ANALYSIS OF PHARMACEUTICAL INVENTORY MANAGEMENT IN A STATE HOSPITAL IN MYANMAR

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การวิเคราะห์การจัดการเภสัชภัณฑ์คงคลังของโรงพยาบาลรัฐแห่งหนึ่งในเมียนมาร์

น.ส.มยา พาน ธาซิน

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
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มยา พาน ธาซิน : การวิเคราะห์การจัดการเภสัชภัณฑ์คงคลังของโรงพยาบาลรัฐแห่งหนึ่งในเมียนมาร์. (ANALYSIS OF PHARMACEUTICAL INVENTORY MANAGEMENT IN A STATE HOSPITAL IN MYANMAR) อ.ที่ปรึกษาหลัก : ผศ. ภญ. ดร.รุ่งเพ็ชร สกุลบำรุงศิลป์

การวิเคราะห์การจัดการเภสัชภัณฑ์คงคลังของโรงพยาบาลประจำรัฐในประเทศเมียนมาร์เป็นการศึกษาโดยการวิเคราะห์เชิงคุณภาพและเชิงปริมาณ เพื่อจำแนกประเภทยาที่ต้องการระดับของบริหารจัดการที่เข้มงวดต่างกัน การวิเคราะห์กระบวนการดำเนินการจัดการเวชภัณฑ์คงคลัง (work-flow analysis) เป็นการวิเคราะห์เชิงคุณภาพ เก็บข้อมูลจากการสัมภาษณ์เชิงลึกของเภสัชกรผู้ปฏิบัติหน้าที่ในคลังเวชภัณฑ์ การวิเคราะห์งบประมาณค่าใช้จ่ายของยาแต่ละชนิดในปีงบประมาณ ปี พ.ศ. 2559 และ 2560 เป็นการวิเคราะห์เชิงปริมาณ ใช้การวิเคราะห์ตามหลักการ ABC, VEN, และ เมทริกซ์ ABC-VEN ผลการศึกษาพบว่ามูลค่าการใช้จ่ายของยาต่อปี เฉลี่ยอยู่ที่ 474,698,280.76 จ๊าต พิจารณาจากยาทั้งหมด 297 รายการ พบว่า ร้อยละ 7.74 (23 รายการ), 16.84 (50 รายการ) และ 75.42 (224 รายการ) จากรายการยาทั้งหมด จัดเป็นประเภทยากลุ่ม A, B และ C ตามลำดับ เท่ากับมูลค่าต้นทุนยา ร้อยละ 70.43, 19.66 และ 9.91 ของมูลค่ายาทั้งหมด การวิเคราะห์โดยใช้หลักการ VEN พบว่ารายการยาร้อยละ 35 (105 รายการ), 45 (133 รายการ) และ 20 (59 รายการ) จากรายการยาทั้งหมด จัดเป็นประเภทรายการยาที่สำคัญจำเป็น และไม่จำเป็นตามลำดับ โดยเมื่อคิดเป็นมูลค่าเทียบกับมูลค่ายาทั้งหมด ได้เป็นร้อยละ 65, และ 32 และ 3 ตามลำดับ ในการวิเคราะห์เมทริกซ์ ABC-VEN ยาถูกจัดกลุ่มใน Category I (ร้อยละ 38) Category II (ร้อยละ 43.1) และ Category III (ร้อยละ 18.9) คิดเป็นร้อยละ 84.48, 14.12 และ 1.4 ของมูลค่ายาในคลังเวชภัณฑ์ทั้งหมด ยาที่ถูกจัดให้อยู่ใน ประเภท 1 (Category I) จำเป็นต้องได้รับการควบคุมอย่างเข้มงวด ในขณะที่ยาประเภท 2 และประเภทที่ 3 ต้องการการบริหารจัดการในระดับกลางและระดับน้อยตามลำดับ การใช้เทคนิคการบริหารคลังเวชภัณฑ์ตามหลักการ ABC-VEN ช่วยให้การบริหารจัดการทรัพยากรเป็นไปอย่างมีประสิทธิภาพ สามารถลดสถานการณ์เวชภัณฑ์ล้นคลัง และสถานการณ์ของขาดคลังเวชภัณฑ์ได้ โรงพยาบาลควรมีกระบวนการประสานงานและการสื่อสารในการจัดซื้อระหว่างหน่วยงานกลางกับโรงพยาบาลอย่างมีประสิทธิภาพเพื่อเพิ่มประสิทธิภาพในการจัดซื้อและการบริหารคลังเวชภัณฑ์ ทั้งนี้ต้นทุนของยาก็เป็นอีกปัจจัยหนึ่งที่ควรนำมาพิจารณาเนื่องจากต้นทุนด้านยาเป็นองค์ประกอบหลักของต้นทุนค่าใช้จ่ายในโรงพยาบาล โดยอาจพิจารณาใช้เครื่องมือการจัดการสินค้าคงคลัง เช่น หลักการจำแนกประเภทของยาทั้งหมด เพื่อจัดการกับระบบตรวจสอบคลัง และจัดการสินค้าคงคลังของยาแต่ละประเภทอย่างเหมาะสม

สาขาวิชา	เภสัชศาสตร์สังคมและบริหาร	ลายมือชื่อนิสิต .....
ปีการศึกษา	2563	ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

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Mya Pann Thazin : ANALYSIS OF PHARMACEUTICAL INVENTORY MANAGEMENT IN A STATE HOSPITAL IN MYANMAR. Advisor: Asst. Prof. RUNGPETCH SAKULBUMRUNGSIL, Ph.D.

Inventory management (IM) analysis in a state-level hospital pharmacy of Myanmar was done by using qualitative and quantitative analysis to classify the drug categories that require different levels of management control. Workflow analysis was qualitatively conducted using in-depth interviews of pharmacists. The annual expenditure consumed on each drug of pharmacy for the years 2016 and 2017 was analyzed and application of ABC, VEN, ABC-VEN matrix analysis was performed. The study showed a lack of classification for drug procurement, monitoring, and reporting. There was a lack of appropriate communication between hospital and central procurement, shortage of pharmacists, lack of training about IM, and manually stock record in sub-stories. The study showed that the average annual expenditure was 474,698,280.76 kyats. Of the total 297 medicines, 7.74% (23), 16.84% (50), and 75.42% (224) items were found to be A, B, and C category items respectively costing 70.43%, 19.66%, and 9.91% of drug expenditure. The VEN analysis revealed that 35% (105), 45% (133), and 20% (59) items as Vital, Essential, and Non-essential category items respectively, accounting for 65%, 32%, and 3% of drug expenditure. On ABC-VEN matrix analysis, drugs were group into Category I (38%), Category II (43.1%), and Category III (18.9%) accounting for 84.48%, 14.12%, and 1.4% of drug expenditure. Category I medicines are needed to be controlled strictly whereas Category II and Category III medicines need middle and lower-level management respectively. ABC-VEN classification techniques should be used for efficient resources utilization and elimination of wastage and stock-out situations in hospital pharmacies. Pharmacist resources planning, and training, stock record with IT, appropriate coordination between two sources of procurement should be considered.

Field of Study:	Social and Administrative Pharmacy	Student's Signature .....
Academic Year:	2020	Advisor's Signature .....

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CHAPTER –I INTRODUCTION

1.1 Background Information

Inventory management (IM) is the supervision and regulation of the purchasing, storage, distribution and use of products that a business/organization would apply in the production of these products it would sell or distribute as well as the supervision and control of quantities of finished goods for distribution or sale (1). IM, is a part of supply chain management, oversees the flow of products from manufacturers to storage area and from these areas to place of distribution or sale. IM also spends money to keep, circulate and provide insurance to inventory. Mismanagement of inventories causes profound financial problems for an economic organization and leads to an inventory shortage or an inventory excess. The cost of IM is comprised in the last price provided by the consumer (2). According to Morris (1995), IM in its widest dimension is to retain the most economical quantity of one kind of useful things in order to maximize the total value of all useful things of the organization consist of both human and material resources (3).

As the medical care institution is a labor based service, salaries and fringe benefits describe nearly sixty percent of hospital operating costs, materials and supplies like drugs and chemicals use thirty to thirty-five percent of total operating costs (4). Interest in health care and medicine shave disproportionately create extensive rate of expenditure in health care delivery (5).In many different countries, large proportion of health care budget is used for pharmaceuticals expenditure. In

most Organization for Economic Cooperation and Development countries (in 2011), the cost of pharmaceuticals is more than 17% of all health care facilities utilization. Purchasing of prioritized drugs and materials is nearly 33% of the yearly operating funds in any tertiary level hospital. The medical stores department combined with the dispensing unit where distribution of medicines, is one of the most highly used service of the hospital and this area spends extensive amount of money for procurement and maintenance activities (6).

Hospital materials management (HMM) is the important part of the clinical sphere of health facilities service performance (7). The intention of supply system in hospital is to ensure that there is sufficient amount of required materials, so that continuous distribution of all essential materials is attained (8). This needs the effective and efficient pharmacy management with a continuous and precise supervision on medicines, prevention of damage, procurement and distribution of first prioritized medicines. Poor inventory management in healthcare industry, especially the public health setting, contributed to the wastage of resources, insufficient availability of essential drugs, stock outs and stock losses. Absence or lack of adequate drugs in health care unit might result poor health care delivery and unwanted belief from patients. This has been experienced in many different countries and has led to failure to achieve better health care outcomes (9).

Ineffective inventory management can be reasoned from inaccurate medical stock records, inadequate and unsystematic monitoring and evaluation of the stock,

and in definite procedures in terms of quantity and frequency. These situations can be traced to inadequate know-how of inventory management and its actual management (9). Lloyd (2008) said that despite initiatives to incline the availability and access to ARV's in East African countries through the Global Fund for fighting AIDS, the pharmaceutical supply management in the region's countries was identified to be deficient. This was attributed to insufficient capacity to quantify needs, set orders and accurately maintain records (10).

The main goal of IM includes balancing the conflicting economics of unwanted to handle excessive stock. In fact, IM can take place profound improvement not only in patient care but also in the appropriate use of financial resources (11).Therefore, IM is a key measurement in a continuous and consistent pharmaceutical supply in a hospital setting. It is important to know the category of medicines in a pharmaceutical set-up in order to maintain the availability of essential category of medicines to avoid all types of wastage such as, under stocking, overstocking and expires. This loss results in the reduced quality of medicines to patient and inefficient quality of healthcare service they receive. Both stock outs or overstocking and drugs expiry represent problems in the medical supply chain components which involve selection, quantification, procurement, distribution, storage and use. Therefore, it is ensured to access and improve inventory management to keep optimization of the medical supply system in terms of its efficiency.

Inventory challenge in Public Hospitals of Myanmar

Myanmar is one of the Southeast Asia countries, 680,000 km^2 wide, surrounded by Bangladesh, China, India, Laos, and Thailand. There are seven states, seven regions and Nay Pyi Taw Union Territory in Myanmar with approximately 53 million populations. In recent years, the demand for health care service has risen among the Myanmar Population. Healthcare services in Myanmar are generally provided under supervision and regulation of Ministry of Health and Sports, Myanmar (MOHS). Public hospitals are branched into general hospitals (2000 beds), teaching and specialist hospitals (1000 to 1200 beds), state and regional hospitals (200 to 500 beds), district hospitals (100 to 200 beds), and township hospitals (25 to 100 beds) (12).

Hospital utilization in Myanmar is increasing; 1.21 million admission cases in 2009 and 2.97 million in 2018, outpatient attendants were 3.38 million in 2009 and 11.48 million in 2018 (13). In recent 5 years, MOHS provide budget to public hospitals to purchase medicines (under the supervision of director of each hospital) to increase drugs availability by patients. The medical supply of hospitals needs inventory management tools to spend budget appropriately to reduce wastage and to increase drugs availability for patient health care.

The study was conducted in a Rakhine State hospital (Sittwe hospital) as this state is second least developed state compared to other states and regions and the benefits from this study can reflex other state and regional level hospitals. In

3.2million population of Rakhine State, 111097 admissions and 230391 outpatient attendants were found in 62 hospitals in this state. Health care organizations all over the world are looking for ways to optimize operational efficiencies and reduce costs with effective patients care and services. Effective IM is one of the important keys to be success in health care. All health care organizations would ideally need to keep enough inventories to cover the consumption by their patients and wouldn't want to inconvenience clients because of insufficient inventories. Otherwise, due to financial constraints, they do not want to keep excess inventory staying in hand due to the cost of carrying inventory. Coyle, Bard and Langley, (2003) said that enough but not excess is the principal goal (14). There is no inventory classification system used in public hospitals in Myanmar to control inventory and they face the problem of stock outs and over stock in hospital pharmacy. The IM of public hospitals in Myanmar is needed to be more efficient to reduce these problems.

1.2 Research Objectives

To analyze the current situation of medicine inventory management system of a state hospital in Myanmar

1.3 Expected Benefits

(1) The result of this study could be used to redesign the inventory system of the state hospital to alleviate inventory management challenges.

