AVAILABILITY AND PRICE VARIATION OF ESSENTIAL MEDICINES IN PUBLIC HEALTH FACILITIES IN RWANDA DURING THE COVID-19 PANDEMIC. Case Study of District Hospitals in Kigali City and Eastern Province

A Dissertation Submitted to the University of Rwanda, in partial fulfillment of the requirement of a Master's degree in Health Supply Chain Management (MSc HSCM)

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DECLARATION

I, Valens NYAGATUNTU declare that the dissertation entitled ***"Availability and price variation of essential medicines in Public Health Facilities in Rwanda during the COVID-19 Pandemic. Case Study: District hospitals in Kigali City and Eastern Province."*** is my original work which has never been submitted for the assessment to any institution of or previously published in its full or in sections. Any sections, phrases, or concepts of the dissertation that are cited from or based on other sources, however, restricted, have been recognized as such.

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SUPERVISOR APPROVAL

The undersigned declare that they have read the dissertation and hereby suggest its approval. entitled **"*Availability and price variation of essential medicines in Public Health Facilities in Rwanda during the COVID-19 Pandemic. Case Study of District Hospitals in Kigali City and Eastern Province."*** For the University of Rwanda in partial fulfillment for the award of the degree of master's in Health Supply Chain Management.

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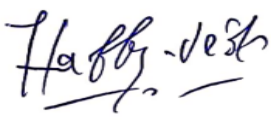
Signature: 

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ABSTRACT

Background: Since long ago, humanity has been facing natural disasters, calamities, and pandemics whose aftermaths were disastrous and affected the availability of essential medicines. Smallpox and tuberculosis devastated the globe before the advancement of health sciences. The situation worsened in December 2019 with the Breakout of COVID-19. The pandemic has affected over 200 countries and territories, with outbreaks in countries such as Mexico, Brazil, South Africa, Western Europe, India, Peru, and the United States of America are just a few of the countries involved among others. This study was conducted to see how the COVID-19 pandemic impacted the availability and price of essential medicines in public health facilities in Rwanda.

Methods: Cross-sectional descriptive study design was used to determine how the COVID-19 pandemic affected the availability and price of essential medicines in Rwandan public health institutions. Participants were selected using the purposive sampling method. To collect data on the availability of vital products, stock cards of essential drugs were carefully selected. Checklists and end-to-end structured questionnaires were used to collect data based on USAID Logistics Indicators Assessment Tool (LIAT). The data were entered into MS Excel, then analyzed with SPSS software version 21.0.

Results: The findings of this scientific work revealed that the level of availability was (89%) and the price during COVID-19 was high relative to the selling price before COVID-19 pandemics where the high price change rate was observed at Cimetidine inj. 200mg/2ml (201%), Dexamethasone 4mg/ml 1ml inj (254%), Examination gloves latex, non-sterile (265%) and Adrenaline inj. 1mg/ml (214%). The availability has been mostly affected by factors like limited number of suppliers and heavy workload (89%), absence from work due to COVID-19 illness (84%), and other factors linked to COVID-19 movement restrictive measures.

Conclusion: The level of availability was at 89%, the delivery status and the level of sufficiency were appreciated. However, more than 73% concurred on factors such as the limited number of suppliers, heavy workload, absence from work due to illness, long lead time, limited transport affected the availability of EM in the Public Health Facilities in Rwanda. Hence, the price of essential medicines during the COVID-19 pandemic was high relative to the price before the COVID-19 pandemic.

Keywords: *COVID-19 pandemic, essential medicines, availability, price variation, public health facilities*

DEDICATION

To the Almighty God

To my beloved mother

To my lovely Fiancé

To my dear brothers and sisters

To all my relatives and friends

To all my lecturers

This dissertation is tenderly dedicated!

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I appreciate every one of you.

ACRONYMS AND ABBREVIATIONS

CPDS	The Coordinated Procurement and Distribution System
DFID	Department for International Development
DH	District hospital
EM	Essential Medicines
HAI	Health Action International Africa
HSSP	Health Sector Strategic Plan
MDG	Millennium Development Goals
MPPD	Medical Production and Procurement Division
MSH	Management Sciences for Health
RBC	Rwanda Biomedical Centre
RCE-VIHSCM	Regional Center of Excellence for Vaccine, Immunization and Health Supply Chain Management
Rwanda FDA	Rwanda Food and Drugs Authority
SPSS	Statistical Package for the Social Sciences
UK	The United Kingdom
RMS	Rwanda Medical Supply Ltd
UN	United Nations
Freq.	Frequency
PHF	Public Health Facilities
UNICEF	United Nations Children's Fund
UR	University of Rwanda
WHO	World Health Organization
AMC	Average Monthly Consumption
LIAT	Logistics Indicators Assessment Tool
DAF	Director of Administration and Finance

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CHAPTER ONE: INTRODUCTION

1.1 Background

Humanity has been facing natural disasters, calamities, and pandemics whose repercussions were disastrous. The plague killed an estimated 75-200 million people, this was the worst pandemic in the 14th century. Then the Spanish flue of 1918 also killed a huge number of people. Other pandemics like Smallpox, Cholera, HIV, SARS, and Ebola also have ravaged the globe [1]. The situation worsened in late December 2019 with the COVID-19 pandemic breakout. The pandemic has touched over 200 nations and territories, including outbreaks in Mexico, Peru, Brazil, India, South Africa, the United States, and Western Europe [2].

During the outbreak of COVID-19, the supply chain experienced uncertainty [3]. This was due to measures imposed by different governments worldwide as a strategy to mitigate the impact of the disease's spread on humans. Curfews, transport restrictions (humans and goods), border closures, logistical constraints, business and trade slowdown, etc. are the manifestations of the COVID-19 lockdown measures [3]. The pharmaceutical industries in the majority of developing countries are in the early stages [5]. This explains why they rely on pharmaceuticals, raw materials, and equipment imported from nations outside the area, such as India and China. Rwanda, as one of the African countries, is reliant on other countries for its medical requirements [6].

Rwandan pharmacies experienced the problem of shortage in medications specifically essential medicines owing to the limited importation of products from other countries (mostly China and India), as well as panic shopping by customers and certain institutions in response to the epidemic, and the avoidance of probable healthcare shortages [6].

To curb the effects of the pandemic on the health sector, the Government of Rwanda decided to allow the movement of goods and other cargo since there was a limited number of people crossing the border. There is still, however, the problem of drugs shortage especially essential medicines in the health facilities [6].

1.2 Problem statement

Numerous efforts were applied by the Government of Rwanda to keep the health sector supplied with medications and other health commodities, public health facilities are still suffering from a shortage of medicines specifically, essential medicines [5]. Pharmacists at different district hospitals are experiencing difficulties in explaining to patients that the medication used to combat their disease is not available in stock [6]. There is a need to use an alternative solution in case the drug has a stock-out in DH pharmacy. The responsible pharmacist would tell the patient to go to private pharmacies to buy the prescribed medication and today such medications may not be available even at private pharmacies because even in the private sector drugs are available at 71.3% [7]. Moreover, patients could not afford to buy such medication because the purchase of the COVID-19 consumables such as examination gloves, surgical masks, hand sanitizer, and other payment fees for the COVID-19 rapid test had increased price. Some patients were obliged to wait for a long time to get some essential medicines or they can get an incomplete treatment due to medication shortage [5].

Taking into account the current situation of the COVID-19 pandemic, having realized that no other study was done on the availability and price variation of essential medicines in Public health facilities of Rwanda during the COVID-19 Pandemic, the researcher has decided to undertake research on the availability and price variation of essential medicines in public health facilities in Rwanda during the COVID-19 Pandemic to propose prevention and mitigation measures to cope with an emergency like an outbreak of COVID-19 pandemic to avoid disruption to access essential medicines in Public health facilities in Rwanda.

1.3 Research purpose

The purpose of the current study is to measure the availability and price variation of essential medicines in the Public health facilities in Rwanda during the COVID-19 Pandemic.

1.4 Research objectives

1.4.1 General Objective

The general objective of this study was to investigate how the COVID-19 pandemic affected the availability and the price of essential medicines in Public health facilities in Rwanda.

1.4.2 Specific Objectives

1. To measure the availability of essential medicines in the Public health facilities in Rwanda during the COVID-19 Pandemic.
2. To assess the price variation of essential medicines in Public health facilities in Rwanda during the COVID-19 Pandemic.

1.5 Research questions

1. What are the factors associated availability of essential medicines in Public health facilities in Rwanda during the COVID-19 Pandemic?
2. What are the factors associated with the price variation of essential medicines during the COVID-19 Pandemic in Public health facilities in Rwanda?

1.6 Significance of the study

The findings from the current study could help top health policymakers from the Ministry of Health and its affiliated agencies like Rwanda Biomedical Centre (RBC) and Rwanda Food and Drugs Authority (Rwanda FDA) to enhance capacity building in the medicines supply chain. Senior health managers could also make better planning consisting of an establishment of buffer stock to aid in quick responses in case of emergencies. Health professionals and implementers also could benefit from a better understanding of the disease pattern and its influence on essential medicines' availability and price variation.

1.7 Scope of Study

1.7.1 Geographic scope

The study was conducted in Kigali city and the Eastern Province.

1.7.2. Content Scope

The study focused on determining the availability and price variation of EM in Public health facilities in Rwanda during the COVID-19 pandemic.

