UNIVERSITY OF NAIROBI

DRUG CONSUMPTION AND EXPENDITURE PATTERNS AT JARAMOGI OGINGA ODINGA TEACHING AND REFERRAL HOSPITAL

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DEDICATION

I dedicate this work to my Dad Ezekiel Abuka, my Mum Christine Abuka, my Wife Agneta Khatali, my Brothers, Nelson Mandela and Tonny Onyango and my Sister Sarah Judith for their encouragement as I worked through this thesis always reminding me of the tasks ahead and fruits that will come with its completion.

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LIST OF ABBREVIATIONS AND ACRONYMS

ABC – Always Better Control

AIDS – Acquired Immune Deficiency Syndrome

ATC – Anatomical Therapeutic Chemical

CMS – Central Medicine Stores

COT – Course of Therapy

DALY – Disability - Adjusted Life Years

DDD – Daily Defined Dose

DUE – Drug Use Evaluation

KEML – Kenya Essential Medicines List

HIV – Human Immunodeficiency Virus

ICD - International Classification of Diseases

JOOTRH – Jaramogi Oginga Odinga Teaching and Referral Hospital

KEMSA – Kenya Medical Supply Agency

KNPP – Kenya National Pharmaceutical Policy

LMIC – Low and Middle Income Countries

MEDS - Mission for Essential Drugs and Supplies

NHIF – National Hospital Insurance Fund

NHS – The National Health Service

RPPS - Regional Pharmacy Procurement Specialist

TC – Therapeutic Category

UHC – Universal Health Coverage

UK – United Kingdom

USA – United States of America

VEN – Vital Essential and Non-Essential

WHO – World Health Organization

OPERATIONAL DEFINITIONS

ABC analysis is an inventory categorization technique that divides an inventory into three categories namely "A items" with very tight control and accurate records, "B items" with less tightly controlled and good records, and "C items" with the simplest controls possible and minimal records.

Class A drugs are those between 10 to 20% in number and consume 70 to 80% of expenditure in medicines.

Class B drugs are between 10 to 20% in number and consume 15 to 20% of the pharmaceutical budget.

Class C drugs are those that constitute 60 to 80% in number but consume 5 to 10% of expenditure in medicines.

Essential medicines are those active against less serious but nonetheless considerable types of diseases but not completely critical to provision of basic health care.

Morbidity refers to having a disease or a symptom of disease, or to the extent of a disease within a population. It also refers to medical problems caused by a treatment.

Nonessential medicines are those used for simple or self-limiting diseases, have disputable efficacy or are extremely expensive with negligible therapeutic advantage.

Quantification is the process of estimating quantities and costs of medicines and health products required for a specific period and determining when shipments of the products should be delivered to ensure an optimal and uninterrupted supply.

Rational use of medicines is when patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to them and their community.

Therapeutic Drug Category is a set of medications and other compounds that have similar chemical structures, the same mechanism of action, a related mode of action, and/or are used to treat the same disease.

Total health expenditure is the sum of public and private health expenditure. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation.

VEN analysis is a method to help set up priorities for purchasing medicines and keeping stock where drugs are divided, according to their health impact, into vital, essential and non-essential categories.

Vital medicines are those capable of saving lives, have marked withdrawal side effects or are critical in provision of basic health care services.

ABSTRACT

Background: Efficient drug supply chain systems ensure sustained accessibility, availability and affordability of essential medicines. This may be achieved through rational selection, quantification, procurement, distribution and use of drugs while taking into account consumption and morbidity patterns. Drug Utilization Studies are used to identify irrational medicine use in health facilities and to estimate the extent of current utilization patterns. Assessment of these patterns can be done by aggregate data methods that include Always Better Control (ABC), Vital Essential and Non-essential (VEN) and Therapeutic Category (TC) analyses. The results from the analysis help in setting priority for medicine purchase and stocking.

Objective: To determine drug consumption and expenditure patterns at Jaramogi Oginga Odinga Teaching and Referral Hospital for the period of January 2018 to December 2020 using ABC, VEN and Therapeutic category analysis.

Methodology: This was a retrospective longitudinal study whereby annual consumption and expenditure data of drugs for 3 years was analyzed using ABC, VEN and TC analysis techniques. Sources of data for the ABC and VEN analysis included bin cards, invoices and delivery notes. Morbidity data was extracted from patient files and the Kenya Health Information System. ABC analysis was done by listing all drugs purchased and their unit costs, calculating consumption, ranking consumption value in descending order, calculating cumulative percentages and eventually choosing cut off points for class A, B and C medicines. VEN classification was based on Kenya Essential Medicine List 2019 and done by ranking all medicines using a pre-designed form and then calculating expenditure for each class. The drugs were assigned to a therapeutic category thereafter total cost of drugs in each category and their expenditure calculated.

Results: Annual drug expenditures were Ksh 49,956,278.00, Ksh 64,360,327.00 and Ksh 56,314,585.00 for 2018, 2019 and 2020 respectively adding up to a total expenditure of Ksh 170,631,190.00. Injury Poisoning and Certain other Consequences of External Causes class accounted for the highest number at 13.6% of all cases managed at the hospital. Diseases of the eye and adnexa cases were the lowest at 0.8%. Expenditure was highest for anti-infective therapeutic category at Ksh 45,967,567.00 and lowest for anti-parkinsonism medicines and Ear

Nose and Throat medicines at 0.01% and 0.04% respectively. The number of class A drugs were 53(18.9%) in 2018 and 56(19.9%) in both 2019 and 2020. Class B drugs were 56(19.9%) in all the three years while class C were 172(61.2%) in 2018 and 169(60.1%) in both 2019 and 2020. Class A consumed 70.2%, 71.7% and 72.7% of drug expenditure in 2018, 2019 and 2020 respectively. Class B consumed 18.7%, 18.2% and 17.3% in 2018, 2019 and 2020 while class C consumed 11.1%, 10.1% and 10.0% in 2018, 2019 and 2020 respectively. Class V drugs were 61.6% and consumed 75.5% of the total expenditure, class E were 23.5% consuming 17.4% of the budget while class N were 14.9% and consuming 7.1%. Category I drugs constituted 67.3% of all medicines and utilized 82.2% of total drug expenditure. Category II were 21.4% and accounted for 12.7% of the expenditure while category III took up 5.1% of the budget and were 11.4% of all drugs.

Conclusion: A remarkable percentage of drug expenditure at the hospital was used in procuring class A drugs like Flucloxacillin Capsules 250mg, Vital drugs like Adrenaline 1mg injection and Category I drugs like ephedrine 30mg/ml injection which are crucial in health care provision and are potentially lifesaving. These drugs should always be available in stock demanding a strict inventory control to avert wastage. Anti-infectives category of drugs consumed the highest proportion of the budget with Flucloxacillin 250mg capsules requiring a further Drug Use Evaluation study due to its high expenditure. This study will help guide cyclic stock counts, set purchasing priorities and selection of cost-effective drugs to be procured.

1.0 CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Strong supply chain systems ensure uninterrupted accessibility to life-saving medicines and health technologies for successful achievement of global goals that improve the quality of health outcomes. However, strategies to strengthen key supply chain components are inadequate in scores of low - middle income countries (LMICs) while available systems cannot effectively manage local and global health program demands. Furthermore, the surge of new epidemics, introduction of new medicines and technologies, and the need to adapt to new delivery strategies strain already challenged systems (1).

Achievement of equity in accessing essential medicines is enhanced by making them affordable. Affordability is a key pillar for any health care system laboring to actualize Universal Health Coverage, and thus appears markedly on the global agenda. Making informed decisions about pharmaceutical purchases by individuals and health systems is burdensome due to lack of medicine pricing information (2).

Health facilities should store a predetermined scope of medicines and aligning ideas to revamp their consumption and reinforce the supply chain to contain emerging concerns (3). Appropriate management of medicines in hospitals promotes availability of drugs that boosts health outcomes of patients thus lessening mortality and morbidity. In this perspective, pharmaceutical stores should be programmed and formulated to result in productive administrative and clinical practice(4).

Drug Utilization Studies are used to identify irrational medicine use in health care set ups and to estimate the extent of current utilization patterns. These methods include Always Better Control (ABC), Vital Essential and Non-essential (VEN) and Therapeutic Category (TC) analyses. VEN analysis helps set priority for medicine purchase and stock. In the acronym, V which stands for vital medicines which are potentially lifesaving and central to administration of basic health services; E which means essential are medicines for less severe, significant, but not vital illness; while N which is nonessential are medicines for minor illnesses, are of high cost and low therapeutic advantage (5). ABC analysis determines and compares pharmaceutical costs within

the formulary. Class A drugs are between 10 to 20% of all medicines found in health facilities and are responsible for approximately 70 to 80% of the whole budget for pharmaceuticals; Class B make up 10 to 20% of the stock taking up 15 to 20% of the entire budget while Class C constitute the other 60 to 80% but exhaust only 5–10% of the annual pharmaceutical budget (5).

Health facilities in resource limited setting do not have requisite funds to procure all drugs in the essential medicine list, notably with pharmaceuticals consumption already taking up a third of total hospital expenditure(6). It is desirable that optimal selection of drugs should be based on available evidence conjoined with priority setting that empowers institutions to promote long-term efficiency of drug use given the growing threats of medicine unavailability and their costs (7).

There exists a knowledge gap on efficient medicine use and prioritization among majority of public hospitals in Kenya. This study will determine drugs accounting for the greatest magnitude of the pharmaceutical budget allocation in a referral hospital in Western Kenya.

1.2 PROBLEM STATEMENT

Efficient provision of quality healthcare is hindered by challenges in selection, quantification, procurement, inadequate budget allocations and irrational use of medicines. These were listed at a World Health Organization (WHO) workshop in 2006 which outlined the difficulties of the drug supply in African countries(8). Health facilities in Kenya equally face these challenges and Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH) shares similar experiences. The consequence of these challenges include frequent drug shortages prompting costly emergency purchases, overstocking, expiries, poor ordering, poor warehousing, disposal challenges and impulse buying. Efficient inventory management should entail use of cost minimization approaches and regular assessment of consumption using ABC and VEN analyses. This ensures constant availability of required medicines and mitigates against future expiries and unnecessary wastages. No study has been done in the JOOTRH using the inventory management techniques implying existence of a knowledge gap in this essential discipline. The study findings are expected to inform the Hospital management and the County Government of Kisumu on areas of inappropriate medicine inventory management and irrational use in the hospital and how to improve on these medicines selection. This study will not only form a baseline for in-depth

investigations of specific problems identified but also aid in development, implementation and evaluation of strategies to correct the problems.

1.3 RESEARCH QUESTIONS

1. What are the trends of drug consumption and expenditure at the Jaramogi Oginga Odinga Teaching and Referral Hospital?
2. Which medicines record between 70 to 80 % of the total drug expenditure at Jaramogi Oginga Odinga Teaching and Referral Hospital?
3. What is the proportional expenditure on vital, essential and non - essential drugs?
4. What is the proportionate expenditure based on various therapeutic categories?

1.4 OBJECTIVES

1.4.1 Main Objective

The main objective was to determine drug consumption and expenditure patterns at the Jaramogi Oginga Odinga Teaching and Referral Hospital for the period of January 2018 to December 2020 using ABC, VEN and Therapeutic category analyses.

1.4.2 Specific Objectives

The specific objectives were to:

1. Identify consumed medicines that account for between 70 to 80 % of the total drug expenditure at Jaramogi Oginga Odinga Teaching and Referral Hospital
2. Determine the proportion of expenditure and consumption of vital, essential and non - essential drugs
3. Determine the proportionate expenditure on various therapeutic categories based on their respective consumption.

1.5 STUDY JUSTIFICATION

Class A drugs are expected to account for 70 to 80% of the total drug expenditure with vital drugs utilizing more than half of expenditure on pharmaceuticals when efficient inventory management is practiced in any institution. In addition, expenditure in any given therapeutic category should reflect the quantity of items in the respective category. The findings of this study will enable the hospital to adopt more cost-effective alternative medicines, negotiate for lower prices with suppliers, spot opportunities for therapeutic substitution, identify irrational drug use and aid the hospital in revision of its own formulary. This study will also benefit the Ministry of Health and County Government of Kisumu by contributing to priority setting for medicine purchases and identification of therapeutic categories responsible for top expenditures and consumptions in the referral hospital. The other beneficiaries, when the recommendations of the study are applied, will be the patients seeking healthcare services at the hospital. They will benefit from consistent supply and availability of cost-effective medicines that shall raise the general quality of life of the entire society. This study will also inform the relevant policy makers at the County Department of Health by providing evidence for decision making on procurement, storage and control of drugs.

Efficient prioritization and eventual selection of medicines coupled with effective inventory management techniques would ensure adequate financial allocation to propel continuous supply of medicines for treatment of the different conditions referred to JOOTRH. This will in turn avoid expiration of drugs thereby minimizing wastages especially in a resource limited setting and also ensuring constant availability of required medicines.

CHAPTER TWO: LITERATURE REVIEW

2.1 ACCESS TO ESSENTIAL MEDICINES

Access to health care encompasses availability, affordability and acceptability of essential health care services which include but not limited to antiretroviral therapy, family planning, tuberculosis treatment, antenatal care, child immunization, skilled birth attendance, clean water and good sanitation (5). More than 400 million people are deprived of essential healthcare services and more than 5% inhabiting in developing countries are driven more into uttermost poverty as a result of paying for health care (9). A high number of those who have access to healthcare are given inappropriate treatment, obtain less drugs for their illness, or utilize medicines inappropriately. Most prominent causes of mortality and morbidity in many regions can be managed and mitigated with cost-effective essential medicines (5).

World Health Organization (WHO) defines essential medicines as those medicines that satisfy the priority health care needs of the greater part of the population(10). They are of specific significance since they save lives, promote health and enhance trust and utilization of health care services. They vary from other consumer products because they are welfare goods. Attempts to broaden the availability of modern pharmaceuticals began within the first decade of their production which led to substantial improvement in their use and supply (2).

The population's health care needs are satisfied by the presence of essential medicines and legislation that are critical to improving health and attaining sustainable development. Sustainable Development Goal 3 highlights the prominence of "access to safe, effective, quality and affordable essential medicines and vaccines for all" as a core unit of Universal Health Coverage (UHC), and emphasizes the need to revamp production of medicines to address perpetual treatment gaps (2).

All countries need to increase investments in health systems to broaden service provision in order to achieve Sustainable Development Goal 3 health targets. Foreseen resource constraints will force each country to strategically plan and prioritize its own route towards Sustainable Development Goal 3 and Universal Health Coverage (11).

The Lancet's Commission on Essential Medicines Policies identified five pivotal areas which are funding, affordability, quality assurance, safety and developing essential medicines list to bolster accessibility to essential medicines (2).

The Commission approximated that between 77 and 152 billion US dollars is necessary to fund the primary package of 201 essential medicines in all developing countries while in 2010, the bulk of these countries spent less than 15 US dollars per capita on pharmaceuticals. This confirmed that majority still lack access to even the basic essential medicines (2). Moreover, human-related constraints such as lack of training in inventory management, placing orders and information technology have weighty effect on medication shortages (12).

Among the fundamental human rights is access to health care inclusive of essential medicines. Understanding of this right comprises diverse consolidation of public - private financing and rendering of services. The government's mandate is to collaborate with the private arm and Non-Governmental Organizations in realization of rational use and universal access to essential medicines. This task entails establishing bilateral understanding, valuable associations, and suitable motivations (13).

