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Inventory Control Analysis for Efficient Service Delivery in a Pharmaceutical Store

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ABSTRACT
Pharmaceutical stores have always been faced with the problem of proper inventory management, as they deal with products that either expire or become obsolete. Hence the need for efficient inventory control which will enable them to keep the right amount of inventory to meet up with their customers' requirements without having stock-outs or excess inventory. This research is aimed at enhancing the efficient service delivery of a pharmaceutical shop through inventory control techniques and analysis. To provide an in-depth information on the nature of the pharmaceutical products in terms of cost value, clinical importance and how fast they are passing through the inventory, the ABC-VEN-FSN inventory classification matrix we adopted. The EOQ model was also deployed to determine the optimum order quantity per order of the products that will minimize cost in a medium scale pharmaceutical store. A retrospective study (record review) was used for the ABC analysis and the FSN analysis, while a descriptive retrospective study was used for the VEN analysis. Also, a qualitative study was carried out with questionnaire to determine the nature of the pharmaceutical store inventory, while a quantitative retrospective study was applied for the gathering of data like holding cost and ordering cost of inventory items required for the development of the ordering policies. The application of the matrix to the inventory items showed that 28 of the items falls under the category I and accounting for 74.79% of the total annual acquisition cost, while categories II and III have 23 and 6 items and accounts for 21.91% and 2.80% of the total annual acquisition cost respectively. The EOQ analysis showed that the category I items accounted for 73.62% (NGN 13,193,762) of the total annual inventory cost, while categories II and III have 23.22% (NGN 4,161,271) and 3.16% (NGN 567,060) of the total annual inventory cost respectively. The research revealed that the adoption of the inventory control techniques will enable the pharmaceutical store to save NGN 4,011,987 (about 5,586 USD), which is 18.29% of its total annual inventory.

Keywords: inventory, inventory management, economic order quantity, ABC inventory classification, VEN-FSN matrix, pharmaceutical products

I. INTRODUCTION

Inventory can be viewed as one of the main portion or part of asset and working capital in any industry.Therefore every organization needs a kind of inventory to be maintained for a smooth operation and process stability. Management of stocks ensures there is material availability and minimizes the cost of procuring and keeping of these stocks.Over the years health care cost has continued to increase. A significant portion of these costs are inventory components. Improving inventory management in the healthcare sector is important not only because of its financial scale, but also because the availability of supplies is critical to patient care (Evans, 2017).The key issue for the material managers in the hospital setting is the identification of effective strategies to improve inventory availability, while decreasing the costs.

Global health care costs have continued to rise. In 2017, it was $7.8 trillion or $1080 trillion per capita. About $1.25 trillion was spent on pharmaceuticals in 2019, accounting for a significant portion of the healthcare budget accounting for about 10% of annual healthcare spending(Jobira et al., 2021). Spending money on irrelevant or substandard pharmaceutical items increases the cost of inventory management. In order to mitigate these problems and apply effective pharmaceutical supply, there has to be a

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proper Inventory management system and well trained and skilled professionals to manage the system.

An efficient inventory management plays a vital role in the practice of any kinds of drugstore since it covers both financial and operational viewpoints. Inventory decisions must involve a delicate balance since too much stock translates to too little cash and, oftentimes to less profitability. (Okpala, 2014), explained that "the keeping of excess inventory is quite expensive to any company as apart from its direct cost, there are also the costs of transportation, storage in the warehouse, as well as insurance." He listed pilfering, obsolescence, and inferno as the risks associated with excess inventory.

Equally, very low inventory can mean lost sales and most times customer`s goodwill. Handling and managing numerous types of drug is a complex situation for pharmaceutical drugstores that often face multiple issues related to inventory control, such as stock shortage and stock piling,as both cases have tremendous effect on the inventory cost of all drugs.

Also, poor inventory management results to inefficient use of financial resources, shortage or overage of some medicines resulting in expiration and increase in holding cost, as well as decline in quality of service once the drug needed by a customer is not available. This situation can negatively affect productivity and customer satisfaction.

Hospital pharmacy and drug stores have always been faced with the issue of inventory management. Since they deal with products that either expire or become obsolete, they are therefore faced with the problem of how much of the items to maintain at a given period of time, in order to be able to meet customers' requirement by not going out of stock, and also to reduce cost. If they carry too much stock in order to avoid stock out, most of the products end up expiring or becoming obsolete, thereby leading to waste of investment. In a different scenario, if they decide to carry too little stock in order to minimize cost, they might run into the situation of having a stock out leading to loss of customer's goodwill.

