Assessment of Pharmaceuticals Inventory Management by Using ABC-VEN and FSN-XYZ Matrix Analysis in West Shewa Zone, Oromia Regional State, Ethiopia

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Abstract

Background: Effective inventory management is required to balance inventory expenditure against demands for medicines. This study is conducted on pharmaceuticals inventory management by using Always-Better-Control (ABC), Vital-Essential-Nonessential (VEN), ABC-VEN matrix analysis, fast moving-Slow moving-Nonmoving (FSN), XYZ and FSN-XYZ matrix analysis.

Objective: The objective of the study was to assess pharmaceuticals inventory management by using ABC-VEN and FSN-XYZ matrix analysis in West Shewa Zone, Oromia, Ethiopia.

Methods: A facility based cross sectional study was conducted in 15 selected health facilities of West Shewa zone from March 15 to May 31, 2019. Health facilities were categorized as hospitals and health centers, and simple random sampling was used to select samples. The quantitative data was analyzed by using MS Excel spreadsheet and qualitative data analyzed manually.

Results: ABC analysis at health facilities of West Shewa zone revealed that 11.9%, 18.0% and 70.1% of items were classified as class A, B and C that consumed 70.34%, 20.0% and 9.72% of total pharmaceuticals expenditures (TPE) respectively. VEN analysis at this zone showed that 35.94%, 48.75% and 15.31% of items were identified as V, E and N that consumed 53.9%, 42.2% and 3.9% of TPE respectively. ABC-VEN matrix analysis indicated that category I, II and III items consumed 85.5%, 13.3% and 1.3% of TPE respectively. XYZ analysis of pharmaceuticals at zone showed that 70% of stock value was accounted by 17.0% of items that belonged to class X. FSN analysis at this zone revealed that around 20% of items categorized as fast moving accounted for 70% of total number of issues of items. FSN-XYZ matrix analysis of this zone showed that around 30% of items that contribute category I items carried 80% of stock value.

Conclusion and recommendation: ABC-VEN matrix analysis of present study revealed that a majority of TPE was consumed by category I pharmaceuticals that need great attention for control. FSN-XYZ matrix analysis of this study revealed as category I items contributed around 80% of stock value of pharmaceuticals. ABC-VEN and FSN-XYZ matrix analysis should be conducted for efficient use of resources and for enhancing effective patient care service.

Key words: ABC analysis, VEN analysis, ABC-VEN matrix analysis, FSN analysis, XYZ analysis, FSN-XYZ matrix analysis, West Shewa

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Lists of Acronyms

ABC- Always Better Control

ADE- Annual Drug Expenditure

DTC- Drug and Therapeutic Committee

ETB- Ethiopian Birr

FSN- Fast Moving, Slow Moving, Non-Moving

HCMIS- Health Commodity Management Information System

HC- Health Center

HR- Human Resource

IPLS- Integrated Pharmaceutical Logistic System

PI- Principal Investigator

PSA- Pharmaceutical Supply Agency

TPE- Total pharmaceuticals expenditures

VEN/VED- Vital, Essential, Nonessential/Desirable

XYZ- **X**: items whose stock values are high, **Y**: items fall in between two categories X and Z**, Z**: items whose stock values are low

1. Introduction

1.1. Background

Inventory is the stock of any item or resource used in an organization (1) and in pharmacy operations; inventory is referred to the stock of pharmaceutical products retained to meet future demand. Inventory management refers to all the activities involved in developing and managing the inventory levels of raw materials, semi-finished materials (work-in-progress) and finished good so that adequate supplies are available and the costs of over or under stocks are low (2).

About one third annual budget of health facility is spent on purchasing pharmaceuticals (2, 3). To minimize the inventory expenditure, health facilities may keep the medicines inventory low, but on the other hand, maximum service to the patients cannot be provided and the lack of medicines for patients in critical condition may cause serious problem. Therefore, effective inventory management is required to balance inventory expenditure against demands for medicines (4). In short the objective of good inventory management is to maintain a steady supply to operating units (and patients) while minimizing the costs of holding inventory and managing procurement (5).

There are several techniques of inventory management system methods. These are ABC (Always, Better, Control), VED/VEN (Vital, Essential, Desirable/Non-essential), FSN (Fast moving, Slow moving, Nonmoving), XYZ, HML (High, Medium, Low), SDE (Scarce, Difficult, Easy to obtain), GOLF (Government, Ordinary, Local, Foreign sources) and SOS (Seasonal, Off-Seasonal) (6-9).

This study is conducted on the analysis of some of the inventory management techniques described above like ABC, VEN, ABC-VEN Matrix analysis, XYZ, FSN and FSN-XYZ matrix analysis at health facilities of west Shewa zone for the year of 2016 to 2018.

ABC analysis is one of the most effective tools in materials management and is based on "Pareto's Law", which states that *"80 percent of the total value will be accounted by 20 percent of the items"* (10).

ABC analysis can be applied to drug consumption data over a one-year period or shorter (11). The analysis classifies the items into three categories: the first 10-20% of the items account for

approximately 70-80% of cumulative value (cost) (category A), 10-20% are category B items that account for a further 15-20% of the cumulative value and the remaining 60-80% are category C items, amounting for a mere 5-10% of the total value (12). A class items need close day to day control, B class items need periodic review and that of C class items need infrequent review (8).

Sometimes there are insufficient funds to buy all the desired medicines. VEN analysis is a well-known method to help set up priorities for purchasing medicines and keeping stock. Drugs are divided, according to their health impact, into vital, essential and non-essential categories (11). **V:** vital medicines are potentially lifesaving and have significant withdrawal side effects (making regular supply mandatory). **E:** essential medicines are effective against less severe illness. **N:** nonessential medicines are used for minor or self-limited illnesses, are of questionable efficacy (5).

Sometimes, ABC or VEN analysis alone is not enough, and carry certain limitations. ABC is based mainly on monetary value and compromises on essentiality of a drug. Considering VEN alone carries a risk of ignoring costly drugs found in non-essential category. To overcome these limitations an ABC-VEN matrix is prepared, and drugs are categorized as Category I, II and III. This effectively makes use of the complimentarily of each procedure (13). Category I includes all vital and expensive items (AV, BV, CV, AE, AN). Category II includes the remaining items of the E and B groups (BE, CE, BD). Category III includes the nonessential (desirable) and cheaper group of items (CN/CD) (1, 10, and 14). 1st Category pharmaceuticals need to be monitored and controlled continuously, 2nd Category need to be controlled periodically and 3rd Category do not need to be controlled periodically (15).

Inventory items are classified as fast moving, slow moving and non-moving (FSN) based on their frequency of issue or consumption pattern or their movement from the store. Fast moving items are those items which are used at a rapid rate, slow moving items are used in lesser frequency, while non-moving items remain in stock for several months without being issued. It is especially useful to control obsolescence, spillage, date-expiry and deterioration of items (10). FSN analysis is also used to control loss of clinical effectiveness of pharmaceuticals by longtime inappropriate storage conditions.

XYZ analysis is based on the value of closing stocks of inventory (16). The study is undertaken once a year at the time of annual stock taking. X items are those items whose stock values are high, while Z items are those items whose stock values are low. Y items fall in between two categories X and Z. This classification helps in identifying the items, which are being excessively stocked. It helps to control obsolescence and tells how the values are distributed amongst materials in stores (17).

The combination of FSN and XYZ can be applied for the timely prevention of obsolescence and to control the piling up of obsolete items (16). In case of pharmaceutical products FSN-XYZ matrix analysis is used to control expiry, loss of clinical effectiveness and accumulation of unneeded pharmaceuticals.

Currently there has been no study conducted concerning pharmaceutical inventory management practice at the study area. This study has been conducted on pharmaceutical inventory management by using ABC-VEN and FSN-XYZ matrix analysis in health facilities of West Shewa zone. Then it has an importance for administrative bodies, pharmaceutical suppliers and health facilities to design intervention activities based on the findings of the study.

1.2. Statement of the Problem

Resources of health care organizations are limited, it is essential that the existing resources be appropriately utilized, and health managers must be use scientific inventory control methods of the medical materials (18). Inadequacy and inefficient use of resources results in stock outs which may have grave consequences for the patient (19).

Some of the factors which compromise good inventory management practices are inadequate storage space, non-availability of computerized inventory system, delay in delivery and excessive lead times for purchasing products and lack of human resource (20). In many countries, poor inventory management in the public pharmaceutical supply system leads to waste of financial resources, shortages of some essential medicines or overages of others resulting in expiration, and decline in the quality of patient care (5) and also it leads to irrational drugs utilization and it increases inventory holding cost (21).

Most leading causes of death and disability in developing countries can be prevented, treated, or at least alleviated with cost-effective essential medicines (5), however World Health Organization (WHO) reported that about 30% of the world's population lacks regular access to essential medicines (22, 23); in the poorest parts of Africa and Asia this figure rises to over 50% (22). Different studies conducted concerning pharmaceuticals inventory management in Ethiopia and other African countries indicated as unavailability (stock out) and wastages of essential pharmaceuticals in health facilities are challenging issues. A study conducted in eight sub-Sahara African countries indicated that the mean availability of 12 priority essential medicines for women ranged from 22% to 40% and 12 priority medicines for children ranged from 28% to 57% (24). Another study conducted on ten tracer drugs in 15 health centers (HC) of Rwanda revealed that 73% of health facilities faced a challenge of medium to high levels of stock outs (25). The study conducted at Adama (Ethiopia) HCs indicated that the average availability of eleven tracer drugs on the day of the survey was 76.3% (26). A study conducted in East Shewa zone (Ethiopia) indicated that the mean stock out rate of key essential medicines was around 27.25% and around 10.43% of medicines were wasted resulting in loss of 174,366.98 Ethiopian birr (ETB) (27). Another study conducted at South West Shewa zone (Ethiopia) showed that as medicines wastage in health facilities is increasing from time to time (28).

Most of the studies conducted on the analysis of pharmaceutical inventory management are only ABC-VEN matrix analysis. Consumption pattern and annual closing value of pharmaceuticals were not clearly studied. Then in addition to ABC-VEN matrix analysis this study carried out the analysis of combination of consumption pattern of pharmaceuticals and their annual closing stock value which is known as FSN-XYZ matrix analysis.

1.3. Significance of the study

Inventory management is the heart of the pharmaceutical supply system and without a healthy inventory management system, the pharmaceutical supply system as a whole will not be viable (5). Then pharmaceutical inventory management is the core area of study in pharmaceutical supply systems.

Theoretically the finding of this study gives information and adds the knowledge of pharmaceutical inventory management for the reader and it can be taken as baseline study for another study to be undertaken at this study area. The practical importance of this study will be seen if health facilities found in the study area will use the findings of this study. By using this study health facilities can improve their pharmaceutical inventory management practices to save their pharmaceutical budget and serve the patients appropriately.

There has been no previous study conducted concerning pharmaceuticals inventory management in West Shewa zone and the status of pharmaceutical inventory management concerning budget spent on vital, essential and nonessential pharmaceuticals was unknown. Pattern of consumption (flow of pharmaceuticals) and the status of budget locked up on the closing stock year and type of pharmaceuticals those need greater attentions for control were also not identified. The baseline study conducted here identifies these all problems and it would help to take corrective actions depending on the finding of the study.

2. Literature Review

Inventory management seeks to ensure availability of the right material, at the right time, to the right place, at the least cost so that adequate stocks of the required essential items are maintained; for the uninterrupted supply of the items. Maintenance of proper inventory levels can avoid the issues like low inventory and high inventory turnover, excessive procurement cost, high carrying costs and higher frequency of stock-outs (10). In short, the objective of inventory management is to have the appropriate amounts of materials in the right place, at the right time and at low cost (1). Inappropriate pharmaceuticals inventory management may lead to waste of resources and has a negative impact on patient care. This might be due to miss-management of pharmaceuticals with in facility by health facility managements or due to challenges found at suppliers.

Health care organizations should ensure that they take specific actions to optimize the inventory level with the minimum total annual inventory cost and they implement the actions consistently. But, to determine which actions are the right ones for the organization, they first carry out the detailed analysis of the inventory. The results of the analysis can be used as a basis for defining the appropriate inventory optimization measures (17).

Several studies were conducted on the analysis of pharmaceutical inventory management practices by using ABC-VEN matrix analysis and identify items those need great attention for management control while forecasting, selecting, purchasing, stocking their inventory and use. But analysis of pharmaceutical inventory management practice by using FSN-XYZ matrix analysis was not clearly studied.

2.1. Literature Review of ABC, VEN and ABC-VEN Matrix Analysis

In 2007 a study conducted by Gupta R et al on ABC and VED analysis in medical stores inventory control in military hospital in New Delhi (India) and the findings of ABC analysis revealed that 14.6% class A drugs consumed 70% of ADE, 22.46 % class B items consumed 19.99 % of ADE and 63% class C drugs consumed 9.99 % of the total budget. The author discussed as, if drug inventory management considered ABC analysis alone, they would effectively control the recommended 47 drugs from class A, but would be compromising on the availability of 21 drugs of vital nature from B and C categories. VEN analysis of the study showed that 7.3% of drugs were vital, 49.3% essential and the rest 43.3 % were non-essentials.

The ABC-VED matrix of this study showed that 68, 159 and 98 drugs were found in category I, II and III respectively (29).

In 2010 at tertiary care teaching, research and referral healthcare institute in India 421 items analyzed by using ABC and VED Analysis, and on ABC analysis 13.78%, 21.85% and 64.37% items amounting for 69.97%, 19.95% and 10.08% of annual drug expenditure (ADE). VED analysis showed 12.11%, 59.38% and 28.51% items were found to be V, E and D category items respectively, amounting for 17.14%, 72.38% and 10.48% of ADE. On ABC-VED matrix analysis 22.09% items were found in category I, 54.63% items in category II and 23.28% items in category III, amounting for 74.21%, 22.23% and 3.56% of ADE respectively (14).

In 2010 a study conducted at Black Lion specialized hospital (Ethiopia) showed on ABC analysis of pharmaceuticals less than 3% of items for three years consumed around 80% of total budget. Class B items in each year were medium in number and consumed less than 20% of medicines budget. Class C medicines in each three years were more than 80% consumed only around 5% of the budget. From class 'A' medicines in each year only one medicine called Imatinib 100 mg alone which was received through donation consumed more than half value spent on medicines (30).

The result of study conducted in 2015 at secondary level hospital in India showed that ABC analysis from a total of 182 drugs; 10% of the drugs used 70% of the expenditure, 20% of drugs used 20% of ADE and 70% of the drugs used 10% of the expenditure. VED analysis of that study showed 31.9%, 53.3% and 14.8% of drugs were categorized as V, E and D amounting 12.1%, 84.5% and 3.4% of budget respectively. On ABC-VED matrix analysis, 40% of the drugs were categorized as category I, 47% of drugs were categorized as category II and13% of drugs were categorized as category III. 77% of cost was consumed by category I drugs. The author discussed as only 1.2% of the drug budget was spent on category III drugs and because this was very small ADE incurred on category III it can be said that inventory management practice of the hospital was appropriate (13).

The finding of ABC-VEN matrix study conducted on 5 year medicine consumption in Sudan 2016 showed that 17.83%, 50.53% and 31.64% items were classified as category I, II and III, accounting for 71.23%, 24.17% and 4.60% medicine budget respectively. The author discussed that the results from this study showed that Category I consists less than one-fifth of the items

consuming more than two-third of the total fund while Category II consists half of the items consuming almost one-fourth and Category III consists of close to one-third of the items costing only less than 5% of the total fund. The findings of the study indicated that a small number of items were responsible for large percentage of the total budget, whereas around quarter of number of items were responsible for only a small percentage of the total budget (31).

In 2016 a study conducted by ABC analysis on 233 medicines at Ayurveda Institute (India) showed that 25% class A items used 70% of medicine budget, 30% class B items used 20% of the budget and 45% class C items used 10% of the budget (7).

In Turkey another study conducted in 2017 on ABC and VED analyses for pharmacy showed that, On ABC analysis 10%, 23% and 67% items were classified as A, B and C category items amounting for 80 %, 17 % and 3 % of ADE respectively. VED analysis showed that 24.20%, 14.01% and 61.78% items were found to be V, E and D category items, respectively amounting for 43.08%, 19.22% and 37.70% of ADE. ABC-VED matrix analysis showed as 47 (29.94%) items were present in category I, 39 (24.84%) items in category II and 71 items in category III, amounting for 84.81%, 13.39% and 1.80% of the ADE, respectively (15).

Study conducted 2017 in Turkey on drug inventory management using ABC and VEN analysis revealed that, 160(10.31%) of drugs categorized as A class and 338(21.78%) of drugs as B class items consumed 69.96% and 20.02% of the total pharmacy expenditures respectively. The remaining 1054(67.91%) of drugs which were classified as class C, constituted 10.01% of ADE. The results of VEN analysis of the study revealed that, 10.67% of drugs in V class and 45.49% of drugs in E class constituted 23.31% and 55.85% of the total ADE. The remaining 43.75% of drugs which were in category N, constituted 20.84% of the ADE. The study showed that 17.04% drugs belong to category I and constituted about 79% of the ADE of the pharmacy. Category II consisted 33.9% of drugs, which accounts for 17.3% of the ADE of the pharmacy. The remaining 48.7% drugs were in category III, accounts for 3.7% of the total drug expenditure (32).

2.2.   Literature Review of XYZ, FSN and FSN-XYZ Matrix Analysis

Different authors classified inventory items in to fast moving, slow-moving and non-moving by different methods. Kumar Y et al (33) classified items into fast-moving, slow-moving and non-

moving by considering cumulative percentage of annual demand of items which has similarity with ABC analysis. Manivel P and Ranganathan R (9) and Vaisakh PS, Dileeplal J and Unni VN (34) classified items by considering both average stays of the item in inventory and consumption rate of it. The higher the average stay of an item in the store, the slower its movement from inventory and a fast-moving item will have a shorter stay in the store. A very high consumption rate implies that the item is a fast-moving and a slow-moving item will have a low consumption rate. FSN Analysis takes into account both these criteria in determining the final FSN status of an item (9).