2.2 PROCUREMENT POLICIES IN SELECTED DEVELOPED COUNTRIES

Good governance, appropriate legislative framework, applicable administrative designs backed by efficient technical capacity guides development of procurement policies which should be regularly reviewed, monitored and modified as need be. In enhancing the use of affordable medicines, countries should advocate for pharmaceutical procurement policies addressing both demand and supply of drugs (6).

Both high and upper middle-income countries have adopted procurement policies in line with the main objective of ensuring access to medicines. The policy directions include efficient allocation of pharmaceutical resources, medicines price reductions, and user financial protection with upper middle-income countries focusing more on increasing affordability of medicines through medicine price reduction and user financial protection policies (14).

A study done to investigate a broad range of regulatory measures in 16 European health systems found out that all the countries incorporate regulatory mechanisms and procurement policies to

monitor pharmaceutical expenditure and ensure efficiency and quality in pharmaceutical care (15).

In USA, Food and Drug Administration (FDA) procurement exercises are guided by the Federal Acquisition Regulations which require that all contracts and purchases are made on competitive basis as far as possible. Necessary implementation and supplementation of these regulations are done by the Department of Health and Human Services Acquisitions Regulations (HHSAR) (16).

In the United Kingdom, medicines procurement is headed and regulated through a framework spearheaded by the Commercial Medicines Unit housed by National Health Service and backed by the National Pharmaceutical Supply Group and The Pharmaceutical Market Support Group. Operationally, medicines purchasing in England is done through 10 regional pharmacy purchasing groups each having a regional pharmacy procurement specialist (RPPS). Licensed medicines are categorized during contracting and tendering based on varying characteristics and risks related to each category that eventually determine the nature of the contract. There are tough procurement policies to make sure that the NHS achieves competitive pricing for drugs while permitting UK to continue being commercially attractive for pharmaceutical industries (6).

China’s pharmaceutical procurement policy focuses principally on price regulations at chosen levels within the supply chain to control expenditure on drugs. Nonetheless, such an approach is tainted with unethical market enticements, bringing about increases in drug prices for patients and controversial prescribing practices that lead to degrading public health. Reforms in drug policies are therefore core to ongoing attempts to improve China’s health care system (17).

A centralized procurement policy is prevalent in public hospitals in Australia as compared to private hospitals. Non-governmental entities are advised to utilize the opportunity presented by the centralized procurement policy which promotes standardization through integration of procurement and information technology and further enhanced by teamwork among clinicians. (18).

2.3 KENYA NATIONAL PHARMACEUTICAL POLICY

The Kenya National Pharmaceutical Policy's goal is ensuring that all Kenyans are accorded effective and efficient pharmaceutical services that are sustainable, equitable, accessible and affordable with safe, efficacious and high-quality medicines, which are appropriately used. Access to essential medicines is a basic human right and the policy aims to address the needs and trends in pharmaceutical service delivery and to ensure harmony with other health and development policies. The policy's vision is a well-managed coherent pharmaceutical services making Essential Medicines accessible to all Kenyans by having a strategy to ensure equitable access to affordable medicines through the public, private, and other sectors. Its other strategy is to ensure continuous availability of safe and effective Essential Medicines especially in the public sector (19).

Overall, the Policy focuses on strengthening the management and delivery of pharmaceutical services through relevant legislative and institutional reforms; strengthening national institutions for medicines procurement, supply, regulation and quality control; developing and appropriately managing pharmaceutical human resources; and enhancing collaboration with other sectors and with partners. It is important to note that the Kenya National Pharmaceutical Policy (KNPP) is not only a policy for pharmaceutical personnel but also a national guide to effective health sector reform (19).

2.4 PHARMACEUTICAL SUPPLY CHAIN MANAGEMENT

Pharmaceutical supply chain entails four key operations namely selection, procurement, distribution, and use. Selection analyzes the most common health conditions, determines best possible treatment options, picks respective medicines and their pharmaceutical types and influences medicine availability at all health care levels. Procurement includes drug quantification, selection of procurement methods, tender management, pharmaceutical quality assurance, contract negotiation and certification. Distribution encompasses customs clearance, warehousing, controlling stock, managing stores and transportation to health facilities. Use comprises making correct diagnosis, appropriate prescription and eventually dispensing the right quantity to the patient (20).

The Pharmaceutical Management Framework (Figure 2.1) underlies a system necessary for improving access to medicines. In the framework, the basis of selection should be healthcare needs and consumption patterns which influence decisions made for procurement and drugs bought ought to be distributed to their end point use. Centrally, management support systems hold the framework together and it banks entirely on legislations, that if reinforced by favorable administration, institute and uphold the public dedication to essential medicine supply (5).

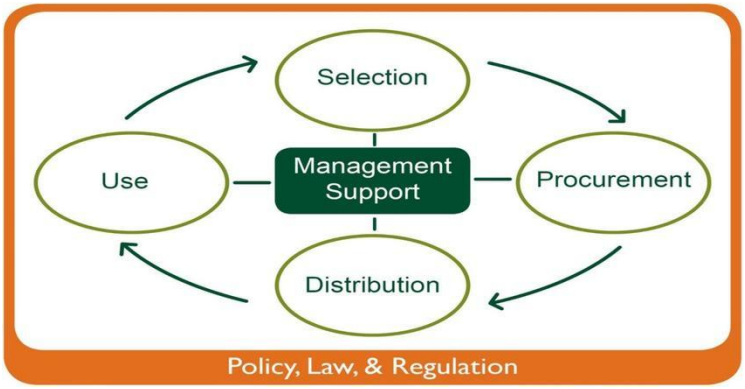

Figure 2.1: The Pharmaceutical Management Framework (5)

Many developing countries are shifting from the traditional centralized pharmaceutical purchasing and distribution systems to a decentralized one by choice or since the centralized system is crumbling. On the other hand, decentralized procurement management has demonstrated challenges in several countries including undoubtedly higher prices, product quality issues, prescriber influenced purchasing patterns and predominantly erratic supply due to local inefficiencies, wastage and lack of funds (5). Basically Central Medical Stores (CMS), direct delivery system, primary distributor system, autonomous supply agency and primary private system are approaches used to supply pharmaceuticals to public health facilities.

To manage the pharmaceutical supply chain, national and county health directorates should call for regular documentation and reporting from procurement and distribution departments of health facilities. It should be a top priority to avail tools to strengthen the supply chain system to enhance production of these reports in a timely manner (21).

Kenya Essential Medicines List provides a guide as to which medications should be stocked, especially in public facilities; some hospitals have also developed their own medicine formularies to suit their specific needs. The Ministry of Health procures and distributes

medicines that are used for malaria, tuberculosis, sexually transmitted infections, HIV/AIDS, and reproductive health programs; these medications are funded through international partners. The counties procure drugs for facilities under their jurisdiction (other than those procured by the Ministry of Health). Medicines for other conditions, such as antibiotics, are sourced from private wholesale suppliers, nongovernmental organizations (such as MEDS), and KEMSA. KEMSA and MEDS have a broad variety of products available at lower prices than private wholesalers. In the private and faith based health facilities, the availability of medicines and their prices are higher than in the public sector (22).

2.5 PHARMACEUTICAL FINANCING AND EXPENDITURE IN KENYA

Globally, medicines take up to 25 percent of all expenditure on health. Direct payment by patients which is the major source of financing for drugs is both inefficient and inequitable and its minimization is a key target for Universal Health Coverage. Pharmaceuticals are generally funded in a similar manner as those for the general health care. Sources of the funding include national and local government revenues, out of pocket payment by patients, health insurance, community, employer, donor funding and development loans (5).

Devolution established two levels of the health system which are national and county tiers with distinct functions as laid down in the 2010 Constitution of Kenya. Budgeting, planning, development and implementation of health policies in addition to evaluation of county health management systems are some of the important roles of the counties. (23).

Health funds emanate largely from county governments and household units varying throughout the country. Donors play a huge role in health care financing particularly in counties with elevated HIV and AIDS prevalence. Pre-payment schemes play a minimal part in the management of health care financial resources. National Health Insurance Fund was responsible for averagely only 3 and 4% of the Total Health Expenditure in 2013/2014 and 2014/2015 respectively, whereas private health insurance controlled 6 and 7% of the Total Healthcare Expenditure during similar periods. The key beneficiaries for county health expenditure are the public health activities providing curative services which take a huge chunk of the budget. During the financial years 2013/14 and 2014/15 pharmaceuticals took 3.98 and 3.91% of total health expenditure respectively in Kisumu County (44).

2.6 QUALITIES OF A GOOD PHARMACEUTICAL PROCUREMENT SYSTEM

Procurement is defined as the process of purchasing supplies directly from private or public distributors who can either be national or multinational done through procurement mechanisms or regional procurement systems(5). These sources may be utilized in isolation or in unification to satisfy all pharmaceutical needs.

An efficient procurement mechanism ethically and transparently handles the buyer-seller relationship, rightfully procure medicines in sufficient quantities and gets the lowest possible purchase price (24). It should also ensure achievement of recommended standards of quality; timely deliveries to avert stock outs and shortages; ensure reliability of supplier in relation to service and quality; set attainable itinerary for purchases and prepare formats for quantities to order and the level of safety stock to actualize the minimum total purchasing cost.

The procurement cycle is instrumental in decisions made and actions taken to ensure correct quantities and quality of medicines are availed at the best market prices. The steps are depicted in Figure 2.2.

Quantification is the initial step in the procurement process and assists in determining the volume required for procurement purpose. It estimates the volume needed for a given product. It can be done by four methods namely consumption method, proxy consumption method, service-level projection of budget requirements and morbidity method. When doing the quantification analysis circumstantial factors like human resource capacity, available funds, storage capacity and capacity to deliver services must be included (25).

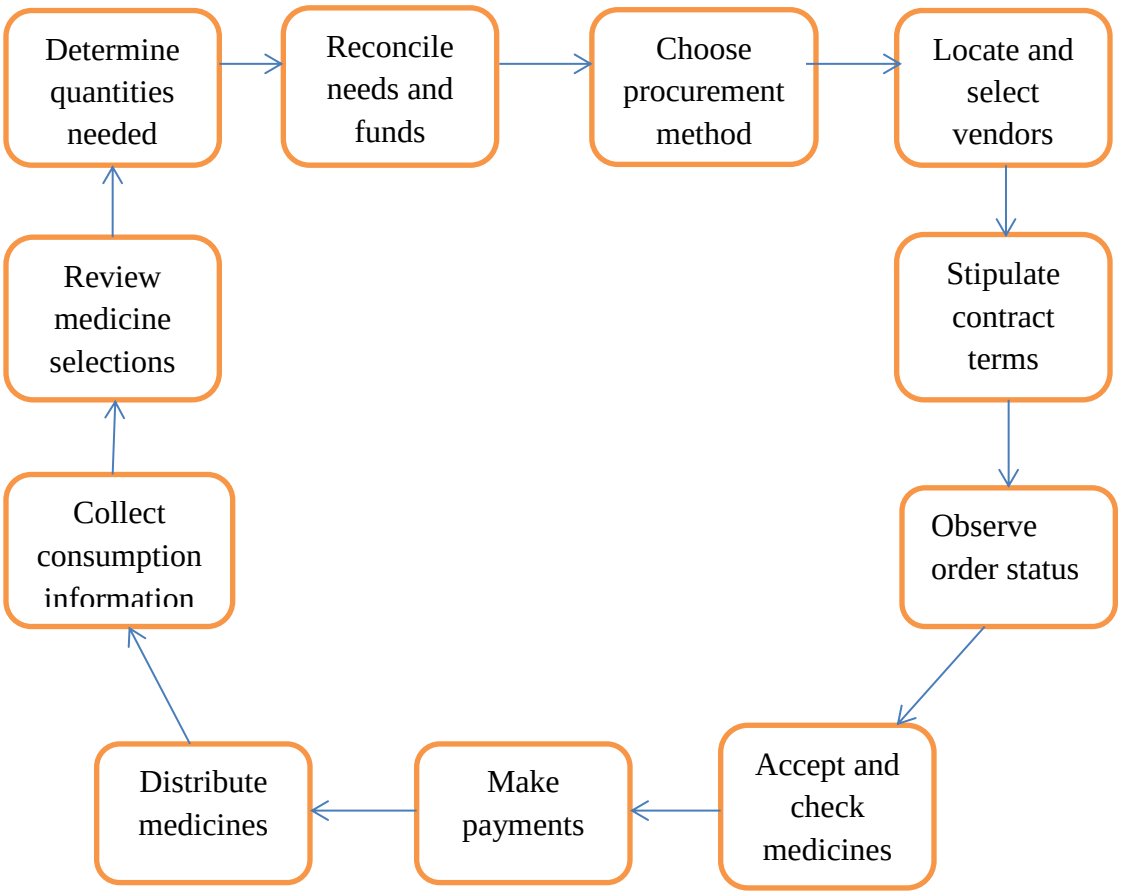

Figure 2.2: Steps in Procurement Cycle (5)

2.7 PHARMACEUTICAL INVENTORY MANAGEMENT

Inventory management is the core of the pharmaceutical supply system and if poorly done in the public supply system has significant negative effects including wastage of financial resources, scarcity of essential medicines, expiries and eventual deterioration in quality of patient care. Wrong determination of quantity of drugs to order, the frequency of ordering, poor stock takes, and lack of performance monitoring are linked to lack of adequate knowledge and recognition of inventory management leading to its inefficiency (5).

There exist two major objectives for stock management in a pharmacy. First is that the needs of the pharmacy and its clients should determine the drugs that are routinely stored within the premise. Highly expensive, hardly used and those that require burdensome storage should be ordered as need be. Secondly is to minimize as much as possible the costs of medications. Most pharmacies have preferred suppliers and companies they obtain drugs from since this builds

good customer relationship that aids in keeping medication costs at a minimum. Many pharmacies have favorite wholesalers and drug companies which they build good reputation with in order to decrease the cost of purchasing medications. Loss prevention by properly regulating stock and utilizing products before they expire also contributes to controlling medication costs (26).

Seven basic issues underline the development of an efficient inventory management system. These include context definition of the inventory management system, decision of the stock records types and needed reports, item selection and service level maintenance. Others are adoption of a model for establishing reorder status, identification and control of stock management costs using ABC analysis, VEN analysis and other cost reducing measures (27). Documentation is a key element in inventory control as it forms a foundation of its effective management. This is normally done through utilization of several reports and stock cards such as vertical file cards and bin cards. Sufficient stock of pharmaceuticals should be maintained in health facilities to enable patients to receive medicines instantly, prevent stock outs even in delivery delays, replenish supplies at scheduled intervals and build patients confidence in public health systems. Adequate stock also has extra benefits of saving on administrative and logistics costs as well as ensuring accountability for supplies (28).

2.8 ANALYSIS OF PHARMACEUTICAL CONSUMPTION AND EXPENDITURES

Analysis of expenditures and consumption for pharmaceuticals and medical supplies determines priorities in procurement and inventory management and assists in making decisions on which items to include in hospital inventory and those to include in a formulary when a decision is made to come up with one.

2.8.1 ABC analysis and its applications

Basically, a fairly low number of items are responsible for most of the annual consumption, it is therefore advantageous to analyze consumption trends total value of consumption for all products. ABC (Always, Better, Control) determines and compares pharmaceutical costs within the hospital. Reexamination of class A medicines may reveal highly used drugs which have cost effective substitutes readily available in the market. At the same time ABC analysis is used to

review a drug's inclusion in the hospital formulary or essential drug list and also if it is necessary to reduce the number of expensive medications selected for the hospital (29).

