

Antibiotic Prescription Suitability Assessment in Health Centers of Gisagara District, Rwanda

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ABSTRACT

INTRODUCTION: Antibiotic over-prescription is a global public health problem. This leads to increased antimicrobial resistance, health costs and other adverse effects. In Rwanda, most outpatient visits take place in health centers where most of the antibiotics are prescribed. This study aimed to assess antibiotic prescription suitability in selected health centers in the District of Gisagara, Rwanda.

METHODS: This is a cross-sectional study which included 645 antibiotic prescriptions between January and December 2017 in the health centers of Kigembe, Kibayi and Agahabwa of Kibizi Hospital, Gisagara district in Southern province, Rwanda. Data were collected from outpatient consultation registries. A systematic sampling technique was used to select study participants. A checklist comprising clinical symptoms, signs, diagnosis and prescribed antibiotics was used for data collection. EPI DATA and STATA software were used respectively for data entry and data analysis.

RESULTS: Average of antibiotic prescription was 54.2%. The mean age of patients treated was 26.6 years. The common symptoms related to antibiotics prescription were fever at 29%, cough at 26.9% and running nose at 17%. The most prescribed antibiotics were: Amoxicillin (37.1%), Penicillin V (13.2%) and Cloxacillin (12.1%). The main indication was upper respiratory tract infection at 40.6%. Among all antibiotics prescriptions, only 38.6% were found to be suitable.

CONCLUSION: Based on the recommended antibiotic prescription rate set at 30% by WHO, the rate antibiotics prescription in the three health centers is higher. There is a need to train health center nurses in diagnostic and rational antibiotic practices to limit the antibiotics' over-prescription and antimicrobial resistance.

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INTRODUCTION

Antibiotic over-prescription, which leads to antimicrobial resistance (AMR), is a current global health challenge [1,2]. AMR leads to

increased health expenditure due to the high cost of developing new antibiotics or purchasing more expensive but currently effective antibiotics [3,4]. Studies done in European and South American outpatient clinics have shown high prescription

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rates of antibiotics [5,6]. Studies in Sub-Saharan Africa showed that antibiotics treat more than 70% of upper respiratory infections (URTI) without clinical evidence of bacteria as a causative agent [7,8]. It was also found that 40% of infectious diarrhea is treated with antibiotics without confirmation of bacterial cause [9]. A study done in a tertiary hospital in Rwanda documented that Amoxicillin was commonly used even though bacteria resistant to Amoxicillin were present in 89.3% of bacterial cultures [10].

The 2017 Rwanda Health Management Information System report showed in March 2017 an increased trend towards antibiotic prescriptions in health centers of Kibilizi District Hospital, Gisagara compared to the previous years. The National Institute of Statistics in Rwanda (NISR) report from 2018 showed that most outpatient visits (77.0%) occur at health centers. We could not find any study conducted at the health center level about antibiotics prescription. Most of the primary health care is provided by nurses at health centers [11,12]

Our study's objectives are to assess the proportion of outpatients receiving antibiotic prescriptions and evaluate the antibiotic prescriptions' suitability based on diagnosis.

METHODS

Study type: This is a descriptive retrospective cross-sectional study done in 2019.

Study site: This study was conducted in three of nine health centers of Kibilizi Hospital, Gisagara District, Rwanda. The hospital serves a population of 207,883. The three health centers, Kigembe, Kibayi and Agahabwa, were selected for this study because they treated the largest number of patients (125,805) from a total of 345,846 patients consulted from January to December 2017.

Study design: We checked the hospital data for the year 2017. We reviewed all patients' registries for each of the three selected health centers and counted all the patients who visited the health centers. We divided the number of patients who received antibiotics by the number of those who received any prescription to calculate the antibiotics prescriptions rate. We also reviewed the symptoms and diagnoses for which the antibiotics were prescribed. We matched the diagnosis and the criteria for prescribing antibiotics to determine the suitability of the antibiotic prescription.

Study population: This consisted of patients who were prescribed antibiotics in outpatients' consultations (68,186) for the period from January to December 2017. We included patients who received antibiotic prescriptions and had complete required information in the health center registry in the study. We excluded from the study those whose record had incomplete information.