It has been observed that most of these pharmacies do not practice standard inventory management methods. This was the plight of the case study company, a medium scale pharmaceutical store in Nigeria. The store is practicing eye ball inventory management. That is, they rely on the staff to know when to make an order for a product, and this often leads to stock outs or stock pilings of some items that are not vital or essential to treatment, and most of these items later go on to become dead stocks, thereby tying up capital that can be better be utilized elsewhere.

Some of the factors that attribute to the above mentioned issues are the inability of the store staff to have a clear understanding of the nature of these items in terms of their cost value, clinical importance and rate of usage, as well as the optimum quantity of the items to order per order. This explains the need for the study which was carried out to solve the above mentioned problems by first employing inventory classification methods known as ABC, VEN, and ABC-VEN-FSN matrix to categorize the products based on their dollar or monetary value, as well as clinical importance, and on their rate of usage, in order to determine the ones that requires more control than the rest. Secondly, the study was aimed at developing the Economic Order Quantity (EOQ) model in order to determine the optimum order quantity that will reduce cost, before comparing the results with the one practiced by the pharmacy.

The Fast moving, Slow Moving, and Nonmoving (FSN) analysis is an inventory management technique that classifies inventory according to their consumption rate. While VEN analysis which assists in the prioritization of different drugs in their selection for purchase and usage in a pharmaceutical store supply system, ranks pharmaceuticals based on their significance as vital, essential, and normal.

II. LITERATURE REVIEW

In this work, ABC-VEN-FSN matrix inventory classification was employed for the management of inventory of the case study firm, which is a medium scale pharmaceutical store where the main issue facing their inventory managementis lack of proper knowledge of the nature of the items under study, in order to determine the inventory policy to adopt since these items have low shelf life. EOQ model was also applied to determine the optimum order quantity per order of the items, in order to minimize cost of inventory.

Some related studies includes (Tanwari et al., 2000), which made use of the ABC analysis method to tackle the inventory issues facing the spare parts store of a service firm. They highlighted some of the issues facing the inventory of the spare parts store as congestion of spare parts and use of inappropriate inventory management computer packages which leads to the problem of some parts being difficult to locate when they are required. They applied ABC inventory analysis to classify

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the items into A, B, C categories where they found out that Acategory items requires tight control, low lot size, continuous review and small safety stock. While B category items needs moderate control, moderate lot size, occasional review and moderate size of safety stock, and C category items needs lose control, large lot sizes, infrequent review and large safety stock size.

Also,(Pholpipattanaphong and Samingwong 2021)carried out a research to improve the efficiency of MaharajNakorn Chiang Mai Hospital's Pharmaceutical Inventory. The principle of ABC-VED Classification was applied in this research to prioritize the medicine inventory. Moreover, the optimal number of inventory is defined using Economic Order Quantity (EOQ), Safety Stock (SS), and Reorder Point (ROP). The result of the developed models can reduce the total cost by 17.62%, medicine storage by 64.40% and medicine shortages.

(Sefinew et al., 2016) in the work they carried out at TikurAnbessa specialized hospital pointed out that the problem facing the pharmaceutical inventory management in the hospital is that of shortages. They also observed that the units in the hospital have only 20% of the pharmaceuticals they need. They proposed the use of ABC-VEN matrix approach to mitigate the problem. Their findings indicated that the majority of pharmaceuticals were either vital or expensive, and require proper management and attention.

(Edefo et al., 2019) carried out a study aimed at identifying the categories of available drugs in Federal Neuro-Psychiatric Hospital (FNPH) Benin City,andequallymade recommendations for strict managerial control. They analyzed the annual consumption and expenditure incurred for pharmaceuticals from 2014-2018. The adoption of the ABC, VED, and a matrix based on ABC and VED analysis, was developed to narrow down the group of items for effective managerial monitoring. The ABC-VED matrix analysis of drugs for 2014, 2015, 2016, 2017 and 2018 revealed that category I items which were 21 (20.19%), 26 (21.14%), 27 (19.02%), 27 (18.12%), and 27 (18.49%) respectively consumed NGN18, 991,634 (72.21%), NGN28, 817,113 (74.22%), NGN37, 955,459 (73.76%), 42,562,300, (70.79%), NGN44,430,522 (74.03%) for each year Annual Drug Expenditure respectively. From the result the authors were of the view that scientific inventory management tools need to be applied strictly and routinely for category I of the ABC-VED matrix in order to save money for the establishment and also reduce out of stock syndrome.

