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East African Community Regional Centre of Excellence for VaccinesImmunization and Health Supply Chain Management (EAC RCE-VIHSCM)

EVALUATION OF DRUG USE INDICATORS FOCUSING ON ANTIBIOTIC USE IN PRIMARY HEALTHCARE FACILITIES IN BUJUMBURA MAIRIE, BURUNDI

A dissertation submitted in partial fulfilment of the requirements for the Masters Degree of Health Supply Chain Management (MSc HSCM)

By

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STUDENT DECLARATION

I do hereby declare that this dissertation titled **“Evaluation of drug use indicators focusing on antibiotic use in primary healthcare Centers in Bujumbura Mairie, Burundi”** is my own original work.

Therefore, I do affirm that there is no evidence that it has been presented for any degree defense at any university in the world

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DEDICATION

This dissertation is dedicated to Mrs. Gaudence Nizigiyima, the spouse of the author as well as to their four children: Epi d'Or MANIRAKIZA, Andy Colette MANIRAKIZA, Aubin MANIRAKIZA, and Abel Colin MANIRAKIZA. They have been incredibly supportive of my academic objectives. In addition, they have continuously inspired me throughout this academic journey.

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ABSTRACT

Background

Rational medicine use improves patient and community health; however, irrational medicine use persists despite official efforts to reduce it. This study used WHO indicators to evaluate medicine use, with a focus on antibiotics, at twenty primary healthcare centers in Bujumbura Mairie, Burundi.

Methods

This descriptive cross-sectional study assessed 20 Bujumbura Mairie PHCs. The formula k= (population size/sample size) was used to select 100 encounters per PHC at regular intervals. RANDBETWEEN Excel was used to randomly select the first encounter and PHC.

Results

2000 prescriptions from outpatient encounters were subjected to analysis. The results indicated that 50.5% of encounters were female, while 49.5% were male. This study revealed that the average prescription drug per each visit was 2.4, the rate of prescription drug by generic name was 76.6%, the proportion of encounters whith an antibiotic prescription was 57.7%, the proportion of encounters with a prescription of injection was 13.2%, and 85.9% of drugs were prescribed from the EML. The proportion of antibiotic prescritions by generic name were at 94.4% and from EML at 94.5%. The proportion of surveyed PHCs that held a copy of the EML was 50%, and the availability of key medicines was 85%, while the STGs were unavailable. In bivariate and multivariable models, antibiotic prescribing was significantly associated with patients aged under 5, the range of 3 to 4 drugs prescription, the generic drug number, the EML drug number, and the percentage of key medicines availability.

Conclusion

This study's findings of irrational drug use and overuse of antibiotics, highlight the critical need for implementing interventions to promote rational use of drugs and increase awareness of proper antibiotic use.

KEY WORDS

Primary healthcare centers, drug use indicators, Prescribing indicators, Specific facility indicators, Bujumbura Mairie, Burundi

LIST OF ABBREVIATIONS ACRONYMS

ABR:	AntiBactrial Resistance
ABREMA :	Autorité Burundaise de Régulation des Médicaments et des Aliments
AMR:	AntiMicrobial Resistance
DRA:	Drug Regulatory Authority
EAC RCE-VIHSCM:	East African Community Regional Center of Excellence for Vaccines, Immunization, and Health Supply Chain Management
F.O.S.A.:	Formation Sanitaire
G.R.A.M.:	Global Research on Antimicrobial resistance
I.N.R.U.D.:	International Network Rational Use of Drugs
K.A.P.:	Knowledge, Attitudes, and Practices
L.N.M.E.:	Liste Nationale des Médicaments Essentiels
M.S.H.:	Management Sciences for Health
P.H.C.:	Primary Healthcare Centres
S.P.S.S.:	Statistic Package for the Social Sciences software
U.R.:	University of Rwanda
W.H.O.:	World Health Organization

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CHAPTER ONE: INTRODUCTION

1.1. Background

The use of medicines in rational way is key to improving patient and community health [1–3]. Improvement of medical care and health for both patients and community can only be achieved through the use of drugs properly [4]. The rational use of medicine is defined by the WHO as "patients receiving 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" [3,5].

Referring to estimates provided by the World Bank, the proportion of total healthcare expenditures made up by health commodities ranges from one-fifth to one-half in developing countries. Over half of all medicines are either incorrectly sold or prescribed, and research revealed that the same proportion of patient encounters did not capture advice that would have enabled them to observe dosing instructions [6].

Prescription errors lead to higher healthcare costs, patient impairment (such as increased suffering and hospitalizations), and treatment failure [7].

Irrational drug use in healthcare settings is causing patients to lose faith in the healthcare system. Fewer resources and fewer drug policies implemented or enforced are two factors that contribute to the problem's exacerbation in developing nations, for illustration in Pakistan, Eritrea, and Sri Lanka [8,9].

Major causes of irrational drug use have been identified, including antibiotic misuse, polypharmacy, injectable overuse, self-medication, and non-STG-compliant prescribing patterns [6,8,9]. A number of factors are contributing to the irrational prescription of drugs, such as medical personnel, the workplace setting, capacity building, health supply chain management, a lack of regulations, and inaccurate information about medicines.

Many studies conducted in the world revealed antibiotic overuse, for instance, according to a modeling study on global antibiotic consumption and usage in humans, undertaken by Browne A. et al, antibiotics are the most commonly used drugs, with a 46% rise in worldwide consumption from 2000 to 2018[10].

In addition, according to Klein E. et al. in a systematic review of antibiotic consumption in seventy countries, from 2000 to 2015 and according to Bell B. et al. in another systematic review of the antibiotic consumption effects done in 2014, antibiotic resistance is increasing as a result of a rise in antibiotic usage [11,12], and several studies revealed that misuse or overuse exacerbates the problem [13–18]. According to WHO in a report for averting antimicrobial resistance of 2019, antibacterial resistance infections were estimated to result in approximately 700,000 deaths per year [19], with the possibiltiy of reacing 10 million in 2050 [19,20].

Drug use indicator studies have been conducted in some African countires, such as Egypt, Eritrea, Ethiopia, Namibia, and Tanzania, etc… [21–25], however, in other African countries like Burundi, there is less evidence.

In conclusion, as described previously, evidence-based African studies suggest that antimicrobial prescribing and usage errors by health care professionals and patients are fueling the crisis.

Particularly, prescribers may play a pivotal role in rationalizing antibiotic use and then reducing the emergence of resistance.

It is therefore essential to evaluate drug use with an emphasis on antibiotic use in Burundi. Referring to a practical guide of Drug and Therapeutics Committees as well as to How to evaluate drug use in healthcare facilities, this study aims to evaluate drug use with an emphasis on antibiotic use among outpatients in twenty (20) primary healthcare centers in Bujumbura Mairie, Burundi. How to look into drug use in medical facilities

1.2.**Problem statement**

Despite efforts to promote rational medicine usage, irrational use remains a global concern. WHO estimates that prescription-only drugs are improperly prescribed, delivered, and sold within the healthcare system. Consequently, this leads in negative health outcomes and causes serious adverse reactions or drug interactions in patients [6]. In addition, irrational drug and antibiotic use contributes to an increase in resistance due to antimicrobial misuse, a growing concern in the health community and one of the main causes of illness and death globally, and [26,27].

According to WHO, AMR poses a significant threat to public health [28]. Consequences include higher incidence, death, lengthier illness, and extended hospitalizations [27,29].

According to the research on AMR global report (2022) and European Public Health Alliance (2019), an estimation of 4,95 million deaths were estimated to be caused by AMR, including 1,27 million deaths attributable to the disease. This makes it the main cause of mortality worldwide [30,31].

According to "WHO European Region and the European Union/European Economic Area (EU/EEA), in antimicrobial resistance surveillance report 2022", around 670 000 infection illnesses and 33 000 deaths related to antimicrobial resistance are expected annually [31].

According to a study on prescription and non-prescription antibiotic dispensing practices in Moshi of Tanzania, conducted by Pius G. in 2017; Over-the-counter antibiotics promote irrational antibiotic use and antibiotic medicines are often provided to patients without a medical prescription, despite regulations and processes requiring them to be prescribed exclusively [32].

In Europe, 5 percent of all antibiotics were used without a prescription in 2016, according to data provided in 2016 [33]. This is relatively low incidence compared to developing countries, where pharmaceutical regulation is poor, and it is quite easy to obtain any medicine with or without a medical prescription.

Moreover, developing countries are experiencing an insufficience of trained medical personnel. In most of the healthcare facilities, drug prescribers have different qualifications lack professional training in pharmacy, but perform this duty with varied degrees of proficiency [34,35].

Evidence-based studies have been reported in East African Community countries.

For instance, according to a research conducted in Uganda, at least four out of ten patients are treated with antibiotics [36].

Furthermore, In Burundi, according to an antibiotic consumption regulation evaluation carried out in 26 private and 6 public pharmacies in the urban area of Bujumbura in 2015, 26 out of 32 of the medicines sellers (82%) agreed that they always sell non-prescription antibiotics, and all the medicines sellers who took part in the study (100%) were unaware of any regulatory measures or laws that stipulate that antibiotics are prescription-only-drug [37].

It is essential to examine current drug use patterns in order to promote proper medicine use referring to WHO medicine use indicators. First, researchers need to characterize and identify the various manners in which medicine use is irrational, such as improper antibiotic use, drug over usage, and the overuse of injectables, before they can successfully advocate rational pharmaceutical use.

Researchers from all over the world have done a lot of research and found that most of the bacteria that cause diseases in humans have become very resistant to the antibiotics that are usually used early in the course of treatment. Thus, WHO core indicators are the best way to make prescription habits better and promote medication efficacy in healthcare system.

Clinicians' expirtise to write prescriptions in a logical way needs to be tested, and this can be done by evaluating prescriptions regularly. In light of this, the goal of this research is to evaluate the use of drugs with an emphasis on antibiotic use among outpatients in 20 primary healthcare facilities in Bujumbura Mairie, Burundi, using prescribing and specific facility parameters that are part of WHO-selected drug use indicators.

1.3. **Objectives**

1.3.1 **Main objective**

Conduct a drug use evaluation with a focus on antibiotic use in 20 PHCs in the Bujumbura Mairie using the indicators established by WHO

1.3.2 **Specific objectives**

Within the 20 PHC and referring to WHO/INRUD guidelines:

(i) Assess the drug prescribing indicators.
(ii) Assess the specific facility indicators.
(iii) Identify factors or predictors associated with antibiotic prescribing

1.4. Significance of the research

In Burundi, a few piece of research have been carried out on drug use with an emphasis on antibiotic use. To-date, this was the first of its nature study that was been carried out in 20 primary health facilities regarding drug use evaluation with an emphasis on antibiotic use using WHO prescribing and facility indicators.

This research was not only contribute to the successful completion of my Master's degree but will also benefit other future academics in the study area as well as pharmaceutical stakeholders including but not limited to health supply chain managers and government decision-makers in health systems.

