Inventory Management Framework to Drug Receiving Project at a Local Drug Store

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Abstract

A mental health problem in Thailand tends to grow over the year. The increasing of psychiatric patients causes hospital congestion and complexity of medication accessing including Suanprung Hospital in Chiang Mai province. Thus, the hospital has developed a new project to set a local drugstore as a dispensing for patients instead of the hospital. Inventory control is the key to the success of this project. Inventory cost is a significant factor of concern. The data of drug expenditure is collected from surveys and interviews of the pharmacists. Then, ABC-VED analysis is applied to the overview of the inventorying process. After that, a framework for inventory management is proposed. As a result, the analysis can help to categories the drug priority which required frequent monitoring, Practical framework and inventory cost reduction are the expected results. Future research to testing a result, the simulation process can provide the analysis and development of the logistics operation model in a project to reduce the workload of pharmacists in hospitals and develop an operating procedure in the project.

Keywords
Inventory Management, ABC-VED matrix, Drug Inventory, Health Care, Hospital

1. Introduction

A mental health problem in Thailand tends to grow over the year. Nowadays, psychiatry is an important problem for people in the Suanprung Psychiatric Hospital, it is a Psychiatric hospital in Northern Thailand. The region includes thirteen provinces with a population of nearly ten million people causes hospital congestion and complexity of medication accessing. According to Figure 1, the number of outpatients has increased by 6.12 %, there were 16985 patients in 2015 and 18024 patients in 2020. The number of outpatients receiving treatment services has increased by 7.84 %, there were 57445 treatments in 2015 and 61946 treatments in 2020.

Thus, the hospital has developed a new project to set a local drugstore as a dispensing for patients instead of the hospital, there are 13 pharmacies in the project. This resulted in a change in inventory management and increased workload for pharmacists in hospitals and drugstores. Inventory management is one of the significant savings purchasing costs, storing costs, and expand efficient management. There are several methods of drug inventory management.

Therefore, this study focuses on the analysis of medicines inventory from 2018-2019 by using ABC analysis, VEN analysis, ABC-VEN matrix techniques, and identify categories of medicines that require strict management control. Including present the framework in the project.
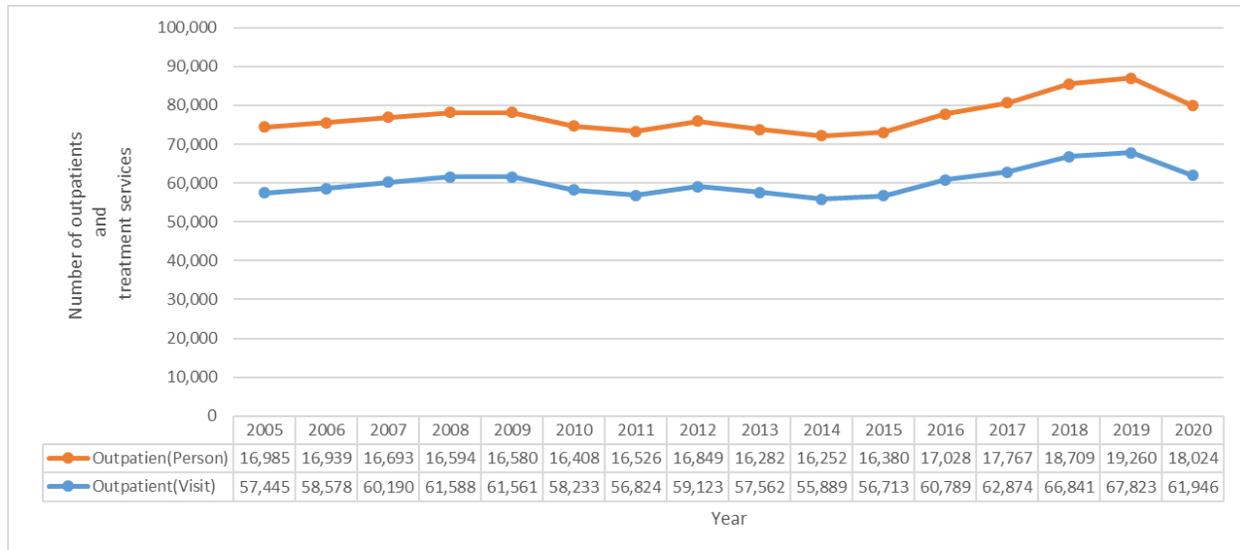
Figure 1. Number of outpatients receiving treatment services
Source: Department of Mental Health Suanprung Psychiatric Hospital

