. Variables with *p*-values < 0.05 after adjustment were considered significantly associated with antibiotic prescription.

Results

There were 1669 patient records with a diagnosis of RTI reviewed from outpatient registers. We remained with 1542 after data cleaning (Fig. 1).

Of the 1542 outpatients, 55.0% were female. The highest number of patients (44.9%) were from health center IVs and 11.4% were from the Jinja Regional Referral Hospital. No rapid point diagnostic test was used at all the facilities (Table 1).

We interviewed 30 prescribers of whom 60.0% were male, 60.0% were clinicians (clinical officers or medical officers), the rest being nurses. Only 10.0% of the prescribers had a certificate in nursing (Table 2).

Prevalence of antibiotic prescription

Out of 1,542 patients with respiratory tract infections (RTIs), 79.8% (1,230) received antibiotics. Of the total antibiotics (*n* = 1,230) prescribed, most were received for un-categorized ARTI (40.9%), followed by un-categorized URTI (28.5%) and common cold 8.13% (Fig. 2).

Category of antibiotics prescribed for patients with RTIs

A total of 1,387 antibiotics were prescribed with the majority (86.6%; *n* = 1,197) falling into the access group. Among the access group, amoxicillin accounted for approximately half (50.45%) of all antibiotic prescriptions and was the most commonly prescribed, followed by cotrimoxazole at 17.3%. The Watch category comprised 186 (13.4%) of the prescriptions, with azithromycin at 4.56%, erythromycin at 3.9%, ciprofloxacin at 1.45%, and cefixime at 2.1% being the most prescribed antibiotics within this category. Notably, no antibiotics were prescribed from the Reserve group (Fig. 3).

Appropriateness of antibiotic prescription

This study found that a significant majority (79.8%) of outpatients seeking treatment for respiratory tract

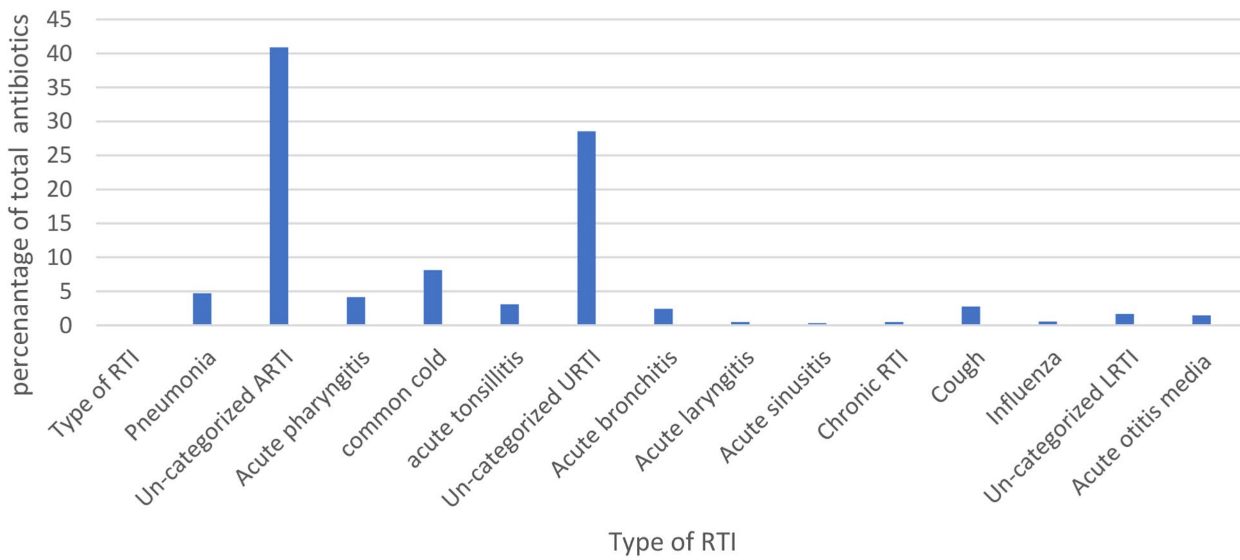

Fig. 2 percentage of the total antibiotics prescribed for different types of RTIs among outpatients in Jinja City, Uganda, June 1, 2022 to May 31, 2023, (*n* = 1, 230); RTI: Respiratory tract infection; LRTI: Lower respiratory tract infection