ABC analysis is relevant in pharmaceutical procurement activities as it facilitates sourcing for cheaper products, assures expenditure is relevant to public health preferences and assesses relationship between order frequency and general supply (30). Focus should be made on order status of class A medicines since accidental shortage can lead to costly emergency purchases. ABC analysis can help monitor procurement patterns and set priorities for medicines to be procured. Non- essential medicines should be considered for removal from class A since they are expensive or if not removed should be given last priority when making purchases. There should be periodic review for the less expensive class C because of their low demand (31).ABC analysis is also applicable in monitoring shelf life, delivery schedules, stock count and identification of drugs for which strict inventory is required (32). ABC analysis can lead to review of the rational use of medicines by health practitioners and may indicate both under usage and over usage (33). The ABC analysis may also inform whether prescribed pharmacotherapy is in conformity and in accordance with the clinical protocols (34). The basic methodology for the analysis is described in seven steps as presented in Figure 2.3

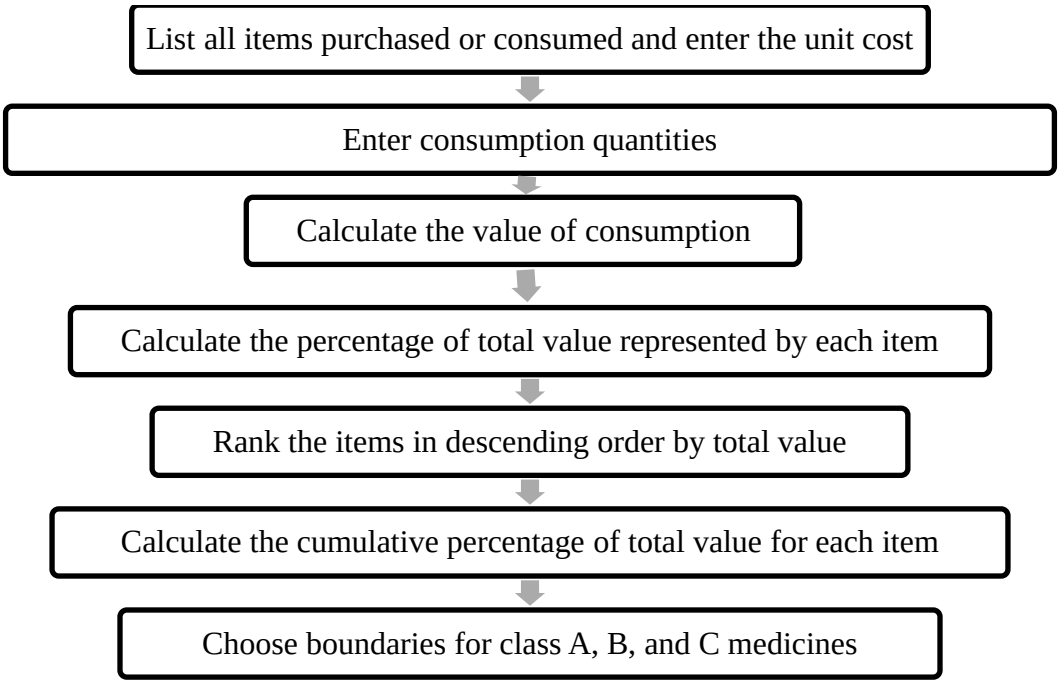

Figure 2.3: Steps in ABC analysis (5)

2.8.2 VEN analysis and its applications

The VEN system confers each product in the essential medicine list or formulary to any of the three categories namely V, E and N. V stands for vital medicines that are capable of saving lives, have marked withdrawal side effects (making regular supply mandatory) or are critical in provision of basic health care services. E stands for essential medicines that are active against less serious but nonetheless considerable types of diseases but not completely critical to provision of basic health care. N stands for nonessential medicines used for simple or self-limiting diseases, disputable efficacy, or extremely expensive with negligible therapeutic advantage. Inclusion of a drug to nonessential category does not imply exclusion from the formulary or essential medicine list but are given less preference during procurement than other drugs especially when funds are limited (5).

The categorization should be a continuous exercise dependent on changes in public health priorities and updates on essential medicine list or the hospital formulary. A new drug added to the essential list ought to be classified correctly and previous category allocations for medicines should be reviewed and changed as needed. Public health impact of individual drugs should primarily determine the categorization while unit prices and medicine popularity should be secondary considerations and have minimal influence on the process (5).

VEN classification may help in monitoring orders for vital and essential medicines, as shortages of these items require expensive emergency purchases. The analysis also help hospital management to determine the safety stock level of medicines that account for substantial fraction of the total expenditure and to prudently handle limited financial resources (35).

2.8.3 VEN-ABC analysis in Kenya and Africa

Studies have been done in Africa and particularly in Kenya to study drug expenditure and consumption patterns using ABC-VEN analyses. One such study in Tikur Anbessa Specialized Hospital Addis Ababa, Ethiopia between 2009 and 2013 indicated that there are many pharmaceuticals in the hospital which need proper management and supervision. Most pharmaceuticals were vital items. From these; Category I medicines took a greater portion than Category II & III and most of Category I drugs were also Class A and V products like insulin

and normal saline that require great awareness of top administrative personnel for yearly budget allocation and their availability (36).

A study in Saint Paul's Hospital, Ethiopia used ABC and VEN approaches to analyze medicine expenditures and explore inventory control practices. The study found that adoption of the ABC and VEN techniques as a regular practice is vital for improved use of resources. The priority for the purchase of pharmaceuticals should be based on VEN list which again should be updated regularly. Endocrine medicines were responsible for the highest percentage followed by anti-infectives In general, poor performance of inventory control management was indicated in the hospital with arbitrary decisions on quantity and frequency of ordering leading to frequent stock-out and expiry of pharmaceuticals indicating a need for follow-up actions in order to curb the challenges and hence, efficient use of limited resources (37).

A similar study done in Sudan showed that medicine usage in National Health Insurance Fund substantially escalated between 2006 and 2010. ABC analysis showed that small number of items in Class A account for large proportion of the fund whereas large number of items of Class C account only for 9.92% of the total fund. Similarly, the VEN analysis showed that small number of items of Class V account for 5.46%, whereas Class N consists of 212 (45.01%) items that account for 26.43% of the total fund. Drugs for blood and blood-forming organs were the mostly utilized class of pharmaceuticals, while folic acid tablet was medicine that was mostly used (38).

In Kenya, a study done in Nyeri County, the findings from a study revealed that all the five hospitals reported insufficient budgetary allocation for medicines with a proposal for the county government to increase the allocation. ABC analysis done in the hospitals revealing that approximately 10% of pharmaceuticals consumed almost 70% of the total annual expenditure on drugs in the hospitals. These items are vital, hence had to be procured. To avoid capital lock up by these drugs, the study recommended that a small buffer stock needs to be maintained while keeping a keen watch on the utilization and stock in hand (39).

A study done in Busia county to assess the pharmaceutical supply chain management constraints employed ABC analysis to find out if funds earmarked for procurement of medicines are used for the intended purpose. The main findings were that most of the facilities experienced long lead

time and delays in delivery of essential supplies, funds for procurement of medicines were well utilized but facility staffing levels were inadequate. Its recommendation was that the County Government should embrace a competent and streamlined supply chain management system, the Logistics Management Information System, to reduce waste and inefficiencies in procurement of pharmaceutical commodities (40).

The total cost analysis of medicines expenditure at Lodwar County Referral Hospital aided in identification of pharmaceutical supply chain costs that should be controlled. And the ABC – VEN analysis helped in identifying a comprehensive group of drugs among the essential medicines list that may require higher managerial control ABC– VEN analysis resulted in identification of three groups requiring different level of managerial control. Class I drugs comprising of 74 of the 200 products (37%) accounted for 82% of the total cost. This group was identified for stringent fiscal and managerial control (31).

In Kenyatta National Hospital, ABC-VEN categorization supplemented by Therapeutic category and Morbidity pattern analysis highlighted drugs which could aid in reducing pharmaceutical expenditure if their procurement is streamlined. The study results showed that there was a decrease in expenditure for sodium chloride infusion, heparin injections and recombinant granulocyte colony stimulating factor (G-CSF) over the 3 years, whilst there was an increase in expenditure on meropenem, acyclovir and isoflurane from 2013 to 2015. The findings also revealed that there were a number of non-formulary (NF) items procured and consumed in the hospital during the 3 years, and these accounted for an average of 17.4% (141) of all medicine types procured. Human normal immunoglobulin 5% was the most expensive non-formulary medicine procured during the last 2 years of the study period. There was a high percentage of non-formulary items, which needs to be addressed. Inventory control techniques should be applied routinely to optimize medicine use within available budgets especially in low and middle income countries. (41).

2.8.4 Therapeutic Category analysis

Therapeutic category analysis scrutinizes the quantity of usage and cost of multiple therapeutic classes and subclasses of drugs. This approach has a foundation on ABC analysis whereby it sorts the ABC list into therapeutic categories. Formularies and essential medicine lists are best

organized according to therapeutic category and to get accurate insights on pharmaceutical requirements, consumption or pricing, drugs have to be arranged according to their therapeutic classes.

Several therapeutic classification systems are in use globally. Some are structured by target organ or disease condition like the British National Formulary system while others are organized by pharmacologic-therapeutic action like the American Hospital Formulary Service Drug Information system (42). Combination of anatomic, therapeutic, and chemical criteria to classify medicines is well illustrated by the Nordic ATC system. The complexity of therapeutic classification systems differ with some having up to six levels of subdivisions but this ought to be relevant to the targeted use of the respective system (43). Pharmaceutical delivery programs should aim at implementing the use of a non-complex therapeutic classification system easily interpreted by all health care practitioners and hospital administrators irrespective of their level of training and educational background. Most regions are progressively embracing the Anatomical Therapeutic Chemical (ATC) classification scheme used in the WHO Model List of Essential Medicines under which drugs are classified based on their chemical, pharmacological, therapeutic properties and the part of the body on which they act (44).

There are two phases in therapeutic category analysis; the first phase consisting of about five steps which are presented in Figure 2.4 and the detailed analysis that entails a deep look at the high-cost categories with an objective of making adjustments in treatment schemes that might demonstrate cost effectiveness. This analysis does comparison on cost for a defined daily dose and the cost of a defined Course of therapy.

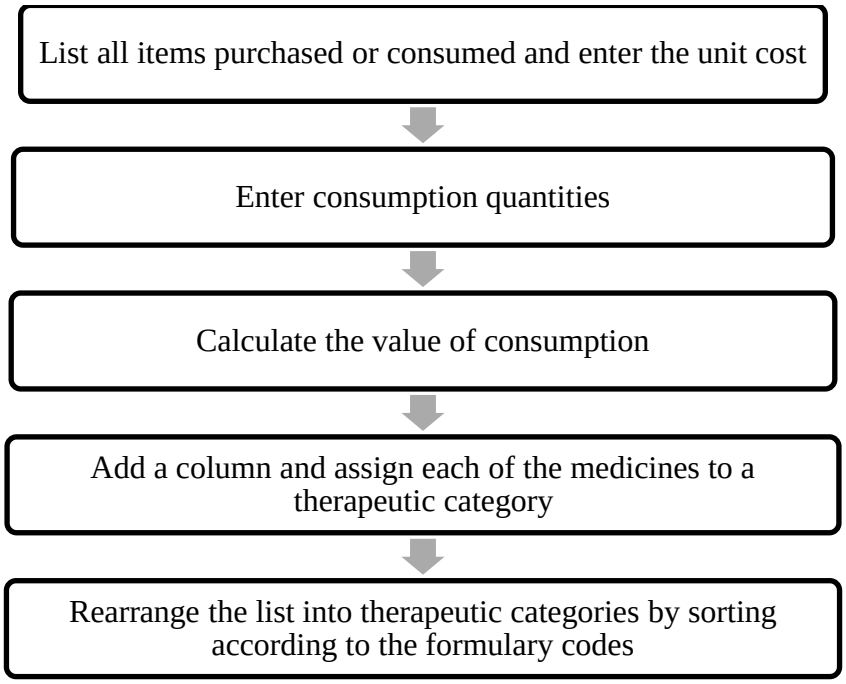

Figure 2.4: Steps in therapeutic category analysis (5)

2.9 PATTERNS OF MORBIDITY IN KENYA

Injuries, communicable and non-communicable conditions keep on imparting high disease burden in Kenya with patterns indicating that non communicable conditions will soar in the near future if they remain uncontrolled(45). Amongst the three disease spheres cited, HIV/AIDS is the primary cause of mortality within the country at about 19 percent others being perinatal conditions at about 9%, lower respiratory tract conditions arising at 8%, tuberculosis at 6.3% and diarrhea at 6%. Road traffic accidents account for 1.9% and assault contribute 1.6% respectively. At the same time, HIV/AIDS is the principal cause of DALYs in the country followed by perinatal conditions, malaria and lower respiratory tract conditions (45). The Kenya Health Policy (2014-2030) preempts substantial drop in some conditions including HIV/AIDS and Malaria, and a rise in conditions like cancer and those involving the cardiovascular system (46)

The top five causes of outpatient morbidity in Kenya are Malaria, Diseases of the Respiratory System (including pneumonia), Skin Diseases, diarrhea and accidents accounting for about 70 percent of total causes of morbidity. Malaria contributes about a third of total outpatient morbidity(46).

2.10 CONCEPTUAL FRAMEWORK

The theoretical basis of the study is a classification type of theory. Classification theories are schemes for classifying a given phenomenon. In this study the phenomenon is drug consumption and expenditure patterns which will be classified using three different approaches. The first one is the VEN classification and ideally classifies drugs as vital, essential and non-essential. The next scheme for classifying the drugs is by therapeutic category analysis and here expenditure will be classified by therapeutic category. Given that non communicable diseases are increasing, expenditures will be initially classified into non communicable diseases and communicable diseases as depicted in the conceptual framework depicted in figure 2.5. Particular focus is on diseases with high prevalence like hypertension, asthma and diabetes mellitus. The third scheme for classification of medication expenditure is ABC analysis. Variables of interest will be drug name, pharmaceutical dosage form, unit of issue, unit cost, quantity procured per year, quantity consumed per year, number of cases in a given disease class and the annual expenditure on each class.

2.11 EXISTING LITERATURE GAP

There is lack of data from such a study done in a level 5 hospital like JOOTRH in the western region of the country. This study brings new knowledge on drug consumption and expenditure patterns analyzed by ABC and VEN analysis which is not only useful to JOOTRH but also other hospitals with similar disease burdens. The study also informs on categories of drugs and disease classes utilizing the largest proportion of pharmaceutical expenditure. Finally it classifies all drugs in the hospital as vital, essential or non-essential, an element that will be instrumental when updating the hospital formulary that currently lacks this classification.