Mitra S, Reddy MS and Prince K (35) and Hlaing NNN et al (36) classified based on turnover ratio. Another study conducted by Mallick B, Dutta ON and Das S was carried out by considering the rate of movement of items from the stores per month (37). Then there is no general rule to restrict you to use only one method. In present study number of issues of pharmaceuticals from store within three years was used for FSN analysis; it can be obtained easily then this study had classified pharmaceutical items by considering their number of issues from store per three years.

The findings of a study conducted by Manivel P and Ranganathan R (2016) on analysis of private and hospital pharmacy in India revealed that 46.03% out of 126 drugs were classified as F class. 33.33% drugs were considered as S class and the remaining 20.63% drugs were of N class (9). Another study conducted by Kumar Y et al on FSN analysis for inventory management of sponge iron plant in India showed that out of 20 items 10% of them were categorized as F, 30% as S and 60% as N class items (33).

A study which was done in the cardiology department of a tertiary care hospital found in India showed that 10% of items were classified as X Class items and contributed 59% of the total closing stock value, Y Class items (20 % of items) contributed 35% of the total closing stock value and Z Class items (70 % of items) contributed 6% of the total closing stock value (17).

Currently there is no published literature on pharmaceutical inventory management analyzed by using FSN-XYZ matrix analysis. The study of combined FSN and XYZ analysis was conducted by Devarajana D and Jayamohan MS on chemical firm found in India. First non-moving items at a firm have been identified and then XYZ analysis applied on identified non-moving items. the finding of the study revealed that from a total of 720 items 625 of them were categorized under

NZ (non-moving item found in Z category), 62 items under NY (non-moving item found in Y category) and 33 items under NX (non-moving item found in X category). The study has identified total stock value of all NX items those should be avoided from facility; because of they were non-moving items having high stock value. The author told as avoiding these items made the space and money could be saved (16).

2.3. Conceptual Framework

Conceptual framework is developed by considering factors which affect pharmaceutical inventory management of ABC, VEN, FSN and XYZ analysis and it is shown in the following figure.

Independent variables

Pharmaceutical Product related factors
- ✓ Quantity of pharmaceuticals consumed
- ✓ Stock out from store
- ✓ Frequency of issue from store
- ✓ Purchasing Cost of pharmaceuticals

Health facility related factors
- ✓ Support of management
- ✓ Functionality of drug and therapeutic committees (DTC)

Dependent variables

1. Proportion of pharmaceuticals categorized as A, B and C as per ABC analysis and their expenditures
2. Proportion of pharmaceuticals categorized as V, E and N as per VEN analysis and their expenditures
3. Proportion of pharmaceuticals categorized as F, S and N as per FSN analysis
4. Proportion of pharmaceuticals categorized as X, Y and Z as per XYZ analysis and their stock value

Supplier related factors
- ✓ Over/under supply
- ✓ Stock out at supplier
- ✓ Supplying near expire

Disease related factors
- ✓ Disease prevalence
- ✓ Severity of disease

Figure: 1 Conceptual frame work of factors affecting ABC, VEN, FSN and XYZ analysis of pharmaceutical inventory management

3. Objective of the Study

3.1. General Objective

To assess pharmaceuticals inventory management by using ABC-VEN and FSN-XYZ matrix analysis in West Shewa Zone, Oromia regional state, Ethiopia.

3.2. Specific Objectives

The specific objectives of the study were the following ones:
- To analyze annual pharmaceuticals consumption for the year of 2016 – 2018
- To identify the categories of pharmaceuticals requiring stringent management control by using ABC-VEN matrix analysis
- To identify class of pharmaceuticals by using FSN-XYZ matrix analysis.
- To explore challenges health facilities faced in pharmaceutical inventory management.

4. Methods

4.1. Study Area and Study Period

The study was conducted in public health facilities found in West Shewa zone. West Shewa zone is one of the 21 zones of the Oromia region in Ethiopia. This zone has 22 districts and by the data of 2007 census its total population was 2,058,676 (38). There were 581 public health facilities giving service in the zone (8 of them were hospitals, 91 HCs and 482 health posts). There were a total of 3513 health professionals in this zone (1541 Males and 1972 Females). From this 84 of them were Pharmacists (68 Male and 16 Female) and 102 were druggists (79 Male and 23 Female). The study was conducted between March 15, 2019 and May 31, 2019.

4.2. Study Design

A facility based cross sectional study was conducted using both qualitative and quantitative methods in which pharmaceutical inventory management practice of health facilities found in West Shewa zone were analyzed by using ABC-VEN and FSN-XYZ matrix analysis.

4.3. Population

4.3.1. Source population

Source population of the study were all public health facilities like HCs, hospitals and health posts found in West Shewa zone, all pharmaceutical products used in this zone, all health professionals working in the health facilities of the zone and records used in inventory managements like health commodity management information system (HCMIS), bin cards, stock cards, goods receiving voucher (model no 19) and goods issuing voucher (model no 22).

4.3.2. Study population

Study population includes all budget pharmaceuticals which were collected from 15 selected public health facilities' pharmaceutical records and health professionals participated on the study.

4.4. Inclusion and Exclusion Criteria

4.4.1. Inclusion criteria

Both hospitals and HCs included in the study were public health facility. Pharmaceuticals included in the study were budget drugs, laboratory reagents and chemicals, and medical supplies.

For the qualitative study head of pharmacy department and store keeper of pharmacy were purposively selected and included for the interview as a key informant because they were supposed to be information rich than other health professionals. They were included if available during the data collection period and willing to participate in the study.

4.4.2. Exclusion criteria

Hospitals and HCs those did not start giving service before September 2008 EC (September 2015 GC) were not included in the study. Health posts were excluded from the study because they are under the umbrella of HCs and most logistic activities are conducted at HC. Health professionals those had below one year work experience were excluded from the study.

4.5. Sample size Determination and Sampling Techniques
4.5.1. Sample Size Determination

The total number of public hospitals and HCs in this zone was 99 (91 HCs plus 8 hospitals). The number of health facilities required for the study was calculated based on the recommendation of USAID delivery project logistics indicators assessment tool (LIAT) which states a minimum of 15% of the available health facilities (39).
The number of health facilities required for this study = (total number of hospitals and HCs X 15% = 99 X 0.15 = 14.85). A total of 15 health facilities were needed for the study. Number of hospitals and HCs required for the study was calculated proportionally. Number of hospitals required was ((Total number of hospitals/total number of hospitals and HCs) X sample size = (8/99) X15 = 1.21) was 2 and that of HC was 13 (15 minus 2).

4.5.2. Sampling Techniques

To take samples to be included in the study health facilities were categorized into hospitals and HCs. Hospitals then categorized into referral hospital (but it was excluded since it started working at the end of 2008 EC), general hospital and district hospital. From 4 district hospitals available in the zone three of them were excluded by their service year and the left 1 hospital was included for the study. From three available general hospitals one of them was selected by simple random sampling using lottery method. To select HCs to be included for the study first from a total of 22 districts found in the zone, 13 of them were selected by simple random sampling and then from each of the selected districts one HC was selected using lottery method.

4.6. Study Variables

4.6.1. Dependent variables

The dependent variables were Proportion of pharmaceuticals categorized as class A, B and C as per ABC Analysis and their expenditures, Proportion of pharmaceuticals categorized as class V, E and N as per VEN Analysis and their expenditures, Proportion of pharmaceuticals categorized as class F, S and N as per FSN Analysis, and Proportion of pharmaceuticals categorized as class X, Y and Z as per XYZ Analysis and their stock value.

4.6.2. Independent variables

Independent variables of the study were those variables which affect the value of analysis of ABC, VEN, FSN and XYZ. A) **Pharmaceutical Product related variables** were consumed quantity of pharmaceuticals, purchasing cost of pharmaceuticals, Frequency of issue of product from store and Stock out from store. B) **Supplier related variables** were supplying over/under required, stock out of pharmaceuticals at supplier and supplying near expire C) **Disease related variables**: prevalence and severity of the disease. D) **Health facility related variables**: support of management and functionality of DTC

4.7. Data Collection Procedures

Data used for ABC analysis was quantity of annual consumption and unit price of each pharmaceuticals used in the health facilities. The data of three years consumption between

September 12, 2015 and September 5, 2018 was collected by reviewing issue documents model no 22 and HCMIS (if facility was using it).

Tool used for collecting data for VEN analysis was taken from Management science for health (5). Data was collected by giving self-administered questionnaires to health professionals (physicians, health officer, nurse, mid-wife and others) doing at each department of the health facility. Tool used for data collection of VEN analysis of medical supplies is not the same as that of medicines, and then it was developed from Management Science for Health (5) by considering their criticality in giving basic health care service and their supply behavior.

Data used for XYZ analysis was collected through documents review like data of the physical count of the 3 years at the end of financial year and if facility used HCMIS data base, data was taken from it. Total quantity available at physical count with their unit price collected.

Data used for FSN analysis was number of issue of pharmaceuticals. Data was collected through documents review and taken from HCMIS if the facility was using it.

Tool used for collection of qualitative data was taken from previously conducted studies (20, 40). For collecting qualitative data an in depth interview was conducted by principal investigator (PI). Interview guide was first prepared in English language, and translated into Afaan Oromoo and after interview then back translated to English. Digital voice recorder was used for the interview after getting consent from participants and the information was transcribed after the interviews.

4.8. Data Processing and Analysis

In general the analysis of ABC, XYZ and FSN was done by using MS Excel spreadsheet. Data of three years of different health facilities aggregated together and analysis conducted. The simplified procedure is as follows: the collected data of annual consumption, inventory available on last annual budget year, number of issues of pharmaceuticals and unit price of the pharmaceutical were transcribed in a Windows Excel spreadsheet. The statistical analysis was carried out using the Windows Excel statistical functions (14, 41).

The ABC, XYZ and FSN analysis were analyzed by following their own procedure. VEN analysis was done after the questionnaires were filled by health professionals. ABC-VEN and FSN-XYZ matrix analysis was done by cross-tabulating the results of the corresponding ABC

and VEN, and FSN and XYZ analysis respectively. The procedure of the analysis of individual method is discussed one by one below.

The **procedure of ABC analysis** is as follows: the annual expenditure of individual items was calculated and arranged in descending order. The cumulative cost of all the items was calculated. Percentage expenditure of individual pharmaceuticals calculated and then cumulative percentage of expenditure and the cumulative percentage of number of items calculated. The list then subdivided into three categories: A, B and C, based on the cumulative cost percentage of 70%, 20% and 10%, respectively (13, 14).

The following table shows overview of how **VEN analysis** is carried out.

Table 1: Sample guidelines for VEN categories (source: MSH 2012)

Characteristic of medicine or target condition	Vital	Essential	Nonessential
Occurrence of target condition			
Persons affected (percent of population)	Over 5	1–5	Less than 1
Persons treated (number per day at average health center)	Over 5	1–5	Less than 1
severity of target condition			
Life-threatening	Yes	Occasionally	Rarely
Disabling	Yes	Occasionally	Rarely
Therapeutic effect of medicine			
Prevents serious disease	Yes	No	No
Cures serious disease	Yes	Yes	No
Treats minor, self-limited symptoms and conditions	No	Possibly	Yes
Has proven efficacy	Always	Usually	May or may not
Has unproven efficacy	Never	Rarely	May or may not

The ABC-VEN matrix analysis was formulated by cross-tabulating the ABC and VEN analysis. From the resultant combination, three categories were classified (I, II and III). Category I was constituted by items belonging to AV, AE, AN, BV and CV subcategories. The BE, CE and BN subcategories constitutes category II, and the remaining items in the CN subcategory constitute category III (14).

Steps to conduct XYZ analysis are listed below: a) available stock and the unit cost of the selected items was collected, b) Stock value was obtained by multiplying available stock and unit cost of each item, c) Sort the stock value in descending order, d) % stock value and cumulative % stock value was calculated and e) Finally, the class was allotted. Generally the first 70% of the total Inventory value corresponds to X Class, the next 20% are of Y Class and the last 10% of the value corresponds to the Z Class (16).

FSN Analysis: method of analysis was based on number of issues of pharmaceuticals. Number of issue of each item recorded and arranged in descending order. The cumulative number of issues was calculated. Percentage of issues and then cumulative percentage of issues calculated for all pharmaceuticals. Then cut of point decided; items those account for 70% of total number of issues of pharmaceuticals were categorized as F class items. The next items accounted for 20% and 10% of total number of issues of pharmaceuticals were classified as S and N class items respectively.

FSN-XYZ Matrix Analysis: It was analyzed by cross tabulation of FSN and XYZ. By cross tabulation nine different groups were formed. Then they grouped in to three main categories. Category I constitutes FX, FY, FZ, SX and NX. Category II contains SY, SZ and NY. Category III contains NZ items.

The **analysis of qualitative data** was done manually. All audio recorded interviews were transcribed and translated to English. After multiple readings of the text, coding and sub-coding was made to themes and relevant quotations were used to illustrate themes in the presentation of study findings.

4.9. Data Quality Assurance

To keep the quality of data collected, it was collected by trained data collectors. While they were collecting data they were supervised by PI. On each day collected data was cross checked for its completeness.

4.10. Ethical Considerations

Ethical clearance was obtained from Ethical Review Board of Institute of Health Science, Jimma University. Permission letter was written to West Shewa zone health department. From zonal

health department then wrote permission letter to the District Health offices and Hospitals. District Health Offices wrote a letter to HCs. A permission letter was obtained from HCs' administrative officers and taken to the pharmacy department and would inform other departments of the facility where data was collected. Before any data collection, the main purpose of the study was clearly explained to each department (concerned personnel).

4.11. Dissemination Plan

The finding of this study will be presented to school of pharmacy, Institute of health science, Jimma University. Then it will be disseminated to each health facilities and other concerned bodies like District health offices, Zonal health department, Oromia regional health bureau and Pharmaceutical suppliers. Finally it will be published on scientific journal.

4.12. Operational definitions and definitions of terms

A class items – stock of pharmaceuticals those consumed 70% of total pharmaceutical expenditures

B class items – stock of pharmaceuticals those consumed 20% of total pharmaceutical expenditures

Budget pharmaceuticals – in this study budget pharmaceuticals were pharmaceuticals supplied to health facilities by purchase and it didn't include pharmaceuticals supplied by program.

C class items – stock of pharmaceuticals those consumed 10% of total pharmaceutical expenditures

Essential – in this study any pharmaceutical was categorized as essential if it was essential at one or more health facility and it may be non-essential at other health facilities.

F class items- pharmaceuticals those represent 70% of total number of issues of pharmaceuticals used in three years

Health facility: in this study it includes public hospitals and health centers where health care service is given.

N class items- pharmaceuticals those represent 10% of total number of issues of pharmaceuticals used in three years

Non-Essential – in this study any pharmaceutical categorized as non-essential if it was non-essential at all health facilities from which data collected.

Pharmaceutical: in this study it includes budget drugs, laboratory reagents and chemicals, and medical supplies which were bought by revolving drug fund.

S class items- pharmaceuticals those represent 20% of total number of issues of pharmaceuticals used in three years

Total pharmaceutical expenditures – is total expenditures spent by health facilities included in this study for all budget pharmaceuticals in the three years.

X class items- stock of pharmaceuticals those account for 70% of stock value

Y class items- stock of pharmaceuticals those account for 20% of stock value

Vital – in this study any pharmaceutical was categorized as vital if it was vital at one or more health facility and it may be essential or non-essential at other health facilities.

Z class items- stock of pharmaceuticals those account for 10% of stock value

5. Results

This study was conducted in fifteen public health facilities of West Shewa zone. Thirteen of them were HCs and two of them were hospitals. The findings of the study were presented in three different categories namely a) aggregated result of all 15 selected health facilities, b) aggregated result of two selected hospitals and c) aggregated result of 13 selected HCs. In each of category ABC analysis, VEN analysis, ABC-VEN matrix analysis, FSN Analysis, XYZ analysis and FSN-XYZ matrix analysis were presented separately.

5.1. **ABC Analysis**

5.1.1. ABC Analysis for pharmaceuticals of selected health facilities of West Shewa zone.

At selected public health facilities of West Shewa zone in three years between September 12, 2015 and September 5, 2018 about 539 pharmaceutical items were utilized and consumed 30,837,628.61 ETB. ABC analysis showed that 64(11.9%) number of items were categorized as class A and consumed around 70.34% of total pharmaceuticals expenditures (TPE). Class B and C accounted for 97(18.0%) and 378(70.1%) number of items that consumed 19.68% and 9.98% of TPE respectively.

