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 cross-sectional study at 11 public health facilities in Jinja City, Eastern Uganda, from June 1, 2022, to May 31, 2023. We abstracted 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. 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 antibiotic training 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 significant 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.

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

1.0 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 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]. The high prevalence of antimicrobial resistance at Jinja Regional Referral Hospital, Uganda, as reported in a recent study[18], suggests the potential for inappropriate antibiotic use in Jinja City. However, the specific patterns of antibiotic prescription and associated factors among patients with respiratory tract infections (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 study in which patient data was collected retrospectively while prescribers were interviewed by a questionnaire in 11 public health facilities of purposively selected service levels. The facilities included Jinja Regional Referral hospital 01, Health centers IVs (n=4), and Health centers IIIs (n=06) in Jinja City, Uganda. Data were collected from June1, 2022 to May 31, 2023. he public health system in Jinja City consists of 26 public health facilities, including Jinja Regional Referral Hospital, 13 Health Center IIs, 8 Health Center IIIs, and 4 Health Center IVs. The 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, Regional Referral Hospital (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 lowest level refer patients to the next highest level. Uganda Clinical guidelines (UCG) and Integrated Management for Child hood 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. Exclusion criteria comprised records with missing entries for age, sex, and diagnosis. Additionally, we excluded records from Health Center IIs and those of RTI patients with other infectious comorbidities.

Sample size and sampling procedure

In order to determine the prevalence of antibiotic prescription, the appropriateness for prescription of antibiotic, and patient factors associated with antibiotic prescription, we targeted to retrospectively abstract 1790 patient records from the outpatient register. The reason was to have a sample size which was above 600 and that would allow having more than 100 records from each of the 11 public health facilities as recommended by WHO/INRDU for studies assessing the quality of prescribing, [20].

To cater for patient load at different levels of the facilities so as to avoid oversampling and under sampling at individual facilities, we calculated the sample size for each facility based on the average rate of out-patients with RTIs at the facility during the study period.

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

The total number of patients diagnosed with RTIs was obtained from the Health unit out-patient monthly HMIS 105 report. This report summarizes the total number of cases for each disease condition diagnosed at the health facility within a month. In order to establish health system factors that were associated with antibiotic prescription we targeted to interview all prescribers available in the 11 public health facilities.

We purposively selected public health facilities: one being Jinja Regional Referral Hospital premised on having the highest population of prescribers. The same method was used to select four health center IVs being the only ones in the Jinja City. Six out of eight health center IIIs in Jinja City were selected by simple random sampling. The prescribers were purposively sampled, on the premise of being persons who had prescribed antibiotics for more than 30 days during the study period.

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 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 responses in the excel sheet from the interview of prescribers were applied to patient’s records excel sheet. This was done in such way that if more than 75% of the prescribers accepted that a certain health system factor applied to their facility, then it was applied on all its patients. For-example if 75% of the prescribers accepted that there was no access to UCG then every patient at that facility was assumed to be diagnosed when there was no access to UCG by the prescriber. 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 Europe. 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 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.

The patient and institutional factors that can be used to predict antibiotic prescription were determined by modified Poisson regression analysis. A bivariate analysis was performed and the results for association between each individual variable with antibiotic prescribing were summarized into frequencies and crude prevalence ratio at a confidence interval of 95% and P-value. A multivariate analysis was then performed by including all the factors with p-value < 0.05, however all the sub-variables under type RTI diagnosis were included irrespective of their P-value at bivariate analysis. Any variables with a p value that is less than 0.05 after adjustment was considered to be associated with antibiotic prescription among RTI out-patients in public health facilities in Jinja City.