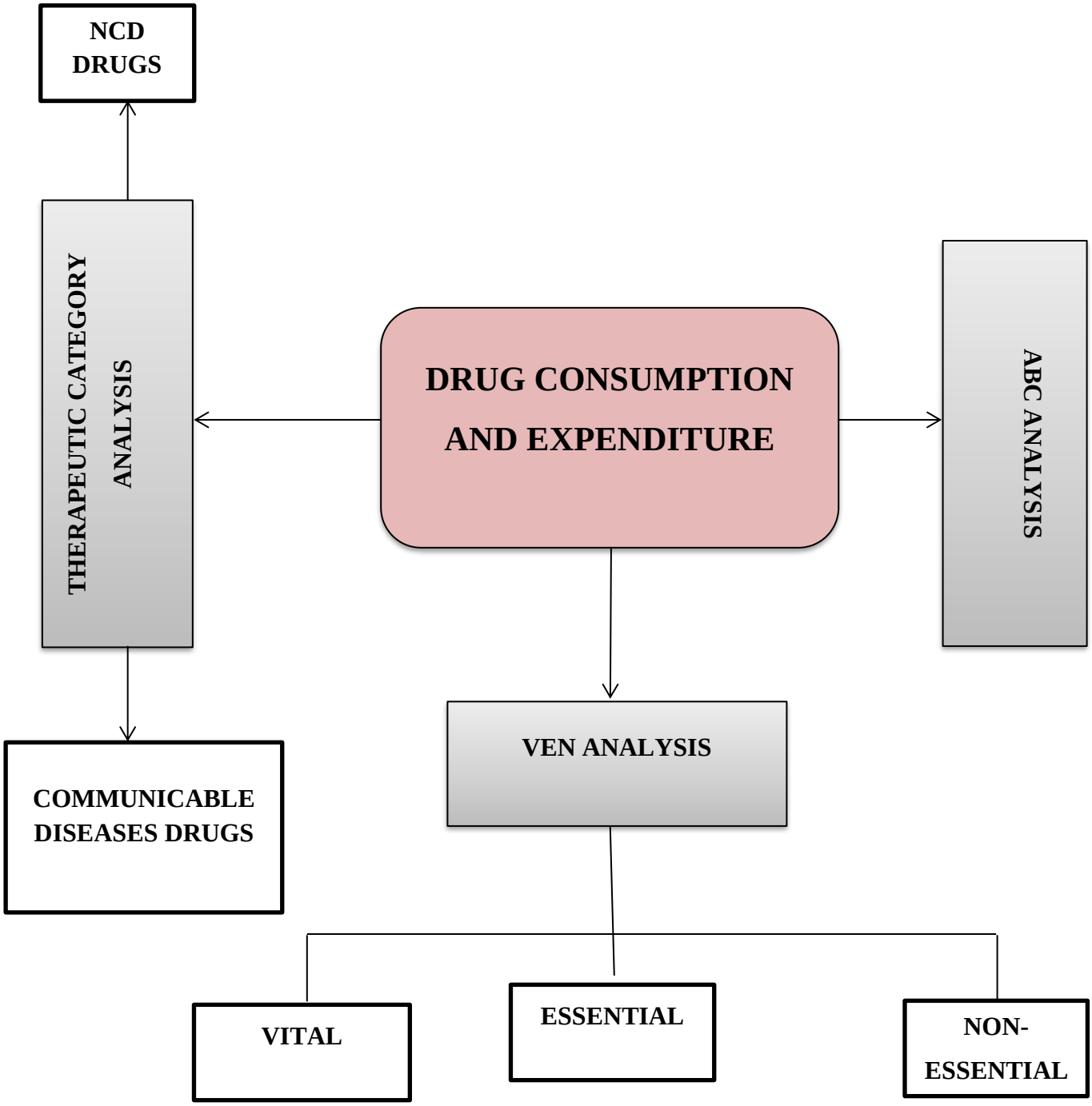

Figure 2.5: Conceptual Framework

CHAPTER THREE: METHODOLOGY

3.1 STUDY DESIGN AND POPULATION

This was a retrospective longitudinal study whereby annual consumption and expenditure data of the drugs from the drug stores for the period January 2018 to December 2020 were retrieved and used for ABC, VEN and TC analysis.

3.2 STUDY SITE

The study was conducted at Jaramogi Oginga Odinga Teaching and Referral Hospital in Kisumu County which is located about 360 km North-West of the capital city of Kenya, Nairobi. The facility is a regional referral hospital in Western Kenya with a bed capacity of 467 and its catchment area extends to almost 10 counties in the Western Kenya region, namely Kisumu, Siaya, Homa Bay, Migori, Kisii, Kakamega, Vihiga, Bungoma, Busia, and Nandi counties. The hospital provides curative, preventive, promotive, and rehabilitative health services.

3.3 STUDY POPULATION AND ELIGIBILITY CRITERIA

The study population was all medicines procured by Jaramogi Oginga Odinga Teaching and Referral Hospital between January 2018 and December 2020. A drug was included for study if it was procured between 2018 and 2020 and if this was done using the pharmacy budget funded by the county. Drugs were excluded if they were donations and were procured outside the tendering system.

3.4 SAMPLE SIZE AND SAMPLING METHOD

Universal sampling technique was utilized where all eligible medicines procured during the study period were included in the analysis. Sample size determination was therefore not required. Every record which contained relevant information was incorporated in the study to achieve the most precise consumption data as much as possible.

3.5 SOURCES OF DATA

Permission was given to access data about consumption from the bin cards available in main pharmacy stores and dispensing areas with expenditure data being obtained from invoices available in the pharmacy dispensing areas, pharmacy stores, accounting and procurement departments of JOOTRH.

3.6 DATA COLLECTION

A Data Collection Form designed by WHO for ABC and TC analysis was used (Appendix II, III and IV) (47). The information captured included the drug name, drug code, pharmaceutical dosage forms, quantity, unit of issue and price.

Annual morbidity data which entails total number of cases observed in a given class of diseases and the annual expenditure on each class, for the years 2018 to 2020 was extracted from the Health Information System database and entered into a predesigned data collection form (Appendix V).

3.7 STUDY VARIABLES

Data was collected on the following variables: drug ATC code, drug name, pharmaceutical dosage form, unit of issue, unit cost, quantity procured per year, quantity consumed per year, number of cases in a given disease class and the annual expenditure on each class.

The variables from ABC analysis were the number of medicines affiliated to class A, B and C and their percentage yearly expenditure. In VEN analysis, the variables of interest were the number of medicines belonging to the V, E and N categories and their annual expenditure while for TC analysis the main variable was the total expenditure for each therapeutic category.

3.8 DATA MANAGEMENT AND QUALITY ASSURANCE

A pretesting of the data collection forms, with ten drugs, was done beforehand to ensure they fully captured all the information required. Cleaning of collected data was by reconciliation, deleting errors such as duplicate entries and inappropriate information. Back up was done on a daily basis by use of a flash disk safeguarded by a password and kept under lock and key with

the researcher being the sole custodian of the keys. Daily verification of all the data entered in the Microsoft Excel worksheet was done to ascertain accurate entries.

3.9 DATA ANALYSIS

ABC analysis was conducted by listing all items purchased or consumed and their unit costs. The annual expenditure of specific medicines was computed by multiplication of the annual drug consumption and the unit price and arranging them in descending order. The percentage of annual drug expenditure and cumulative drug expenditure percentages were thereafter calculated. Eventually cut off points for class A, B and C medicines were chosen by checking the cumulative percentage expenditure of the initial 20% of drugs, followed by the next 20% and finally the last 60% during each of the three years of study.

The VEN categorization of the pharmaceuticals basing drugs as vital which are potentially lifesaving or have significant withdrawal effects, essential which are for less severe but significant illnesses and non-essential for minor illnesses was rooted on the Kenya Essential Medicines List 2019. The medicines were ranked using a pre-defined form (Appendix III) and the total percentage of expenditure for each class estimated.

After performing the ABC and VEN analysis, the drugs were assigned to a therapeutic category. This was based on the World Health Organization model list of essential medicines and the Kenya Essential Medicines List 2019. The total cost of drugs in each category and the total expenditure for each year were then calculated. The international classification of diseases (ICD-10) developed by the WHO was used to categorize diseases during morbidity pattern analysis (47).

The results are presented in tables, graphs and charts after analysis by Microsoft Excel (2010). The total number of drugs that were available for use at the dispensing area and drug stores during the study period were classified into different categories and referred to as the consumption while expenditure was the actual amount of money used to purchase these drugs.

3.10 ETHICAL CONSIDERATIONS

Ethical approval was obtained from Kenyatta National Hospital – University of Nairobi Ethics and Research Committee (KNH/UON-ERC) under the approval number P961/12/2019 and

JOOTRH administration under approval number IERC/JOOTRH/180/20 as shown in appendix I. Confidentiality was maintained by only allowing authorized study personnel to have access to obtained data.

CHAPTER FOUR: RESULTS

4.1: TOTAL DRUG EXPENDITURE

A total of 281 drugs were analyzed for each of the three years included in the study period from January 2018 to December 2020. Total drug expenditure for the three-year period was Ksh 170,631,190.00 of which Ksh 64,360,327.00 accounting for 37.7% was used to procure drugs in 2019. In 2020 and 2018, Ksh 56,314,585.00 (33.0%) and Ksh 49,956,278.00 (29.3%) were spent on drugs respectively as shown in figure 4.1.

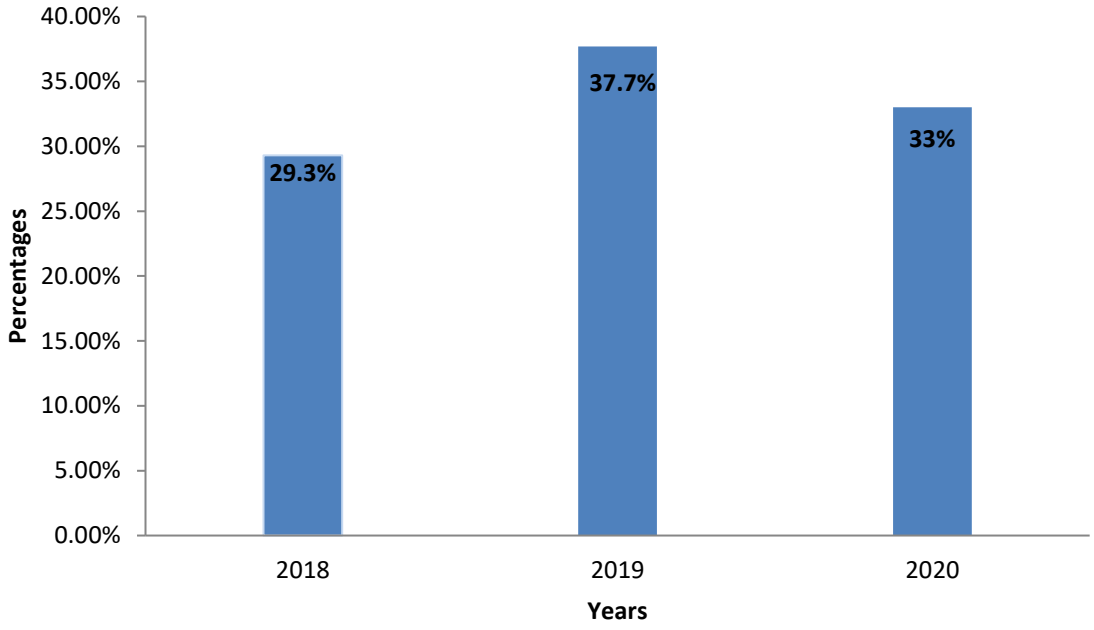

Figure 4.1: Percentage annual distribution of total drug expenditure at JOOTRH

Flucloxacillin 250mg capsules, sodium chloride/normal saline solution 0.9% and ceftriaxone injection IM/IV 1G consumed 5.0%, 3.7% and 3.1% of the total drug expenditure as shown in table 4.1 making them the first, second and third highest consumers of the drug budget for the study period. It is also important to note that Aceclofenac+Paracetamol 100/500mg tablets, cefuroxime 500mg tablets and *H. pylori* kit are among the highest consumers even though they do not appear in Kenya Essential Medicines list 2019.

Table 4.1: Top thirty drugs consuming highest proportion of total drug expenditure at JOOTRH

ITEM	UNIT SIZE	2018	2019	2020	TOTAL COST	% OF TOTAL VALUE
Flucloxacillin Capsules 250Mg	Tin of 1000s	935	1075	1353	8,407,500	5.01
Normal Saline Solution - 0.9%	500Ml	24500	69000	44400	6,205,500	3.70
Ceftriaxone Injection IM/IV, 1g	Vial	42429	51426	42671	5,187,988	3.09
Erythropoetin 2000 I.U Injection β	Vial	1902	930	597	5,006,340	2.99
Enoxaparin Sodium 40mg/0.4ml Injection	Syringe	2570	4572	5592	4,546,038	2.71
Metronidazole Injection – 5mg/ml	Vial	52083	50833	45247	3,555,912	2.12
Ceftriaxone Injection IM/ IV, 250mg	Vial	9943	15045	82227	3,538,095	2.11
Aceclofenac+Paracetamol TabS 100/500mg	Pack of 10s	1912	3495	2380	3,387,345	2.02
Heparine Injection - 5000Units/ml 5ml	Vial	1282	6239	2325	3,308,256	1.97
Phenytoin Sodium 250mg/5ml Injection	Ampoule	2200	3038	3578	3,209,024	1.92
Oxytocin Injection - 5iu/ml (Syntocinon)	Ampoule	12491	17052	1500	2,949,085	1.76
Amoxycillin/Clavulanic Potassium Tabs (875+125mg) 1gm	Pack of 10s	1243	3480	5531	2,922,390	1.74
Erythropoetin 5000 I.U Injection β	Vial	466	253	199	2,478,600	1.48
Paracetamol Solution For Intravenous Infusion 10mg/ml, 100ml .	Vial	5241	21460	14086	2,447,220	1.46
Atracurium Injection-10mg/ml, 5ml Ampoule	Ampoule	3952	2399	2175	2,387,280	1.42
Goserelin Implant 10.8 mg (As Acetate)	Syringe	18	112	67	2,344,300	1.39
Anti-D (Rh) Injection - 300mcg	Vial	137	173	156	2,330,000	1.39
Flucloxacillin Capsules 500mg	100'S	760	1181	1015	2,205,176	1.32
Halothane Inhalation	250Ml Bottle	179	192	168	2,193,730	1.31
Amoxycillin/Clavulanic Dispersible Tablets 228.5mg	Pack of 10s	2574	1450	2036	2,151,300	1.28
Isoflurane Liquid For Inhalation	250Ml Bottle	176	206	177	2,068,300	1.23
Cefuroxime 500mg tablets	Pack of 10s	2486	5369	2160	2,053,075	1.22
Diazepam Injection 5mg/ml, 2ml Ampoule	Pack of 10s	1650	3356	1243	1,993,431	1.19
Valproic Acid (Sodium Valproate) 200mg Tablets	Pack Of 100S	1540	1300	1610	1,913,500	1.14
H.Pyroli Kit	Kit	282	780	1160	1,866,480	1.11
Snake Venom Antiserum I.V Injection 10ml vial	Vial	124	104	89	1,859,205	1.11
Insulin Biphasic 30/70 - 100Iu/ml	Vial	1336	2227	2143	1,711,800	1.02
Lactulose Solution 3.4mg/ml,200ml	Bottle	2237	1760	1890	1,707,230	1.02
Carboplatin Injection,10mg/ml, 45ml vial (450mg)	Vial	74	166	217	1,599,500	0.95
Dextrose - 5% Euro Cap Bottle	500Ml	11873	13765	10207	1,433,800	0.86
TOTAL					**88,967,400**	**53.09**

4.2 MORBIDITY PATTERNS ANALYSIS

There were a total of 494,263 cases managed at JOOTRH during the study period whereby 450,310, accounting for 91.1% were out-patient while 43,953 which were 8.9% represented in-patient. Annually 152,290, 171,511 and 170,462 cases were managed in 2018, 2019 and 2020 respectively. All these cases were classified according to ICD-10 classification and Class S00-T98 [Injury poisoning and certain other consequences of external causes] accounted for 13.6% of cases. This was followed by diseases of the respiratory system ICD-10 code J00-J99 at 12.2% and certain infectious and parasitic diseases of code A00-B99 at 11% as illustrated in figure 4.2.