Table 2: Summary of ABC Analysis of pharmaceuticals of selected health facilities of West Shewa zone, Oromia, Ethiopia, January 2020

Class	Number of items (%)	Consumption value in ETB	Value in %
A	64(11.9%)	21,690,111.68	70.34%
B	97(18.0%)	6,069,077.62	19.68%
C	378(70.1%)	3,078,439.31	9.98%
Total	539(100%)	30,837,628.61	100.0%
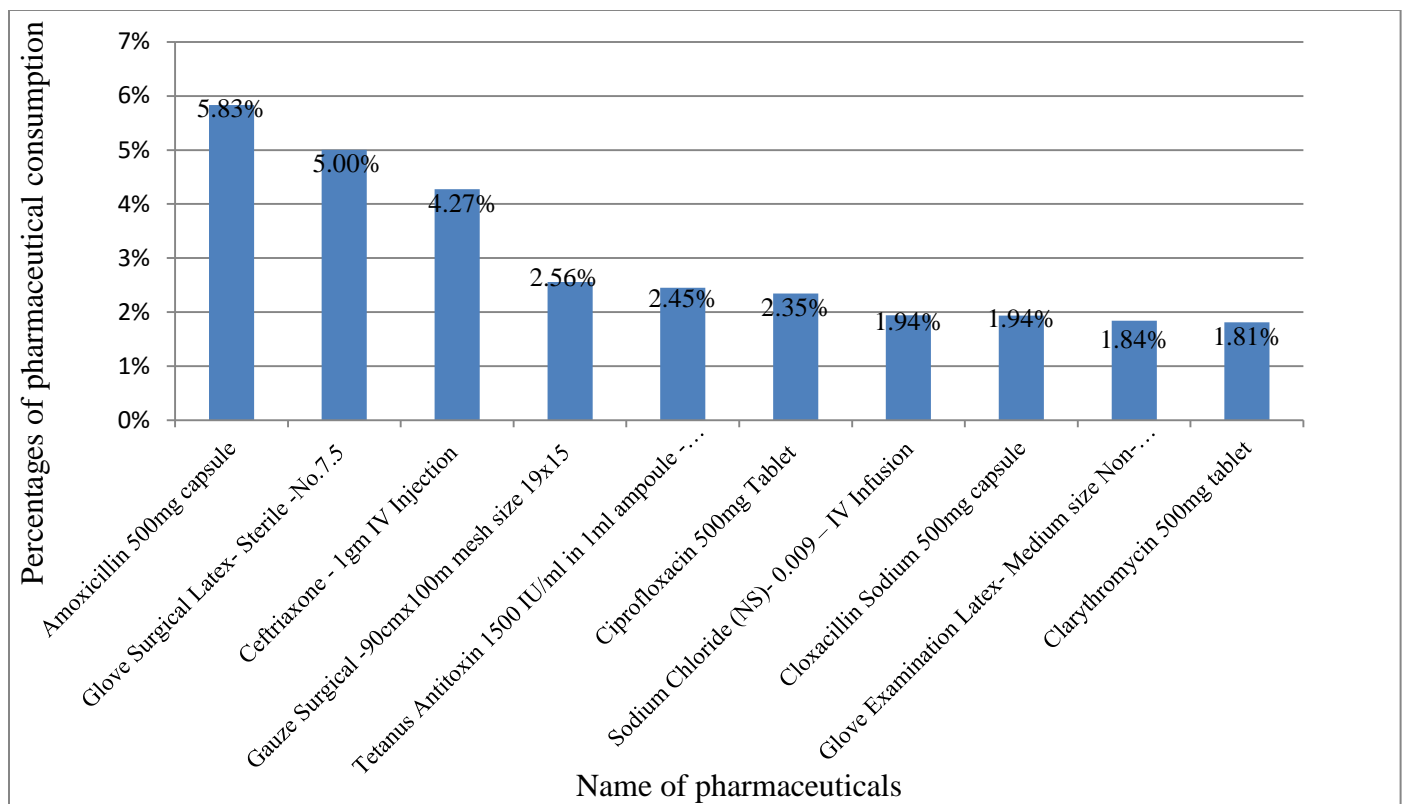
Figure 2: Top ten most costly pharmaceuticals of selected health facilities of West Sheewa zone, Oromia, Ethiopia, January 2020

Out of 64 items found in class A only amoxicillin 500mg capsule, surgical glove latex (sterile) number 7.5 and ceftriaxone 1gm injection contributed 15.1% of TPE.
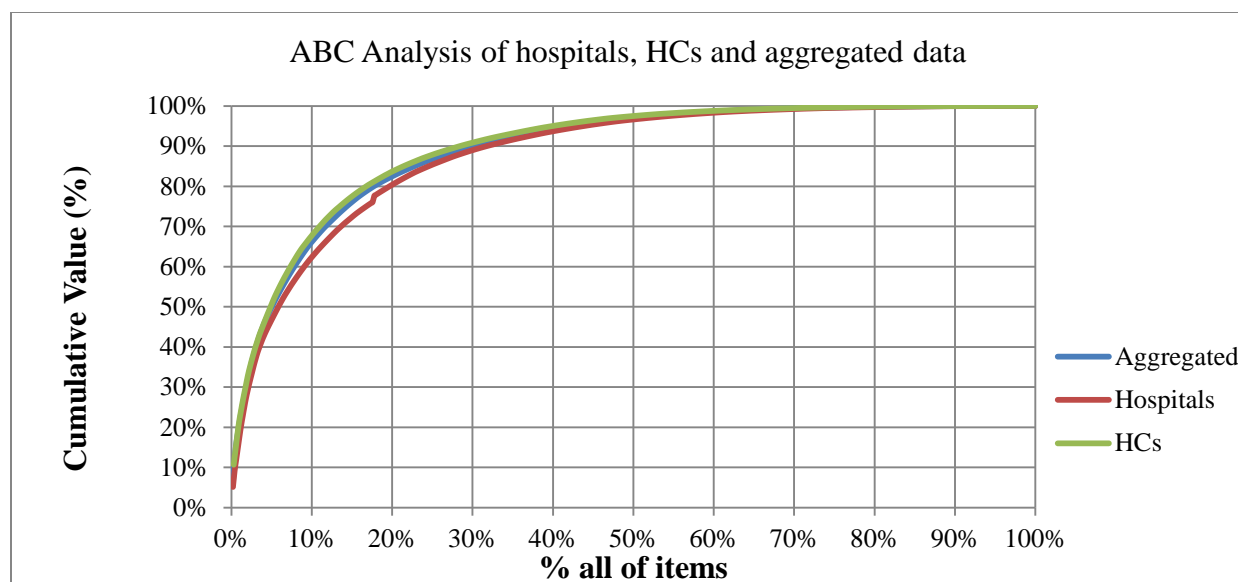
Figure 3: Pharmaceuticals' ABC Analysis curve of Hospitals, HCs and aggregated data of West Shewa zone, Oromia, Ethiopia, January 2020

As it is shown above on figure 3 ABC analysis of the hospitals, HCs and aggregated data are compatible under V. Pareto curve. From this graph relatively ABC analysis curve of HCs at class A is steeper than others and then it shows as lower proportion of pharmaceutical items of this class took maximum of budget percentage range than others. But at hospitals ABC analysis curve of class A is less steeper than other two and then it shows as pharmaceuticals in this class took lower portion of budget range and maximum of items proportion.

5.1.2. ABC Analysis of selected hospitals of West Shewa zone

For the last three years at selected hospitals of West Shewa zone around 495 numbers of items were utilized and consumed 19,241,061.7 ETB. ABC analysis of these items showed that 68(13.74%) number of items were accounted for class A and consumed around 70.18% of TPE. Class B and C items accounted for 90(18.18%) and 337(68.08%) number of items and consumed 19.91% and 9.91% of TPE respectively.

Table 3: Summary of ABC Analysis of selected hospitals of West Shewa zone, Oromia, Ethiopia, January 2020

Class	Number of items (%)	consumption value in ETB	Value (%)
A	68(13.74%)	13,502,614.5	70.18%
B	90(18.18%)	3,831,682.63	19.91%
C	337(68.08%)	1,906,764.57	9.91%
Total	495(100%)	19,241,061.7	100.00%

Out of 68 of class A surgical glove number 7.5 and ceftriaxone 1gm injection contributed around 9.1% of total APE.
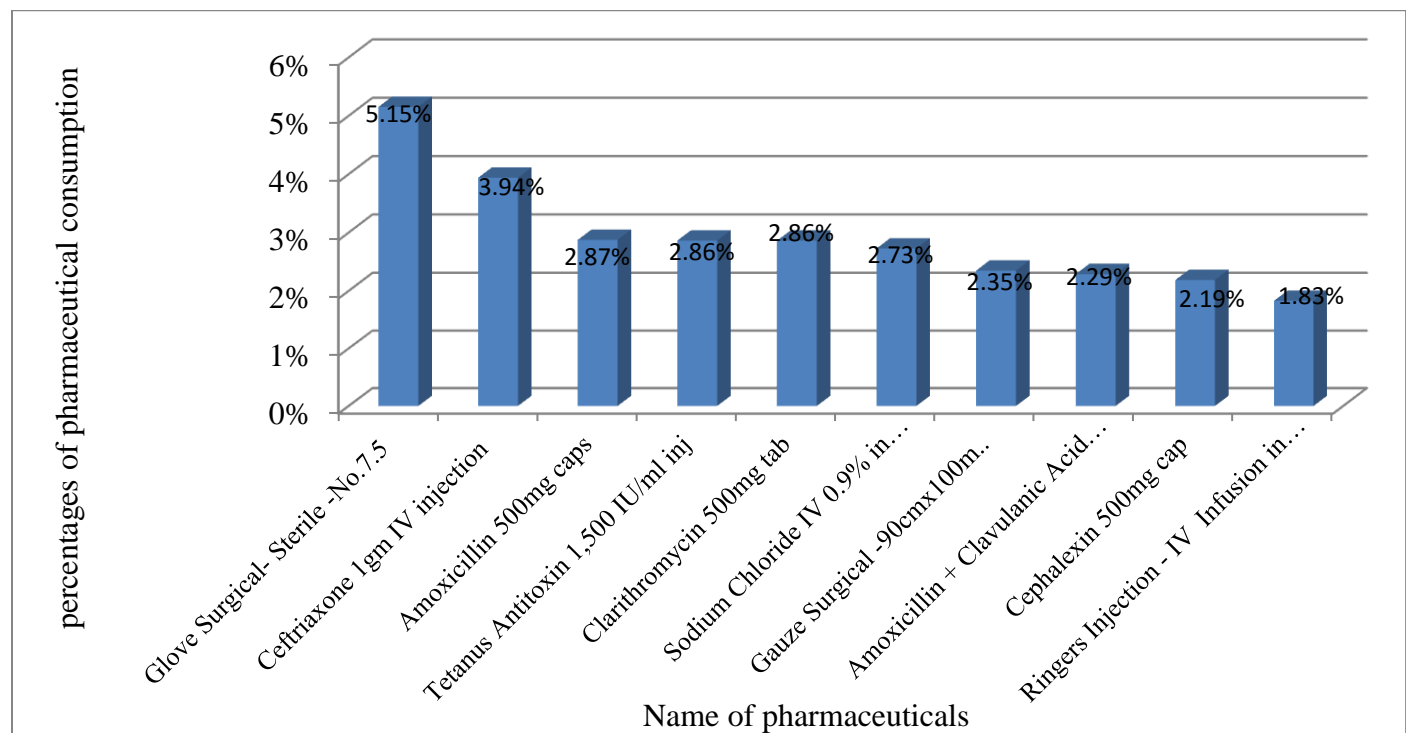
Figure 4: Top ten costly items of selected hospitals at West Shewa zone, Oromia, Ethiopia, January 2020

5.1.3. ABC Analysis of selected Health centers of West Shewa zone

At selected HCs of West Shewa zone around 341 pharmaceuticals were utilized and consumed 11,635,306.17 ETB. ABC analysis showed that 38(11.14%) number of items were categorized as class A and consumed 70.40% of TPE. The rest class B and C items accounted for 61(17.89%) and 242(70.97%) number of items that consumed 19.95% and 9.65% of TPE respectively.

Table 4: Summary of ABC Analysis of selected Health centers of West Shewa zone, Oromia, Ethiopia, January 2020

Class	Number of items (%)	Consumption value in ETB	Value (%)
A	38(11.14%)	8,191,559.04	70.40%
B	61(17.89%)	2,321,154.46	19.95%
C	242(70.97%)	1,122,592.67	9.65%
Total	341(100.00%)	11,635,306.17	100.00%

At selected HCs out of 38 items classified as class A only amoxicillin 500mg capsule consumed 10.7% total TPE.
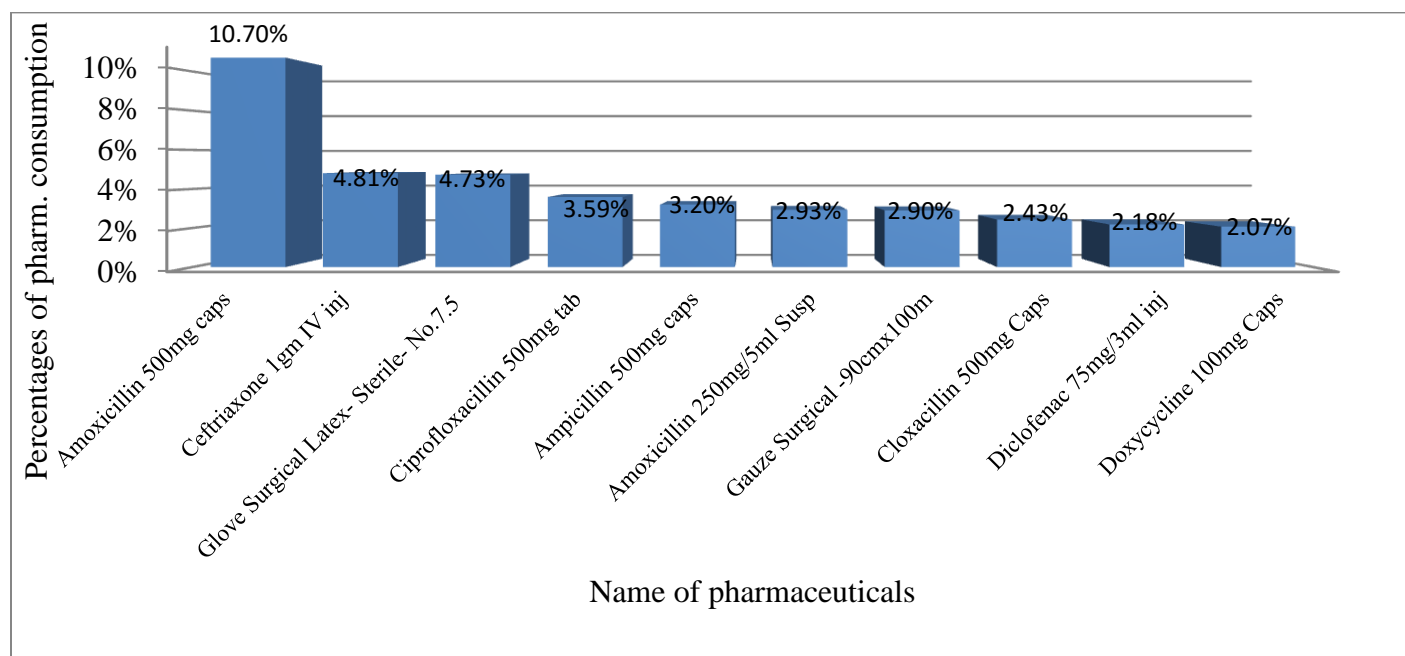
Figure 5: Top ten costly items of selected HCs at West Shewa zone, Oromia, Ethiopia, January 2020

5.2. VEN Analysis

5.2.1. VEN Analysis of pharmaceuticals of selected health facilities of West Shewa zone

At selected health facilities of West Shewa zone a total of 320 pharmaceuticals were identified by VEN analysis. From this 115(35.94%) of them were categorized as vitals. 156(48.75%) and 49(15.31%) items were categorized as essential and non-essentials respectively. Items in vital category consumed 14,243,893.81 ETB (53.9%) of TPE. The rest 11,162,220.06 ETB (42.2%) and 1032,168.31 ETB (3.9%) were consumed by essential and non-essential items respectively.

Table 5: VEN analysis of pharmaceuticals of selected health facilities of west shewa zone, Oromia, Ethiopia, January 2020

VEN Analysis	Number of items (%)	Consumption value (in ETB)	Value (%)
V	115(35.94%)	14,243,893.81	53.9%
E	156(48.75%)	11,162,220.06	42.2%
N	49(15.31%)	1,032,168.31	3.9%
Total	320(100.0%)	26,438,282.18	100.0%

5.2.2. VEN Analysis of pharmaceuticals at selected hospitals of West Shewa zone

VEN analysis of pharmaceuticals at selected hospitals of West Shewa zone revealed that a total of 278 pharmaceuticals were identified. From this 99(35.61%), 138(49.64%) and 41(14.75%) number of pharmaceuticals were classified as vitals, essentials and non-essential respectively. Vital items consumed 7,380,201.70 ETB (51.59%) of TPE. Essentials and non-essential pharmaceuticals consumed 6,423,565.65 (44.90%) and 501,744.27 ETB (3.51%) of TPE respectively.

Table 6: Summary of VEN Analysis of selected hospitals of West Shewa zone, Oromia, Ethiopia, January 2020

VEN category	Number of items (%)	Consumption value (in ETB)	Value (%)
V	99(35.61%)	7,380,201.70	51.59%
E	138(49.64%)	6,423,565.65	44.90%
N	41(14.75%)	501,744.27	3.51%
Total	278(100.00%)	14,305,511.62	100.00%

5.2.3. VEN Analysis of pharmaceuticals at selected health centers of West Shewa zone

A total of 192 pharmaceuticals were identified and classified by VEN Analysis in selected HCs of West Shewa zone. From this 40(20.83%), 116(60.42%) and 36(18.75%) of items were categorized under vital, essential and non-essential class respectively. Vital, essential and non-essential items consumed 36.93%, 56.24% and 6.84% of TPE at selected HCs of West Shewa zone.

Table 7: Summary for VEN analysis of pharmaceuticals of selected HCs of West Shewa zone, Oromia, Ethiopia, January 2020

VEN Analysis	Number of items (%)	consumption value (in ETB)	Value (%)
V	40(20.83%)	3,761,507.51	36.93%
E	116(60.42%)	5,728,539.28	56.24%
N	36(18.75%)	696,596.98	6.84%
Total	192(100.00%)	10,186,643.77	100.00%

5.3. ABC-VEN Matrix Analysis

5.3.1. ABC-VEN Matrix Analysis of pharmaceuticals of selected health facilities at West Shewa zone

The findings of ABC-VEN matrix analysis at selected health facilities of West Shewa zone revealed that 142(44.4%) of items classified as category I pharmaceuticals and consumed 85.5% of TPE. 137(42.8%) and 41(12.8%) of items classified as category II and III consumed 13.3% and 1.3% TPE respectively.