1.7.3 Time Scope

The study treated data records over 2 years: 2020 & 2021, the black time when COVID-19 pandemic was threatening the whole world.

CHAPTER TWO: LITERATURE REVIEW

2.1 RESEARCH TOPIC OVERVIEW

This chapter focuses on the literature on priority essential medicines, their availability and price variation, the factors affecting their availability and price, the theoretical framework, and the conceptual framework. All pharmaceutical commodities, from essential medicines to laboratory reagents, are supplied by the RMS. RMS Branches deliver medical items to district hospitals and health facilities at the district level. In the case of a shortage, health centers and district hospitals may seek permission from the Ministry of Health or district pharmacies to purchase pharmaceuticals from private wholesalers. Many distributors and pharmaceutical enterprises in the private sector import pharmaceuticals directly from overseas manufacturers and local drug compounding facilities. These private wholesalers supply medical supplies to community pharmacies, private health clinics, and hospitals.

2.1.1 Medicines availability Concepts definition

The Department for International Development (DFID) [8] defines Medicine as any therapeutic substance or mixture of substances used or purported to be suitable for the diagnosis, treatment, mitigation, modification, or prevention of disease, abnormal physical, mental, or psychological states, or symptoms thereof in man, or the restoration, correction, or modification of any somatic, psychic, or organic function in man [8]. Essential medications are those that meet the population's most pressing healthcare needs [4].

It's crucial to keep in mind that pharma companies are always releasing new products. The World Health Organization defines medicine as "essential drugs that are required to address the bulk of priority health conditions and should be available at all times." Essential medications are those that address the most critical healthcare needs of the population. The medications used in different programs are said to be available when there is adequate stock on hand to be served to the patients on their prescription products on the day of their appointment [10].

Essential medicines availability has been shown to decrease morbidity and mortality, and the procurement system's impact on medicine prices and availability is significant and far-reaching, thus it must be addressed [11].

To protect human safety, governments in many countries have implemented laws in manufacturing, prescription, and distribution of properly chosen medications, and worked on it to assure the ongoing supply of vital medicines [12].

2.2 DETERMINANTS OF FACTORS ASSOCIATED WITH THE AVAILABILITY AND PRICE VARIATION OF ESSENTIAL MEDICINES

2.2.1 Global situation of medicine availability

The availability of high-quality essential drugs in public health facilities is critical for efficient healthcare policy implementation. One of the most significant components in making this happen is the acquisition of these drugs and their supply management system. The essential pharmaceutical procurement procedure was claimed to be ineffective in vital drugs. It should also be a proper method for procuring and distributing high-quality vital pharmaceuticals at various levels [13].

According to the WHO [14], Medicine availability was found to be 60% on average across WHO areas. Medicine availability scored 32 percent in the Eastern Mediterranean area, compared to 58 percent in the European zone. The average availability in the African and South Asian areas was less than 60%

According to a survey done in 36 countries, the availability of 15 generic drugs in the public sector is poor, with availability varying from 9.7% in Yemen to 79.2% in Mongolia. Regional availability ranged from 29.4% in Africa to 54.4% in America. Generic medication was less readily available in the private sector, with availability varying from 50% in the Western Pacific to 75% in Southeast Asia. Chad had the lowest medicine availability at 14.8 percent, Kuwait had 36.3%, the Philippines had 33.6%, and China had 34.6% to 38.3% [15].

The average of availability of medicines in the public sector was found to be lower than in the private sector. Inadequate financing, a lack of incentives to maintain stockpiles, an inability to anticipate properly, inefficient distribution networks, or leakage of medicine for private use are all reasons that contribute to low drug availability in the public sector. The price was the primary determinant of availability and access in the private sector. However, the private sector has a high availability of generic pharmaceuticals, as evidenced by figures of 97.5% in Syria and 91.8% in China and India, respectively. Setting price mark-up limitations and eliminating taxes on medicinal items were also factors that contributed to the availability of essential medicines [12,15,16].

According to a recent statement in a Belgian pharmacy journal, the problem is global, covering "Afghanistan to Zimbabwe," with 21 nations affected by various medical supply problems. Patients from lower-income nations, such as South Africa, are obliged to acquire medicine privately due to a lack of drug availability in the public health system, where original brands are marketed for up to four times the price of generic medicines [17].

Medicine is a critical item for folks all over the world to keep their health. It should be free at the point of service for low-income populations and inexpensive in all countries. However, according to Mercurio in 2009, the availability of medicine is also influenced by increased medicine prices as a result of tariffs imposed by the producing nations on medicine leaving their coasts [12,19]. Inflationary medicine prices are caused by tariffs imposed by producing nations on medicine leaving their ports also impact the drug supply. Medicine is subject to a 30% tax in the Democratic Republic of Congo. Other nations, such as India, Sierra Leone, Nigeria, and Bolivia, have tariffs of 55 percent, 40 percent, 34 percent, and 32 percent on pharmaceutical imports, respectively. Another issue impacting drug supply and access by individual patients is the imposition of extra sales taxes in countries such as South Africa (14%), Argentina (21%), Bangladesh (15%), the Dominican Republic (28%), Greece (15%), and Turkey (18%) [12].

Increase finance and distribution efficiency, encouraging the use of generic medications, and reducing supply chain costs by restricting mark-ups and reducing customs and taxes on medicine are among the WHO's suggestions to improve EM's availability and accessibility [14]. The WHO also recommends that policies aimed at increasing drug availability be reviewed, including medicine selection, procurement, distribution, and finance [14].

The formulation and implementation of a national medicine policy to govern the selection, procurement, distribution, and use of medicines is considered an essential priority for the provision and ongoing availability of medicines. The national medicine policy is seen as a statement of political intent as well as a road map for how the government intends to guarantee that high-quality, efficacious, and safe medicines are inexpensive, accessible, and sensibly utilized [12]. Rwanda, like the majority of WHO member nations, has approved national medicine policies.

2.2.2 Problems associated with essential medicines' nonavailability.

According to many researchers [15,20], the public health system, particularly in Sub-Saharan African nations, has limited availability and access to necessary medications (29.4–54.4%). Another research [20] found that despite the reduced pricing of medications in India compared to foreign rates, 50-80 percent of the Indian population is unable to obtain all of the medicines they require due to a lack of availability and high price. India and Africa together account for 53% of the world's population without access to essential medicines [20].

Large portions of the population in most developing countries lack access to medicines due to a lack of sufficient incentives for developing new medicines to combat the communicable diseases that disproportionately affect the poorest countries, as well as an inability to pay for and effectively distribute those that do exist. As a result, there is a "mismatch between pharmaceutical demands in developing nations and the existing functioning of the pharmaceutical industry," according to the UK government [21].

In underdeveloped nations, when economic restrictions contribute to the low affordability of critical medications, access to essential medicines is a significant predictor of health outcomes. It's impossible to come up with precise figures for this problem, but it's believed that between 1.7 and 2 billion people throughout the world have little or no access to vital medicines [21]. The majority of these individuals reside in impoverished nations, where medications are the single most important factor in maintaining health and successfully treating sickness and illness after the availability of qualified health workers. The inability of healthcare personnel to respond correctly to patient requirements is harmed by a lack of essential medicines, which erodes patients' and their families' trust in local health systems. The

absence of access to essential medicines and health-supporting medications for an estimated two billion impoverished people runs counter to the core notion of health as a human right since poverty and sickness form a vicious circle in medicine access [21]. As a result, ensuring that essential medicines are always available and cheap to all is one method to ensure that everyone has access to them.

2.2.3 Essential medicines Procurement

The success of medication delivery systems in ensuring a consistent supply of vital medicines must be evaluated on a regular and objective basis. Selection, procurement, distribution, and usage are the four key responsibilities of the medications management cycle [22,23]. The medicines are chosen based on the most common diseases in the area and their inclusion in the NEML. The Regional Medical Stores receive their supplies from the central medical stores and distribute the medications to public health facilities, where they are used by the clients. Because it is a fully cost-recovery system, it requires a reliable source of financing to keep the procurement system running [23].

2.2.4 Price of Essential Medicines

Due to a lack of purchasing power, a huge percentage of the population is denied access to medications [24]. Every year, around 10 million people, the majority of whom live in low income countries die because of lack of access to drugs and vaccines [21]. One of the most significant barriers to access is the price of medicine [16]. The procurement of medications accounts for a major portion of a developing country's healthcare budget, with drug expenses accounting for 50% to 90% of non-personnel costs [16]. The first step in designing medication pricing regulations that assure pharmaceutical affordability is to measure and understand the causes behind the price of medicines [25].

2.2.5 Factors affecting availability and price of essential medicines

The National drug policy is to ensure that all citizens have access to vital, safe, efficacious, and cost-effective pharmaceuticals. Despite this, access to high-quality vital pharmaceuticals remains a concern [15].

In overseas countries there is availability and affordability of essential medicines tend to be at a satisfactory level although there few factors which could hamper the full accessibility and availability of essential medicines. For example, in the USA, medicine 43% shortage could be explained by manufacturing quality problems, doctors who do not prescribe generic medicines, and limited suppliers [12]. Russo found out that in Mexico, the availability of essential medicines was affected by stock-outs and financial problems of public institutions [27].

