AVAILABILITY AND AFFORDABILITY OF ANTICANCER MEDICINES AT CANCER TREATING HOSPITALS IN RWANDA

By

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Submitted in fulfillment of the requirements of the degree of Master's in

Health Supply Chain Management (MSc HSCM)

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The academic year 2020-2021

April, 2022

Declaration

I declare that this Dissertation contains my own work except where specifically acknowledged, and it has been passed through the anti-plagiarism system and found to be compliant and this is the approved final version of the Dissertation:

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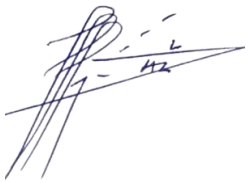
Signature: 

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DEDICATION

To my wife,

To my Children,

To my parents, sisters, and Brothers, for your love, support, encouragement, and patience, this dissertation is tenderly dedicated.

ACKNOWLEDGEMENT

Firstly, I thank God for guiding me throughout this research.

The completion of this dissertation would not have been possible without the valuable support. My heartfelt gratitude goes to the Government of Rwanda, to University of Rwanda, EAC RCE-VIHSCM, College of Medicine and Health Sciences for kindly accepting to sponsor my Master's program.

I am particularly indebted to my supervisor and co-supervisor, Dr. Eric NYIRIMIGABO and

Mr. Jurdas SEZIRAHIGA, respectively, for their excellent supervision. Their encouragement and constructive comments were invaluable.

My sincere gratitude also goes to all the EAC RCE-VIHSCM lecturers for their valuable academic inputs and my colleagues at University for the kind support and encouragement they provided to me along this path. I am also thankful to cancer treating hospitals in Rwanda, and all staffs of those hospitals for their support during my fieldwork.

To all of you who contributed to this project, but whom I may not have mentioned, I say, "Thank you, and May God bless you."

ABSTRACT

Background

Availability and accessibility of anti-cancer medicines is the pillar of cancer management, and it is one of the main concerns in low-income countries including Rwanda. The objective of this study was to assess the availability and affordability of anticancer medicines at cancer treating hospitals in Rwanda.

Methodology

A descriptive cross-sectional study was conducted at 5 cancer treating hospitals in Rwanda. Quantitative data were collected from stock cards and software that manage medicines, and included availability of anti-cancer medicines at the time of data collection, its stock status within the last two years, and the selling price. Qualitative data were also collected, and 7 individuals whose responsibility is to avail anti-cancer medicines at cancer treating hospitals in Rwanda were interviewed.

Results

Our study found the availability of anti-cancer medicines at 41% in public hospitals at the time of data collection, and 45% within the last two years. We found availability of anti-cancer medicines at 45% in private hospitals at the time of data collection, and 61% within last two years. 80% of anti-cancer medicines in private hospitals were unaffordable while 20% were affordable. The public hospital that had most of anti-cancer medicines in public sector provided free services to the patients, and no cost applied to the anti-cancer medicines. Key informants recommended bulk procurement as a strategy to increase availability and affordability of anti-cancer medicines in Rwanda.

Conclusion

Availability of anti-cancer medicines in cancer treating hospitals is low in Rwanda, and most of them are unaffordable. Policy makers should design strategies that can increase the availability and affordability of anti-cancer medicines, for the patients to get recommended cancer treatment options.

Key words: Availability, Affordability, Anti-cancer medicines, Cancer-treating hospitals, Rwanda

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LIST OF ACRONYMS

DNA: Deoxyribonucleic Acid

HIC: High Income Countries

LIC: Low Income Countries

LMIC: Low and Middle Income Countries

MoH: Ministry of Health

RBC: Rwanda Biomedical Center

SC: Supply Chain Management

SCM: Supply Chain Management

RNA: Ribonucleic Acid

WHO: World Health Organization

CHAPTER I: INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Cancer is referred to as a worldwide issue and among the primary root causes of life losses (1). There were approximately 9.6 million deaths and 18.1 million new cases reported in 2018 around the world, and most of the cases were found in low and middle income countries (2). In the same year, 1,806,590 new diagnosed cases of cancer cells were found in United States and acknowledged 606,520 fatalities from cancer diseases. Cancer diseases includes abnormal cell development which spreads or invades various other parts of the body and encompasses more than 100 unique diseases with varied risk aspects and also epidemiology (3).

Cancer is a globally major concern as well as the second fatality's cause in the USA. Improved therapy plus early detection helped to lower death mortality from lung cancer cells (4). In Africa, around 1.1 million cases were projected to be favorably detected prior to 2020 (5), as well as estimate of 10.704 cases and 7.662 deaths in Rwanda in 2018 (Rubagumya et al.; 2020).

A new era of metal-based drugs started in the 1960s, indicated by the discovery of potent platinum-based complexes, commencing with cisplatin [$(H_3N)_2PtCl_2$], which are effective anti-cancer chemotherapeutic drugs (6). The cost of anticancer medicines has a large burden on the national healthcare budget, where 173 million Euros was invested for dental anticancer medicines in 2015 in the Netherlands. Those costly drugs should be taken care of, maintained, as well as moved under needed conditions (7).

The European Culture for Medical Oncology had carried out a research study in 63 nations outside Europe in 2020 and found that poor supply chain plus a restricted spending plan were the sources of poor availability as well as absence of some anti-cancer medicines (8).

In July 2012, the Rwandan Ministry of Health (RMoH) in cooperation with Partners in Health/ Inshuti Mu Buzima (PIH/ IMB) and other collaborators launched the BUTARO Cancer Center of Excellence (BCCOE) in the northern province. Currently, BCCOE gives the medical health care such as cancer relevant diagnosis, palliative care, chemotherapy and surgery such as mastectomies services.

Cancer disease control started in 2012 with the establishment of the BUTARO Cancer Center of Excellence. Ever since, a lot has been attained in terms of cancer control plan, advocacy, medical diagnosis, therapy, and also screening (2).

