Research Article

Development and Evaluation of AVSER Matrix Analysis of Inventory Control Technique for Community Pharmacy Practice in a Tertiary Care Hospital

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Abstract: Approximately 40% of annual hospital budget is spent on drug procurement. The objective of the study was to design and evaluate suitable inventory management formula for a community pharmacy attached to a tertiary care government medical college hospital. The duration of the study was 10 months. All the conventional inventory control techniques, such as ABC analysis, VED analysis, ABC –VED Matrix analysis, EOQ and SOS classification were done and their merits and demerits were identified. All these inventory control techniques along with the ROL calculation formula developed, was then combined together to develop a novel inventory control technique known as "AVSER matrix analysis". In the AVSER matrix analysis model, A stands for ABC analysis, V stands for VED analysis, S stands for SOS classification, E stands for EOQ and R stands for ROL. A percentage error within 20% in the EOQ formula with respect to that of the actual consumption was considered to be accurate prediction. About 85% of the items were almost accurately predicted, 10% of the items were predicted in excess and 5% of the items were predicted in lesser quantity than the actual consumption by the AVSER matrix analysis of inventory control. When the ROL level for each item was fixed as half the value of EOQ, the reordering of all the items was found to be done at the appropriate time and none of the items in pharmacy reached the level of "No stock" over a period of 4 months. The AVSER matrix analysis model helped in giving a better priority management and economic forecasting of the items in a community pharmacy.
Keywords: ABC, VED, SOS, EOQ, ROL, AVSER

INTRODUCTION

About one-third of the annual hospital budget is spent on buying materials and supplies, including medicines [1]. The pharmacy is one of the most extensively used therapeutic facilities of the hospital and one of the few areas where a large amount of money is spent on purchases on a recurring basis. This emphasizes the need for planning, designing and organizing the pharmacy in a manner that results in efficient clinical and administrative services [2].

The goal of the hospital supply system is to ensure that there is adequate stock of the required items, so that an uninterrupted supply of all essential items is maintained. A study conducted by the Department of Personnel and Administrative Reforms in India has revealed that not only does the quantity of medicines received fall short of the requirement but also the supply is often erratic. Even common medicines are out of stock and remain so for a considerable period [3]. Of the various explanations for non-availability of even simple medicines in the third world countries, a large number are related to materials management. A study from a 1,500-bedded state-funded hospital has claimed

that review and control measures for expensive drugs brought about 20% savings [4].

Inventory can be defined as "an itemized list of goods with their estimated worth; specifically an annual account of stock taken in any business". In the case of pharmacies, inventory is the list of stock of medicines, surgical goods and other patient care items. Inventory control is the operation of continuously arranging the receipts and issues in such a way so as to ensure that stock balance in quantity and value are adequate to support the current rate of consumption, at all times, with due regard to the economy. It involves policies and procedures prescribed and followed, by which the establishment or the organisation for the procurement and stocking, ensures its operational smoothness. The level of inventory is always the optimum one that can be economically maintainable and professionally manageable. Inventory control helps to reduce investment in inventories and simultaneously minimise idle time by avoiding 'stock-outs' and shortage [5, 6].

Inventory control in hospital pharmacy is very essential in a developing country like India [7]. As

resources are limited, it is essential that the existing resources be appropriately utilized. With the existing drug budget, if rational drug use and improved drug management practices are followed, more number of patients can be served. It is essential that health managers use scientific methods to maximize their returns from investment at a minimal cost.

Thus, a hospital materials manager must establish efficient inventory system policies for normal operating conditions that also ensure the hospital's ability to meet emergency demand conditions [8-14].

For developing a novel inventory control technique, initially all the conventional inventory control techniques such as ABC analysis, VED analysis, ABC – VED Matrix analysis, EOQ and SOS classification are done and their merits and demerits are identified.

Inventory control techniques such as ABC analysis, VED analysis, ABC – VED Matrix analysis and SOS classification are selective inventory control techniques. Selective inventory control techniques are based on the principle that there are variations in the method of inventory control from item to item and this differentiation plays a key role in the selection of items to be procured [5].