In the same vein (Nag and Anany, 2016) applied ABC – VED matrix, an inventory control tool which encompasses both the criteria of usage value and criticality of items for managing inventory of major drugs for a pharmaceutical distributor in Kuwait. The study was undertaken for 100 drugs, accounting for a total drug expenditure of 27231151KWD (approx. 90 million USD) for the financial year 2013-2014. The combined ABC – VED matrix was able to identify the right combination of drugs which requires stringent control (Category I). It was observed that "Category I" consisted of 27% drugs consuming 71.02 % of the annual drug expenditure (ADE), "Category II" comprised 51% items consuming 27.10 % of ADE, and "Category III" consisted of the remaining 22% items consuming only 1.88 % of ADE. Such categorization was able to focus attention on a limited group of drugs although covering a major percentage of ADE. This eliminates the need for equal focus on trivial items, for which, moderate (Category II) to low control (Category III) may be deemed enough. The matrix classification therefore, was found to be an important tool in decision making for purchasing, maintaining buffer stock and forecasting requirements in order to eliminate out-of-stock situations with optimal use of resources.

Also,(Taddele et al., 2019) assessed the inventory of hospitals by means of an ABC-VEN matrix analysis to identify drugs that require strict supervision. The study showed that Category I medicinal products require strict inventory controls while Category II and Category III medicinal products require mid-and lower-level control, respectively. The Research suggests that ABC-VEN techniques are to be implemented in a health care facility for efficient use of resources and waste disposal.

III. METHODS

Research Area and Period

This study was carried out using the data from a medium scale pharmaceutical store inAwka, Anambra state, Nigeria. The study was carried out with the firm's data from October 2021 to December 2021.

Study Design

Retrospective study is used to investigate a phenomenon or issue that has occurred in the

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past. It involves secondary data collection based on data available from previous studies or databases. So, a retrospective study (record review) was used for obtaining the data for the ABC analysis and the FSN analysis while a descriptive retrospective study was used for the VEN analysis. Also, a qualitative study was carried out to determine the nature of the pharmaceutical store's inventory by preparing a questionnaire, while a quantitative retrospective study was used for the gathering of data like holding cost and ordering cost of inventory items necessary for the development of the ordering policies.

Data Collection Tool

A structured data collection format was used to collect the required data for the ABC analysis, FSN analysis,VEN analysis, as well asthe data for holding cost of inventory items and ordering cost of inventory items per order.

Data Collection Procedure

For ABC analysis, the annual expenditure of each drug for the year 2019 was collected from sales record and was compiled with excel spreadsheet. The VEN classification was obtained from information collected through a structured questionnaire that was filled by medical experts and compiled using excel. The FSN data was gotten by reviewing issuing vouchers and calculating the frequency of issue with excel spreadsheet. The data necessary for the development of ordering policies like holding cost, ordering cost, lead time, etc. was gotten through the use of questionnaire and reviewing of previous data.

The ABC Analysis (Based on Cost)

ABC analysis is an inventory classification method where inventory items are divided into three categories namely A, B, C in descending order of value, with the A category having the highest value and the C category the lowest value. This method or strategy enables a company's management to focus more on the highest value goods (the A items) and not on the many low value goods (C category items). ABC inventory analysis is based on the Pareto principle. The Pareto Principle states that 80% of sales come from products in the top 20%. This means that the top 20% of the product generates 80% of the business revenue. This can also be referred to as the 80/20 rule.

Item A:

Items classified as A in the ABC inventory management model are the items that record the highest value in terms of annual consumption. It is interesting to note that the highest 70-80% of a company's annual consumption value only accounts for 10-20% of its total inventory. Therefore, prioritizing these items is very important.

Item B:

These are items that have a medium consumption value. This amounts to about 30 percent of the total inventory in a company which accounts for about 15 to 20 percent of annual consumption value

Item C:

Items in this category have the lowest value in use and account for less than 5% of annual consumption costs, accounting for approximately 50% of total inventory.

The ABC analysis can be achieved with the following steps: First, the annual demand for the drug items under study in the year 2019 was extracted from the sales record. The unit cost for each medicine and the total quantity sold were used to calculate the value of each item. The value of consumption was furthermore calculated by multiplying the unit cost by the number of units of each drug purchased to obtain the total value. Then, the percentage of the total value represented by each medicine was also calculated by dividing the value of each medicine by the total value of all medicines. The list was then rearranged, ranked in descending order by the total value.

A cumulative percentage of the total value for each medicine was calculated. Cut-off points or boundaries for Class A, B, and C medicines were determined. "A" class has about 20% of items and 66.6% of expenditure value; "B" class has around 30% of items and 23.3% of expenditure value while "C" class has around 50% of items or 10.1% of expenditure value. Finally, the results were presented in tables showing proportions of items in different classes and the proportion of budget utilized.