(2) This study will provide a method to improve the performance of drug inventory management.

(3) The results from this research could be used to develop process of drug procurement in health care facilities

1.4 Conceptual Framework of the study

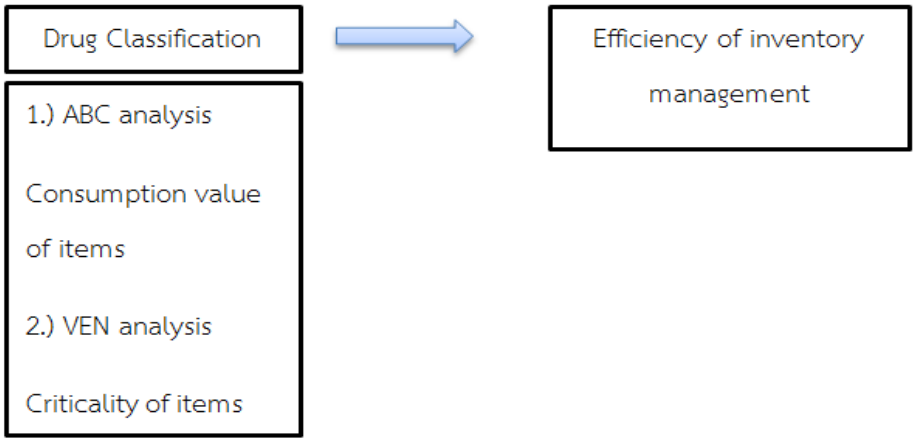

Figure 1: Conceptual Framework of the study

CHAPTER –II LITERATURE REVIEW

This chapter includes relevant literature about the determinants of supply chain and effective drug IM in healthcare facilities.

2.1 Pharmaceutical supply-chain management

Supply chain management is the management of the movement of services and products along with inventory process from starting point to end of consumption. Supply-chain management can be defined as the structure, strategy, order, monitoring and control supply-chain activities with the aim of having advantage.

Powerful health care systems can be created by efficient pharmaceutical supply systems Sufficient human resources, consistent budget, broad information systems, advanced technology, coordinated healthcare participants and institutions are important factors to ensure accessibility and uninterrupted availability of essential medicines (15) .

The medicines management cycle includes the main processes of effective medicines supply management: selection, quantification and forecasting, procurement, storage, and distribution. Improved availability of medicines can be found when rational selection, affordable prices, good inventory systems and consistent finance are present.

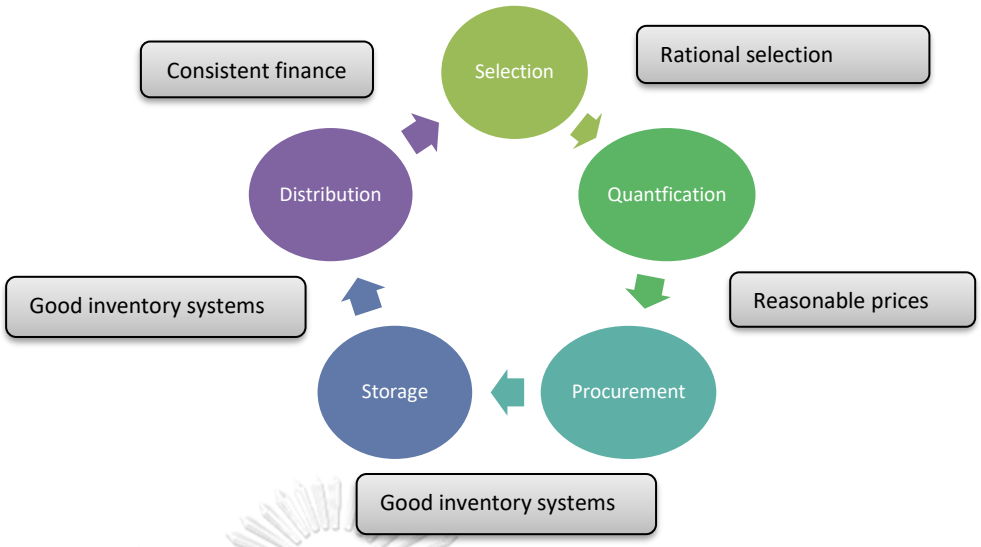

Figure 2: *Medicine Management: Source WHO essential medicine and health products*

2.2 Inventory Management/Control

Inventory control is a task or situation that tests business activities. Controlling inventory can have direct action on performance of business. The concept of having stocks or inventories is to balance between demand and supply of inventories. Existing large amount of inventory on hand presents high carrying cost, and existing very small amount forwards to an incline in ordering cost. Thus, IM should be appropriately proposed with the aim of obtaining the smallest possible total expenses (16).

Although inventory is recognized in business activities as an unfavorable impact as large volume of total costs is set up, however having inventory is a reasonable requirement for many business activities. IM are mandatory practices for firms that seek profits. The objectives of IM are reducing the total expenses and

raising service quantity by adjusting supply and demand. There are many components incorporated in inventory controlling. Businesses are described by two individualized strategies, pull and push. Just in time is a pull strategy in the time economic order quantity) (EOQ) consist of factors of push system proactive appearance.

Since IM hits hospital pharmacy, being proactive is the most essential capability. Commonly, demand or order cannot be accurately calculated at first since the patient's number is well difficult to estimate. On the other hand, it can be estimated in some circumstance, for example, patients with diabetic and HIV who must receive regular treatments and continuously needs specified medicines. Thereupon, push strategy is widely used in hospital pharmaceutical supply and other healthcare sectors because of availability of medicines by the patients.

Medical materials are unique in comparison with other goods because they relate with health and lifesaving. It is common for logistic officers to effort to decrease the level of inventory and drop the total cost. This results in service level decreasing. IM in hospital is performed differently to other institutions in healthcare industry since hospitals do not find profits from drug sales. Hence, IM in hospital pharmacy should be handled differently. The first priority should be service level, then lower costs and decrease losses (16).

Reasons for having an IM system in a pharmacy is to ensure that there are no unexpected drug stock outs, there is a frequent costing and maintaining of inventory, the cost of ordering of drugs from wholesaler is minimized. Inventory system also ensures that the time taken in ordering and purchasing drugs is reduced. It also prevents costs associated with damages and expiration of inventory and it reduces the total costs to the pharmacy and hence the entire health care facility (1).

A critical component of pharmaceutical services in a hospital set up relates to drug supply and management. Jitta, et al. considered the availability of medicines as a key indicator of health care in African settings (17). This is because medicine provision acts as a key link between patients and heath service providers, especially for treatment-seeking patients.

2.2.1 Reasons for Having Inventory

- Economies of scale are accessed by buying high amounts that enables cost lowering of per unit adjusted cost. Additionally, transportation would obtain economies of scale along with using by carrying high amounts of products.
- Another crucial rational for having inventory is balancing of demand and supply. In case that supply depends on the season, inventory can guide reach demand when items are not handy. Conversely, if it undergoes seasonal demand, inventory must be added to reach demand in the forthcoming period.

- Long production process needs specialization of products that can take economies of scale to manufacturers. Rather than manufacturing different types of products, each production site can provide only type of product and distribute to customers and warehouse.
- Not being uncertainties is a fundamental factor for carrying inventory. Having enough stock on hand diminish risk of shortage and stock out problems which may forward to loss in sale and lack of trustworthiness. Customers are likely to buy competitors' products instead (16).

2.3 Classification of Inventory

To develop IM, different inventory measurements have been advanced with different aims. If a firm produces different types of products, inventory required to do classification before application of inventory methods. For pharmaceuticals, there are many procedures to analyze the inventory depending on different basic factors, for instance, consumption value, criticality, consumption rate, consumption pattern and sources. Among different types of classifications, ABC ,VEN, ABC-VEN matrix classifications are the most choice for drug inventory in hospital medical stores (18).

2.3.1 ABC Classification of Inventory

ABC analysis is one the most useful mechanisms for IM. Vilfredo Pareto, an Italian economist and philosopher has introduced and promoted this A B C classification. He described that a very high proportion of total income and wealth of nation was applied for a small population percentage. This rule of thumb describes that 20 % of

items account for the 80 % of total value. This analysis is considered as a universal principle. Hence, it is widely applied in many business activities.

- Class (A) highlights 20 % of items in inventory with 70 % of monetary value of the inventory.
- Class (B) describes 30 % of items in inventory with 20 % of monetary value of the inventory.
- Class C describes 50 % of material in inventory with only 10 % of monetary value of the inventory.

Class	% Of Items in Inventory	% Of Inventory value
A	20	70
B	30	20
C	50	10

As reported in ABC classification, it is recommended to need more analysis for items that have higher inventory value. According to the study of Gaither & Grazier 1999, Class A should be made most comprehensive analysis and Class C is needed to analyze little. This classification has an advantage that control of small numbers of materials to 20 % will produce in the control of up to 75 % of the inventory value (19).

If classification of inventory materials is not made, the cost of handling and controlling items would be very high due to same attention is provided to all materials. By classifying the inventory, different control systems can be designated to materials in the different classes. V. Venkat Reddy has demonstrated the selective control procedures for this classification applied in pharmaceuticals supply as mentioned as,

For A items, a very strictly control process should be planned then the controller with great authority should supervise this procedure. Stock exists in safety situation (safety stock) should be in very low level or should not be ordered frequently. Supervision of consumption pattern and movement of products should be performed regularly as daily or weekly. To be effective IM such as good supplier performance and lead time reduction, sources for high valued materials should be increased in numbers. Centralized procurement of items should be done.

Middle level of management is needed for B class items to be controlled. Not too much safety stock strategy is suitable for this class as monthly or quarterly orders. Order quantity can be calculated depending on past consumption as a basis. This class should use 2 or 4 reliable items sources (suppliers) to make reduction in lead time.

To determine stock level of C class items, higher authorized person can send authority to lower one. High controlling is not required for this group of items. In

comparison with A class and B class items, this group are lowest value in inventory. Therefore, orders can be set at a larger size to get advantage of discount.

Despite ABC analysis highlights mainly on the A class, consumption of B and C class should not be ignored. These three classes of drugs might be in one prescription found in especially hospital pharmacy. If a C class medicine is vital for the illness, shortage of this drug can result in treatment failure (20).

2.3.2 VEN classification of Inventory

VEN classification is a tool of analysis which presents criticality of medicines. Medicines are classified into three categories depend on the priority status and level of importance for patients' health.

- Class V items (Vital drugs) are potentially determined in lifesaving items. The withdrawal side effects of this type of medicines are very significant. Drugs in this group are very necessary for providing basic health care services.
- Class E items (Essential drugs): In comparison with class V drugs, effectiveness of class E drugs is less severe, but they are important for basic health care facilities.
- Class N items (Nonessential drugs): For minor and limited illness, class N drugs are suitably used. Efficiency of this drugs group is still questionable. In addition, expensive medicines used for minimum therapeutic advantage are included in this group.

To classify medicines according to this system, a committee of pharmacists, physicians should be organized because decision can differ. Medicines that appear in all three groups are determined as vital. Drugs that fall into Class V and E are identified as vital and drugs that appear in class E and N are categorized as essential drugs. This classification method guides staff to perform respective degree of management for each group of medicines. The extent of importance of procurement and inventory control practices drops from class V to class E drugs (8).

Since the pharmaceutical inventory procedure often faces problem of inventory control including stock outs and expiry of essential medicines. Thus, the organizations have chosen to apply inventory control tools such as ABC and VED analysis for the medical items distributed in the hospital pharmacy. Such inventory control analysis is necessary for improving health care services quality and would cause reduction in stock outs level of essential medicines.

2.3.3 HML classification

Like ABC classification, the High, medium, and Low (HML) classification stands on the costs of items. The only difference between ABC and HML is that, in HML classifying all items into various categories and ignore the annual consumption value. For all inventory items, unit value of items are arranged in the descending order and it is up to the management to specify limits for three groups of items. As examples, the management may determine that H items are items with unit value of US $ 30

and above, M items are items with US $ 15 to 30 and L items are those with less than US $ 15.

This analysis is used for controlling over consumption of items at departmental levels, for identifying the frequency of physical verification, and for controlling purchases (21).

2.3.4 FSN classification

FSN classification (F= fast moving, S =slow moving, N = non-moving) assumes that all inventory items are not needed on regular basis and some occasionally. Thus, F items must be stored close to the place of issue and N items can be stored in a remote place because those are required infrequently.

For FSN analysis, receipt date or issue date is considered to identify the number of months, which have lapsed since the last transaction. Commonly, the items are categorized in one year period.

This analysis is useful to determine fast flowing items that are required to check frequently and surplus items that also need to be reviewed. N items are checked more and their disposal should be done carefully (21).

2.3.5 SDE classification

The SDE analysis is according to the items availability and is very useful in the situation of scarcity of supply. In this analysis S stands for scare items with shortened supply. D stands for items that are not easily accessible in local markets and need to be procured from faraway markets. In the case of D items, supplier numbers are limited, or reliable suppliers are rare. E items are items that are feasibly found in the local markets.

