International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 41 No. 4 Feb. 2024, pp. 1109-1120
© 2022 Innovative Space of Scientific Research Journals
http://www.ijias.issr-journals.org/

Evaluation of drug prescribing patterns and factors associated with antibiotics prescribing at first-line health facilities in the city of Kisangani, Democratic Republic of Congo

Samuel Bosongo[1-2], Meffy Mokwano[3], Alpha Ngandru[3], and Eugène Basandja[1]

[1]Department of Public Health, Faculty of Medicine and Pharmacy, University of Kisangani, Kisangani, RD Congo

[2]Centre de Connaissances en Santé, Kinshasa, RD Congo

[3]Provincial Health Division of Tshopo, Kisangani, RD Congo

ABSTRACT: ***Introduction***: Irrational prescription of drugs is still a public health issue, especially in low- and middle-income countries. This study aimed to assess prescribing quality using WHO indicators and identify factors associated with antibiotic prescribing at first-line health facilities in the city of Kisangani, the Democratic Republic of Congo.
Methods: We conducted a cross-sectional study from 1 July 2019 to 30 June 2020. Using systematic sampling, we selected 21 first-line health facilities and 715 outpatient consultation forms. We then performed univariate, bivariate, and multivariate analyses using Epi Info7 and OpenEpi 3.01.
Results: The average number of drugs prescribed per consultation was 4.0 (SD=1.5); the percentages of consultations with an antibiotic and an injection prescribed were 69.2% and 69.5%, respectively; 75.2% of drugs were prescribed by generic name, and 83.5% were from the national essential drugs list. Factors associated with antibiotic prescribing were the absence of care flowcharts in health facilities (OR= 0.36, 95%CI= 0.20-0.63), two or more diagnoses (OR= 1.51, 95%CI=1.05-2.17), three or more drugs prescribed (OR=4.12, 95%CI=2.49-6.79), and more than ten years of prescriber's professional experience (OR=1.92, 95%CI=1.33-2.78).
Conclusion: The prescribing indicators did not align with WHO standards, demonstrating the poor rationality of drug prescribing behaviour. Promoting rational drug prescribing in first-line health facilities, with a particular focus on antibiotics, is necessary.

KEYWORDS: First-line facilities, Drugs, prescribing indicators, Antibiotics, World Health Organisation, Democratic Republic of Congo.

1 INTRODUCTION

In both the North and South, the irrational prescription of drugs remains a public health issue. The World Health Organization (WHO) has estimated that more than half of all drugs are prescribed, dispensed or sold inappropriately [1]. This situation is particularly concerning in low- and middle-income countries, which are facing an epidemiological transition characterised by the double burden of infectious and non-communicable diseases [2]. Irrational use of drugs can harm the quality of care. It may lead to adverse effects, drug interactions, antimicrobial resistance, non-adherence to treatment and catastrophic expenditure for patients [1], [3], [4].

The WHO advocates for the rational use of drugs, which involves providing patients with *"medications appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to them and their community"* [5], [6]. To achieve this end, the WHO, in collaboration with the International Network for the Rational Use of Drugs (INRUD), has developed a set of indicators to assess, compare, monitor and supervise the rational use of drugs. These indicators are grouped into three categories: prescribing indicators, patient care indicators and facility indicators.

In addition, methodological guidance has been developed to measure these indicators [6]. This study focuses on the prescribing indicators.

The irrational prescription of drugs continues to be a significant concern in sub-Saharan Africa. A systematic review of 18 studies conducted between 1993 and 2013 in six African countries showed that antibiotics and injections were overprescribed in primary care facilities [7]. Another systematic review of 43 studies conducted in 11 African countries between 1995 and 2015 also showed that prescribing indicators did not meet the WHO's standards in primary care facilities [8]. Unfortunately, this situation has persisted beyond this period, as evidenced by studies conducted in Ethiopia [9], [10], Sudan [11], Botswana [12], Namibia [2], Cameroon [13] and Eritrea [14], regardless of the level of care.

In addition, most of the studies cited above reported that antibiotics were over-prescribed. According to the literature, several factors may be associated with antibiotic prescribing. These include factors related to the patient, such as age [2], [14], [15] and sex [14], [16]; factors related to the prescriber, like the number of years of experience [17], [18], qualification or specialisation [2], [18], [19] and training in the rational use of drugs [17]; factors related to the health facility, especially the level of care in the health pyramid [15], [18], [19] and other factors such as performance-based funding and prescribing after laboratory tests [13].

The situation in the Democratic Republic of Congo (DRC) is similar to other sub-Saharan African countries. A study conducted in six district hospitals in the former provinces of Katanga, Kasaï Oriental, and South Kivu revealed that prescribing indicators did not meet the WHO standards [20]. Another study conducted in 11 hospitals in Butembo in the province of North Kivu showed a high prevalence of antibiotic prescription [21]. However, no study has been conducted at the first level of care, which provides primary care to most of the population. This research aims to fill this gap by (1) assessing the quality of drug prescribing using WHO indicators and (2) identifying factors associated with antibiotic prescribing in first-level health facilities in the city of Kisangani. The findings of this study will provide a starting point for subsequent evaluations and assist health authorities in promoting the rational use of drugs on the basis of local evidence.