On World Cancer Day of 2020, Rwanda Biomedical Center introduced a National Cancer Control Plan (NCCP 2020-2024), which is intended to reduce cancer mortality as well as morbidity in the nation (9). From the current study conducted by International agency for Study on (IARC) in 2018, 10,704 new cancer cases were diagnosed in Rwanda, 4,520 male and 6,184 female cases were registered and annual mortality rate reached 7,662 (10).

The objectives of decreasing cancer related mortality as well as country morbidity will certainly be achieved via control of cancer in all dimensions: prevention of risk factors, early detection, accessibility to high quality diagnosis, treatment and other essential heath care services including palliative care, and also use an extensive contemporary system of examination and monitoring on the basis of statistical information quality (9).

Although cancer treatment techniques are well recorded and understood, when it concerns the details on the anti-cancer medicines availability which are used in cancer therapy in Rwanda, it is difficult to discover due to the fact that no studies or various other kind of publications made regarding them. The current study will attempt to fill the gap by checking out the availability of the anticancer medicines in Rwanda and share the findings for helping policymakers, stakeholders, as well as implantation of practitioners to have actually evidence-based information. The information will contribute to the future plans, and interventions in promotion of top quality cancer healthcare solutions and especially in terms of ensuring that cancer patients have access to anti-cancer medicines whenever they are needed.

1.2 PROBLEM STATEMENT

Africa has a small number of publications on availability and affordability of anti-cancer medicines, and studies done reported a scarcity of important medicines including anti-cancer medicines (11,12). According to similar study carried out in Tanzania, it was discovered that only 50% of defined anti-cancer medicines were readily available (13,14).

When it comes to Rwandan context, it is obvious that there is something which was done, because Rwanda in cooperation with different stakeholders and Partners in Health has actually established BCCOE in 2012 to diagnose and treat cancer (2). The type of cancer

therapies which are given to the cancer patients consist of radiotherapy, surgical procedure and also chemotherapy. This health care services for cancer treatment are provided by tertiary level health facilities and these centers are CHUK, CHUB, RMH, KFH, and BCCOE (15). Rwanda is expected to spend 36,525,222,844 RWF (38,856,620 USD) for cancer management for the next 5 years (2019-2024)(9).

Anticancer medications are amongst the only life-prolonging therapies readily available for patients with metastatic lumps, which implies that the growth of tumor has spread beyond its original site to a nonadjacent area. Most recently approved anticancer drugs are accepted on the basis of their efficiency in individuals with metastatic illness (16).

Although Rwanda has taken commitment and strong measures put in place to lower the mortality rate as a result of cancer diseases, the studies regarding the availability of anticancer medicines is still neither well-described nor publically available. There is no research ever done before concerning this variable, which has a high direct effect on cancer health care in Rwanda. Consequently, it hinders adoption of effective measures the government and partners can use to ensure that cancer patients receive efficient and inexpensive anticancer medicines accordingly.

The management of cancer depends or counts first on the availability and access of anti-cancer medicines (17). The research on availability and affordability of anti-cancer medicines will add a literature on cancer treatment in Rwanda.

1.3 OBJECTIVES OF THE STUDY

1.3.1 General objective

The general objective was to assess the availability and affordability of anticancer medicines at cancer treating Hospitals in Rwanda.

1.3.2 Specific objectives

- Determine the availability of the anti-cancer medicines at the cancer treating hospitals in Rwanda
- Determine the affordability of the anti-cancer medicines by the cancer patients in Rwanda.

1.4 RESEARCH QUESTIONS

- Are the anticancer medicines available at the cancer treating hospitals in Rwanda?
- Are the anticancer medicines affordable by the cancer patients in Rwanda?

1.5 JUSTIFICATION OF THE STUDY

Our research assessed the availability and affordability of anticancer medicines at cancer treating hospitals in Rwanda. The availability of anti-cancer medicines in Rwanda could be inadequate. Some patients are required to wait for a long time to get some anti-cancer medicines or get incomplete treatment due to shortage, and it is very costly to get those medicines from private pharmacies in the country. The patients are supposed to get all essential medicines needed to get recovered and this is in line with Sustainable Development Goal, which states that by 2030 *"Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all"*(18).

The most excellent and trusted method of comprehending the availability and affordability of the anticancer medicines at cancer treating hospitals was needed to assess information related to chemotherapy in Rwanda. The current study provided a genuine picture of availability and affordability of anti-cancer medicines, and provided recommendation to different levels of individuals in health systems such as policy makers and policy implementers to enhance the availability of anticancer medicines.

1.6 ORGANIZATION OF THE DISSERTATION

Research thesis is organized in six chapters. Chapter one is the introduction, which is made of background of the study, problem statement, objectives, research questions, justification, and organization of the dissertation.

Chapter two deals with related literature review of the related studies, and consists of an introduction of the chapter, theoretical literature, theoretical framework and conceptual framework. Chapter three deals with research methodology, and consists of an introduction of the chapter, research design, sample size, sampling technique, data collection method, data analysis procedure, and ethical consideration. Chapter four is for results presentation and their discussions. Dissertation ends with conclusion and recommendation containing conclusion, recommendations, suggestion for further research.

CHAPTER II: LITERATURE REVIEW

2.0 Definition of Key Terms and Concepts.

Cancer

Cancer is a big group of illness that can begin in any kind of body organ or tissue of the body when irregular cells grow uncontrollably, go beyond their common boundaries to invade adjacent parts of the body and/or infect other organs. The latter procedure is called metastasizing and is a major cause of death from cancer. A neoplasm as well as malignant tumor are other usual names for cancer cells (19).

Anti-cancer medicines

Anticancer medicine, also called antineoplastic medication is any kind of medicine that works in the treatment of deadly, or cancerous disease. There are numerous major classes of anticancer medicines; these consist of alkylating representatives, antimetabolites, herbal remedies, and also hormonal agents (20,21). Though anticancer medicines have the impact on the cancer cells as their main targets, even normal cells which are not tumors are also attacked by medications during the occasion. One of the most affected cells are: bone marrow, gonads (sex body organs), stomach system, as well as skin (hair follicle cells (22).