The findings might be used to elaborate and put in place policies and strategies to promote proper use of drugs/antibiotics.

1.5. **Delimitation**

This research is associated with rational medicine use, which is a component of health commodity supply chain management and access to essential medicines framework. The study was carry out in primary healthcare centres in Bujumbura Mairie, the economic capital city of Burundi.

CHAPTER TWO: LITERATURE REVIEW

2.1. **Drug and antibiotic use overview.**

Despite various efforts by various official authorities to encourage rational medicine use, irrationalmedicine use remains prevalent and a significant concern globally. Referring to data from the WHO, over 50% of all drugs are used irrationally [27,38].

Relevant studies have been carried out in developed countries, however, there is less evidence in African countries.

The use of antibiotics increased globally by 46% from 2000 to 2018 [20]. Both the associated threat to global health and related dispensers were revealed by the literature on antibiotic misuse [39,40].

The number of deaths caused by drug-resistant infections is expected to increase by 2050, as antibiotic resistance is a major global public health concern. Therefore, it is crucial to promote the responsible drug including antibiotic use to preserve their effectiveness for future generations [41]. .

In this chapter, it is highlighted the key drivers of irrational drug usage, with a focus on antibiotic use and how regulation is established to improve the issue. Furthermore, studies on antibiotic stewardship in healthcare facilities was discussed, highlighting the current research gaps that were explored through this proposed research.

2.2. **Determinants of factors associated with antibiotic use and resistance**

2.2.1. Health services in Burundi

2.2.1.1. **Health services administration in Burundi**

The Burundi Ministry of Health is charge of developing and implementing health policies. It is in charge of promoting healthcare, disease prevention and control, treatment, and rehabilitation. Burundi's health care system is structured in three levels that are the central, intermediate, and the peripheral levels.

Policies and strategies are defined and established at the central level. This extends to planning, monitoring, and evaluating performance, resource mobilization and management, and regulation.

It is responsible for the organization and coordination of the intermediate and peripheral levels, in addition to providing administrative, logistical, and technical support.

The intermediate level consists of eighteen provincial health offices responsible for coordinating and assisting health districts. This level is responsible for the implementation of health policies, coordination of activities, and provision of administrative, logistical, and technical support.

It ensures the equitable and efficient distribution of resources to health districts.

The health districts are located at the periphery, are considered as the fundamental organizational units of the healthcare systems. It is comprised of 47 health district offices, each of which consists of an administrative center, a district hospital, and a network of all the health care facilities [42,43].

2.2.2. Regulation of medicines usage

Medicines regulation is a combination of administrative, technical, and legal measures established by governments to guaranty the efficacy, safety, and quality of pharmaceuticals, as well as the relevance and accuracy of product-related information. The goal of regulation of medicines is in the interest of protecting public health [44].

The Drug Regulatory Authority (DRA) of each nation is charged with ensuring that pharmaceuticals are of high quality, safe, and effective. Important variables include having qualified and experienced staff members, adequate financial resources, and freedom from political interference. In order to ensure fair and impartial decision-making in regards to drug regulation, autonomous DRAs are an absolute necessity [45]. However, there is a lack of legislation in many countries[45].

According to Havyarimana C. et al. (2015), in a research on “Evaluation of the regulation of antibiotics consumption in Bujumbura, Burundi”, the national policy to regulate antibiotics use is lacking [37].

2.2.3. The Medicines and Food Regulatory Authority of Burundi

The Medicines and Food Regulatory Authority of Burundi, also known as “ABREMA”, is the only parastatal technical department that was established to ensure that the people of Burundi have access to food and medicine of high quality. It is a newly created authority that was established on February 26, 2021, by decree number 100/039. It is in charge of protecting the health of the population by guarantying that human and veterinary medicines, biological and other health technologies that acquired and distributed are safe and of high quality[46].

The manufacturing and distribution of the products above-mentioned fall under its responsibility, and they must be regulated accordingly. In addition to this, it is the organization's responsibility to advance public health in Burundi by accelerating innovations that make health technologies more efficient, affordable, and safe. This is done to ensure that the general public receives accurate and scientifically based information necessary to make appropriate use of health technologies and food in order to maintain and improve public health [47].

2.2.4. Human resources of ABREMA

According to the council board of the Burundi Regulatory Authority, the ABREMA lacks sufficient personnel to complete all assigned tasks. This newly established institution is still awaiting authorization to hire the personnel required to fulfill its mission [48].

2.2.5. Financial resources of ABREMA

ABREMA is a financial autonomous authority with a cost recovery system for services provided, according to the decree of its establishment decree [47]. However, the ABREMA is still awaiting the first budget allocation for autonomous effectiveness [48].

2.2.6.Antibiotics regulation in Burundi

Although antimicrobial stewardship guidelines are lacking in Burundi, ABREMA has developed a core list of mandatory prescription drugs that includes antibiotics. This document is not disseminated for its comprehensive implementation.

2.2.7. Antibiotic resistance combating program in Burundi

As stated previously, Burundi lacks antimicrobial stewardship guidelines, but ABREMA has compiled a list of essential prescription-only medications. Even after being refined, the compiled document is not disseminated for implementation [49].

According to the 8th East African Health Conference held in Nairobi, Kenya between November 17-19, 2021, a biannual event organized by the East African Health Commission (EAHRC) and partner states from EAC which include Burundi has outlined many different socioeconomic factors that contribute to antibiotic resistance that include extreme poverty, low public awareness, and a lack of knowledge.

Following recommendations from the meeting, Burundi has elaborated the multisectoral national action plan against AMR for 2022-2023 [35]. The AMR containment and prevention program estimates the national burden of antibiotic resistance and promotes infection control and antimicrobial stewardship[50].

The Burundi action plan to combat AMR which refers to “WHO Global Plan” on AMR is aligned with in the following strategic axes[49]:

(i) Awareness, communication, and training on the risks of antimicrobial resistance
(ii) Increasing the knowledge and evidence base through research and surveillance
(iii) Reducing the number of infectious diseases through improved sanitation
(iv) Optimizing antimicrobial use in plant, animal, human health
(v) Coordination and mobilization of funds for its implementation.

The Burundi AMR Action Plan includes the following five (5) objectives:

i) Increase understanding and awareness of the problem of the resistance to antimicrobials through training, effective communication, and education
ii) Increase knowledge and evidence base through research and surveillance
iii) Reduce the number of infection diseases through effective infection control and hygiene measures
iv) Rationalize antimicrobial use in animal and human health
v) Make long-term investments that consider the country needs, with focus on development of new drugs, diagnostics, vaccines.

Despite all efforts mad in developing the Burundi action plan, and given the Burundi’s economic capacity, its effective implementation is still questioned. There is a need for investments from partners to ensure its effective implementation.

2.3.**Summary of literature review**

Evidence-based research demonstrated that dispensing practices at drug retail pharmacies are influenced by knowledge and attitudes towards rational antibiotic usage. Data from European countries (2016) indicates that the rate of using antibiotics without prescription was 5% [33], this rate should be lower in comparison to low and middle-income nations. According to WHO estimations, over fifty percent (50%) of all medicines are used inappropriately [3]. According to a systematic review done by Figueiras A. and Dopazo M. on the antibiotic dispensing determinants (without prescription) in 2018, sometimes antibiotics are given to patients without requiring a medical prescription, which is a contributing factor to their misuse [51].

Gajdács M. and collaborators conducted research in 2020 on community pharmacists' attitude, knowledge, and practice regarding infectious diseases and antibiotic use in Hungary, and found that 25% of respondents acknowledged to dispense antibiotic as aver-the counter drug [13].

This type of survey is used in pharmacy practice research to investigate understanding, beliefs, and behaviors[52]. For decades, the KAP survey model has been used in health studies to collect information from patients and practitioners[53,54]. Following are the results of previous studies conducted to collect information on the antibiotic or antimicrobial use .

2.3.1. The association between health personnel knowledge and inappropriate practice in the use of antibiotics

The health personnel knowledge involved in drug dispensing can influence the antibiotic provision practice. Evidence based studies indicated that inappropriate use of antibiotics is linked to poor knowledge[55–63].

Tanveer A. et al. conducted a study in various regions of Hyderabad, India, in 2022 and found that community pharmacists possessed inadequate antibiotic knowledge and dispensing practices. 15 of 40 respondents considered AMR to be a serious problem, with half agreeing that they can dispense antibiotics even though patients do not have a prescription and twenty-six (26) agreeing that antibiotic drugs can be dispensed without a prescription to treat minor illnesses. The study determined that pharmacist personnel were in need of antibiotic resistance knowledge and then enhance their level of perception to the issue [55].

Mallah N. et al. carried out research in 2020 in Beirut, Lebanon, and revealed that resistance due to antibiotic is one of the main health concerns that has been linked to improper consumption of antibiotics, and linked to sub-knowledge, habits, and to the characteristics of study population. Therefore, the present study elucidates the substantial prevalence of antibiotic misuse, encompassing the practice of self-administering antibiotics by more than half of the population. In addition, the practice of dispensing of antibiotics without considering medical prescription is for over than 30% of antibiotics. According to the study's findings, there is a higher risk of improper antibiotic use when there is a lack of knowledge and false notion about antibiotics [56].

Agarwal et al. conducted a KAP survey on parents in 2015 on antibiotics use and misuse in Children at Children hospital in Vashi, in India, and found that twenty-eight percent (28%) of

872 parents could correctly identify that bacterial infection illnesses re treated with antibiotics, while 15. 5% understood the meaning of the antibiotic resistance[57].

In 2019, Abdelaziz A. et al. conducted a study titled "Quality of community pharmacy practice in antibiotic self-medication encounters" in Upper Egypt. The findings indicated that amoxicillin is prescribed for common cold at a frequency of 99.1% and for acute bronchitis at 97.6%. This antibiotic was administered without collecting clinical condition information. Among 50 pharmacists, it was found that 64% of them identified illogical dispensing or prescribing as the leading factor contributing to the overuse of antibiotics. In summary, the study demonstrated a deficiency in understanding among community pharmacists pertaining to the utilization of antibiotics [58].

In 2016, El-Hawy R. et al. carried out a KAP study in on antibiotic misuse among the population of Alexandria. The study revealed that nearly 64% (231 out of 359) of the population self-medicated using amoxicillin combined with clavulanic acid, the most used antibiotic due to a lack of knowledge [59].

In 2018, Shrestha R. et al. conducted, among students for medical school, a KAP study on resistance resulting from the use of antibiotics in Hospital of Tertiary Care level in Nepal. The findings revealed a need for educating students on rational antibiotic prescribing, delivering, and utilization, as 82.9% and 50%, respectively, of 228 students had moderate knowledge and practice regarding antibiotics use [60].

Zakaa M. et al. Carried out a 2018 research on the practices and attitudes of Egyptian pharmacists regarding antibiotic delivering and resistance in the Greater Cairo. In the first section of the survey, he discovered that approximately 10% of the 461 pharmacists had a score of less than 5 out of 9 on a questionnaire of knowledge, indicating a low level of basic knowledge. The author discovered that the absence of government policies and laws regulating the process led to a rise in antibiotic dispensing and consumption [61].