2. Literature Review

The regular availability of the necessary medicines is important for every hospital. Each hospital has to develop its own drug inventory management depending on the population and level of service the health care. Selecting appropriate inventory control techniques are in drug management can contribute to efficiency better, because suitable inventory management tools promote in terms of fulfilling its customer requirements and service for the patient. (Migbaru et al. 2020) The stocking of hospital drug items is expensive with the majority of the hospital budget is held up in these items which can be reduced by 30-40% of a hospital's budget. (Singh et al. 2015) Two factors considered important in drug management are cost and the criticality of the drug. Among many selective inventory control techniques, methods that are commonly used are ABC analysis and VED analysis.

ABC analysis is Always, Better, and Control which a method of classifying items or according to their annual usage value (Kumar and Chakravarty 2015), According to Table 1, Pareto's theory is 10% of items amount to about 70 % of the value (Category A). The next 20% items amount to 20 % of expenditure (Category B) and the remaining 70 % items account for just 10% of the value (Category C). (Gupta et al. 2007) The limitation of ABC analysis is that it is based only on the value and the rate of expenditure of the item. Then, ABC analysis can't use some drugs such as Anti-snake venom serum, which must have in stock only. Therefore, another parameter of the inventory drug is its criticality. (Mathew et al. 2016)

Table 1. ABC Analysis

Category	percentage of value	Percentage of items
A	70–80%	10-20%
B	15–20	30-40%
C	5-10%	40-50%

VED analysis is based on the criticality of an item. "V" is for vital items which for life and patient care, "E" for essential items that may few affect the quality of the services and "D" stands for desirable items, unavailability of which will not essential a therapeutic impact. (Gupta et al. 2007) However, considering VED alone risk of some nonessential drugs although expensive could get included as a primary drug.

ABC-VED matrix is combining the results of ABC and VED analysis ABC-VED matrix analysis consists of three main categories and nine subcategories shown in Table 2. These three categories requiring different types of controlling methods. This is to reduce the limitations that arise in each method. (Biruk et al. 2019)

Category I: AV+BV+CV+AE+AD
Category II: BE+CE+BD
Category III: CD

Table 2. Categorization of drugs with the ABC-VED matrix method

	V	E	D	Categorization of drugs
A	AV	AE	AD	categories I - Items are vital and expensive, requiring a high degree of control
B	BV	BE	BD	categories II - Items are essential and less expensive, requiring medium control
C	CV	CE	CD	categories III - Items are desirable but not essential a therapeutic impact and low cost, requiring a simple control

Since many hospitals will inventory should be examined both qualitatively and quantitatively. Found that one-third of the annual hospital budget is spent on buying medicines. However, holding large amounts of inventory is a waste because a lot of capital was kept in the inventory. Then, large amounts of inventory caused several problems involving expired drugs and carrying costs. (Lestari et al. 2019) Inventory management plays a critical role in all health care and organizations, from medical centers to group hospitals. Many methods are used for inventory management and the (ABC-VED) matrix method will provide considerable benefits for hospitals because of the evaluations made both economically and important, this method is the simple user. (Yilmaz 2018)

3. Methods

3.1 Data Collection

The study was carried out at the Suanprung Psychiatric Hospital for three months. The hospital has served patients with nearly 60,000 outpatient visits annually and caring for up to 420 Psychiatric inpatients daily. The data for annual consumption and cost of medicines were collected from the Pharmacy Department for the annual drug expenditure year 2018-2019. From the request for information, it was found that the hospital had a total of 197 items for 2018 and 201 items for 2019. Thus, the data were further transcribed to a Microsoft Excel spreadsheet for quantitative calculations, analysis was carried out using the Excel functions. Including interviews with the pharmacist that process the project to create a framework.

3.2 Data Analysis

ABC analysis

For ABC analysis, the annual consumption of all the drugs was listed and entered their unit cost. Then, the number of basic units purchased was entered, and calculated the total cost of each drug. The total expenditure of individual drugs was arranged in descending order. The cumulative percentage total cost of all medicines and the cumulative percentage of the number of drugs were then calculated for performing ABC analysis. The drugs then classified into A B C categories according to the cumulative percentage total cost of 70%, 20%, and 10%, respectively.