This classification, based on challenges in procurement, is important for the analysis of lead time analysis and decision on purchasing policies (22).

2.3.6 SOS classification

SOS classification is based on seasonality of items and all items are grouped into two classes, Seasonal and off seasonal. This analysis used to determine items which are available only within a specific period of the year and to identify items which are seasonal but available around the whole year however the costs of items in offseason are comparatively high (22).

2.3.7 XYZ classification

XYZ classification is based on the value of inventory stored when ABC is based on value of consumption to values. X refers to items with high value, Y stands for

medium value items and Z refers to those with least values. The objective of this analysis is to identify items which are excessively stocked (22).

2.4 Inventory Costs

Inventory is related with 3 important costs are mentioned in the following.

2.4.1 Ordering Cost

Ordering cost involves all costs spending along the ordering practice of an order, not considering any ordered quantity or volume. It consists of time and costs use on quotations requesting, determining order to buy, confirming order, monitoring received order, checking invoice, preparing payment, and analyzing order report. It might not be a large part of the total cost for firms however dealing with time last on one order and management efforts, ordering cost should be appropriately lowered. Ordering cost can save the total cost, furthermore it can cut some other costs including wages.

2.4.2 Carrying Cost

Holding Cost is categorized into risk costs, storage costs and finance costs. Cost of degradation, obsolescence (discontinuance), destruction, deterioration and theft are involved in risk cost. Storage costs are the cost to rent, rack, build and certain storage cost such as cost for refrigeration, and handy. Lastly, finance cost is the emphasis on money invested in inventories and insurance.

2.4.3 Stock out cost

Stock out cost is the cost of products non-availability or insufficiency of products when they are consumed by customers. This cost might not be easily calculated. As an instance, stock out cost creates sales loss in both present and future because customers might choose other competitors. Stock out cost might be larger in some sectors such as hospital than other organizations.

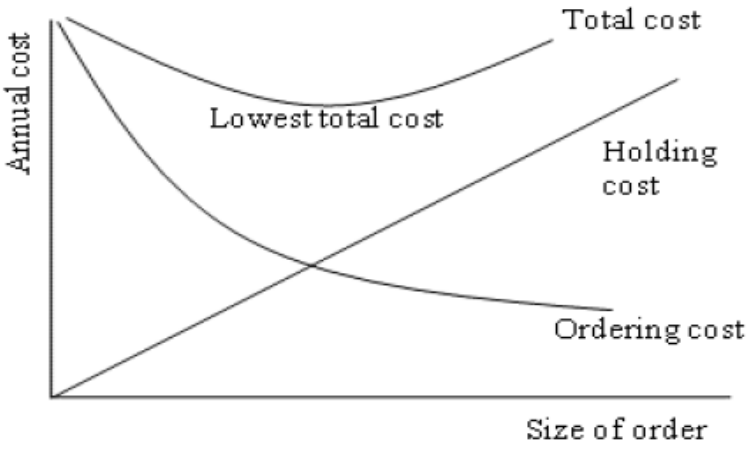

Figure 3: *Inventory cost*

Fig 3 highlights the relationship of ordering cost and carrying (holding) cost. The trend of both costs is generally across to each other. Difference in volume of order significantly affects the total cost. The lowest total cost can be found at an appropriate order quantity which can be obtained by balancing ordering and holding costs. On the other hand, the other cost categories can have impact on the total cost according to different logistic operations for instance transportation, storage, or in-transit inventory holding costs (23).

2.5 Inventory Performance Indicators

Indicator is a measurement of efficiency of the performance. Indicators can be objected to evaluate the current situation of the organization as well as to indicate whether new techniques for improvement are suitable for current setting. The objective of inventory performance indicators is to test the inventory control techniques which can produce desired outcomes or not.

2.5.1 Inventory Turnover Rate

Inventory turnover rate measures the number of inventory cycles or turnovers for an item for a specified period for time, usually calculates yearly. The total cost of items issued is divided by the average inventory value of that item within a defined period. Low inventory turnover rates point out the item has been overstocked. Conversely, higher inventory turnover rates show insufficient stock level which could finally lead to stock outs and drops in distribution. High inventory turnover causes reduction in the inventory holding costs (24).

Calculation of Inventory turnover rate

Inventory turnover formula includes cost of goods distributed/sold (COGD) and average inventory. To calculate the inventory turnover ratio, the formula is

Inventory turnover rate = COGD/Average Inventory

COGD is the direct cost related with the service provided. It is typically formulated with the following formula

COGD= Beginning Inventory +Purchase – Ending Inventory

Average inventory is the median inventory value during a defined period. Inventory value may vary significantly during this period. Hence, calculation of the average inventory is necessary to compare inventory to total sales or COGD. The formula for average inventory is

Average Inventory = Opening Inventory + Ending Inventory / 2

It is widely accepted that good inventory management could be shown by high turnover rate.

2.5.2 Days in Inventory (Converse; Duration of Stock out)

Days in inventory (DDI) (known as Inventory Period, Days Inventory Outstanding Inventory or Days of Supply) is an efficiency ratio that counts the average number of days the pharmacy holds its inventory before distribution of medicine. The formula for DDI is

$$\text{DDI (for one year)} = \frac{\text{Average Inventory}}{\text{COGD}} \times 365 days$$

Stock out days can be calculated by 365days minus DDI for one year. Better inventory management is presented by long duration of inventory (large numbers of days in inventory) or short duration of stock out.

2.5.3 Average inventory cost

Inventory cost is the sum of purchasing cost and inventory carrying cost as explained above.

Purchasing Cost = Number of times order × Purchase cost per order

Carrying (holding Cost) = Average inventory value × Unit Price × Carrying charge

This indicator helps the inventory supervisors to keep the adequate quantity of supplies and to understand more about the carrying cost and budget for future planning. Better inventory control methods are methods with low cost (24).

2.5.4 Numbers of overstock item and under stock item

In comparison of inventory control models, the number of overstock drugs and understock drugs from each method can be counted. Better inventory method must have lower number of overstock and unstock drugs.

2.6 Inventory Control Methods

2.6.1 Ideal Inventory control models and reorder times

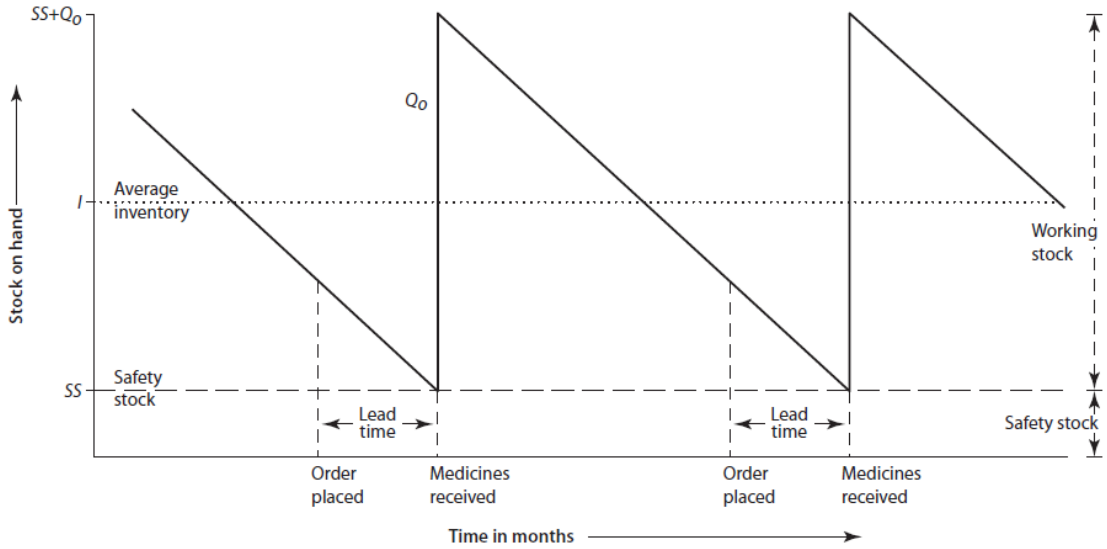

Figure 4: *Optimal inventory control model (source; Management Science for Health 2012)*

The optimal IM model is shown in figure 3. In this figure, medicines are supplied to meet demand but not permitted stock outs; stock on hand gradually drops till the place where an order must be set. Two types of stock known as working stock and safety stock SS, are two parts of stock position. In this model, the supplier fills with plan, the shipments reach on time, the quantity ordered Q_0 is held, then the inventory level is back to its stating point where the sum of order quantity and safety stock. Working stock changes from 0 to the quantity ordered and describes the used stock to meet demand during procedures. From this model, the average working stock is 50% of the order quantity.

Average working stock = 50 % Q_0

The average inventory is the sum of the average working stock and safety stock

$$\text{Avg: inventory I} = 1/2\ Q_0 + SS$$

Reduction of cycle stock, the safety stock, or both should be taken to decrease the average inventory and then lower the inventory carrying costs. Since drugs are utilized at a steady rate, the line in above diagram shows stock on hand drops with a steady slope. Infrequent and larger size orders result in elevated average inventory levels. The average inventory can further decrease by not keeping the safety stock; however, this way can create stock outs situation. Differently, holding costs of stock could be lowered by reducing the individual cost which can vary inventory carrying cost, as mentioned in the model. These advance approach would help to improve in stock controlling procedures and efficient financial management practices (25).

As shown in this figure, any IM model for procurement must consider the below factors

1) Safety Stock: amount of stock will be on hand in reserve to avoid stock outs

2) Reorder quantity: the number of items determined when an order is allocated.

3) Reorder frequency- duration between each order for a product (called procurement period)

2.6.2 Variables in calculating reorder quantity

According to the reorder formula applied, any or all of the below variables may be fundamental (25).

2.6.2.1 Average Consumption

Average consumption also known as demand, is predicted for the upcoming purchasing cycle is the essential factor which represents the amount stock required to be ordered. Estimating of future consumption is the key point of IM. Although consumption is exactly forecasted, stock outs would happen under the situation of underestimated lead time or ignoring and miscalculation of other variables.

2.6.2.2 Lead Time

Lead time is the period of time between the start point of a purchasing order and final receipt point at the storage areas from the proposed supplier. If a noticeable trend occurs in lead time, the average supplier performance should be weighted towards good performance practice with regular supply. However, if the irregular supply happened, for examples, 2 months, 6 months, 2 months, 6 months – it is the best to analyze supplier lead time or compute the standard deviation of lead time.

2.6.2.3 Safety Stock

Safety stock is the amount that is always be kept in inventory to avoid stock outs. When demand and lead times can be expected and constant, the reorder point

is not necessary to keep safety stock, but highly change in lead times and consumption require an additional safety stock.

2.6.2.4 Reorder Level

The reorder level is the amount of remaining stock that activates to reorder the material. This is known as the minimum stock level in the minimum-maximum ordering system. The ideal method to calculate reorder level in a reordering formula is the multiplication of the average lead time with the average consumption within this lead time. The reorder level may or may not be equal to the safety stock level because it contains a separate stock amount as a safety stock.

2.6.2.5 Maximum stock level

Maximum stock level in purchasing formula is the proposed stock level that is the stock needed to meet demand till the upcoming order after receiving the current order.

2.6.2.6 Stock Position

Stock position can be calculated by the summation of stock on hand including both cycle stock and safety stock and order stock then minus any stock backordered to clients. Over stocking can result when next order is allocated although there is excessive stock on hand used for several months. Stock outs may occur if the significant quantities from next order are on back order to lower level and this amount is not factored into the reorder quantity.

2.6.2.7 Procurement Period

The procurement period is the duration till the upcoming regular order would be set. In a scheduled purchasing system (periodic orders at set times in a year), procurement period might be in multiples of one month. It could be described in weeks or days according to the forecasting purpose in a perpetual system (order when stock becomes low). The sum of the quantity ordered with the safety stock level must cover the period, which is the procurement period plus the lead time.

Stock levels depend on accurately forecasting medicine consumption. If forecasting does not depend on exact stock records and stock level calculation will not have certainty, then health care sectors will face the mismanaging procurement, outcome in stock outs or over stocks.

2.7 Relevant studies in Inventory Management

V. R. Thawani et al conducted a study in a public college hospital of India where budget is limited. The researcher studied medicine expenditure analysis by categorization of drugs that need managerial control. The result of this study shows annual drug expenses is 11.59% of total hospital cost. By classifying the drug inventory, the study identified the priority class of medicine need to more stringent control. The studied hospital has implemented ABC-VEN classification system. Improvements such as drug availability, budget management, demand reduction and emergency purchase are noticed after introduction of these methods to the study place (26). The study of Biruk Wogayehu Taddele describes that ABC-VEN matrix

analysis is the best method in a secondary level health care to control inventory efficiently and effectively (27).