Table 8: Summary of cross-tabulation of ABC-VEN matrix analysis of pharmaceuticals of selected health facilities at West Shewa zone, Oromia, Ethiopia, January 2020

ABC-VEN	A		B		C		Total		
	No	Value (ETB)	No	Value (ETB)	No	Value (ETB)	No	Value (ETB)	Value (%)
V	29	11833534.48	27	1812147.69	59	598211.64	115	14243894	54.0%
E	25	8027378.59	33	2089804.14	98	1045037.326	156	11162220	42.3%
N	2	320695.68	6	372602.6	41	338870.03	49	1032168	3.9%
Total	56	20181608.75	66	4274554.43	198	1982119.00	320	26438282.18	100%

No- indicates number of items found in each sub-category
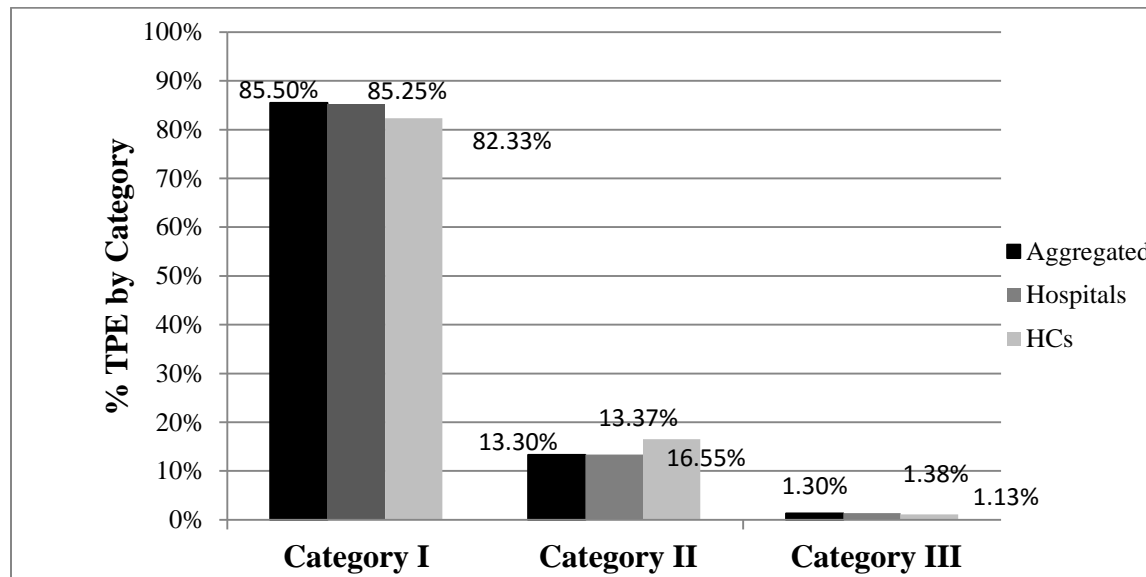
Figure 6: ABC-VEN matrix analysis of pharmaceuticals consumption at different level of health facilities of West Shewa zone, Oromia, Ethiopia, January 2020

5.3.2. ABC-VEN Matrix Analysis of pharmaceuticals at selected hospitals of West Shewa zone

ABC-VEN matrix analysis of pharmaceuticals at selected hospitals of West Shewa zone revealed that 123(44.24%), 120(43.17%) and 35(12.59%) number of items contribute category I, II and III that consumed 85.25%, 13.37% and 1.38% of TPE respectively.

Table 9: summary of cross-tabulation table of ABC-VEN Matrix Analysis of pharmaceuticals of selected hospitals of West Shewa zone, Oromia, Ethiopia, January 2020

ABC-VEN	A		B		C		Total		
	No	Value (ETB)	No	Value (ETB)	No	Value (ETB)	No	Value (ETB)	Value (%)
V	30	6310416.36	22	848607.58	47	221177.758	99	7380201.69	51.59%
E	23	4674601.89	24	1091565.69	91	657398.07	138	6423565.65	44.90%
N	1	140663.55	5	162736.02	35	198344.7	41	501744.27	3.51%
Total	54	11125681.8	51	2102909.29	173	1076920.52	278	14305511.61	100%
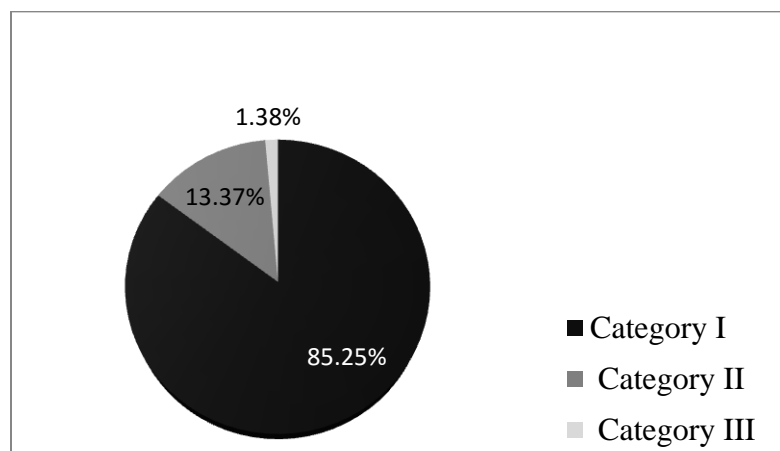
Figure 7: ABC-VEN matrix analysis of pharmaceuticals consumption of selected hospitals at West Shewa zone, Oromia, Ethiopia, January 2020

5.3.3. ABC-VEN Matrix Analysis of Pharmaceuticals at selected Health Centers of West shewa zone

ABC-VEN matrix analysis of pharmaceuticals at selected HCs of West Shewa zone revealed that 61(31.77%) items contribute category I and consumed 82.33% of TPE. 105(54.69%) and 26(13.54%) items contribute category II and III that consumed 16.55% and 1.13% of TPE respectively.

Table 10: Summary of cross-tabulation table of ABC-VEN matrix analysis of pharmaceuticals of selected HCs at West Shewa zone, Oromia, Ethiopia, January 2020

ABC-VEN	A		B		C		Total		
	N<u>o</u>	value (ETB)	N<u>o</u>	value (ETB)	N<u>o</u>	value (ETB)	N<u>o</u>	value (ETB)	Value (%)
V	15	3235677.2	10	380115.04	15	145715.27	40	3761507.51	36.93%
E	19	4383937.13	28	999302.59	69	345299.56	116	5728539.28	56.24%
N	2	240201.75	8	341088.06	26	115307.17	36	696596.98	6.84%
Total	36	7859816.08	46	1720505.69	110	606322	192	10,186643.77	100%

Table 11: Summary of Category of ABC-VEN Matrix analysis of pharmaceuticals of selected HCs of West Shewa zone, Oromia, Ethiopia, January 2020

Category	Number of items (%)	consumption value (ETB)	Value (%)
I (AV+BV+CV+AE+AN)	61(31.77%)	8,385,646	82.33%
II (BE+CE+BN)	105(54.69%)	1,685,690	16.55%
III (CN)	26(13.54%)	115,307.17	1.13%
Total	192(100.00%)	10,186,643.17	100.00%

5.4. XYZ Analysis

5.4.1. XYZ Analysis of selected health facilities of West Shewa zone

From a data of three years a total of 483 pharmaceuticals were found on physical inventory of selected health facilities of West Shewa zone. The stock value tied up by these pharmaceuticals was 10,437,358.17 ETB. XYZ analysis of these pharmaceuticals showed that 83(17.18%) of items classified as X Class contributed around 70.12% of stock value. 101(20.91%) and 299(61.90%) items were classified as class Y and Z which contribute 19.91% and 9.97% of stock value respectively.

Table 12: Summary of XYZ analysis of pharmaceuticals at selected health facilities of West Shewa zone, Oromia, Ethiopia, January 2020

Class	Number of item (%)	Stock Value (ETB)	%Stock Value
X	83(17.18%)	7,318,705.95	70.12%
Y	101(20.91%)	2,077,971.01	19.91%
Z	299(61.90%)	1,040,681.21	9.97%
Total	483(100.0%)	10,437,358.17	100.00%

Percentages of stock values of mostly stocked items of selected health facilities of West Shewa zone is shown on figure below.
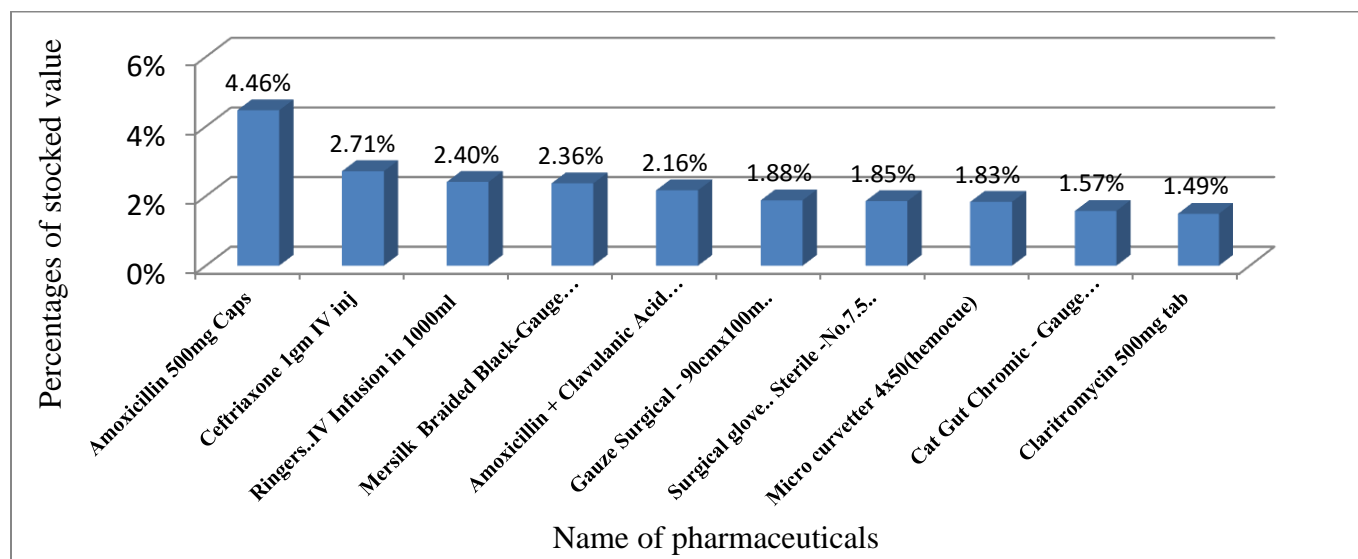
Figure 8: Top ten mostly stocked pharmaceuticals of selected health facilities of West Shewa zone, Oromia, Ethiopia, January 2020

5.4.2. XYZ Analysis of pharmaceuticals at selected hospitals of West Shewa zone

At selected hospitals of West Shewa zone there were 416 pharmaceuticals on physical inventory with stock value of 7,413,567.48 ETB. **X**, Y and Z class items were contributed by 73(17.55%), 93(22.36%) and 250(60.10%) of items with stock value of 5,209,952.53 ETB (70.28%), 1,465,709.46 ETB (19.77%) and 737,905.49 ETB (9.95%) respectively.

Table 13: Summary of XYZ Analysis of pharmaceuticals of selected hospitals of West Shewa zone, Oromia, Ethiopia, January 2020

Class	Number of items (%)	Stock Value (ETB)	%Stock Value
X	73(17.55%)	5,209,952.53	70.28%
Y	93(22.36%)	1,465,709.46	19.77%
Z	250(60.10%)	737,905.49	9.95%
Total	416(100.00%)	7,413,567.48	100.00%

Stock values of mostly stocked items of selected hospitals of West Shewa zone is shown below.
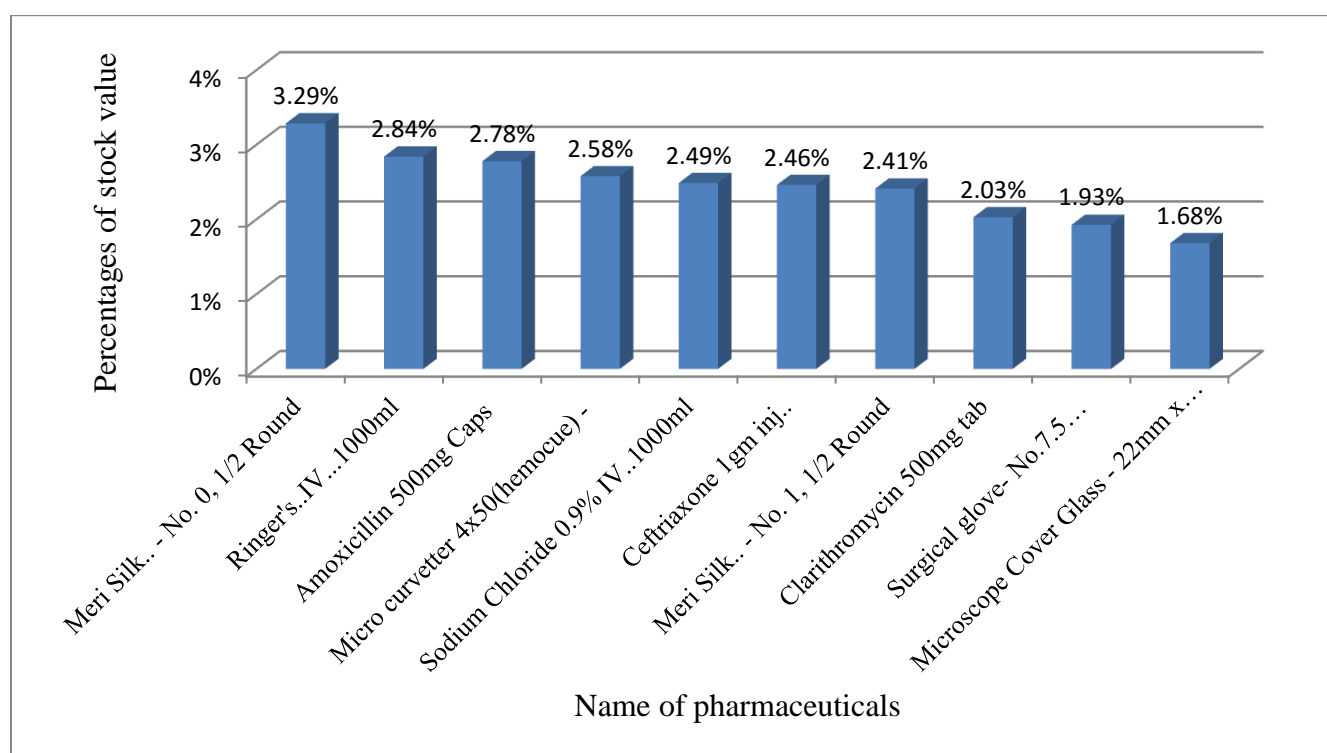
Figure 9: Top ten mostly stocked pharmaceuticals of selected hospitals at West Shewa zone, Oromia, Ethiopia, January 2020

5.4.3. XYZ Analysis of pharmaceuticals at selected health centers of West Shewa zone

A total of 268 pharmaceuticals were available on physical inventory of selected HCs of West Shewa zone with the stock value of 2,838,915.13 ETB. The number of items identified by XYZ analysis with their stock value is summarized in table below.

Table 14: Summary of XYZ Analysis of pharmaceuticals at selected HCs of West Shewa zone, Oromia, Ethiopia, January 2020

Class	No of items (%)	Stock Value (in ETB)	% Stock Value
X	46(17.16%)	2,001,061.62	70.49%
Y	62(23.13%)	556,315.86	19.60%
Z	160(59.7%)	281,537.65	9.91%
Total	268(100.00%)	2,838,915.13	100.00%

From mostly stocked items of selected HCs of West Shewa zone only Amoxacillin 500mg capsule accounted for 9.22% of total stock value.
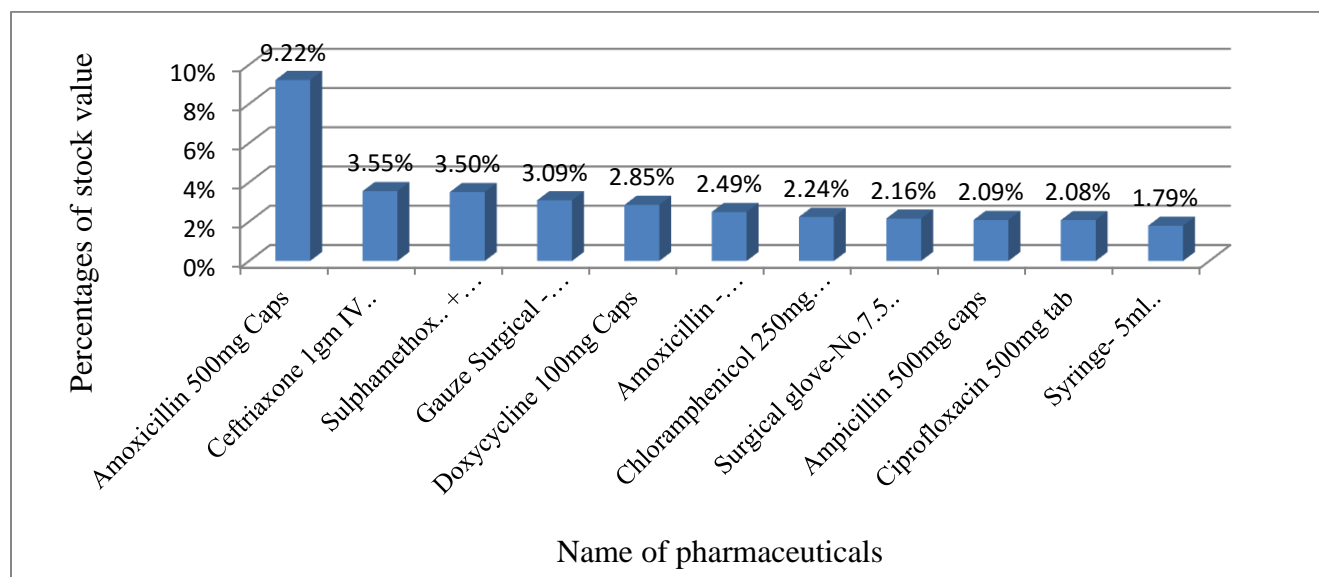
Figure 10: Top ten mostly stocked pharmaceuticals of selected HCs at West Shewa zone, Oromia, Ethiopia, January 2020

5.5. FSN Analysis

5.5.1. FSN Analysis of pharmaceuticals at selected health facilities of West Shewa zone

At selected health facilities of West Shewa zone a total of 561 pharmaceuticals were issued to different dispensing units. FSN analysis of these pharmaceuticals at this zone showed that 107(19.07%) items contribute 70.40% of total number of issues of pharmaceuticals and

categorized as class F. 109(19.43%) and 345(61.50%) number of items classified as class S and N which contribute 19.60% and 10.0% of total number of issues of pharmaceuticals respectively.