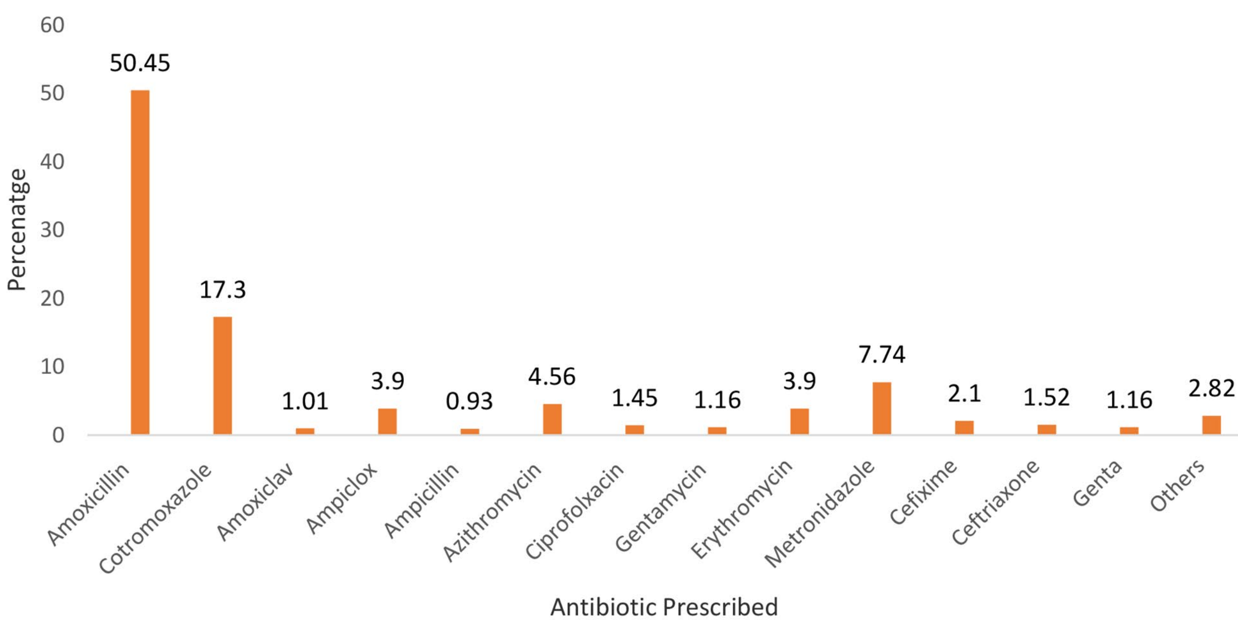

Fig. 3 Antibiotics frequently prescribed to outpatients with respiratory tract infections, Jinja City, Uganda, June 1, 2022 to May 31, 2023; RTI; Genta: gentamycin

Table 3 WHO/INRUD prescribing indicators and their index scores

Prescribing indicators	Observed value	WHO Standard	Index score	Optimal index score
Average drugs per encounter	2.8	≤ 3	1	1
%encounter with antibiotics	79.8%	< 30%	0.38	1

infections (RTIs) were prescribed antibiotics, indicating a high rate of antibiotic prescription that substantially exceeds the WHO's optimal threshold of 30% [23]. Additionally, using the calculated index score for percentage encounter with antibiotic of 0.38 (Table 3), the level of inappropriate antibiotic prescription was calculated at 62.0%.