Sampling: WHO recommends investigating at least one hundred of all prescriptions in a facility when researching drug use indicators [13]. We set the proportion of the antibiotic prescription's suitability at 50% as there were no data about the previous prevalence in our setting. The rate of the incompleteness of the register was set at 40% to increase the sample size. We divided 384 (minimum sample size for a population where an expected proportion of the element studied is set at 50%, precision at 5%) and 1 (100% completeness) minus the above rate of incompleteness, the sample size became 645. We considered a number of more than a hundred participants (patient who received antibiotic prescriptions) enough recommended by WHO. We considered almost an equal number of sample size for each health center. The sample sizes were 213,217, and 215 patients from Kibayi, Kigembe, and Agahabwa health centers, respectively. For each of the health centers, patients were registered by order of arrival from the first to the last day of the month. We set a new order from 1st January to 31st December 2017 from which to allow sampling. We used a systematic sampling technique to select study participants from the list of patients who received antibiotic prescriptions. We obtained the sampling interval by dividing the total number of patients by the sample size. We considered the first patient who took the antibiotic then we found the second by adding the interval to the first one and so on until the required number was reached.

Data Collection: We trained three nurses, one for each health center, to collect information from the registry. A predefined questionnaire (checklist) was used. The questionnaire included patient age, sex, symptoms, signs, diagnosis, treatment (antibiotics), and dosage. These elements were used to determine the suitability of the prescription, which is the outcome variable. We completed the data collection from July to August 2018.

Data Analysis: We set criteria (with reference to a study done in Lesotho) to determine suitable or unsuitable antibiotic prescription [14]. A suitable antibiotic prescription was defined as one that

includes the drug prescribed with dosage and duration appropriately indicated for the patient's clinical condition or prophylaxis [15,16]. The prescription was considered suitable when it met the following criteria: suggestive signs and symptoms of bacterial infection present, or presence of infection established by laboratory test if any; presenting signs and symptoms absolute for bacterial infection; site of infection or possible areas of infection identified; potential site of infection (i.e. open wound); antibiotic prescribed is only one and indicated against all commonly likely pathogens associated with the area of infection; the prescribed antibiotic, the dosage, and duration of treatment are correct; and antibiotics in multiple therapies are compatible.

We considered the antibiotic prescription unsuitable when it did not meet the above criteria. We entered data in Epidata and exported these in STATA. Descriptive analysis for demographics and other variables (clinical signs and symptoms, prescribed antibiotics) were done using frequency and proportions.

Ethical approval: Rwanda National Ethics Committee reviewed and approved this study (Ref: NHRC/2018/PROT/023).

RESULTS

Out of 125,805 patient visits at the three selected HCs, 68,186 (54.2%) were prescribed antibiotics. The mean age of study participants was 26.6 years. Children under five years old represented 21.4% of patients. More than half of the study population were female (Table 1).

Table 1: Age and gender distribution of study participants (n=645)

Characteristics	n (%)
Age group (years)	
< 5	138 (21.4)
5-14	96 (14.9)
15-24	101 (15.7)
25-44	166 (25.7)
45-64	105 (16.3)
65+	39 (6.0)
Sex	
Male	281 (43.6)
Female	364 (56.4)

Fever was the most common presenting symptom (29%), followed by dry cough (26.9%), runny nose (17.0%), productive cough (12.5%) and dysphagia (10.9%). Upper respiratory tract infection was the

most frequent clinical diagnosis at 40.6% followed by non-specific infection (no clear diagnosis) at 26.7%, tonsillitis at 21.5%, intestinal parasites at 13.2% and wound at 10.1% (Table 2).

Table 2: Distribution of the symptoms and diagnosis (n=645)

Characteristics	n (%)
Symptoms	
Fever	176 (29.0)
Dry cough	163 (26.9)
Running nose	103 (17.0)
Productive cough	76 (12.5)
Dysphagia	66 (10.9)
Wound	33 (5.4)
Liquid diarrhoea	30 (4.9)
Abdominal pain	30 (4.9)
Dysuria	30 (4.9)
Skin ulceration	29 (4.8)
Dyspnea	16 (2.6)
Ear discharge	15 (2.5)
Thoracic pain	13 (2.1)
Urethral/vaginal discharge	12 (2.0)
Abscess	11 (1.8)
Vomiting	10 (1.7)
Hemoptoic cough	2 (0.3)
Bloody diarrhoea	2 (0.3)
Eye discharge	1 (0.2)
Other	49 (8.1)
Clinical Diagnosis	
URTI	262 (40.6)
Urinary tract infection	42 (6.5)
Pneumonia	14 (2.2)
Gastroenteritis	10 (1.6)
Other	326 (50.5)
Other (specified diagnosis)	
Non-specific infection	87 (26.7)
Tonsillitis	70 (21.5)
Intestinal parasites	43 (13.2)
Wound	33 (10.1)
Cutaneous infections	32 (9.8)
Otitis media	15 (4.6)
Abscess	12 (3.7)
Dental decay	8 (2.5)
Sexually transmitted infection	5 (1.5)

The most commonly used antibiotic was amoxicillin at 37.1%, followed by penicillin at 13.2%, cloxacillin at 12.1%, cotrimoxazole at 11.0% and metronidazole at 9.8% (Table 3).