The process of drug inventory control and inventory performance across the hospital pharmacy in Thailand was studied by Chungsiwapornpong in 2007.According to the findings from her study, ABC and VEN analysis systems are effective and powerful techniques for hospital pharmacies. Private hospitals with VEN analysis faced lower stock out percentage (0.99%) than those without this classification (3.94%). In addition to this, average months of drug in stock in hospitals using ABC-VEN inventory control tools was less than those did not use these methods. Otherwise, hospitals which apply EOQ, minimum-maximum stock level and reorder point approaches have lower inventory level. This study recommended that the hospitals use effective inventory control methods such as EOQ, ABC and VEN to develop their inventory control process and inventory performance (28).

A study conducted in Arizona Health Science Centre, USA used combination of ABC classification and EOQ model to explore whether this combination can lower the costs of inventory compared with the minimum-maximum stock level system. The study found that combination of ABC and EOQ can reduce inventory costs more than 10,000 US dollars than the minimum-maximum system.

CHAPTER –III METHODOLOGY

This study is descriptive research explaining the current situation of inventory management of a state hospital. The study aims at analyzing the current medicine inventory management system of a state hospital to improve pharmaceutical inventory management of the studied hospital.

This chapter explains data source and characteristics together with the detailed methodological approach and analysis used to conduct the study.

3.1 Research Design

The objective on situation analysis of the current inventory management system is composed of 2 parts. Part I is the workflow analysis of the procurement and inventory control, whereas part 2 is the analysis of current inventory management performance. Workflow analysis was qualitatively conducted using in-depth interview. The result of this part reflects limitations and difficulties of the procurement and inventory management system of the hospital.

3.2 Population and sampling design

The pharmacy department of the Sittwe General Hospital was purposively selected as the site for this study. The hospital inventory data of 2 fiscal years, 2016 and 2017 were gathered for analysis. For qualitative interview, three people, including the pharmacist officer who works in the administrative level of the medical store, the pharmacist who is currently working in this medical store and one former pharmacist were recruited as informants.

3.3 Qualitative Data Collection and Analysis

The semi-structure questions related to workflow of the inventory management system were formulated. Face to face and in-depth interview with the pharmacist officer and pharmacists were conducted individually. The interview was audio recorded, transcribed verbatim, and translated into English. Semi-structured questionnaires are attached in the Appendix I. Content analysis was conducted, difficulties and challenges were discussed and concluded.

3.4 Quantitative Data Collection, Management, and Analysis

The secondary data on the inventory monthly movement from the pharmacy department of the Sittwe general hospital during 2 financial years, Apr 2016 -Mar 2017 and Apr 2017 – Mar 2018, were collected from stock record books. The data on inventory movement of each medicine item were coded or categorized into designed variables and transcribed onto Microsoft Office Excel spreadsheet.

To analyze the current medicine inventories of a state hospital in Myanmar by using ABC, VEN, and ABC-VEN matrix analysis, the following information were gathered from the stock records.

- Opening & Closing balance of stock of each fiscal year
- Data on issuance & receipt of each item from the main inventory and across each dispensing unit
- Price and quantity of individual items.

Average price of two years was used for comparison analysis across 2 years. In case of some medicine items which price was available only for either year, the only available price was use for analysis.

Data Analysis

Data management and calculation were conducted as following to prepare for further analysis.

Calculation 1- Consumption of drugs using ABC, VEN and ABC-VEN matrix analysis

Step 1

In the first step, annual expenditure of drug was computed for 2 financial years, 2016 –2017 and 2017 –2018 by the sum of expenditure all drugs.

Step 2

In the second step, ABC analysis of all medicines in the inventory was performed. To do this analysis, the annual expenditure of each medicine was organized in descending order. And then calculation of the cumulative cost for all medicines was done. Calculation of the cumulative percent of number of medicines and the cumulative percent of expenditure was added. This arrangement was then classified into 3 categories such as class A, class B and class C according to the cumulative cost of 70%, 20% and 10% respectively.

Step 3

In third step, all medicines were classified with the VEN criticality analysis into vital (V), essential (E) and non-essential (N) groups. Medicines critically required for the survival, and those that need to be accessible at any times as non-availability of them had negative impact on both the patients and the impression of the health care institution were included in the group V. Medicines with less severe effectiveness compared with class V items, and their shortage could be allowed for a short, were included in the E category. Expensive medicines with minimum therapeutic advantage were included in the N group. Under the supervision of medical superintendent of hospital, two pharmacists and one former pharmacist of hospital served as experts to classify all medicine items into VEN status in a meeting. Discussion among all three experts was organized and VEN status of each item was decided upon all agreement in this meeting.

Step 4

In the final step, a cross table of the ABC and VEN analysis for the purpose of the ABC-VEN matrix analysis was constructed. From the combination of ABC and VEN analysis, 3 groups were classified as category I, category II and category III. Subcategories AV, AE, AN, BV and CV belonged to category I. Category II combined the BE, BN and CE subgroups and the subgroup CN was included in the category III.

In these subgroups, the first alphabet referred its position in the ABC analysis, whereas the second one denoted its position in the VEN analysis (18).

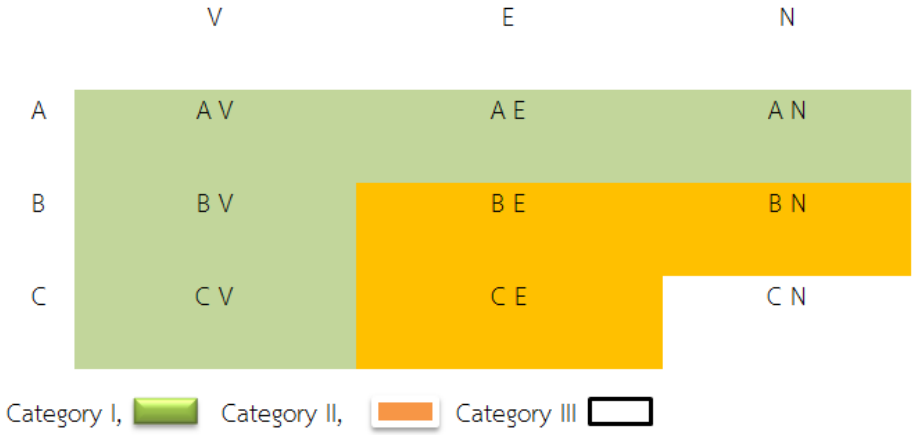

Figure 5: *ABC-VEN matrix analysis*

From this analysis, the total annual drug expenditure was known. The percentage of total cost for (1) class A, Class B, Class C (2) Class V, E, N and (3) Category I, II, III was obtained.

Calculation 2 - Hospital Procurement and Central Procurement within 2 years were calculated for ABC, VEN and ABC-VEN matrix group.

Calculation 3- Calculation 3- Analysis between remaining value in 2016 and consumption value in 2017

Number of months when the drugs might be consumed after 2016 was calculated from the remaining value at the end of 2016 and the average monthly

consumption value 2017. The calculated number of months determines the stock out and over stock conditions of drug groups, ABC, VEN and ABC-VEN matrix groups.

Example: Amlodipine 10 mg

The remaining value of amlodipine 10 mg at the end of 2016= 99,900 kyats

The average monthly consumption value during 2017 = 15,610 kyats

No: of months Amlodipine might be consumed after 2016 = 99,900 kyats/15,610 kyat

= 6.3 months

3.5 Ethical Consideration

The study was approved by thesis committee in the department of Social and Administrative Pharmacy, Faculty of Pharmaceutical Science, Chulalongkorn University.

The study was then reviewed by Institutional Review Board (1), Ministry of Health and Sports, Myanmar. The approval of data collection was taken from medical Superintendent of Sittwe Hospital, Rakhine State, Director General of Department of Medical Service and Minister of Ministry of Health and Sports, Myanmar. Informed consent form of qualitative research was written with English and Myanmar language and informed to research participants.

CHAPTER –IV RESULTS AND DISCUSSION

The result chapter contains 2 major parts. The first part concerns the qualitative interview on the inventory management system of the hospital pharmacy as well as the challenges of the system. The quantitative data analysis on the inventory management situation represents the other part of this chapter.

4.1 Qualitative Analysis of the inventory management system

The result from the qualitative analysis are as follows; Medical store of the hospital was supervised and managed by one medical store doctor and one pharmacist officer within the Pharmacy Department. Under their management guidelines, three positions of pharmacists were responsible for functions of medical stores. Two pharmacists were in service, and one is vacant. Pharmacists were supported by three senior pharmacist assistants and four pharmacist assistants in respective tasks. Placement of medicines, cleaning of medical store and other supportive work done were performed by two general workers. The total of 14 workforces included 1 medical doctor, 4 pharmacists, 7 pharmacist assistants, and 2 general workers working under the medical store unit.

Six functions of the medical store under the Pharmacy Department included

(1) Purchasing of medicine and supplies

(2) Receiving

(3) Storing

(4) Issuing

(5) Monitoring

(6) Reporting

4.1.1 Purchasing of medicine and supplies

There were 2 sources of procurement. The procurement of medicine was performed by hospital itself and by central procurement. The hospital procurement was usually performed twice a year. An approximation of 4 months was required for each cycle of hospital purchase starting from the estimation of demand till the medicine was received at the medical store. The first procurement cycle started around June and ends around September of the year. The second cycle was usually from December of the first year to March of the next year.

For hospital procurement, estimation of purchased amount of medicine was based on Average Monthly Consumption (AMC), calculated by pharmacists. The average monthly consumption (AMC) of each medicine was firstly calculated from the record of last year consumption. For some medicines, stock-out days were inclusively thought and formulate in AMC. Then, multiplication of AMC for 6 months was done for purchasing. List of medicines and purchased amount were checked and confirmed by medical superintendent and committee of medicine procurement in hospital. Procurement method conducted by the hospital was open tender. There

were three committees in the process including ground price calculating committee, tender receiving and checking committee, and quality control committee. Purchased items were mainly essential drugs. The process of determining medicine lists and their purchased amount took two weeks, then open tender was announced in newspaper and submission of tender was for one month later. During this month suppliers submitted envelop A and B together with drug samples to compete tender. The tender receiving and checking committee received and checked envelop A and B. For checking, suppliers provided a sample package for each competed medicine which was checked whether the sample possesses the same quality as the specification mentioned in their documents. These specifications included medicine name, amount, price, batch number, FDA approval documents, manufacturing pharmaceutical company and country and expired date. Expiry date of medicines must be longer than two years. Information was entered with excel format of complete drug list which includes all the quotations. While the process of receiving and checking the tender document offered took 2 weeks, the information entry took one week. After the quotation was checked and confirmed, the order documents must be prepared for approval. For selection and order approval, the quality control commitee selected first, second, and third prioritized medicines among medicines from many suppliers and reported the state authorities. Selected and confirmed orders were posted on the announced board of the hospital with list of suppliers and name of medicines. After order was confirmed, medical superintendent from the

hospital contracted suppliers to continue to perform receiving the selected medicines. The hospital procurement is usually performed twice a year. However, hospital sometimes received extra budget to purchase more medicines which was not sufficient in previous procurement.

The diagrams showing the process of each method of purchasing is presented in figure 6.

