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SIGNIFICANCE OF CONSUMPTION PATTERNS AND ABC/FSN MATRIX TO OPTIMIZE VITAL DRUGS INVENTORY MANAGEMENT

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ABSTRACT

Drug shortage affects patient's life, especially life-saving medicines. The main objective of the study was to analyze the retrospective consumption data from 2016 in order to optimize the inventory management of vital drugs. 136 of vital drug items were categorized by ABC (Always Better Control) and FSN (Fast, slow and non-moving) matrix and analyzed the consumption patterns of vital drugs in each group. Total consumption value for vital drugs during 2016 were 361,091,149 Thai Baht. ABC and FSN matrix were sub-categorized into Category I (AF, AS, AN, BF, CF), Category II (BS, BN CS) and Category III (CN). Irregular consumption patterns from Category I and II, required special attention regarding stock control to overcome shortage and oversupply. Although Category III consists of non-moving items, these drugs have to be in stock in sufficient amount for emergency issues. Depending on the nature of consumption patterns, different inventory control methods are necessary for different characteristics of demand patterns.

Key words: inventory management, inventory control matrix, ABC/FSN, consumption patterns, vital drugs.

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INTRODUCTION

Drug shortage becomes alarming high in developing and under developing countries in the world due to several reasons [3,4]. The main reasons of shortage include inadequate raw materials, decrease number of manufacturers, unstable demand (especially when using just in time inventory control), purchasing and inventory practice, changes in therapeutic indication, natural disasters, and the emergence of the grey market, etc. Shortage is one of the factor that affected health care service in hospitals [1,4]. Shortage not only has impact on patients' safety but also on large economic burden, especially life-saving medicines or vital drugs. According to WHO, vital drugs are drugs that are potentially life-saving and crucial for health services. Therefore, hospital should ensure adequate stock quantity to overcome interrupted supply of vital drugs. Shortage of life-saving anti-infective drugs in United States hospital adversely affect patient outcome [4]. Moreover, injectable antibiotics shortage in Australia also leads to serious problems in metabolic syndrome [1]. Therefore, at the hospital level, many researchers pay attention in supply of medicines and inventory management using statistical, mathematical and modelling approach for inventory control [5]. Moreover, traditional methods such as ABC (Always better control), VEN analysis (Vital, essential and non-essential), and FSN analysis (Fast, slow and non-moving), etc. are the most widely used inventory control classification in both hospitals and pharmaceutical industry. ABC analysis is based on Pareto's Law, which classified drug items by ranking the monetary value and consumption rate. VEN analysis is classification of drug items according to priority of importance as vital, essential and non-essential or desirable. ABC analysis consider only monetary value and VED analysis consider criticality of importance, ABC/VEN matrix is the most suitable inventory control technique use in hospital. Developed inventory model for different characteristics of vital and expensive (AV) drugs by ABC/VEN matrix [5]. The method used in this study is different from other study in that, the author used inventory classification FSN (Fast, slow, non-moving) and ABC matrix to optimize the inventory management of vital drugs (V). Vital drugs are drugs that hospital has to keep in suffient quantity even though low consumption or no consumption. Since ABC consider only high value items, vital drugs which utilize low monetary value will be omitted. FSN analysis is applied to overcome

this limitation. The objective of this study is to optimize the inventory management of vital drugs by classified the vital drugs (V) into ABC/ FSN matrix and analyze the consumption patterns.

METHODS

Study site: A public teaching hospital in Bangkok, Thailand, Data collection: retrospective data of vital drugs consumption during 2016 from hospital information system (HIS)

ABC analysis

Total of 136 vital drugs were categorized by ABC analysis, in which total drug expenditure was ranked by descending order. Cumulative percent of total drug expenditure and cumulative percent of drug items were calculated. 10-15% of drug items, which utilized 70-80% of total drug expenditure were classified as Category A. Drugs that expense 20-30% of monetary value for 15-20% items were categorized as category B and the remaining expense 5-10% of total value accounts for 60-70% of items were classified as category C [6,7,2].

FSN analysis

Total of 136 drug items were categorized by FSN analysis according to inventory turnover rate as fast, slow and non-moving groups. Inventory turnover rate in 2016 was calculated by using the following equation:

$$\text{Inventory turnover rate} = \frac{\text{Total annual consumption value (THB)}}{\text{Average Inventory (THB)}}$$

Drugs which have turnover rate higher and lower than average turnover rate were classified into fast and slow-moving items, respectively. Ones which have no inventory turnover rate or turnover rate approximately equal to zero were regarded as non-moving or dead stock.

ABC/ FSN matrix

Both ABC and FSN analysis were tabulated in the table and further sub-categorized into Category I, II and III. Category I composed of AF, AS, AN, BF, CF and BS, BN, CS in Category II, CN in Category III. Pattern analysis were performed to see the consumption patterns in each category.

RESULT AND DISCUSSION

Total consumption value for vital drugs in 2016 were 361,091,149 THB. The drugs in the category A were utilized by 282,639,909.9 THB (78%) and 17 items (12%) were included in this category. In category B, the expense were 8,253,129.19 THB for 30 items (22%). Drugs in the category C were contributed by the remaining 20,198,110.22 THB (6%) of the expenses for 90 items (66%). In comparison to other study, percent of total drug expenditure of group A was higher than other studies [2,6,7]. This may be due to the author only include vital drugs in this study. Because some of the vital drugs are used for longer duration of treatment. For example, clopidogrel alone utilized 23% of total expenditure which is use for prevention of atherothrombotic events in patients suffering from myocardial infarction from a few week to six months. Moreover, some drugs are expensive innovator brands which is not available in generic name. Therefore, in this study drugs belong to Category A utilized 78% of total expenditure to obtain 12% of drug items, which is higher in expenditure and lower in quantity in compare to other study. Whereas, 69.1% of total drug expenditure accounts for 13.4% of drug items [7], 70% of monetary value for 15% of drug items [2], respectively (Table I).