2 METHODS

2.1 CONTEXT: CONGOLESE HEALTH SYSTEM AND STUDY SETTING

The Congolese health system consists of three levels: national, provincial, and district. The national level sets norms, the provincial level provides technical support to health districts, and the district level implements national health policies [22]. The district level comprises two specific but complementary healthcare levels under the stewardship of the district health management team [23]. The first level is made up of a network of first-line health facilities that provide primary care to the population. The second level includes one or more hospitals that offer more technical or specialised care [24]. The health district is divided into health areas, which are geographical spaces of 5,000 to 10,000 inhabitants [25]. Each health area has one or more first-level health facilities, and one of these facilities is responsible for the area and reports to the district health management team. Given the limited number of physicians during the decades following the decolonisation, first-level care has been delegated to nurse practitioners or non-physician clinicians. However, this situation is changing as more physicians are being trained and are starting to operate at the first-line facilities but in a poorly controlled and regulated way [24], [26], [27].

The healthcare provision in the DRC is pluralist, consisting of a complex mix of providers and platforms [28] belonging to the public sector, the faith-based sector and the for-profit private sector [23], [29]. The healthcare provision is highly fragmented, under-regulated, and underfunded. Health facilities are self-funded and rely on out-of-pocket payment via fee-for-service. Despite the fact that extreme poverty affects 74% of the population [22], health service users remain the main source of health system funding (43% of current health expenditure) [30].

This research was conducted in Kisangani, the capital city of Tshopo province in north-eastern DRC. The provincial health division has estimated the population to be around 1.5 million, distributed across five health districts. Kisangani City counts one university hospital, one provincial hospital, five district hospitals, and 88 health areas, along with several first-line facilities, whose exact numbers are unknown due to inadequate health system regulation.

2.2 STUDY DESIGN, PERIOD AND POPULATION

We conducted a cross-sectional study in first-line health facilities. Between December 2020 and March 2021, we collected data from patient files from 1 July 2019 until 30 June 2020. We chose one year to account for any seasonal variations. The study population consisted of first-line health facilities located in Kisangani. The inclusion criterion was being a health facility responsible for a well-defined health area, regardless of institutional affiliation. We chose this criterion based on the assumption that the first-line facilities responsible for health areas are likely to have better-organised records of outpatient consultation forms, as district health management teams are supposed to supervise them regularly.

2.3 SAMPLING

According to the WHO, at least 600 prescriptions from 20 health facilities are recommended for basic cross-sectional studies [6]. Our sample consisted of 756 outpatient consultation forms randomly selected from 21 health facilities, i.e., 36 records per facility. Our goal was to avoid the possibility of incomplete data leading to a reduction in our sample size and to ensure an equal representation of facilities from different institutional affiliations (state-run, faith-based, and private for-profit facilities).

We conducted a two-stage sampling. In the first stage, we stratified health facilities into three institutional affiliation categories (state-run, faith-based, and private for-profit facilities) using their list obtained from the provincial health division office. We excluded 16 peri-urban health facilities from this list because of resource constraints. Within each category, we selected seven health facilities using systematic sampling. In the second stage, within each selected health facility, we classified the available outpatient consultation forms by month for the study period. Then we selected three forms per month using systematic sampling.

2.4 DATA COLLECTION

We collected data between December 2020 and March 2021 using a pre-tested grid. These data included variables necessary for calculating the WHO's prescribing indicators and identifying factors associated with antibiotic prescribing. These variables were**:**

- The dependent variables: the total number of drugs prescribed, the number of drugs prescribed by generic name, the number of consultation forms with an antibiotic prescribed, the number of consultation forms with an injection prescribed, and the number of drugs prescribed from the national essential drugs list
- The independent variables: the features of the health facilities (institutional affiliation, presence of flowcharts or guidelines, presence of national essential drug list), the patients (sex, age and number of diagnoses) and the prescribers (qualification, seniority in post, training in rational drug prescribing)

Data were collected by trained and supervised collectors under the supervision of the first author to ensure their quality. To distinguish antibiotics from other antimicrobials, we referred to the drug classification outlined in the WHO's 21st edition of the model list of essential medicines [31]. The WHO classifies antibiotics into three groups: Access group (effective against common pathogens and lower resistance potential), Watch group (higher risk of resistance), and Reserve group (only for multi-drug-resistant infections). Access antibiotics are essential and should be available, affordable, and of high quality. Watch antibiotics should be prioritised for stewardship programs and monitoring. Reserve antibiotics are a last resort [31]. This classification is known as the AWaRe (Access, Watch, Reserve) classification. Additionally, we consulted the DRC's national list of essential drugs to identify each drug's generic name [32].