One of the first drugs that was used clinically in modern medicine for the treatment of cancer was the alkylating agent mechlorethamine, a nitrogen in nature medicines that in the 1940s was found to be effective in treating lymphomas (20,21). Today, different drugs have been used for chemotherapy, either alone or in combination with other treatments (23). An increasing resistance of mammalian tumor cells to chemotherapy along with the severe side effects of commonly used cytostatics have raised the urgency in the search for new anti-cancer drugs (24). These drugs can be separated right into different classifications based on their mechanism of action.

Anti-metabolites

Antimetabolites are a category of anticancer drugs specified as compounds, structurally similar to all-natural purine or pyrimidine base, nucleoside or nucleotides, molecules required to execute key metabolic responses that through their similarity act as analogues of a typical metabolites, disrupt the regular metabolic processes within cells as well as, hence, avoiding

the synthesis of Cell, RNA, and DNA department. Stock out price of anti-cancer medicines (25).

Supply chain management

At the start of the 1980s, R.K. Oliver as well as M.D. Weber, 2 experts in the field of logistics, presented the idea of Supply Chain Management (SCM) in literary works (26).

SCM is the process of planning, executing and regulating the operations of the supply chain with the purpose to satisfy customer requirements as efficiently as possible. SC monitoring extends all activity and also storage space of resources, work-in-process inventory, and ended up items from point-of-origin to point-of-consumption (27).

The maximum level

Maximum stock level is that level of stock over which the supply in hand should not normally be enabled to go beyond. It is the largest quantity of a specific product which might be kept in the shop any time.

Maximum stock level will certainly rely on the list below factors:

- The accessibility of funding for the purchase of products in the company.
- The maximum requirements of products at any type of factor of time.
- The schedule of space for storing the products as stock.
- The price of usage of materials during lead time.
- The expense of keeping the stores.
- The possibility of variations in rates of different products.
- The nature of materials. If the products are subject to spoiling in nature, after that they cannot be stored for long periods.
- Schedule of materials. Then they will have to be stored for the future period, if the materials are available only during seasons.
- Restrictions imposed by the Government. Often, Government solutions the maximum amount of products which an issue can save. The limit dealt with by the Government will certainly end up being the determining element and optimum level cannot be fixed moreover restriction.
- The opportunity of changes in vogue will certainly also impact the maximum degree.

This is the complying with formula for determining optimal supply level:

Maximum Stock Degree = Reordering Level + Reordering Quantity-- (Minimum Intake x Minimum Reordering period).

The minimum level

Minimum stock degree is that level below which the stock of products should not usually be permitted to drop under. It is the lowest amount of a certain product which may be kept in the store in any way times (28).

Lead Time

An acquiring company calls for a long time to process the order and time is additionally called for by the supplier/vendor to implement the order. The time absorbed processing the order and then executing it is called lead time.

Rate of Consumption

It is the ordinary intake of product as consumed by the clients. The rate of usage will be decided on the basis of previous experience as well as the level of the stock refill.

Nature of product

The nature of the product also influences the minimum level. Then minimum stock will not be required for such materials, if a material is required only against special orders of the customer. In order to determine the minimum stock level, the following formula applies;

Minimum supply Level = Re-ordering Level-- (Typical Usage x Typical Reorder Duration).

Re-ordering Level

This is that level of supply at which fresh order need to be positioned for refilling the stock with new supply. It is fixed somewhere in between maximum and also minimum levels in such a way that fresh products are obtained in such manner in which fresh they are obtained just before the minimum level is reached. It is the level at which purchase of the stock products ought to be made out for fresh supplies.

The average level

This is the stock level which suggests the typical stock held by the company.

$Average\ Stock\ Level$ = 1/2($Minimum\ Level + Maximum\ Level$)

Or

Average Stock Level = Minimum Level + ½ (Re order Quantity)

The danger level

This is the level any stock should not get under no matter what and whole stock management team work together to prevent it from happening. Then immediate steps should be taken to replenish the stocks even if more cost is incurred in to refill the stock, if danger level is next to happening.

Danger level can be determined with the following formula:

Danger Level = Average Consumption x Maximum reorder period for emergency purchases.

Days of stock out per item

This is the number of days the stock remains empty of a particular product or item (medical product/item in this case) and the consumer/patients don't get prescription of that particular medicines until they are added in the stock again. For example; if a patient needs a particular anti-cancer medicine but it is not available in the stock and the doctor decide not to prescribe it, we have to measure how long in days that item has been out of stock until the day of new inventory. Having an accurate inventory day's calculation available lets you set up accurate reorder points and have the right amount of stock available, whenever you or the consumers need it.

2.1.1 Availability of Anti-cancer medicines in high income countries versus low income countries.

The arrangement of budget-friendly, excellent quality and also availability of suitable important medications is an important element of a well-functioning wellness system, however the accessibility to totally free vital medications is still an essential element of global health and wellness protection (12).

Availability of Anti-Cancer Medicines in High Income Countries

In high income country, the availability of the anti-cancer medicines is measured depending on the purchasing power and the Government ability to set the procurement price on high

level, so that anti-cancer medicines can be available due to the willing of the sellers to go for that demand. In terms of affordability, the anti-cancer medicines are usually expensive for both Governments and patients but the affordability assessment showed that medicines were more affordable in HICs than in MICs (29). However, the patients with high financial income have more access than the patients who have low financial income (30). The difference in financial status of the cancer patients and the Government's purchasing power both indicates that the high income countries have the high availability of anti-cancer medicines compared with LMICs.

Availability of Anti-Cancer Medicines in Low Income Countries

Cancer is the second leading cause of death around the world representing majority of fatalities in LMICs (11). The schedule as well as price of anticancer medicines is an issue of major concern particularly for center as well as reduced revenue nations (17).

According to the research study performed in Pakistan as a MIC, the findings revealed that the schedule of Anti-cancer medicines was better at personal health centers as well as drug stores as contrasted to public health centers. The study went on stating that the high revenue class of people had much more cost of Anti-cancer medicines compared to the reduced earnings clients (17). Up until today, the cancer therapy is costly and also the high rates of cancer medications have a significant influence on the availability in the LICs (11).