Table 15: Summary of FSN analysis of selected health facilities of West Shewa zone, Oromia, Ethiopia, January 2020

Class	Number of items (%)	Number of Issues	% No of Issues
F	107(19.07%)	21,647	70.40%
S	109(19.43%)	6,026	19.60%
N	345(61.50%)	3,074	10.0%
Total	561(100.00%)	30,747	100.00%
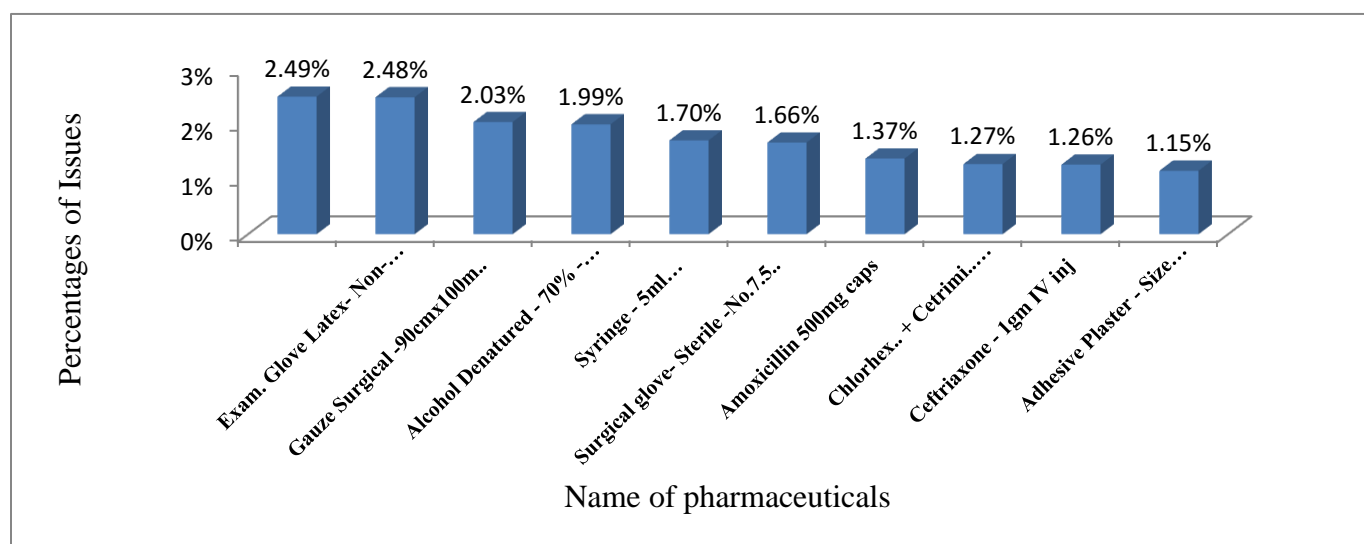
Figure 11: Top ten fast moving pharmaceuticals of selected health facilities of West Shewa zone, Oromia, Ethiopia, January 2020

5.5.2. FSN Analysis of pharmaceuticals at selected hospitals of West Shewa zone

From a total of 516 pharmaceuticals issued at selected hospitals of west shewa zone FSN analysis revealed that 122(23.64%), 118(22.87%) and 276(53.49%) of items were classified as class F, S and N which represents 69.61%, 20.87% and 9.52% of total number of issues respectively.

Table 16: Summary of FSN analysis of selected hospitals of West Shewa zone, Oromia, Ethiopia, January 2020

Class	Number of items (%)	Number of Issues	% No of Issues
F	122(23.64%)	9,401	69.61%
S	118(22.87%)	2,819	20.87%
N	276(53.49%)	1,285	9.52%
Total	516(100.00%)	13,505	100.00%
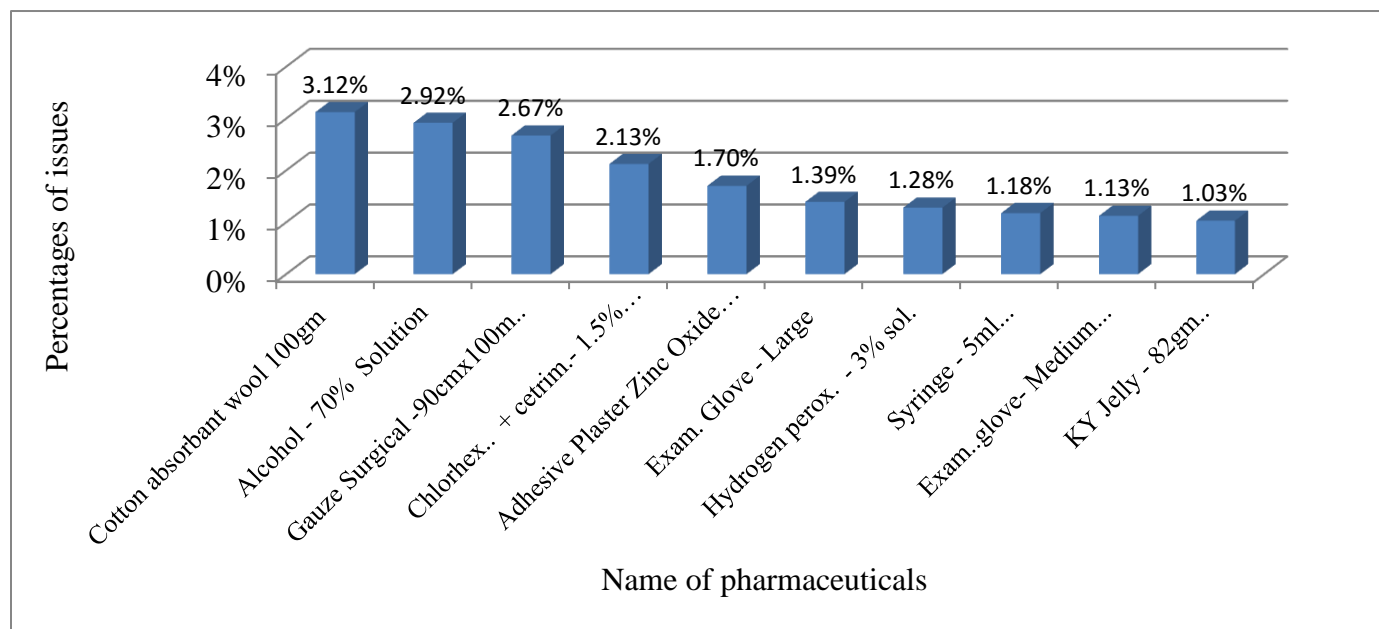
Figure 12: Top ten fast moving items of selected hospitals at West Shewa zone, Oromia, Ethiopia, January 2020

5.5.3. FSN Analysis of pharmaceuticals at selected health centers of West Shewa zone

At selected HCs of West Shewa zone 355 pharmaceuticals were issued to different dispensing units. FSN analysis of these pharmaceuticals at this zone showed that 75(21.13%), 71(20.00%) and 209(58.87%) of items were categorized as class F, S and N which represents 70.56%, 19.50% and 9.94% of total number of issues of pharmaceuticals.

Table 17: Summary of FSN analysis of pharmaceuticals of selected health centers of West Shewa zone, Oromia, Ethiopia, January 2020

Class	Number of items (%)	Number of Issues	% No of Issues
F	75(21.13%)	11,952	70.56%
S	71(20.00%)	3,302	19.50%
N	209(58.87%)	1,684	9.94%
Total	355(100.00%)	16,938	100.00%
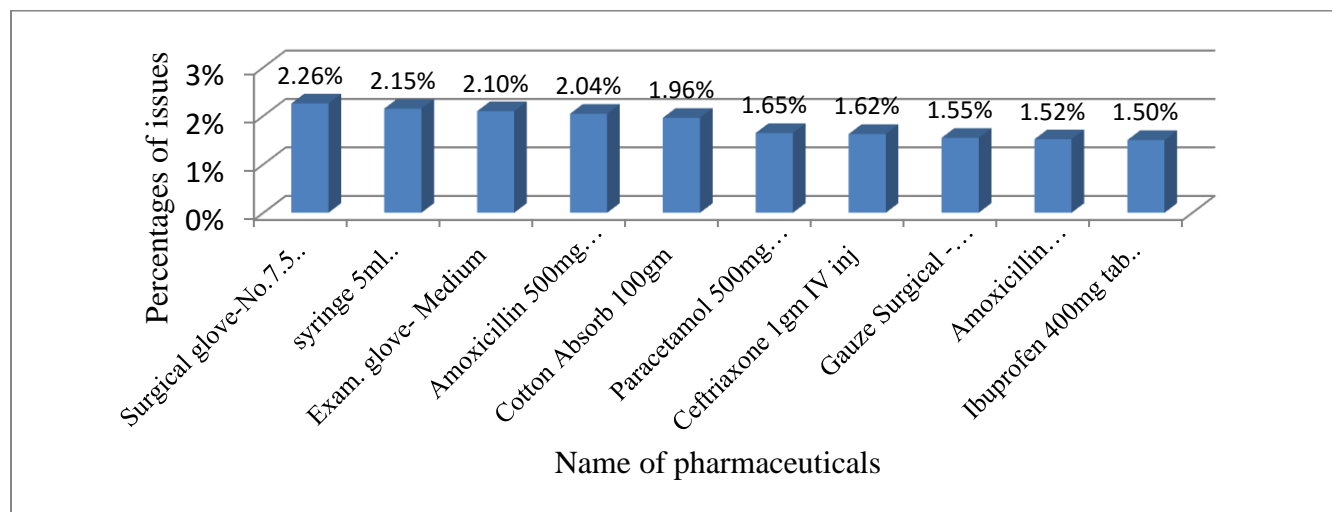
Figure 13: Top ten fast moving pharmaceuticals of selected HCs at West Shewa zone, Oromia, Ethiopia, January 2020

5.6. FSN-XYZ Matrix Analysis

Cross-tabulation of FSN and XYZ analysis gives nine different sub-categories. These sub-categories can be grouped in to three main categories. Category I contains items which are fast moving and have high stock value namely FX, FY, FZ, SX and NX. The left S and Y class items classified as category II (SY, SZ and NY). Items which are both non-moving and have small stock value are classified as category III (NZ).

5.6.1. FSN-XYZ Matrix analysis of pharmaceuticals at selected health facilities of West Shewa zone

FSN-XYZ matrix analysis of pharmaceuticals at selected health facilities of west shewa zone revealed that 136(28.16%) items classified as category I that contributed 78.82% of stock value.

116(24.02%) and 231(47.83%) items classified as category II and III contributed 15.47% and 5.71% of available total stock value respectively.

Table 18: summary of cross-tabulation of FSN-XYZ Matrix analysis of pharmaceuticals of selected health facilities of West Shewa zone, Oromia, Ethiopia, January 2020

FSN-XYZ Matrix	F		S		N		Total		
	No	Stock value	No	Stock value	No	Stock value	No	Stock value	%value
X	51	5021940.91	15	1059301.96	17	1237463.08	83	7318705.95	70.12%
Y	37	787920.29	30	591081.92	34	698968.80	101	2077971.01	19.91%
Z	16	119230.01	52	325007.98	231	596443.22	299	1040681.21	9.97%
Total	104	5929091.21	97	1975391.86	282	2532875.1	483	10437358.17	100%

No – means number of pharmaceutical item included in the class.

Table 19: Summary of category of FSN-XYZ matrix analysis of pharmaceuticals of selected health facilities at West Shewa zone, Oromia, Ethiopia, January 2020

Category	Number of item (%)	Stock Value (ETB)	% stock value
Category I (FX, FY, FZ, SX, NX)	136(28.16%)	8,225,856.25	78.82%
Category II (SY, SZ, NY)	116(24.02%)	1,615,058.70	15.47%
Category III – NZ	231(47.83%)	596,443.22	5.71%
Total	483(100.00%)	10,437,358.17	100.00%

5.6.2. FSN-XYZ matrix analysis of pharmaceuticals at selected hospitals of West Shewa zone

At selected hospitals of West Shewa zone FSN-XYZ matrix analysis showed that 139(33.41%), 120(28.85%) and 157(37.74%) items contributed for category I, II and III which carries 80.95%, 14.54% and 4.51% of stock value respectively.

Table 20: Summary of cross-tabulation of FSN-XYZ Matrix analysis of pharmaceuticals of selected hospitals of west shewa zone, Oromia, Ethiopia, January 2020

FSN-XYZ Matrix	F		S		N		Total		
	No	Stock value	No	Stock value	No	Stock value	No	Stock value	%value
X	45	3355908.78	14	935883.22	14	918160.53	73	5209952.53	70.27%
Y	37	634577.93	31	446834.11	25	384297.42	93	1465709.46	19.77%
Z	29	156988.29	64	246875.13	157	334042.06	250	737905.48	9.96%
Total	111	4147475	109	1629592.46	196	1636500.01	416	7413567.47	100%

Table 21: Summary of category of FSN-XYZ matrix analysis of pharmaceuticals of selected hospitals of West Shewa zone, Oromia, Ethiopia, January 2020

Category	Number of items (%)	Stock Value (ETB)	% stock value
Category I (FX, FY, FZ, SX, NX)	139(33.41%)	6,001,518.75	80.95%
Category II (SY, SZ, NY)	120(28.85%)	1,078,006.66	14.54%
Category III – NZ	157(37.74%)	334,042.06	4.51%
Total	416(100.00%)	7,413,567.47	100.00%

5.6.3. FSN-XYZ matrix analysis of pharmaceuticals at selected health centers of west shewa zone

At selected HCs of this zone FSN-XYZ matrix analysis showed that 81(30.22%), 74(27.61%) and 113(42.16%) of pharmaceuticals were contributed for category I, II and III that represents 80.40%, 14.20% and 5.40% of available stock value respectively.

Table 22: Summary of cross-tabulation of FSN-XYZ Matrix analysis of pharmaceuticals of selected health centers of West Shewa zone, Oromia, Ethiopia, January 2020

FSN-XYZ Matrix	F		S		N		Total		
	N<u>o</u>	Stock value	N<u>o</u>	Stock value	N<u>o</u>	Stock value	N<u>o</u>	Stock value	%value
X	40	1864854.03	5	104650.61	1	31556.98	46	2001061.62	70.49%
Y	27	253988.69	16	144025.78	19	158301.39	62	556315.9	19.60%
Z	8	27692.03	39	100661.76	113	153183.86	160	281537.65	9.93%
Total	75	2146534.75	60	349338.15	133	343042.23	268	2838915.13	100%

Table 23: Summary of category of FSN-XYZ matrix analysis of pharmaceuticals of selected health centers of West Shewa zone, Oromia, Ethiopia, January 2020

Category	Number of items (%)	Stock Value (ETB)	% stock value
Category I (FX, FY, FZ, SX, NX)	81(30.22%)	2,282,742.34	80.40%
Category II (SY, SZ, NY)	74(27.61%)	402,988.93	14.20%
Category III – NZ	113(42.16%)	153,183.86	5.40%
Total	268(100.00%)	2,838,915.13	100.00%

5.7. Results of Qualitative study

In-depth interviews were held with a total of 17 key informants (16 male and 1 female) and their duties were head of pharmacy department and store man. The ages of informants' ranges from 24 to 40 years old and their work experience ranges from 2 to 10 years. 7 of them have Bachelor of pharmacy, 5 Diploma in pharmacy, 2 Bachelor of Science in nursing, 1 Bachelor of Science in public health officer, 1 diploma in nursing and 1 diploma in laboratory.

As introduction before asking challenges present the key informants were asked about the concept of pharmaceutical inventory management. Seven of the respondents knew the concept of both ABC and VEN analysis, five of them knew only about VEN analysis, one of them knew the concept of ABC, VEN and FSN analysis and four of them didn't know any of these inventory management methods.

Data was analyzed and categorized into four themes based on the characteristics of the findings. These are supplier related challenges, Challenges related to shortage of budget and storage space, Challenges related with management and other committees of health facility, and Challenges related with Lack of human resources.

5.7.1. Supplier related challenges

Supplier related challenges were not supplying all requested quantity and unavailability of all needed items , supplying near expire pharmaceuticals in excess quantity, delay of arrival of ordered pharmaceuticals to health facility, sending unrequested items and pharmaceuticals are expensive.

One informant told supplier related challenges as it doesn't supply their entire request and as near expire pharmaceuticals supplied like this ……''*In Oromia Health centers have allocated budget of 180, 000 ETB per year and supplier called Biftu Adugna has supplied HCs two times per year. And then we request our annual need on first month and this supplier doesn't supply us our entire request. It supplies us near expire pharmaceuticals in excess quantity which is not consumed in all here, they send us only pharmaceuticals available on their hand to balance with the allocated budget 180,000 ETB.''*

An informant told that expiry of budget pharmaceuticals at hospitals was not common due to more patient flow. But at HCs relatively it is high due to supply of unneeded and near expire pharmaceuticals by suppliers.