2.5 DATA ANALYSIS

After preliminary cleaning, the data were entered and analysed in Epi Info 7 and OpenEpi 3.01. We used univariate analysis (frequency, mean and standard deviation, median and interquartile range) to describe the characteristics of the sample and summarise the prescribing indicators. These indicators were the average number of drugs prescribed per consultation, the percentage of drugs prescribed by generic name, the percentage of consultations with an antibiotic prescribed, the percentage of consultations with an injection prescribed and the percentage of drugs prescribed from the national essential drugs list [6]. They were calculated as follows:

- The average number of drugs prescribed per consultation was calculated by dividing the total number of drug products prescribed by the number of outpatient consultation forms surveyed [6]
- The percentage of drugs prescribed by the generic name was calculated by dividing the number of drugs prescribed by the generic name by the total number of drugs prescribed, multiplied by 100 [6]

- The percentage of consultations with an antibiotic prescribed was calculated by dividing the number of outpatient consultation forms in which an antibiotic was prescribed by the total number of outpatient consultation forms surveyed, multiplied by 100 [6]
- The percentage of consultations with an injection prescribed was calculated by dividing the number of outpatient consultation forms in which an injection was prescribed by the total number of outpatient consultation forms surveyed, multiplied by 100 [6]
- The percentage of drugs prescribed from the essential drug list was calculated by dividing the number of drugs prescribed which are in the essential drug list by the total number of drugs prescribed, multiplied by 100 [6]

To evaluate the rationality of prescriptions, we compared these indicators with WHO standards [2], [33] and calculated the rational drug use indexes developed by Zhang and Zhi [33]. These indexes are the index of polypharmacy, the index of generic name, the index of rational antibiotic use, the index of safe injection drug use, and the index of essential drug list. They were calculated as follows:

- For the average number of drugs per consultation (index of polypharmacy), the percentage of consultations with an antibiotic prescribed (index of rational antibiotic use) and the percentage of consultations with an injection prescribed (index of safe injection drug use), the optimal value (WHO standard) is divided by the observed value
- For the percentage of medicines prescribed by generic name (index of generic name) and the percentage of medicines prescribed from the essential drug list (index of essential drug list), the observed value is divided by the optimal value (WHO standard)

The optimal index value is set at 1 for each indicator. The closer the calculated index value is to 1, the more rational the prescription. The general Index of Rational Drug Prescribing (IRDP) is obtained by adding the index values of all prescribing indicators, and its optimal value is 5. The closer the IRDP is to 5, the more rational the prescription.

In addition, we used one-way analysis of variance (ANOVA) to analyse the differences among the institutional affiliations of healthcare facilities. The statistical significance was determined by $p < 0.05$. We also carried out bivariate and multivariate analyses (logistic regression) to determine the factors associated with antibiotic prescribing, using the Odds Ratio (OR) with a confidence interval of 95% and a significance level of $p<0.05$.

2.6 Ethical Considerations

The study protocol was approved by the head of the provincial health division of Tshopo (reference number 701/DPS/TSHOPO/SEC/0731/2020). The heads of Kisangani's five urban health districts authorized data collection in their jurisdictions. The heads of the selected health facilities were requested to provide written informed consent before data collection. The privacy of patients, prescribers, and facilities was maintained by keeping their identities anonymous.

3 Results

3.1 Characteristics Of The Sample

We collected data from 756 outpatient consultation forms but excluded 41 due to missing information. Our analysis focused on 715 outpatient consultation forms, whose characteristics are outlined in Table 1. Most patients were female (58.18%), with a median age of 19 years (IQR=26). Almost three-quarters of the patients attended health facilities with available care flowcharts (72.45%) and the national essential drugs list (76.92%). We found that most patients, about 72.45%, were consulted by providers untrained in rational drug prescribing. These providers were mainly nurses with a median professional experience of 12 years (IQR=12). They belonged to the higher school (45.45%) and secondary school (44.48%) education categories.

Table 1. Characteristics of the sample

Variables	Frequency (n=715)	Percentage
Distribution of patients by facility affiliations		
State-run facilities	245	34.27
Faith-based facilities	245	34.27
Private for-profit facilities	225	31.47
Patients seen in health facilities with care flowcharts or guidelines		
Yes	518	72.45
No	197	27.55
Patients seen in health facilities with essential drugs list		
Yes	550	76.92
No	165	23.08
Age of patients (Md = 19, IQR=26, Min. = 0, Max. = 84)		
0 - 4 years	174	24.34
5 - 14 years	128	17.90
15 years and more	413	57.76
Sex of patients		
Male	299	41.82
Female	416	58.18
Number of diagnoses per patient		
1 diagnose	381	53.29
2 diagnoses and more	334	46.71
Number of drugs prescribed per patient		
0 - 2 drugs	86	12.03
3 - 4 drugs	400	55.94
5 drugs and more	229	32.03
Distribution of patients by prescriber qualification		
General practitioner	56	7.83
Nurse – High school	325	45.45
Nurse -Secondary school	318	44.48
Others	16	2.24
Distribution of patients by prescribers' years of experience (Md = 12, IQR=12, Min. = 1, Max. = 44)		
0 - 5 years	139	19.44
6 - 10 years	197	27.55
11 years and more	379	53.01
Patients seen by a provider trained in rational use of drugs		
Yes	197	27.55
No	518	72.45

3.2 INDICATORS OF RATIONAL PRESCRIBING

Table 2 shows the indicators of rational prescribing. The average number of drugs prescribed per consultation was 4.00 (SD=1.47). Antibiotics and injections were prescribed in 69.23% and 69.51% of consultations, respectively. Almost three-quarters of drugs (75.22%) were prescribed by generic name, and 83.46% were prescribed from the national essential drugs list. The high percentages of consultations with an antibiotic (72.65%) and an injection (79.11%) were observed in state-run and private for-profit health facilities, respectively. The difference among the institutional affiliations was statistically significant for all indicators except the average number of drugs per consultation.