Chinese researchers [12] According to the survey, the availability of low-cost generic medicine was determined to be 44.4% in the private sector and 38.9% in the public sector in Hubei province. Doctors don't prescribe medicines on essential medicines list the managers fail to order them which results in being inadequate [8]. In a 2006 survey done in Shanghai, China, it was discovered that there were inadequate drugs available.

In the public sector, generic medication was more easily available than in the private sector. In the public sector, the average availability for innovator (non-generic expensive) brands was 13.3 % and 33,3 % for lower-priced generics was 33.3 % [16]. As for India [12], according to a research done in six Indian cities, the availability average of key medications according to WHO methodology was poor, ranging from 30% in Chennai to 10% in Haryana and 12.5% in Kartnataka.

Limited budgets for medicine, inadequate distribution networks, and pharmacy usage of separate essential medicines lists resulting in the non-availability of medicines indicated by specialists were all factors contributing to the low availability of medicines prescribed by specialists. Thawani offers the following ways to boost drug availability: To reduce the number of medicines available in the country, India should legalize the use of one-country essential medicines lists; generic medicines should be promoted over non-generic brands; pharmacists should be empowered to issue generic brand equivalents, and national medicinal price control should be executed [12].

Concerning the African countries, according to researchers like Daniel Tumwine and Yousif [27,28,22] said that the common factors affecting medicines availability and price are the following: human resource shortage and supply chain which is weak, poor inventory management, poor

deliveries, lack of training and long lead time, poor quantification and procurement methods, lack of local industries and poor value for money [21].

The research done on the price and availability in 30 countries adds that most of the factors on non-availability are due to manufacturing issues [26]. Lack of raw materials, inadequate production capacity, or product quality issues that result in more severe inspections and plant closures are just a few examples. Health situations, like disasters and disease outbreaks, can also result in shortages as a result of massive and unanticipated increases in demand. This is the case for the COVID-19 pandemic which broke out in late 2019.

2.3 Empirical literature

The current research will be underpinned by two theories namely the Business Network Theory and the Logistic Integration Theory [29]. To construct the necessary linkages in the supply chain, the Business Network Theory is used. One of the big theories for purchasing and supply management that has been established in recent decades is Business Network Theory. The business network theory is primarily used to define the links that exist between organizations, suppliers, customers, and purchasers [3].

A business network theory is used to describe the supply chain. The healthcare industry's network starts with suppliers, then moves on through manufacturers, distributors, hospitals, and finally to the "internal chain," where it reaches the "payers" of the patients. The vendor delivers items and supplies to the hospital receiving dock, which is organized by the user department [31]. Then, daily, they are carried straight to the department. Pharmacies, in addition to hospitals, are the last stop in the healthcare supply chain before pharmaceuticals reach the patient [30].

Pharmacies buy drugs from wholesalers or manufacturers directly, then take actual custody of the drugs. Pharmacies are responsible for the safety, storage, and distribution of drugs after they have been purchased [31]. Then, daily, they are carried straight to the department. Pharmacies, in addition to hospitals, are the last stop in the healthcare supply chain before pharmaceuticals reach the patient [30]. Pharmacies buy pharmaceuticals from wholesalers or manufacturers directly, then take actual

custody of the drugs. Pharmacies are responsible for the safety, storage, and distribution of drugs after they have been purchased [32].

It is important to remember that logistic management is a portion of the supply chain, and it is the part that plans, implements, and regulates storage and product movement, services, and information between the point of origin and point of consumption to fulfill customer needs [32]. As a result, logistic management influences all supply chain operation. Because these operations are intertwined, they must be coordinated for the supply chain to function properly. "A well-coordinated flow of supplies from suppliers is the essence of logistics integration, which helps enterprises to have a seamless manufacturing process" [31].

Integrated logistics also enables businesses to implement lean manufacturing processes, which are defined by predictable order cycles and lower inventory levels [33]. Logistic integration enables organizations and their supply chain partners to operate as a single entity, resulting in increased chain performance [34]. Many logistical difficulties in supply chain management, distribution, and inventory management, such as a worldwide pandemic, necessitate the integration of many components of the product. The supply chain is now experiencing routing challenges as a result of the spread of the coronavirus COVID-19, and this difficulty develops when items such as medications must be gathered from the source and transported to the final destination [31].

The European Union is experiencing a shortage of various items due to restricted borders, ports, and routing issues. Some hospitals in Sweden, for example, have canceled non-essential operations owing to a scarcity of devices and other drugs after a new supplier failed to provide disposable equipment such as hand disinfectants, sterile gloves, and catheters. Logistics and supply chain management are critical to a company's capacity to stay competitive in the marketplace [32,21]. Due to the complexity and participation of different organizations, logistic integration remains a difficulty. However, it is regarded as an effective solution in the management of working time for care personnel by allowing them to focus on their primary duties and improving patient care conditions [5, 35].

As a result, the supply chain in the healthcare business may be examined through the lens of logistics integration theory. When citizens have health difficulties, healthcare institutions try to help them [35].

This service is targeted at addressing client requests in terms of logistics. Patients travel through a variety of healthcare functions [3].

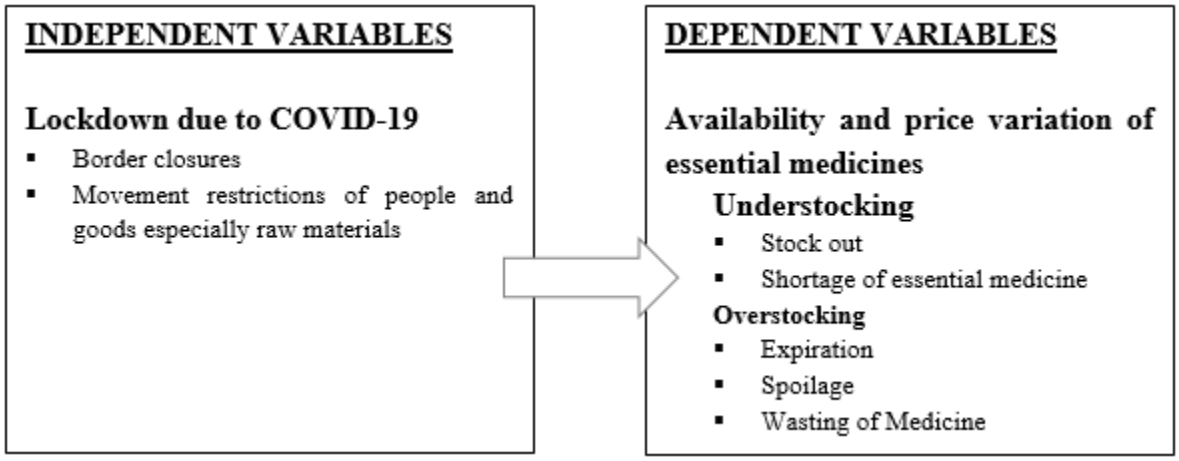
Indeed, the logistics role in healthcare and hospital administration has piqued people's curiosity [35]. Healthcare firms may also discover numerous risks in the SCM and make strategic decisions using logistics.

The experience of hospitals is a process in the supply chain that has benefitted greatly from technological advancement [35]. As a result, to successfully industrialize healthcare, flexible logistic methods that may alter as market conditions change are required. In the healthcare business, logistics play an important role in determining a company's performance. As a result, logistics should be incorporated into the healthcare industry's SCM as much as feasible [3].

2.4 Conceptual framework

According to Grant 2014 [36], A conceptual framework represents the researcher's synthesis of the literature on how to explain a phenomenon. It sets out the actions required during the study based on his past knowledge of other researchers' points of view and observations of the research field. To put it another way, the conceptual framework is the researcher's understanding of the relationships between the variables in his study.

As a result, it specifies the factors that must be included in the research study. It serves as the researcher's "road plan" for carrying out the inquiry. The conceptual framework for this research asserts that the COVID-19 pandemic, taken as an independent variable, affects the availability and price of EM, taken as a dependent variable, in public health facilities in Rwanda.



Source: Researcher's model in 2021

Figure 1: Conceptual framework

Figure 1 shows the variable relationship. The independent variable is the "COVID-19" virus whose value is the lockdown with its characteristics such as border closures, movement restrictions for both people and goods, etc. COVID-19 is a constant variable that is unaffected by other variables.

The dependent variables are as follows: "Availability of essential medicines" and "price of essential medicines". Both variables depend on the "COVID-19" and are likely to change in response to the development of the virus. Figure one helps to answer the research dissertation's research question It demonstrates that the COVID-19 pandemic creates medical supply shortages as well as has an indirect impact on the business network, raising questions and distrust between vendors and customers.

CHAPTER THREE: RESEARCH METHODOLOGY

The researcher's methodology is presented in this chapter, which was used to examine the availability and price of essential medicines in public health facilities in Rwanda during the COVID-19 pandemic.

3.1 Research Design

The study used a cross-sectional descriptive research design that employed both qualitative and quantitative techniques for data collection [37]. The administration of questionnaires to the selected sample was used method for collecting data in this descriptive study design.

3.2 Study population

The study population was 30 health care providers that entailed Pharmacists, and nurse assistants in the 15 districts hospitals out of which 5 districts from the City of Kigali and 10 districts from the Eastern Province were taken as an accessible population.

3.3 Target population

The Target population was 20 healthcare providers due to time constraint sampled from 30 healthcare providers that entailed Pharmacists, and nurse assistant in the 10 districts hospitals out of which 3 districts from the City of Kigali and 7 districts from the Eastern Province were taken as an accessible population.