One informant told the expiry of pharmaceuticals like this....*''Most of pharmaceuticals expired at health posts are program drugs those supplied freely. Expiration of pharmaceuticals at this HC is not challenging.''*

One informant at hospital told about expires of pharmaceuticals by saying....*''We have more patient flow then no challenge of expiration for budget pharmaceuticals but may be program drugs expire.''*

Another informant said the challenge of sending unrequested items and not getting the requested ones like this……….''*For example at initial of 2011 I made an order depending on the top ten diseases of the HC. The supplier sends us by pushing system not as I have requested them. I have listed and requested pharmaceuticals which are needed in the facility but the supplier send us other items which I didn't request, I couldn't get pharmaceuticals I have ordered. This is a challenge for me at the level of the HC.''*

Delay of sending pharmaceuticals to health facilities was another challenge……..*''There is a case when they supply us at any time they want; they don't supply it when it is needed. For example if they supply twice per year, at one time they supply full of Paracetamol which is enough for a year, and another time they supply Amoxacillin or another thing. If paracetamol is stocked out we have to wait them till they send it again, if we buy it before they send us, it may be out of our forecasted budget and it may be over stocked if they send it again. We don't know when and whether they send us or not, and they send it when they want by themselves not when we want it. With this way of supply it is challenging for us.''*

Another informant told the delay of arrival of pharmaceuticals like this…….. *''This year till now Biftu Adugna supplied us only one time. They should supply us for more than three times a year but they supply us only two times a year.''*

One informant told as items supplied by one supplier was expensive…….. '*'Pharmaceuticals which are supplied by Biftu Adugna are expensive. The cost is even more expensive than private one*.''

Another person added to this point by saying ……….*''Pharmaceuticals supplied by Biftu Aduqna in relative to Pharmaceutical supply Agency (PSA) are more expensive.''*

One informant told the challenge of unavailability of pharmaceuticals at supplier*……...''Most essential pharmaceuticals are not available both at PSA and private whole sales. For example Metronidazole injection was not available for a long time on market this year and now it is purchased by 75 ETB, which was 14 ETB before.''*

Another informant told the challenge of unavailability of pharmaceuticals like this…….''*You couldn't get pharmaceuticals you want from PSA. The need of dispensing unit here is high but pharmaceuticals are unavailable at supplier, here they think as you simply go and buy a soap from shop and come, then they always make you busy.''*

5.7.2. Challenges related to shortage of budget and storage space

Six respondents told as there is shortage of pharmaceutical budget. Here is the idea of one of the informants ……''*When we purchase by our HC's health care finance, if drugs are not available at PSA needed medications will be purchased by proforma which needs additional budget and more human resource.*''

Another informant told the tedious process of purchase by proforma which needs additional budget like this*……'' pharmaceuticals can be purchased by proforma from Finfine and proforma committees go Finfine with perdium. The process is tedious you go there and come repeatedly. This requires budget and vehicles.''*

One informant at HC told as there is lack of allocation of enough pharmaceutical budgets. *………''Oromia allocate us only 180,000 ETB per year, this is not enough to purchase all needed pharmaceuticals.''*

One informant told the resistance of the management of HC to purchase all needed pharmaceuticals at once. ……'*'Even though the budget is present, there is a case when they limit you not to purchase by more than 100,000 ETB at once. They decided as it is enough for now. If you get pharmaceuticals to be purchased, permitted cash is not enough to purchase all pharmaceuticals you need.''*

One informant told the absence of separate room for usable pharmaceuticals.

…………''For example stationary materials like paper, other chemicals like barakina, omo, expired pharmaceuticals and usable ones are stored here in the same room. Even the distance of the shelf from roof and wall is not as standard due to narrowness of the store.''

5.7.3. Challenges related with management and other committees of health facility

One informant told lack of commitment of management and DTC members like this……*''Starting from the management of this facility no attention is given for purchase of pharmaceuticals. DTC don't meet each other to select pharmaceuticals necessary for HC. Commitment of the management of HC is poor regarding to the selection of pharmaceuticals to be purchased and not purchased.''*

One informant told the non-commitment of inventory committee like this…… '*'due to lack of commitment of inventory committee to conduct physical counts of pharmaceuticals in our HC it is conducted only once per year.''*

One store man at a hospital told the absence of decision of management to give motivation and as it affects moral of working…….*''Store work is a labor work. Incentive (motivation) is not given then you don't do it by your own motive and payment for risky is already present on guideline but it is not given.''*

As one informant told flow of information between management and pharmacy profession is not in the way it satisfy them to apply the message from management…… ……*''I don't think as the higher government bodies give commitment on pharmaceuticals. On any meetings they send a message regarding pharmaceuticals to unconcerned person and they may not give you a message for you, and you are also not satisfied to hear from unconcerned person. If a concerned person gives a message to a concerned body you can take it and it can't challenge you to apply the message. The attitude of management starting from higher to this HC doesn't satisfy you.''*

Another informant person told the bureaucratic process of purchase by proforma like this ………… '*'You can't get administration committee at once those decide on budget when you want to purchase by proforma**. One committee is chairman of local kebele, other is director of school found around there, other is chairman of district and others are from district offices. Unless they sign on it you can't purchase pharmaceuticals you want.''*

5.7.4. Challenges Related with Lack of human resources (HR)

Nine of the respondents interviewed told as there is lack of HR.

…………..''This is a general hospital and it has Drug information center (DIC), ART Pharmacy, OPD Pharmacy, In-patient pharmacy and Emergency Pharmacy and to run these units independently it needs additional pharmacy professionals. As structure said general hospital needs 21 pharmacy professions, but including store man this hospital has only 6 pharmacy professions. Even we didn't start auditable pharmaceutical transactions and services (APTS) due to lack of pharmacy professionals and to start it needs more HR.''

There was a work load due to absence of pharmacy professions at store room. ………*''Only one person is assigned here at store room to register entry on computer and model 19 and later issue them, to update bin card, to monitor both budget and program pharmaceuticals, to identify for purchase whether stock out is present or not. This makes me busy.''*

One informant told the challenge of absence of pharmacy data clerk structure at HC like this…..……*''rules said prescription should be registered and to register it take a time, as hospital data clerk should work registration but here at HC it has no data clerk structure.*

This informant added another challenge related to absence of pharmacy professions like this….''*As a rule said even if one tablet issued it should be updated on bin card, this contradicts with a practical work here. If there is another person you can update when you are issuing it.''*

6. Discussion

The present study assessed the pharmaceutical inventory management of health facilities of West Shewa Zone by using ABC-VEN and FSN-XYZ Matrix Analysis. Conducting ABC analysis or VEN analysis alone has its own limitations. ABC analysis has a limitation of ignoring the criticality of pharmaceuticals and VEN analysis alone also ignore the cost value of pharmaceuticals. Then to use complimentary advantages of these methods ABC-VEN matrix analysis is needed to identify pharmaceuticals that need stringent control.

FSN analysis considers only the frequency of movement of the item and it doesn't consider the stock value they have. XYZ analysis considers only the stock value of the item tied up and it doesn't show consumption pattern of the item. To avoid the limitations of individual analysis of FSN and XYZ, it is possible by conducting the combination analysis of FSN and XYZ.

6.1. ABC Analysis

In the present study at selected health facilities of West Shewa zone about 539 pharmaceutical items were utilized and consumed 30,837,628.61 ETB. Out of the total items consumed in this zone 495(91.84%) of them were used at selected hospitals of this zone that consumed 19,241,061.7 ETB (62.4%) of TPE of the zone. From items consumed in this zone 341 (63.27%) of pharmaceuticals were utilized at HCs and consumed 11,635,306.17 ETB (37.73%) of TPE of the zone. The three years pharmaceuticals budget consumption at two hospitals was 1.65 times higher than that of 13 HCs. As it was explained by key informants this difference might be due to more patient flow at hospitals and lack of allocation of enough budgets that decreases consumption of pharmaceuticals at HCs.

Out of 539 pharmaceuticals used at selected health facilities of this zone ABC Analysis showed that 64(11.9%) number of items consumed 21,690,111.68 ETB (70.34%) of TPE and classified as 'class A'. This study indicated as few pharmaceutical items consumed high amount of pharmaceutical budget and these items need close day to day control by top level managers. Miss-management of these items in-terms of their selection and procurement leads to waste of high pharmaceutical budget, and then they should be controlled continuously. At health facilities of this zone 97(18.0%) and 378(70.1%) number of items classified as class B and C consumed 6,069,077.62 ETB (20.0%) and 3,078,439.31 ETB (9.72%) of TPE respectively. Here class B

items were medium in number and in consumption of pharmaceutical budget, and then they need periodic review for their inventory control by middle level managers. The result of class C items of present study showed that more than two-third of pharmaceuticals (70%) consumed small amount of pharmaceutical budget (around 10%) and these items require minimum attention for control, and low level managers can control them. This study showed that if only ABC analysis alone was considered for pharmaceutical inventory management at the selected health facilities of this zone, it would help effectively control 64 number of items in the class A, with 70.34% of TPE, but it would compromise on the availability of 86 vital items from class B and C (27 items from class B and 59 items from class C).

Present study revealed that out of 495 items used at selected hospitals of West Shewa zone 68(13.74%) class A pharmaceuticals consumed around 13,502,614.5 ETB (70.18%) of TPE. 90(18.18%) and 337(68.08%) number of items contributed for class B and C that consumed 3,831,682.63 ETB (19.91%) and 1,906,764.57 ETB (9.91%) of TPE respectively. Considering only ABC analysis at these hospitals would help effectively control 68 items in class A with 70.18% of TPE, but it would compromise on availability of 69 vital items found in class B and C (22 items from class B and 47 items from class C).

From a total of 341 pharmaceuticals consumed at selected HCs of West Shewa zone ABC analysis showed that 38(11.14%) of them belonged to class A and they consumed 8,191,559.04 ETB (70.40%) of TPE. 61(17.89%) and 242(70.97%) items belonged to class B and C that consumed 2,321,154.46 ETB (19.95%) and 1,122,592.67 ETB (9.65%) of TPE at HCs respectively. Considering only ABC analysis at these HCs would effectively control 38 items found in class A with 70.4% of TPE, but it would compromise on the availability of 25 vital items found in class B and C (10 items from class B and 15 items from class C).

ABC analysis of present study was comparable with previously conducted study by Ceylan Z and Bulkan S in Turkey in which 10.31% class A items consumed 69.96%, 21.78% class B items consumed 20.02% and 67.9% class C items consumed 10.01% of pharmaceutical expenditures (32). It was also comparable with study conducted at secondary level hospital in India by Kant S et al in which 10.4% class A, 19.8% class B and 69.8% class C items consumed 69.7%, 21.2% and 9.10% of pharmaceutical expenditures respectively (13). It was also comparable with similar study conducted at Tertiary Care Teaching, Research and Referral Healthcare Institute of India by Devnani M et al in which 13.78% class A items, 21.85% class B items and 64.37% class C

items consumed 69.97%, 19.95% and 10.08% of pharmaceutical expenditures respectively (14). Similarity of these studies with the present study might be related with that classification of ABC analysis follows V. Pareto classification way and in ranges he recommended.

However present study was different from a study conducted at hospital in Turkey by Gören HG and Dağdeviren O where only 10% class A items consumed 80% of pharmaceutical expenditures. 23% (class B items) and 67% (class C items) consumed 17% and 3% of pharmaceutical expenditures respectively (15). The finding of the present study had a big gap with a study conducted at Black Lion specialized hospital (Ethiopia) in which 2.99% (for 2008), 0.25% (for 2009) and 1.48% (for 2010) items assigned as class A and consumed 79%, 77% and 80 % of the total medicines budget respectively. Class B items in each year was 14.54%, 11.4% and 17.8% accounting 16.21%, 17.79% and 16.19% of medicines budget respectively. Class C medicines representing 82%, 88%, and 81% of the items consumed 5.1%, 4.93% and 4.94% of the budget in each year respectively (30). This difference might be due to the difference of level of health facility, pharmaceutical products included for the study and difference of pharmaceutical budget allocated.

From top ten expensive pharmaceuticals of class A at selected hospitals five of them were antibiotics and at HCs it was increased to seven. Amoxicillin 500mg capsule and ceftriaxone 1gm injection were commonly available at both level of health facilities. The high consumption of these antibiotics might be due to high prevalence of infectious disease at study area or the prescribers might prescribe antibiotics for every suspected case without confirmation of microbes. The high consumption of ceftriaxone injection gauze surgical at HCs needs additional investigation. There is no patient admitted and treated at HCs, and then it is not clear why ceftriaxone injection was consumed more there, it might be due to abused prescribing of antibiotics which leads to resistance of antibiotics. Another item which was consumed highly at both hospitals and HCs is gauze surgical; at hospitals it is consumed by different departments like operation room (OR), delivery (labor ward), emergency and at other departments but it is not clear why its consumption was high at HCs. It might be purchased from private suppliers by high price or consumed inappropriately.

6.2. VEN Analysis

Out of a total of 539 pharmaceuticals used for provision of health care services at selected health facilities of West Shewa zone only 320(59.4%) of them were included in to VEN list by health professionals. At selected hospitals and HCs from a total of 495 and 341 pharmaceuticals utilized only 278(56.2%) and 192(56.3%) of them were listed in VEN list of health facilities respectively. Variation of the used pharmaceuticals at each level of health facilities and VEN lists was due to exclusion of laboratory products from conducting their VEN analysis, Prescribers might not memorize all used pharmaceuticals while filling the questioner of this study, poor information flow between prescribers and pharmacy department, and as it was explained by key informants it might be also due to unavailability of functional DTC members to select pharmaceuticals to be purchased and used in health facilities.

The present study showed that out of a total of 320 pharmaceuticals listed in VEN at selected health facilities of West Shewa zone 115(35.94%), 156(48.75%) and 49(15.31%) of them were classified as vital (V), essential (E) and non-essential (N) that consumed 14,243,893.81 ETB (53.9%), 11,162,220.06 ETB (42.2%) and 1,032,168.31 ETB (3.9%) of TPE respectively. At selected hospitals of West Shewa zone from 278 items 99(35.61%), 138(49.64%) and 41(14.75%) of them were categorized as V, E and N which consumed 7,380,201.70 ETB (51.59%), 6,423,565.65 ETB (44.90%) and 501,744.27 ETB (3.51%) of TPE respectively. At selected HCs of this zone from a total of 192 items 40(20.83%), 116(60.42%) and 36(18.75%) of them were categorized under V, E and N class and they consumed 3,761,507.51 ETB (36.93%), 5,728,539.28 ETB (56.24%) and 696,596.98 ETB (6.84%) of TPE respectively. At selected health facilities of the zone and hospitals around one third of pharmaceuticals identified by VEN analysis were vitals that consumed more than half of pharmaceutical budget. Since these items are life saving their stock out can harm health care service provision and they need continuous inventory control. They should be available always and it is mandatory to supply them regularly. If there is lack of budget to purchase all needed pharmaceuticals, they should get priority and purchased. Around half pharmaceuticals listed by VEN analysis of this study were essentials and they need medium inventory control. Few items of present study were non-essentials and their stock out doesn't affect giving health care service of health facilities. Then least priority would be given for these items while purchasing pharmaceuticals. Attention for control of

pharmaceuticals while their selection, procurement, keeping their stock and use should be given first for vital items then for essentials and lastly non-essential items should be considered.

As you go from HC to hospital and then to the aggregation of both the percentages of pharmaceuticals classified as V class increases and that of N decreases (N decreased only from HC to hospital). The percentages of E class items also decreased from HC to hospitals then to aggregation of the both. This might be due to increased number of items used at hospitals, vitality of pharmaceuticals could be changed at different level of health facilities and when data of different health facilities aggregated class of item also changed.

Considering VEN analysis alone of the present study of the selected health facilities of West Shewa zone can effectively control 115 vital items with 54.0% of TPE and 156 essential items with 42.3% of TPE which gives a total of 96.3% of TPE, but it would compromise expensive (items which consume high pharmaceutical budget) items of class A found in non-essential category here two items called tramadol 50mg capsule and Paracetamol 500mg tablet which contributed around 1.2% of TPE. Considering only VEN analysis of hospitals and HCs of this zone can control effectively 99 vital and 138 essential items with 96.49% of TPE at hospitals, and 40 vital and 116 essential items with 93.17% of TPE at HCs, but it would compromise expensive items called tramadol 50mg capsule at hospital with 0.98% of TPE, and Paracetamol 500mg tablet and ibuprofen 400mg tablet with 2.36% of TPE at selected HCs. Then it is impossible to ignore all non-essential items as it contains expensive pharmaceuticals.

The findings of VEN analysis of present study was different from study conducted by Ceylan Z and Bulkan S in Turkey in which 10.67% vital items consumed 23.31% of pharmaceutical budget, 45.49% essential items consumed 55.85% and 43.75% non-essential items consumed 20.84% (32). This study was also different from the study conducted at Tertiary Care Teaching, Research and Referral Healthcare Institute of India by Devnani M et al (14) and a study conducted in Sudan by Mousnad MA et al (31). The finding of the study conducted in India was 12.11% vital, 59.38% essential and 28.51% non-essential items that consumed 17.14%, 72.38% and 10.48% respectively. The findings of the study conducted in Sudan were 2.34% vital items (consumed 5.46% of pharmaceutical expenditure), 52.65% essential (consumed 68.11%) and 45.01% non-essential items (consumed 26.43%). Both in terms of percentages of items and TPE vital items of present study were higher than previous conducted studies and that of non-essential

items of the present study were smaller than these previous studies. This variation might be due to aggregation of findings of different health facilities by this study, each and every level of health facility serves different health care conditions and they may use different items for different health conditions, and a drug which is vital at one health facility may be essential or non-essential (completely not needed) at others, and then it may vary consumption value of pharmaceuticals from other studies.