VEN Analysis (Based on Criticality)

All drugs purchased during the reporting year were grouped into three according to the VEN classification, after a threshold analysis was performed at the medical store. As lifesaving medicines, urgently needed medicines and medicines that must be kept at all times were included in group V. Drugs that are less severe and those available at the hospital were included in

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group E. N included products with the lowest severity or products for which the deficiency did not pose a threat to the patient's health.

Coupling of ABC-VEN Analysis

ABC and VEN analysis were combined by cross tabulation to obtain the ABC-VEN matrix and various drug categories. A total of nine subcategories were derived from the ABC-VEN matrix, from which three main categories were constructed: Category I comprises all the expensive and vital medicine items: AV+AE+AN+BV +CV, Category II included the remainder of the items in B and E items: BE+BN+CE and Category III included the cheapest and non-essential medicine items: CN.

FSN Analysis (Based on Frequency of Issue)

FSN, also known as FSN analysis, is an acronym for fast moving, slow and immobile in inventory management. FSN is one of the inventory management methods that classify products according to consumption rate, inventory quantity, and inventory utilization rate. Fast-moving stocks, as the name suggests, include stocks that move quickly and need to be replenished very often. Typically, inventory in this category has a turnover of 3 or greater and accounts for about 10-15% of total inventory. Slow moving inventory is inventory that moves slowly through the supply chain and has an inventory turnover of between 1 and 3. Typically this is 30-35% of the total inventory. The inventory that rarely moves (below 1), which accounts for 60-65% of total inventory is called fluctuating inventory. Inventory can be classified based on various parameters such as consumption rates, average dwell time, annual demand rate, reorder frequency, and how often products are used or moved from their location. To figure out which product belongs to which category, there is a need to calculate the above-mentioned parameters, such as average dwell time and consumption rate over that time period.

In this study, the drugs were categorized into FSN according to their frequency of consumption. First, the frequency of each item issued was obtained and re-arranged in descending order. Accordingly, those items which were issued more than 15 times within a year were classified as fast-moving items (F), those issued 5–15 times were considered as slow(S), and those items issued less than 5 times were classified as non-moving (N) items.

ABC-VEN-FSN Matrix Analysis

The analysis of the combination of the three classifications was reviewed in order to get the matrix. The matrix will provide 27 sub-categories with the first letter representing the ABC classification, while the second and last letter will each represent the VEN and FSN classifications respectively. These 27 categories will then be further divided into three major categories; I, II, III. Category I will contain the “A” and “V” categories with the FSN, category II will contain “B” and “E” categories with the FSN and the “III” category will contain the remaining.

IV. THE ECONOMIC ORDER QUANTITY MODEL (EOQ)

The main advantage of EOQ is that it provides the most cost-effective unit-per-order model to minimize ordering and inventory costs. However, it assumes that a new supply will occur when there is no shortage of inventory because the stock level drops to zero. The company can meet the demand as it arises, and the supplier can supply the necessary stock in full without delay.

The economic order quantity is given by the formula;

$$\mathbf{EOQ} = \sqrt{\frac{2SD}{H}}$$

Where C is the inventory reorder cost, and D is the annual demand. The result is divided the annual inventory holding costH.

The reorder cost Sincludes labor, supplies used to place an order, and accounts payable procedures. The annual demand D was developed from the Consumables Usage Data. The inventory holding cost H is equal to 30% of the average price per item.

Some of the assumptions of this model include the following:

1. Demand is known and constant
2. Lead time is known and constant
3. Receipt of inventory is instantaneous. That is inventory from an order arrives in one batch at one point in time.
4. Purchase cost per unit is constant throughout the year and there is no quantity discount.
5. The only variable cost is the ordering cost and holding cost for storing inventory over time.
6. Orders are placed so that shortages or stock out are completely avoided.

The next step is to calculate the total annual policy cost under the EOQ model where Q is the optimal quantity.

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$$TC = \sum(\frac{Q}{2}H + \frac{D}{Q}S + CD)$$

The total cost TC is the sum of product's average in-stock quantity$\frac{Q}{2}$multiplied by the holdingcost H, number of reorders$\frac{D}{Q}$multiplied by the reorder cost S and the purchase cost **CD**. This total cost was calculated for each item and then summed across items in order to derive the total cost for the EOQ policy.

V. RESULTS

ABC Analysis

The ABC analysis showed that 16 (28.07%) of the items under study falls under the A category, 20 (35.09%) of the items falls under the B category, while 21 (36.84%) of the items falls under the C category as shown in table 4. The "A" category items consumed 66.19% of the total annual drug expenditure while the "B" and "C" categories consumed 22.83% and 10.98% of the total annual drug acquisition cost.