3.4 Study area and sampling techniques

This study used convenience, stratified random, and purposive sampling from 15 district hospitals as presented in *Table 1*. The purposive sampling that allowed more knowledgeable staff was preferred for their position in supply chain [22]. Three district hospitals in Kigali City and seven districts hospitals in the Eastern Province were grouped into subgroups (strata) per district. Nyarugenge and Gatunda hospitals were not selected because they are new hospitals below two years' experience.

Table 1: **Study area and sampling sites**

District	Hospital name	Selected (Yes) Not Selected (No)
BUGESERA	Nyamata hospital	**Yes**
GASABO	Kacyiru Hospital	No
	Kibagabaga Hospital	**Yes**
GATSIBO	Kiziguro Hospital	**Yes**
	Ngarama Hospital	No
KAYONZA	Gahini Hospital	**Yes**
	Rwinkwavu Hospital	No
KICUKIRO	Masaka Hospital	**Yes**
KIREHE	Kirehe Hospital	**Yes**
NGOMA	Kibungo Hospital	**Yes**
NYAGATARE	Gatunda Hospital	No
	Nyagatare Hospital	**Yes**
NYARUGENGE	Muhima Hospital	**Yes**
	Nyarugenge Hospital	No
RWAMAGANA	Rwamagana Hospital	**Yes**
	Total:	**10/15 (67%)**

For each of the thirteen districts of the Eastern Province and Kigali City, one district hospital of each district was considered as part of the study participant. This population was randomly selected using the RAND function of MS Excel. Thus, 10 district hospitals were selected as presented in *Table 1*.

3.5 Sample size

The sample size of 20 respondents was selected using stratified random sampling, and purposive sampling from the study population of 30 respondents, there are 10 hospital pharmacists and 10 nurse assistants.

3.6 Selection of study population

3.6.1 Inclusion criteria

The study population was:
Pharmacist, and nurse assistant whose roles are linked to health supply chain management in public health facilities in Kigali city and Eastern Province

3.6.2 Exclusion criteria

Healthcare providers that are located in non-selected district hospitals to be part of the study, patients, and healthcare providers whose roles are not linked to health supply chain management in sampled district hospitals in Kigali city and Eastern were excluded in this study and other healthcare who was unable to consent willingly.

3.6.3 Criteria of selecting essential medicines

The selected study medicines were sampled from the list of vital products and COVID-19 treatment guidelines. The samples were selected using stratified random sampling and purposive sampling grouped into two subgroups (strata) which are the *"List of 252 vital products"* [38] and the *"COVID-19 treatment guidelines"* [40] all included in the National List of Essential Medicines [39]. Purposively, we decided to select fifteen (15) essential medicines randomly using the RAND function of Microsoft Excel.

3.7 Data collection method

Data collection method was developed based on Logistics Indicators Assessment Tool (LIAT) of USAID DELIVER Project [41], two types of data were treated: primary and secondary data. The former has been collected through the structured questionnaire while the latter (secondary data) was accessed by analyzing data from the computer software, stock cards, delivery notes, delivery schedules, NEML for adults 6th edition [39], Vital product list [38] and COVID-19 treatment guidelines 3rd edition [40]. The questionnaire was administered to healthcare professionals (pharmacist, and nurse assistant).

3.8 Data analysis procedure

The coded data was loaded in MS Excel and analyzed with SPSS Version 21.0 computer software after the returned questionnaires were reviewed for reliability. The data was summarized and categorized according to the study's goals variable. Inferential statistics were employed as well as descriptive statistics [frequencies, and graphical illustrations). The qualitative data were thematically coded before being statistically analyzed. The data was presented in a variety of ways, including Tables, graphs, and prose format.

3.9 Research Validity and Reliability

3.9.1 Research Validity

Validity refers to an instrument's capacity to measure what it claims to measure. It evaluates whether the data acquired in the study accurately represent the study's variables. This is significant because data-driven judgments are more accurate, relevant, and meaningful [42]. The researcher employed content validity to assess how representative data acquired with a certain instrument is. A Pilot research was conducted to check that the study tools were valid including language.

The piloting was carried out in the Masaka District hospital and was included in the main research. The data, on the other hand, were utilized to evaluate the data gathering equipment. A test sample of 10.5 percent of the research sample size was employed to test the instruments. The goal of the pilot project was to see if the questions in the questionnaire observation checklist and key informant guide were clear. To ensure validity, the questionnaire was pretested with 2 healthcare providers at Masaka District hospital. Two research assistants who were trained before were assisted in data collection to ensure the uniformity and Data entry was done the same day as data collection to avoid errors.

3.9.2 Reliability

The research tool dependability relates to the tool consistency when used in similar settings [43]. The test-retest approach was used to determine the tool dependability during the pilot research. The consistency of the data was checked by giving the tool to the same respondents twice to ensure that their replies were consistent. The replies were evaluated, and the reliability coefficient was found to be over 0.70, which was deemed sufficient for the tool dependability [44].

3.10 Ethical considerations

Approval permission to conduct this research was granted by the College of Medicine and Health Sciences at the University of Rwanda, School of Public Health. This research was conducted district hospital in Kigali City and Eastern Province. All respondents have asked all the questions and got explanation and signed the consent voluntarily to participate in the research study. The anonymity and confidentiality of the respondents were maintained throughout the study.

CHAPTER FOUR: RESULTS

This chapter is where presentation of primary data collected through a questionnaire, and secondary data from stock cards, delivery notes, and delivery schedules. Descriptive statistics, frequencies, and percentages are also presented.

4.1 Sociodemographic profile of respondents

The respondents' profiles (pharmacists and nurse assistants) by position, department, educational background, and work experience are presented in the following table.

***Table 2*: Sociodemographic information of DH pharmacy personnel**

Variables	Frequency	Percentage
PHARMACISTS AND NURSE ASSISTANTS		
Position		
Pharmacist	10	52.6
Nurse assistant in pharmacy	9	47.4
Total	**19**	**100.0**
Educational background		
Masters	0	0.0
A0	14	73.7
A1	5	26.3
A2	0	0.0
Total	**19**	**100.0**
Years of work experience		
0-5	7	36.8
6-10	8	42.1
Above 10	4	21.1
Total	**19**	**100.0**

N = 19 (Total number of respondents)

In total 19 out of 20 respondents participated, one nurse assistant was not available the period of data collection. Hence, 52.6% were pharmacists and 47.4% were nurse assistants.

As far as the educational background is also concerned, it can be noticed that the majority (73.7%) of the DH pharmacy staff were holding A0 degrees, and 26.3% holding A1 degrees. There were no cases of Masters degrees nor A2 certificates. This can explain the pharmacy staff's good qualification rate in the DH of Kigali City and the Eastern Province. As for the work experience, it can be noticed that the majority (i.e. 63.2%) in the DH pharmacies had experience of more than 5 years.

4.2 Presentation of other findings

The main data from the district hospitals was presented and examined based on the study goals during the analysis of the findings. The study was guided by research questions that addressed the goals. As a result, the first goal was to analyze availability of EM during the COVID-19 pandemic in Rwandan public health facilities, while the second goal was to examine cost variation of EM during COVID-19 pandemic in the studied Rwandan public health facilities.

4.2.1 Availability of essential medicines during the COVID-19 pandemic

The availability of EM in the public health facilities in Rwanda was assessed using a questionnaire distributed to pharmacists and nurse assistants in the studied districts hospitals of City of Kigali and Eastern Province. Table 3 entails responses from the pharmacists and nurse assistants on factors affecting the availability of EM.

Table 3: **Responses on the factors affecting the availability of EM during COVID-19 pandemic in PHF in Rwanda**

SN	Statements	Options							
		SA		A		D		SD	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%
1	Limited number of suppliers	13	68.4	4	21.1	1	5.3	1	5.3
2	Heavy workload	8	42.1	9	47.4	1	5.3	1	5.3
3	Absence from work due to COVID-19 illness	11	57.9	5	26.3	2	10.5	1	5.3
4	Long procurement process and lead time	8	42.1	6	31.6	2	10.5	3	15.8
5	Limited transport due to restricted movement	10	52.6	7	36.8	1	5.3	1	5.3
6	Limited training opportunities due to COVID-19 preventive measures.	7	36.8	10	52.6	1	5.3	1	5.3

Number of respondents = 19; Strongly Agree (SA), Agree(A), Disagree (D) and (SD) Strongly Disagree

As it can be seen in Table 3, the majority of respondents (more than 73% of SA and A answers) agreed and strongly agreed on the six factors affecting the availability of essential medicines during COVID-19 pandemic in Rwanda.

In the same way, 89.5% of respondents considered the Limited number of suppliers, Heavy workload, Limited transport due to restricted movement and Limited training opportunities due to COVID-19 preventive measures as factors affecting the availability of EM in Rwanda during the pandemic.

According to Table 3, COVID-19 pandemic not only affected ordinary people but also healthcare professionals like pharmacy staff in district hospitals. Resultantly, 84.2% of respondents revealed that

absence from work due to COVID-19 sickness was also deemed as significant factor affecting the availability of EM in PHF. Infected people were restricted to isolation and the remaining employees were forced to bridge the gap. Another factor that respondents (73.7%) judged detrimental to the availability of EM in PHF is the general Long procurement process and related Lead time due to COVID-19 consequences at the national and international levels. District hospitals would make essential medicines orders but their delivery was delayed.