Two Methods of Purchasing

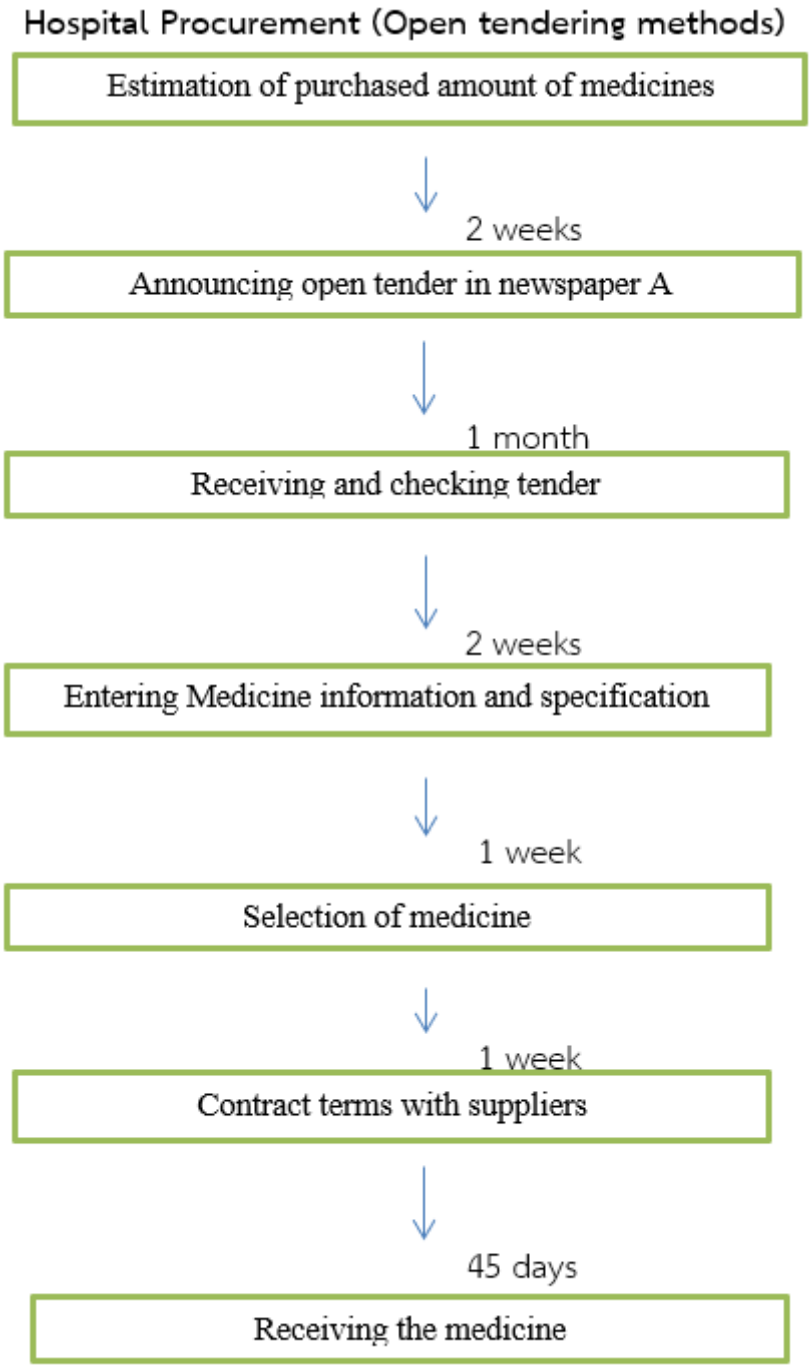

Figure 6: *Hospital Procurement*

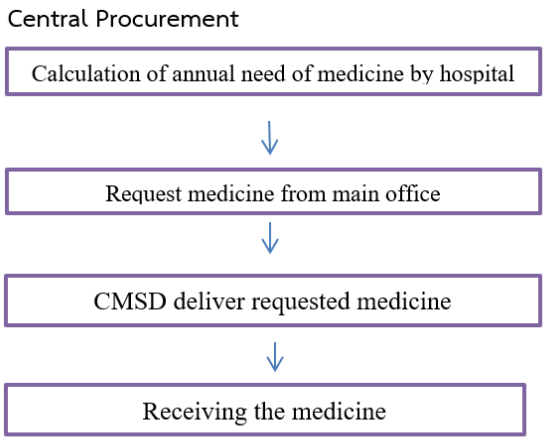

Figure 7: Central Procurement

For central procurement, medical service department sent the list of specific medicines and requested the hospital to submit the need of these available medicines. AMC of these items were calculated, and request list was sent back from hospital pharmacy. Sending the specific medicines list from central side could not be predictable by hospital medical store management. When the hospital received list from central side after hospital procurement, some medicines from the list were already purchased therefore hospital expenditure was high without saving hospital budget. Since the list was received before hospital procurement, some medicines were requested from central side and removed from hospital procurement. Delivery of requested medicines was performed by medical service department through central medical store department (CMSD). However, delivery time from CMSD was unknown by hospital side and was longer and stock out condition underwent in hospital pharmacy.

Although the central supply is very supportive in hospital pharmacy, it requires effective coordination and communication between central supply and hospitals to improve advantageous procurement and inventory of medicines.

The timeline of drug delivery and providing information about delivered drugs (drug name, available amount to specific hospital, expired date, etc.) from central side should be determined as specific timeline in each year. As a result of specific timeline, hospital pharmacy can check stock level of medicines which are requested from central side only and can adjust procured medicines lists and amount using hospital budget properly.

For some drugs (control drugs such as morphine, ephedrine) which were not be competed from local suppliers, hospital requested these items from the central side.

4.1.2 Receiving of medicines

For hospital procurement, delivery and transportation of medicines were performed by suppliers. Delivery period was determined as within 45 days, described in the contract with suppliers. If the suppliers were absent to deliver within this period, fines were paid as 0.5 % of ordered value per one week delayed. When the order medicines were delivered at the medical store from the respective suppliers, it was usually kept together with invoice forms and package list. The members of medicine checking and receiving committee and pharmacist assistants checked the

medicine item received with quantities, expiry date, price and other conditions of drugs as described in contract terms.

If damage and expired products were detected or products delivered were found not to be the same with the required conditions, the pharmacists contacted the suppliers to handle the expired and damaged items. The replacement process was carried out by suppliers by transportation of new items and retaking the damaged and expired one. When the orders were properly received, checking evidence forms were signed by medical superintendent of the hospital and this form was submitted to the finance department of hospital to process the payment.

In the case of receiving items from central procurement, staffs from CMSD delivered requested medicines. They transported requested medicines with invoice forms and packing lists. Receiving and checking process was same with the hospital procurement, organized by medicine checking and receiving committee and check to meet with the requirements. After confirming by the committee, the evidence forms of checked and received was reported to medical service office, Ministry of health and sports.

For receiving of control drugs from central side, the transportation was performed by hospital side. The responsible person of hospital pharmacy went to CMSD and received drugs with the received evidence invoices.

4.1.3 Storing

Medical products were separately stored by categories such as tablets and capsules, injection, and ointment eye drops. These items were arranged alphabetically in respective storage area. Drugs with earlier expired date were placed first in front of the products with late expired date therefore it was easy to pick up and proper to perform first expire-first out (FEEO) procedure.

Most medicines were stored on shelves with alphabetical orders according to their generic name. And some were kept on wood pallets. Medicines that require low temperature were stored in the refrigerators. Temperature of refrigerators was monitored daily for these items to control quality and prevent damage. Walls and floor of medical store was cleaned daily to prevent insects.

The stock record card for each medicine was put as a tool for helping stock flow. Information on received date and quantities, issued date and quantities, present stock and signature of medical store staff were noted in these stock record cards. The present balance and expired date of all medicines were monthly monitored to prevent the expiration and informed these data to all wards of the hospital.

Since the medicines are costed, it is important to prevent wastage of medicines in the medical store. Therefore, keeping of fire extinguishers and good ventilation system was set up to prevent damage.

4.1.4 Issuing

Medicines from the main store were distributed to two departments, inpatient (IPD) and outpatient (OPD). To facilitate IPD dispensing, each ward had its own medicine storage as medical sub-stores. The head of nurse in each ward managed sub-store and dispensing in their own ward as inpatient dispensing. Required quantities of medicine from each ward were monthly requested to main medical store of the hospital. Distribution of requested medicines from main store to sub-stores was performed on determined date within a month. Regular distribution is usually one time in a month but sometimes urgent request from sub-store is organized. Manually stock recording was done in each sub- store. Medicine distribution to outpatient department was done by pharmacist assistant of main medical store. Some items were reallocated to other hospitals when these items were not mostly used in the hospital but are needed by other hospitals.

All the medicines were distributed based on FEFO policy. Whenever an item was taken from the main store, the stock record card was updated by filling the information about date of issue, quantities issued, current outstanding balance and signature of responsible staff. Usually, the medicines were delivered to OPD and IPD storage in a smallest stock keeping unit such as tablets, for example paracetamol 500 mg 1000 tablets.

There is lack of monitoring by pharmacists in sub-stories, lack of proper communication with main medical store and lack of training about inventory management.

4.1.5 Monitoring

Procedure and method of purchasing from hospital budget was monitored by an external audit from office of the auditor general of the union. Payment methods and supplier performance were monitored with guideline as mentioned in the contract term of tendering. They checked and monitored the stock flow within the last six months and checked the update ground balance with the stock card.

For monitoring inventory, in addition to stock record card method, computerized information system was used so that the overwhelming information could be stored, and more accurate reports can be generated. Pharmacists entered the stock data such as medicines received date, source, and quantities, issued date, source and quantities, AMC, expired date monthly. Data was recorded in Microsoft excel.

4.1.6 Reporting

Reporting is an important process for inventory management. The reports that were gradually generated concentrate on consumption rate and inventory levels. The consumed drugs for the last six months were reported to the medical superintendent and the external audit. The reports were separated for each ward.

Balance from last month, received number of medicines during six months, issued amount of medicines to each ward, latest balance were reported.

4.1.7 Difficulties and Challenges

Purchasing and controlling inventory are key activities in procurement process. One cannot be effective without the other. Purchasing includes selection of right quality products and knowing the right quantities. Inventory which is a result of the purchasing process must be well controlled. In performing procurement process, how much to order is still difficult.

In purchasing, calculation of order quantities depends on AMC. However, AMC during the last 6 months was not sufficient and representative to cover all future consumption. Stock out of some items occurred. Main reason of stock out was increased consumption due to increased number of patients. As in this region, number of private hospitals is few and most of the population depends on public hospitals. Since Sittwe hospital is a state hospital, patients from township hospitals and rural health centers are referred to this hospital. Other unexpected conditions in this state such as seasonal variations are factors contributing to increase numbers of patients in this state. One pharmacist said that better calculation of order quantity and using inventory tools to manage stock may not entirely overcome stock out problem however can reduce the magnitude of stock out rate.

Since procurement time is twice a year, stock out items could be filled early because the hospital needs to wait for another budget time to purchase these

medicines. In the case of known procurement time, calculation of required quantities to cover the real consumption is essential.

Another finding is that overstock of some items occurred in the medical stores. These overstock products were mostly used for specific purpose for example oncology. During oncologist was transferred to the other hospital and new oncologist has not arrived, medicines used for oncology had not been consumed and became overstocked.

In summary, hospital inventory procedures even followed essential principles and guidelines required for good inventory management. Major problems of the hospital inventory system were led by stock out of medicines challenged by periodic procurement only 2 times annually, limited budget, as well as unpredictably increased number of patients. Overstock was contributed by uncertain physician availability at the hospital.

4.2 Quantitative Analysis

Table 1: Descriptive statistics of drug purchase, inventory, and consumption of fiscal year 2016-2017

Performance	2016 (Kyats)	2017 (Kyats)	Average (Kyats)
Hospital purchase	298,841,827.84	308,193,857.88	303,517,842.86
Central Purchase	220,235,216.97	98,793,975.01	159,514,595.99
Total purchase	519,077,044.80	406,987,832.89	463,032,438.85
Consumption	490,320,246.21	459,076,315.31	474,698,280.76

From two sources of procurement, the above purchase and consumption data were collected for each budget year. The purchase value was calculated from known amount of purchase and price. To comparison value across 2 fiscal years, the price of each medicine used to calculate the value is the same price of both fiscal years. The price was derived from the average price of both years in case that both prices are available. The available price data was used if only one price was available. Items delivered by the central procurement did not have price information, thus the purchased price of the hospital procurement was used for calculation.

In 2016, the sum of the value of hospital purchase (298,841,827.84 Kyats) was nearly 1.3 times of the sum of the value of central purchase (220,235,216.97 kyats). However, the sum of value from hospital purchase (308,193,857.88 kyats) was approximately 3.1 times of the central purchase (98,793,975.01 kyats) during the second year. In comparison of purchase values of two year, the value from both sources in 2016 (519,077,044.80 kyats) was nearly 112 million kyats higher than those in 2017 (406,987,832.89 kyats). While hospital purchase values did not very much differ between two years, central purchase was 2.2 times less in the second financial year.

In calculation of the average purchase value from each source for two years, the average value from hospital side 303,517,842.86 kyat was 1.9 times higher than

the central average purchase (159,514,595.99 kyats). Average total purchase value per financial year was 463,032,438.85 kyats.

Average value of consumption per year was 474,698,280.76 kyats. Consumption value during the first year (490,320,246.21 kyats) was 31.2 million kyats greater than those in the second year (459,076,315.31 kyats). Total purchase value has corresponded to consumption value evidenced by both values of 2017 were less than those of the year 2016. So the cost of remaining medicine in 2017 was 281,311,463.21 kyats while 2016 is 299,065,916.69 kyats. (Table 1)

Table 2: Expenditure of drugs across dosage forms

Dosage Form	Number of drugs	%of drugs	Consumption value (2016) kyats	Consumption value (2017) kyats	Average Consumption Value
Injection	96	32%	353,775,735	351,791,593	352,783,664
Oral	153	52%	109,388,369	88,108,926	98,748,648
Topical	48	16%	27,156,142	19,175,796	23,165,969
	297	100%	490,320,246	459,076,315	474,698,281

The medical store inventory of the Sittwe Hospital consisted of approximately 297 generic drugs. There were 153 oral items (52%), 96 injection (32%) and 48 topical items (16%). For each dosage form, consumption and remaining values for two years were calculated from the hospital inventory data. Though the number of injection items was less than that of oral forms, the average annual expenditure of injection (352,783,664 kyats) was accounted for the highest value of the three dosage forms whereas oral products use 98,748,648 kyats and topical forms consume 23,165,969 kyats. (Table 2) As mentioned above, first year consumption values for all medicines were more than the values, of second year and the expenditure of all dosage forms also follows the same pattern.