A KAP study conducted by in 2019 regarding resistance resulting from the antibiotics utilization in Pakistan, showed poor to moderate antibiotic knowledge[64].

In accordance to a KAP study carried out by Gillani A. et al in 2019 among 2106 individuals regarding antibiotics use in Punjab, Pakistan, revealed poor antibiotics knowledge(at a rate of 60% of the participants)[62].

In a 2019 KAP study on the use of antibiotics among Nepal's community members of Rupandehi District, Nepal A. et al. discovered antibiotic identification poor knowledge among respondents that respondents. Respondents living in cities had more knowledge about the use of antibiotics than those living in rural areas. Antibiotic resistance was a well-known concept but poorly understood [63].

2.3.2.The association between attitudes and inappropriate practice in antibiotic dispensing/use

Several studies have revealed a correlation between the opinions of retail pharmacy dispensers towards antibiotics use or antimicrobial use and resistance and their practices [61–66].

Alnasser A. et al. conducted a KAP study on the use of antibiotics and resistance from antimicrobial utilization in Saudi Arabia in 2021 and found that while the numbered of participants had good knowlegdge on the use of antibiotics (88 percent of 443) and good practices (85.6% of 443), the majority had negative attitudes toward antibiotics use [65].

According to a 2019 KAP study of the personnel of community pharmacies regarding programs managing antimicrobial use conducted by Feng Z. et al, a large number of community pharmacy staff had a good antimicrobial knowledge, but their awareness of the antimicrobial cost and bihaviors toward antimicrobial stewardship programs were poor[66].

Zakaa M. et al. carried out a 2018 research on the attitudes and behaviors of Egyptian pharmacists on antibiotic delivering and resistance in Greater Cairo. In the second phase of the study, he found that nearly 49% of 461 pharmacist personnel believed that not delivering antibiotics when patients do not held a medical prescription would decrease medicine sales. 44.5% of the pharmacists agreed that patients with a fever would request antibiotics when he do not have a medical prescription. Thus, the author revealed that the majority of pharmacists (90%) believed the Ministry of Health will create standards to regulate antibiotic dispensing practices [61].

A KAP survey done in 2019 among consumers in Swat, Khyber-Pakhtunkhwa, Pakistan, about antibiotics use and resistance revealed opinions of inappropriate use of antibiotics, including their storage at home and use or reuse only when necessary[64].

In accordance to a 2019 KAP research carried out by Gillani A. et al among 2,106 individuals in Punjab, Pakistan regarding antibiotics use, there are misunderstandings regarding the use of antibiotics for self-limiting illnesses as runny nose, cough, sore throat, and fever. 52.2% of respondents agreed that antibiotics should be used for these symptoms [62].

In a 2019 KAP study on antibiotic use among community members (101 participants) of Nepal's Rupandehi District, Nepal A. et al. found that 50.9% of respondents were uncertain as to whether skipping doses contributed to the development of antibiotic resistance, while 88.2% would visit a different doctor if they were not prescribed an antibiotic. Nearly half of the respondents (47.7%) who had a fever believed antibiotics helped them recover more quickly [63].

2.3.3. Practices for antibiotic provision and stewardship

According to Belachew et al. in a 2021 systematic review on “Non-prescription dispensing of antibiotics among community drug retail outlets in Sub-Saharan African countries”, over-the-counter antibiotics were provided in 69% of cases[67].
In a study conducted in Ethiopia, in region of Amhara, focusing on non-minicipality towns, Belachew S. et al. (2022) discovered that 58% of 276 staff members from 270 medicine outlets among those filled out the questionnaire aggreed to dispense antibiotics when patients do not hold a prescription [67].

According to a study caaried out by Karuniawati H. et al. (2021) among Boyolali population of Indonesia, on a sample of 575 individuals with a response rate of 99.96%, 73.12% of participants agreed that antibiotic drug could be utilized to treat infections due to virus, and 63.65% said that fever is reduced by antibiotics. Concerning attitude, fifty percent (50%) of those surveyed reported that they stopped taking antibiotics as soon as their symptoms disappeared. 40% of the study participants reported obtaining antibiotic drugs from a pharmacy as over-the-counter drugs [68].

In 2019, a KAP study conducted by Khan F. et al. among 399 consumers in Swat, Khyber-Pakhtunkhwa, Pakistan regarding antibiotics use and resistance indicated inadequate antibiotic use practices. 66.7% of consumers did not follow to the specified regimen and 72.9% discontinued taking their (2–3 doses) antibiotics after feeling better. 57.6 % of participants stored medications at home for future use, and participants often do not discard previously used antibiotics [64].

More than half (59.6%) of respondents in a 2019 KAP survey done by Gillani A. et al among 2106 individuals in Punjab, Pakistan addressing antibiotics use acknowledged self-medicating with antibiotics without a prescription on at least one occasion. The most common cause for self-medication using previously prescribed antibiotics was the treatment of same symptoms with medications stockpiled at home (33.9%)[62].

Nepal A. et al. discovered in 2019 KAP study on antibiotic use among Rupandehi District community members (101 participants) that while the majority of respondents reported correct antibiotic access and use practices, 84.6% preferred an antibiotic at least occasionally when they had sore throat and a cough [63].

Ansari M. studied 161 community pharmacies in Nepal in 2017 to determine antibiotic dispensing procedures. He found that 66.5% supplied antibiotics without a prescription and that 91.4% of dispensing employees were non-pharmacists. The survey also identified widespread behaviors such as substituting of antibiotic brand by another (66%) and providing none complete antibiotic courses (73%), and concurred not offer any advice on proper use of antibiotics (39%) or finishing the entire course of treatment (80%)[69].

In a phenomenological qualitative study on "Sale of Antibiotics without Prescriptions in Alexandria, Egypt," all respondents said antibiotics were regularly administered without a prescription, and 60% reported that this tendency was progressive [70].
Zakaa M. et al. studied attitudes and practices of Egyptian pharmacists in Greater Cairo in 2018. In the third phase of the study, 304 out of 461 participants reported they sometimes distribute antibiotics without prescription[61].
According to a study conducted in Abidjan, Ivory Coast (2007), 21% of antibiotics were delivered at the request of the patient while 14% were recommended by pharmacists[71].

In a Tanzanian study on antibiotic delivery, 143 (72.6%) of 197 pharmacists admitted delivering them without a prescription. They revealed that pharmacy owners desired increased profit, the patient lacked a prescription, and authorities did not properly regulate pharmacies, and then antibiotics were administered without a prescription [72].
According to the findings from a study conducted in 70 private pharmacies of Dar-es-Salaam in Tanzania on dispensing practices by Kagashe G. et all (2010), 20% of customers who purchased antibiotics received partial doses, and only 20% of the 70 dispensers provided them with dosage instructions in accordance with recommendations [73].
According to Mukonzo J. et al. (2013), in a study entitled "Over-the-counter suboptimal dispensing of antibiotics in Uganda," conducted in a one national referral hospital, eight (8)

district hospitals, 62 registered community pharmacies, and one health center II, suboptimal dispensing of antibiotics over the counter was observed. Overall, 43.2% of antibiotics were dispensed, and 41% of antibiotics were delivered as over-the-counter drugs [36].

In Burundi, according to an antibiotic consumption regulation evaluation carried out in 26 private and 6 public pharmacies in the urban area of Bujumbura in 2015, 26 out of 32 ofthe medicines sellers (82%) agreed that they always sell non-prescribed antibiotics, and all the medicines sellers who took part in the study (100%) were unaware of any regulatory measures or law that stipulate that antibiotics are prescription-only-drug[37].

2.1.1. The conceptual framework

Figure 1 below showed the framework concept in which antibiotic prescribing serves as the independent variables and the dependent variable consist of the related factors to drugs and the healthcare system, as well as the sociodemographic characteristics of patient encounters.

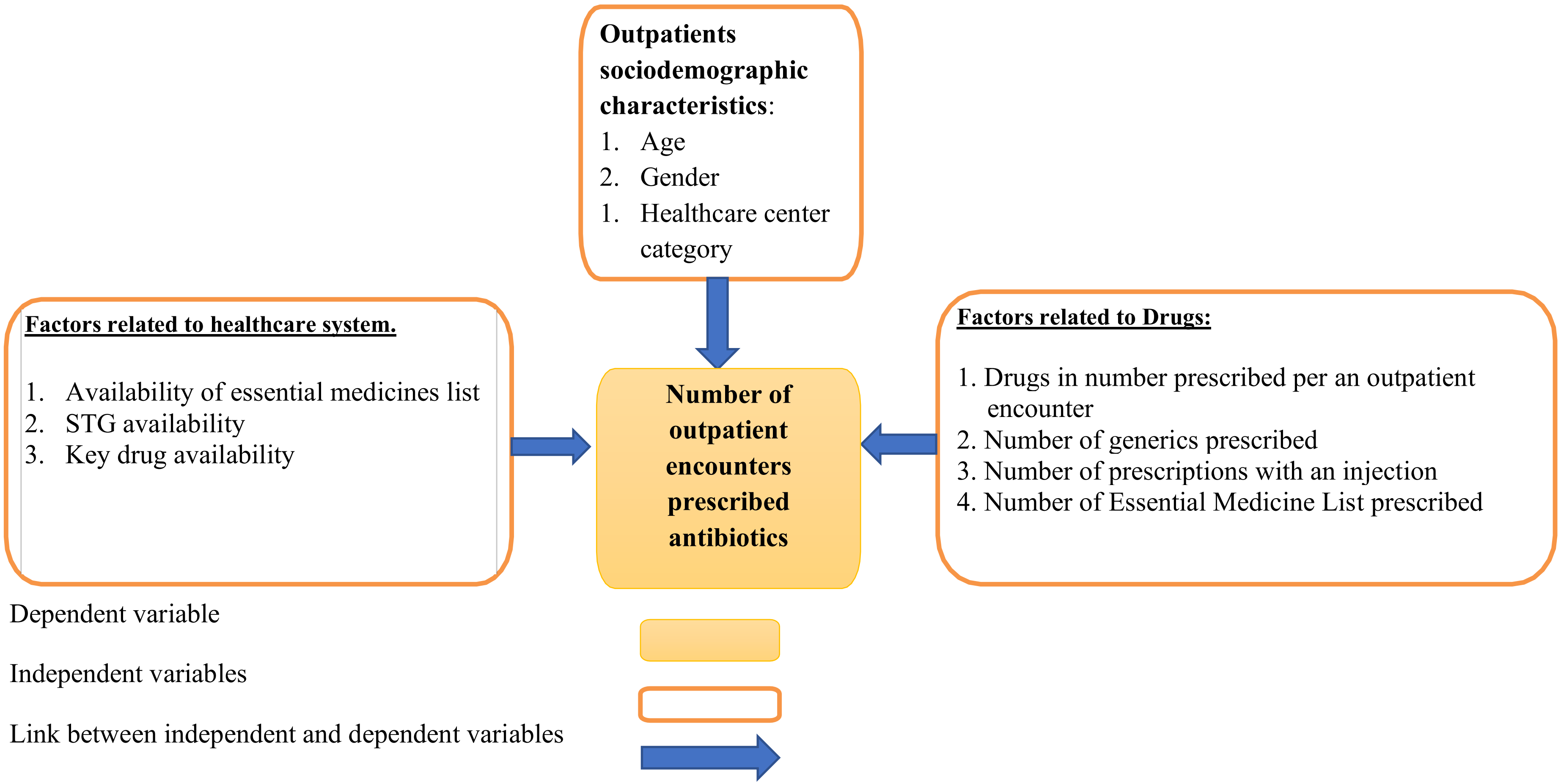

Figure 1: Evaluation of drug/antibiotic use framework

CHAPTER THREE: METHODOLOGY

3.1. **Study design**

The study was cross-sectional in nature, with indicators of medicine prescription evaluated retrospectively and facility-specific indicators evaluated prospectively. This research is part of the evaluation of the rational drug use by evaluating WHO/INRUD drug use indicators focusing on antibiotic use among outpatients in 20 primary healthcare centers in Bujumbura Mairie, Burundi.