After presentation and analysis of the pharmacy staff responses on factors affecting the availability of EM in PHF in Rwanda during the COVID-19 pandemic, the next Tables 4-11 present secondary data as collected using the checklist.

***Table 4*: Management status of essential medicines**

S/N	Product description	Unit of count	Managed	
			Frequency	**%**
1	ADRENALINE INJ. 1MG/ML	AMP	10	100.0
2	AMOXICILLIN CLAVULANIC TAB 500MG/125MG	Tab	10	100.0
3	CIMETIDINE INJ. 200MG/2ML	AMP	10	100.0
4	FUROSEMIDE INJ. 10MG/2ML	AMP	10	100.0
5	HYDRALAZINE INJ. 20MG/ML	AMP	10	100.0
6	KETAMINE INJ. 50MG/1ML	Vial	10	100.0
7	DEXAMETHASONE 4MG/ML 1ML INJ	AMP	10	100.0
8	OXYGEN INHALATION (MEDICAL GAS	Litre	10	100.0
9	PARACETAMOL INJ. 10MG/ML	FL	8	80.0
10	DENATURED ALCOHOL	Litre	10	100.0
11	BLOOD GLUCOSE TEST STRIPS	Strip	10	100.0
12	EXAMINATION GLOVES LATEX, NON STERILE PC	Pc	10	100.0
13	IVERMECTIN TAB. 6 MG	Tab	7	70.0
14	ENDOTRACHEAL TUBE 7 MM + PILOT BALLOON	Pc	10	100.0
15	ENDOTRACHEAL TUBE 7.5 MM + PILOT BALLOON	Pc	8	80.0

N = 10 (Total number of public hospitals)

***Table 5*: Essential medicines stock card availability**

S/No	Product description	Unit of count	Stock card available	
			Frequency	**%**
1	ADRENALINE INJ. 1MG/ML	Amp	10	100.0
2	AMOXICILLIN CLAVULANIC TAB 500MG/125MG	Tab	10	100.0
3	CIMETIDINE INJ. 200MG/2ML	Amp	10	100.0
4	FUROSEMIDE INJ. 10MG/2ML	Amp	10	100.0
5	HYDRALAZINE INJ. 20MG/ML	Amp	10	100.0
6	KETAMINE INJ. 50MG/1ML	Vial	10	100.0
7	DEXAMETHASONE 4MG/ML 1ML INJ	Amp	10	100.0
8	OXYGEN INHALATION (MEDICAL GAS	Litre	10	100.0
9	PARACETAMOL INJ. 10MG/ML	FL	8	80.0
10	DENATURED ALCOHOL	Litre	10	100.0
11	BLOOD GLUCOSE TEST STRIPS	Strip	10	100.0
12	EXAMINATION GLOVES LATEX, NON STERILE PC	Pc	10	100.0
13	IVERMECTIN TAB. 6 MG	Tab	7	70.0
14	ENDOTRACHEAL TUBE 7 MM + PILOT BALLOON	Pc	10	100.0
15	ENDOTRACHEAL TUBE 7.5 MM + PILOT BALLOON	Pc	8	80.0

N = 10 (Total number of public hospitals)

Like in the preceding Table 4, it can be noticed in Table 5 that 12 essential medicines out of 15 that had been selected had the stock form at a high level (100%). Paracetamol inj. 10mg/ml and Endotracheal tube 7.5 mm + pilot balloon were managed at 80% level while Ivermectin 6mg tablet was managed at 70%. This means there are hospitals where the three products have never been managed (inventoried), and that they use other alternatives in the treatments requiring those unmanaged medical products. Based on inventory management policy and the fact they are part of the national list of essential medicines, all the studied medicines should be available all the time and maintained at the security level stock based on their consumption rate. For this reason, public health facilities are not recommended to miss any stock card of essential medicines.

***Table 6*: EM stock cards updated information**

S/No	Product description	Unit of count	Stock card updated	
			F	%
1	ADRENALINE INJ. 1MG/ML	Amp	9	90.0
2	AMOXICILLIN CLAVULANIC TAB 500MG/125MG	Tab	10	100.0
3	CIMETIDINE INJ. 200MG/2ML	Amp	9	90.0
4	FUROSEMIDE INJ. 10MG/2ML	Amp	9	90.0
5	HYDRALAZINE INJ. 20MG/ML	Amp	10	100.0
6	KETAMINE INJ. 50MG/1ML	Vial	9	90.0
7	DEXAMETHASONE 4MG/ML 1ML INJ	Amp	10	100.0
8	OXYGEN INHALATION (MEDICAL GAS	Litre	9	90.0
9	PARACETAMOL INJ. 10MG/ML	FL	8	80.0
10	DENATURED ALCOHOL	Litre	10	100.0
11	BLOOD GLUCOSE TEST STRIPS	Strip	10	100.0
12	EXAMINATION GLOVES LATEX, NON STERILE PC	Pc	8	80.0
13	IVERMECTIN TAB. 6 MG	Tab	7	70.0
14	ENDOTRACHEAL TUBE 7 MM + PILOT BALLOON	Pc	10	100.0
15	ENDOTRACHEAL TUBE 7.5 MM + PILOT BALLOON	Pc	8	80.0

N = 10 (Total number of public hospitals)

According to Table 6, it can be noticed that the level of updated stock cards was satisfactory. There were six essential medicines whose stock cards were updated in all studied hospitals, five at 90% level, three at 80% level, and one at 70% level. In general, one can say it is not a bad situation as 93% of the studied products have updated stock cards in 8 out of 10 studied public hospitals. But by principle all stock cards should be updated in all health facilities to comply with the requirements of inventory management system. The following Table 7 provides the data on the availability of EM the day of visit.

***Table 7*: EM availability status on the day of visit**

S/No	Product description	Unit of count	Available on the day of visit	
			F	**%**
1	ADRENALINE INJ. 1MG/ML	AMP	9	90.0
2	AMOXICILLIN CLAVULANIC TAB 500MG/125MG	Tab	10	100.0
3	CIMETIDINE INJ. 200MG/2ML	AMP	9	90.0
4	FUROSEMIDE INJ. 10MG/2ML	AMP	9	90.0
5	HYDRALAZINE INJ. 20MG/ML	AMP	10	100.0
6	KETAMINE INJ. 50MG/1ML	Vial	10	100.0
7	DEXAMETHASONE 4MG/ML 1ML INJ	AMP	10	100.0
8	OXYGEN INHALATION (MEDICAL GAS	Litre	10	100.0
9	PARACETAMOL INJ. 10MG/ML	FL	6	60.0
10	DENATURED ALCOHOL	Litre	10	100.0
11	BLOOD GLUCOSE TEST STRIPS	Strip	10	100.0
12	EXAMINATION GLOVES LATEX, NON STERILE	Pc	8	80.0
13	IVERMECTIN TAB. 6 MG	Tab	5	50.0
14	ENDOTRACHEAL TUBE 7 MM + PILOT BALLOON	Pc	10	100.0
15	ENDOTRACHEAL TUBE 7.5 MM + PILOT BALLOON	Pc	8	80.0

N = 10 (Total number of public hospitals)

From Table 7, it can be noticed that eight essential medicines out of 15 (i.e. 53.3%) were available at 100%; three essential medicines (i.e. 20%) were available at 90% level; two (i.e. 13.3%) available at 80% level, and other two essential medicines at 60% and 50% levels respectively. The Table 8 presents the data sufficiency levels.

***Table 8*: Essential medicines sufficiency level at the day of visit**

S/N	Product description	Unit of count	Sufficient	
			F	%
1	ADRENALINE INJ. 1MG/ML	Amp	10	100.0
2	AMOXICILLIN CLAVULANIC TAB 500MG/125MG	Tab	7	70.0
3	CIMETIDINE INJ. 200MG/2ML	Amp	10	100.0
4	FUROSEMIDE INJ. 10MG/2ML	Amp	10	100.0
5	HYDRALAZINE INJ. 20MG/ML	Amp	8	80.0
6	KETAMINE INJ. 50MG/1ML	Vial	10	100.0
7	DEXAMETHASONE 4MG/ML 1ML INJ	Amp	10	100.0
8	OXYGEN INHALATION (MEDICAL GAS	Litre	10	100.0
9	PARACETAMOL INJ. 10MG/ML	FL	6	60.0
10	DENATURED ALCOHOL	Litre	10	100.0
11	BLOOD GLUCOSE TEST STRIPS	Strip	10	100.0
12	EXAMINATION GLOVES LATEX, NON STERILE	Pc	10	100.0
13	IVERMECTIN TAB. 6 MG	Tab	4	40.0
14	ENDOTRACHEAL TUBE 7 MM + PILOT BALLOON	Pc	9	90.0
15	ENDOTRACHEAL TUBE 7.5 MM + PILOT BALLOON	Pc	8	80.0

N = 10 ***(Total number of Public hospitals)***

According to Table 8, the level of sufficiency was calculated based on average monthly consumption (AMC) and Stock on hand of every essential medicine where it was considered as sufficient when generally it can serve for minimum two weeks and maximum two months (8 weeks). In DH the security stock is two weeks' period and every EM that had the quantity below security stock was considered not sufficient. From those calculations, it was observed that nine (9) essential medicines out of 15 (i.e. 60%) were 100% sufficient. Endotracheal tube 7 mm + pilot balloon was sufficient at 90% level and Ivermectin 6mg tablet was the lowest sufficient at 40% level. The level of sufficiency was also satisfactory apart from Ivermectin 6mg tablet which was at 40% level. That medicine is generally used in the treatment of parasitic worms, and was widely used in COVID-19 treatment. After analysis of the level of sufficiency of EM, the following Table 9 includes the number of stock-outs days in 2021 during COVID 19 pandemic.