4.2.1 Categorization of drugs by ABC analysis

Since there are approximately 297 medicines in the medical store, there should be some methods to categorize and organize them so that it is easier to

manage and handle. In this case, ABC classification is a powerful tool to prioritize and classify items according to inventory value. ABC analysis for all medicines was coordinately performed for two years. In ABC analysis, the classification was divided as following

(1) All 297 items were listed,

(2) Calculated the consumption values for two financial years

(3) Average consumption per year, cumulative consumption value and cumulative consumption percentage were calculated for each medicine.

(4) Cumulative expenditures were ordered decreasingly

(5) Determined and decided three categories by ABC analysis. The category A accounted for almost 70 percent of cumulative drug expenditure and 23 items were included in this group. For the B group, approximately 20 percent of consumed values were classified, and 50 medicines were included. The rest of items (224 items) were in the category C of which value was around 10 percent of total drug expenditure. In summary, of the total 297 items, class C occupied 75.42% of all medicines and class B and A consisted of 16.84% and 7.74 % respectively.

4.2.1.1 ABC Categories and their drug expenditure

Table 3: Average total drug expenditure for two financial years for respective ABC groups

Drug Category	Number of drugs	%of total drugs	Average Consumption Value per year (kyats)	Total Consumption Value (2016) (kyats)	Total Consumption Value (2017) (kyats)
A	23	7.74%	334,312,825 (70.43%)	333,193,546 (67.95%)	335,432,103 (73.07%)
B	50	16.84%	93,333,150 (19.66%)	106 629 898 (21.75%)	80,036,403 (17.43%)
C	224	75.42%	47,052,306 (9.91%)	50 496 803 (10.3%)	43,607,809 (9.5%)
Total	297	100	474,698,281 (100%)	490,320,246 (100%)	459,076,315 (100%)

For each category of medicines, both hospital and central consumption values were calculated from stock data and sum of these two values for two accounting years and average consumption per year are then described in table 3.

In observation of the first accounting year data, Group A accounted 67.95 % of total drug expenditure in 2016 which was the largest percent and C group represents the smallest value (10.3%). The consumption values of ABC groups were 333,193,546 kyats, 106,629,898 kyats and 50,496,803 kyats correspondingly.

The flow of drug expenditure for all three groups in the second year was same as in 2017, 73.07 % of total drug expenditure (335,432,103 kyats) was consumed by class A. The second highest expenditure (80,036,403 kyats) was B items, and the least expenditure 43,607,809 kyats was observed in C group.

The average consumption values per year for these three groups were explored after representing consumption values of each year. The highest average expenditure, 334,312,825 kyats was occupied by group A (70.43%), and lowest average expenditure, 47,052,306 kyats was detected in the case of group C (9.91%). (Table 3)

4.2.1.2 ABC Categories and their drug purchase

Table 4: Hospital and Central drug purchase in 2016 categorized by ABC group

Drug Category	Number of drugs	%Of drugs	Hospital Purchase value 2016(kyats.)	Central Purchase value 2016(kyats.)	Total Purchase Value 2016(kyats.)
A	23	7.74%	183,169,916 (61.29%)	192,698,430 (87.50%)	375,868,347 (72.41%)
B	50	16.84%	73,427,823 (24.57%)	22,234,234 (10.10%)	95,662,05 (18.43%)
C	224	75.42%	42,244,089 (14.14%)	5,302,553 (2.41%)	47,546,642 (9.16%)
Total Value			298,841,828 (100%)	220,235,217 (100%)	519,077,045 (100%)

Comparison of hospital and central purchase values for three groups were shown in table 4. In 2016 accounting year, purchase value of group A (375,868,347 kyats) was highest among three groups when value of group B (95,662,057kyats) was followed by group C with the lowest procurement value (47,546,642 kyats). The percentage of purchase value for each group was found as declining order 72.41%, 18.43% and 9.16% for categories A, B and C accordingly.

Investigation of drug obtaining from two sources of supplies (hospital and central procurement) within each drug groups, central purchase value (192,698,430 kyats) was higher than hospital purchase value (183,169,916 kyats) in the case of class A buying. When class A consumed 61.29% of all hospital drugs purchase, this class spent 87.5 % of all central drug purchase value. As discussed above total hospital purchasing value was higher than the total central procurement in 2016. Class B and C items were profoundly more acquirable with hospital budget than central side. Group B used 24.57% (73,427,823 kyats) of total hospital drug purchase and 10.10% (22,234,234 kyats) of central drug purchase. 14.14 % (42,244,089 kyats) of total hospital budget and only 2.41% (5,302,553 kyats) of central budget was utilized by C items. When considering each group, central purchase shared 51.27% of A group, while only 23.24% and 11.15% for B and C groups accordingly. (Table 4)

Table 5: Hospital and Central drug Purchase in 2017 categorized by ABC group

Drug Category	Number of drugs	%Of drugs	Hospital Purchase value 2017(kyats.)	Central Purchase value 2017(kyats.)	Total Purchase Value 2017(kyats.)
A	23	7.74%	218,615,074 (70.93%)	87,523,493 (88.59%)	306,138,566 (75.22%)
B	50	16.84%	62,803,471 (20.38%)	7,607,544 (7.70%)	70,411,015 (17.30%)
C	224	75.42%	26,775,313 (8.69%)	3,662,938 (3.71%)	30,438,251 (7.48%)
Total value			308,193,858 (100%	98,793,975 100%	406,987,833 100%

Drug purchase for each of ABC group during 2017 accounting year were also described and evaluated in table 5. Similarly in 2016, drug purchase value was falling from group A to group C with 75.22% (306,138,566 kyats), 17.30% (70,411,015 kyats) and 7.48% (30,438,251).

Continuously, drug value using two types of budgets were separately computed for three medicines categories. In comparison, sum of hospital purchase value in 2017 was significantly higher than the sum of central value in 2017. Therefore, items of all three groups were more utilized with hospital finance in 2017. Conversely with previous accounting year, the central purchase of A products with central budget was lower than using hospital budget itself.

Therefore, description of purchase from two sources was found in ratio as; approximately 70:20:10 represents A: B: C in hospital side and 90:8:2 represents A: B: C central side.

While 2016, hospital budget accounts for 57.57% of drug procurement, 42.43% was purchased by central budget, 2017 central budget accounts for only 24.27%. The significant difference was found from the central budget procurement of group A. In 2016 central budget procures 51.27% of group A value, but only 28.59% in 2017. (Table 5) The expensive nature of group A items had major influence on total budget spent of central purchase.

4.2.2 VEN analysis

According to VEN analysis, there were 133 of essential items followed by 105 items of vital drug group and 59 items of non-essential group.

4.2.2.1 VEN Categories and their drug expenditure

Table 6: Total drug expenditure for two financial years for respective VEN groups

Drug Category	number of drugs	Consumption value 2016 (kyats)	Consumption value 2017(kyats)	Average consumption value/year (kyats)
V	105	312,926,958 (64%)	305,304,436 (67%)	309,115,697 (65%)
E	133	159,491,355 (33%)	141,374,694 (31%)	150,433,025 (32%)
N	59	17,901,933 (4%)	12,397,185 (3%)	15,149,559 (3%)
	297	490,320,246 (100%)	459,076,315 (100%)	474,698,281 (100%)

The consumption values for three VEN groups of each year and average consumption values per year were obtained from the calculation using consumption data and price (Table 6). The consumption value in 2016 was compared with the consumption value in 2017 within each group.

The first-year data reported that Group V accounts 312,926,958 kyats (64%) of total drug expenditure in 2016 which was the largest expenditure among three categories and N group had the lowest consumption values 17,901,933kyats (4%). The expenditure of E group was calculated as 159,491,355 kyats (33%).

The pattern of drug expenditure for all groups in 2017 was similar as in 2016, 67% of total drug expenditure (305,304,436 kyats) was consumed by vital group. The second highest expenditure (141,374,694 kyats) was found in using of E items and N group consume only 3 % of total drug expenditure (12,397,185 kyats).

After representing each year's consumption values, the average consumption values per year were compared for these three groups. The average expenditure for V group, 65% of average drug expenditure per year was also highest (309,115,697 kyats) and the N group had lowest average expenditure. (Table 6)

After describing the separate calculations for each year, consumption values within each group were compared. It was found that the total consumption value in 2016 was greater than those in 2017. Appropriately in the case of within group consumption, V group was more consumable in 2016 than 2017. The same consumption design was observed in E and N groups.

4.2.2.2VEN categories and their purchase value

Table 7: Hospital and Central drug Purchase in 2016 categorized by VEN group

Drug Category	number of drugs	Hospital Purchase value 2016 (kyats)	Central Purchase Value 2016(kyats.)	Total Purchase Value 2016 (kyats.)
V	105	157,494,156 (53%)	196,054,085 (89.02%)	353,548,241 (68%)
E	133	125,245,669 (42%)	24,081,132 (10.93%)	149,326,800 (29%)
N	59	16,102,004 (5%)	100,000 (0.05%)	16,202,004 (3%)
	297	298,841,828 (100%)	220,235,217 (100%)	519,077,045 (100%)

From the hospital stock books, and files, the hospital and central purchase value of three VEN categories were calculated for each year and discussed. In 2016 financial year, purchase value of V items (353,548,241 kyats) was topmost within three groups where value of group E (149,326,800 kyats) and purchase N group with only 16,202,004 kyats. V group occupied 68% of the total 2016 purchase and 29 % of total budget use for E group and only 3% for non-essential drugs group.

In consideration of two types of purchase in 2016 financial year, vital group used 89.02% (196,054,085 kyats) of central budget (220,235,217 kyats) where essential group accounts for 10.93% (24,081,132 kyats) and non-essential group utilizes only 0.05% (100,000 kyats) of central purchase value. And from the hospital

purchase side, hospital buys V items with 157494156 kyats which was 53% of the total hospital budget. With the close value of V items, 42% of budget purchase E items (125,245,669 kyats). N items (16,102,004 kyats) were least purchased as similar in central procurement. (Table 7)

Table 8: Hospital and Central drug Purchase in 2017 categorized by VEN group

Drug Category	number of drugs	Hospital Purchase value 2017 (kyats)	Central Purchase Value 2017(kyats.)	Total Purchase Value 2017 (kyats.)
V	105	190,087,235.4 (62%)	92,303,592.8 (93.43%)	282,390,828.2 (69%)
E	133	108,961,396.8 (35%)	6,130,382.212 (6.21%)	115,091,779 (28%)
N	59	9,145,225.737 (3%)	360,000 (0.36%)	9,505,225.737 (2%)
		308,193,857.9 (100%)	98,793,975.01 (100%)	406,987,832.9 (100%)

The total purchase of VEN category from two sources in the economic year 2017 were calculated and tabulated in table 8. A similar purchase style with 2016 was found in this year. As in the previous year, the highest purchase values were for V items (282,390,828.2 kyats) and the second was E items purchasing (115,091,779 kyats) and the lowest purchase value (9,505,225.737 kyats) was for N group. V, E and V groups were reported by using 69%, 28% and 2% of total budget in 2017.

Discussion on the two sources of purchase in the accounting year 2017, vital group was purchased by 93.43% (92,303,592.8kyats) of central budget (282,390,828.2kyats) which was also the highest in three groups as well in using hospital budget. The rest of central purchase value was used for E group (6,130,382.212 kyats) and N group (360,000 kyats). In the looking of purchase pattern using hospital budget for these three groups, V items were purchased with 62% of hospital budget since group E and group N used 108,961,396.8 kyats (35%) and 9,145,225.737 kyats (3%). (Table 8)

4.2.3 ABC-VEN matrix analysis

From the combination of ABC and VEN analysis, 3 groups were classified as category I, category II and category III. There were nine subcategories, AV, AE, AN, BV and CV represent category I (Cat I). Category II (Cat II) consisted of the BE, BN and CE and CN is in the category III (Cat III).

There were 15 items in AV, 7 items in AE, 1 item in AN, 24 in BV and 66 in CV.113 items of total medicine are included in Cat I. Cat II counted 128 items (24 in BE, 2 in BN and 102 in CE). The rest items (56 items) were determined as Cat III.

Table 9: ABC-VEN matrix analysis

	V	E	N
A	A V	A E	A N
B	B V	B E	B N
C	C V	C E	C N

Table 10: count of drugs across ABC- VEN combination

	V	E	N	Total
A	15	7	1	23
B	24	24	2	50
C	66	102	56	224
	105	133	59	297

4.2.3.1 Drug Consumption Value of ABC-VEN categories

The drug expenditures of nine subcategories for two years were calculated using ABC-VEN inventory analysis method. Table 11 showed the consumption values of all nine groups for both financial years. Purchase values of Cat I were obtained from the sum of purchase values of five categories (AV, AE, AN, BV and CV). The purchase values of BE, BN and CE subcategories were added to form the purchase value of Cat II and the purchase values of Cat III were known from the values of CN groups. After the calculation, the purchase values of three main categories were compared within each year.