Furthermore, when comparing the prescription rates of antibiotics for individual respiratory tract infections

(RTIs) in selected age groups with European standard optimal rates (Table 4), the rates observed: Acute tonsillitis 99.3%, Acute otitis media 93.3%, Acute upper respiratory tract infections (URTIs) 74.36% signified inappropriate antibiotic prescribing. Considering the European standard optimal rates for RTIs patients eligible for antibiotics excluding pneumonia (90–100%) and bronchitis (30%) (Table 4), the rate of inappropriate prescribing was calculated at 74.9%.

Factors associated with antibiotic prescription

At multivariable analysis, several factors were significantly associated with antibiotic prescription. Prescribers who had access to Uganda Clinical Guidelines [Adjusted Prevalence Ratio (aPR)=0.61, 95% CI=0.01–0.91, $P<0.001$] and Integrated Management of Childhood Illness [aPR=0.14, 95% CI=0.12–0.87, $P=0.002$] were less likely to prescribe antibiotics than those without access to a standard treatment guideline. Prescribers who had not received training on antibiotic use [aPR=3.55, 95% CI=1.92–3.98, $p=0.01$] were 3.55 times more likely to prescribe antibiotics than those who had received training. Additionally, patients with common cold [=0.06, 95% CI=0.04–0.20, $p=0.001$] and cough [aPR=0.11, 95% CI=0.09–0.91, $p=0.015$] were less likely to be prescribed antibiotics compared to those with pneumonia (Table 5).

Discussion

The study assessed antibiotic prescription patterns and associated factors among outpatients diagnosed with RTIs in Jinja City, Uganda. The overall rate of antibiotic prescription for RTIs was 79.8%, with specific rates for acute bronchitis at 71.4%, acute otitis media at 93.3%, and acute upper respiratory tract infections (URTIs) at 74.4%. The study also revealed a 62.0% rate of inappropriate antibiotic prescription. Factors significantly associated with antibiotic prescription included access to reference guidelines, prescriber training on antibiotic use, and the type of RTI.

This study found that a significant majority (79.8%) of outpatients seeking treatment for respiratory tract infections (RTIs) were prescribed antibiotics, indicating a high rate of antibiotic prescription for RTIs, that substantially exceeds the WHO's optimal threshold of 30% [23]. This highlights the common practice of antibiotic use in managing RTIs. These findings are consistent with those from public health facilities in Mbarara City, Uganda, which reported an antibiotic encounter rate among RTI patients of 77.6% [8].

According to World Health Organization, most respiratory tract infections are viral and therefore minimal use of antibiotics is recommended [25]. WHO recommends maximum antibiotic prescription for RTIs at 20.0–26.8% [26]. In this study we found that even RTIs which are largely considered to have a viral cause had very high antibiotic prescription rates. These include acute otitis media 94.7%, Acute tonsillitis 92.7%, common cold 41.0%, uncategorised URTIs 87.1%, re-categorized and un-categorized URTIs 72.8%. The findings are similar to those of various studies in China where an average 83.7% with URTIs received antibiotics [27]. Appropriate use of antibiotics for management of infections is one of the leading causes of antimicrobial resistance [28]. While most respiratory tract infections (RTIs) are viral, they can sometimes be associated with bacterial infections [10, 29]. The high use of antibiotics for managing RTIs may be attributed to clinical diagnosis, which often leaves prescribers uncertain about whether the RTI is solely viral or also involves bacterial infection. To mitigate the risks of antibiotic resistance, it is crucial to enhance diagnostic methods. Implementing rapid point of care diagnostic tests for RTIs could help differentiate between viral and bacterial infections, enabling more targeted and appropriate use of antibiotics.

This study assessed the appropriateness of antibiotic prescriptions based on the rates for different RTI categories. The rates were as follows: acute bronchitis (71.4%), acute tonsillitis (99.3%), acute otitis media (93.33%), and acute upper respiratory tract infection (URTI) (74.36%). These rates exceeded the acceptable ranges of 0–30% for acute bronchitis and 0–20% for the other RTIs [21]. The rate of antibiotic prescription for acute URTIs was slightly higher than that reported in Mbarara City, Uganda at 68.7% [8], indicating an over-prescription of antibiotics for viral RTIs where they are not required. Comparison with international rates showed that Canada had lower rates for acute bronchitis (52.6%), acute sinusitis (48.4%), and otitis media (39.3%) [30]. In the United States, Fleming also reported a low rates noting that it was 84.7% for sinusitis and 21.2% for viral URTIs [31].