3.2. **Study location**

This study was conducted in 20 primary health centers of Bujumbura Mairie. This study area was strategically selected since it was the province with the highest concentration of healthcare employees compared to other provinces (14% nurses, 71% of non-specialist physicians and 35% of specialized physicians), as well as the province with the highest concentration of healthcare facilities and retail pharmacies (14% for health facilities and 26% for pharmacies) [74]. Moreover, it was the highly populated city with 11 668 inhabitants km² and a surface area of 127 km².

3.3. **Target and study population**

A research population can be defined as individuals with similar characteristics and who are the objects of the researcher. For prescribing indicators, the population targeted was the outpatient encounters of the study area whereas for specific facility indicators, the target population was primary healthcare centers. The study area contained 94 primary healthcare centers. Prescribing data were collected from historical medical records.

3.4. **Sample size and sampling methods**

3.4.1 **The sample size**

Before designing research data collection form, it has been better to get statistics about outpatient encounters at each of the primary healthcare facilities.

The WHO has defined the basic parameters of drug use studies in a document named “How to investigate drug use in health facilities” as well as in a practical guide of “Drug and Therapeutics Committees”. In light of this, the WHO suggests a minimum of 30 encounters in each of the surveyed facilities. In order to obtain more reliable results regarding drug use indicators, WHO recommended a minimum of 600 encounters for studies of this nature that describe current treatment practices [68]. To accomplish this, the researcher surveyed a total of 100 encounters for each of the healthcare surveyed [4]. As a result, the researcher ensured to follow this WHO recommendation. The study has been carried out in 20 primary healthcare centers.

For prescribing indicators, at each of the 20 healthcare centers, it has been chosen 100 recorded outpatient encounters, and then the total sample size was 2000 outpatients. For specific facility indicators, the targeted population was the 20 primary healthcare centers.

3.4.2 **The sampling techniques**

Random systematic sampling was used in this study. Initially, the first primary health center was randomly selected using the RANDBETWEEN Excel formula, and then the remaining 19 primary health facilities in Bujumbura Mairie were selected at regular intervals using the formula k= (population size/sample size). The researcher ranked first the primary health facilities in alphabetical order, allowing him to choose each facility based on the ranking.

Secondly, the first encounter was also selected using the RANDBETWEEN Excel formula, and the remaining encounters were chosen using the formula k= (population size/sample size). Medical records or prescription forms of outpatient encounters who visited a primary healthcare center for 2022 year, from January to December 2022 were used. The formula k = (population size/sample size) was used to calculate the intervals between PHCS and encounters at each health facility.

3.5. Data collection

The primary goal of a well-designed survey instrument is to mitigate the occurrence of errors during the process of gathering the intended information. In order to ensure the validity and reliability of responses, researchers must employ meticulously crafted data collection instruments. Validity is attained when the interrogative prompts a response that is both truthful and precise, and effectively evaluates the intended construct.

An effective form should yield accurate measurements of the intended indicators, so facilitating the respondent's comprehension of the sought-after information. The attainment of reliability is contingent upon the ability of a question to elicit a consistent response, irrespective of the questioner's identity or the context in which it is posed. In order to enhance the robustness of data collection, it is imperative that all surveys are translated into the languages spoken by the local population, thereby ensuring optimal levels of validity and reliability. For this study, the researcher used a validated WHO/INRUD standard collection form to look at facility and prescribing indicators[4].

Note: This project did not include an informed consent form in its appendices because it did not involve human biomedical or behavioral research. The research data were collected from the historical medical records.

3.5.1. Questionnaire Development

A data collection form has been elaborated with regard to the previous similar literature. In addition, the data collection form has been developed in accordance with the WHO/INRUD facility-specific and medicine prescribing parameters or indicators at primary healthcare facilities [4,75]and survey research references. In this study, the researcher used the WHO/INRUD validated data collection forms and to the similar studies carried out previously in other countries [21,22,25].

3.5.2. Questionnaire design

A data collection form to assess the WHO indicators for medicine prescription was developed referring to previous literature and the format developed by WHO in the document designed to investigate the use of drugs in health facilities [4].

3.5.3. Pre-Testing

Before deploying the survey questionnaire for data collection purposes, it is imperative to conduct a thorough testing process. Pre-testing and piloting are valuable methods for identifying potential issues with participant comprehension and questionnaire ambiguity. To ensure the data reliability, the researcher adhered to the WHO/INRUD guidelines and utilized the WHO standard prescribing and facility-specific indicator forms designed for this purpose.

3.5.4. Data collection technique

Randomly selected, PHC were visited during working hours. After a brief explanation on the purpose of visit and the relevance of the research, data collection forms were used by the researcher using paper-based questionnaire after consulting the outpatient encounter medical prescription from the historical medical records. Data were copied by using the designed questionnaire for this purpose.

Data were collected on prescribing encounters, on the head of facility centers and in the pharmacy services. Each outpatient encounter data was recorded on a form containing the data required to compute the indicators.

3.6.**Data processing and analysis**

Data were collected using data collection form developed by WHO. After data collection in twenty healthcare facilities in the Bujumbura Mairie, data entry was performed using Excel sheets.

After data collection, the data were evaluated using the "Statistical Package for the Social Sciences (SPSS) version 23". Descriptive statistics were employed to depict sociodemographic and antibiotic prescribing data. Continuous variables were summarized using measures such as mean and standard deviation, while categorical variables were summarized using frequency and percentage. The computation, evaluation, and comparison of trends in antibiotic prescribing were conducted in relation to the prescribing standard values set by the WHO.

The present study employed logistic regression to examine the association between antibiotic prescribing behavior and its corresponding predictive parameters. The 95% confidence interval was reported when calculating the odds ratio in logistic regression analyses, with a p-value less than 0.005 indicating that the analyses were statistically significant.

A total of 2000 encounter prescriptions were analyzed, corresponding to 2000 outpatient encounters. Data processing was done according to the defined specific objectives for this study.

3.1.1. Variable descriptions

- Dependent variable.

The dependent variable is "antibiotic prescribing ". It has been operationalized into two modalities: Yes or No.

Table 1. Variable descriptions

Variables	**Descriptions**	**Definitions**	**Values**
Dependent variable			
Antibiotic prescribing	Binary variable	A variable was defined with the intention of calculating the proportion of occurrences that include the administration of a specified antibiotic. In order to get the percentage, it is necessary to divide the total number of outpatients who received one or more antibiotics by the total number of encounters. Subsequently, the obtained quotient is multiplied by a factor of 100.	0=No, 1=Yes
Independent variables			
1. Outpatients sociodemographic characteristics			
Age	Numerical variable	• <5 • 5-14 • 15-24 • 25-44 • 45-65	1,2,3,4……

Variables	Descriptions	Definitions	Values
		• >65	
Gender	Binary variable	• Female • Male	0=Female, 1=Male
Healthcare category	Binary variable	• Private • Government owner	0=Private, 1=Government owner
Drugs in number prescribed per an outpatient encounter	Numerical variable	This variable was employed in the computation of the mean quantity of medications per encounter. In order to determine this indicator, the mean value was computed by dividing the aggregate count of distinct pharmaceuticals prescribed by the number of encounters that were assessed. The total count of encounters, including of instances where no medications were prescribed, was recorded for data collection purposes. In this study, the sample size for each facility was 100.	0,1,2,3,……..
Number of generics prescribed	Numerical variable	This variable was employed in the computation of the proportion of medications prescribed in their generic names. In order to get this value, employe a method of dividing the aggregate count of generic pharmaceuticals prescribed by the overall count of drugs prescribed, and subsequently multiplied the result by 100 to obtain a percentage representation.	0,1,2,3,……..

Variables	Descriptions	Definitions	Values
Number of prescriptions with an injection	Binary variable	The purpose of this variable was to calculate the percentage of encounters in which an injection was prescribed. To get the percentage, divide the aggregate count of patients who received one or more injections by the overall count of encounters, and afterwards multiply the quotient by 100.	• 0=No, 1=Yes
Number of Essential Medicine List prescribed	Numerical variable	The purpose of this variable is to calculate the percentage of medications prescribed from the Essential Medicine List (EML). To calculate the percentage of EML drugs prescribed, one should divide the total number of EML drugs prescribed by the total number of drugs prescribed, and then multiply the result by 100.	0,1,2,3,……..
2. Antibiotic prescribing			
Number of antibiotics prescribed per outpatient encounter	Numerical variable	The purpose of this indicator was to calculate the mean amount of antibiotics administered with each outpatient encounter. In order to determine this indicator, the mean value was derived by dividing the aggregate count of distinct antibiotics prescribed by the total number of contacts examined. In this study, the total number of encounters each facility was 100. This metric is valuable for the purpose of	0,1,2,3,…… ..

Variables	Descriptions	Definitions	Values
		comparing it with the average number of drugs per encounter.	
Generic antibiotic number prescribed	Numerical variable	The purpose of this indicator was to calculate the proportion of antibiotics that were prescribed using their generic names. To calculate the percentage of generic antibiotics prescribed, one must divide the total number of generic antibiotics prescribed by the total number of antibiotics prescribed and then multiply the result by 100.	0,1,2,3,……..
Encounters prescribed an antibiotic injection	Binary variable	The current variable has been developed to determine the percentage of cases in which an antibiotic injection is prescribed. In order to get the percentage, it is necessary to divide the total number of patients who had one or more antibiotic injections by the overall number of encounters. The given quotient is subsequently multiplied by a factor of 100.	• 0=No, 1=Yes
EML antibiotic prescribed	Numerical variable	This variable was established with the purpose of calculating the proportion of antibiotics that were prescribed under the Essential Medicines List (EML). In order to accomplish this, calculate the ratio of EML antibiotics prescribed to the total number of antibiotics prescribed. To accomplish this, divide the total number of EML antibiotics prescribed by the total	0,1,2,3,……..