RESULTS

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

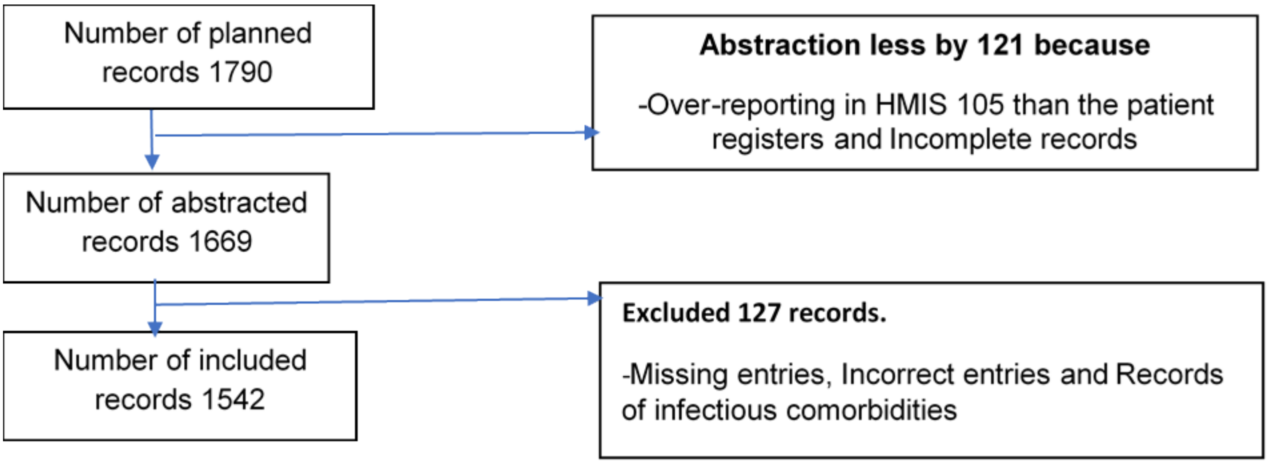

Fig.1. Flow chart showing included and excluded outpatient records, Jinja City, Uganda, June 1, 2022 to May 31, 2023.

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 (Table1).

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)		
0-2	264	17.1

3-18	579	37.5
19-64	671	43.5
Over 65 (65+)	30	1.9

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).

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

Variable	**Frequencies (n=30)**	**Percentages (%)**
Facility Service level		
HCIII	13	43.33
HCIV	11	33.67
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

Prevalence of antibiotic prescription

Out of 1,542 patients with respiratory tract infections (RTIs), 79.8% (1230) received antibiotics. Among specific RTIs, the highest rates of antibiotic prescription were observed for acute laryngitis (100%), acute otitis media (94.7%), acute tonsillitis (92.7%), and uncategorized acute respiratory tract infections (ARTIs) (91.1%) (Fig. 2).

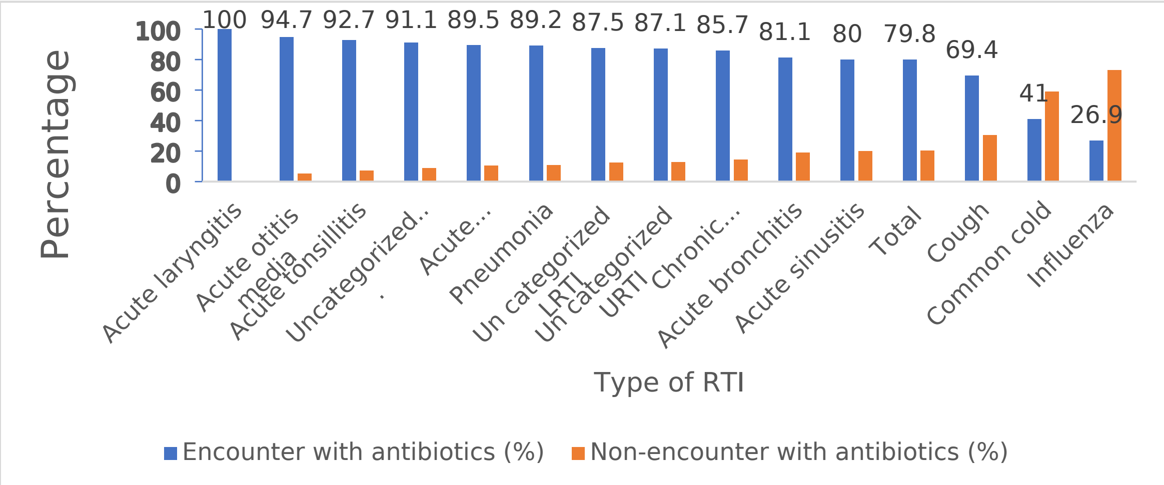

Figure.2: Prevalence of antibiotic prescription by specific RTIs, among outpatients in Jinja City, Uganda, June 1, 2022 to May 31, 2023.

Category of antibiotics prescribed for patients with RTIs

A total of 1387 antibiotic prescriptions were recorded, 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).