***Table 9*: Stock-out days for EM in 2021 during COVID 19 pandemic**

S/No	Product description	Unit of count	Freq. of stock-outs in 2021	Total Nbr of stock-outs days in 2021
1	ADRENALINE INJ. 1MG/ML	Amp	3	39
2	AMOXICILLIN CLAVULANIC TAB 500MG/125MG	Tab	4	21
3	CIMETIDINE INJ. 200MG/2ML	Amp	6	84
4	FUROSEMIDE INJ. 10MG/2ML	Amp	2	34
5	HYDRALAZINE INJ. 20MG/ML	Amp	1	3
6	KETAMINE INJ. 50MG/1ML	Vial	5	78
7	DEXAMETHASONE 4MG/ML 1ML INJ	Amp	4	68
8	OXYGEN INHALATION (MEDICAL GAS	Litre	0	0
9	PARACETAMOL INJ. 10MG/ML	FL	3	26
10	DENATURED ALCOHOL	Litre	2	8
11	BLOOD GLUCOSE TEST STRIPS	Strip	3	32
12	EXAMINATION GLOVES LATEX, NON STERILE PC	Pc	0	0
13	IVERMECTIN TAB. 6 MG	Tab	4	240
14	ENDOTRACHEAL TUBE 7 MM + PILOT BALLOON	Pc	3	54
15	ENDOTRACHEAL TUBE 7.5 MM + PILOT BALLOON	Pc	1	8

N = 10 (Total number of public hospitals)

The findings in Table 9 show that Ivermectin 6mg tablet experienced the highest level of stock-out days (240 days), cimetidine inj. 200mg/2ml (84 days), ketamine inj. 50mg/1ml (78 days), dexamethasone 4mg/ml 1ml inj (68 days), endotracheal tube 7mm + pilot balloon (45 days), etc. while examination gloves latex non-sterile pc and oxygen inhalation (medical gas) did not experience any stock out in 2021. In general, it can be inferred that EM experienced high stock-out cases between January and December 2021 during the COVID-19 Pandemic.

After analysis of the number of stock-outs in 2021, the following Table 10 includes EM delivered at DH on due date**.**

***Table 10*: EM delivered at DH on due date**

S/N	Product description	Unit of count	On-time delivery	
			F	**%**
1	ADRENALINE INJ. 1MG/ML	Amp	8	80.0
2	AMOXICILLIN CLAVULANIC TAB 500MG/125MG	Tab	5	50.0
3	CIMETIDINE INJ. 200MG/2ML	Amp	8	80.0
4	FUROSEMIDE INJ. 10MG/2ML	Amp	8	80.0
5	HYDRALAZINE INJ. 20MG/ML	Amp	6	60.0
6	KETAMINE INJ. 50MG/1ML	Vial	8	80.0
7	DEXAMETHASONE 4MG/ML 1ML INJ	Amp	8	80.0
8	OXYGEN INHALATION (MEDICAL GAS	Litre	8	80.0
9	PARACETAMOL INJ. 10MG/ML	FL	6	60.0
10	DENATURED ALCOHOL	Litre	8	80.0
11	BLOOD GLUCOSE TEST STRIPS	Strip	8	80.0
12	EXAMINATION GLOVES LATEX, NON STERILE PC	Pc	8	80.0
13	IVERMECTIN TAB. 6 MG	Tab	9	90.0
14	ENDOTRACHEAL TUBE 7 MM + PILOT BALLOON	Pc	8	80.0
15	ENDOTRACHEAL TUBE 7.5 MM + PILOT BALLOON	Pc	6	60.0

N = 10 (Total number of public hospitals)

According to Table 10, it can be noted that the most essential medicines that were delivered on time like Ivermectin 6mg tablet with 90%. Ten essential medicines were also delivered on time at 80%. Two essential medicines namely Hydralazine inj. 20mg/ml and Endotracheal tube 7.5 mm + pilot balloon were also delivered on time at 60%. The most delayed in different hospitals was Amoxicillin clavulanic tab 500mg/125mg which was at 50%.

In general, despite the COVID-19 pandemic crisis worldwide, the availability of EM in PHF was not critically disturbed in the studied hospitals. This is due to the government of Rwanda's efforts to efficiently control the implementation of procedures for Preparedness and Response to Corona Virus Disease (COVID-19) Outbreak.

4.2.2 Price variation of essential medicines during the COVID-19 pandemic in PHF

The price variation of EM in PHF was analyzed based on the comparison between prices before COVID-19 and the price of EM during COVID-19. The findings are presented in the following table.

***Table 11*: Price variation status of essential medicines in public health facilities**

S/N	Medicine name	Unit	Price (RWF)		
			Before COVID-19	During COVID-19	Change rate(%)
1	ADRENALINE INJ. 1MG/ML	Amp	69.6	149.0	+214.1
2	AMOXICILLIN CLAVULANIC TAB 500MG/125MG	Tab	124.0	140.0	+12.9
3	CIMETIDINE INJ. 200MG/2ML	Amp	197.0	593.0	+301.0
4	FUROSEMIDE INJ. 10MG/2ML	Amp	78.7	79.0	+0.4
5	HYDRALAZINE INJ. 20MG/ML	Amp	1404.0	1504.6	+7.2
6	KETAMINE INJ. 50MG/1ML	Vial	1409.1	1805.0	+28.1
7	DEXAMETHASONE 4MG/ML 1ML INJ	Amp	37.0	131.0	+254.1
8	OXYGEN INHALATION (MEDICAL GAS	Litre	350.0	350.0	+00
9	PARACETAMOL INJ. 10MG/ML	FL	2095.0	2300.0	+9.8
10	DENATURED ALCOHOL	Litre	2527.0	2879.0	+13.9
11	BLOOD GLUCOSE TEST STRIPS B/25	Strip	6680.0	7650.0	+14.5
12	EXAMINATION GLOVES LATEX, NON STERILE	Pc	24.5	65.0	+265.3
13	IVERMECTIN TAB. 6 MG	Tab	N/A	N/A	N/A
14	ENDOTRACHEAL TUBE 7 MM + PILOT BALLOON	Pc	680.0	698.0	+2.6
15	ENDOTRACHEAL TUBE 7.5 MM + PILOT BALLOON	Pc	815.8	820.0	+0.5

N=10 (Total number of public hospitals)

As shown in Table 11, during the COVID-19 pandemic, prices of the majority of EM and other health commodities increased as a result from restrictive measures to curb the spread of the COVID-19 pandemic. Blatantly this may have affected citizens' purchasing power. Substantial increase concerns specifically 4 essential medicines (i.e. 27%) whose prices were over the double of their price before COVID-19 pandemic: adrenaline inj. 1mg/ml (214%), cimetidine inj. 200mg/2ml (301%), dexamethasone 4mg/ml 1ml inj (254%) and examination gloves latex (265%). Other 9 EM's price increased between 0.4% and 28.1%, and two others remained constant (Oxygen inhalation) and Ivermectin 6mg tablet whose price was not applicable as received as donation for COVID-19 management and distributed free of charges.

CHAPTER FIVE: DISCUSSION

In this chapter, the researcher gives a discussion of the study's findings based on the study's objectives and research questions.

5.1 Availability of EM during COVID-19 pandemic

The first objective sought to measure the availability of EM in PHF in Rwanda and the findings revealed factors that mostly affected the availability of EM such as the limited number of suppliers, heavy workload for pharmacy staff due to the COVID-19 restrictive measures, absence from work due to the COVID-19 pandemic illness, long procurement and related lead time, limited transport due to restricted movement and limited on the job training. The findings are in tandem with studies from Ethiopia which concluded that the long duration stock-out can bring an impact on public health facilities efficiency [46].

The International Finance Corporation [45] found that the COVID-19 pandemic impacted negatively on both nationally and internationally supply chains to the extent that essential medicines and other pharmaceutical products were restricted to border closures, difficulties in trading between or among countries and transportation problems. In this pandemic neither could investors easily import raw materials nor export the finished goods (essential medicines) and other health commodities to different consumers over the world.

Notwithstanding the above-mentioned COVID-19 related issues, the Government of Rwanda through the Ministry of Health and RBC were able to control the spread of the pandemic and to manage its negative effects on the availability of EM in PHF, especially district hospitals. After analyzing the stock cards and other relevant documents, the findings revealed that essential medicines availability was relatively high at 89% compared to the findings in Ethiopia/Africa where the availability was 76.3% [46], owing to the following indicators: management status of essential medicines and their availability at the visit day, their level of sufficiency, their delivery status and stock card availability and updated. Each indicator had a high level of availability, sufficiency, or delivery status majority ranging between 80% and 100% this result is high relative to the finding in China where the availability of Essential Medicines was ranging between 4.29% and 32.87% [47].