Table 3: Distribution of type of antibiotic prescribed (n=645)

Antibiotics	n (%)
Amoxicillin	239 (37.1)
Penicillin V	85 (13.2)
Cloxacillin	78 (12.1)
Cotrimoxazole	71 (11.0)
Metronidazole	63 (9.8)
Erythromycin	59 (9.2)
Ciprofloxacin	32 (5.0)
Chloramphenicol	1 (0.2)
Doxycycline	14 (2.2)
Tetracycline	1 (0.2)

The study findings revealed that, of all antibiotics prescriptions, the antibiotic prescription suitability was 38.6%.

Lowest test rate (24.6%) of the antibiotic prescriptions suitability was observed in children less than five years of age. Among the antibiotics prescribed, amoxicillin was associated with the lowest rate (20.1%) of prescription suitability. URTI was the diagnosis most frequently associated with unsuitable antibiotic prescribing at 98.1% (Table 4).

DISCUSSION

In this study, we assessed antibiotic prescriptions' suitability in three HCs of Kibilizi District Hospital, South Rwanda.

The percentage of patients receiving antibiotic prescriptions was 54.2%. This was more than the WHO's standard, which is less than 30% [13]. It was almost equal to what has been found in a study done in Ghana where the percentage of patients receiving antibiotic prescriptions was 55.2% but considerably higher than that found in Egypt and Saudi Arabia at 39.2% and 32.2% respectively [17,18].

There was a clear difference in age distribution: children below 5 years old had the lowest suitability rate. This may be explained by the fact that children suffer more frequently from URTIs compared to adults.

Table 4: Characteristics of antibiotic prescription in relation to the appropriateness

Characteristics	Antibiotic prescription appropriateness		Total
	Yes	No	
Overall	249 (38.6%)	396 (61.4%)	645
Age group			
< 5 years	34 (24.6)	104 (73.4)	138
5-14 years	41 (42.7)	55 (57.3)	96
15-24 years	51 (50.5)	50 (49.5)	101
25-44 years	72 (43.4)	94 (56.6)	166
45-64 years	38 (36.2)	67 (63.8)	105
65+ years	13 (33.3)	26 (66.7)	39
Type of antibiotics			
Amoxicillin	48 (20.1)	191 (79.1)	239
Ciprofloxacin	18 (56.3)	14 (43.8)	32
Penicillin V	60 (70.6)	25 (29.4)	85
Metronidazole	31 (49.2)	32 (50.8)	63
Cloxacillin	43 (55.1)	35 (44.9)	78
Cotrimoxazole	12 (16.9)	59 (83.1)	71
Erythromycin	26 (44.1)	33 (55.9)	59
Clinical diagnosis			
Pneumonia	13 (92.9)	1 (7.1)	14
URTI	5 (1.9)	257 (98.1)	262
Gastroenteritis	3 (30.0)	7 (70.0)	10
UTI	39 (92.9)	3 (7.1)	42

We have observed that antibiotics are commonly prescribed inappropriately for this condition [19].

Clinical diagnosis and antibiotic prescriptions

Among the diagnoses made based on the presenting symptoms and signs, we have observed that URTI constitutes 40.6% of the diagnoses. This is not different from the observations made in other studies done in Japan, Cameroon, or Brazil where the percentage of patients diagnosed with URTI were 46.2%, 21.27% and 50%, respectively [19,20,21]. The most prescribed antibiotic for this condition was amoxicillin (37.1%), followed by penicillin V (13.1%). The use of amoxicillin for this common condition has been observed in many other studies done elsewhere including studies done in Ethiopia, Botswana and Bangladesh where the percentage of patients prescribed amoxicillin

was 64.4%, 28.4% and 17% respectively [22, 23, 24]. Amoxicillin is frequently used in URTI management, which seems to be linked to low cost and availability as a generic antibiotic. It is also recommended as the first-line medication in the management of URTI of bacterial origin.