Table 4 Extent of appropriate prescribing based on disease specific prescribing quality indicators according to European standards

Morbidity	Age group (years)	Antibiotics Prescribed		Acceptable range (%)	Appropriateness
		No *n* (%)	Yes *n* (%)		
Acute bronchitis	18–75	4 (28.7)	10 (71.4)	0–30	Inappropriate
Acute tonsillitis	> 1	3 (7.5)	37 (99.3)	0–20	Inappropriate
Acute Otitis media	> 2	1 (6.67)	14(93.3)	0–20	Inappropriate
Acute URTI	> 1	189 (25.6)	548(74.36)	0–20	Inappropriate
Pneumonia	18–65	0 (00)	7(100)	90–100	Appropriate

URTI: Upper respiratory tract infection

Table 5 Regression analysis of patient and health system factors associated with antibiotic prescription, Jinja City, Uganda, June 1, 2022 to May 31, 2023

Variable	Antibiotic prescribed		cPR (95% CI)	*P*-value	aPR (95% CI)	a*P*-value
	Yes 1230(79.8)	No 312(20.2)				
Age (years)						
0–5	350(78.0)	99(22.0)	Ref			
6–18	320(81.2)	74(18.8)	1.0(0.94–1.16)	0.45		
19–30	276(79.8)	70(20.2)	1.0(0.92–1.14)	0.68		
31–64	260(80.5)	63(19.5)	1.0(0.92–1.16)	0.57		
≥ 65	24(80.0)	6(20.0)	1.0(0.77–1.34)	0.89		
Sex						
Female	667(78.5)	182(21.5)	Ref			
Male	564(81.4)	129(18.6)	1.47(0.13–3.89)	0.27		
Supervision of prescribing						
No	815(78.8)	220(21.2)	Ref			
Yes	416(81.8)	92(18.2)	1.02(0.01–3.67)	0.45		
Accessible Ref guide**						
None	293(85.7)	49(14.3)	Ref		Ref	
IMCI	88(77.2)	26(22.8)	1.02(0.01–8.62)	0.71	0.14(0.12–0.87)	*0.02**
UCG	849(78.2)	237(21.8)	0.11(0.02–0.98)	*0.01**	0.61(0.01–0.91)	0.01*
Training on antibiotic use**						
Yes	130(73.9)	46(26.1)	Ref		Ref	
No	1101(80.5)	266(19.5)	1.87(1.02–1.99)	*0.03**	3.55(1.92–3.98)	*0.01**
Health facility Level**						
HCIII	568(84.4)	105(15.6)	Ref		Ref	
HCIV	532(76.8)	161(23.2)	0.91(0.11–0.99)	*0.01**	0.71(0.19–3.16)	0.75
RRH	130(73.9)	46(26.1)	0.43(0.15–0.91)	*< 0.01**	0.32(0.11–1.73)	0.33
Re-attendance						
No	1216(80.1)	303(19.9)	Ref			
Yes	15(65.2)	8(34.8)	0.21(0.76–1.29)	0.07		
RTI diagnosed**						
Pneumonia	58(89.2)	7(10.8)	Ref		*Ref*	
Un-categorized ARTI	503(91.1)	49(8.9)	0.25(0.01–1.27)	0.12	0.62(0.17–1.03)	0.63
Acute pharyngitis	51(89.5)	6(10.5)	0.31(0.26–2.19)	0.10	0.14(0.01–19.16)	0.47
common cold	103(41.0)	146(58.6)	0.11(0.01–0.29)	*0.03**	**0.06(0.04–0.20)**	***0.001****
acute tonsillitis	38(92.7)	3(7.3)	0.41(0.12–3.13)	0.15	0.63(0.18–10.1)	0.15
Un-categorized URTI	351(87.1)	52(12.9)	0.18(0.11–4.87)	0.45	0.13(0.04–3.32)	0.22
Acute bronchitis	30(81.1)	7(18.9)	0.33(0.27–7.19)	0.76	0.13(0.01–2.95)	0.21
Acute laryngitis	6(66.5)	2(33.5)	0.67(0.19–2.21)	0.18	0.27(0.14–3.64)	0.33
Acute sinusitis	4(80.0)	1(20.0)	0.12(0.11–4.15)	0.91	0.17(0.05–6.19)	0.61
Chronic RTI	6(85.7)	1(14.3)	0.13(0.11–1.25)	0.06	0.61(0.05–1.71)	0.16
Cough	34(69.4)	15(30.6)	0.13(0.11–1.19)	0.06	**0.11(0.09–0.91)**	**0.015***
Influenza	7(26.9)	19(73.1)	0.03(0.01–0.39)	*0.01**	**0.15(0.12–0.39)**	**0.01***
Un-categorized LRTI	21(87.5)	3(12.5)	0.45(0.01–1.14)	0.45	0.17(0.03–4.03)	0.41
Acute otitis media	18(94.7)	1(5.3)	0.52 (0.08–7.12)	0.68	0.21(0.06–3.95)	0.26