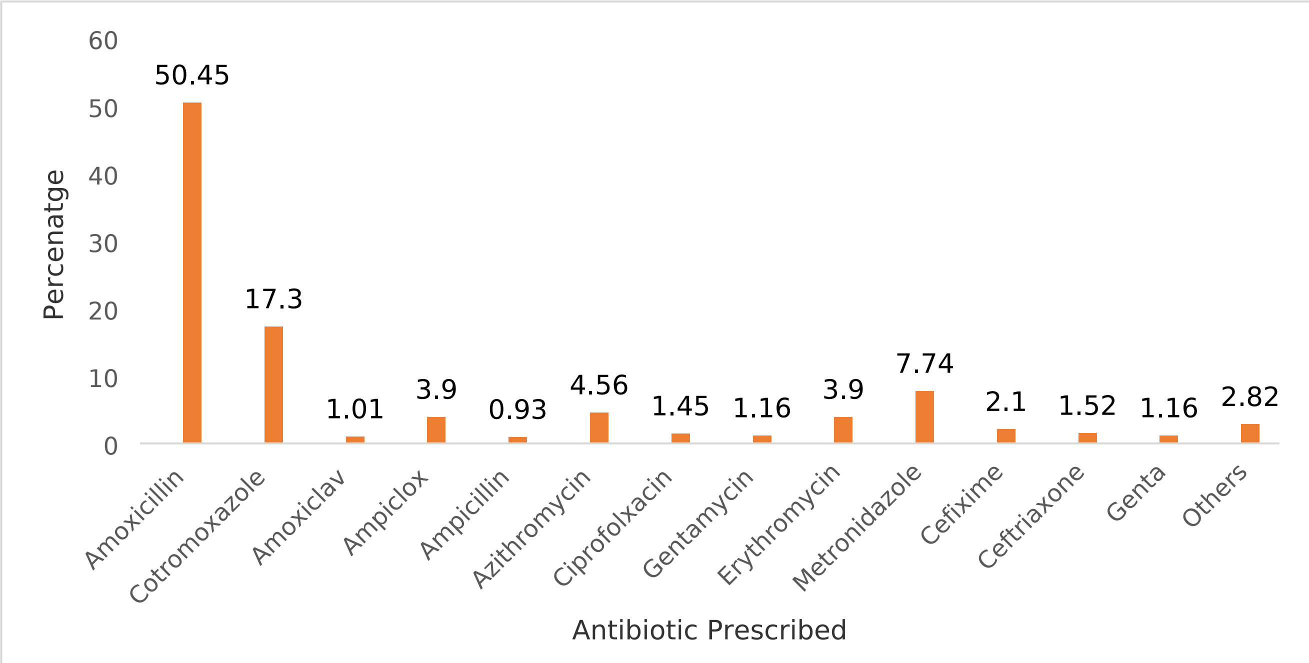

Figure 3. Antibiotics frequently prescribed to outpatients with respiratory tract infections, Jinja City, Uganda, June 1, 2022 to May 31, 2023; RTI; Genta: gentamycin

Appropriateness of antibiotic prescription

Based on the World Health Organization's (WHO) general optimal rate of antibiotic prescription for general infectious morbidities (<30%, Table 3), the 79.8% encounter with antibiotics in our study indicated inappropriate antibiotic use. Additionally, using an index score of 0.38 (Table 3), the level of inappropriate antibiotic prescription was calculated to be 62.0%.

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

Furthermore, when comparing the prescription rates of antibiotics for individual respiratory tract infections (RTIs) in selected age groups with European standard optimal rates of 20% for RTIs (Table 4), the following inappropriate prescribing rates were observed: Acute tonsillitis 99.3%, Acute otitis media 93.3%, Acute upper respiratory tract infections (URTIs) 74.36%. 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 to be 74.9%.

Table 4: Extent of appropriate prescribing based on disease specific prescribing quality indicators in Europe

Morbidity	Age group (years)	Antibiotics Prescribed No n (%)	Yes n (%)	Acceptable range (%)	Appropriateness
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
Generalized RTI	NA	312 (20.2)	1231(79.8)	0-30	Inappropriate
Pneumonia	18-65	0 (00)	7(100)	90-100	Appropriate

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).

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)**	**aP-value**
	Yes 1231(79.8)	No 312(20.2)				
Age (years)						
0-2	201(76.4)	62(23.6)				
3-18	468(80.8)	111(19.2)	1.41(0.11-5.85)	0.11		
19-64	538(80.2)	133(19.8)	1.34(0.12-1.94)	0.41		
65+	24(80.0)	6(20.0)	2.13(0.14-15.12)	0.76		
Sex						
Female	667(78.5)	183(21.5)				
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)				

Yes	416(81.8)	92(18.2)	1.02(0.01-3.67)	0.45		
Accessible Ref guide*						
None	294(85.7)	49(14.3)				
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)				
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	569(84.4)	105(15.6)				
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	1214(80.0)	303(20.0)				