Table 2. Indicators of rational prescribing

Indicators	Faith-based facilities	State-run facilities	Private for-profit facilities	All facilities	WHO Standards [2], [33]	p-value*
Average number of drugs per consultation (SD)	4.07 (1.69)	4.11 (1.48)	3.83 (1.17)	4.00 (1.47)	<2	0.0884
Percentage of consultation with an antibiotic prescribed	63.27	72.65	72.00	69.23	<30	0.0454
Percentage of consultation with an injection prescribed	64.49	65.71	79.11	69.51	<20	<0.0005
Percentage of drugs prescribed by generic name	74.92	79.44	61.89	75.22	100	<0.0005
Percentage of drugs prescribed from national essential drugs list	83.25	86.96	69.71	83.46	100	0.0017

**Result of ANOVA (significance level: p<0.05)*

Table 3 outlines the overall IRDP of 2.80, which is the sum of the index of non-polypharmacy (0.5), the index of rational antibiotic use (0.43), the index of safe injection drug use (0.29), the index of generic name (0.73) and the index of essential drug list (0.83). The state-run facilities have the highest IRDP, which is 2.87.

Table 3. Index of rational drugs prescribing

Indexes	Faith-based facilities	State-run facilities	Private for-profit facilities	All facilities	WHO Standards [2], [33]
Index of non-polypharmacy	0.49	0.49	0.52	0.5	1
Index of rational antibiotic use	0.47	0.41	0.42	0.43	1
Index of safe injection drug use	0.31	0.30	0.25	0.29	1
Index of generic name	0.75	0.79	0.62	0.75	1
Index of essential drug list	0.83	0.87	0.70	0.83	1
IRDP	2.86	2.87	2.51	2.80	5

A total of 743 antibiotics were prescribed during 495 consultations, resulting in an average of 1.49 (SD= 0.61) antibiotics per consultation. The majority of antibiotic prescriptions (76.45%) were from the "access" group, with amoxicillin (20.3%), gentamycin (18.6%), and cotrimoxazole (12.9%) being the most commonly prescribed antibiotics, as indicated in Table 4.

Table 4. Distribution of prescribed antibiotics (AWaRe)

AWaRe Classification	Frequency (n=743)	Percentage
Access group antibiotics	**568**	**76.45%**
Amoxicillin	51	20.32%
Gentamycin	138	18.57%
Sulfamethoxazole + Trimethoprim (cotrimoxazole)	96	12.92%
Metronidazole	80	10.77%
Ampicillin	68	9.15%
Doxycycline	11	1.48%
Others*	24	3.23%
Watch group antibiotics	**157**	**21.13%**
Ceftriaxone	78	10.50%
Ciprofloxacin	40	5.38%
Cefixime	23	3.10%
Others**	16	2.15%
Reserve group antibiotics	**0**	**0.00%**
No classified	**18**	**2.42%**

**Phenoxymethylpenicillin, Chloramphenicol, Nitrofurantoin, Cloxacillin, Procaine Benzylpenicillin, Amoxicillin + Acid Clavulanic, Benzathine Benzylpenicillin*

***Cefotaxime, Azithromycin, Erythromycin, Cefuroxime*

FACTORS ASSOCIATED WITH ANTIBIOTIC PRESCRIBING

Table 5 displays the outcomes of bivariate and multivariate analyses. After adjusting for potential confounders using logistic regression, the presence of care flowcharts or guidelines at the health facility, the number of diagnoses, the number of drugs prescribed and the number of prescriber's years of professional experience were significantly associated with antibiotic prescribing. The presence of care flowcharts or guidelines in facilities was associated with a lower probability of prescribing antibiotics by 66% compared to facilities without flowcharts or guidelines (OR: 0.36, 95% CI: 0.20-0.63; p=0.0004). In our sample, patients with two or more diagnoses were 1.5 times more likely to receive a prescription for antibiotics than those with only one diagnosis (OR: 1.51, 95% CI: 1.05-2.17; p=0.025). Patients who have been prescribed three or more drugs were four times more likely to be prescribed antibiotics than those prescribed less than three. (OR: 4.12, 95% CI: 2.49-6.79; p<0.0001). Patients who visited providers with 11 or more years of professional experience were 1.92 times more likely to be prescribed antibiotics than those with less than 11 years of experience. (OR: 1.92, 95%IC: 1.33-2.78; p=0.0005).