Variables	Descriptions	Definitions	Values
		number of antibiotics prescribed. To express this ratio as a percentage, multiply the result by 100.	
2. Facility specific indicators			
EML copy availability	Binary variable	The purpose of this variable is to assess the accessibility of a copy of the EML. This indicator provides a binary response, indicating either a Yes or No for the facility as a whole.	• 0=No, 1=Yes
Availability of a copy of STG	Binary variable	This variable was meant to evaluate the availability of Standard Treatment Guidelines (STG). This indicator reads either yes or no, for the facility as a whole.	• 0=No, 1=Yes
Availability of key drugs	Binary variable	The purpose of this variable was to assess the accessibility of key drugs within a healthcare facility during the specific visit. This indicator provides a binary response, indicating either Yes or No for each key medication.	• 0=No, 1=Yes

3.1. **Data collection approval**

The approval to collect data has been granted from the Bujumbura Mairie Health Province authorities.

CHAPTER FOUR: RESULTS PRESENTATION

A total of 2000 outpatient prescriptions were analyzed, corresponding to 2000 outpatient encounters. Data were collected in the Bujumbura urban area, where medical prescriptions were surveyed using a WHO/INRUD validated form. The researcher collected data using a paper-based form.

Twenty (20) primary health centers (PHCs) were surveyed. The research ensured to survey PHCs where medical records on medical prescriptions were archived.

Data processing was done according to the conceptual framework and defined specific objectives for this study.

Firstly, sociodemographic, and antibiotic prescribing data were described through the use of descriptive statistics. Secondly, drug and antibiotic prescribing trends have been computed, evaluated, and compared to WHO prescribing standard values. Analytical statistics have been used to analyze predictors of antibiotic prescribing.

4.1. Descriptive analysis results

4.1.1. Study population socio-demographics

Table 2: Study population socio-demographics (n=2000)

	Freq.	Percent	Cum.
Age (Years) (Mean=21.836; Median= 21.0; Mode= 1; Min= 0.3; Max=85; SD=15.6787)			
< 5	342	17.1	17.1
5 to 14	336	16.8	33.9
15 to 24	524	26.2	60.1
25 to 44	624	31.2	91.3
45 to 65	146	7.3	98.6
> 65	28	1.4	100
Gender			
Male	990	49.5	49.5
Female	1010	50.5	100
Healthcare category			
Private	1800	90	90
Govnerment owner	200	10	100

Findings from the Table 2 are summarized as follow:

- Our study population was composed of 2000 outpatients or medical prescriptions. The gender was equally distributed at 990 and 1010 (49.5 to 50.5%), respectively, for males and females.

- The age average was 21.83 years ±SD 15.67
- The most frequent age range was 25 to 44 years (524, 26.2%), while the least frequent was over 65 years (28, 1.6%).
- The private healthcare category was the most represented (1,800, or 90%), whereas the government-owned healthcare was the least represented (200, or 10%).

4.1.2. Results for factors related to drug use.

Below is a table showing patient distribution by drug prescription number.

Table 3:Drug-prescribed by outpatient distribution

Drugs	Frequency	Percentage	Cumulative
0	57	2.9	2.9
1-2	1 126	56.3	59.2
3-4	761	38.1	97.3
≥5	56	2.7	100.0
Total	2 000	100.0	

Based on the data presented in the table above, it can be observed that the category with the greatest proportion of patients is 56.3% (1 126 patients), received one to two drugs, while the lowest percentage, 2.7% (56 patients), received 5 or more drugs per prescription.

Table 4:Generics prescribed by outpatient distribution

Generics	Frequency	Percentage	Cumulative
0	200	10.3	10.3
1-2	1 245	64.1	74.4
3-4	478	24.6	99.0
≥5	20	1.0	100.0
Total	1 943	100.0	

The table 4 shows that, out of 1 943 encounters or prescriptions, the highest percentage of outpatients, 64.1% (1 1245 patients), received one to two generic drugs, while the lowest percentage, 1% (20 patients), received 5 or more generic drugs per prescription.

The number of patients who received or did not receive an antibiotic in their prescriptions is described below in Table 5.

Table 5:Prescription of antibiotics per encounters

Antibiotic prescription	Frequency	Percentage	Cumulative
No	846	42.3	42.3
Yes	1 154	57.7	100.0
Total	2 000	100.0	

Table 5 shows that out of 2000 encounters, 1 254 (57.7%) received antibiotics and 846 (42.3%) did not.

Table 6: Injection prescribed per encounters

Injection prescrivions	Frequency	Percentage	Cumulative
No	263	13.2	13.2
Yes	1 737	86.8	100.0
Total	2 000	100.0	

Table 6 shows that out of 2000 encounters, 1 737 (86.8%) received antibiotics and 263 (13.2%) did not.

Table 7: Outpatient distribution by antibiotic generic prescriptions

ATB generics	Frequency	Percentage	Cumulative
Yes	1 097	95.1	95.1
No	57	4.9	100.0
Total	1 154	100.0	

Table 7 shows that, out of 1154 encounters prescribed antibiotics, 1 097 encounters (95.1%) were prescribed generic antibiotics, while 57 (4.9%) were prescribed brand-names.

Table 8: Outpatient distribution by EML drugs prescribed

Drugs	Frequency	Percentage	Cumulative
0	94	4.8	4.8
1-2	1 248	64.2	69.0
3-4	572	29.5	98.5
≥5	29	1.5	100.0
Total	1 943	100.0	

Out of 1 943 encounters or prescriptions, Table 8 revealed that 64.2% (1 1248 patients) of outpatients were prescribed between 1 and 2 EML drugs per prescription, while 1.5% (29 patients) were prescribed 5 or more. 4.8% of patients (94) were prescribed drugs that are not included in the EML policy.

Table 9: Antibiotic prescribing from EML

ATB from EML	Freq.	Percent	Cum.
Yes	1 101	95.4	95.4
No	53	4.6	100.0
Total	1 154	100.0	

Table 9 shows that, out of 1154 encounters prescribed antibiotics, 1101 encounters (95.4%) were prescribed antibiotics from the EML policy, while 53 (4.6%) were prescribed antibiotics that are not included in EML policy.

Table 10:Prescribing indicators using WHO/INRUD core indicators presented per PHC

PHC Code	Average drugs per outpatient encounter	Percentage of generics	Percentage encounters with antibitics	Percentage antibiotic generics	Percentage EML antibiotics	Percentage encounters prescribed injections	Percentage EML drugs
WHO optimal values[70][73]	1.6-1.8	100	20-26.8	100	100	13.4-24.1	100
1	2.3	85.9	60	100	94.7	12	91.6
2	2.7	90.4	67	100	100	2	90.4
3	2.0	95.9	57	100	100	3	99
4	2.1	83.7	41	97.6	100	22	82.3
5	2.3	58.8	61	90.0	84.3	4	60.1
6	2.0	56.3	44	87.3	94.5	9	78.9
7	2.3	51.1	66	97.4	97.4	7	84.9
8	2.6	86.1	45	100	100	10	93
9	2.4	95.9	65	100	100	38	91
10	3.4	71.1	73	87.4	100	32	85
11	2.8	82.6	80	97.7	97.7	11	83
12	2.1	61.2	64	100	98.8	14	84.7
13	2.2	99.5	56	100	98.4	5	97.7
14	3.1	62.5	78	71.4	85.7	22	79.5
15	2.4	92.8	24	100	100	8	91.9
16	2.8	80.7	59	97.3	61.6	45	82.8
17	2.4	63.9	60	89.1	92.2	7	70.9
18	1.8	73.9	59	88.9	95.2	9	90.6
19	1.3	65.6	36	97.2	100	2	89.8
20	2.3	73.3	59	98.5	100	1	91.4
Mean (SD)	2.4±1.07	76.6±1.11	57.7	94.4±0.6	94.5±0.6	13.2	85.6±1.07

SD= Standard deviation

According to Table 10, the results are detailed below:

Indicator 1: Average drug in number per outpatient encounter

The PHC, coded 18, had a score of 1.8, which is in accordance with WHO optimal values

(1.6–1.8).

The PHC coded 19, had a score of 1.3, which is lower than the WHO-recommended threshold (1.6–1.8). Others surveyed PHC have averages that are higher than the WHO-recommended levels (1.6–1.8).

In conclusion, for this indicator, the average drugs in number per encounter among the 20 PHCs surveyed is 2.4, which was greater than the WHO-recommended value.

Indicator 2: The percentage of generic drugs prescribed

The percentage of generic drugs prescribed was 76.6% in the 20 PHCs surveyed, which is less than the WHO-recommended value (100%). The PHC, coded 13, scored the highest value, at 99.5%, while Hop's God Center has the lowest value, at 51.08%.

In conclusion, none of the PHCs surveyed met the indicator's threshold of 100%. Five (5) PHCs scored greater than 90% on this indicator; these are PHCs numbered 2, 15, 9, 3, and 13, with respective scores of 90.4%, 92.8%, 95.9%, and 99.5%.

Indicator 3: The percentage of encounters prescribed antibiotics.

The percentage of encounters prescribed antibiotics was 57.7% in the 20 PHCs surveyed globally, which is the highest rate compared to WHO value (20-26.8%). The PHC 11 was with the highest value, at 80%, while the 19 has the lowest value, at 36%. In conclusion, none of the health centers met the indicator's threshold (20-26.8%).

Indicator 4: Encounter percentage prescribed injections

The PHCs 4, 12, and 14 scored 22%, 14%, and 22%, respectively, which were in accordance with WHO optimal values (13.4–24.1%).

The PHCs 16, 9, and 10 had respective values of 45.5%, 38.0%, and 32.0% that exceeded the WHO-recommended threshold (13.4–24.1%). Other PHCs surveyed had percentages that fell below WHO-recommended levels (13.4–24.1%).

In conclusion, for this indicator, the encounter proportion prescribed injections among the 20 PHCs surveyed was 13.2%, which was near the minimum value of the WHO threshold (13.4–24.1%).

Indicator 5: Percentage of EML drugs prescribed.

The PHCs 3, 13, 8, 15, 1, 20, 9, 2, and 18 scored 99.0%, 97.7%, 93.02%, 91.9%, 91.6%, 91.4%, 91.0%, 90.4% and 90.6%, respectively, that are among the PHCs with the highest percentages over 90%.

Based on these results, the PHC 3 scored 99.0%, which is near to 100% recommended by the WHO, whereas the PHC with the lowest score was CSU with 60.09%.

In conclusion, for this indicator, 85.9% of the 20 PHCs surveyed prescribe medications from EML, which is a lower value compared to 100% recommended by WHO.

Indicator 6: Percentage of generic antibiotics

Seven PHCs performed well in this indicator. They are number 1, 2, 3, 8, 9, 12, 13, and 15 performed well on this indicator by reaching the WHO recommended score of 100%. In addition, five (5) PHCs (numbered 4, 7, 11, 16, and 19) performed this indicator at a percent over 90.