Clinical conditions and antibiotic prescriptions

The three most common clinical conditions where antibiotics were prescribed were fever at 29%, dry cough at 26.9% and runny nose at 17.0 % (Table 4). In studies done in Ethiopia and the United Kingdom, acute cough accounted for 22.7% and 34.4% respectively, of the clinical conditions where antibiotics have been prescribed [25,26]. These symptoms are usually related to the upper respiratory tract infections and do not require antibiotics in their management [21].

Suitability of antibiotic prescription

We found that antibiotics were used suitably at a rate of 38.6%. Suitability is defined as prescriptions given with clinical evidence of bacterial infection. In Lesotho, the suitability of the antibiotic prescription was 76.8% [14]. In a study done in Ecuador, the antibiotic prescription's suitability was found to be 9.7%, both very different from the results of our study [27]. Similar results were found in a study done in China, where 39.4% of the antibiotic prescription was suitably done [15].

REFERENCES

- [1] James Prah, Joseph Kizzie-Hayford, Emmanuel Walker, Adelaide Ampofo-Asiama, "Antibiotic prescription pattern in a Ghanaian primary health care facility," Pan African Medical Journal, vol. 28, no. 214, 2017.
- [2] Akande TM, Ologe MO., "Prescription pattern at a secondary health care facility in Ilorin, Nigeria.," Ann Afr Med, vol. 6, no. 4, pp. 186–189, 2007.
- [3] Smith Richard, Coast Joanna, "The economic burden of antimicrobial resistance: Why it is more serious than current studies suggest. Technical Repor," London School of Hygiene & Tropical Medicine, London, 2012.
- [4] Sujith J Chandy, Girish S Naik, Veeraraghavan Balaji, Visalakshi Jeyaseelan, Kurien Thomas, and Cecilia Stålsby Lundborg, "High cost burden and health consequences of antibiotic resistance: the price to pay," J Infect Dev Ctries, vol. 8, no. 9, pp. 1096–1102, 2014.
- [5] Goossens H, Ferech M, Coenen S, Stephens P, "Comparison of outpatient systemic antibacterial use in

CONCLUSION

Though our study is purely descriptive, we found that the suitability of antibiotic prescription is low in the three health centers, the decision making is mainly based on clinical symptoms. This is likely the primary factor leading to the high rate of unsuitable antibiotic prescription. unsuitable use of antibiotics is felt to be one of the major causes of antibiotic resistance.

Recommendations: Physicians at District hospital should supervise the application of the available guidelines on managing different clinical conditions, mainly upper respiratory tract infection. Training of nurses regarding on use of antibiotics and misuse effect, primarily Amoxicillin, is necessary. A countrywide prospective research on antibiotics prescription at the primary health care level is recommended to investigate antibiotic over-prescription.

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2004 in the United States and 27 European countries," Clin Infect Dis., vol. 44, no. 8, pp. 1091–1095, Apr. 2007.

[6] Holloway Kathleen, van Dijk Liset, "The World Medicines Situation 2011-Rational Use of Medicines," WHO, Geneva, 2011.

[7] Kariuki S, Dougan G, "Antibacterial resistance in sub-Saharan Africa: an underestimated emergency," Ann N Y Acad Sci, vol. 1323, no. 1, pp. 43–55, Sep. 2014.

[8] Kimang'a AN, "A situational analysis of antimicrobial drug resistance in Africa: are we losing the battle?," Ethiop J Health Sci., vol. 22, no. 2, pp. 135–143, Jul. 2012.

[9] WHO, "Medicines use in primary care in developing and transitional countries: Fact book summarizing results from studies reported between 1990 and 2006," WHO, Geneva, 2009.

[10] Carroll M, Rangaiahagari A, Musabeyezu E, Singer D, Ogbuagu O, "Five-Year Antimicrobial Susceptibility Trends Among Bacterial Isolates from a Tertiary Health-Care Facility in Kigali, Rwanda," Am J

Trop Med Hyg., vol. 95, no. 6, Dec. 2016.

[11] WHO, "How to investigate drug use in health facilities: selected drugs use indicators -EDM research series No. 007," Geneva, 1993.

[12] Matthias Adorka, Honoré Kabwebwe Mitonga,² Martie Lubbe, Jan Serfontein,³ and Kirk Allen, "Assessment of the appropriateness of antibiotic prescriptions in Lesotho public hospitals: a novel methodology based on principles of antibiotic prescribing," *Journal of Public Health in Africa*, vol. 5, no. 1, Feb. 2014.