Table 5. Factors associated with antibiotic prescribing

Independent variables	Antibiotic prescribing		Bivariate analysis		Multivariate analysis	
	Yes	No	OR [IC 95%]	P-Value	OR [IC 95%]	P-Value*
Facility affiliations						
Faith-based facilities	155	90	Ref.			
State-run facilities	178	67	1.54 [1.05-2.26]	0.0264	1.31 [0.86-1.99]	0.2051
Private for-profit facilities	162	63	1.49 [1.01-2.21]	0.0440	0.63 [0.36-1.11]	0.1069
Presence of care flowcharts in facilities						
No	152	45	Ref.			
Yes	343	175	0.58 [0.39-0.84]	0.0049	0.36 [0.20-0.63]	0.0004
Age of patients						
<15 years	209	93	Ref.			
≥ 15 years	286	127	1.00 [0.73-1.38]	0.9899	1.11 [0.78-1.58]	0.5464
Sex of patients						
Female	296	120	Ref.			
Male	199	100	0.81 [0.58-1.11]	0.1891	0.86 [0.61-1.22]	0.4036
Number of diagnoses						
1 diagnosis	243	138	Ref.			
≥ 2 diagnoses	252	82	1.74 [1.26-2.42]	0.0008	1.51 [1.05-2.17]	0.0250
Number of prescribed drugs						
< 3 drugs	33	53	Ref.			
≥ 3 drugs	462	167	4.44 [2.78-7.10]	<0.0001	4.12 [2.49-6.79]	<0.0001
Prescriber's qualification						
Physician	42	14	Ref.			
Non-physician	495	220	0.73 [0.39-1.37]	0.3316	0.75 [0.37-1.52]	0.4207
Number of prescriber's year of experience						
< 11 years	214	122	Ref.			
≥ 11 years	281	98	1.63 [1.19-2.25]	0.0026	1.92 [1.33-2.78]	0.0005
Training in rational use of drugs						
No	48	172	Ref.			
Yes	149	346	1.54 [1.06-2.24]	0.0227	1.50 [1.00-2.27]	0.0490

*OR: Odds Ratio, CI: confidence interval, *significance level: p<0.05*

4 DISCUSSION

This study revealed that prescribing indicators at first-line facilities did not meet WHO standards, indicating irrational prescribing. The absence of care flowcharts in health facilities, the number of diagnoses ≥2, the number of drugs prescribed ≥3, and the prescriber's professional experience ≥11 years was significantly associated to antibiotic prescribing.

4.1 RATIONAL PRESCRIBING INDICATORS

Our study found that, on average, 4.00 drugs were prescribed per consultation, which is more than the double of WHO standard (<2). This result is higher than those of the first-line facilities in the WHO African region (3.1) [8] and those of hospitals in the DRC (3.5) [20]. This result shows similar prescribing patterns (polypharmacy) for outpatients at primary care facilities and inpatients at referral facilities (hospitals) in the DRC. This situation could be due to the need for health facilities to self-finance, which opens the way to the commercialisation of healthcare. Indeed, this polypharmacy may be a mechanism of institutional survival as providers tend to prescribe more drugs to generate income. However, this practice results in increased costs for the patient and likely also to negative impacts on the quality of care due to adverse drug interactions.

We also evidenced a high percentage of consultations with an antibiotic prescribed (69.2%) compared with the WHO standard (<30%). This result mirrors those of studies conducted in district hospitals in the DRC (68%) [21]. This over-prescribing of antibiotics may be explained by the healthcare providers' habit of directly prescribing antibiotics for common symptoms such as fever, cough or diarrhoea without any laboratory confirmation tests [8]. There is also a high demand from patients who were made to believe that antibiotics constitute the best possible treatment [34], [35]. Ideally, however, healthcare providers are expected to inform their patients about the risks of overusing antibiotics rather than simply giving them out upon request. Antibiotic overuse can lead to resistance, which is increasingly becoming a global public health problem [36].

The percentage of consultations with an injectable prescribed in our study (69.5%) was again situated above the WHO standard (<20%). This percentage is also higher than for first-line facilities in the WHO African region, which stands at 25% [8]. This situation can be explained by the search for the financial survival of the facility, and beyond that, perhaps even the intention to generate profits, and by irrational (largely provider-induced) patient demand. On the one hand, in a fee-for-service context, as is predominantly the case in the DRC, health facilities benefit from prescribing injections as it generates additional funds for purchasing the necessary injection materials (syringes, needles, water for injection) and ensuring providers an income. On the other hand, patients increasingly request injectable drugs despite their high costs because they perceive them – or are made to perceive them - to be more effective than orally-administered drugs [8], [35]. Whether induced by healthcare providers or patients, irrational prescribing of injections can lead to catastrophic expenditure and negatively affects the quality and efficiency of healthcare delivery.

Our study showed that the percentage of drugs prescribed with their generic name (75.2%) was lower than the WHO standard (100%). This situation is likely due to the influence of representatives of pharmaceutical companies promoting their products in health facilities. Indeed, in a context of poor health system regulation, pharmaceutical firms are incentivising healthcare providers to prescribe them using brand names. Additionally, the supply of most health facilities with brand drugs from common markets may also contribute to this situation.

We found that only 83.46% of drugs were prescribed from the national list of essential drugs, which falls short of the WHO standard of 100%. This situation may be explained by the fact that some facilities (23%) do not have the national list of essential drugs [8], while others have it but do not use it. The non-availability of the national essential drug list in some facilities may be explained by financial constraints preventing the district health management teams from printing and distributing it to their staff. Meanwhile, the non-use of this list in other facilities may be the result of scarce clinical supervision at the primary care facilities by the members of district health management teams. Indeed, supervision visits are increasingly becoming an administrative exercise, focusing on preventive activities designed within the frame of externally funded vertical programs.