Worldwide, the high rate of cancer treatment postures a difficulty to cancer disease patients as well as federal Governments alike. Regardless of much dispute on how to decrease the treatment price of cancer disease, it remains suboptimal (30). According to the WHO technical document , countries with a decreased gross domestic products minimized ease of access of anti-cancer medicines, or timetable simply with higher out-of-pocket specific negotiations, especially for higher-cost medicines, including targeted therapies (11). Less availability as well as the high price of cancer therapies are a powerful challenges to accessibility in numerous LMICs, where regular monthly medication expense commonly surpasses yearly earnings (30). As well as just 32.0 and also 57.7% of cancer disease medications on the important medication checklist were offered in low-income as well as lower-middle-income nations, specifically, just if clients wanted to sustain their complete expenses (11).

2.2.2 Health supply chain management metrics used in assessing the availability of anti-cancer medicine.

There are different important factors of supply chain management which have direct or indirect impact on the availability of anti-cancer medicines in health facilities. This availability may vary from different nations and income capacity classes of the nations. In this work, we are going to review and discuss about the most common ones which crosscut all nations. Those factors are, stock levels, days of stock out per item, percentage or ratio of items received versus prescribed, supply chain knowledge and capacity of anti-cancer medicines managers, stock out rate of anti-cancer medicines.

Stock out rate of anti-cancer medicines and Availability of Anti-cancer medicines

The stock levels are the direct indicators of the availability of anti-cancer medicines. The reduced accessibility of anticancer medicines as a result of high stock out rate, it is most likely brought on by the inadequate motivation on preserving supplies as well as ineffective purchase recording systems (11). Stock levels and Availability of Anti-cancer medicines

Stock level is an essential quantifiable variable which need to be well managed in order to understand when the supply have all essential medical products or lacking the customer needed products (anti-cancer medicines) (31). On routine basis, the stock level management assists with establishing the set up time of supply fill up and this makes certain the availability of the medications in any way time. In addition to that, it assists the company to satisfy the consumers' need (32). In this discussion, we are going to look at major stock level practice and the required tool to ensure its success, which are practices of maintaining the stock level and the documents required for stock handling.

Maintaining stock levels

Any type of organization that holds a supply of products available for sale, whether for public or various other services, maintains a precise document of all the products in hand (32). Several of the approaches utilized are supply journal, container card, digital supply monitoring system, interior packaging note, and digital information systems

Documents required for stock handling

When supply gets to the store, it typically shows up in a vehicle or in a container, which requires to be unloaded. Prior to beginning the dumping procedure, the retailer supervisor

need to learn about the supplies features. The complying with records are generally prepared while supply handling, distribution note, billing, consignment note, and digital information systems. Making use of delivery notes aid a company obtain a far better introduction of their input as well as outcome, whilst also offering their clients a method to examine that they have actually gotten every one of the items they spent for. Electronic information systems are unique computer system software program for obtaining of consignments or recording of items and this is called an automatic system. Automated systems minimized paper job and are extremely fast in picture monitoring as well as moving details (32).

Days of stock out per medical product and Availability of Anti-cancer medicines

Days of a certain anti-cancer medication stock out causes a significant obstacle to invoice of top quality cancer cells treatment in LMICs (33) and throughout days that specific medications are not offered it offer the people experience specifically when there is no alternatives with the exact same restorative capability (34). It has actually been placed by WHO in much more initiative in offering the vital anti-cancer medicines listing to make sure that they are available and easily accessible by cancer patients. Crucial cancer medication stock outs are taking place at a high regularity around the world and stand for a complicated worldwide concern (33). When a certain anti-cancer medication is not readily available, having the days of supply of that specific anticancer medication helps to assess its availability in days or months and also established the procedures of enhancement (17). In research study performed in Nigeria, the adhering to late order positioning, hold-up in repayment and bad provider lead-time mostly attributable to lateness in repayment for previous medication materials were discovered to be the leading root cause of the stock out for some medications (35).

Percentage or ratio of items received versus prescribed and availability of anti-cancer medicines

There are no much data about this metric, but when it comes to measuring the availability of anti-cancer medicines, understanding the ration of items received versus prescribed is so important. For example, if the doctor prescribed 10 medicines but the patient only gets 4, it means that 6 out 10 anti-cancer medicines are not available. To measure this indicators, it is good to have a long time frame, like weeks or months to understand the clear image of the problem.

Supply chain knowledge and capacity of anti-cancer medicines managers and availability of anti-cancer medicines

Lowering international illness worry calls for boosting accessibility to medications, hence the demand for strong and also reliable SCM for medications (36). SCM procedure includes numerous contexts, stages as well as practitioners calls for high abilities in its techniques (37). Restricted recognition and preparedness on SCM of medications is still an issue in health and wellness centers. This might be because of insufficient supply chain administration abilities as well as framework, bad funding, absence of responsibility and also inadequate monitoring (38).

Expertise voids associating with decision-making duties, procedures as well as standards at the workplace in appointing companies; the influence of power on joint inter-organizational partnerships in time; as well as the range to use incorporated SCM reasoning and methods to provide chains providing physical items have a critical impact on the availability of the clinical items at health facilities (37). All these elements suggest that the schedule of anti-cancer medicines can be much less or high depending on the capability of the supply chain supervisors.

1.7 CONCEPTUAL FRAMEWORK

Availability and affordability of anti-cancer medicines are mainly affected by the global cost of the anti-cancer medicines, the supply and drug use regulations. The policy maker in the country may depend on this to set policies in regards to the supply, use of the drugs, pricing, insurances percentages and etc. The policy implementers depend on the policies which guide the anti-cancer medicines within the country and it brings huge impact on the affordability and availability of the anti-cancer medicines within the country.

Affordability

Affordability of the anti-cancer medicines are mainly affected by the socio-economic categories, also known as UBUDEHE categories. Individual UBUDEHE categories indicate the income level which can directly affect the purchasing power. Affordability of anti-cancer medicines are also affected by health insurance used by the patients. The percent of the cost the health insurance can determine whether or not the patient can afford certain type of anti-cancer medicines (39).