Table 1: ABC analysis of the items

CATEGORY	NUMBER OF ITEMS	PERCENTAGE OF ITEMS	PERCENTAGE EXPENDITURE
A	16	28.07	66.19
B	20	35.09	22.83
C	21	36.84	10.98

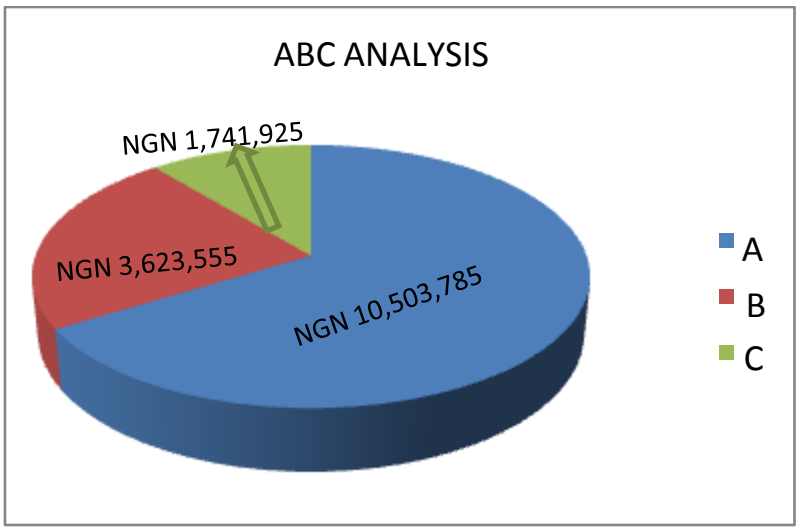

Figure 1: showing the annual drug acquisition cost of each category

VEN Analysis

After conducting the VEN analysis it was determined that 16 (28.07%) of the items falls under the V or vital category, while the E and N categories comprised of 25 (43.86%) of the items and 16 (28.07%) of the items respectively as depicted in table 5. It was also discovered that the E category consumed the most of the annual drug expenditure as it consumed up to 49.00%. The N category follows it with a consumption of 32.04%,while the V category is in the last place with a consumption of 18.97% of the total annual drug expenditure as shown in Table 2.

Table 2: VEN Analysis of the items

CATEGORY	NUMBER OF ITEMS	PERCENTAGE OF ITEMS	PERCENTAGE EXPENDITURE
V	16	28.07	18.965
E	25	43.86	48.997
N	16	28.07	32.039

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The annual drug acquisition cost of each category is depicted in Figure 2.

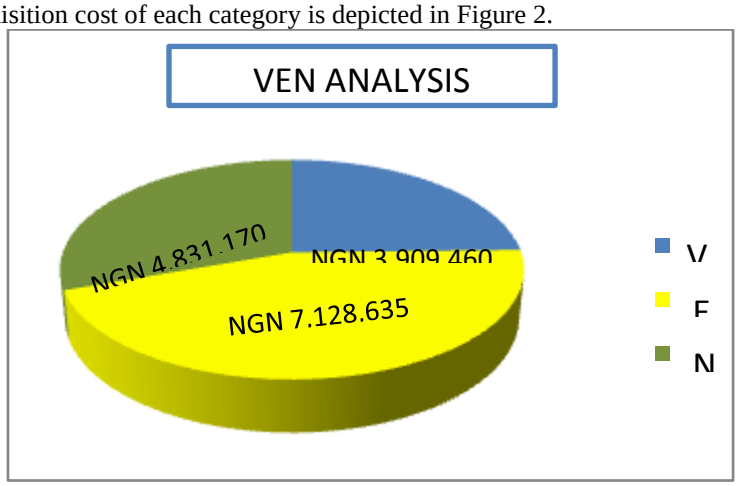

Figure 2: The annual drug acquisition cost of each category

FSN Analysis

The following results were obtained after the FSN analysis: The F (fast moving) category came out with 12 (21.05%) of the items, the S (slow moving) category with 25 (43.86%) of the items and the N (non-moving) category with 20 (35.09%) of the items as shown in Table 3. The analysis also showed that the F category consumed 38.09% of the total annual drug expenditure while the S and N categories consumed 39.64% and 22.27% of the total annual drug expenditure respectively.

Table 3: FSN Analysis of the items

CATEGORY	NUMBER OF ITEMS	% OF ITEMS	% EXPENDITURE
F	12	21.05	38.09
S	25	43.86	39.64
N	20	35.09	22.27

The annual drug acquisition cost of each category is shown in Figure 3.