Diseases of the eye and adnexa of ICD code H00-H59 was the lowest in terms of number of cases at 0.8% while its percentage total expenditure was the second lowest at 0.9% for the study period as shown in appendix VIII where the code names are indicated.

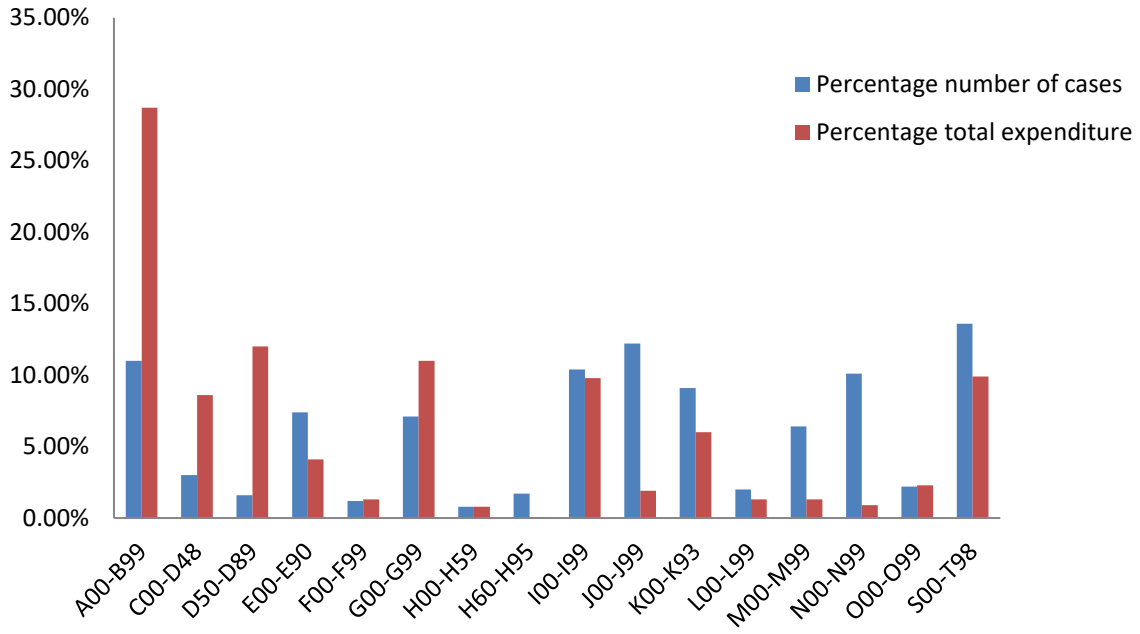

Figure 4.2: Comparison between percentage number of drugs purchased and total drug expenditure per ICD-10 Class at JOOTRH

4.3 THERAPEUTIC CATEGORY ANALYSIS

Drugs were classified into 25 therapeutic categories based on the Kenya Essential Medicines List 2019. Expenditure on anti-infective therapeutic category was a total of Ksh 45,967,567.00 translating to 26.9% of total drug expenditure hence accounting for the highest consumption in the study period. Annually, anti-infective consumed 27.4%, 23.5% and 30.4% in 2018, 2019 and 2020 respectively. The other two top consuming categories were medicines for pain and palliative care and medicines affecting the blood at 9.6% and 9.5% respectively as shown in figure 4.3. The least consumed medicines were anti-parkinsonism medicines and Ear Nose and Throat medicines at 0.01% and 0.04% respectively as shown in appendix VII.

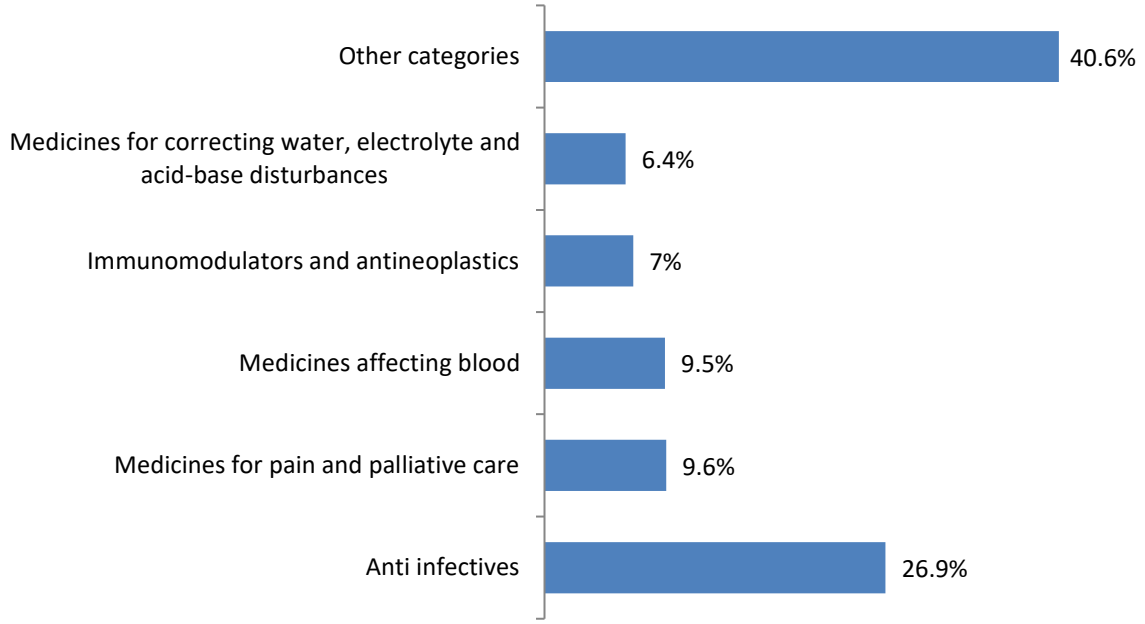

Figure 4.3: Top five therapeutic categories utilizing drug expenditure at JOOTRH

Three drugs with the highest percentage expenditure among the anti-infectives were flucloxacillin 250mg capsules, ceftriaxone injection IM/IV 1G and metronidazole injection 5mg/ml at 5%, 3.1% and 2.1% respectively.

4.4 ABC CLASSES AND EXPENDITURE

The number of class A drugs were 53(18.9%) in 2018 and 56(19.9%) in both 2019 and 2020. Class B drugs were 56(19.9%) in all the three years while class C were 172(61.2%) in 2018 and 169(60.1%) in both 2019 and 2020. Class A drugs consumed the highest proportion of the budget in the study period followed by class B with class C consuming the least as shown in table 4.2. Examples of class A drugs were Flucloxacillin Capsules 250Mg, Sodium Chloride 0.9% and Ceftriaxone Injection IM/IV 1g consuming 5%, 3.7% and 3.1% off total annual drug expenditure respectively. Class B drugs included oral rehydration salts, filgrastim injection and pregabalin 75mg while class C had potassium chloride injection 15%, insulin soluble 100IU/Ml, azithromycin 500mg among others as partly illustrated in appendix IX.

Table 4.2: ABC Classes of drugs at JOOTRH from 2018 to 2020

Analysis parameter	**n (%)**			**% Annual expenditure on drugs**		
Year	2018	2019	2020	2018	2019	2020
A	53(18.9)	56(19.9)	56(19.9)	70.2	71.7	72.7
B	56(19.9)	56(19.9)	56(19.9)	18.7	18.2	17.3
C	172(61.2)	169(60.1)	169(60.1)	11.1	10.1	10.0
TOTAL	281(100)	281(100)	281(100)	100	100	100

In 2018, 18.9% of all drugs accounted for 70.2% of the total annual expenditure and these were the class A drugs. Class B drugs were 19.9% of all drugs and consumed 18.7% of the total annual expenditure. The remaining 61.2% of the drugs belonged to class C and they took up 11.1% of the expenditure.

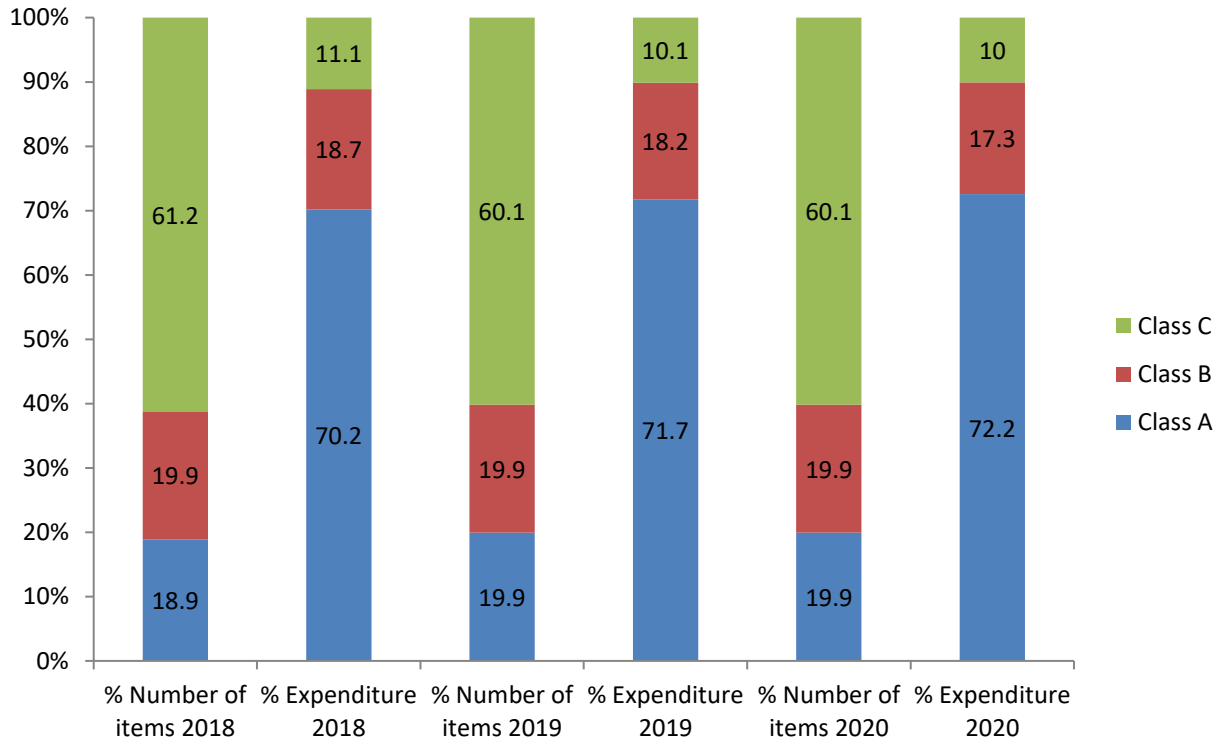

Figure 4.4: ABC Classes for the years 2018, 2019 and 2020 at JOOTRH

In 2019, 19.9% of all drugs accounted for 71.7% of the total annual expenditure and these were the class A drugs. Another 19.9% of all the drugs were class B drugs and consumed 18.2% of the total annual expenditure. The remaining 60.1% of the drugs belonged to class C and they took up 10.1% of the expenditure.

In 2020, class A drugs which were 19.9% consumed 72.7 % of the annual drug expenditure. A further 19.9% of all the drugs were class B drugs and consumed 17.3% of the total annual expenditure. The remaining 60.1% of the drugs belonged to class C and they took up 10% of the expenditure as illustrated in figure 4.4.

An important finding worth noting is that three drugs namely Aceclofenac + Paracetamol, antacid syrup and cefuroxime 500mg tabs were among the class A drugs even though they are not in the Kenya Essential Medicines List. The three accounted for 3.9% of the total drug expenditure. A sample of 30 drugs from each of the three study years categorized into class A, B and C is shown in appendix IX.

4.5: VEN CLASSES OF DRUGS AT JOOTRH

On VEN analysis of the drugs at JOOTRH, 61.6%, 23.5% and 14.9% of medicines belonged to V, E and N classes of drugs respectively for each of the three years in the study period as shown in figure 4.5.

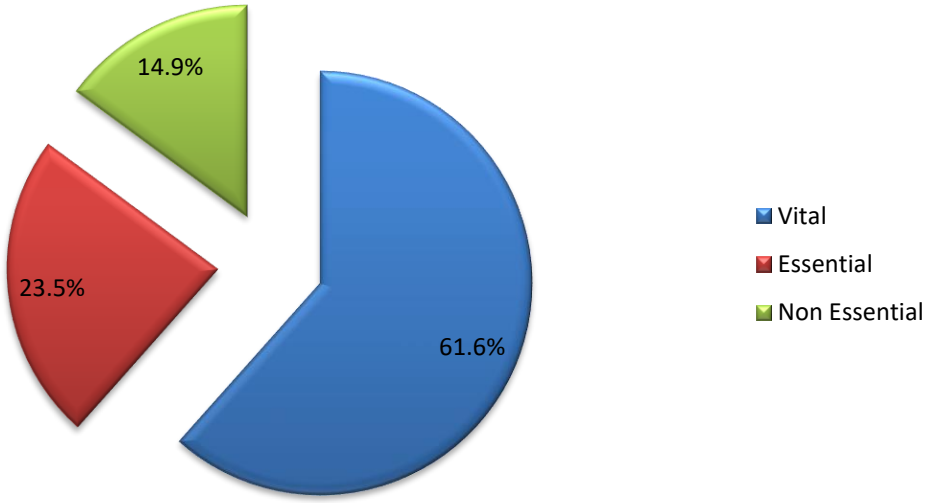

Figure 4.5: Proportion of drugs categorized as Vital, Essential and Non-essential at JOOTRH

In 2018 class V drugs consumed 77.1% of the annual expenditure; class E drugs consumed 16.3% while class N consumed the remaining 6.6%. In 2019 class V drugs consumed 75.1% of the annual expenditure; class E drugs consumed 17.8% while class N consumed the remaining 7.1%. In 2020 class V drugs consumed 74.2% of the annual expenditure; class E drugs consumed 18.2% while class N consumed the remaining 7.6% as shown in table 4.3.

Table 4.3: VEN Classes for drugs in JOOTRH from 2018 to 2020

Analysis parameter	n (%)			Annual expenditure on drugs (%)		
	2018	2019	2020	2018	2019	2020
V	173(61.6)	173(61.6)	173(61.6)	38,502,749(77.1)	48,317,384(75.1)	41,810,056(74.2)
E	66(23.5)	66(23.5)	66(23.5)	8,144,214(16.3)	11,428,941(17.8)	10,227,800(18.2)
N	42(14.9)	42(14.9)	42(14.9)	3,309,315(6.6)	4,614,002(7.1)	4,276,729(7.6)

A significant finding indicates that diclofenac sodium 75mg injection, atenolol 50mg tablet, sodium bicarbonate 8.4% injection, pancuronium 4mg/2ml injection, pregabalin 150mg capsules and neonatal ampicillin+cloxacillin 90mg/0.6ml accounting for 1.3% of total drug consumption during the study period are not in the Kenya Essential Medicines list of 2019. Appendix X shows a sample of 40 drugs classified into Vital, Essential and Non-essential categories during the entire study period.