More than two-thirds of the antibiotics prescribed in our study are situated in the "access" group. Of all the antibiotics prescribed, amoxicillin was the most common, accounting for 18.6% (138/743). This aligns with previous research in the DRC [21] and Cameroon [13] that also placed amoxicillin as the most prescribed antibiotic.

4.2 FACTORS ASSOCIATED WITH ANTIBIOTIC PRESCRIBING

In our study, the presence of care flowcharts or guidelines in health facilities was significantly associated with a reduction in antibiotic prescribing (OR: 0.36, 95% CI: 0.20-0.63; p=0.0004). This finding highlights the importance of providing staff at health facilities with such guidelines. However, this may not suffice. It also matters to ensure that healthcare providers are using them. More regular clinically oriented supervision visits, looking into routine outpatient consultations, would be most helpful in that respect. Hence the need for district health management teams to (want to) make good use of their clinical skills. District health management teams are often incentivised to prioritize specific activities of vertical programs like, for instance, vaccination campaigns or distribution of insecticide-treated mosquito nets. Effective use of care flowcharts may also minimise multiple diagnoses and prescriptions of three drugs, which were significantly associated with antibiotic prescribing in our study (respectively OR: 1.51, 95% CI: 1.05-2.17; p= 0.025 and OR: 4.12, 95% CI: 2.49-6.79; p<0.0001).

We found that healthcare providers with 11 or more years of professional experience prescribed significantly more antibiotics than those with less experience (OR: 1.92, 95%CI: 1.33-2.78, p<0.0005). In Cameroon, however, such a statistically significant association between longevity in service and antibiotic prescription was not demonstrated (p=0.699) [13]. Our study did not confirm the hypothesis that older prescribers are more rational in prescribing than younger ones. It could be assumed that younger prescribers are also better trained in this aspect and are more aware of the issue of antibiotic resistance.

Providers untrained in rational drug prescribing prescribed 1.5 times more antibiotics than their trained colleagues, but this association was not statistically significant (OR: 1.50, 95%CI: 1.00-2.27; p=0.049). This finding raises doubts about the effectiveness of the training provided and its follow-up measures.

4.3 IMPLICATIONS FOR POLICY AND PRACTICE

The results suggest the need to take steps to enhance the rational prescribing of drugs at the primary care level.

First, it is crucial to strengthen the clinical supervision of healthcare providers in order to ensure the effective use of care flowcharts and disseminate and monitor WHO prescribing indicators. Since primary healthcare is intrinsically integrated, supervision must also be integrated so as to boost healthcare providers' abilities in curative, preventive, promotional, and rehabilitative care. Effective clinical supervision can be a promising alternative to conventional training, which in our study has shown to have no positive impact on antibiotic prescribing.

Second, it is pertinent to replace fee-for-service payments with flat fees per disease episode in health facilities in order to mitigate the risk of commercialisation of care and irrational drug prescribing. However, a flat fee payment covering all drugs is likely to be so high that it could further compromise financial access to care for an impoverished population without third-party payment subsidies. Furthermore, more than flat fee payment is needed to improve the quality of prescriptions in a complex healthcare system. It is crucial to enhance the quality of both basic and continuing education for healthcare workers regarding diagnosis and therapy. This should focus on a patient-centred approach that values dialogue with patients.

And third, it is recommended to strengthen the national essential drug supply system so as to ensure that health facilities receive sufficient high-quality generic drugs, which in turn may reduce the negative impact of pharmaceutical companies on rational drug prescribing.

4.4 STRENGTHS AND LIMITATIONS OF THE STUDY

This study has the merit of being the first to assess prescribing indicators at first-line facilities in the DRC. It offers valuable evidence to the scientific community and health authorities for research, planning, and monitoring of the rational use of drugs in primary care health facilities.

However, the study findings cannot be generalised to the whole country, as it was carried out in a highly urbanised setting. Moreover, this study only focused on prescribing indicators and did not consider other categories of WHO's indicators, which are patient care and facility indicators. Therefore, further studies in rural areas encompassing all three indicator categories are necessary to provide a complete understanding of the challenge of drug use practices. Additionally, our study did not consider the relationship between the diagnoses established by the providers and the prescription pattern because of the low accuracy of the former, particularly in the case of infectious diseases. Most health facilities indeed lack laboratory tests, making differentiation between viral and bacterial infections difficult.

5 CONCLUSION

Our study revealed that drug prescribing in primary healthcare facilities in the city of Kisangani did not, by far, meet WHO standards. This calls for stronger promotion of rational drug prescribing in health facilities, with particular attention to antibiotic and injection prescribing. This promotion implies large dissemination of WHO's prescribing indicators in the community of healthcare providers, but also among health systems managers. Furthermore, health facilities should be provided with up-to-date flowcharts for diagnostic and therapeutic decision-making, and their effective use should be monitored. Next to the traditional classroom training programs, due priority should be given to regular in-service clinical supervision by district health managers of routine healthcare provision in these first-line health facilities.