[13] Jin Wang, MD; Pan Wang, BPharm; Xinghe Wang, PhD; Yingdong Zheng, PhD; Yonghong Xiao, MD, PhD, "Use and Prescription of Antibiotics in Primary Health Care Settings in China," *JAMA Intern Med.*, vol. 174, no. 12, p. 2029, Oct. 2014.

[14] David R. M. Smith, F. Christiaan K. Dolk, Koen B. Pouwels, Morag Christie, Julie V. Robotham and Timo Smieszek, "Defining the appropriateness and inappropriateness of antibiotic prescribing in primary care," *J Antimicrob Chemother*, vol. 73, no. 2, 2018.

[15] Ola A. Akl, MBBS, Azza A. El Mahalli, MBBS, Ahmed Awad Elkahky, MBBS and Abdallah Mohamed Salem, MBBS, "WHO/INRUD drug use indicators at primary healthcare centers in Alexandria, Egypt," *Journal of Taibah University Medical Sciences*, vol. 9, no. 1, pp. 54–64, 2014.

[16] A.A. El Mahall, "WHO/INRUD drug prescribing indicators at primary health care centres in Eastern province, Saudi Arabia," *EMHJ*, vol. 18, no. 11, 2012.

[17] Elvis Dzelamonyuy Chem, Damian Nota Anong, Jane-Francis K. T. Akoachere, "Prescribing patterns and associated factors of antibiotic prescription in primary health care facilities of Kumbo East and Kumbo West Health Districts, North West Cameroon," *PLoS ONE*, vol. 13, no. 3, Mar. 2018.

[18] Iwata Kentaro, Takahiko Fukuchi, Midori Hirai, Kenichi Yoshimura, and Yasuhiro Kanatani, "Prevalence of inappropriate antibiotic prescriptions after the great east Japan earthquake, 2011," *Medicine*, vol. 96, no. 15, Mar. 2017.

[19] Otávio Bejzman Piltcher, Eduardo Macoto Kosugi, Eulalia Sakano, Olavo Mion, and José Ricardo Gurgel Testa, Fabrizio Ricci Romano, "How to avoid the inappropriate use of antibiotics in upper respiratory tract infections? A position statement from an expert panel," *Braz J Otorhinolaryngol.*, vol. 84, no. 3, pp. 265--279, Feb. 2018.

[20] Endalew Gebeyehu, Laychiluh Bantie, Muluken Azage, "Inappropriate Use of Antibiotics and Its Associated Factors among Urban and Rural Communities of Bahir Dar City Administration, Northwest Ethiopia," *PLoS ONE*, vol. 10, no. 9, Sep. 2015.

[21] Tiroyakgosi C, Matome M, Summers E, Mashalla Y, Paramadhas BA, Souda S, Malone B, Sinkala F, Kgatlwane J, Godman B, Mmopi K, Massele A, "Ongoing initiatives to improve the use of antibiotics in Botswana: University of Botswana symposium meeting report," *Expert Rev Anti Infect Ther.*, vol. 16, no. 5, May 2018.

[22] Fahad B.M., Matin A, M.C. Shill, Asish K.D., "Antibiotic usage at a primary health care unit in Bangladesh," *Australasian Medical Journal AMJ*, vol. 3, no. 7, pp. 414–421, 2010.

[23] Henock Yebyo, Araya Abrha Medhanyie, Mark Spigt and Rogier Hopstaken, "C-reactive protein point-of-care testing and antibiotic prescribing for acute respiratory tract infections in rural primary health centres of North Ethiopia: a cross-sectional study," *npj Primary Care Respiratory Medicine*, vol. 26, Jan. 2016.

[24] F. Christiaan K. Dolk, Koen B. Pouwels, David R. M. Smith, Julie V. Robotham and Timo Smieszek, "Antibiotics in primary care in England: which antibiotics are prescribed and for which conditions?," *J Antimicrob Chemother*, vol. 73, 2018.

[25] Xavier Sánchez Choez^{1,2*}, María Luciana Armijos Acurio¹ and Ruth E. Jimbo Sotomayo, "Appropriateness and adequacy of antibiotic prescription for upper respiratory tract infections in ambulatory health care centers in Ecuador," *BMC Pharmacol Toxicol.*, vol. 19, no. 46, Jul. 2108.