4.6: ABC-VEN MATRIX CLASSES

The ABC-VEN Matrix of drugs in JOOTRH from 2018 to 2020 resulted in drugs being classified to nine different subcategories namely AV, AE, AN, BV, BE, BN, CV, CE and CN as shown in figure 4.6. AV group of drugs consumed the highest budget at Ksh 79,463,678.00 (46.6%) while AN was least at Ksh 3,115,308.00(1.8%). Annually drugs in category AV utilized the highest proportion of the total expenditures at 59.3%, 39.3% and 43.6% for the years 2018, 2019 and 2020 respectively. In 2019 and 2020 the least utilization of expenditure was recorded in group AN at 1.1% and 1.9% respectively while in 2018 this was in BN.

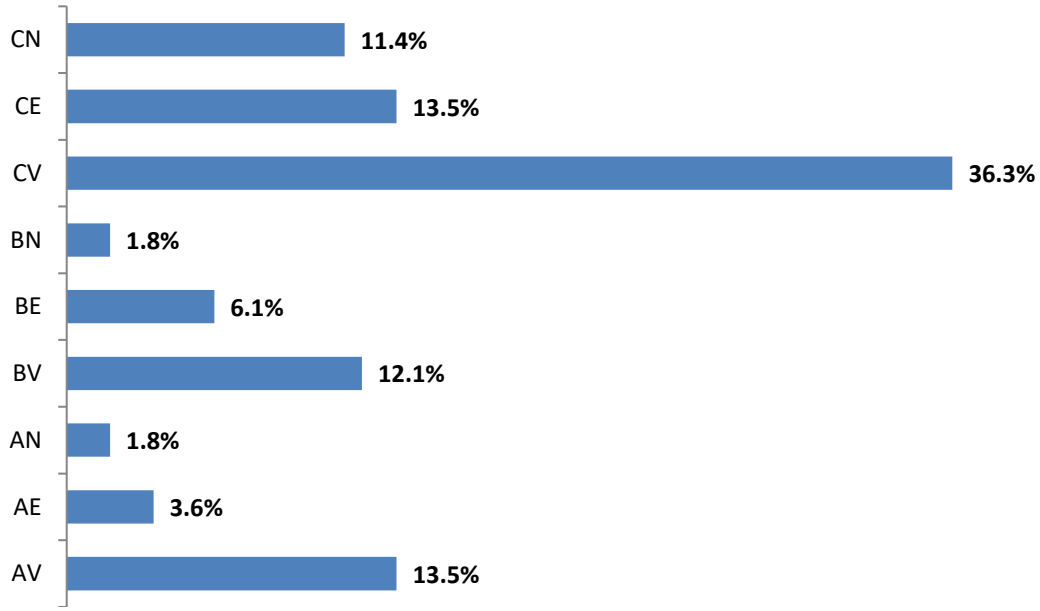

Figure 4.6: Drug proportions as classified by ABC-VEN Matrix for the study period at JOOTRH

The subcategories were assembled further into three main categories with category I including AV, AE, AN, BV and CV drugs like ceftriaxone 1g injection, lactulose solution, glucosamine 500mg + chondroitin 400mg, ephedrine 30mg/ml injection and salbutamol nebulizing solution 5mg/ml constituted 67.3% of all items and utilizing 82.2% of total drug expenditure. Category II including matrices BE, CE and BN are 21.4% of drugs and account for 12.7% of the expenditure while category III medicines like dexchlorpheniramine 2mg + betamethasone 0.25mg in matrix CN take up 5.1% of the budget and make up 11.4% of all drugs as shown in table 4.4.

Table 4.4: Annual expenditure of ABC-VEN Matrix categories at JOOTRH

ANALYSIS PARAMETER	TOTAL ANNUAL EXPENDITURE (%)			CATEGORY TOTALS (%)
	2018	2019	2020	
Category I	44,084,377(88.3)	50,578,062(78.6)	45,618,508(81)	140,280,947(82.2)
Category II	4,809,524(9.6)	9,357,922(14.5)	7,582,273(13.5)	21,749,719(12.7)
Category III	1,062,377(2.1)	4,424,343(6.9)	3,113,804(5.5)	8,600,524(5.1)
TOTAL	49,956,278	64,360,327	56,314,585	170,631,190.00

CHAPTER FIVE: DISCUSSION, CONCLUSION, & RECOMMENDATIONS

5.1 DISCUSSION

There was uniformity on the number and types of drugs analyzed in each of the three years under study implying the same procurement system was used during this time. Additionally, there was a slight difference in yearly expenditure on drugs with the highest consumption being observed in 2019 with 37.7% and lowest in 2018 with 29.3% which is a percentage difference of 8.4%. A probable reason may be an expenditure cap placed on pharmaceuticals purchases conforming to the limited available resources. The slight decrease in expenditure from 37.7% in 2019 to 33% in 2020 coupled with reduction in number of cases managed in 2019 to 2020 from 171,511 to 170,462 could also be attributed to effects of Covid 19 in drug expenditure and hospital visits.

Flucloxacillin 250mg capsules, an antibiotic treating skin infections, bone infections, ear infections, chest infections and for prophylaxis was responsible for utilizing the highest portion of the annual drug expenditure. Anti-infectives category of drugs where Flucloxacillin and other antibiotics belong accounted for the highest percentage of expenditure on medicines during the duration under study. This could be in relation to an observation made in morbidity pattern analysis where infectious diseases ranked high among the cases managed at JOOTRH leading to their increased prescription not only unique to the hospital but also observed country wide (48).

On the contrary the high consumption could be due to prolonged duration of treatment with antibiotics, extensive prescribing of broad-spectrum antibiotics, treatment use rather than prophylaxis in intensive care unit and high rates of empiric prescribing (49). Ear, nose and throat medicines utilized the lowest percentage of drug expenditure and this is attributed to their low numbers in terms of cases managed at the hospital which was 0.05% of all the cases. Moreover, this being a regional referral hospital the number of such cases could be limited as most are treated at the lower sub county hospital.

This being a regional hospital and set up in an urban area that is densely populated, injury poisoning and certain other consequences of external causes (class S00-T98) recorded the highest percentage of the cases accredited to either road traffic injuries and violence not

forgetting it being a regional referral facility for surgical cases (50). The high rates of injury could also explain high use of flucloxacillin for skin soft tissue and bone infections. Its locality further precipitates diseases of the respiratory system which ranks second highest in terms of cases managed and this is primarily due to air pollution and the high population exposing residents to overcrowding (51).

ClassA00-B99 (Certain infectious and parasitic diseases) exhibited the greatest disparity in terms of case numbers and respective expenditure and this signals irrational prescription of antibiotics, use of costly antibiotics, non-adherence to available standard treatment guidelines, pilferages, poor antibiotic procurement procedures and inventory control (52). This disparity is also noted in disease class C00-D48 (Neoplasms) and class D50-D89 (Diseases of the blood and blood forming organs and certain disorders involving the immune mechanism this could be primarily due to the high cost of anticancer drugs, immunomodulators/immunologicals and medicines affecting blood (53). Another variation noted is the case where the percentage number of cases are way more than the percentage total expenditure as observed in class E00-E90 (Endocrine, nutritional and metabolic diseases), classJ00-J99 (Diseases of the respiratory system), class M00-M99 (Diseases of the musculoskeletal system and connective tissue) and class N00-N99 (Disease of the genitourinary system) most likely due to lower costs of drugs used in their management, unavailability of drugs used in their treatment or poor management through omission of the right drugs .

In JOOTRH Class A drugs analyzed from 2018 to 2020 were between 10 to 20% of all medicines and recorded approximately 70 to 80% of the whole budget for pharmaceuticals; Class B were the subsequent 10 to 20% taking up 15 to 20% of the entire budget while Class C constituted the other 60 to 80% but consumed slightly above 10% of the budget. Class A medicines demand stringent managerial control, precise data-driven demand prediction, close scrutiny of budgetary allocation, lowest safety stock, spaced purchase orders, repeated stock taking, sensible purchasing and wise inspection policy (7). Class B items need moderate control with Category C calling for adequate control measures for orders and purchases with a higher safety stock levels.

Additionally, ABC classification may be helpful in designing physical counting strategies with periodic counting done for class A and B whereas annual is applied for class C items (54).The

analysis can help monitor procurement patterns in comparison with health system priorities for instance buying generic versions of enoxaparin sodium 40mg/0.4ml injection, phenytoin sodium 250m/5ml injection and erythropoietin 2000 I.U injection that collectively take up to 6.4% of expenditure on medicines instead of the branded products.

Similar studies indicated similar findings as in the case of one conducted in Jimma zone Southwest Ethiopia showing that class A accounted for 53(15.3%), whereas class B and C items accounted for 72(20.8%) and 221(63.8%) of drugs at selected public health facilities with annual drug expenditure being 69.9%, 19.9% and 10.1% for the three classes (55). Bhondve et. al, in a study at a tertiary hospital in India also indicated that 23.7% of drugs belonged to class A consuming 67.5% of the annual expenditure, 50.2% were in class B consuming 20.1% while 26.3% were in class C taking up 12.4% of the expenditure (56). Kivoto et. al, in their study on Clinical and financial implications of medicine consumption patterns in aa tertiary hospital in Kenya found out that class A drugs which were 13.2% to 14.2% consumed 80% of annual drug consumption, class B which were 15.9% to 17% consumed 15% while class C drugs which were 70% consumed 5% (41). Another study done in Lodwar County referral Hospital had class A drugs which were 12% taking up 70% of drug expenditure, class B drugs which were 18% consumed 20% while class C drugs accounting for 70% of the drugs took up 10% of the expenditure (31).

VEN analysis assigned drugs at JOOTRH to Vital (V) medicines with lifesaving potential and critical in provision of basic healthcare services or have significant withdrawal effects; Essential (E) beneficial against barely severe but remarkable forms of illnesses and Non-essential drugs managing less significant illnesses or are costly for a marginal therapeutic advantage. The results from the study show that Vital and Essential medicines utilized approximately 92.9% of total drug expenditure signaling they were given the higher priority during selection, procurement and use compared to non-essential medicines especially in such a resource limited setting. Additionally, orders for vital and essential drugs should be monitored and their safety stocks made higher to limit expensive impulse buying and subsequent realization of inventory savings. In this study vital and essential drugs accounted for 85.1% of all the drugs procured in the three-year period. The VEN system can aid the hospital in ensuring that enough quantities for vital and essential drugs are bought first and only from reliable suppliers.

Corresponding earlier studies in similar settings indicated comparable outcomes. Endeshaw et. al, in their study in Southwest Ethiopia had same results showing vital and essential drugs were the majority in number at 85.6% in selected public hospitals consuming 94.9% of annual drug expenditure (55). Another study at a tertiary hospital in North India also indicated vital and essential drugs to be the highly bought at 91.4% and consuming 87.5% of drug budget with Non-essential only being 8.6% and consuming a paltry 12.4% of the budget (57). There was a similar trend in Kenyatta National Hospital where vital and essential drugs were the majority at 76.1% and consuming 92.2% of drug expenditure (41) However there was a considerable difference in studies carried out in Nyeri and Busia County referral hospitals where Non-essential drugs were the highly procured drugs at 50.4% and 52.1%. (39,40). The results in Busia further indicated that 43.1% of expenditure was used on the Non-essential drugs while only 3.2% went to essential drugs (40). This difference could be attributed to financial limitations, incompetent budget utilization, ineffective drug prioritization and disparity in policies of classifying drugs into VEN (58). The hospital can use the VEN classification done in this study to help in drug prioritization during procurement and adequate financial allocation to vital and essential drugs.

From ABC-VEN matrix analysis majority of drugs the hospital procured were in category I at 67.2% which had potential in saving lives, were crucial in the provision of basic health services while consuming 82.1% of the budget. Drugs available during the study period in the lowest quantities were in category III used for minor illnesses, are costly for limited therapeutic advantage and utilized the lowest percentage of the budgetary allocation at 5%. Category II were 21.4% and took up 12.9% of expenditure. This shows that the hospital prioritized purchases of drugs with high therapeutic benefits and of greater public health impact while minimizing the costs of such purchases.

It is important to note that the hospital procured category I drugs that were lifesaving and crucial for basic healthcare provision while also the most costly in the hospital and needs close monitoring of their procurement to always settle within budgetary limits. By being potentially lifesaving, they are drugs that should also be availed at the hospital most of the times with stringent administration and dispensing control, updated records and timely audit on their use. Their substitution is not encouraged thereby stock outs cannot be tolerated necessitating sufficient budget (59).

Considering their high numbers at 21.4%, the hospital spent comparatively low on Category II drugs which is a commendable move signaling that cheaper alternatives could have been procured from affordable and reliable suppliers. These drugs could also be procured in large quantities since they are relatively cheap and might not require maximum supervision when handling them though measures should be put in place to minimize pilferages (58). Category III had both the lowest consumption and expenditure rates implying that JOOTRH spent low on drugs used for minor illnesses or those without significant therapeutic advantage.

Related studies illustrated matching findings as seen in one by Jobira et. al, showing category I , II and III consumed 84.7%, 13.2% and 2.1% respectively in selected health facilities in West Arsi Zone Oromia in Ethiopia (60). In Reza Educational hospital pharmacy, Iran 83.8% of drug expenditure was used for category I drugs while category II and III utilized 13.5% and 2.7% (61). Additionally, Zeynep et al, in their study on drug inventory management using ABC/VEN analysis in an hospital pharmacy in Turkey revealed that category I used up 75.3% of total drug expenditure, category II 22.2% while category III consumed 2.5% (62). Lastly in Lodwar County Referral Hospital the trend continued with category I utilizing 82%, category II and III using 17% and 1% respectively (31).

Finally this study has brought out the expenditure rates of different categories of medicines as well as different disease classes; data which was not available for JOOTRH. New information on procurement practices and trends within the hospital has also been acquired highlighting the purchase of expensive medicines outside the KEML.

5.2 CONCLUSIONS

A remarkable amount of the pharmaceutical budget at Jaramogi Oginga Odinga Teaching and Referral Hospital was used in procuring class A drugs which were the fewest in numbers compared to class B and C signaling the demand for a strict inventory control to avert wastage and holding of funds in unnecessary buffer stocks. Vital and essential drugs utilize over 90% of the annual drug expenditure pinpointing that priority is given to them and adequate stock can still be maintained throughout the year. Category I drugs which are crucial in health care provision and potentially lifesaving are costly and use more than half of the budget. Not with standing,

these items should always be in drug stores and buffer stock encouraged. Anti-infectives category of drugs consumed the highest while ear, nose and throat medicines utilized the lowest percentage of drug expenditure. Injury, poisoning and certain other consequences of external causes (class S00-T98) recorded the highest percentage of the total hospital case load while Class A00-B99 (Certain infectious and parasitic diseases) exhibited the greatest disparity in terms of the total number of cases compared to their expenditure. This study determined the drugs accounting for the greatest magnitude of pharmaceutical budget allocation, justified expenditure of some therapeutic categories and will help the hospital compare drug use to their public health effects. Notably, a different interpretation about the hospital's consumption could be made if the study was conducted using volume of units consumed instead of value of medicines.

5.3 RECOMMENDATIONS

5.3.1 Recommendations for further research

More studies need to be done to ascertain the high expenditure of anti-infectives in the hospital and also to inquire on the disparity in number of disease cases and the expenditure on these disease classes.