The PHC with the lowest rate for this indicator is number 6, with a score of 87.3%.

In conclusion, 94.4% of antibiotics are prescribed under generic names in the 20 PHCs surveyed for this indicator. This rate is closer to 100% recommended by WHO.

Indicator 7: Percentage of antibiotics prescribed from EML

Nine PHCs performed well in this indicator. They are number 2, 3, 4, 8, 9, 10,15, 18, and 19 performed well on this indicator by reaching the WHO recommended score of 100%. In addition, eight (8) PHCs (numbered 1, 6, 7, 11, 12, 13, 17, and 18) performed this indicator at a percent over 90.

The PHC with the lowest rate for this indicator is number 16, with a score of 61.6%.

In conclusion, 94.5% of antibiotics are prescribed from EML policy in the 20 PHCs surveyed for this indicator. This rate is closer to 100% recommended by WHO. The global results for drug prescribing indicators, summarized in Table 11.

Table 11: Summary of prescribing indicators

Prescribing indicators	**Total drugs or encounters (frequencies)**	**Average or percentage**	**Recommended values (WHO)** [8,21]	**Standars from Africa[21]**
Average drugs per outpatient encounter		2.4±1.07	1.6-1.8	<2
Percentage of generics	3 616	76.6±1.11	100	65.1
Percentage of encounters with antibiotics	1 154	57.7	20-26.8	45.9

Prescribing indicators	Total drugs or encounters (frequencies)	Average or percentage	Recommended values (WHO) [8,21]	Standars from Africa[21]
Percentage encounters presribed injections	263	13.2	13.4-24.1	28.4
Percentage of EML drugs	4 033	85.6±1.07	100	89
Percentage of antibiotic generics	1 256	94.4±0.6	100	NA
Percentage of EML antibiotics	1 258	94.5±0.6	100	NA
Number of outpatient encounters analyzed	2 000			
Total drugs prescribed	4 711			
Total antibiotics precribed	1 331			

NA: Not applicable because there was not data available from literature

According to Table 11, a total of 4,711 drugs, including 1,331 antibiotics, 1,256 generic antibiotics, and 1,258 EML antibiotics, were prescribed.

From the studies PHCs (20) in Bujumbura Mairie are, we found the following results:

- Per encounter, an average of 2.4 (SD:2.36) drugs were prescribed, exceeding both the WHO-recommended value of 1.6–1.8 and the standards derived from the African region (<2).
- The percentage of generic names prescribed was 76.6% (n=3 616 drugs), which is the lower percentage compared to 100% recommended by WHO but higher than the average derived from the African region (65.1%).
- A percentage of 57.7% (n=1 154) of outpatient encounters prescribed antibiotics, which exceeding both the WHO-recommended value (20-26.8%) and the standard derived from African region (45.9%).
- A percentage of 13.2 % (n=263) of outpatient encounters prescribed injections, which is closer to the minimum rate recommended by WHO (13.4–24.1%) and do not exceed the standard value derived for African region (28.4%).
- A percentage of 85.9% (n=4 033) of drugs prescribed from EML, which is lower percentage compared to 100% recommended by WHO, and lower than the standards derived from the African region (89%).
- A percentage of 94.4% (n=1 256) generic antibiotics, which is lower compared to 100% recommended by WHO but higher than the average derived from the African region

(65.1%).

- A percentage of 94.5% (n=1 258) antibiotics prescribed from EML, which is lower than the WHO-recommended value (100%) for drugs prescribed from EML policy but higher than the percentage derived from the African region (65.1%).

4.1.3. Results for antibiotics prescribed

Antibiotics prescribed are listed below.

Table 12: Frequency of topical antibiotics

The frequency indicates how frequently the topical antibiotics had been prescribed.

Topical antibiotics	Frequency
Fucidine cream	1
Clindamycine/Cotrimazol ovule	2
Gentamycin eye drop	29
Tetracyclin eye ointment	5
Total	**37**

In the study area, 2.8% of all antibiotics prescribed were topical antibiotics.

Table 13: Frequency and percentage of parenteral and oral antibiotics

In the following table, the frequency indicates how frequently the parenteral and oral antibiotics had been prescribed.

Nr	Parenteral and oral antibiotic	Frequency	Percentage
1	Amoxicillin	282	21.8
2	Ciprofloxacin	172	13.3
3	Cefixim	153	11.8
4	Metronidazole	92	7.1
5	Co-trimoxazole	86	6.6
6	Cloxacillin	78	6.0
7	Azithromycin	61	4.7
8	Ceftriaxon	53	4.1
9	Ampicillin and cloxacillin	49	3.8
10	Amoxicillin and clavulanic acid	48	3.7
11	Penicillin V	47	3.6
12	Erythromycin	47	3.6
13	Ampicillin	29	2.2
14	Doxycycline	26	2.0
15	Chloramphenicol	21	1.6
16	Levogloxacin	16	1.2
17	Gentamycin	15	1.2
18	Clarythromycin	5	0.4
19	Norfloxacin and metronidazole	4	0.3
20	Benzathine benzylpenicillin	3	0.2

Nr	Parenteral and oral antibiotic	Frequency	Percentage
21	Cefotaxim	3	0.2
22	Tetracycline	2	0.2
23	Neomycin	1	0.1
24	Nitrofurantoine	1	0.1
	Total	**1294**	**100**

Table 14: Frequency and percentage of parenteral and oral antibiotic pharmaceutical class

This table outlined how frequently the pharmaceutical classes of parenteral and oral antibiotics had been prescribed.

SN	Pharmaceutical class	Frequency	Percentage
1	Penicillin	536	41.4
2	Cephalosporin	209	16.2
3	Fluoroquinolone	188	14.5
4	Macrolid	113	8.7
5	Ntroimidazole	92	7.1
6	Sulfonamide	86	6.6
7	Tretracycline	28	2.2
8	Phenicolin	21	1.6
9	Aminosid	16	1.2
10	Fluoroquinolone and nitroimidazole	4	0.3
11	Nitrofuran	1	0.1
	Total	**1294**	**100.0**

4.1.4. Results for factors related to healthcare system.

The following table includes factors related to healthcare system.

Table 15: Specific-facility indicators using WHO/INRUD core indicators.

PHC Code	EML copy availability	STG copy availability	Key medicines Availability
Optimal values[25][24]	100	100	100
1	0	0	75
2	1	0	88
3	1	0	91
4	0	0	75
5	0	0	72
6	1	0	81
7	0	0	78
8	0	0	94
9	1	0	97
10	1	0	97
11	1	0	94
12	0	0	94
13	1	0	94
14	0	0	34
15	0	0	91
16	0	0	88
17	1	0	97
18	0	0	84
19	1	0	94
20	1	0	88
Total	**10**	**0**	**1703**
Mean	**50**	**0**	**85**

The table reveals the following:

- The number of PHCs that had a copy of the EML was 10 out of 20 which represents a percentage of 50%. This percentage is the lower percentage than 100% set by WHO.
- The STG was unavailable in all the PHCs surveyed.
- The percentage of key drug availability was 85%, which is the lower percentage than 100% set by WHO.

4.2. Predictors of antibiotic prescribing

To test the relationship between variables, we used an association test in each case to cross-tabulate the antibiotic prescription variable with the other variables in our study in order to determine whether the variables were independent of each other.

4.2.1. The bivariate analyses

Table 13 identifies predictors of antibiotic prescription by bivariate analysis

Table 16: Bivariate analysis

Variables	Was antibiotic prescribed?		Bivariate analyses	
	No. Number (%)	Yes. Number (%)	OR (95% CI)	p-value*
Age				
<5	84 (4.3%)	252 (13.0%)	3.00 (1.33-6.72)	0.008
5 to 14	145 (74.6%)	184 (94.7%)	1.26 (0.57-2.82)	0.559
15 to 24	224 (11.5%)	281 (14.5%)	1.25 (0.57-2.76)	0.573
25 to 44	266 (13.7%)	340 (17.5%)	1.27 (0.58-2.80)	0.540
45 to 65	57 (29.3%)	84 (43.2%)	1.47 (0.63-3;41)	0.365
>65	13 (0.6%)	13 ((0.6%)	Ref.	
Gender				
Male	386 (19.8%)	580 (29.8%)	1.05 (0.88-1.26)	0.563
Female	403 (20.7%)	574 (29.5%)	Ref.	
PHC category				
Private	706 (36.3%)	1041 (53.5%)	1.08 (0.80-1.46)	0.601
Government owner	83 (4.3%)	113 (5.8%)	Ref.	
Number drugs prescribed				
1 to 2	563 (29.0%)	563 (29.0%)	Ref.	
3 to 4	223 (11.4%)	538 (27.7%)	2.41 (1.98-2.93)	0.000
≥5	3 (0.1%)	53 (2.7%)	17.66 (5.48-56.86)	0.000
Number of injection prescribed				
No	686 (35.3%)	994 (51.1%)	0.93 (0.71-1.21)	0.608
Yes	103 (5.3%)	160 (8.2%)	Ref.	
Copy of EML avail.				
No	409 (21.0%)	380 (19.6%)	0.86 (0.72-1.03)	0.122
Yes	557 (28.6%)	597 (30.7%)	Ref.	
Number generics prescribed				
1 to 2	505 (28.9%)	740 (42.5%)	4.77 (3.37-6.74)	0.000
3 to 4	131 (7.5%)	347 (19.9%)	8.62 (5.87-12.65)	0.000
≥5	0 (0%)	20 (1.1%)	Ref.	
Number of drugs from EML				
1 to 2	550 (29.7%)	698 (37.7%)	10.66 (5.48-20.73)	0.000
3 to 4	155 (8.3%)	417 (22.5%)	22.59 (11.43-44.65)	0.000
≥5	0 (0%)	29 (1.6%)	Ref.	
Key drugs avail.				
≥70%	767 (39.5%)	1076 (55.4%)	2.52 (1.56-4.09)	0.000
<70%	22 (1.1%)	78 (4.0%)	Ref.	

From the table 13 results, all the predictors of antibiotic prescribing (independent variables) that had a *p-value* under 20% had been tested using multivariate logistic regression. They are seven: **patient age, number of prescribed generics, number of EML drugs, number of prescribed drugs, and key drugs availability**.

Note: Given that their odds ratios exceed **1** and their (95% CI) confidence intervals do not contain **1**, **the number of prescribed drugs for under 5-year outpatient**, **the number of generics**, and **the number of prescribed EML drugs** are thought to increase the likelihood of receiving **an antibiotic prescription**.

4.2.2. The multivariate analyses

To determine the association among variables with antibiotic prescribing variable, all significant variables significant (*p<0.05*) and those with a *p-value* of less than 20% in the bivariate analyses (using logistic model) were entered into the multivariate logistic analyses.

We proceeded to a top-down elimination of the variables with *p>0.05* until remaining with a final model with only variables whose *p-value* is lower than 5%. The variables included in the logistic multivariate model are **patient age, number of prescribed EML drugs, number of generics, number of prescribed drugs, and key drugs availability**.