Table 11: Consumption Value and balance value of ABC-VAN categories

Category	Sub Category	Consumption value 2016 (kyats)	Consumption value 2017(kyats)	Average consumption value/year (kyats)
Cat I	AV	239,498,256	245,314,977	242,406,617 (51.07)
	AE	86,085,589	85,966,827	86,026,208 (18.12%)
	AN	7,609,700	4,150,300	5,880,000 (1.24%)
	BV	56,167,847	40,971,077	48,569,462 (10.23%)
	CV	17,260,855	19,018,383	18,139,619 (3.82)
	Total	**406,622,248 (82.93%)**	**395,421,563 (86.13%)**	**401,021,905 (84.48%)**
Cat II	BE	47,672,967	36,646,269	42,159,618 (8.88%)
	BN	2,789,083	2,419,058	2,604,070 (0.55%)
	CE	25,732,798	18,761,599	22,247,199 (4.69%)
	Total	**76,194,849 (15.54%)**	**57,826,926 (12.60%)**	**67,010,887 (14.12%)**
Cat III	CN	**7,503,150 (1.53%)**	**5,827,827 (1.27%)**	**6,665,488 (1.4 %)**
Total items		***490,320,246* (100%)**	***459,076,315* (100%)**	***474,698,281* (100%)**

The consumption values of nine categories for 2016 and 2017 were described in table 11. The consumption values of nine subgroups in 2016 were found in the decreasing arrangement such as AV>AE>BV>BE>CE>CV>AN>CN>BN. Their expenditure in 2017 were found in the decreasing order, AV>AE>BV>BE>CV>CE>CN>AN>BN. Then,

the average consumed values per year were calculated and were observed as the sequence, AV>AE>BV>BE>CE>CV>CN>AN>BN.

On investigation of consumed value in first financial year, Cat I was the most consumed group, and it consumed 82.93% (406,622,248 kyats) of total drug expenditure in 2016. 15.54% of total expenditure (76,194,849 kyats) was consumed by Cat II and Cat III was the lowest expenditure group (7,503,150 kyats).

The same drug expenditure pattern for all groups in 2017 was observed as in 2016. Also in accounting year 2017, the highest drug expenditure group was Cat I (395,421,563 kyats) and the rest two groups Cat II and Cat III accounted 12.60% (57,826,926 kyats) and 1.27% (5,827,827 kyats) of total drug expenditure in 2017.

From the known drug expenditure of three groups for two financial years, the average consumption values per year were enumerated for each year and discussed. The average consumption values of Cat I were 401,021,905 kyats (84.48%) and those of Cat II and Cat III were 67,010,887 kyats (14.12%) and 6,665,488 kyats (1.4 %) respectively.

Cat I needs strict management control because these medicines are either vital or expensive. In the case of the three subgroups of Cat I (AV, AE and BV), AV consisted of 15 medicines (5.1% of all medicines) that consumed 51.07% of average drug expenditure, 7 AE items (2.4%) occupied 18.12% expenditure and 24 BV items

(8.1%) was 10.23 % consumption. As these subgroups are vital or essential, their unavailability is unacceptable. They should be maintained a small buffer before purchasing with strict monitoring of their consumption and stock levels. The subgroup CV consists 22.2% of all items which was the highest numbers of items within Cat I however their cost was 3.82% of total expenditure. As this percentage is small, these CV items should be purchased less than twice a year with adjusted order amount and stocked as their holding cost is low. The AN subgroup (high expenditure but non-essential) contained only one medicine which consumed 1.24% of all drug expenditure. Although only one medicine located in this group, its expenditure was high. Therefore, medicines in this subgroup should be carefully ordered after the appropriate inspection of their need. Medicine from this group can whether be removed according to rational medicines use without significant effect on health care.

Since Cat II items consumed 14.12% of average drug expenditure, these medicines can be procured once a year hence reducing ordering costs and administrative overhead lead to save hospital spending. Drugs from Cat III used only 1.4% of average drug consumption and their ordering times can be reduced thereby reducing their carrying cost without affecting patient care.

4.2.3.2 Purchase Value Analyzed by ABC-VEN matrix

By the analysis of ABC-VEN combination methods, the hospital and central purchase value of all nine subcategories were first computed for two budget year, listed and explained. And then purchase values of five subcategories (AV, AE, AN, BV and CV) were summarized to obtain the hospital and central purchase of Categories I (Cat I). The values of Categories II (Cat II) were calculated from the combination of three subcategories (BE, BN and CE) and the values of the last subcategory CN represent those of Categories III. The purchase values of three main categories were matched within each year and between two years.

Table 12: Hospital and Central drug Purchase in 2016 of subcategories and categories of ABC-VEN matrix

Category	Sub Category	Hospital Purchase value 2016 (kyats)	Central Purchase Value 2016(kyats.)	Total Purchase Value 2016 (kyats.)
Cat I	AV	104,029,843	186,338,430	290,368,274
	AE	73,162,073	6,360,000	79,522,073
	AN	5,978,000	0	5,978,000
	BV	39,334,836	7,609,521	46,944,357
	CV	14,129,476	2,106,134	16,235,610
	Total	**236,634,228 (79.18%)**	**202,414,085 (91.91%)**	**439,048,313 (84.58%)**
Cat II	BE	32,341,216	14,624,713	46,965,929
	BN	1,751,770	0	1,751,770
	CE	19,742,379	3,096,419	22,838,798
	Total	**53,835,366 (18.01%)**	**17,721,132 (8.05%)**	**71,556,498 (13.79%)**
Cat III	CN	**8,372,234 (2.80%)**	**100,000 (0.05%)**	**8,472,234 (1.63%)**

The first inspection is the purchase values of 9 categories in 2016 (Table 12). The declining sequence of total purchase values were AV>AE>BE>BV>CE>CV>AN>BN. The decreasing order of hospital purchase values were found as AV>AE>BV>BE>CE>CV>CN>AN>BN. For the central purchase values, the values of AV>BE>BV>AE>CE>CV>CN> (AN=BN) were investigated in order.

Within 2016 accounting year, total purchase value of Cat I (439,048,313 kyats) from both sources was largest among three categories while total procurement value of Cat II (71,556,498 kyats) and the smallest purchase value (8,472,234 kyats) for Cat III. 84.58% of total purchase values were for Cat I and Cat II and Cat III possessed 13.79% and 1.63% (table xx).

After discussion on total purchase values, the two types of purchase in this year for three categories were described and matched. Of the hospital budget, 79.18% (236,634,228kyats) were provided for the use of cat I items, 18.01% (53,835,366 kyats) were for Cat II and 2.80% (8,372,234 kyats) were for Cat III purchase. As well in total purchase value, hospital purchase value was the most used for Cat I items. In the case of central procurement, the same flow of purchase was seen across three categories. The highest purchase group was Cat I (202,414,085 kyats), the second purchase group was Cat II (17,721,132 kyats) and the lowest purchase group was Cat III (100,000 kyats).

Table 13: Hospital and Central drug Purchase in 2017 of subcategories and categories of ABC- VEN matrix

Category	Sub Category	Hospital Purchase value 2017 (kyats)	Central Purchase Value 2017(kyats.)	Total Purchase Value 2017 (kyats.)
Cat I	AV	138,775,747	87,523,493	226,299,239
	AE	74,939,327	0	74,939,327
	AN	4,900,000	0	4,900,000
	BV	39,942,810	3,853,500	43,796,310
	CV	11,368,678	926,600	12,295,278
	Total	**269,926,562 (87.58%)**	**92,303,593 (93.43%)**	**362,230,155 (89.00%)**
Cat II	BE	21,187,531	3,754,044	24,941,575
	BN	1,673,130	0	1,673,130
	CE	12,834,539	2,376,338	15,210,877
	Total	**35,695,200 (11.58%)**	**6,130,382 (6.21%)**	**41,825,582 (10.28%)**
Cat III	CN	**2,572,096 (0.83%)**	**360,000 (0.36%)**	**2,932,096 (0.72%)**

Analysis of purchase value of nine subcategories was also performed for 2017. The total purchase value, hospital purchase value and central purchase value were described in table 13. The total purchased value was listed in decreasing order across subcategories were AV>AE>BV>BE>CE>CV>AN>CN>BN. The hospital purchase values of 2017 were in the order of AV>AE>BV>BE>CE>CV>AN>CN>BN. The central

purchase value of 2017 was high to low across the subgroups as AV>BV>BE>CE>CV>CN> (AE=AN=BN=0).

The purchase pattern in 2017 was the same with 2016. In this accounting year, Cat I was also the highest purchase category with the use of both finance 362,230,155 Kyats (89.00%). The purchase values of Cat II were 41,825,582 kyats which was only 10.28% of total purchase values of all medicine. Cat III were purchased only with 2,932,096 kyats (0.72%) which was the lowest purchase category.

Since the total purchase values in 2017 had been described, investigation of the two sources of purchase in this accounting year for each category were performed. Of the hospital purchase budget, 87.58% (269,926,562 kyats) were utilized for purchase of cat I medicine, 11.58 % (35,695,200 kyats) were for Cat II and 0.83% (2,572,096 kyats) were for Cat III purchase. The hospital purchase values were the most used for Cat I medicines. Also with the central budget, the same purchase style was found across three categories. The highest purchase group was Cat I (92,303,593 kyats); the second purchase group was Cat II (6,130,382 kyats) and the lowest purchase group was Cat III (360,000 kyats).

4.3 Analysis between remaining value in 2016 and consumption value in 2017

4.3.1 Analysis between remaining value in 2016 and consumption value in 2017 for ABC group

The inventory analysis was performed between the remaining value in financial year 2016 and consumption value in financial year 2017 for ABC groups. The numbers of months when each drug group might be consumed are separately calculated. The number of months for each drug to be consumed was calculated from the division of the balance value at the end of 2016 by the average monthly consumption of drugs during 2017.

Table 14: Number of months when drug group A to be consumed

A Group			
Number of months when drug might be consumed after 2016	no of drugs	% Of A group	%Of Total medicines
0 month	0	-	-
1-2 month	1	4.30%	0.34%
2-3 month	3	13.04%	1.01%
3-4 month	8	34.80%	2.69%
4 -6month	3	13.04%	1.01%
>6 month	7	30.43%	2.35%
consumption =0	1	4.30%	0.34%
	23	100%	7.74%

Investigation of group A items was done and listed in table 14. There was 1 medicine which values might be sufficient for 1 to 2 months, is 4.3 % of total 23 items of group A and 0.34 % of all items in hospital inventory. During 2 to 3 months, 3 medicines might be consumed completely. These 3 items were 13.04% of group A medicines and 1.01% of all medicines. There were 8 medicines which might be consumable within 3 to 4 months, 32.8% of all group A medicines and 2.69% of all medicines. Drugs which values might not be sufficient for more than 4 months, it is said that it might be stocked out. Because about 4 months were determined for processing period of procurement before receiving drugs.

13.04% of 23 A items had enough values for these 4 to 6 months. There were 7 items which values were left as in stocks for more than 6 months, 30.43% of all A items. 1 medicine was found as no consumption. Therefore, it might be concluded that there 8 items were over stock at the end of 4 months after 2016 budget year (April, 2017) before receiving purchased drugs in 2017 budget year.

Table 15: Number of months when drug group B to be consumed

B Group			
Number of months when drug might be consumed after 2016	no of drugs	% Of B group	%Of Total medicines
0 month	2	4.00%	0.67%
0-2 month	2	4.00%	0.67%
2-3 month	3	6.00%	1.01%
3-4 month	6	12.00%	2.02%
4 -6month	11	22.00%	3.70%
>6 month (6-12 month - 10 drugs 12-24 month - 12 drugs >2 years - 2 drugs)	24	48.00%	8.08%
consumption =0	2	4.00%	0.67%
	50	100%	16.84%

Balance and consumption values were continuously observed for Group B to know the number of months when drug group B will be used. The values of 2 medicines (4% of B items) had not remained for even one month and those of other 2 medicines were remained for only 0 to 2 months. There were 3 items (6 % of all B items) which had the deadline of 2 to 3 months to be to be completely used. These 7 drugs which values might not be enough for more than 4 months, these 7 items became stock out.