*statistically significant, $P<0.05$, cPR crude prevalence ratio, aPR adjusted prevalence ratio: Ref: Reference category; RTI: Respiratory tract infection; LRTI: Lower respiratory tract infection; URTI: Upper respiratory tract infection; UCG: Uganda Clinical Guidelines; IMCI: Integrated Management of Childhood Illness; ARTI: Acute respiratory tract illness; RRH: Regional referral hospital; HC: Health center; **variables included in the multivariate analysis model if P value was below 0.05

The lower rates in Canada and the USA are attributed to interventions such as evidence-based antibiotic stewardship and patient and clinician education, which aim to reduce antibiotic prescriptions. Overuse of a antibiotics for viral infections significantly contributes to antibiotic resistance [32]. Strengthening antibiotic stewardship programs targeting both healthcare providers and the public, could reduce antibiotic overuse in this setting and preserve the effectiveness of antibiotics for future generations.

In this study, prescribers without access to standard treatment guidelines were more likely to prescribe antibiotics for RTIs compared to those with access to UCG and IMCI. This highlights the importance of clinical guidelines in guiding prescription decisions. In settings where diagnosis is primarily symptom-based and guidelines are lacking, prescribers may error on the side of caution, leading to overprescription of antibiotics to avoid potential consequences of withholding or delaying treatment. This finding is consistent with literature emphasizing the role of clinical guidelines in promoting appropriate antibiotic use [32, 33]. However a study by Durkin in U.S.A showed that inappropriateness of antibiotic prescribing remained high despite national efforts to avail best practice guidelines to reduce antibiotic prescribing [34]. This suggests that guidelines alone may not be sufficient, and additional interventions such as regular trainings, support supervision, and stricter monitoring may be necessary to reduce inappropriate prescribing. Prescribers who are trained in antibiotic use are likely to have a better understanding of the risks and benefits associated with antibiotic prescriptions [35]. This finding is consistent with a study by [36], where prescribers believed that the quality of their prescriptions was influenced by the availability of regular educational activities, as well as stricter rules and monitoring of antibiotic prescribing. This finding underscores the importance of education and training in promoting judicious antibiotic use, aligning with the principles of antibiotic stewardship.

Patients with common cold and cough were less likely to receive antibiotics compared to those with pneumonia, indicating a higher likelihood of correct classification of viral infections (e.g., common cold and cough) versus bacterial infections (e.g., pneumonia). This observation suggests that the high rate of inappropriate antibiotic use in Jinja City was mainly due to other types of RTIs, excluding common cold and cough. In Canada common cold along with acute bronchitis, acute sinusitis and miscellaneous non-bacterial infections contributed to the highest percentage (80%) of unnecessary prescription of antibiotics for RTIs [30]. However, the actual rate (18%) was lower than the rate at which common cold patients were prescribed with antibiotics in Jinja City (41%). The difference can be explained the fact that Canada has more elaborate guideline for RTIs which reduce the chance for prescribing antibiotics for all RTIs.