Table 17: Multivariate analyses of antibiotic prescribing predictors

Variables	Multivariate analyses	
	AOR. (95% CI.)	***p-value.**
Age		
<5	3.45 (1.41-8.41)	0.006
5 to 14	1.34 (0.55-3.24)	0.507
15 to 24	1.25 (0.52-2.98)	0.612
25 to 44	1.31 (0.55-3.13)	0.511
45 to 65	1.52 (0.60-3.83)	0.367
>65	Ref.	
Number drugs prescribed		
1 to 2	Ref.	
3 to 4	1.77 (1.27-2.46)	0.001
≥5	3.78 (1.04-13.7)	0.042
Number generics prescribed		
1 to 2	3.02 (2.06-4.42)	0.000
3 to 4	2.64 (1.58-4.42)	0.000
≥5	Ref.	
Number drugs from EML		
1 to 2	6.22 (3.05-12.68)	0.000
3 to 4	8.24 (3.68-18.46)	0.000
≥5	Ref.	
Key drugs avail.		

Variables	Multivariate analyses	
	AOR. (95% CI.)	*p-value.
≥70%	2.41 (1.41-4.13)	0.001
<70%	Ref.	

CI Confidence Interval, AOR Adjusted Odds Ratio, *p<0.05 was considered significant

Five variables were found associated with the dependent variable (antibiotic prescribing).

The risk of being prescribed an antibiotic increased 3-fold for the patient aged under 5 years old (OR=3.45; 95% CI [1.41-8.41]) in a prescription.

The risk was increased 3-fold for 1 to 2 drugs and 3 to 4 drugs, respectively, (OR = 3.16; 95% CI [2.18-4.58] and (OR=3.37; 95% CI [2.07-5.48]) compared with patients prescribed 5 or more drugs.

The risk of being prescribed an antibiotic increased 6-fold for 1 to 2 generic medicines (OR=6.22; 95% CI [3.05-12.68]) in a prescription and 8-fold for 3 to 4 generic medicines (OR = 8.24; 95% CI [3.68-18.46]) compared with patients prescribed 5 or more generic medicines.

The risk of being prescribed an antibiotic increased 6-fold for 1 to 2 essential medicines (OR=6.12; 95% CI [3.03-12.35]) in a prescription and 11-fold for 3 to 4 essential medicines (OR = 11.05; 95% CI [5.16-2.66]) compared with patients prescribed 5 or more essential medicines.

The availability of key drugs at a level equal to or higher than 70% in PHC remains statistically significant, and antibiotic prescribing and the associated risk increased 3-fold (OR=2.45; 95% CI [1.46-4.12]) compared to the availability of key drugs at a level lower than 70% in PHC.

4.3. Results discussion

This section discusses and provides evidence for the findings of this research.

The discussion of our research's findings is based on two points:

- Comparison of our study's outcomes with those of the existing literature and the researcher's view on indicators that don't meet WHO standards.
- The merits and limitations of our research

4.3.1. Comparison of the study's results with existing literature

This research findings were compared to those of other studies and both of WHO-optimal values [70,73] and standards derived from African region [70], and explanations were provided based on similarities or differences.

4.3.2. Drugs prescribing indicators

Indicator 1: Average drugs per encounter.

In this study, the average of drugs per encounter was 2.4, inconsistent with both the WHO optimal value (1.6 –1.8) and the standards derived from the African region (2). But, comparing to findings from other studies, this was significantly the lower average than 3.4 reported in Pakistan [7]and the 2.5 reported in Ethiopia [23].

From a research perspective, the higher average could be due to a lack of regular therapeutic training, inappropriate diagnostic equipment, practices influenced by patient demand, or profits from drug sales.

Indicator 2: The percentage of generics.

This study revealed that 76.6% of prescribed drugs were generics, which is lower percentage compared to 100% recommended by WHO but higher than the standards derived from the African region (65%). This is significantly less than what a study from Ethiopia reported (83,1%)[21].

From a research viewpoint, the lower number of generics per encounter may be attributable to the predominance of branded drugs in healthcare facilities, the lack of prescribers' willingness to prescribe generics, the frequency with which pharmaceutical representatives visit prescribers, and the promotional materials in branded names left for them to use. It could also be due to branded drugs sale profits.

Indicator 3: The encounter percentage with antibiotics

In this study, the encounter percentage with antibiotics was 57.7%, exceeding both the WHO-recommended range of 20–26.8% and the African Standards of 45.9%. This is significantly higher than the 53.0% and 48.9% found in Ethiopia and Pakistan studies, respectively [7,21].

The higher percentage of antibiotic prescriptions can potentially be attributed to cultural views surrounding antibiotics, heightened patient expectations for specific antibiotic treatments, the influence of drug marketing strategies, or a limited understanding of antibiotic resistance.

Indicators 5: The percentage of EML drugs

From the 4 711 drugs, 85.9% of all medicines were EML drugs, which is the lower percentage than both the 100% set by WHO and 89% found from the African region (89%). This is significantly less than the 97.6% found in a research conducted in the Ilala district of Tanzania, the 98.39% found in Asmara, Eritrea, and the 93.4% found in Bahawalpur, Pakistan [7,21,22].

The lower percentage of drugs prescribed from EMLs may be attributable to an insufficient supply of drugs on the list, the comparative value of EMLs versus non-EMLs, a lack of knowledge about the majority of drugs prescribed that are not on EMLs, or prescribers who are unaware of the existence of the list and its function in healthcare facilities.

Indicator 6: The percentage of EML antibiotics

The percentage of EML antibiotics was 94.5%, which is the lower percentage compared to 100% set by WHO for drugs prescribed from EML but higher than the percentage derived from the African region (65 percent). This is less than the 97.6% found in the Tanzanian district of Ilala [71].

The lower percentage of EML antibiotics could be attributable to an insufficient supply of antibiotics on the list, the comparative value of EMLs versus non-EMLs, and prescribers who are unaware of the existence of the function of EML in healthcare facilities as described above.

Indicator 7: The percentage of generic antibiotics

The percentage of generic antibiotics was 94.4% of 1 331 antibiotics prescribed, which is the lower percentage compared of 100% set by WHO for generics to be prescribed but higher than the average derived from the African region (65.1%). This is greater than the 84.4% found in the study from Tanzania's Ilala district [22].

This percentage of generic antibiotics may be due to the predominance of branded antibiotics in healthcare facilities, the lack of prescribers' willingness to prescribe generics, and the promotional materials in branded names. It could also be due to branded drugs sale profits.

4.3.3. Specific facility indicators

In this research, 50% of the PHCs surveyed missed a copy of EML, none of the the PHCs had a STD copy and the availability of key drugs was a rate of 85%. Note that the WHO optimal value is 100% for EML and Key drugs availability.

The findings of the qualitative study conducted at public health institutions in Eswatini indicate that inadequate adherence to guidelines for treatment is a contributing factor to the irrational utilization of drugs [76]. This highlights the need to implement STGs into healthcare systems as a means to enhance health outcomes.

The guidelines availability, such as EML and STGs, could be attributable to their lack of dissemination and enforcement. Also, the lack of 100% availability of key drugs could be attributable to health professionals who lacked adequate knowledge and skills in supply chain management.

4.3.4. Predictors of antibiotics prescribing

The logistic multivariate model revealed a significant association between antibiotic prescribing and five variables, all of which were introduced into the model after meeting the criterion of having a p-value less than 20%. The findings obtained from the logistic multivariate analysis are outlined as follows:

The risk of being prescribed an antibiotic increased threefold for patients under 5 years old.

- The risk of being prescribed an antibiotic increased 6-fold for 1 to 2 generic medicines in a prescription and 8-fold for 3 to 4 generic medicines compared with patients prescribed 5 or more generic medicines.
- The risk of being prescribed an antibiotic increased 6-fold for 1 to 2 generic medicines in a prescription and 8-fold for 3 to 4 generic medicines compared with patients prescribed 5 or more generic medicines.
- The risk of being prescribed an antibiotic increased 6-fold for 1 to 2 essential medicines in a prescription and 11-fold for 3 to 4 essential medicines compared with patients prescribed 5 or more essential medicines.
- The availability of key drugs at a level equal to or higher than 70% in PHC remained statistically significant, and antibiotic prescribing and the associated risk increased 3-fold compared to the availability of key drugs at a level lower than 70% in PHC.

This demonstrated how the overuse of antibiotics is linked to other independent factors, as described in a 2019 research conducted in Eritrea, where antibiotic prescribing was linked to patients' gender, age, and the amount of drugs prescribed.

This study has provided evidence to support the importance of teaching healthcare practitioners and patients regarding the appropriate utilization of antibiotics, with the aim of addressing the issue of antibiotic resistance and guaranteeing the efficacy of bacterial illness therapy.

4.1.1. Merits and limitations of our research

Given that this research included a retrospective method conducted in the primary healthcare centers of Bujumbura City, it was impossible to avoid some limits. Indeed, only two indicators of the drug's use, drug prescribing, and facility-specific indicators, were evaluated; the other indicators, including patient care and supplementary indicators, were not evaluated due to a lack of resources and insufficient time.

Other possible limits are associated with the availability of data from medical records (curative consultation registers); given that this includes a retrospective study, some information could not be collected because it was not available in these registers in its entirety (payment methods, disease conditions, level of education of patients, etc.).

In addition, because the sample size only included Bujumbura City's primary healthcare centers, we cannot extrapolate our findings to the entire national territory. The results of our study provide insight into drug use, particularly antibiotics, in the city of Bujumbura.

Based on our research, there exists a significant correlation between the frequency of antibiotic prescriptions and several factors, namely the quantity of generic pharmaceuticals administered, the quantity of Essential Medicines List (EML) drugs prescribed, and the availability of key drugs.

However, it is imperative to conduct a more extensive study in order to examine the underlying factors contributing to the elevated frequency of antibiotic prescriptions and suggest potential solutions that might be feasibly implemented.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

The issue of antibiotic resistance poses a significant challenge to public health. Healthcare professionals working in healthcare institutions are required to engage in the responsible prescription of antibiotics and actively contribute to antimicrobial stewardship programs. The objective of this study was to assess the utilization of pharmaceutical substances, specifically antibiotics, throughout primary healthcare facilities located in Bujumbura Mairie. This study was conducted utilizing a data collection form provided by the World Health Organization (WHO).

5.1. Conclusion

This research's main objective was to conduct a drug use evaluation with a focus on antibiotic use in 20 PHCs in the Bujumbura Mairie using the indicators established by WHO.

In order to do this, three distinct objectives were defined: (i) to assess the drug prescribing indicators; (ii) to assess specific-facility indicators; and (iii) to identify predictors of antibiotic prescription.

In addition, the results indicate that the aims of this study were successfully achieved. The present study offered insights into the indicators of drug usage within the Bujumbura Mairie province.