ABC analysis is a method of classifying items or activities according to their relative importance. ABC analysis is based on the cost criteria and tells the purchase officer to place his efforts on those items where the result will be the greatest. It helps to identify where one should be liberal; where one should concentrate and where one need not put in his entire effort. According to the ABC method, the items in a store can be categorised into 3 groups namely 'A' items, 'B' items and 'C' items. The 'A' items comprising about 10 per cent of the total number of items are responsible for 70 per cent of the annual consumption cost; the 'B' items comprising about 20 per cent of the total number of items are responsible for 20 per cent of the annual consumption cost, the 'C' items comprising about 70 per cent of the total number of items are responsible for 10 per cent of the annual consumption cost [5, 9- 11, 15, 17, 18].

However as monetary value and the rate of consumption alone cannot be taken into account for stocking policies in a pharmacy store, VED classification is used. VED stands for vital, essential and desirable. The utility, criticality and essentiality of the items are the dominating factors in VED analysis. The VED method classifies the items in store into three groups – 'vital' items, 'essential' items and 'desirable' items. In VED classification, the public health impacts of individual items are given prime importance, whereas the unit prices of the items are given only secondary consideration [5, 9-11, 16-18].

ABC-VED matrix analysis, which is a combination of ABC and VED analysis can be gainfully employed to evolve a meaningful control over the material supplies. Category X includes all vital and expensive items (AV, BV, CV, AE, AD). Category Y includes the remaining items of the E and B groups (BE, CE, BD). Category Z includes the desirable and cheaper group of items (CD) [11, 18-25].

In SOS classification, the inventory is grouped into two – 'Seasonal' and 'Off-seasonal' items. Some medicines required are seasonal in nature and require special purchasing and stocking strategies. A buying and stocking strategy for seasonal items would depend on many factors; special care, knowledge and calibre are required for the pharmacists to look after the matter efficiently. All the items in the pharmacy are classified as seasonal (S) or as off-seasonal (OS)[5].

The SOS classification is then combined with the ABC-VED matrix analysis to form the SOS-ABC-VED matrix analysis. The SOS-ABC-VED matrix analysis classifies the inventory into three categories namely, category I (SX, SY, SZ), category II (OSX, OSY) and the category III (OSZ). Category I includes all the items of Category X, Category Y and category Z that are seasonal. Category II includes all the items of Category X and Category Y that are off-seasonal. Category III includes all the items of category Z that are off-seasonal.

The EOQ (Economic order quantity) model is one of the most effective techniques for determination of quantity of the items to be purchased. The EOQ (Economic order quantity) model is also known as the Minimum Cost Quantity approach. A pharmacy can fix the EOQ of various items based on suitable calculations. In India many pharmacies calculates the EOQ based on the average requirement of an item.

Re-order level (ROL) is used to denote the stock level at which fresh order has to be placed. By placing the order for an item at a quantity calculated by the EOQ method described above, at a time when the stock reaches the re-order level, the pharmacy store can be fairly assured that the chance of 'stock out' or 'no stock' problem does not come into effect.

All these conventional inventory control techniques, along with the ROL calculation formula developed, was then combined together to develop a novel inventory control technique known as "AVSER Matrix Analysis". In the AVSER matrix analysis model, A stands for ABC analysis, V stands for VED analysis, S stands for SOS classification, E stands for EOQ and R stands for ROL. The objective of the study was to develop a novel inventory control technique for Community Pharmacy Practice by using the conventional inventory control techniques.

METHODOLOGY

The study was carried out in In-house Drug Bank (IHDB), attached to SAT hospital, Government Medical College, Thiruvananthapuram. All the inventory control techniques such as ABC analysis, VED analysis, EOQ and SOS classification required retrospective collection of data from the In-house drug bank (IHDB). The study duration was 10 months.