ACKNOWLEDGMENT

We would like to thank the head of the provincial health division of Tshopo, the heads of five urban health districts of Kisangani and the heads of selected health facilities for the authorisation to conduct the research in their jurisdictions. We also thank Professor Bart Criel for his insightful comments on and editing of this paper.

FUNDING

The author (s) received no financial support for the research and publication of this article.

AUTHORS' CONTRIBUTIONS

SB, MM and AK designed the study with contribution from EB. SB supervised data collection, conducted data analysis and drafted the initial manuscript. SB, MM, AK and EB contributed to manuscript revision. All authors read and approved the final version of this manuscript.

COMPETING INTERESTS

The authors declare that they have no competing interests.

REFERENCES

[1] World Health Organization, «The World Medicines Situation,» *WHO/EDM/PAR/2004.5*. p. 145, 2004.

[2] Q. Niaz *et al.,* «Validity of World Health Organisation prescribing indicators in Namibia's primary healthcare: Findings and implications,» *International Journal for Quality in Health Care,* vol. 31, no. 5, pp. 338–345, 2019, doi: 10.1093/intqhc/mzy172.

[3] World Health Organization, «Global Action Plan on Antimicrobial Resistance,» 2015. doi: 10.1128/microbe.10.354.1.

[4] A. A. Desalegn, «Assessment of drug use pattern using WHO prescribing indicators at Hawassa University teaching and referral hospital, south Ethiopia: a cross-sectional study,» *BMC Health Serv Res,* vol. 13, no. 1, p. 170, 2013, doi: 10.1186/1472-6963-13-170.

[5] O. O. Enwere, C. O. Falade, and B. L. Salako, «Drug prescribing pattern at the medical outpatient clinic of a tertiary hospital in southwestern Nigeria,» *Pharmacoepidemiol Drug Saf,* vol. 16, pp. 1244–1249, 2007, doi: 10.1002/pds.

[6] World Health Organisation, «How to investigate drug use in health facilities. Selected drug use indicators,» *WHO/DAP/93.1*. p. 87, 1993. doi: 10.1016/B978-0-12-384947-2.00761-3.

[7] R. Ofori-Asenso and A. A. Agyeman, «A review of injection and antibiotic use at primary health care (public and private) centers in Africa,» *J Pharm Bioallied Sci,* vol. 7, no. 3, pp. 175–180, 2015.

[8] R. Ofori-Asenso, P. Brhlikova, and A. M. Pollock, «Prescribing indicators at primary health care centers within the WHO African region: A systematic analysis (1995-2015),» *BMC Public Health,* vol. 16, p. 724, 2016, doi: 10.1186/s12889-016-3428-8.

[9] B. Wogayehu, Y. Chisha, B. Tekabe, A. Adinew, and M. Asefaw, «A cross sectional comparison of drug use indicators using WHO methodology in primary level hospitals participating in an Auditable Pharmaceutical Transactions and Services program versus non-APTS primary hospitals in Southern Ethiopia,» *PLoS One,* vol. 14, no. 10, pp. 1–26, 2019, doi: 10.1371/journal.pone.0223523.

[10] M. Sisay, G. Mengistu, B. Molla, F. Amare, and T. Gabriel, «Evaluation of rational drug use based on World Health Organization core drug use indicators in selected public hospitals of eastern Ethiopia: A cross sectional study,» *BMC Health Serv Res,* vol. 17, p. 161, 2017, doi: 10.1186/s12913-017-2097-3.

[11] S. N. Abdalla and B. A. Yousef, «Prescribing patterns of antimicrobials in the internal medicine department of ibrahim malik teaching hospital in Khartoum, 2016,» *Pan African Medical Journal,* vol. 34, pp. 1–10, 2019, doi: 10.11604/pamj.2019.34.89.17023.

[12] Y. Mashalla *et al.,* «Assessment of prescribing practices at the primary healthcare facilities in Botswana with an emphasis on antibiotics: Findings and implications,» *Int J Clin Pract,* vol. 71, no. 12, pp. 1–10, 2017, doi: 10.1111/ijcp.13042.

[13] E. D. Chem, D. N. Anong, and J. F. 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, pp. 1–18, 2018, doi: 10.1371/journal.pone.0193353.

[14] N. D. Amaha, D. G. Weldemariam, N. Abdu, and E. H. Tesfamariam, «Prescribing practices using WHO prescribing indicators and factors associated with antibiotic prescribing in six community pharmacies in Asmara, Eritrea: A cross-sectional study,» *Antimicrob Resist Infect Control,* vol. 8, p. 163, 2019, doi: 10.1186/s13756-019-0620-5.

[15] M. A. Ahiabu, B. P. Tersbøl, R. Biritwum, I. C. Bygbjerg, and P. Magnussen, «A retrospective audit of antibiotic prescriptions in primary health-care facilities in Eastern Region, Ghana,» *Health Policy Plan,* vol. 31, no. 2, pp. 250–258, 2016, doi: 10.1093/heapol/czv048.

[16] V. Lukali and C. Michelo, «Factors Associated with Irrational Drug use at a District Hospital in Zambia : Patient Record-based Observations,» *Med J Zambia,* vol. 42, no. 1, pp. 25–30, 2015.