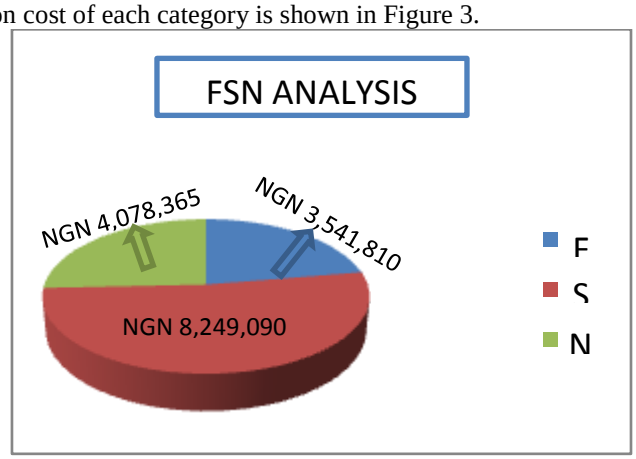

Figure 3: The annual drug acquisition cost of each category

ABC-VEN Analysis

The coupling of ABC and VEN classification gave the following results: The AV (vital and expensive) category has 4 (7.02%) of the items with 15.55% of the total annual drug acquisition cost, the AE (essential and expensive) category has 8 (14.04%) of the items with 28.78% of the total annual drug acquisition cost, the AN (non-essential and expensive) category has 4 (7.02%) of the items with 21.89% of the total drug acquisition cost, the BV (vital and less expensive) has 4 (7.02%) of the items with 4.63% of the total drug acquisition cost.

Also, the BE (essential and less expensive) category has 10 (17.54%) of the items with 12.45% of the total drug acquisition cost, the

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BN (non-essential and less expensive) category as depicted in Table 4 has 6 (10.53%) of the items with 5.76% of the total drug acquisition cost, the CV (vital and not expensive) category has 8 (14.04%) of the items with 4.46% of the total drug acquisition cost, the CE (essential and not expensive) has 7 (12.28%) of the items with 3.72% of the total drug acquisition cost and the CN (non-essential and not expensive) category has 6 (10.53%) of the items with 2.80% of the total annual drug acquisition cost.

The results revealed that the AE, AN, BE and AV categories are the categories having the highest percentage consumption of the annual drug acquisition cost with 28.78%, 21.89%, 12.45% and 15.55% respectively while the CN category has the least consumption of the total annual drug acquisition cost of 2.8%. We further categorized the items from nine categories to three major categories; categories I, II and III. Category I comprises of the sub categories having "A" and "V" categories (AV, AE, AN, BV, CV), category II comprises of "B" and "E" categories (BE, BN, CE) and the last category, category III comprises of the CN category.

Table 4: ABC-VEN Analysis of the Three Major Categories

Category	Percentage Expenditure	Number of Items	Percentage of Items
I	75.31	28	49.12
II	21.93	23	40.35
III	2.8	6	10.53

ABC-VEN-FSN Analysis

The calculations of the ABC, VEN and FSN classifications gave the ABC-VEN-FSN classification matrix that takes into consideration the three criterions (cost or expenditure, importance or vitality, and rate of movement or how fast the items are moving). The analysis presented 27 categories with their respective values for the number of items, percentage of items, and percentage of total annual drug expenditure as presented in table 5.

Table5: ABC-VEN-FSN Classification

	AVF	AVS	AVN	AEF	AES	AEN	ANF	ANS	ANN
Number of Items	3	1	0	1	5	2	0	3	1
% of Items	5.26	1.75	0	1.75	8.77	3.51	0	5.26	1.75
% Expenditure	13.64	1.9	0	2.02	14.49	12.24	0	20.13	1.76
	BVF	BVS	BVN	BEF	BES	BEN	BNF	BNS	BNN
Number of Items	1	2	1	2	6	2	1	2	3
% of Items	1.75	3.51	1.75	3.51	10.53	3.51	1.75	3.51	5.26
% Expenditure	1.22	2.74	0.67	2.17	7.53	2.74	1.01	1.91	2.83
	CVF	CVS	CVN	CEF	CES	CEN	CNF	CNS	CNN
Number of Items	0	4	4	2	1	4	2	1	3
% of Items	0	7.02	7.02	3.51	1.75	7.02	3.51	1.75	5.26
% Expenditure	0	1.78	2.2	1.18	0.45	2.09	1.07	0.56	1.17

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They were further categorized into three major categories; categories I, II, and III. The first category, category I comprises of the "A" and "V" categories with the FSN (AVF, AVS, AVN, AEF, AEN, ANS, ANN, BVF, BVS, BVN, CVF, CVS, CVN), the II category comprises of the "B" and "E" categories with the FSN(BEF, BES, BNF, BNS, BNN, CEF) and the last one, the III category comprises of the remaining(CNF, CNS, CNN). The result of the ABC-VEN-FNS of these three categories showing the number of items, percentage number of items and the percentage total annual drug expenditure is shown in table 6.