6.3. ABC-VEN Matrix Analysis

In present study ABC-VEN matrix analysis at selected health facilities of West Shewa zone revealed that 142(44.4%) of items classified as category I consumed 22,591,968.27 ETB (85.5%) of TPE. 137(42.8%) and 41(12.8%) pharmaceuticals were classified as category II and III that consumed 13.3% and 1.3% of TPE respectively. At selected hospitals of this zone 123(44.24%), 120(43.17%) and 35(12.59%) number of items were categorized as category I, II and III that consumed 12,195,467.14 ETB (85.25%), 1,911,699.78 ETB (13.37%) and 198,344.7 ETB (1.38%) of TPE respectively. ABC-VEN matrix analysis at selected HCs of the zone showed that 61(31.77%) items that belonged to category I consumed 8,385,646 ETB (82.33%) of TPE. The remaining 105(54.69%) and 26(13.54%) items were belonged to category II and III, and consumed 1,685,690 ETB (16.55%) and 115,307.17 ETB (1.13%) of TPE respectively. ABC-VEN matrix analysis of present study showed that category I items consumed high percentage of TPE and it enhances the ability to narrow down the attention on these items for strict managerial control, since these items are either costly or vital. Category II items consumed medium percentage of TPE and majority of them were essential items (BE, CE) and they need moderate inventory control by middle level managers.

Category III items of present study were small in number and they consumed very small percentages of TPE which was less than 1.4%, then they need less attention for control since they were both less costly and non-essentials. These items can be ordered once or twice a year, thereby saving on ordering cost at a moderate carrying cost and without blocking substantial capital (20).

Category I items at selected health facilities of West Shewa zone and that of hospitals consumed equal percentage of TPE, but only very small difference was occurred on consumption value of HCs. The similarity of consumption value may be related with the occurrence of these all health

facilities in the same area that treat similar cases and they may use similar pharmaceutical products for similar health care conditions treated in the area. The small difference of percentages of consumption value at selected hospitals and HCs might be related with the knowledge and experiences of prescribers have on management of the health care conditions treated at health facilities, number of pharmaceuticals used and difference of pharmaceutical budget allocated for hospitals and HCs.

Category I items of ABC-VEN matrix analysis needs continuous monitoring and control. At health facilities of West Shewa zone from 142 items belonged to category I (consumed 85.5% of TPE) only AV, AE and BV subgroups of this category consists of 81(25.31%) items that consumed 82.1% of TPE and the stock out of these items is unacceptable as they are either vital or essential. To prevent locking up of capital due to these items, low buffer stock needs to be maintained while keeping a strict control on the consumption level and stock on hand (20). From category I 59 (18.44%) pharmaceuticals were belonged to CV and they consumed 2.3% of TPE, these items are low in cost but high criticality. Since the carrying cost of these items (CV) is very low to decrease their ordering cost and to prevent their stock out they can be purchased once a year. AN the other subgroup of category I in this zone contains two items (Tramadol 50mg capsule and Paracetamol 500mg tablet) with 1.2% of TPE. These two items consumed medium percentage of TPE but they were non-essentials.

Since they are expensive and non-essential studies recommends as AN class items should be monitored for economic order quality, and their order placement must be made after careful study of the items need (12, 14, 20). Rational use of items in this subgroup, including their removal from the list if possible and substitution with equal therapeutic medicine but less cost can bring about substantial savings without affecting patient care (14, 20).

The findings of this study were comparable in terms of percentages of pharmaceutical expenditures with the study conducted at Saint Paul Hospital Millennium Medical College (Ethiopia) for 2013/14 to 2015/16 in which category I, II and III items in each three years consumed around 85%, 12% and less than 1% of annual pharmaceutical expenditures (20). The similarity might be due to the occurrences of these health facilities in the same country which treat similar cases and might use similar pharmaceutical products.

The findings of this study had a gap with a study conducted at a tertiary care neuropsychiatry hospital in India where category I items (33.8%) consumed 92.33% of pharmaceutical expenditures, category II items (60%) and category III items (6.2%) consumed 7.29% and 0.38% of annual pharmaceutical expenditures respectively (42). The present study had also a difference with another study conducted at Tertiary Care Teaching, Research and Referral Healthcare Institute of India by Devnani M et al (14) in which 22.09% category I items consumed 74.21% of pharmaceutical expenditures, 54.63% category II items consumed 22.23% and 23.28% category III items consumed 3.56% of pharmaceutical expenditures. This variation might be due to the difference of the level of the health care settings, each health facility may use different pharmaceutical products and pharmaceuticals budget of each health facility.

6.4. XYZ Analysis

XYZ analysis identifies pharmaceuticals that carry high, medium and low stock value at specific time. This can tell us the pharmaceutical budget tied up by excessive storage of the items.

From a total of 483 pharmaceuticals available on physical inventory of selected health facilities of West Shewa zone XYZ analysis revealed that 83(17.18%) items belonged to X Class and it contributed 7,318,705.95 ETB (70.12%) of stock value. 101(20.91%) and 299(61.9%) items were classified as class Y and Z which holds 2,077,971.01 ETB (19.91%) and 1,040,681.21 ETB (9.97%) of stock value. At selected hospitals of West Shewa zone from 416 pharmaceuticals available on physical inventory 73(17.55%), 93(22.36%) and 250(60.10%) of items belonged to class X, Y and Z with stock value of 5,209,952.53 ETB (70.28%), 1,465,709.46 ETB (19.77%) and 737,905.49 ETB (9.95%) respectively. From a total of 268 pharmaceuticals found on physical inventory of selected HCs of this zone 46(17.16%), 62(23.13%) and 160(59.7%) items were categorized as class X, Y and Z with the stock value of 2,001,061.62 ETB (70.49%), 556,315.86 ETB (19.60%) and 281,537.65 ETB (9.91%) respectively. At each level of health facilities around 17% of pharmaceuticals stocked on inventory carried 70% of stock value. These items need great attention for control since they carried high percent of stock value which might block pharmaceutical budget to be used for other purposes. Class Y items (around 20%) need moderate inventory control because they carried medium stock value (around 20%). Huge amount of items in this study were found under class Z and they represent only small percent of stock value, then they need less attention for control.

The findings of this study at selected health facilities of West Shewa zone, hospitals and HCs were similar in terms of percentages of items contribute to each class and their stock value. It might be related with similarity of pharmaceuticals stored in the facilities.

By using XYZ analysis a few percentages of pharmaceuticals which covered high percentages of stock value would be monitored. But it doesn't show the pattern of consumption and whether all pharmaceuticals that carry high stock value (X class items) are required frequently or are nonmoving (dead moving) at all. This analysis can also show the percentages of pharmaceutical budget tied up, but it doesn't show the probability of this budget to be lost due to expiry and longtime inappropriate storage conditions. Here in present study from all X category 17, 14 and 1 pharmaceutical items were found under non-moving category at selected health facilities of West Shewa zone, hospitals and HCs of the zone respectively. To prevent the loss of pharmaceutical budget due to expiry of these non-moving items which carry high stock value it is impossible only by considering XYZ analysis.

Most of pharmaceuticals highly stocked (from top ten mostly stocked) at health facilities of West Shewa zone were fast moving items. Then they need adjusting their purchase time and quantity to avoid locked up budget, but stock out of these items is not the priority problem here. From top ten highly stocked items only two non-moving items (micro curvetter 4x50 (hemocue) and merisilk braided black- gauge 3.5(0) 75cm on 32 mm ½ circle round bodied needle) were excessively stocked and it needs avoiding loss of pharmaceutical budget due to their expiry.

6.5. FSN Analysis

FSN analysis classifies items by considering their frequency of movement/issue from store. From a total of 561 pharmaceuticals issued from store to different dispensing units FSN analysis showed that 107(19.07%) items contribute 70.40% of total number of issues of pharmaceuticals and categorized as class F. 109(19.43%) and 345(61.50%) number of items classified as class S and N which contribute 19.60% and 10.0% of total number of issues of pharmaceuticals respectively. From a total of 516 pharmaceuticals issued at selected hospitals of this zone FSN analysis revealed that 122(23.64%), 118(22.87%) and 276(53.49%) of items were classified as class F, S and N which represents 69.61%, 20.87% and 9.52% of total number of issues of pharmaceuticals used. At selected HCs of this zone 355 pharmaceuticals were issued to different dispensing units. FSN analysis of these pharmaceuticals at HCs showed that 75(21.13%),

71(20.00%) and 209(58.87%) items were categorized as class F, S and N which represents 70.56%, 19.50% and 9.94% of total number of issues of pharmaceuticals. In general in present study around 20% of pharmaceuticals issued from store were fast moving and they should be controlled effectively as their stock out can interrupt health care service provision. The left around 20% of items used were slow moving and they need minimizing to low quantity to avoid loss of pharmaceutical budget due to long time inappropriate storage condition and chance of expiry.

This study showed that more than half of pharmaceutical items used were non-moving and they need avoiding these items to save loss of pharmaceutical budget by expire of these items. They should be transferred to other health facilities where it is needed or if there is agreement it should be sold back to supplier. Relatively percentages of non-moving pharmaceutical items at selected HCs of West Shewa zone was higher than that of hospitals, as it was explained by key informants at HCs this might be due to supply of unrequested items by suppliers.

In this study at selected hospitals of West Shewa zone majority of top ten (seven of them) fast moving items were medical supplies with three chemicals, but at HCs they were both medical supplies and medicines. This difference might be due to at hospitals there are many dispensing units than that of HCs and these fast moving items issued frequently to these different dispensing units. But medicines issued only to a few dispensing units like dispensary pharmacy. On average at selected health facilities of West Shewa zone majority of top ten fast moving items were medical supplies.

6.6. FSN-XYZ Matrix Analysis

From a total of 483 pharmaceuticals available on physical inventory at health facilities of West Shewa zone FSN-XYZ matrix analysis revealed that 136(28.16%) items classified as category I that contributed 8,225,856.25 ETB (78.82%) of stock value. 116(24.02%) and 231(47.83%) items classified as category II and III contributed 1,615,058.70 ETB (15.47%) and 596,443.22 ETB (5.71%) of available total stock value respectively. Category I items accounts for high percentages of stock value and they need great attention for control. From category I of FSN-XYZ matrix analysis at this zone FX, SX and NX items 83(17.18%) carries 70.13% of stock value. These items carry a high amount of stock value and they need strict management control. Items which are in the FX sub-category are fast utilized items having high stock value, and then

require a tight and strict inventory control. SX and NX category items should be controlled to avoid loss of pharmaceutical budget. SX class items should be controlled by minimizing their quantity in inventory. NX class items controlled by avoiding from facility or decreasing to minimum requirement of the items because they were non-moving and carry high percent of stock value. From category I both FY and FZ items 53(10.97%) represent small percent of stock value (8.69%) and they should be controlled to avoid their stock out.

From a total of 416 items available on stock taking at selected hospitals of West Shewa zone FSN-XYZ matrix analysis showed that 139(33.41%), 120(28.85%) and 157(37.74%) items contributed for category I, II and III that carries 6,001,518.75 ETB (80.95%), 1,078,006.66 ETB (14.54%) and 334,042.06 ETB (4.51% of stock value respectively. FX, SX and NX class items 73(17.55%) of category I represents 70.27% of stock value of pharmaceuticals at these hospitals. FY and FZ items 66(15.87%) of category I represent 10.68% stock value should be controlled to avoid their stock out.

At selected HCs of this zone from 268 pharmaceuticals available on stock taking FSN-XYZ matrix analysis revealed that 81(30.22%), 74(27.61%) and 113(42.16%) of pharmaceuticals were contributed for category I, II and III that represents 2,282,742.34 ETB (80.40%), 402,988.93 ETB (14.20%) and 153,183.86 ETB (5.40%) of available stock value respectively. FX, SX and NX items 46 (17.16%) of category I hold 70.49% of stock value of HCs of the zone. FY and FZ items 35(13.06%) represent 9.93% stock value should be controlled to avoid their stock out.

Category II of FSN-XYZ matrix analysis of present study at each level of health facility represents around 15% of stock value. Since this category items are slow moving and non-moving (SY, SZ and NY) they should be controlled to avoid loss of pharmaceutical budget tied up.

At each level of health facilities category III (NZ) items carry small percent of stock value (around 5%) and they should be avoided, since they are both non-moving and carry small percent of stock value. Before deciding avoidance of these pharmaceuticals it is better to see their criticality (by conducting VEN analysis) and then take any necessary action. If vital items found in this subgroup, store it in small quantity to avoid their stock out and avoid others to save storage space and decrease work load of store man.

7. Limitations of the study

1. Pharmaceuticals consumption data used for ABC analysis was taken from issue documents (model number 22), all items issued to different departments might not be consumed and it may not represent the exact consumption data of items.

2. Except health facilities those were using HCMIS data base majority of them used the same issue document (model number 22) both for program and budget pharmaceuticals. This might affect data of pharmaceuticals supplied both by program and budget to be included in the study. It is not possible to know from which the item was issued and it may lead to over report/under report of these pharmaceuticals.

3. Some health facilities issue some products in large quantity at ones which is enough for a long time or they wrote it on issue document by adding together which was issued at different times, this might decrease number of issues which in-turn affects the analysis of FSN.

4. Some health facilities didn't write the price of pharmaceuticals when physical inventory conducted then average price was used for XYZ analysis.

8. Conclusion and Recommendations

8.1. Conclusion

This study assessed the pharmaceuticals inventory management of health facilities found in West Shewa zone by using ABC-VEN and FSN-XYZ matrix analysis and it revealed the following conclusions. ABC analysis of pharmaceuticals of selected health facilities in the zone revealed that around 10% of pharmaceuticals consumed 70% of TPE and they need continuous day to day control. VEN analysis showed that one-third of pharmaceuticals of the health facilities of this zone were vitals those should not be stocked out. ABC-VEN matrix analysis of the study identifies category I items that consumed majority of TPE and which need greet attention for control while forecasting, selecting, purchasing and keeping their stock. Since category III items of selected health facilities of West Shewa zone consumed very small percentages of TPE their pharmaceutical inventory management practice was appropriate.

XYZ analysis of pharmaceuticals of health facilities at West Shewa zone showed that 17% of pharmaceuticals found on physical inventory contributed around 70% of the stock value. FSN analysis of the health facilities of this zone indicated that around 20% of pharmaceuticals issued from store were fast moving items and they need high management control to avoid their stock out as not to interrupt service provision. FSN-XYZ matrix analysis revealed as category I items contributed around 80% of stock value and from this category FX, SX and NX class items carried high stock value and they need great attention for control.

8.2. Recommendations

Based on the findings of the study the following recommendations were revealed for specific health facilities, for district and zonal health department, pharmaceutical suppliers (PSA and Biftu Adugna) and Oromia regional health bureau.

a. For specific Health facilities
   - Health facilities should conduct ABC-VEN and FSN-XYZ matrix analysis of pharmaceuticals yearly to identify categories of pharmaceuticals requiring stringent control to enhance effective patient care and efficient use of resources.
   - Health facilities should conduct VEN analysis of pharmaceuticals those VEN list didn't included in this study and take any necessary actions.
   - DTC members of each health facilities should meet regularly to discuss and select pharmaceuticals needed in the health facility and to be purchased.
   - Management of health facility should pay incentives for store man to motivate and compensate work load.

b. For district health offices and zonal health department
   - District health offices and Zonal health department should support health facilities found in the areas to solve lack of HR and communicate with suppliers on program of sending pharmaceuticals and items to be supplied.

c. For Oromia regional health bureau
   - Majority of key informants at health facilities complain lack of HR, then it should be solved by hiring pharmacy professions.

d. For Pharmaceutical suppliers
   - PSA should communicate with health facilities on the stock status of pharmaceuticals to minimize unavailability of pharmaceuticals at health facilities.
   - A supplier called Biftu Adugna should announce program of sending pharmaceuticals to health facilities and should not sent unrequested items to health facilities.

e. For Academic and research institutes
   - Pharmaceutical inventory management practice on FSN-XYZ matrix analysis is not studied clearly and then it needs further investigation to identify class of pharmaceuticals requiring frequent supply and unneeded ones

- FSN-XYZ matrix analysis alone is not enough to say NZ sub-category items should be avoided from health facilities, it may contain vital items and then further study on FSN-XYZ-VEN analysis is needed to identify vital items found in NZ sub-category.

9. References

1. Mani G, Annadurai K, Danasekaran R and Ramasamy DJ. Drug Inventory control analysis in a Primary level Health care facility in Rural Tamil Nadu, India. *Healthline.* 2014; 5(2).

2. Dwivedi S, kumar A and kothiyal P. Inventory Management: A Tool of Identifying Items That Need Greater Attention for Control. *The Pharma Innovation.* 2012; 1(7)

3. Anand T, Ingle GK, Kishore J and Kumar R. ABC-VED Analysis of a Drug Store in the Department of Community Medicine of a Medical College in Delhi. 2013. Available at https://pdfs.semanticscholar.org/55ae/7e40ca684f9ea5885c6443aa39a0f74a59b1.pdf. [Accessed on October 24, 2018].

4. Singam A, Dudhgaonkar S, Mamarde A, Salwe KJ and Khan H. ABC–VED Analysis of Drug Store in Tertiary Care Hospital for Year 2013-14. 2016. Available at https://www.ejmanager.com/mnstemps/36/36-1473666172.pdf. [Accessed on October 24, 2018].

5. Management Sciences for Health. 2012. MDS-3: Managing Access to Pharmaceuticals and Health Technologies. Arlington, VA: Management Sciences for Health.

6. Techniques of inventory management. Retrieved from http://shodhganga.inflibnet.ac.in/bitstream/10603/25185/10/10_chapter-3.pdf. [Accessed on December 15, 2018].

7. Seema Ahlawat *et al.* ABC Analysis of Pharmacy Store of an Ayurveda Institute. *Int. j. phar. Pharmaceutical res. Human (Ijppr.Human)*, 2016; 7 (3): 423-435.