From the total 50 B items, the remaining values of 12% and 22% were adequate for the use within 3-4 months and 4-6 months respectively. Nearly half of the total B medicines might undergo over stock issue. The values of 48% (24 items) of B items were remained which might be used for over 6 months. Among these 24 items, 10 drugs might be enough for one year, 12 drugs were for two years, and 2 drugs might be used for more than two years. There were 2 drugs which have no consumption. (Table 15)

Table 16: Number of months when drug group C to be consumed

C Group			
Number of months when drug might be consumed after 2016	no of drugs	% Of C group	%Of Total medicines
0 month	24	10.71%	8.08%
0-2 month	10	4.46%	3.37%
2-3 month	9	4.02%	3.03%
3-4 month	16	7.14%	5.39%
4 -6month	10	4.46%	3.37%
>6 month (6-12 month - 40 drugs 12-24 month - 21 drugs >2 years - 30 drugs)	91	40.63%	30.64%
consumption =0	64		21.55%
	224	100%	75.42%

For the last group C, table 16 shows the number of months when drug C consumes and counted the number of medicines. There were 24 medicines (10.71% of C group) which had no stock at the end of 2016 accounting year. These items experienced about 4-months stock out condition before receiving them in 2017 accounting year. 10 drugs (4.46% of C items) could be used for 0-2 months, and they might be nearly zero during the 2 months before receiving the new batch of purchase. 9 items (4.02%) were found to be enough for 2-3 months and 16 items (7.14%) were for 3-4 months use.

4.46% of C group (10 items) had enough stock for 4 months before handing the new purchase amount. There were 40 drugs which might be sufficient for next 1 year. Many over stock items were found in the use of group C. 21 drugs were for about 2 years and 30 drugs which were very slow in stock movement and might be used for more than 2 years. There were 64 medicines which have no consumption in the accounting year 2017.

4.3.2 Analysis between remaining value in 2016 and consumption value in 2017 for VEN group

The months of drug when drug might consume were analyzed with VEN analysis using the stock data. As previously mentioned in ABC analysis, the months of drug in stock were calculated by the subtraction of the remaining balance value in 2016 and consumption in 2017. The calculation was done separately for each group and tabulated in the following tables.

Table 17: Number of months when drug group V to be consumed

Group V			
Number of months when drug might be consumed after 2016	no of drugs	% Of V group	%Of Total medicines
0 month	9	8.57%	3.03%
0-2 month	8	7.62%	2.69%
2-3 month	5	4.76%	1.68%
3-4 month	18	17.14%	6.06%
4 -6month	9	8.57%%	3.03%
>6 month (6-12 month - 20 drugs 12-24 month - 14 drugs >2 years - 14 drugs)	48	45.71%	16.16%
consumption =0	8	7.62%	2.69%
	105	100%	35.35%

Most drugs under V group had enough stock and stock out percentage was less than in other E and N groups. There were 18 drugs (17.14%) among 105 drugs of V group which had enough stock for 3-4 months. 9 drugs might be used for 4-6 months and 48 drugs (45.71% of 105 V drugs and 16.16% of total drugs) had enough stock for more than 6 months. However, there were 8 items which had no consumption during 2017.

Observation of over 20 stock-out drugs was described continuously in table 17. Under V groups, there were 9 drugs (8.57%) which have no stock at the end of

2016 financial year. From this group, 8 items (7.62%) and 5 items (4.76%) might be sufficient for 0-2 months and 2-3 months respectively. (Table 17)

Table 18: Number of months when drug group E to be consumed

Group E			
Number of months when drug might be consumed after 2016	no of drugs	% Of E group	%Of Total medicines
0 month	12	9.02%	4.04%
0-2 month	3	2.26%	1.01%
2-3 month	9	6.77%	3.03%
3-4 month	12	9.02%	4.04%
4 -6month	14	10.53%	4.71%
>6 month (6-12 month - 25 drugs 12-24 month - 15 drugs >2 years - 15 drugs)	55	41.35%	18.52%
consumption =0	28	21.05%	9.43%
	133	100%	44.78%

In the E group, the 55 medicines were stock in hand for more than 6 months, where 25 medicines had stock for one year, 15 medicines were over stocked with the value for nearly two years and 15 medicines had stock for more than 2 years. Nearly10% of E group (28 items) had no consumption within the year 2017.

Less stock items were also known from this group. There were 3 medicines which had stock only for 0-2 months and 9 medicines with 2-3 months stock. 12 medicines (9.02%) were observed with no stock at the end of the first budget year. (Table 18)

Table 19: Number of months when drug group N to be consumed

Group N			
Number of months when drug might be consumed after 2016	no of drugs	% Of N group	%Of Total medicines
0 month	5	8.47%	1.68%
1-2 month	1	1.69%	0.34%
2-3 month	1	1.69%	0.34%
3-4 month	1	1.69%	0.34%
4 -6month	1	1.69%	0.34%
>6 month (6-12 month - 9 drugs 12-24 month - 5 drugs >2 years - 3 drugs)	19	32.20%	6.40%
consumption =0	31	52.54%	10.44%
	59	100%	19.87%

In the case of non-essential drugs, over half of N drugs (31 drugs) were found with no use in 2017. 32.20% might be used for more than 6 months where, 9 drugs had enough for one year without considering the added value in 2017 accounting

year and 5 drugs were enough for 2-year use. There were 5 items (8.47%) which have no stock to use for 4 months period before receiving new amount. (Table 19)

4.3.3 Analysis between remaining value in 2016 and consumption value in 2017 by ABC-VEN combination

The stock conditions of all medicines were analyzed according to ABC-VEN combination. The balance value in 2016 and average consumption during 2017 was calculated for all medicines, categorized with the correlation of ABC-VEN matrix and analyzed. Nine subcategories (AV, AE, BV, BE, CE, CV, AN, CN, BN) from ABC-VEN combination were calculated and investigated first and then three main categories (Cat I, Cat II and Cat III) were analyzed sequentially with the use of the result from nine subcategories.

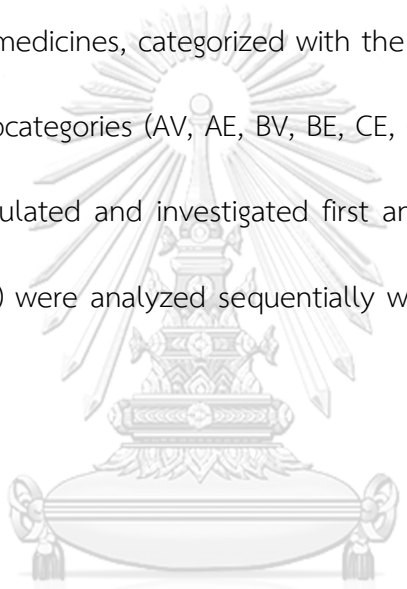

Table 20: Number of months when Category I to be consumed

Category I			
Number of months when drug might be consumed after 2016	no of drugs	% of Cat I	% of Total medicines
0 month	9	7.96%	3.03%
1-2 month	8	7.08%	2.69%
2-3 month	7	6.19%	2.36%
3-4 month	20	17.70%	6.73%
4 -6month	11	9.73%	3.70%
>6 month (6-12 month - 21 drugs 12-24 month - 14 drugs >2 years – 14 drugs)	49	43.36%	16.50%
consumption =0	9	7.96%	3.03%
	113	100.00%	38.05%

After calculation of five subcategories (AV, AE, AN, BV and CV) under main drug Category I, the data from these five groups were combined and analyzed within Cat I. There were generally half of the medicines assumed as over stock, more than 20% were stock out and 30% occupied proper stock control conditions.

Of the total 113 medicines of Cat I, 49 medicines (43.36%) had much stock which might be enough for more than 6 months. Among these 49 items, 21 drugs might be in hand from 6 to 12 months, 14 drugs had adequate for 2 years and 14

items are over stock for longer than 2 years. There were 9 items which has no consumption during the year 2017.

Some under stock items were found under Cat I. There were 9 medicines which have no stock at last month of 2016 accounting year. (Table 20)

Category II

Table 21: Number of months when Category II to be consumed

Category II			
Number of months when drug might be consumed after 2016	no of drugs	% of Cat II	%of Total medicines
0 month	12	9.38%	4.04%
1-2 month	4	3.13%	1.35%
2-3 month	7	5.47%	2.36%
3-4 month	10	7.81%	3.37%
4 -6month	12	9.38%	4.04%
>6 month (6-12 month - 26 drugs 12-24 month -15 drugs >2 years - 15 drugs)	56	43.75%	18.86%
consumption =0	27	21.09%	9.09%
	128	100.00%	43.10%

The numbers of months to be used was separately calculated for three sub-categories (BE, BN and CE) and then combined as Cat II. 43.75% of Cat II items (56 items) might be enough for more than 6 months. Within these 56 items, 26 drugs

might be in enough stock from 6 to 12 months, 15 drugs might be in hand for 2 years and 15 items were over stock for more than 2 years.27 items had no consumption in 2017. (Table 21)

Category III

Table 22: Number of months when Category III to be consumed

Cat III (Subcategories CN)			
Number of months when drug might be consumed after 2016	no of drugs	%of Cat III	%of Total medicines
0 month	5	8.93%	1.68%
1-2 month	1	1.79%	0.34%
2-3 month	1	1.79%	0.34%
3-4 month	0	0.00	0.00%
4 -6month	1	1.79%	0.34%
>6 month (6-12 month - 9 drugs 12-24 month - 5 drugs >2 years - 3 drugs)	17	30.36%	5.72%
consumption =0	31	55.36%	10.44%
	56	100.00%	18.86%

In the view of stock in Cat III drugs, over half of cat III drugs (31 drugs) were found with no use in 2017. Of the total 56 medicines of Cat III, 17 medicines (30.36%) had much stock which might be enough for more than 6 months. Among these 17 items, 9 drugs might be in hand from 6 to 12 months, 5 drugs had adequate for 2

years and 3 items were over stock for longer than 2 years. There were 9 items which had no consumption during the year 2017. (Table 22)

The use of scientific inventory management tools is needed for effective and efficient pharmacy stock management, effective prioritization, decision making in the purchase and distribution of specific items, and close monitoring of items belonging to important categories. ABC -VEN analysis shows drugs that require close monitoring for effective and efficient utilization of budget. Procurement of drugs should be performed with this analysis for state general hospitals in Myanmar.

Since this study was done in state level hospital and result from the study might be the same flow with the other state and division level hospitals in Myanmar. Therefore, the recommendation that the inventory management of public hospitals should be optimized with the appropriate inventory management tools, ABC-VEN matrix as mentioned in this study could be applied to other state hospitals. Central procurement and hospital procurement should be effectively coordinated and solve the problems of stock out and save the two sources of budget. Recommendation from this study could be applicable for the inventory management of other state and division level hospitals in Myanmar and therefore might reduce inventory problems and save the budgets.

CHAPTER –V CONCLUSION

This qualitative study of the inventory management system through interview shows the routine functions of hospital pharmacy and human resources in hospital pharmacy. The current practice of medicine procurement is mainly depending on hospital budget with self-management twice a year. The documental collection of medicine data and information and contract process with suppliers in open tender is quite good. It is found that extra budget is used in some conditions and purchase more than twice a year. It might lead to more workload in hospital pharmacy. It is recommended that hospital purchase use inventory control method, more than 2 times with enough human resources Although central supply is very supportive in hospital pharmacy, it requires effective coordination and communication between central supply and hospitals to improve advantageous procurement and inventory of medicines. Effective and appropriate forecasting of purchase number of medicines with inventory control method is needed and there should be massive and in-depth view on relation between these two procurements.

In the case of data recording and communication between sub-stores in each ward and main medical store, transparent and informative stock data should be linked using information technology rather than manually stock books and paper files. Therefore, pharmacists can check stock level from sub stores and can receive

accurate consumption data and helpful in procurement and inventory management to save hospital budget with effective patient care. As lack of pharmacist and lack of personnel with pharmacy inventory management training in each ward were found, pharmacist resources planning, and training should be considered for policy makers. This study only describes the consumption of medicines in the whole hospital, inventory management and stock flow of each ward is needed to study, and effective inventory control method is recommended to be used not only the whole hospital but also in each dispensing unit. Training of personnel in each sub store and helpful inventory control should be done for improvement of the whole hospital budget management

Monitoring of inventory in hospital medical store use stock record card and computerized stock data entry such as medicines received date, source, and quantities, issued date, source and quantities, AMC, expired. In this section, cost of each medicine is needed to consider for improvement of inventory management because drug expenditure is one of the main components of the hospital spending. Inventory management tools such as classification of all medicines is recommended to handle proper monitoring system.

This quantitative study the inventory management system using stock data shows the purchase and expenditure of all medicines with both hospital and central budget during 2016 and 2017. There are approximately 297 medicines in the medical

store. The purchase of all medicine's costs 519,077,044.80 kyats in 2016 and 406,987,832.89 kyats in 2017. It is difficult and unnecessary to provide equal interest to each medicine. Therefore, all medicines should be classified and prioritized. The matrix analysis descended by linking ABC analysis and VEN analysis can decrease the number of medicines which are required to be rigidly handled.

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APPENDIX I

Semi-structure questionnaire

1. What are the functions of medical store in your hospital?

2. What are the procedures for each function?

3. What kind of difficulties and challenges in each function?

4. How many staff in medical store of your hospital? What professional are they?

5. What kind of procurement methods does your hospital use?

6. How do you quantify the required medicines to purchase?

7. Does your hospital have any monitoring and evaluation system of current procurement method?

8. Does your hospital have any inventory management model?

9. Does your hospital have any monitoring and evaluation system of current inventory management?

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