VEN analysis

For VED analysis, to decide on the criticality of drugs. The list drugs of 197 items and 201 items were distributed to a panel of 3 pharmacist specialists comprising lecturer in Pharmaceutical Care Faculty of Pharmacy Chiang Mai University, Pharmacy Supervisor (Outpatient) in the hospital, and Pharmacy Inventory Supervisor in the

hospital. They were to classify the drugs/items into Vital, Essential, and Desirable. The drugs were categorized if members of the panel pharmacist concurred.

ABC-VEN matrix

The matrix was prepared by combining the results of ABC and VED analysis. The combinations were classified grouped into three main categories, categories I, II, and III. Category I consisted of items belonging to AV, AE, AN, BV, and CV subcategories. The BE, CE, and BN subcategories consisted of category II. Category III consisted of items belonging to the CD subcategory. The result ABC-VED matrix was shown subcategories in the table 2.

5. Results and Discussion

The drug inventory of the hospital in 2018-2019 consisted of 197 and 216 items respectively. The total annual drug expenditure of the store on drugs issued was found to be 97,905,542.34 baths.

5.1 Framework

The diagram in Figure 2 represents a framework of the drug receiving project at a local drug store, the above new project resulted in a change in inventory management which there must be stricter control. Also, increased workload for pharmacists in hospitals and drugstores such as packing of drugs to be delivered.

Analyzed and Improved, there are two main sections including inventory management and simulation shown the color difference in Figure 1. Inventory management is a part process in the project which reduces more cost. This research focuses on part of the inventory. The simulation is a recommendation of an alternative process to improve the service outpatients (OPD), It mainly focuses on reducing the working time of the pharmacist. It will compare before and after the new project, that is to remove the portion of the drug delivery to the pharmacy. That is the current state.
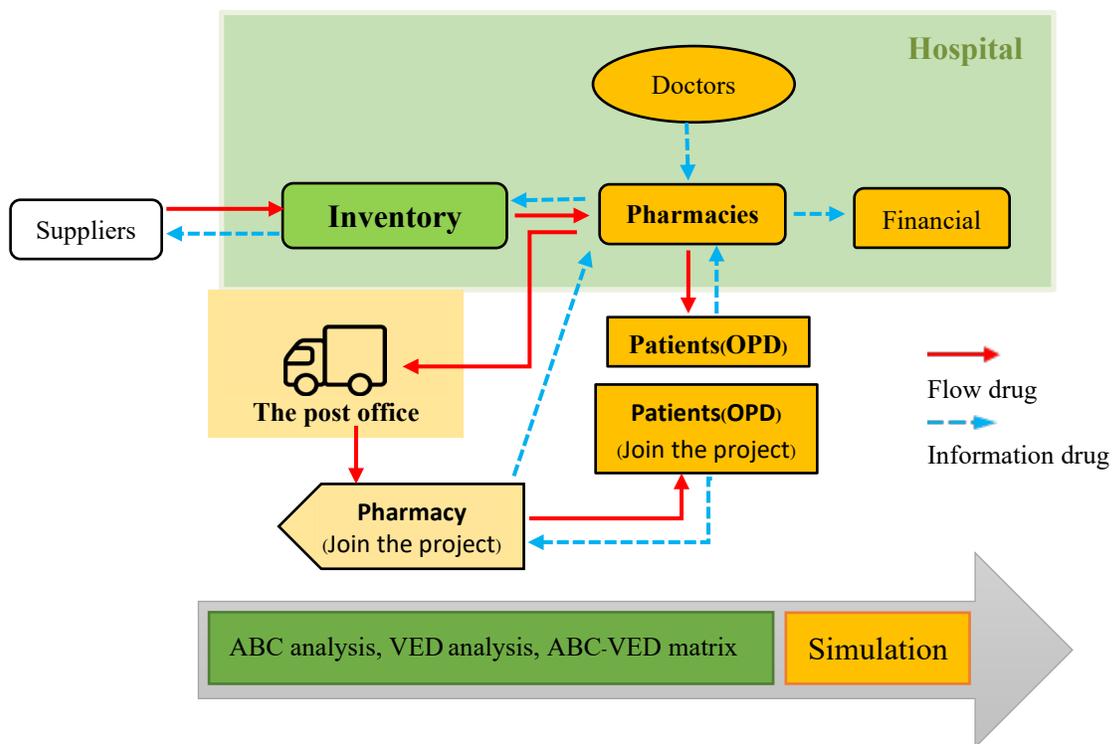