Availability

Availability of anti-cancer medicines can be affected by the stock out-rate. When the stock out rate of certain anti-cancer medicine is high during certain period of time, it directly affects the availability of that anti-cancer medicine for consumption (11). Availability can also be affected by budget or funds available for pharmaceutical services. For example; if the funds or budget are high the procurement of the anti-cancer medicines become easy and they become available for the consumption. Another indirect fact is the patient's demand which might be high compared with the requisition of anti-cancer medicine. For example, when the demand is high compared to the available stock, it can lead stock out for certain medicines more often (40).

CHAPTER III: RESEARCH METHODOLOGY

Research design and target population

This was a descriptive cross-sectional study and purposive sampling was used to collect data. Quantitative data were recorded from stock cards as well as software that manage medicines. Data were recorded from a total of Five cancer-treating hospitals that were expected to have the stock of anticancer medicines and their doctors regularly prescribed anti-cancer medicines to cancer patients. Those hospitals were University Teaching Hospital of Kigali (CHUK), University Teaching Hospital of Butare (CHUB), King Faisal Hospital (KFH), Butaro Cancer Center of Excellence (BCCOE), and Rwanda Military Hospital (RMH). Recorded data included availability of anti-cancer medicines at the time of data collection, its stock status within the last two years, and the selling price.

The qualitative data were also collected to record opinions from individuals that manage or influence availability of anti-cancer medicines, and included the policymakers, policy implementers, and staff of cancer-treating hospitals in Rwanda that are involved in management of anti-cancer medicines. A total of seven staff were recruited. For the policymakers, we interviewed a staff in charge of setting policy regarding oncology from the Ministry of Health. For the policy implementers, we interviewed a staff of oncology from the Rwanda Biomedical Center. From each selected hospital, we chose to interview a staff who regularly work in the supply chain of the anticancer medicines and their management as well, and one person was selected from either the pharmacists, stock managers, medical doctors, or procurement officers. This is simply because they can give the most reliable information regarding the availability and affordability of anti-cancer medicines by cancer patients.

Sampling technique

The selection of the respondents was done depending on the appropriate characteristics required for an individual member of departments which are related to the anti-cancer medicine prescription, stock management, and pharmacy activities.

The research used purposive sampling to select key departments which are involved in management and provision of anti-cancer medicines from all sectors which influence the availability and affordability of anti-cancer medicines and staff members who can provide the relevant information on the availability and affordability of anti-cancer medicines.

Data collection method

Data collection covered 2 weeks of February 2022. One part of the data collection was perception interviews, which collected quantitative and qualitative data about different variables which are related to the availability and the affordability of anti-cancer medicines. Every sector had its own designed questionnaire according to its most important role in the supply chain of anti-cancer medicines. The first part of the data collection was both the perception interview for quantitative data collection and the key informant interviews for qualitative data collection.

The second part of data collection was management tools (software and stock cards). A data collection tool was developed according to the design of this study. Our study assessed 33 anti-cancer medicines that included 29 medicines used to treat cancer listed in the National List of Essential Medicines for Adults(41) and also those on the list of medicines that the cancer-treating hospitals are required to have. We recorded the information of affordability and availability at the time of data collection and in the two years from August 2019 up to August 2021.

Data analysis procedure

Both quantitative and qualitative data were collected using the questionnaires. The quantitative data were analyzed by using Statistical Package for the Social Sciences. SPSS also helped us to analyze different variables which are related to the availability and affordability of the anti-cancer medicines by the cancer patients such as the cost and pricing of the medicine. Qualitative data was consolidated and be used to give reliable information for our study. All those findings were useful in providing evidence-based recommendations, which can be used to improve the availability and affordability of anti-cancer medicines in cancer-treating hospitals.

Ethical consideration

Ethical approval to conduct this study was obtained from the Ethical Board CMHS/UR. Every respondent was provided with the consent form, a self-consent to be a participant in the study. To minimize the bias errors, the respondents were not given any incentives to participate in the study. The information was kept as a great secret and will never be shared anywhere else, except a use to make a written report from collected data.

CHAPTER IV: RESULTS AND DISCUSSION

RESULTS

Availability of anti-cancer medicines

Anti-cancer medicines were available at two out of five cancer treatment hospitals, of which one was public and the other private. At the public hospitals had availability of surveyed anti-cancer medicines 14 (42%) while private hospitals had an availability of 15 (45%). No stock of anti-cancer medicines was available at the other three surveyed hospitals though they are cancer treating hospitals that are expected to have all of the assessed anti-cancer medicines.

Stock status within the last two years showed that three cancer-treating hospitals had anti-cancer medicines. Public hospitals had availability of anti-cancer medicines of 15 (45%) within the last two years, including one item that was not available in the stock at the time of data collection (Methotrexate 50 mg injection). The private hospital had availability of anti-cancer medicines of 20 (61%) of surveyed medicines within the last two years, including five items that were not available in the stock at the time of data collection (Methotrexate 2.5 mg tab, Methotrexate 50 mg injection, Vincristine 1 mg/ml injection, Letrozole 2.5 mg tab, and Rituximab 100 mg injection). Within the last two years, all items that were found in public hospitals were available in BCCOE, but 2 (6%) of surveyed medicines were also available in another cancer-treating hospital. Two cancer-treating hospitals had no anti-cancer medicines for last the two years. Figure one shows the availability of assessed anti-cancer medicines: 4 (12%) were available in public hospitals only. They were Folinic acid (15 mg), Mercaptopurine (50 mg), Imatinib mesylate (100 mg), and Melphalan (2 mg). 9 (27%) were available in private hospitals only. They were Cyclophosphamide (500 mg), Trastuzumab (150 mg), Zoledronate (5 mg/100 ml), Carboplatin (100 mg/ml) Paclitaxel (6 mg/ml) Irinotecan (200 mg/ml), Docetaxel (20 mg/ml), Cyclosporine (25 mg), and Mycophenolate

(500 mg). 11 (34%) were available in both public and private hospitals. They were Bleomycin (15 mg), Doxorubicine (50mg), Methotrexate (2,5 mg), Methotrexate (50 mg), Vincristine (1 mg/ml), Tamoxifen citrate (20 mg), Letrozole (2.5 mg), Cisplatin (1 mg/ml), Oxaliplatin (5 mg/ ml), Fluorouracil (50mg/ml), and Rituximab (100 mg). 9 (27%) were not available in any hospital. They were Cyclosphamide (50 mg), Doxorubicin (10mg), Hydroxycarbamide (200 mg), Hydroxycarbamide (1 gr), Anastrozole (1 mg), Ifosfomide (1000 mg), Fluorouracil (0.5%), Fluorouracil (1.0%), Fluorouracil (5.0%).