5.2. Price variation of essential medicines

Even though the Government of Rwanda has been combining efforts to fight against the COVID-19, the pandemic affected mostly the people with low incomes at different aspects including access to healthcare products. This is confirmed by the increase of some essential medicines whose prices had doubled or tripled during the pandemic period while the economic growth was decreasing and several businesses affected during lockdowns especially in private sector where some businesses had totally closed or suspended a certain number of their staff.

On the other hand, another study conducted in Rwanda in 2021 on Drug Supply Situation during COVID-19 has revealed that prices increased and even doubled in private sector [5].

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The purpose of this research was to assess the availability and price variation of essential medicines in public health facilities in Rwanda. After analyzing data from different respondents and also by exploiting secondary data from existing records, it was noticed that, the majority of respondents (more than 73%) concurred on six factors that have affected the availability of essential medicines during COVID-19 pandemic in Rwanda: Limited number of suppliers; Heavy workload; Limited transport due to restricted movement; Limited training opportunities due to COVID-19 preventive measures; Absence from work due to COVID-19 illness; and Long procurement process and related lead time.

On the selected 15 medical products, 12 (i.e. 80%) were found in the records of all studied hospitals while three of them (i.e. 20%) namely the Paracetamol inj. 10mg/ml and Endotracheal tube 7.5 mm + pilot balloon (both unmanaged in 2 hospitals), and Ivermectin 6mg tablet (unmanaged in 3 hospitals) were found unmanaged in some hospitals where they use other alternative medical products in patients' treatment.

About the updated stock cards, it was noticed that in general the status is relatively good as 93% of the studied products (i.e. 14/15) have updated stock cards in 8 out of 10 studied public hospitals.

Then, for products sufficiency, stock out status and cost variation during COVID-19 pandemic in 2021; it was noticed in general that the level of stock sufficiency was satisfactory in all hospitals except for Ivermectin 6mg tab and Paracetamol inj 10mg/ml whose stock levels were lower than the minimum security level or in stock out in more than three hospitals out of ten. About stock out status, some products had experienced very long stock out days like Ivermectin 6mg tablet (240 days), Cimetidine inj. 200mg/2ml (84 days), Ketamine inj. 50mg/1ml (78 days), Dexamethasone 4mg/ml 1ml inj (68 days) and Endotracheal tube 7mm + pilot balloon (45 days).

Finally, about cost variation during COVID-19 period in 2021, it was noticed that prices of the majority of essential medicines and other health commodities increased as a result from restrictive measures to curb the spread of the pandemic. Substantial increase was noticed on four medicines out

of fifteen studied (i.e. 27%) whose prices were over the double of their price before COVID-19 pandemic: Adrenaline inj. 1mg/ml (214% price increase), Cimetidine inj. 200mg/2ml (301% price increase), Dexamethasone 4mg/ml 1ml inj (254% price increase) and Examination gloves latex (265% price increase).

6.2 RECOMMENDATIONS

Having examined the findings put forth in the previous section, the following recommendations were proposed to improve the availability and to handle increased price of EM during the COVID-19 pandemic in PHF of Rwanda. Suggestions are also offered to relevant authorities like the Government of Rwanda, RBC, Rwanda FDA, RMS Ltd. and other health stakeholders to make essential medicines more available and affordable.

The researcher recommends the following:

A. To the Ministry of Health and its agencies

1. The Government of Rwanda through the Ministry of Health should continue to support health insurance policy so that the majority of citizens can get treatment not only in the normal days, but also during outbreaks such as the COVID-19 pandemic.
2. There is a need to improve on continuous professional development especially online training as an alternative solution due to lockdown restrictions.
3. To continue attracting investors in the local manufacturing of pharmaceutical products, reduce the cost of importations, supply lead time, and high quality products.

B. To District hospital management

1. To establish internal mechanisms for effective control of all essential medicines and other health commodities by implementing all needed good practices (GxP) at all steps from forecasting, quantification, procurement, warehousing, distribution, etc.
2. To provide all needed trainings to all staff in charge of procurement of medical products, warehousing and distribution to end users.

C. Action for further studies

There is a need for further studies that will evaluate and provide a unified criterion, providing cut-off points for assessment of affordability which can be used to determine affordability for complete therapy.

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APPENDICES

APPENDIX A: RESEARCH TIME FRAME

APPEDIX A. GANTT CHART: RESEARCH PROJECT TIMELINE

MONTH/WEEK / ACTIVITIES	AUGUST /2021				SEPTEMBER /2021				OCTOBER/2021				NOVEM-BER/2021				DEMBER/2021					JANUARY /2022			FEBRUARY/2022			
	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	w3	w4	w1	w2	W3	W4	w1	w2	w3	w4
Research Proposal writing		◆	—	◆																								
Ethical committee approval					◆	—	—	—	—	—	—	◆																
Training of enumerators and Pilot study												◆	—	—	—	—	—	—	—	◆								
Analysis of data from pilot study																					◆							
Data Collection																						◆	—	◆				
Data processing and data analysis																							◆	◆				
Writing final research report																							◆	—	◆			
Working on the remarks of supervisors																									◆	◆		
Dissemination of study findings																										◆	—	◆

APPENDIX B: CHALLENGES AND SOLUTIONS

CHALLENGES:

- Time and budget constraints, site accessibility.
- Data accessibility due to COVID-19 restrictive measures (lockdown), respondents' willingness, and few reading resources available.

SOLUTIONS

- Adequately use of available means.
- Using an online questionnaire to reach different respondents.
- Encourage respondents on the willing participation

APPENDIX C: BUDGET

N°	ITEM DESCRIPTION	UNIT	QTY	Unit Price (RWF)	Total Price (RWF)	BUDGET JUSTIFICATION
1	SurveyCTO Subscription	1	1	228,439	228,439	Subscription fees for mobile data collection software (surveyCTO): 220USD per month
2	SPSS Subscription	1	1	118,217	118,217	Subscription fees for software (SPSS) for data analysis: 113.850 USD per month
3	Field Communication and internet fees	4	10	5000	200,000	Communication and Internet fees for Three enumerators and one researcher.
5	Hard disk	1	1	15,000	15,000	one hard disk for Data storage
7	Training for enumerators	1	4	20,000	100,000	Perdiem fees for Three enumerators and one researcher during one-day training
8	Conference room for Training	1	1	50,000	50,000	Fees for hiring Conference room during one-day training
9	Perdiem fees for a pilot study	1	4	30,000	90,000	Perdiem fees for Three enumerators during pilot study and one researcher.
10	Transport fees for a pilot study.	1	1	100,000	100,000	Hiring vehicles for three enumerators during the pilot study
11	Perdiem for data collectors	1	10	20,000	20,000	Perdiem fees for three enumerators and one researcher per one district hospital
12	Transport and Lunch for Data collectors	1	10	100,000	1,000,000	Hiring vehicles for three enumerators during data collection period in 10 district hospitals
13	Photocopying	1	1000	30	30,000	Photocopying fees for consent forms and questionnaires.
14	Printing	1	500	50	25,000	fees for print out of research documents
15	Binding	1	4	50,000	200,000	fees for binding four copies of the final research document
16	Publication	1	1	1,034,223	1,034,223	Fee-related to publication procedures
	TOTAL AMOUNT IN RWF				**3,210,879**	

APPENDIX D: CONSENT FORM

The title **"*Availability and price variation of essential medicines in Public Health Facilities in Rwanda during the COVID-19 Pandemic. Case Study: District hospitals in Kigali City and Eastern Province*".

PART I: Information Sheet

Introduction

I am NYAGATUNTU Valens, a final year Master's student at the University of Rwanda, EAC Regional Centre of Excellence for Vaccines, Immunization, and Health Supply Chain Management.

Purpose of the research

The purpose of the current study is to assess the availability and price variation of essential medicines in Public Health Facilities in Rwanda during the COVID-19 Pandemic.

Type of Research Intervention

The research will use a semi-structured questionnaire, review of invoice documents with the key informants.

Selection of participants

The population in this research are employees of the Rwanda District hospital, the inclusion criteria of participants will consider pharmacists and nurse assistants whose roles are linked to health supply chain management in public health facilities with the capacity to provide the richest information regarding the research objective and research questions, other healthcare providers will be excluded in this research.

Voluntary Participation

Your participation in this study is voluntary. It is your choice whether to participate or not. The choice that you make will have no bearing on your professional standing or your everyday life. You may change your mind later and stop participating even if you agreed earlier.

Procedures

The study will include completing the semi-structured questionnaire and review of invoice documents. An interview with the key informant to validate the information obtained from the documented evidence if necessary can be conducted.

Duration

The group discussions will each take approximately thirty minutes (30min) of your time.

Risks and Discomforts

The risks to you as a participant in this study are minimal. During the group discussion, you may decide to share information. But, again, you may decline to answer any questions that you do not wish to answer or stop the interview at any time, without giving any reasons.

Benefits

There will be no direct benefit to you, but with your participation, we hope to improve the availability and to handle the price increase of Essential Medicines in Public Health Facilities in Rwanda.

Reimbursements/ Incentives

You will not receive any payment or any other benefit to take part in this study, but your participation in this research is essential. Only will refund the transportation fees if any

Confidentiality

We will not share information about you and your institution/company with anyone outside of the team undertaking this activity. The information that we collect will be kept private. All collected data will be stored in a database accessible only by the principal investigator. Any information about you and your institution will be identified by a number on it instead of your name/your institution.

Sharing of Research Findings

The research findings will be shared by the Rwanda Ministry of Health, participants, and other key stakeholders. We will in the future publish on the process and the results, but you and your feedback will remain anonymous.