Figure 2 framework to drug receiving project at a local drug store

5.2 ABC analysis

The two years of ABC analysis are summarized in Table 1, which showed that a total of 197 items were stored during the year 2018. Category A of items comprising 50 items (25.38%) costing to 37,566,451.69 baths (79.64%) of annual drug expenditure. There are 50 items (15.32%) in category B, costing 7,226,834.05 baths (15.32%) of annual drug expenditure. The rest of the 97 items (49.24%) costing only 2,378,171.15 (5.50%) of the total budget, classified as group C. In 2019, 205 items were analyzed out of which 32 items (12.17%) 46 items (12.17%), and 105 items (12.17%) were found to be A, B, and C classify respectively, costing 41,511,765.24 baths (79.78%), 7,900,111.85 baths (15.18%), and 2,621,189.63 baths (5.04%) of annual drug expenditure respectively.

Considering ABC analysis in 2018-2019 can require us to ensure enough control over 50 items that spending 79% approximately of the annual drug expenditure of Category A. Category B can always control that spending 15 % approximately of the annual drug expenditure. Category D is the lowest control, which spending only 5% approximately of the annual drug expenditure.

Table 3. ABC analysis of drugs

year	classify	No. of items	% of Items	Annual Drug Expenditure(bath)	% of ADE
2018	A	50	25.38	37,566,451.69	79.64
	B	50	25.38	7,226,834.05	15.32
	C	97	49.24	2,378,171.15	5.04
total		197	100	47,171,456.89	100
2019	A	50	24.88	41,511,765.24	79.78
	B	46	22.89	7,900,111.85	15.18
	C	105	52.24	2,621,189.63	5.04
total		201	100	52,033,378.72	100

*Annual Drug Expenditure = ADE

5.3 VEN analysis

Table 4 shows the results of the VED Analysis. The VEN classification for 2018 propose of 197 items stored show that around 7 (3.55%) items were found Vital, 8(4.06%) Items as Essential, and 182 (92.39%) items as Desirable spending for 424604.65 baths (41.01%), 874688.62 baths (53.24%) and 45872163.62 baths (5.74%) of the annual drug expenditure respectively. In 2019 out of 201 items stored, 50 items (24.88) were found Vital, 46 items (22.89%) were Essential, and 105 item (52.24%) were considered Desirable amounting to 41511765.24 baths (79.78%), 7900111.85 baths (15.18%), and 2621189.63 baths (5.04%) of the annual drug expenditure respectively.

Considering VED analysis in 2018 - 2019, V (Vital) and E (Essential) are found less amount and cost than D (Desirable), there are only 3% items approximately and 0.9% approximately of the annual drug expenditure. D (Desirable) does not drug important, but outnumbered, there are 97% approximately of the annual drug expenditure.

Table 4. VEN analysis

year	classify	No. of items	% of Items	ADE	% of ADE
2018	V	7	3.55	424,604.65	0.90
	E	8	4.06	874,688.62	1.85
	D	182	92.39	4,5872,163.62	97.25
total		197	100	471,714,56.89	100
2019	V	7	3.48	500,025.97	0.96
	E	8	3.98	1,047,855.62	2.01
	D	186	92.54	50,485,497.13	97.03
total		201	100	52,033,378.72	100

*Annual Drug Expenditure = ADE

5.4 ABC-VEN matrix

ABC-VED matrix analysis as given in Table 5 and Table 6, The drug list can be combining into nine different subcategories, which were grouped into three main categories, Categories I, II, and III.

In 2018, Category I includes subcategories AV, AE, AD, BV, and CV, which comprises 57 drugs (28.93%), costing 37,991,056.34 baths (80.54%) of annual drug expenditure. BE, BD, and CE subcategories of category II, there are 54 items (27.41%), costing 7,088,254.05 baths (15.03%) of annual drug expenditure. For the rest of the 86 drug items (43.65%) in category III that CD, the cost was represented 2,092,146.5 baths (4.44%) of annual drug expenditure.