8. Pandya B and Thakkar H. A Review on Inventory Management Control Techniques: ABC-XYZ Analysis. *REST J. on Emerging trends in Modelling and Manuf.* 2016; 2(3): 82-86.

9. Manivel P and Ranganathan R. Prioritized ABC – FSN analysis of inventory management in private and hospital pharmacy followed by questionnaire. *Int. Res. J. Pharm.* 2016; 7(12):104-113.

10. Malhotra N. Inventory Control Techniques for Materials Management of Dental Stores in Clinical Dental Set-up's: A Review Materials Management of Dental Stores in Clinical Dental Settings. SEGi Review ISSN: 1985.5672. 2015; 9. Available at https://fdocuments.in/document/inventory-control-techniques-for-materials-management-of-dental-.html. Accessed on November 11, 2019.

11. Holloway K (Editor) and Green T. Drug and therapeutics committees- A practical guide. WHO/MSH, (2003). Available at http://apps.who.int/medicinedocs/pdf/s4882e/s4882e.pdf. [Accessed on January 15, 2019]

12. Abate SM, Yigeremu M, Woldegerima B and Shibeshi W. Special and Aid Pharmaceuticals ABC-VEN Matrix Analysis of Tikur Anbessa Specialized Hospital for the Years 2009 to 2013, Addis Ababa, Ethiopia. *Indian J. of Basic and Applied Med. Res.* 2017; 6 (2): 669-681

13. Kant S, Haldar P, Singh A and Kankaria A. Inventory Management of Drugs at a Secondary Level Hospital Associated with Ballabgarh HDSS- An Experience from North India. *J Young Pharm.* 2015; 7(2)

14. Devnani M, Gupta AK and Nigah R. ABC and VED Analysis of the Pharmacy Store of a Tertiary Care Teaching, Research and Referral Healthcare Institute of India. *J Young Pharm. 2010; 2(2): 201-205.*

15. Gören HG and Dağdeviren O. An Excel-Based Inventory Control System Based on ABC and VED Analyses for Pharmacy: A Case Study. *Galore Int J of Health Sci and Res.* 2017; 2(1)

16. Devarajana D and Jayamohan MS. Stock control in a chemical firm: combined FSN and XYZ analysis. *ProcediaTechn.* 2016; 24: 562 – 567.

17. Reddy KVK, Siddarth Sai MSS and Prabhu R. A Study on the Selective Controls of Inventory Management and Application of ABC XYZ Control Matrix in the Cardiology Department of a Tertiary Care Hospital. *IOSR J. of Dental and Med. Sci. (IOSR-JDMS). 2017;16(5): 06-09*

18. Vahit YİĞİT. Medical Materials Inventory Control Analysis at University Hospital in Turkey. *Int. J of H Sci & Res*. 2017; 7(1)

19. Kokonya, D.M. (2016). Analysis of medicines expenditure for fiscal year 2014/2015 at Lowdar County Referral Hospital (Thesis). Strathmore University. Retrieved from http://suplus.strathmore.edu/handle/11071/4575 . [Accessed on January 3, 2019]

20. Nanati Legese (2017). Pharmaceutical expenditure analysis and assessment of pharmaceutical inventory control management practices in Saint Paul Hospital Millennium Medical College, Addis Ababa, Ethiopia. Available at http://etd.aau.edu.et/bitstream/handle/123456789/13101/Nanati%20Legese.pdf?sequence=1&isAllowed=y. [Accessed on February 24, 2019]

21. Kokilam MB, Joshi HG and Kamath VG. Assessment of Pharmaceutical Store and Inventory Management in Rural Public Health Facilities–A study with reference to Udupi District, Karnataka. *Pharm Methods*, 2015; 6(2): 53-9.

22. World Health Organization (2004). Equitable access to essential medicines: a framework for collective action. Available at https://apps.who.int/medicinedocs/pdf/s4962e/s4962e.pdf. Accessed on December 21, 2019.

23. Hogerzeil HV and Mirza Z. The World Medicines Situation 2011: Access to Essential Medicines as Part of the Right to Health. World Health Organization 2011; third edition. Available at https://apps.who.int/medicinedocs/documents/s18772en/s18772en.pd. Accessed on December 25, 2019.

24. Droti B, Neill KPO, Mathai M, Dovlo DYT and Robertson J. Poor availability of essential medicines for women and children threatens progress towards Sustainable Development Goal 3 in Africa. *BMJ Global Health*. 2019; 4:e001306. Doi: 10.1136/bmjgh-2018-001306.

25. Nditunze L et al. Assessment of Essential Medicines Stock-Outs at Health Centers in Burera District in Northern Rwanda. *Rwanda Journal Series F: Medicine and Health Sciences*. 2015; 2(1):85-88

26. Kefale AT and Shebo HH. Availability of essential medicines and pharmaceutical inventory management practice at health centers of Adama town, Ethiopia. *BMC Health Services Research*. (2019); 19:254. Available at https://doi.org/10.1186/s12913-019-4087-0. Accessed on December 21, 2019

27. Gurmu TG and Ibrahim AJ. Inventory management performance of key essential medicines in health facilities of East Shewa Zone, Oromia Regional State, Ethiopia. *Cukurova Medical Journal*. 2017; 42(2):277-291.

28. Gebremariam ET, Gebregeorgise DT and Fenta TG. Factors contributing to medicines wastage in public health facilities of South West Shoa Zone, Oromia Regional State, Ethiopia: a qualitative study. *Journal of Pharmaceutical Policy and Practice*. 2019; 12(29).

29. Gupta R, Gupta KK, Jain BR and Garg RK. ABC and VED Analysis in Medical Stores Inventory Control. MJAFI. 2007; 63(4)

30. Abate SM. Assessment of Pharmaceuticals Inventory Management Systems for the Years (2008,2009,2010) Using ABC-VEN Matrix Analysis at Addis Ababa University College of Health Sciences Tikur Anbessa (Black Lion) Specialized Hospital, 2012. Adv Pharmacoep. Drug Saf. 2013; 2(137)

31. Mousnad MA, Ibrahim MIM, Palaian S and Shafie AA. Medicine expenditures in Sudan National Health Insurance Fund: an ABC-VEN analysis of 5-year medicine consumption, J. of Pharm. Health Services Res. 2016; 7:165–171

32. Ceylan Z and Bulkan, S. Drug Inventory Management of a Pharmacy using ABC and VED Analysis, Eurasian J. of Health Techn. Assessment. 2017; 2(1): 13-18

33. Kumar Y, Khaparde RK, Dewangan K, Dewangan GK, Dhiwar JS and Sahu D. FSN Analysis for Inventory Management – Case Study of Sponge Iron Plant. *Int. J. for Res in Appl. Sci & Eng Techn (IJRASET).* 2017; 5(2).

34. Vaisakh PS, Dileeplal J and Unni VN. Inventory Management of Spare Parts by Combined FSN and VED (CFSNVED) Analysis. Int. Jour. of Eng. and Innovative Tech. (IJEIT). 2013; 2(7).

35. Mitra S, Reddy MS and Prince K. Inventory Control Using FSN Analysis – A Case Study on a Manufacturing Industry. Int. Jour. of Innovative Sci, Eng. & Tech. (IJISET). 2015; 2(4).

36. Hlaing NNN, Sooksriwong C, Chanjaruporn F, and Pattanaprateep O. Significance of Consumption Patterns And ABC/FSN Matrix To Optimize Vital Drugs Inventory Management. Jurnal Manajemen dan Pelayanan Farmasi. 2017; 7(3). Available at https://pdfs.semanticscholar.org/109a/1a98a2d66c156351a385cb7ff6587ceec250.pdf. Accessed on October 12, 2019

37. . Mallick B, Dutta ON and Das S. A Case Study on Inventory Management Using Selective Control Techniques. Available at https://www.academia.edu/16774884/a_case_study_on_inventory_management_using_selective_control_techniques. Accessed on February 28, 2019.

38. West Shewa zone, Available at https://www.revolvy.com/page/West-Shewa-Zone. [Accessed on January 9, 2019]

39. John Snow, Inc./DELIVER. 2005. Logistics Indicators Assessment Tool (LIAT). Arlington, Va.: John Snow, Inc./DELIVER, for the U.S. Agency for International Development.

40. Adzimah ED, Awuah-Gyawu M and Aikins I, Duah PA. An Assessment of Health Commodities Management Practices in Health Care Delivery; A Supply Chain Perspective. The Case of Selected Hospitals in Ashanti Region-Ghana. *European Journal of Business and Social Sciences.* 2014; 3(8):78 – 103

41. Fitriana I, Satria RGD and Setiawan DCB. Medicine Inventory Management by ABC-VED Analysis in the Pharmacy Store of Veterinary Hospital, Yogyakarta, Indonesia. *Asian J. Anim. Vet. Adv*. 2018; 13 (1): 85-90

42. Khurana S, Chhillar N and Gautam VKS. Inventory control techniques in medical stores of a tertiary care neuropsychiatry hospital in Delhi. *Health.* 2013; 5(1): 8-13

10. Annexes

Annex-I: Tool for collecting data of ABC analysis

Item No	Medicine name	Unit	Unit price	Annual consumption
1				
2				
3				
4				

Annex-IIA: Tool for collecting data for VEN analysis

Name of Health Facility_____ Department _____ date_____

S/N	Conditions treated	Occurrence of target condition			Persons treated/day			Severity of Target Condition					
		over 5%	1 -5%	<1%	>5 %	1–5%	< 1%	Life Threatening			Disabling		
								yes	occasionally	Rarely	yes	occasionally	Rarely
1													
2													
3													

Annex-IIB: Tool for collecting data for VEN analysis

Please would you rate the medications used for the treatment of each of the above cases.

S/N	Name, strength, dosage/vol. of medications	Prevents serious diseases (A)	Cure serious diseases (B)	Treat minor, self-limited symptoms and conditions (C)	Has proven efficacy (D)	Has unproven efficacy (E)
1						
2						
3						

NB. Choices for the above parameter/options are given below. so fill each of the box with one of the given choices

    A) Yes/No

    B) Yes/No   D) Always/Usually/May or May not

    C) Possibly/No/Yes   E) Never/Rarely/May or May not

Annex III- Tool for collecting data of VEN Analysis of medical supplies

Name of Health Facility_____

Format of VEN analysis of medical supplies

No	Item Description	Supply behavior and its effect on giving basic health services		
		1.Regular supply is mandatory/crucial to provide basic health services	2.used regularly but not absolutely vital to provide basic health care, has alternative	3.Rarely used
1.				
2.				
3.				
4.				
5.				
6.				

Annex-IV: Tool for collecting data of XYZ analysis

S/No	Name of item	Unit	Closing stock	Unit price
1				
2				
3				

Annex-V: Tool for collecting data of FSN analysis

S/No	Name of item	Unit	Frequency of issue
1			
2			
3			

Annex- VIA: Semi structured guiding for key informant interview (English Version)

Introduction

Hello, how are you? I want to thank you for taking time to meet with me today. My name is Magarsa Bayissa. I came from Jimma University School of Pharmacy attending a post graduate study in Pharmaceutical Supply Chain Management. I am the principal investigator for the study entitled *"Assessment of Pharmaceuticals Inventory Management by Using ABC-VEN and FSN-XYZ Matrix Analysis in West Shewa Zone, Oromia Regional State, Ethiopia".* Now I would like to talk with you about pharmaceutical inventory management which is very important for wise utilization of resources and appropriate patient care.

The aim of this study is to assess ABC-VEN and FSN-XYZ matrix analysis of pharmaceuticals inventory management in Health facilities of West Shewa zone, Oromia Regional State, Ethiopia. Considering that the findings and recommendations emanated from this study will help the policy makers and health facilities to design intervention activities, you are kindly requested to participate in this study. The interview should take less than an half an hour. I will be taping the session because I don't want to miss any of your comments and I can't write down all notes you will told me.

All responses will be kept confidential. This means that your interview responses will only be shared with research team members and we will ensure that any information we include in our report does not identify you as the respondent. Remember, you don't have to talk about anything you don't want to and you may end the interview at any time.

Are you willing to participate in this interview?   Yes   No

If yes, the interview will be continued

Name of Health facility _____ Date of interview_____

Part one

1: Back ground information of the key informant

1. Gender_____   2. Age_____   3. Educational level_____

4. Job title_____   5. Work experience_____

Part two: Guiding questions for in-depth interview

1. In your opinion, why does pharmaceutical inventory management is needed?

2. What inventory management methods do you know? _____

   a. Which inventory management methods are you using in the facility?

   _____ Why? _____

3. How do you set priorities for medicines to be stocked in the health facility; determine quantities and determine time for ordering? _____

4. Is there any challenge you faced during setting the above variables? Yes ☐ No ☐

5. What are these specific challenges? _____

   _____

6. What are the causes of these challenges?

   _____

   _____

7. What are actions taken to overcome these challenges?

Thank you very much for your time

Annex- VIB: Semi structured guiding for key informant interview (Afaan Oromoo Version)
Seensa

Nagaa jirtaa? Magarsaa Baay'isaan jedhama. Guyyaa har'aa yerooke irraa naaf kennitee na qunnamuukeef baay'ee sin galateeffadha. Yeroo ammaa Yuunivarsiitii Jimmaatti muummee barnoota Faarmaasiin digirii lammaffaa Bulchiinsa Cancala Dhiyeesssii Qorichaa fi meeshalee yaalaan barachaan jira. Ani qorataa qorannoo mata dureen isaa *"Assessment of Pharmaceuticals Inventory Management by Using ABC-VEN and FSN-XYZ Matrix Analysis in West Shewa Zone, Oromia Regional State, Ethiopia"*jedhu qorachaa jiruuti. Amma waa'ee bulchiinsa qabeenya qorichaa, laaboraatoorii fi meeshaalee yaalaa dhumataa kan faayidaa guddaa sirnaan fayyadama qabeenyaa fi tajaajila dhukkubsataaf qabuu irratti waliin haasofna.

 Kaayyoon qorannoo kanaas haala bulchiinsa qabeenya qorichaa, labooraatoorii fi meeshaale yaalaa dhumataa godinaa Shawaa Lixaa mala ABC-VEN fi FSN-XYZ Matrix Analysis jedhuun qorachuudha. Faayidaa bu'aa qorannoo kanaa fi ergaa inni tarkaanfii fudhannaa qaamota poolisii hundeessanii fi dhaabbilee fayyaaf qabu ilaalcha keessa galchuun, akka qorannoo kana irratti hirmaattuuf kabajaan affeeramteetta. Gaaffii fi deebiin waliin goonu daqiiqaa soddoma caalaa hin fudhatu.

Wanti ati natti himtu tokko illee akka na jalaa hin dabarree fi waan hunda amma barreessee fixuu waan hin dandeenyeef sagalee marii keenyaa nan waraaba. Icciitiin haasaa kanaa eegamaadha. Kana jechuun deebiin ati haasaa kana keessatti gootu miseensota qorannoo kanaaf qofa qoodama, gabaasa keenya keessattis odeeffannoon kamiyyuu eenyummaake akka hin caqasne siif mirkaneessa. Waanta haasahuu hin barbaadne kamiyyuu haasahuu dhiisuu akka dandeessu yaadadhu. Gaaffii fi deebii kanas yeroo barbaaddetti adda kutuu dandeessa.

Gaaffii fi deebii kana irratti hirmaachuu ni barbaaddaa? Eeyyee ☐   Lakkii ☐

Yoo eeyyee jette, gaaffii fi deebiin itti fufna.

Maqaa dhaabbata fayyaa_____ Guyyaa _____

Kutaa tokko

1. Odeeffannoo waa'ee nama gaaffii fi deebii irratti dhiyaatee

   1. Saala_____   4. Gahee hojii_____
   2. Umrii_____   5. Muuxannoo_____
   3. Sadarkaa barnootaa_____

   Kutaa lama: Guiding questions for in-depth interview

1. Akka yaada keetti, bulchiinsi qabeenya qorichaa, laaboaraatoorii fi meeshaalee yaalaa maaliif barbaachisaa?

   _____

2. Tooftaa bulchiinsa qabeenyaa kanaa kam beekta? _____

   a) Dhaabbata fayyaa kanatti tooftaa isa kam fayyadamtu? _____maaliif?

      _____

3. Dhaabbata fayyaa kana keessatti haala kamiin bittaa qabeenya tokkoo irra kan biraaf dursa kennuun bittu; jechuun hanga bitamuu fi yoom akka bitamu?

   _____

4. Yeroo murtoolee armaan olii fudhattan kan danqaa (hudhaa) isinitti tahu ni jiraa?

   Eeyyee ☐   lakki ☐

5. Yoo jiraateef danqaaleen kun maal fa'i? _____

   _____

6. Sababni danqaalee kanaa maal fa'i? _____

   _____

7. Danqaalee kana dhorkuuf tarkaanfii maaltu fudhatame? _____

   _____

Yerookee waan naaf kenniteef baay'ee galatoomi.

Assurance of Principal investigator

The undersigned certify that he has read hereby recommended for acceptance by school of pharmacy, institute of health sciences, Jimma University a research thesis entitled; ''Assessment of Pharmaceuticals Inventory Management by Using ABC-VEN and FSN-XYZ Matrix Analysis in West Shewa Zone, Oromia Regional State, Ethiopia'' in partial fulfillments of requirements for the degree of masters of science (MSc) in pharmaceutical supply chain management.

Name of the student: Magarsa Bayissa Deressa (B.Pharm)

Signature_____ Date _____

Approval of the advisor

Name of advisor: Mr. Awol Jemal (B.Pharm, MSc)

Signature_____ Date _____

Name of internal examiner: Mr Gizachew Tilahun (B.Pharm, MSc, Assistant professor)

Signature_____ Date _____

Name of external examiner: Mr. Edao Sado (B.Pharm, MSc, Assistant professor)

Signature_____ Date _____