For FSN analysis, the highest inventory turnover rate was 21, which meant hospital had to purchase drugs in fast-moving item nearly twice a month. The average inventory turnover rate was 10. Below 10 was slow-moving item and drugs which had inventory turnover rate zero or nearly zero were non-moving item (Table II).

From ABC and FSN matrix (Table III), AF group which represent high value and fast-moving items utilized the highest value 66%, at which hospital can minimize the maximum stock level up to reorder point to optimize inventory level. However, no drug items were found in BN and CN groups, which indicated no-investment in non-moving and high cost vital drugs.

Table I. ABC analysis of vital drugs

Classification	No.of items	% of items	Total drug expenditure (THB)	% of total drug expenditure expenditure
A	17	12%	282,639,909.9	78%
B	30	22%	58,253,129.19	16%
C	90	66%	20,198,110.22	6%
Total	136	100%	361,091,149.35	100%

Table II. FSN analysis of vital drugs

Classification	No.of drugs	% of drugs	Total value (THB)	Cumulative % of value
F	77	57%	287,639,272	80%
S	55	40%	73,277,108	20%
N	4	3%	174,769	≈0%
Total	136	100%	361,091,149	100%

Table III. ABC/FSN matrix of vital drugs

Classification	No.of drugs	% of drugs	Total value (THB)	Cumulative % of value
AF	12	9%	238,298,549	66%
AS	4	3%	44,341,362	12%
AN	0	0%	0	0%
BF	17	13%	36,657,031	10%
BS	12	9%	21,596,098	6%
BN	0	0%	0	0%
CF	47	35%	12,683,693	4%
CS	39	29%	7,339,648	2%
CN	4	3%	174,769	≈0%
Total	136	100%	361,091,149	100%

Table IV. Sub-category of ABC and FSN matrix of vital drugs

Classification	No.of drugs	% of drug items	Total value (THB)	% of value
Category I	80	59%	331,980,634	92%
Category II	51	38%	28,935,746	8%
Category III	4	3%	174,769	≈0%

By categorized the vital drugs according to movement, hospital can minimize the inventory level for dead stock and non-moving items to appropriate level. Moreover, by knowing the patterns of consumption of each category hospital can manage safety stock for emergency case and optimize total inventory holding cost. Three sub-category from matrix were Category I, II and III. The details of the matrix (Table IV).

Category I composed of AF, AS, AN, BF, CF, which utilized 92% of total expenses. Category II comprised of slow-moving items BS, BN, and CS, utilized 8% of total drug expenditure. CN group was under category III. The consumption patterns of vital drugs in Category I were mostly regular and irregular patterns. Example of regular and irregular patterns are shown in below figure 1 and 2.

Since Category I utilized the highest total drug expenditure, special attention of inventory control for irregular consumption patterns are required. Moreover application of different forecasting methods for different consumption patterns can minimize the overestimate and underestimate of drugs. Oversupply of vital drugs in this category will lead to financial burden for hospital.

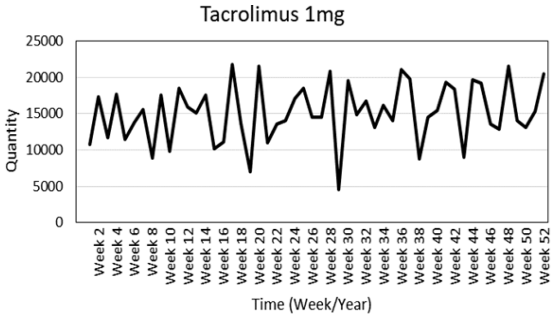

Figure 1. Example of regular pattern.

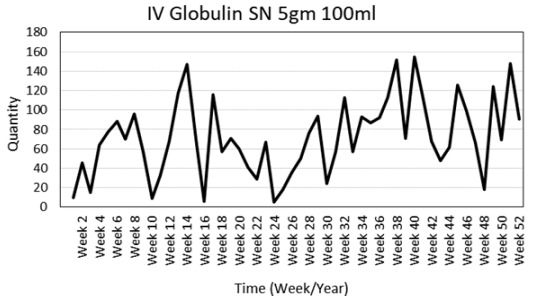

Figure 2. Example of Irregular Pattern

Drug consumption patterns in Category II were irregular and by patient case patterns, the stock level of vital drugs in this category are difficult to control (Figure 3). Unpredictable consumption of by case management items required careful consideration of safety stock for emergency issues.

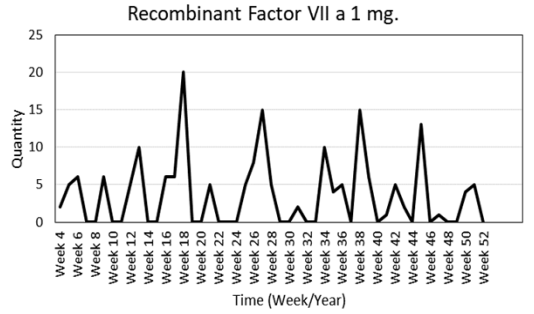

Figure 3. Example of by patient case pattern

CONCLUSION

Categorization of vital drugs according to ABC/FSN matrix benefits hospital to determine the level of inventory with minimum investment in dead-stock or slow-moving items. For inventory management of vital drugs, only ABC and VEN matrix classification are insufficient to control the stock in appropriate level with minimum shortage and oversupply. Moreover, consideration of demand consumption patterns in forecasting and setting inventory level give an accurate stock level for optimization of vital drugs inventory management.

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