Right to refuse or withdraw

To reiterate, you do not have to take part in this research if you do not wish to do so, and choosing to participate will not affect your job or job-related evaluations in any way. You may stop participating in the group discussion (s) or interview at any time that you wish without your job being affected.

Whom to contact in case you have questions about your rights as a research participant

All research on human volunteers is reviewed by the College of Medicine and Health Sciences (CMHS) Institutional Review Board (IRB) which works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject, or if you would like to obtain information or offer input, you may contact the CMHS/IRB through the:

Chairperson:

Prof Kato J NJUNWA
researchcenter@ur.ac.rw
Phone No: 0788 490 522

Secretary:

Francois Xavier Sunday
fsunday@khi.ac.rw
Phone No: 0788 563 312

If you have any questions about this research, you may address your query to lead investigators:

Local Lead Investigator:
NYAGATUNTU Valens
Phone No: 0781 611 896
Email: n.valens05@gmail.com

Supervisor:
Dr Vedaste HABYALIMANA
Phone No: 0785 503 181
Email: vedaste.habby@gmail.com

Mr. Jurdas SEZIRAHIGA
Phone No: 0789 205 787
Email: jurdas.sezirahiga017@gmail.com

If you choose to be part of this research study, I will also give you a copy of this consent form to keep for yourself.

Do you have any questions?

PART II: Certificate of Consent

I have been asked to participate in a study named "Availability and price variation of essential medicines in Public Health Facilities in Rwanda during the COVID-19 Pandemic. Case Study: District hospitals in Kigali City and Eastern Province".

I have read the information provided above. I have asked all the questions; I have at this time. I voluntarily agree to participate in this research study. I may withdraw my consent at any time and stop participation without penalty. By agreeing to be in this research, I have not given up any of my legal rights.

I consent voluntarily to be a participant in this study: Yes / No
I agree to be recorded/……..: Yes / No

Print name of participant:
Signature of participant:
Date (day/month/year):
Print name of Researcher:
Date (day/month/year):

If illiterate:
A literate witness must sign (if possible, this person should be selected by the participant, not be a parent, and should have no connection to the research team). Illiterate participants should include their thumbprints as well.

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness:
Signature of witness:
Date (day/month/year):

The thumbprint of participant:

I have accurately read or witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of Witness:

Signature of Witness:

Date (day/month/year)

Copy provided to the participant

APPENDIX E: RESEARCH QUESTIONNAIRE

PART 1. IDENTIFICATION OF RESPONDENT

S/NO	Participant identification No:	Age	Position	Department	Education Background	Number of years of experience health facilities
1			1. Pharmacist 2. Nurse assistant in a pharmacy	1. Pharmacy	1. Masters 2. Ao 3. A1 4. A2	

PART 2. THE RESPONDENT QUESTIONNAIRE

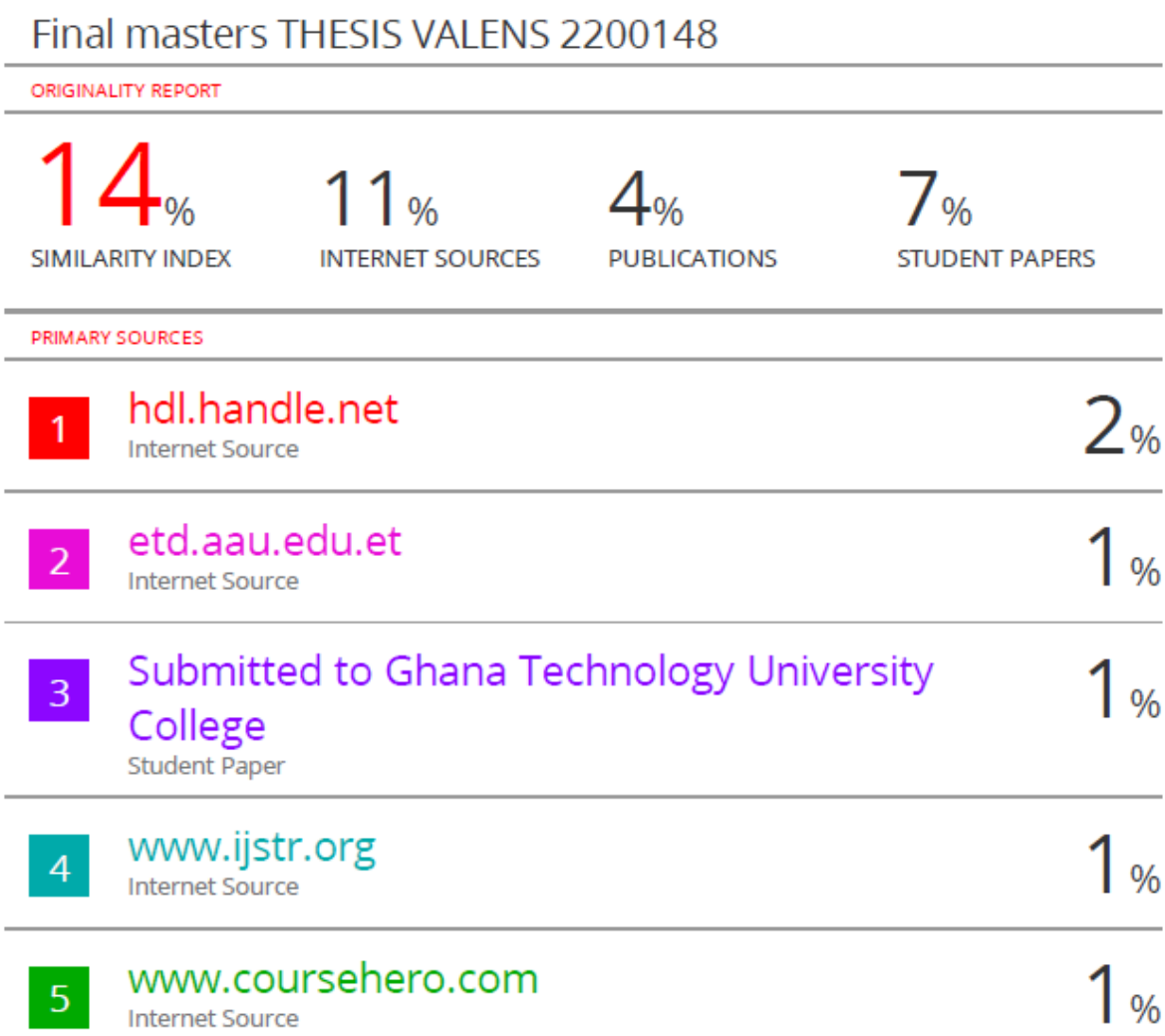
Q1. Select one of the statements by which you agree as COVID-19 based factors that affected the availability of essential medicines in your facility during the COVID-19 pandemic. The Likert scale below will be applicable: Strongly Agree (SA), Agree(A), Disagree(D), and (SD)Strongly Disagree

Nº	**STATEMENTS LIST**	**SA**	**A**	**D**	**SD**
1	A limited number of suppliers				
2	Workload				
3	Absence from work due to COVID-19 illness				
4	Late deliveries from suppliers				
5	Limited transport due to restricted movement d				
6	Limited Job continuous training due to COVID-19 prevention measures.				
7	Other: specify what affected availability: ……				
8	Other: specify what affects the price of essential medicines ……				

APPENDIX F: CHECKLIST ON ESSENTIAL MEDICINES USED AT DISTRICT HOSPITAL

S/No	PRODUCT DESCRIPTION	UNIT OF COUNT	MANAGED AT THIS FACILITY	STOCK CARD AVAILABLE	STOCK CARD UPDATED	AVAILABLE AT DAY OF VISIT	BALANCE ON STOCK CARD	AVERAGE MONTHLY CONSUMPTION	NUMBER OF STOCK OUT IN 2021 DURING COVID 19	TOTAL DAYS OF STOCK OUT IN 2021 DURING COVID 19	ON-TIME DELIVERY(1/0)	SELLING AVERAGE PRICE IN EARLY 2020 and END 0F 2019 BEFORE COVID-19	SELLING AVERAGE PRICE DURING COVID-19 IN 2021
1	ADRENALINE INJ. 1MG/ML	Amp											
2	AMOXICILLIN CLAVULANIC TAB 500MG/125MG	tab											
3	CIMETIDINE INJ. 200MG/2ML	Amp											
4	FUROSEMIDE INJ. 10MG/2ML	Amp											
5	HYDRALAZINE INJ. 1G/ML	Amp											
6	KETAMINE INJ. 50MG/1ML	Vial											
7	DEXAMETHASONE 4MG/ML 1ML INJ	Amp											
8	OXYGEN INHALATION (MEDICAL GAS)	Littre											
9	PARACETAMOL INJ. 10MG/ML	FL											
10	ALCOHOL DENATURED	Littre											
11	BLOOD GLUCOSE TEST STRIPS	strip											
12	EXAMINATION GLOVES LATEX, NON STERILE PC	Pc											
13	IVERMECTIN TAB. 6 MG	Tab											
14	ENDOTRACHEAL TUBE 7 MM + PILOT BALLOON	Pc											
15	ENDOTRACHEAL TUBE 7.5 MM + PILOT BALLOON	PC											

APPENDIX G: DISSERTATION TURNITIN REPORT



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