In 2019, there are 57 drugs (28.36%) and costs 42,011,791.21 (80.54%) of annual drug expenditure in Category I. Category II, there are 49drugs (80.74%)items, costing 7,648,725.85 (15.03%) of annual drug expenditure. For the rest of the 95 drug items (14.70%) in category III, the cost was represented 2,372,549.66 (4.56%) of annual drug expenditure.

Considering ABC-VED analysis in 2018-2019, Subcategories AV has not drug item. Subcategories BV, CV, AE, BE, and CE has less than 10 items. Subcategories AD and BD have less than 50 items. Subcategories CD has more than 80 items. This shows that most drug items are Subcategories CD but have the lowest annual drug expenditure, that 4% approximately.

Table 5. ABC–VED matrix of the drugs for the year 2018-2019

year	classify	V				E				N			
		NO. Of Item	% Of Item	ADE	%ADE	NO. Of Item	% Of Item	ADE	%ADE	NO. Of Item	% Of Item	ADE	%ADE
2018	A	0	0	0	0	1	12.5	549975.72	62.88	49	26.92	37016476	80.69
	B	2	28.57	300150.00	70.69	1	12.5	163142.9	18.65	47	25.82	6763541.2	14.74
	C	5	71.43	124454.65	29.31	6	75.0	161570	18.47	86	47.25	2092146.5	4.56
	Total	7	100.00	424604.65	100	8	100	874688.62	100	182	100	45872164	100
2019	A	0	0	0	0	1	12.5	757232.58	72.28	49	26.34	40754533	80.73
	B	3	42.86	431752.00	86.35	1	12.5	110073.04	10.51	42	22.58	7358286.8	14.58
	C	4	57.14	68273.97	13.65	6	75	180366	17.22	95	51.08	2372549.7	4.70
	Total	7	100	500025.97	100	8	100	1047671.6	100	186	100	50485369	100

*Annual Drug Expenditure = ADE

Table 6. Results Analysis of Drugs' Categories

year	Category	NO. Of Item	% Of Item	ADE(bath)	% ADE
2018	I	57	28.93	37,991,056.34	80.54
	II	54	27.41	7,088,254.05	15.03
	III	86	43.65	2,092,146.5	4.44
	Total	197	100	47,171,456.89	100
2019	I	57	28.36	42,011,791.21	80.74
	II	49	24.38	7,648,725.85	14.70
	III	95	47.26	2,372,549.66	4.56
	Total	201	100	52,033,378.72	100

*Annual Drug Expenditure = ADE

6. Conclusion

The objective of this study is to improve inventory management in the hospital, which has no technique for drug inventory control. while there are an increasing trend of patients and the new project to effect inventory management in the future, there is an increase of 47,171,456.89 to 52,033,378.72 in hospital expenditures in 2018-2019 shown in Table 6.

The study finding indicated that the ABC–VED analysis was a technique for identifying classify drugs, the resultant matrix in 2019 makes it possible to focus on manage according to Category I, II, and III.

Category I there is the highest cost (80%) of expenditure requiring stringent control, these drugs must always be maintained in stock since they are either vital to patient. Category II 49 items required moderate control, the drugs are either essential to the patient. Category III there is required lower control. The drugs are not essential a therapeutic impact, which revealed that 95 items costing 2,372,549.66 baths of the expenditure. The hospitals can consider removing unnecessary drugs in Category III. It saving purchasing budget. The proposal to the hospital improve more efficacy inventory management. Which corresponds to the research (Mani et al. 2014) (Sabah et al. 2020) (Nigah et al. 2010) (Taddele et al. 2019). This analysis is hoped to promote effective management of drug inventory with minimal monetary while required to reduce stocks and order frequency, which there are order 729 times a year in 2019. Moreover, it also recommends calculating the forecasting technique for predicting the demand of drug items with economic order quantity (EOQ) and the re-order point (ROP). It can reduce the total cost of drug inventory in the medical store. (Keerthana et al. 2018) (Kanyakam 2018)

This research discusses the framework to inventory part of the project that can confident reduce cost inventory. Future research, the results of this research are used in the calculation of part project costs. Another, aim of simulation technology to provide alternatives pharmacists to reduce the workload in hospitals caused by the increase in patients and create a project. The collected data of outpatient use the service. Then, the efficiency indicators which are the average total time, the average waiting time of patients, and the working time of pharmacists, are analyzed to create the new simulation systems. The proposal to the hospital better options for hospitals.

Acknowledgements

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