TABLE 6: ABC-VEN-FSN Analysis of the Three Major Categories

Category	Percentage Expenditure	Number of Items	Percentage of Items
I	74.79	28	49.12
II	21.91	23	40.35
III	2.8	6	10.53

The naira value of the total annual drug acquisition cost of the three categories is shown in figure 4.

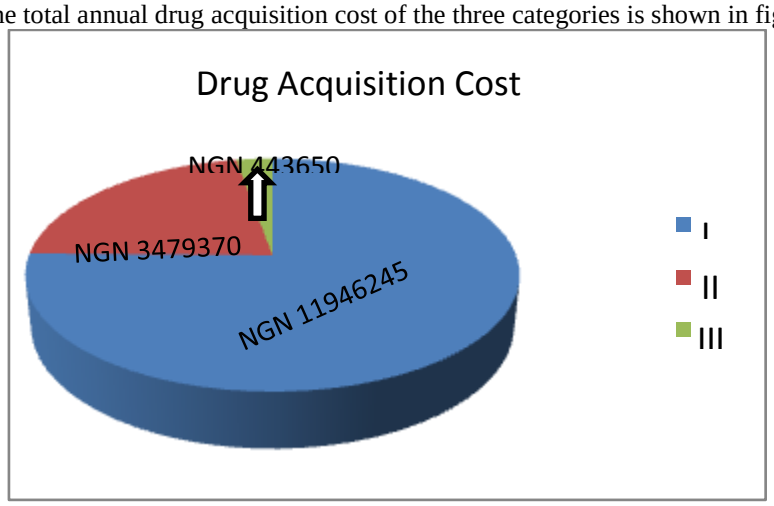

Figure 4: The naira value of the total annual drug acquisition cost of the three categories

VI. ECONOMIC ORDER QUANTITY ANALYSIS

The economic order quantity model is the most widely used and traditional means of determining how much to order in a continuous system. It is derived under a set of simplifying assumptions such as; demand is known with certainty and is constant over time, constant lead time, shortages are not allowed, order quantity is received all at once but in nature demand of pharmaceutical drug items change from time to time, and one good thing about this inventory model is that even if all the assumptions were not satisfied, it is fairly strong in practice. All 57 drug items were subjected to the model and Table 7 shows the summary of the total annual inventory cost of the various categories.

Table 7:Annual Inventory Cost using Economic Order Quantity (NGN)

CATEGORY	I	II	III
DRUG ACQUISITION COST	11946245	3479370	443650
ANNUAL INVENTORY COST	1247518	681901	123410
TOTAL ANNUAL INVENTORY COST	13193762	4161271	567060

Table 7 shows the result gotten from the EOQ analysis and the total annual inventory cost of the three major categories from the ABC-VEN-FSN matrix conducted previously with category I having NGN 13193762 as its total annual inventory, cost while category II and III have NGN 4161271 and 567060 respectively as their total annual inventory cost.

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EOQ Model vs Present Practice

After the EOQ analysis, the result of the EOQ model was compared with that of the current inventory management practice (eye ball inventory management) adopted by the store to determine how the proposed model (EOQ model) performed against the current practice of the store as depicted in Table 8.

Table 8: Result of the EOQ Analysis of the Items

Items	Sub-Category	EOQ Quantity	Total Expenditure in NGN (EOQ)	Total Expenditure In NGN (Current Practice)	Total Saved (NGN)
Amatem Soft Gel by 6	AES	86.1	406467	460540	54073
Lonart Ds Tab	AES	102.1	608990	700480	91490
Ciprotab by 10	AES	113.9	691470	720540	29070
Augmentin 625mg	AEN	70.7	1684859	1751200	66341
Panadol Tab X 100	AVF	154.3	764808	900420	135612
Fleming 1g	BEN	54.3	216299	223761	7462
Augmentin 1g	BEN	30.9	290860	303260	12400
Pyrantrin Tablet	CEN	71.6	78965	105195	26230
Ciprotab by 14	AES	91.8	508297	586570	78273
Amoxil Beecham 500mg	BES	166.7	179997	270180	90183
Sudrex Tab	CEF	226.8	127311	274605	147294
Panadol Extra Tab X 100	AVF	151.4	952664	1140480	187816
Aquaclav 625mg	BES	89.4	310249	350450	40201
Artelumex Forte	BES	121.7	212863	280270	67407
P-Alaxin Tab	BES	112.8	268229	311330	43101
Cipronol-Tn Tablet	CEN	132.6	107980	115521	7541
Cytotec Tab	AEN	50.8	387432	403018	15585
Hb 12 Tonic	AVF	151.9	644245	825390	181145
Procold Tab	CEF	391.6	115495	292060	176565
Lonart Tab By 24	BEF	158.1	277947	470240	192293
M&B Paracetamol By 96 Tablets	BVF	264.1	227573	493629	266056
Ibuprofen 400mg Tabsx84	BVS	108.9	286359	378154	91795
Ampicillin 500mg Capsx100	AEF	104.8	365217	481729	116512
Mist Magnesium Trisilicate 2l	AES	71.4	336000	434588	98588
EmzorChlorpheniramine 4mgx100	CES	115.5	92785	132180	39395
Folic Acid 5mg Tabsx28	CVS	81.2	125617	191303	65686
Cosmogan Promethazine Syrup 5mg	CVS	251.6	118650	184895	66245
Metronidazole 400mg Tabsx21	BVS	52.0	220077	237259	17182
WosanPovidone Iodine	BES	154.3	207404	325210	117806