The findings of this study demonstrate that the average number of drugs prescribed per outpatient visit was higher than the WHO-set value. Additionally, the percentage of generic drugs prescribed was lower than the WHO-set value. Moreover, the percentage of encounters with antibiotics exceeded the WHO-set value. However, the percentage of encounters with injections did not exceed the WHO-set value. Lastly, the EML drug percentage was lower than the WHO-set value.

In addition, this study found that 50% of the PHCs surveyed missed a copy of EML, none of the the PHCs had a STG copy, and the availability of key drugs were at a rate of 85%.

Furthermore, it was observed that several factors were correlated with the prescription of antibiotics, including the age of patients below five years, the prescription of a range of three to four medicines, being prescribed generic drugs, the key drug availability, and the quantity of EML prescribed.

5.2. Recommendations

5.2.1. Recommendations for Policy and Practice

The findings indicate a necessity for interventions aimed at enhancing prescribing practices and promoting adherence to guidelines. This is particularly crucial in addressing the issue of excessive antibiotic usage and promoting the utilization of essential medicines. Additionally, efforts should be made to address the factors identified as contributing to the overuse of antibiotics. Additionally, it is imperative to implement initiatives aimed at encouraging the utilization of generics and enhancing the accessibility of essential drugs and policy documents within primary healthcare facilities.

The findings showed irrational drug prescribing, the non-availability of EML in 50% of cases, the non-availability of STGs in any of the cases, and the key drug availability in 85% of cases.

- **To the Ministry of Health**

To early:

- Develop and implement the STGs
- Enforce the EML policy implementation in the primary healthcare centers
- Invest in training and capacity building for health professionals involved in implementing EML and STGs as well as supply chain management.

To continuously:

- Ensure to use drug in rational way by training health professionals on the appropriate drug use.
- Monitor and evaluate for adherence to evidence-based prescribing guidelines.
- Ensure the availability of key drugs to increase access to medicines.

- **To healthcare centers**

To continuously:

- Ensure the guidelines are available.
- Ensure the Guidelines are followed.
- Assure an uninterrupted supply of key drugs.

- **To the healthcare porviders**

To continuously:

- Adhere to prescribing guidelines.

- Ensure the availability of key drugs to ensure equitable access to healthcare for all individuals.
- Prescribe medicines by their generic names.
- Ensure that only EML-listed medicines are prescribed.

5.2.2. Recommendations for Further Research

In order to enhance the depth of knowledge regarding drug utilization and complement the current study, it is recommended to undertake nationwide research that incorporates patient care and drug utilization indicators that were not evaluated in the present study.

To improve prescribing practices, the findings suggest that there is a need for further research:

- To identify the underlying factors contributing to the elevated prescription number of medicines, with the ultimate aim of formulating effective treatments to mitigate this concern.
- To identify the reasons for the lower percentage of generic name prescriptions, the high percentage of encounters with an antibiotic prescribed, and the lower percentage of drugs prescribed from EMLs compared to the optimal values, and then develop interventions to increase behaviors that promote rational drug use.
- To identify reasons or factors contributing to the decreased proportion of generic prescriptions, the elevated proportion of encounters involving antibiotic prescriptions, and the diminished proportion of drugs prescribed from EMLs in comparison to optimal benchmarks. Subsequently, appropriate interventions can be devised to foster behaviors that facilitate rational drug utilization.

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APPENDICES

Appendix 1: Work plan

	Months									
	Jun, 2022	July, 2022	Aug, 2022	Sept, 2022	Oct, 2022	Nov, 2022	Dec, 2022	Jan, 2023	Feb, 2023	Mar, 2023
Literature review										
Protocol development										
Development of data collection instrument										
Submission to ethics committee										
Data collection										
Data analysis										
Compilation and discussion of results										
First draft of the report, proof reading and editing and submission of the research report										

Appendix 2: Budget

The following table contains a very essential, tidy sum added up of resources activity based.

N°	Item	Description	Units	Unit cost	Amount	Amount in euros
1	Research ethics	Costs of filling the application in Burundi	1	$500	$500	€ 470
2	Stationary (papers, envelopes, pens, inks)	This will be used in the writing process.	5	BIF 50,000	BIF 250,000	€ 115
3	Research assistants training	Helpful in data collection process in the district pharmacies of the four country regions. The fees include honorarium, meals, transportation, airtime and equipments for the training.	4	BIF 300,000	BIF 1,200,000	€ 552
4	Research statistician assistant	Helpful in setting up SPSS software for analyzing data collected	1	BIF 500,000	BIF 500,000	€ 230
5	Transport 1	For Reseacher, one month	30	BIF 20,000	BIF 600,000	€ 276
6	Transport 2	For Reseach Assistants , four times (Distributing and collecting questionnaires in district pharmacies), one month for 4 persons during 30 days.	120	BIF 20,000	BIF 2,400,000	€ 1,104
7	Meals	Meals while in the field for training assistants	4	BIF 40,000	BIF 160,000	€ 74
8	Miscelaneous	Other unforeseen costs	1	BIF 450,000	BIF 450,000	€ 207
Total cost in euros						€ 3,028

Appendix 3: List of Primary healthcare surveyed

For reasons of confidentiality, this list does not correspond to the order of health centers in the tables.

1. Biteho
2. Agakiza
3. Buterere I
4. CESAKIM
5. CSU
6. Espoir-Kira
7. Hop's God Center
8. Izere
9. Nyota
10. Kinama
11. Lumière
12. Mirango I
13. Mpore
14. Mutakura
15. Regina Pacis
16. Sagesse
17. Saint Michel
18. Victoire
19. 18=Santé pour tous
20. Tuyisabe

Appendix 4: Data collection authorization

REPUBLIQUE DU BURUNDI **Bujumbura, le 20/01/2023**

MINISTERE DE LA SANTE PUBLIQUE
ET DE LA LUTTE CONTRE LE SIDA
DIRECTION GENERALE DES SERVICES DE SANTE
ET DE LA LUTTE CONTRE LE SIDA
MUNICIPALITE SANITAIRE DE BUJUMBURA

N°Réf: 633.5/……/MUN SAN BUJA/2023

A Monsieur Audace MANIRAKIZA

à

Bujumbura

Objet : Réponse à votre lettre

Monsieur,

Me référant à votre lettre m'adresser en date du 20/01/2023, sollicitant la récolte des données dans les formations sanitaires offrant des soins de santé primaire dans la Municipalité Sanitaire de Bujumbura, je marque mon accord pour la récolte de ces données.

Vous en souhaitant bonne réception, je vous prie d'agréer, **Monsieur,** l'expression de ma considération distinguée.

Le Médecin Directeur de la Municipalité

Sanitaire de Bujumbura

Dr Cléophile AKINDAVYI

REPUBLIQUE DU BURUNDI
Ministère de la Santé Publique et de la Lutte contre le SIDA

TRANSMIS COPIE POUR INFORMATION A :

- Madame le Médecin Directeur Général des Services de Santé et de la Lutte contre le SIDA

Appendix 5: Data collection instrument

1.1. Data collection instrument

PRESCRIBING INDICATOR FORM

Location: Facility name:

Investigator: Date:

Seq #	Date of patient visit	Gender[a]	Payment method[b]	Health facility category[c]	Patient age	Number of drugs	Number of generics	Antibiotics (0/1)*	Injections (0/1)	From EML	Disease conditions	
											Disease	Code
Total												
Average												
Percentage							% of total drugs	% of total cases	% of total cases	% of total drugs		

*0=No 1=Yes

[a] 0=male 1= female

[b] 0=Insurance 1= Out of pocket

[c] 0=Private 1=Governemnt owner

DETAILED INDICATORS ENCOUNTER FORM

Location: **Facility nam:**

Investigator: **Date:**

ID	**Date**	**Age**	**Sex**	**Health facility category[c]**	
Health problems	Health problem description	Code			
	1.				
	2.				
	3.				
Drugs	Name and strength	Code		Quantity	Unit cost in BIF
	1.				
	2.				
	3.				
	4.				
	5.				
	6.				
	7.				

FACILITY SUMMARY FORM

Location: ………………………. Facility name: ………………………………

Investigator: ………………….. Date: …………………………………………

Contacts: ……….		
Problems or comments:………………………………………………………………………………………………………		
Number of cases: Retrospective:………………………covering date……………………to ……………………………………………..		
Essential Medicine List or Formulary available at facility? (0/1) …………………………………………………………………….		
Standard Treatment Guidelines available at facility? (0/1) ………………………………………………………………………………		
Key drug to treat import conditions known: (0/1) …………………………………………………………………………………….		
Key drug in stock to treat import conditions	In stock (0/1)	
………………………………………………………………..	…………	
………………………………………………………………..	…………	
………………………………………………………………..	…………	
	% in stock for this facility	%

1.2. Data collection instrument in Burundi official language (French) as descripted in WHO guidelines written in French

FORMULAIRE POUR L'ETABLISSEMENT D'INDICATEURS DE PRESCRITION

Adresse:………………………….. Nom de la formation sanitaire (FOSA): ……………..

Enquêteur: ………………………. Date: ………………………………………………….

N°	Date de consultation	Genre[a]	Méthode de payement[b]	Catégorie du FOSA[c]	Âge du patient	Nombre de medicaments préscrits	Nombre de Génériques	Antibiotiques (0/1)*	Injections (0/1)	Nombre sur la LNME**	Maladies	
											Maladie	Code
Total												
Moyenne												
Pourcentage							% du total de médicaments	% du total des cas	% du total des cas	% du total de médicaments		

*0=Non 1=Oui LNME**: Liste Nationale des Médicaments Essentiels

[a] 0=Masculin 1= Féminin

[b] 0=Avec assurance maladie 1= Sans assurance maladie

[c] 0=Privé 1= FOSA du gouvernement

INDICATEURS DETAILLES PAR CONSULTATION

Adresse: **Nom du FOSA:**

Enquêteur: **Date:**

ID	**Date**	**Age**	**Sexe**	**Categorie de la FOSA**[c]	
Problème de santé	Description du problème de santé	Code			
	1.				
	2.				
	3.				
Medicaments	Nom et dosage	Code		Quantité	Coû unitaire en Franc burundais
	1.				
	2.				
	3.				
	4.				
	5.				
	6.				

DONNEES RECAPITULATIVES PAR FOSA

Adresse: **Nom de la FOSA: ………………………………**

Enquêteur: **Date: ……………………………………………**

Contacts: ……….

Problèmes ou observations:……………………………………………………………………………………………………

Nombre de cas : Rétrospectifs:………………………pour la période de …………………….à ……………………………………..

La LNME est-il disponible ou Formulaire ?(0/1) ………………………………………………………………………………..

Les Directives de Traitement Standard sont-elles disponibles dans la FOSA? (0/1) ………………………………………………………

Les Médicaments Clés pour les maladies importantes sont-ils connus ? (0/1) ………………………………………………………….

Les Médicaments Clés pour les maladies importantes	En stock (0/1)	
………………………………………………………………..	………….	
………………………………………………………………..	………….	
………………………………………………………………..	………….	
	% en stock dans la FOSA	%