A Flucloxacillin 250mg capsules use evaluation study at JOOTRH should be done due to its high consumption and growing concerns on antibiotic resistance.

5.3.2 Recommendations for policy and practice

ABC analysis should guide periodic stock counts with more frequent counts for class A items. Planned periodic review of class A drugs in the hospital by a multidisciplinary team should be encouraged to suggest areas of overuse and underuse of these drugs.

The hospital medicines and therapeutics committee should seek major cost reduction by finding cheaper class A drugs, assign a responsible person for efficient inventory control on large orders of class A items also paying attention to the shelf life of these drugs to minimize wastage.

VEN system should always be employed in setting purchasing priorities and determining safety stock levels since it categorizes pharmaceuticals by their relative public health values. This

system will aid in ensuring that enough quantities for vital and essential drugs are bought first and only from reliable suppliers.

Therapeutic category analysis should always be done as it compares cost and therapeutic benefits leading to selection of the most cost-effective medicines to be procured.

5.4 STRENGTHS AND WEAKNESSES OF THE STUDY

5.4.1 Study weaknesses

Incomplete or missing data from earlier years limited the study period to three years although the desire was to include more years. There was a possibility of overlap in consumption and expenditure data since some medicines are used to treat diseases in completely different categories while some diseases require treatment with drugs in different classes.

5.4.2 Study strengths

Use of three aggregate data methods (ABC, TC and VEN) led to collection and analysis of complete and complimentary drug consumption and expenditure data.

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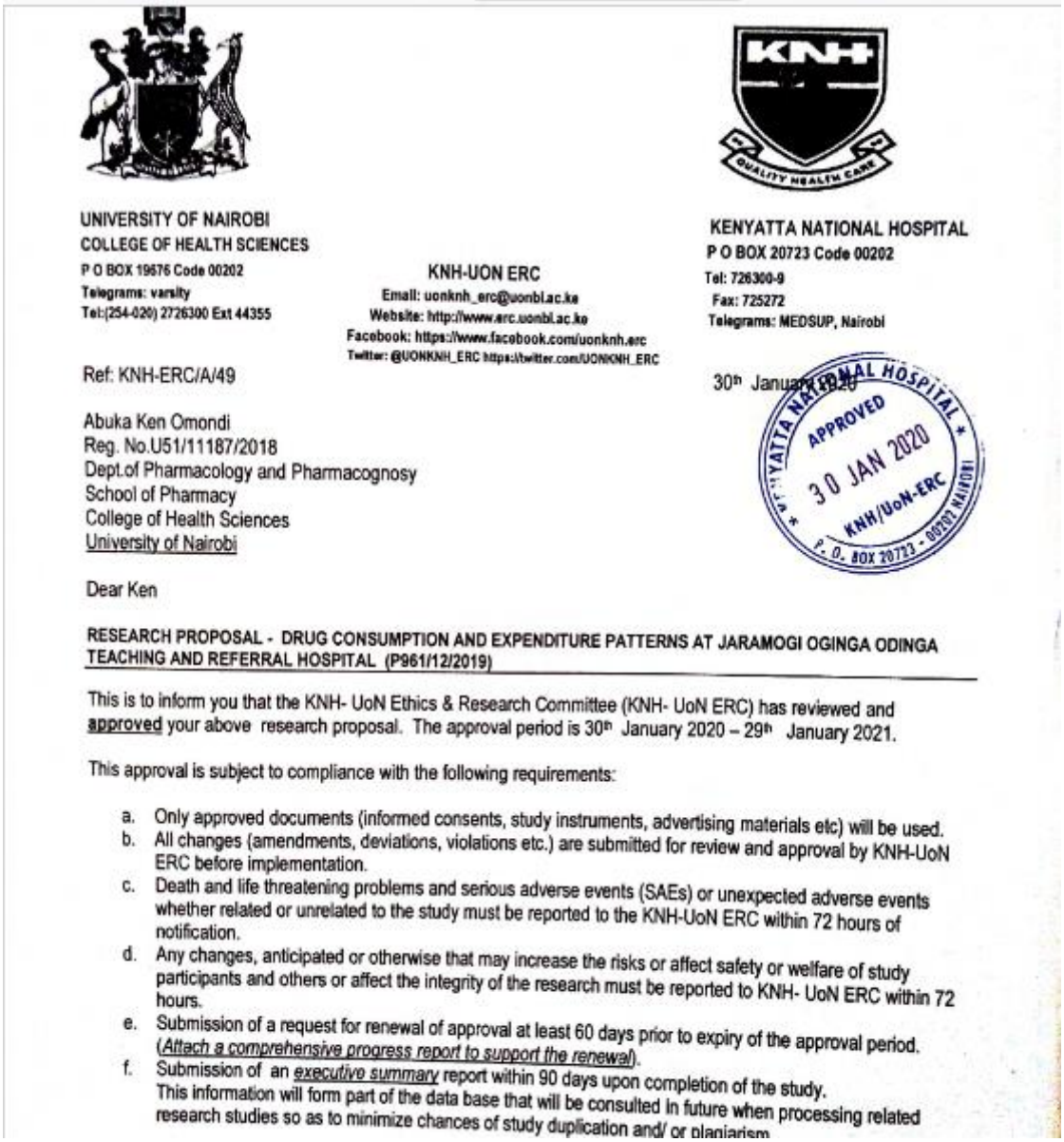
APPENDICES

APPENDIX I: ETHICS APPROVAL LETTERS



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30th January 2020

KENYATTA NATIONAL HOSPITAL APPROVED 30 JAN 2020 KNH/UoN-ERC P. O. BOX 20723 - 00202 NAIROBI

Abuka Ken Omondi
Reg. No.U51/11187/2018
Dept.of Pharmacology and Pharmacognosy
School of Pharmacy
College of Health Sciences
University of Nairobi

Dear Ken

RESEARCH PROPOSAL - DRUG CONSUMPTION AND EXPENDITURE PATTERNS AT JARAMOGI OGINGA ODINGA TEACHING AND REFERRAL HOSPITAL (P961/12/2019)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and approved your above research proposal. The approval period is 30th January 2020 – 29th January 2021.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism

For more details consult the KNH- UoN ERC website**http://www.erc.uonbi.ac.ke**

Yours sincerely,

PROF. M. L. CHINDIA
SECRETARY, KNH-UoN ERC

c.c. The Principal, College of Health Sciences, UoN
The Director, CS, KNH
The Chairperson, KNH- UoN ERC
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Ref: ERC/KSM/180/20

Date 5th February, 2020

RESEARCH & TRAINING DEPARTMENT
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KISUMU

TO: ABUKA KEN OMONDI

Dear Abuka ,

RE: STUDY TITLE:
DRUG CONSUMPTION AND EXPENDITURE PATTERNS AT JARAMOGI OGINGA ODINGA TEACHING AND REFERRAL HOSPITAL

This is to inform you that ***JOOTRH IERC*** has reviewed and approved your above research proposal. Your application approval number is ***IERC/JOOTRH/180/20.***The approval period is ***5th February, 2020 – 5th February, 2021.***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents. study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***JOOTRH - IERC***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***JOOTRH - IERC*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***JOOTRH - IERC*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to JOOTRH - ***IERC***.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

In case the case of study site is JOOTRH, kindly report to Chief Executive Officer before commencement of data collection.

Yours sincerely,

APPENDIX II: ABC ANALYSIS DATA COLLECTION FORM

ATC Drug classification	Drug Name	Pharmaceutical form and unit of issue	Unit cost	Quantity for year_____ _	Total cost	Rank by value	Percentage of Total value	Cumulative percentage

APPENDIX III: VEN CATEGORY ALLOCATION FORM

Drug code	Drug Name	Pharmaceutical form	Unit of issue	VEN CATEGORY

APPENDIX IV: THERAPEUTIC CATEGORY ALLOCATION FORM.

Drug code	Drug Name	Pharmaceutical form	Unit of issue	THERAPEUTIC CATEGORY

APPENDIX V: MORBIDITY DATA AND DRUG EXPENDITURE COLLECTION FORM

Year_____

ICD-10 CODE	HEADING	NUMBER OF CASES	ANNUAL EXPENDITURE
A00-B99	Certain infectious and parasitic diseases		
C00-D48	Neoplasms		
D50-D89	Diseases of the blood and blood forming organs and certain disorders involving the immune mechanism		
E00-E89	Endocrine, nutritional and metabolic diseases		
F01-F99	Mental , Behavioral and Neurodevelopment disorders		
G00-G99	Diseases of the nervous system		
H00-H59	Diseases of the eye and adnexa		
H60-H95	Diseases of the ear and mastoid process		
I00-I99	Diseases of the circulatory system		
J00-J99	Diseases of the respiratory system		
K00-K95	Diseases of the digestive system		
L00-L99	Diseases of the skin and subcutaneous tissue		
M00-M99	Diseases of the musculoskeletal system and connective tissue		
N00-N99	Diseases of the Genitourinary system		

APPENDIX VI: ABC-VEN CATEGORIZATION

Year_____

NO	Item code	Item description	Unit of issue	Unit price	Quantity	Total amount (Kshs)	ABC category	VEN category	ABC-VEN category

APPENDIX VII: THERAPEUTIC CATEGORIES CONSUMPTION RATES

Therapeutic category	Total annual expenditure				percentages
	2018	2019	2020	TOTAL	
ANAESTHETICS, PRE- & INTRA-OPERATIVE MEDICINES and MEDICAL GASES	2,471,675.00	2,922,403.00	2,552,806.00	7,946,884.00	4.66
ANTIALLERGICS and MEDICINES used in ANAPHYLAXIS	631,881.00	337,657.00	322,888.00	1,292,426.00	0.76
ANTICONVULSANTS/ANTIEPILEPTICS	3,558,516.00	3,570,901.00	3,715,326.00	10,844,743.00	6.36
ANTIDOTES and OTHER SUBSTANCES used in POISONINGS	122,920.00	184,112.00	221,401.00	528,433.00	0.31
ANTI-INFECTIVE MEDICINES	13,707,162	15,130,224.00	17,130,181.00	45,967,567	26.94
ANTIPARKINSONISM MEDICINES	3,720.00	7,938.00	7,812.00	19,470.00	0.01
BLOOD PRODUCTS of HUMAN ORIGIN and PLASMA SUBSTITUTES	820,514.00	2,166,914.00	1,351,794.00	4,339,222.00	2.54
CARDIOVASCULAR MEDICINES	2,962,519.00	1,353,175.00	1,556,954.00	5,872,648.00	3.44
DERMATOLOGICAL MEDICINES (Topical)	824,439.00	790,458.00	683,917.00	2,298,814.00	1.35
DISINFECTANTS and ANTISEPTICS	1,118,492.00	937,037.00	879,756.00	2,935,285.00	1.72
DIURETICS	449,680.00	531,079.00	593,654.00	1,574,413.00	0.92
EAR, NOSE and THROAT MEDICINES	19,320.00	29,840.00	29,840.00	79,000.00	0.05
GASTROINTESTINAL MEDICINES	2,719,781.00	3,812,030.00	3,628,097.00	10,159,908.00	5.95
IMMUNOLOGICALS	1,011,054.00	794,040.00	943,785.00	2,748,879.00	1.61
IMMUNOMODULATORS AND ANTINEOPLASTICS	3,704,558.00	4,636,754.00	3,635,603.00	11,976,915.00	7.02

MEDICINES acting on the RESPIRATORY TRACT	397,951.00	860,840.00	624,821.00	1,883,612.00	1.10
MEDICINES affecting the BLOOD	3,021,127.00	7,265,598.00	5,890,949.00	16,177,674.00	9.48
MEDICINES for correcting WATER, ELECTROLYTE and ACID-BASE DISTURBANCES	2,308,643.00	5,035,447.00	3,572,941.00	10,917,031.00	6.34
MEDICINES for ENDOCRINE DISORDERS	1,466,062.00	1,178,749.00	1,492,563.00	4,137,374.00	2.42
MEDICINES for MENTAL and BEHAVIOURAL DISORDERS	1,094,146.00	671,978.00	394,197.00	2,160,321.00	1.27
MEDICINES for PAIN and PALLIATIVE CARE	4,393,084.00	7,291,333.00	4,647,920.00	16,332,337.00	9.57
MEDICINES for REPRODUCTIVE HEALTH and PERINATAL CARE	1,571,321.00	1,958,041.00	335,705.00	3,865,067.00	2.27
MUSCLE RELAXANTS (PERIPHERALLY-ACTING) and CHOLINESTERASE INHIBITORS	276,336.00	1143705.00	749,437.00	2,169,478.00	1.27
OPHTHALMOLOGICAL PREPARATIONS	643,268.00	556,457.00	316,468.00	1,516,193.00	0.89
VITAMINS and MINERALS	658,109.00	1,193,617.00	1,035,770.00	2,887,496.00	1.69
				170,631,190.00	100

APPENDIX VIII: NUMBER AND EXPENDITURE RATES OF DISEASE CASES

ICD 10 CODE	DISEASE	N	%	EXPENDITURE	% TOTAL EXPENDITURE
A00-B99	Certain infectious and parasitic diseases	54541	11.03	48,902,852.00	28.66
C00-D48	Neoplasms	14863	3.01	14,725,794.00	8.63
D50-D89	Diseases of the blood and blood forming organs and certain disorders involving the immune mechanism	7964	1.61	20,516,896.00	12.02
E00-E90	Endocrine, nutritional and metabolic diseases	36637	7.41	7,024,870.00	4.12
F00-F99	Mental and behavioral disorders	5963	1.21	2,160,321.00	1.27
G00-G99	Diseases of the nervous system	35256	7.13	18,791,627.00	11.01
H00-H59	Diseases of the eye and adnexa	3779	0.76	1,516,193.00	0.89
H60-H95	Diseases of the ear and mastoid process	8571	1.73	79,000.00	0.05
I00-I99	Diseases of the circulatory system	51,221	10.36	16,789,679.00	9.84
J00-J99	Diseases of the respiratory system	60187	12.18	3,176,038.00	1.86
K00-K93	Diseases of the digestive system	45154	9.14	10,159,908.00	5.95
L00-L99	Diseases of the skin and subcutaneous tissue	9777	1.99	2,298,814.00	1.35
M00-M99	Diseases of the musculoskeletal system and connective tissue	31839	6.44	2,188,948.00	1.28
N00-N99	Disease of the genitourinary system	50104	10.14	1,574,413.00	0.92
O00-O99	Pregnancy, childbirth and the puerperium	11096	2.24	3,865,067.00	2.27

S00-T98	Injury poisoning and certain other consequences of external causes	67311	13.62	16,860,770.00	9.88
		494263	100	170,631,190.00	100