Availability summary the day of visit

Stock level	Public Hospital			Private Hospital		
	n	N=	%	n	N	%
Availability (Qty>0)	14	33	42	15	33	45
Under Minimum (AMC<1)	9	14	64	3	15	20
Between Min-Max(1<AMC >2)	5	14	36	4	15	27
Over Stock (AMC>2)	0	14	0	8	15	53
Stocked out(AMC=0)	19	14	57	18	15	55

AMC: Average Monthly consumption

Cross-sector analysis of the availability of anti-cancer medicines within the last two years was done between private and public hospitals. Of the total surveyed medicines, 61% were found at private hospitals while 45% were found at public hospitals. Not enough information was found to make a cross-sector price analysis for the affordability of anti-cancer medicines

since no cost was applied at BCCOE, which administered most of the anti-cancer medicines in public hospitals.

Affordability of anti-cancer medicines

The affordability of anti-cancer medicines was assessed at cancer treating hospitals, which had at least one of surveyed anti-cancer medicines within the last two years. Of the total anti-cancer medicines administered at private hospitals within the last two years, 16 (80%) were unaffordable while 4 (20%) were affordable to the patients. Affordable medicines were Methotrexate (2,5 mg), Tamoxifen citrate (20 mg), Letrozole (2.5 mg), and Mycophenolate (500 mg). Apart from BCCOE, one more public hospital had two anti-cancer medicines, where one was affordable and another not affordable to the patients

DISCUSSIONS

In Rwanda, availability of essential anti-cancer medicines is low with a total absence in three major referral hospitals that treat cancers. Cancer treating referral hospitals were expected to have all surveyed medicines for the patients to have access at a convenient cost in line with community-based health insurance. Low availability of anti-cancer medicines in Rwanda can results in a delayed or omitted chemotherapy, which is a risk factor for the worse survival and progression of cancer diseases to advanced stages (42).

BCCOE, a single cancer treating hospital that has anti-cancer medicines is located in Burera district of northern province, at a high distance from Kigali city, which increases the transport cost. Most patients are poor, but BCCOE offers free anti-cancer medicines, social support, and free meals. BCCOE receives a huge support from the international community principally Non-Government Organization Partners In Health (PIH), which covers the cost of medicines and supplementary services (2,42) The patients get anti-cancer medicines free of charge; however, high transport costs subjected to the most patients can reduce care-seeking behaviors and left cancer patients untreated. It is essential to design interventions that will build capacity of public referral hospitals for chemotherapy to save lives of cancer patients.

Our findings of 42% availability of anti-cancer medicines in public hospitals is comparable to the study done in Tanzania that found availability of 50% of surveyed anti-cancer medicines (13). The findings that anti-cancer medicines were available in the private sector more than in the public sector agree with a study conducted in Pakistan that found availability of 71.9% for originator brands and 20.0% for lowest priced generics in private sector against 31.4% for originator brands and 11.7% for lowest priced generics in public health facilities (17). Low availability of anti-cancer medicines in the public sector compared to the private sector can show Government underfunding for cancer treatment, or poor inventory management at public hospitals that results in a suboptimal procurement and utilization of anti-cancer medicines.

We found that the most of available anti-cancer medicines were unaffordable (80%) to the cancer patients when the payment was recommended for the patients to have medicines. Our study findings agree with a study conducted in Mexico, a middle income country that found 86% of surveyed anti-cancer medicines to be unaffordable (43). For the unaffordable drugs, cancer patients pay a cost that is more than the wage of one day to get medicines. It exaggerates poverty, which worsens the patient's outcome. Unaffordability of most anti-cancer medicines shall call for an effort to make cancer-related chemotherapy available and accessible in low and middle income countries that have a high percentage of poor population.

Key informants that actively participated in making anti-cancer medicines available and affordable in Rwanda were aware of low availability and affordability, and the causes included low information of required items and quantities to procure for a given anti-cancer medicine. They believed also that anti-cancer medicines are not affordable in regards to the low income of the patients, and failure of community-based health insurance to cover the cost of medicines. The suggested solutions included bulk procurement, where a single entity shall collect information of all needed anti-cancer medicines in cancer treating hospitals, and order at the same time with price negotiation. The improvement may be experienced if Rwanda Medical Supply (RMS) limited bear the responsibilities, and government as well as other actors monitor the progress closely.

CONCLUSION

Our study found low availability of anti-cancer medicines in Rwanda, which can result in a cancer poor management for our patients. Public referral hospitals that are expected to have anti-cancer medicines were not having their stock at the time of data collection; cancer treatment in public hospitals only depended on BCCOE, a cancer treating hospital that is supported by Non-Government Organization Partners in Health. Availability of anti-cancer medicines in the private sector was higher than the public sector, which can be caused by Government's underfunding for cancer treatment, or poor stock management in public hospitals that cause suboptimal consumption of anti-cancer medicines. As suggested by our key informants, increasing the knowledge of needed anti-cancer medicines and required quantity, coupled with strategies for bulk procurement and negation of price, will increase the availability and affordability of anti-cancer medicines in Rwanda.

STRENGTH AND LIMITATIONS

To the best of our knowledge, this is the first study to report the availability and affordability of anti-cancer medicines in Rwanda, and the generated knowledge shall be used to improve cancer therapy. The limitation of the study is based on the fact that most public hospitals were not managing anti-cancer medicines at the time of data collection. The data on affordability of anti-cancer medicines are not enough to make cross-sector analysis of affordability of anti-cancer medicines in Rwanda.