Strengths and limitations of the study

The study had some limitations. First, there was no opportunity to meet and re-assess the clinical condition of the patients to evaluate the prescriber's basis for withholding/delaying or prescribing antibiotics, as the study was retrospective and such information could not be obtained from the patient registers. Prospective studies that could yield such information were avoided due to the associated Hawthorne effect [37]. Second, the prescribers interviewed were linked to the records based on their prescribing activities during the study period. Thus, there was a potential information bias because individual prescriptions were not directly linked to specific prescribers due to the lack of prescriber identities in the patient registers. This limitation may have introduced inaccuracies in associating prescriber factors with prescribing practices. Finally, a significant proportion RTI diagnoses were generalized into broad categories such as ARTIs, acute URTIs, and LRTIs, rather than being categorized into specific diagnoses. This broad classification limited the assessment of antibiotic prescription appropriateness to a relatively small proportion of patients with specific RTI diagnoses. Additionally, the absence of laboratory data to rule out bacterial infections further limited our ability to accurately determine the appropriateness of antibiotic use; we could not reliably distinguish between viral and bacterial RTIs.

The strengths of this study include a substantial sample size of 1,542 patient records, well distributed across 11 health facilities, which exceeded the WHO's recommended minimum of 600 records. Furthermore, the data collection spanned all months of the year, effectively accounting for seasonal variations in RTI prevalence.

Conclusions

The study reveals a high rate of inappropriate antibiotic prescription for RTIs in Jinja City, Uganda, highlighting significant challenges in adherence to treatment guidelines. This not only undermines efforts to promote rational antibiotic use, a key strategy in combating antibiotic resistance, but also results in the wastage of resources used for RTI treatment. The high prescription rates were notably associated with facilities lacking access to standard treatment guidelines and lacking training programs on antibiotic use. Implementing targeted interventions, such as ensuring adherence to prescription guidelines, could enhance prescription practices and mitigate antibiotic misuse in this setting and similar low-income settings.

Abbreviations

ARTI	Acute respiratory tract infections
AMR	Antimicrobial resistance
INRUD	International Network of Rational Use of Drugs
IMCI	Integrated Management of Childhood Illness
LRTI	Lower Respiratory Tract Infection
RTI	Respiratory Tract Infections
RRH	Regional Referral Hospital
UCG	Uganda Clinical Guidelines
URTI	Upper Respiratory Tract Infection
WHO	World Health Organization

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Author contributions
ZKI wrote was the principle investigator for the study leading to award of the Masters of public health. ZKI wrote the first and main draft of the manuscript, RM played a big role in reviewing and editing the manuscript, JK was the supervisor for the research that led to this work and guided ZIK is developing the study protocol and presentation of the work that led to this manuscript. HM developed the soft ware for collecting raw data and did statistical analysis part of the work that resulted in this manuscript.

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Data availability
Data is provided within the manuscript. Supplementary data supporting the conclusions of this study are available from the corresponding author upon reasonable request. Raw data will be available to interested parties upon request and approval by Mbarara University of Science and Technology Research and Ethics Committee (MUST-REC) and the National Council for Higher Education of Uganda.

Declarations

Ethical approval and consent to participate
Approval to conduct this study was sought and approved by Mbarara University of Science and Technology Research and Ethics Committee (MUST-REC): reference number MUST- 2023 – 814. The study was also approved by National Council of Science and Technology under registration number. HS3499ES. Permission to conduct the study in public facilities Jinja City was thought from the City health officer of Jinja City and the Director of Jinja Regional Referral Hospital. We obtained informed consent from each prescriber who participated in the study. Patient name and other identifiers were concealed throughout the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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