APPENDIX IX: A SAMPLE OF ABC CLASSIFICATION OF DRUGS FROM 2018 TO 2020

	DRUG NAME	UNIT OF ISSUE	UNIT COST (KSH)	QUANTITY FOR YEAR 2020	TOTAL COST	% OF TOTAL COST	CUMMULATIVE %	CLASS
1	Flucloxacillin Capsules 250Mg	Tin of 1000s	2500	1353	3382500	6.006436876	6.006436876	A
2	Ceftriaxone Injection IM/ IV, 250mg	Vial	33	82227	2713491	4.818451561	10.82488844	A
3	Sodium Chloride/Normal Saline Solution - 0.9% Nipple Head Bottle	500Ml	45	44400	1998000	3.54792635	14.37281479	A
4	Enoxaparin Sodium 40mg/0.4ml Injection (Clexane)	Syringe	357	5592	1996344	3.544985726	17.91780051	A
5	Ceftriaxone Injection IM/IV, 1g	Vial	38	42671	1621498	2.879357097	20.79715761	A
6	Amoxycillin/Clavulanic Potassium Tabs (875+125mg) 1gm	Pack of 10s	285	5531	1576335	2.799159401	23.59631701	A
7	Phenytoin Sodium 250Mg/5Ml Injection(Epanutin)	Ampoule	364	3578	1302392	2.312708155	25.90902517	A
8	Metronidazole Injection - 5Mg/Ml	Vial	24	45247	1085928	1.928324607	27.83734977	A
9	Aceclofenac+Paracetamol Tablets 100/500mg	Pack of 10s	435	2380	1035300	1.838422497	29.67577227	A
10	H.Pyroli Kit(Clarithromycin 500Mg,Amoxicillin 1 Gm,Lansoprazole 30Mg)	Kit	840	1160	974400	1.730279998	31.40605227	A
1	Oral Rehydration Salt	Pack of 50s	155	1939	300545	0.533689452	73.20120534	B
2	Filgrastim Injection, prefilled syringe for Injection (300 micrograms) / 0.5 ml	Vial	1400	205	287000	0.509637068	73.7108424	B
3	Pregabalin 75mg	Pack of 30s	300	932	279600	0.4964966	74.207339	B
4	Hydralazine Injection - 20Mg/5Ml	Ampoule	532	513	272916	0.484627561	74.69196657	B
5	Amoxycillin Capsules 250mg	Tin of 1000S	1450	186	269700	0.478916785	75.17088335	B
6	Ceftazidime 1G Inj.	Vial	82	3171	260022	0.461731184	75.63261453	B
7	Povidone- Iodine solution 10%	500ml	190	1277	242630	0.430847533	76.06346207	B
8	Gabapentin Cap 300Mg	Pack Of 30S	300	776	232800	0.413392019	76.47685409	B
9	Water for Injection	10ml Vial	4	58075	232300	0.41250415	76.88935824	B
10	Ephedrine Hcl Inj. 30mg/Ml	Ampoule	170	1243	211310	0.37523139	77.26458963	B
1	Potassium Chloride Injection - 15%	Ampoule	80	1343	107440	0.190785389	89.7997224	C
2	Insulin Soluble - 100Iu/Ml	Vial	300	357	107100	0.190181638	89.98990404	C

3	Azithromycin 500mg	Pack of 3s	30	3565	106950	0.189915277	90.17981931	C
4	Ampicillin/Cloxacillin Neonatal Drop 90Mg/0.6 Ml	8Ml	110	967	106370	0.188885348	90.36870466	C
5	Aceclofenac 100mg	Pack of 10s	85	1243	105655	0.187615695	90.55632036	C
6	Dexamethasone+Neomycin+Polymixin B 600Iu/1%/3.5Mg/G Eye/Ear Drops,5Ml	Bottle	200	510	102000	0.181125369	90.73744573	C
7	Aminosidine Syrup 125MG/5ML, 60ML	60ml bottle	230	443	101890	0.180930038	90.91837576	C
8	Salbutamol Nebulizing Solution - 5Mg/Ml 10Ml	10Ml Vial	530	183	96990	0.172228917	91.09060468	C
9	Ketamine Injection - 50Mg/Ml	Vial	122	780	95160	0.168979315	91.259584	C
10	Esomeprazole 40mg Powder for Solution for Injection	Vial	300	316	94800	0.168340049	91.42792404	C
	DRUG NAME	**UNIT OF ISSUE**	**UNIT COST**	**QUANTITY FOR YEAR 2019**	**TOTAL COST**	**% OF TOTAL VALUE**	**CUMMULATIVE %**	
1	Sodium Chloride/Normal Saline Solution - 0.9% Nipple Head Bottle	500Ml	45	69000	3105000	4.824400597	4.824400597	A
2	Flucloxacillin Capsules 250Mg	Tin of 1000s	2500	1075	2687500	4.175709051	9.000109648	A
3	Paracetamol Solution For Intravenous Infusion 10Mg/Ml, 100Ml .	Vial	120	21460	2575200	4.001222679	13.00133233	A
4	Heparine Injection - 5000Units/Ml 5Ml	Vial	340	6239	2121260	3.295912403	16.29724473	A
5	Ceftriaxone Injection IM/IV, 1g	Vial	38	51426	1954188	3.036323914	19.33356864	A
6	Oxytocin Injection - 5iu/ml (Syntocinon)	Ampoule	100	17052	1705200	2.64945826	21.9830269	A
7	Enoxaparin Sodium 40mg/0.4ml Injection (Clexane)	Syringe	340	4572	1554480	2.415276728	24.39830363	A
8	Aceclofenac+Paracetamol Tablets 100/500mg	Pack of 10s	435	3495	1520325	2.362208321	26.76051195	A
9	Erythropoetin 2000 I.U Injection β **(Recormorn)**	Vial	1460	930	1357800	2.109684744	28.8701967	A
10	Goserelin Implant (In Syringe Applicator) 10.8 Mg (As Acetate) In A Prefilled Syringe	Syringe	11900	112	1332800	2.070840939	30.94103764	A
1	Amoxycillin/Clavulanic Dispersible Tablets 625mg	Pack of 10s	120	2494	299280	0.46500696	72.18283245	B
2	Glucosamine 500Mg +Chondrointin 400Mg Capsules	Pack Of 30S	650	460	299000	0.464571909	72.64740436	B
3	Albumin (Human) 20%	100ml	7930	37	293410	0.455886435	73.10329079	B
4	Paracetamol Suspension 120Mg/5Ml	100Ml Bottle	30	9773	293190	0.455544609	73.5588354	B
5	Dexamethasone+Neomycin+Polymixin B 600Iu/1%/3.5Mg/G Eye/Ear Drops,5Ml	Bottle	200	1460	292000	0.453695644	74.01253104	B

6	Propofol IV 10mg/Ml	Ampoule	249	1137	283113	0.439887448	74.45241849	B
7	Amoxycillin Capsules 250mg	Tin of 1000S	1400	202	282800	0.439401124	74.89181961	B
8	Sodium Lactate Solution Bottle	500Ml	45	6120	275400	0.427903357	75.31972297	B
9	Paracetamol Tablets - 500Mg (Tin of 1000s)	Tin of 1000s	620	435	269700	0.41904697	75.73876994	B
10	Phytomenadione Injection (Vitamin K1) - 10mg/ml, 1ml Ampuole (Adults)	Ampoule	130	2071	269230	0.418316706	76.15708665	B
1	Furosemide Injection - 20Mg/2Ml	Ampoule	7	18436	129052	0.20051483	89.9221581	C
2	Insulin Soluble - 100Iu/Ml	Vial	300	423	126900	0.197171155	90.11932926	C
3	Tramadol 50mg Capsules	Pack Of 100S	280	451	126280	0.196207828	90.31553709	C
4	Amoxicillin Tablet 250mg Dispersible, Scored	Pack of 100s	419	293	122767	0.190749497	90.50628658	C
5	Ondansetron Injection, 2mg/ml, 2ml ampoule	Ampoule	45	2532	113940	0.177034526	90.68332111	C
6	Ketamine Injection - 50Mg/Ml	Vial	100	1134	113400	0.1761955	90.85951661	C
7	Suxamethonium Chloride Injection	Ampoule	45	2517	113265	0.175985744	91.03550235	C
8	Salbutamol Inhaler - 100Mcg/Actuation	200 Doses Cartridge	165	686	113190	0.175869212	91.21137156	C
9	Oxytocin Injection - 10iu/ml	Ampoule	12	9297	111564	0.173342811	91.38471438	C
10	Lignocaine Hydrochloride Injection - 2%	30ml Vial	50	2197	109850	0.17067968	91.55539406	C
	DRUG NAME	**UNIT OF ISSUE**	**UNIT COST**	**QUANTITY FOR YEAR 2018**	**TOTAL COST**	**% OF TOTAL VALUE**	**CUMMULATIVE %**	**CLASS**
1	Erythropoetin 2000 I.U Injection β **(Recormorn)**	Vial	1460	1902	2776920	5.55870075	5.55870075	A
2	Flucloxacillin Capsules 250Mg	Tin of 1000s	2800	935	2618000	5.240582575	10.79928333	A
3	Ceftriaxone Injection IM/IV, 1g	Vial	42	42429	1782018	3.567155263	14.36643859	A
4	Metronidazole Injection - 5Mg/Ml	Vial	25	52083	1302075	2.606429166	16.97286775	A
5	Erythropoetin 5000 I.U Injection β **(Recormorn)**	Vial	2700	466	1258200	2.518602367	19.49147012	A
6	Oxytocin Injection - 5iu/ml (Syntocinon)	Ampoule	100	12491	1249100	2.500386438	21.99185656	A
7	Paracetamol Solution For Intravenous Infusion 10Mg/Ml, 100Ml .	Vial	230	5241	1205430	2.412969997	24.40482656	A
8	Phenobarbitone Injection - 200Mg/Ml	Ampoul	785	1512	1186920	2.375917597	26.78074415	A

		e						
9	Sodium Chloride/Normal Saline Solution - 0.9% Nipple Head Bottle	500Ml	40	24500	980000	1.961715402	28.74245956	A
10	Atracurium Injection-10Mg/Ml, 5Ml Ampoule	Ampoul e	235	3952	928720	1.859065641	30.6015252	A
1	H.Pyroli Kit(Clarithromycin 500Mg,Amoxicillin 1 Gm,Lansoprazole 30Mg)	Kit	840	282	236880	0.474174637	70.69910613	B
2	Water for Injection	10ml Vial	4	58673	234692	0.469794807	71.16890093	B
3	Tranexamic Acid Injection 500Mg/5Ml	Ampoul e	80	2888	231040	0.462484415	71.63138535	B
4	Amoxyclav suspension 312.5mg	1oomls	205	1090	223450	0.447291129	72.07867648	B
5	Pregabalin 150Mg Capsules	Pack Of 30S	445	501	222945	0.446280245	72.52495672	B
6	Antacid Syrup Aluminium Hydroxide, Magnesium Hydroxide With Simethicone 400mg/80mg/100mg/200mg, 180ml	Bottle	220	994	218680	0.43774278	72.9626995	B
7	Paracetamol Tablets - 500Mg (Tin of 1000s)	Tin of 1000s	420	518	217560	0.435500819	73.39820032	B
8	Omeprazole Capsules 20Mg (100s in Blisters)	100s in Blisters	100	2163	216300	0.432978614	73.83117894	B
9	Goserelin Implant (In Syringe Applicator) 10.8 Mg (As Acetate) In A Prefilled Syringe	Syringe	11900	18	214200	0.428774938	74.25995387	B
10	Hydralazine Injection - 20Mg/5Ml	Ampoul e	635	336	213360	0.427093468	74.68704734	B
1	Acetylsalicylic Acid Tablets 75mg-Enteric Coated Blister Pack	Pack of 30s	45	2237	100665	0.201506205	88.90460574	C
2	Atorvastatin 10Mg Tablets	Pack Of 30S	80	1243	99440	0.199054061	89.1036598	C
3	Morphine Oral Solution 10mg/ml, 100ml	100ml	400	248	99200	0.198573641	89.30223345	C
4	Povidone- Iodine solution 10%	500ml	190	514	97660	0.195490945	89.49772439	C
5	Omeprazole Injection 40Mg Vial	Vial	170	568	96560	0.19328902	89.69101341	C
6	Clarithromycin 500mg	Pack of 10s	250	373	93250	0.186663226	89.87767664	C
7	Ketamine Injection - 50Mg/Ml	Vial	100	932	93200	0.186563138	90.06423977	C
8	Amoxicillin/Clavulanic 1.2g Injection	Vial	113	789	89157	0.178470061	90.24270984	C
9	Amlodipine Tablets 5mg	28s	39	2280	88920	0.177995647	90.42070548	C
10	Ampicillin/Cloxacillin Neonatal Drop 90Mg/0.6 Ml	8Ml	110	808	88880	0.177915576	90.59862106	C

APPENDIX X: VEN CATEGORIZATION OF A SAMPLE OF 40 DRUGS

	ITEM	UNIT SIZE	VEN CATEGORY
1	Aceclofenac 100mg	Pack of 10s	V
2	Aceclofenac+Paracetamol Tablets 100/500mg	Pack of 10s	E
3	Acetazolamide Tablets 250mg	Pack of 100s	V
4	Acetylsalicylic Acid Tablets - 300mg	Tin of 1000s	V
5	Acetylsalicylic Acid Tablets 75mg-Enteric Coated Blister Pack	Pack of 30s	V
6	Acyclovir 3% Ophthalmic Ointment	4.5gm	E
7	Acyclovir 5% Cream	10gm	E
8	Acyclovir Tablets - 400mg	Pack of 100s	V
9	Adrenaline Injection - 1Mg/Ml	Ampoule	V
10	Albendazole Tablets 400mg	100s in Blisters	V
11	Albumin (Human) 20%	100ml	V
12	Amikacin Sulphate 500Mg /2Ml Injection	Ampoule	V
13	Aminophylline 250mg injection	Ampoule	V
14	Aminosidine Syrup 125MG/5ML, 60ML	60ml bottle	E
15	Amitriptyline Tablets 25mg	100s In Blisters	V
16	Amlodipine Tablets 5mg	28s	E
17	Amoxicillin Capsules 500mg	100s in Blisters	V
18	Amoxicillin Tablet 250mg Dispersible, Scored	Pack of 100s	V
19	Amoxicillin/Clavulanic 1.2g Injection	Vial	V
20	Amoxycillin Capsules 250mg	Tin of 1000S	V
21	Amoxycillin/Clavulanic Dispersible Tablets 228.5mg	Pack of 10s	V
22	Amoxycillin/Clavulanic Dispersible Tablets 625mg	Pack of 10s	V
23	Amoxycillin/Clavulanic Potassium Tabs (875+125mg) 1gm	Pack of 10s	V
24	Amoxyclav suspension 312.5mg	100mls	V
25	Amphotericin B injection	Vial	V
26	Ampicillin/ Cloxacillin 250mg/5ml 100ml Syrup	100ml	N
27	Ampicillin/Cloxacillin Neonatal Drop 90Mg/0.6 Ml	8Ml	E
28	Anastrozole Tablet, 1mg	Pack of 28s	N
29	Antacid Syrup Aluminium Hydroxide, Magnesium Hydroxide	Bottle	E

30	Anti-D (Rh) Injection - 300mcg	Vial	V
31	Anti-Rabies Serum Inj - 200 1U/Ml 5Ml Ampoule/Vial	Ampoule	V
32	Ascorbic acid tabs 200mg	1000s	N
33	Atenolol 50mg tablets	28s	V
34	Atorvastatin 10Mg Tablets	Pack Of 30S	E
35	Atracurium Injection-10Mg/Ml, 5Ml Ampoule	Ampoule	V
36	Atropine Injection - 1mg/ml	Ampoule	V
37	Azithromycin 500mg	Pack of 3s	N
38	Azithromycin Oral Suspension (Pfr) - 200Mg/5Ml	30ml bottle	N
39	Benzathine Benzylpenicillin 1.2MU Vial	Vial	V
40	Benzathine Benzylpenicillin 2.4MU Vial	Vial	V

Thesis - DRUG CONSUMPTION AND EXPENDITURE PATTERNS AT JARAMOGI OGINGA ODINGA TEACHING AND REFERRAL HOSPITAL

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