The following were the steps involved in the development of AVSER matrix analysis;

Step 1: ABC Analysis

The most common and accurate method of ABC analysis is to find out from the consumption records of issued items from existing drug stores. A list of all the items (serial number and name) was taken from the computer generated consumption records of all the issued items from the pharmacy store of an in-house drug bank attached to a government tertiary care hospital, for the financial year, 2012-2013. The data was then transcribed in a MS-Excel spreadsheet and arranged in the descending order based on annual consumption cost. The cumulative cost was then worked out for each item. Then the percentage of the cumulative cost was worked for each item. The list of items were then categorised into 3 groups – 'A', 'B', and 'C' based on the theoretical concepts. The categorisation of items into 'A', 'B', and 'C' was done on the number of items, the first 10 per cent of the items arranged are grouped into 'A' items, the next 20 per cent items into 'B' items and the remaining 70 per cent items into 'C' items. Now as per the theoretical concepts, A items take a share of about 70 per cent of the total cost, the B items about 20 per cent of the total cost and the C items about 10 per cent of the total cost [5, 9-11, 16-18].

Step 2: VED Analysis

The list of all the items in the pharmacy was collected and were individually given to a panel comprising of physician, surgeon, paediatrician and clinical pharmacists who classified the drugs as vital (V), essential (E) and desirable (D). Then the VED status of each drug was discussed / debated with justification by the study group till a collective consensus was reached. Thus, all the items in the pharmacy were included in the vital (V), essential (E) or desirable (D) category [5, 9-11, 16-18].

Step 3: ABC-VED Matrix Analysis

The ABC-VED matrix was formulated by cross-tabulating the ABC and VED analysis. From the resultant combination, three categories were classified (X, Y and Z). Category X was constituted by items belonging to AV, AE, AD, BV and CV subcategories. The BE, CE and BD subcategories constituted category Y, and the remaining items in the CD subcategory constituted category Z. In these subcategories, the first alphabet denotes its place in the ABC analysis, while the second alphabet stands for its place in the VED analysis. [11, 18-24].

Step 4: SOS Classification

The list of all the items in the pharmacy was collected and was individually given to chief pharmacist, senior pharmacist and a junior pharmacist of IHDB, who then classified the items as either seasonal or off-seasonal. Then the SOS status of each drug was discussed / debated with justification by the study group till a collective consensus was reached. Thus, all the items in the pharmacy were included in the seasonal (S) or off-seasonal (OS) category.

Step 5: EOQ Method

IHDB calculates the EOQ based on the average requirement of an item. In this EOQ method, the requirement of an item for a particular period of time is calculated by taking the actual consumption of that item for a particular review period time and dividing it by the review period time. The value now obtained (which indicates the average consumption of an item per day for the review period) is then multiplied with the period of time for which the item is required.

In general, review period taken in IHDB, was the last 45 days and the items are ordered generally for another 30 days. Such frequent ordering of items are required, because it has been found out that the storage space requirement of items in IHDB, was minimal when compared to the high daily turnover and due to the large number of items in pharmacy (3123). Further the lead time of most of the items procured was minimal in IHDB. The formula used to calculate the EOQ of the items can be mathematically represented as;

$$EOQ = \frac{\text{Actual consumption of an item for the last 45 days} \times 30 \text{ days}}{45 \text{ days}}$$

This method of determining the economic order quantity, works with good accuracy for most of the off-seasonal items in pharmacy. But the accuracy of this method fails for seasonal items in IHDB. Hence there was a need of developing a separate EOQ for seasonal items and off-seasonal items in pharmacy. Furthermore the rate of consumption of an item in pharmacy as well the essentiality and criticality of the item are all important factors in determining the EOQ of an item.

Hence a combination of SOS classification and ABC-VED matrix analysis was done to form the 'ABC-VED-SOS matrix analysis' that categorised all the items in pharmacy into 3 categories. A separate EOQ calculation (based on the average requirement of an item) was developed for each of these categories.

Step 6: SOS-ABC-VED Matrix Analysis

SOS-ABC-VED matrix analysis is formulated by cross tabulating the results of SOS classification and

ABC-VED matrix analysis. The SOS-ABC-VED matrix analysis classifies the inventory into three categories namely, category I (SX,SY,SZ), category II (OSX, OSY) and the category III (OSZ). Category I includes all the items of Category X, Category Y and category Z that are seasonal. Category II includes all the items of Category X and Category Y that are off-seasonal. Category III includes all the items of category Z that are off-seasonal.

Step 7: Developing an EOQ for each ABC-VED-SOS Matrix Category

A separate EOQ calculation was developed for each of SOS-ABC-VED matrix categories.