RECOMMENDATIONS

To the Ministry of Health and Rwanda Biomedical Center

The Ministry of Health (MoH) in partnership with Rwanda Biomedical Center (RBC) can deploy sufficient budget to generate knowledge on epidemiology of cancer in Rwanda, treatment options, and availability of required resources. Our research found low availability of anti-cancer medicines in Rwanda, and key informants who were interviewed linked the problem with uncertainty of needed varieties and quantities. By increasing the knowledge of cancers in Rwanda, MoH and RBC will be able to facilitate cancer treating hospitals to determine required anti-cancer medicines in Rwanda, and to design accurate procurement pathways. They shall also promote a policy of incorporating anti-cancer medicines under coverage of community-based health insurance for the patients to pay at convenient prices.

To the Rwanda Medical Supply Limited

Rwanda Medical Supply Limited (RMS ltd) can make bulk procurement of anti-cancer medicines, which can help to deal with suppliers the lowest possible selling price at desired quality and standards. Ordering multiple procurements of few quantities can stimulate the suppliers to increase a selling price to get high income at a single time. RMS ltd shall collect the information of anti-cancer medicines that cancer treating hospitals will use in a specific time, and make a bulk procurement to represent needs of the country.

To the cancer treating hospitals

All cancer treating hospitals that have the option of chemotherapy shall ensure the availability of anti-cancer medicines in the stock. They shall feel the pain of cancer patients who get worse due to the delayed or omitted treatment as a result of unavailability of anti-cancer medicine(s). If the anti-cancer medicines can be subjected to the payment, cancer treating hospitals can make them available for the patients to pay. Cancer treating hospitals shall also use possible ways that can reduce the selling price of anti-cancer medicines to the patients, which shall include promotion of bulk procurement, knowledge generation, and effective collaboration with concerned institutions.

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ANNEX

ANNEX 1: THE INTERVIEW GUIDE

INFORMED CONSENT FORM

Title: ***Availability and affordability of anticancer medicines at Cancer treating Hospitals in Rwanda***

PART I: Information Sheet

Introduction

Introduction of researcher and the research project

How are you! My Name is RURANGWA Clement, I am a student of University of Rwanda - College of Medicine and Health Sciences going after a Master's Degree of Health Supply Chain Management .I am currently undertaking a study on the topic "Availability and affordability of anticancer medicines at the cancer treating hospitals in Rwanda" as partial fulfillment of the requirements for the graduation.

Purpose of the research

This study will help us to get evidence based information about the factors which influence the availability of anti-cancer medicines at cancer treating hospitals, and the factors which affect their affordability for the cancer patients.

Type of Research Intervention

The finding from this study will help in making evidence based recommendation to the government in order to set and implement new policies and measures which can improve the availability of the anti-cancer medicines and ensure that they can be more affordable by the cancer patients

Selection of participants

As someone who play a role in the supply chain of the anti-cancer medicine at your hospitals we would like you to contribute as a respondent in this study, because your hospital is one of the cancer treating hospitals in Rwanda.

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

This study will be a face to face interview and you will only have to answer the close ended questions. The participation in the study will not require recording of the voice or taking of the photos.

Duration

And the interview will take approximately 20 minutes of your time.

Risks and Discomforts

The participation in this study is by free will. During the interview you may decide whether or not to answer certain answer. But, again you may stop the interview at any time, without giving any reasons.

Benefits

There will be no direct benefit to you for participation in this study, but with your participation we hope to improve the availability of the anti-cancer medicines and ensure that they become more affordable to the cancer patient.

Reimbursements/ Incentives

You will not receive any payment or any other form of incentives to participate in to take part in this study, but your participation in this research is essential.

Confidentiality

The information you give us will never be shared with anyone else not even in the report of this study. They will be only known by the research team only and the team will never share them with anyone else. They will only be used in addition to other respondents to make a general report of the findings without identifying who said this or that.

Sharing of Research Findings

The findings from this study will be shared to all people who participated in this study. 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 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 Rwanda National Ethics Committee (RNEC) that 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 …IRB……through the:

Chairperson:	Secretary:
……..	…….
Mobile phone: …….	Mobile phone: ……

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

Local Lead Investigator: ……..

Supervisor: ……. Tel…….

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 ……

I have read the information provided above. I have asked all the questions; I have at this time. I agree to participate in this research study voluntary. 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

Print name of participant:

Signature of participant:

Date (day/month/year):

Print name of Researcher:

Date:

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). Participants who are illiterate should include their thumb print 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 :

Thumb print 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

Copy provided to the participant

INTERVIEW QUESTIONNAIRE

BACKGROUND INFORMATION

Dear Respondent,

I'm RURANGWA Clement, a student of University of Rwanda - College of Medicine and Health Sciences going after a Master's Degree of Health Supply Chain Management. The goal of our study is to assess the availability and affordability of anticancer medicines at cancer treating hospitals in Rwanda. Kindly spare some minutes to answer these questions. All provided information will be confidential and will be used only for the purpose of this study.

.

Questionnaire for policy implementer

Determine the factors influencing the availability of the anti-cancer medicines in the different Cancer treating hospitals in Rwanda.

a. Briefly please share with us the roles of policy implementers in availability of anti-cancer medicines?

b. In your opinion, what do you think about the current situation in regard to availability of anti-cancer medicines?

c. In your opinion, what do you think about the budget/funds for pharmaceutical services of anti-cancer medicines is enough? How do they affect the availability and affordability of anti-cancer medicines?

d. In your opinion, what do you think about the balance between the patients demand for anti-cancer medicines and their stock rates at cancer treating hospitals?

e. How do you think the supply chain knowledge of stock managers impact the availability of anti-cancer medicines?

f. What are the challenges are you facing with in regards to making the anti-cancer medicines more available in cancer treating hospitals?