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ChlorhexidineGluconate	CVS	48.1	110045	187651	77605
Gentian Violet Solution 1% 28ml Bells	CNF	66.7	94500	253815	159315
Dermazin Silver Sulphadizine 1% 50g	CEN	45.6	101909	120480	18571
Calamin Lotion 100ml Skg	CNF	333.3	120000	256072	136072
Absorbent Cotton Wool 500g	AVS	117.5	344568	382362	37795
Sterile AbsorGuaze Swabs	CVS	374.6	97354	146057	48703
5% Salicyclic And Sulphur	CEB	64.9	125841	131580	5738
Benzyl Benzoate	BVN	95.0	131577	146585.8	15009
BelaxBisacodyl Tabx10	CNN	280.6	29741	39088	9347
Magnesium Sulphate Injection	CVN	55.0	126739	132450	5711
Menthol Crystals 5g(Core)	ANN	44.0	319915	329930	10015
Puntan's Pride Vitamin C-500mg	ANS	74.9	2006771	2011425	4654
Emvite Multivitamin Syrup	BEF	239.0	130100	355105	225005
Puntan Vitamin B Complex	BNF	148.0	192081	421210	229129
GoldlineSenna Genx100	CVN	65.9	96499	105573	9074
Ferrous Sulphate 200mg Almus	CVN	40.0	120000	146600	26600
YtacanClotrimazole	CNN	258.2	113238	120090	6852
Hydrogen Perox 20vol 6%(Bells)	BES	106.9	222675	339315	116640
Bithiol 10% (Ichttammol)	CNN	42.0	97924	117010	19086
Lactulose 3.3g/5ml Oral 500ml	BNN	22.3	166333	173890	7557
Azithromycin Tab 250mg	BNN	114.9	236814	237303	489
Calcium Carbonate Powder	ANS	51.3	349223	397186	47962
Calcium Gluconate Injection 10%	BNS	76.5	140153	174342	34189
Ethimtcin Gentamicin Eyedrop	CNS	173.5	111656	238733	127076
Chloramphenicol Eyedrop	CVN	187.3	97354	106114	8760
Dioctyl 100(Docusate Sodium)	BNN	26.5	135489	140789	5300
Glycerol Suppositories Children	ANS	103.9	1064994	1108741	43747
Glycerol Suppositories 4g For Adult	BNS	88.9	223492	270130	46638

Total	17922093	21934080	4011987

VII. CONCLUSION

The results of the analysis revealed that the application of the ABC-VEN-FSN matrix to the management of the inventory items was able to give an in-depth information regarding the nature of the items in terms of their cost, clinical importance, and their rate of movement through the inventory. The application of the matrix to the inventory items showed that 28 of the items falls under the "I" category and accounting for 74.79% of the total annual acquisition cost, while category "II" and "III" each have 23 and 6 items and account for 21.91% and 2.80% of the total annual acquisition cost each.

The category I comprise of the high cost, vital and FSN items, the category II comprises of the medium cost, essential and FSN items, while the category III comprises of the low cost, non-essential and FSN items. The matrix as shown Table 5 revealed that even though some of the items are of high cost and vital to patients' treatment, they can also be slow moving or non-moving items, and as such great care should be taken in the management of these items as buying too much of them because they are vital to patients care may lead to their becoming dead stocks and in the process tie up capital.

The EOQ analysis showed that the category I items accounted for 73.62% (NGN 13,193,762) of the total annual inventory cost, while category II and III has 23.22% (NGN 4,161,271) and 3.16% (NGN 567,060) of the total annual inventory cost respectively. Comparing the EOQ and the present practice of the pharmaceutical store revealed that the firm will save NGN 4,011,987 (about 5,586 USD) which is 18.29% of the total annual inventory by adopting the inventory control techniques.

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