[17] R. Andrajati, A. Tilaqza, and S. Supardi, «Factors related to rational antibiotic prescriptions in community health centers in Depok City, Indonesia,» *J Infect Public Health,* vol. 10, no. 1, pp. 41–48, 2017, doi: 10.1016/j.jiph.2016.01.012.

[18] M. Ndhlovu, E. Nkhama, J. M. Miller, and D. H. Hamer, «Antibiotic prescribing practices for patients with fever in the transition from presumptive treatment of malaria to 'confirm and treat' in Zambia: A cross-sectional study,» *Tropical Medicine and International Health,* vol. 20, no. 12, pp. 1696–1706, 2015, doi: 10.1111/tmi.12591.

[19] R. Bharathiraja, S. Sridharan, L. R. Chelliah, S. Suresh, and M. Senguttuvan, «Factors affecting antibiotic prescribing pattern in pediatric practice,» *Indian J Pediatr,* vol. 72, pp. 877–880, 2005, doi: 10.1007/s12098-007-0093-z.

[20] D. Nzolo and R. Mulongo, «Evaluation de l'utilisation des médicaments dans six hôpitaux pilotes où les CPT sont fonctionnels en République Démocratique du Congo,» 2013.

[21] M. W. José, L. I. Jean-Marie, M. M. Divine, K. K. Sabine, and K. Takaisi-, «Point prevalence study of antibiotic use in hospitals in Butembo,» *International Journal of Medicine and Medical Sciences,* vol. 8, no. 12, pp. 133–139, 2016, doi: 10.5897/ijmms2016.1249.

[22] Ministère de la Santé Publique RDC, «Plan National de Développement Sanitaire 2019-2022.» 2018.

[23] Chenge F, De la nécessité d'adapter le modèle de district au contexte urbain : Exemple de la ville de Lubumbashi en RD Congo, vol. 31. 2013.

[24] S. I. Bosongo, F. C. Mukalenge, A. M. Tambwe, and B. Criel, «Les médecins prestataires à la première ligne des soins dans la ville de Kisangani en République Démocratique du Congo: vers une typologie,» *Afr J Prim Health Care Fam Med,* vol. 13, no. 1, pp. 1–8, 2021, doi: 10.4102/phcfm.v13i1.2617.

[25] Ministère de la Santé Publique RDC, «Recueil des Normes d'organisation et de fonctionnement des structures sanitaires de la Zone de Santé en République Démocratique du Congo.» 2012.

[26] S. Bosongo, F. Chenge, A. Mwembo, and B. Criel, «L'influence des prestations des médecins à la première ligne de soins sur le système intégré de district sanitaire à kisangani, république Démocratique du Congo: Une étude qualitative,» *Pan African Medical Journal,* vol. 39, 2021, doi: 10.11604/pamj.2021.39.215.25737.

[27] K. Bello *et al.,* «The expanding movement of primary care physicians operating at the first line of healthcare delivery systems in sub-Saharan Africa: A scoping review,» *PLoS One,* vol. 16, no. 10, pp. e0258955-, Oct. 2021, [Online]. Available: https://doi.org/10.1371/journal.pone.0258955.

[28] J. Van Olmen *et al.,* «The Health System Dynamics Framework: The introduction of an analytical model for health system analysis and its application to two case-studies,» *Health, Culture and Society,* vol. 2, no. 1, pp. 1–21, Mar. 2012, doi: 10.5195/hcs.2012.71.

[29] Ministère de la Santé Publique RDC, «Plan National de Développement Sanitaire 2016-2020 : vers la couverture sanitaire universelle.» 2016.

[30] Ministère de la Santé Hygiène et Prévention RDC, «Rapport sur les comptes nationaux de la santé 2020,» Matadi, Dec. 2021.

[31] World Health Organisation, World health organization model list of essential medicines. 2019.

[32] Ministère de la Santé Publique RDC, *Liste Nationale des Médicaments Essentiels*. 2010.

[33] M. Atif, M. R. Sarwar, M. Azeem, M. Naz, S. Amir, and K. Nazir, «Assessment of core drug use indicators using WHO/INRUD methodology at primary healthcare centers in Bahawalpur, Pakistan,» *BMC Health Serv Res,* vol. 16, p. 684, 2016, doi: 10.1186/s12913-016-1932-2.

[34] K. Thriemer *et al.,* «Antibiotic Prescribing in DR Congo: A Knowledge, Attitude and Practice Survey among Medical Doctors and Students,» *PLoS One,* vol. 8, no. 2, p. e55495, Feb. 2013, doi: 10.1371/journal.pone.0055495.

[35] T. Eibs *et al.,* «Qualitative study of antibiotic prescription patterns and associated drivers in Sudan, Guinea-Bissau, Central African Republic and Democratic Republic of Congo,» *BMJ Open,* vol. 10, no. 9, p. e036530, Sep. 2020, doi: 10.1136/bmjopen-2019-036530.

[36] Organisation mondiale de la Santé, «Manuel de l'OMS pour la mise en œuvre des plans d'action nationaux de lutte contre la résistance aux antimicrobiens. Recommandations pour le secteur de la santé humaine,» Genéve, 2022. Accessed: Jul. 08, 2023. [Online]. Available: https://apps.who.int/iris/?locale-attribute=fr&.