Determine the factors influencing the affordability of the anti-cancer medicines by the cancer patients.

a. Briefly, share with us the roles of policy makers in affordability of anti-cancer?

b. In your opinion, what do you think about the current situation in regard to affordability of anti-cancer medicines?

c. In your opinion, how is the pricing of anti-cancer medicines affect the affordability of anti-cancer medicines for the cancer patients?

d. In your opinion, how is the cost-coverage by the health insurances of patient are having impact on the affordability of the anti-cancer medicines?

e. Briefly, tell us how the Social economic categories (UBUDEHE) are affecting the affordability of anti-cancer medicines for cancer patients?

f. What are the challenges are you facing with in regards to implementing policies in regard with making the anti-cancer medicines more affordable in cancer treating hospitals?

Provide the suggestions for effective measures to be executed in order to improve the availability and affordability of the anti-cancer medicines in Rwanda.

a. As policy implementers, what can you recommend to be done which can make anti-cancer medicines more available?

b. As policy implementers, what can you recommend to be done which make anti-cancer medicines more affordable?

Questionnaire for policy makers

Determine the factors influencing the availability of the anti-cancer medicines in the different Cancer treating hospitals in Rwanda

g. Briefly please share with us the roles of policy makers in availability of anti-cancer?
h. In your opinion, what do you think about the current situation in regard to availability of anti-cancer medicines?
i. In your experience how do the global pricing, drug supply and drug use regulations affect the availability of anti-cancer medicines in the country?
j. What are the challenges are you facing in setting policies which help in making the anti-cancer medicines more available in cancer treating hospitals?

Determine the factors influencing the affordability of the anti-cancer medicines by the cancer patients.

g. Briefly share with us the role of policy implementers in ensuring the affordability of anti-cancer medicines.
h. In your opinion, what do you think about the current situation in regard to availability of anti-cancer medicines?
i. In your experience how do the global pricing, drug supply and drug use regulations affect the affordability of anti-cancer medicines in the country?
j. What are the challenges are you facing with in setting policies which help in making the anti-cancer medicines more affordable in cancer treating hospitals?

Provide the suggestions for effective measures to be executed in order to improve the availability and affordability of the anti-cancer medicines in Rwanda.

c. As policy makers, what can you recommend to be done make anti-cancer medicines more availability?
d. As policy makers, what can you recommend to be done make anti-cancer medicines more affordable?

Questionnaire for the procurements staff

Determine the factors influencing the availability of the anti-cancer medicines in the different Cancer treating hospitals in Rwanda.

k. Briefly please share with us the roles of procurement staff in availability of anti-cancer medicines?

l. In your opinion, what do you think about the current situation in regard to availability of anti-cancer medicines?

m. In your opinion, what do you think about the budget/funds for pharmaceutical services of anti-cancer medicines is enough? How do they affect the availability and affordability of anti-cancer medicines?

n. How do you think the supply chain knowledge of procurement impact the availability of anti-cancer medicines?

o. As procurement staff what are challenges are you still facing with in ensuring the efficient availability of anti-cancer medicines?

Determine the factors influencing the affordability of the anti-cancer medicines by the cancer patients.

k. In your opinion, what do you think about the current situation in regard to affordability of anti-cancer medicines?

l. In your opinion, how is the cost-coverage by the health insurances of patient are having impact on the affordability of the anti-cancer medicines?

m. Briefly tell us how the Social economic categories (UBUDEHE) are affecting the affordability of anti-cancer medicines for cancer patients?

n. What are the challenges are you facing with in regards to implementing policies in regard with making the anti-cancer medicines more affordable in cancer treating hospitals?

Provide the suggestions for effective measures to be executed in order to improve the availability and affordability of the anti-cancer medicines in Rwanda.

e. What is your suggestion of what can be done by policy makers and policy implementers to make anti-cancer medicines more available?

f. What is your suggestion of what can be done by policy makers and policy implementers to make anti-cancer medicines more affordable?

MEDICINES STOCK MANAGEMENT TOOLS REVIEW CHECKLIST

- Patients' information Record books
- Stock cards
- Software used
- Annual quantification report

ANNEX 2: WORK PLAN

No	Task	June 2021	July 2021	Feb 2022	Feb 2022	Feb 2022	November 2021
1	Research Proposal writing						
2	Research Proposal Presentation						
3	Ethical committee approval						
4	Data Collection						
5	Data processing						
6	Data analysis						
7	Report writing						
8	Working on the remarks of supervisors						
9	Thesis defence						
10	Dissemination of study findings						

ANNEX 3: ANTI-CANCER MEDICINES

Product Name	Dosage form & Strength	RH	PH	DH	HC	HP	Co
Acide Folinique	Tablet. 15 MG	X	X				
Bleomycine	Injection. 15 MG	X	X				
Cyclophosphamide	Tablet . 50 MG ;	X	X				
Cyclophosphamide	Injection. 500 Mg	X	X				
Doxorubicine	Powder for injection .10; 50 mg	X	X				
Methotrexate	Tab. 2,5 mg	X	X				
Methotrexate	Inj. 50 mg	X	X				
Vincristine	Inj. 1mg/ml	X	X				
Mercaptopurine	Tab. 50mg	X	X				
Hydroxycarbamide	Caps. 200mg; 1g	X	X				
Tamoxifen Citrate	Tab. 20mg	X	X				
Anastrozole	Tab. 1mg	X	X				
Letrozole	Tab. 2.5mg	X	X				
Cisplatin	Inj. 1mg/ml	X	X				
Imatinib mesylate	Tab. 100mg	X	X				
Melphalan	Tab. 2mg	X	X				
Trastuzumab	Powder for inj. 150mg	X	X				
Zoledronate	Inj. 5mg/100ml	X	X				
Oxaliplatin	Inj. 5 mg/ml	X	X				
Carboplatin	Inj. 10mg/ml	X	X				
Paclitaxel	Powder for inj. 6 mg/ ml.	X	X				
Ifosfomide	Powder for inj. 1000mg	X	X				
Fluorouracil (5-fu)	Inj. 50mg/ml	X	X				
Fluorouracil (5-fu)	Cream 0.5%, 1% and 5 %	X	X				
Irinotecan	Inj. 20mg/ml	X	X				
Docetaxel	Inj. 20mg/ml	X	X				
Rituximab	Powder for inj.100mg	X	X				
Cyclosporine	Tab. 25mg	X	X				
Mycophenolate	Tab 500mg	X	X				