Yes	15(65.2)	8(34.8)	0.21(0.76-1.29)	0.07		
RTI diagnosed ***						
Pneumonia	58(89.2)	7(10.8)				
Un-categorized ARTI	503(91.1)	49(8.9)	0.25(0.01-1.27)	0.12	0.25(0.01-1.27)	0.12
Acute pharyngitis	51(89.5)	6(10.5)	0.31(0.26-2.19)	0.10	0.31(0.26-2.19)	0.10
common cold	103(41.0)	148(58.9)	0.11(0.01-0.29)	***0.03****	0.11(0.01-0.29)	***0.03****
acute tonsillitis	38(92.7)	3(7.3)	0.41(0.12-3.13)	0.15	0.41(0.12-3.13)	0.15
Un-categorized URTI	351(87.1)	52(12.9)	0.18(0.11-4.87)	0.45	0.18(0.11-4.87)	0.45
Acute bronchitis	30(81.1)	7(18.9)	0.33(0.27-7.19)	0.76	0.33(0.27-7.19)	0.76
Acute laryngitis	6(66.5)	2(33.5)	0.67(0.19-2.21)	0.18	0.67(0.19-2.21)	0.18
Acute sinusitis	4(80.0)	1(20.0)	0.12(0.11-4.15)	0.91	0.12(0.11-4.15)	0.91
Chronic RTI	6(85.7)	1(14.3)	0.13(0.11-1.25)	0.06	0.13(0.11-1.25)	0.06
Cough	34(69.4)	15(30.6)	0.13(0.11-1.19)	0.06	0.13(0.11-1.19)	0.06
Influenza	7(26.9)	19(73.1)	**0.03(0.01-0.39)**	***0.01****	**0.03(0.01-0.39)**	***0.01****

Un-categorized LRTI	21(87.5)	3(12.5)	0.45(0.01-1.14)	0.45	0.45(0.01-1.14)	0.45
Acute otitis media	18(94.7)	1(5.3)	6.17(0.08-12.12)	0.68	0.81(1.05-0.95)	**0.01***

***statistically significant, P<0.05, cPR crude prevalence ratio, aPR adjusted prevalence ratio**

*****variables exported to multivariate analysis model if P value was below 0.05***

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. 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 [23]. WHO recommends maximum antibiotic prescription for RTIs at 20.0% to 26.8% [24]. In this 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 [25]. Appropriate use of antibiotics for management of infections is one of the leading causes of antimicrobial resistance [26]. While most respiratory tract infections (RTIs) are viral, they can sometimes be associated with bacterial infections[10, 27]. 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%) [28]. In the United States, Fleming also reported a low rates noting that it was 84.7% for sinusitis and 21.2% for viral URTIs [29]. 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 [30]. 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 [30, 31]. 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 [32]. 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 [33]. This finding is consistent with a study by [34], 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 [28]. 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 has some limitations; 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 [35].

Additionally, it was not possible to link prescription records to individual prescribers since this was not provided for in the patient registers, hence the individual prescriber-related factors associated with the high rate of antibiotic prescription could not be quantitatively determined. Although the prescribers interviewed were generally linked to the records by having prescribed during the study period[31]. Most RTI diagnoses were uncategorized and instead generalized into acute RTIs, acute upper respiratory tract infections (URTI), and acute lower respiratory tract infections (LRTI). Therefore, assessing the appropriateness of antibiotic prescription was based on a small proportion of patients with specific RTI diagnoses [25]. There was un explainable less significantly associated of otitis media with antibiotic prescription than pneumonia [APR=0.81, 95% CI=1.05-0.95, p=0.01], when Otitis media 94.7% received antibiotics, likely due to residual confounding effect from such unassessed factors.

The strengths of the study include a large sample size of 1542 patient records, well distributed over 11 facilities, exceeding the WHO recommended minimum of 600 records. Additionally, the sample was spread over all months of the year to account for seasonal variation 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 allocated 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.

List of 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

UCG Uganda Clinical Guidelines

URTI Upper Respiratory Tract Infection

WHO World Health Organization.

Declarations: Not applicable

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 interest.

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Author Contributions

ZKI conceptualized and designed the study, collected the data and drafted the manuscript.

HM designed the software for data collection and did statistical analysis of the data.

ZKI, RM and JK contributed to the, analysis, interpretation of data and discussion of the results. ZIG drafted the manuscript while RM and JK critically reviewed and revised it.

All authors approved the final version of the manuscript.

ZKI, RM, JK and HM are personally accountable for the integrity of this work.

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Availability of data and materials

All the 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.

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