- **Category I:**

Review period taken in IHDB, is the last 14 days and the items are ordered generally for another 30 days. It can be mathematically represented as;

$$EOQ = \frac{\text{Actual consumption of an item for the last 14 days} \times 30 \text{ days}}{14 \text{ days}}$$

- **Category II:**

Review period taken in IHDB, is the last 30 days and the items are ordered generally for another 30 days. It can be mathematically represented as;

$$EOQ = \frac{\text{Actual consumption of an item for the last 30 days} \times 30 \text{ days}}{30 \text{ days}}$$

- **Category III:**

Review period taken in IHDB, is the last 45 days and the items are ordered generally for another 30 days. It can be mathematically represented as;

$$EOQ = \frac{\text{Actual consumption of an item for the last 45 days} \times 30 \text{ days}}{45 \text{ days}}$$

Step 8: ROL fixation for each item

The re-order level for an item was fixed as half the value of EOQ for that item.

All these conventional inventory control techniques, such as ABC analysis, VED analysis, ABC-VED matrix, SOS classification and EOQ along with the ROL calculation formula developed, was then combined together to develop a novel inventory control technique known as "AVSER matrix analysis"**.** In the AVSER matrix analysis model, A stands for ABC analysis, V stands for VED analysis, S stands for SOS classification, E stands for EOQ and R stands for ROL.

RESULTS AND DICUSSION

From study, it was found that the ADE of IHDB for the year 2012-2013 was 50% of AHE. This percentage

of ADE was much higher when compared to the previous studies.

Step 1: ABC Analysis

It has been found from the study that there has been a variation from the theoretical concept of ABC analysis, as 10%, 20% and 70% of A, B and C items took a share of 50.19%, 27.25% and 22.55% per cent of the total annual consumption cost respectively as shown in Fig1.
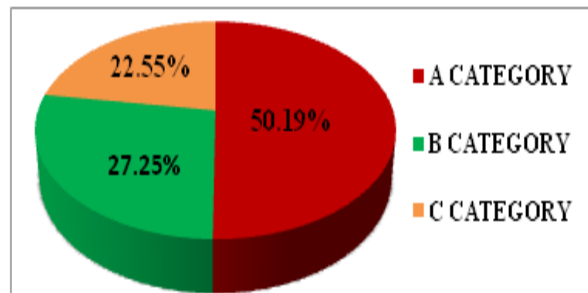
Fig. 1: Percentage annual consumption cost of ABC categories

Plotting the above results, as the percentage of items used during the year on X axis and the value of annual consumption cost on the Y axis, yields a graph as shown in Fig. 2.
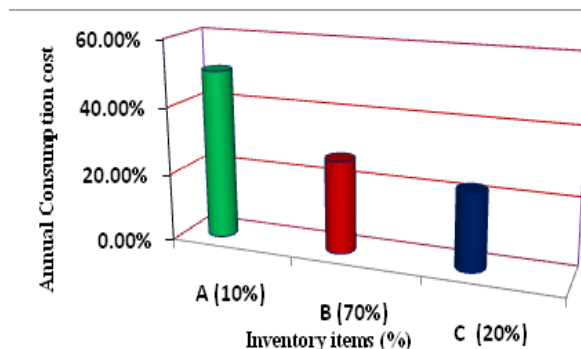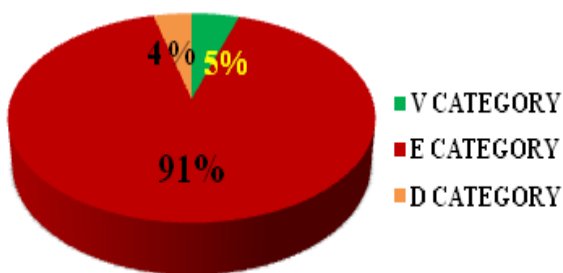

Fig. 4: Annual consumption cost of ABC categories

The results of the study were not comparable with similar studies conducted in India From the above graph, it can be analysed that the A category items contribute to only 50.19% of annual consumption cost, which was well below the expected 70% of annual consumption cost as per theoretical concept. Further it was observed that not much significant difference was there in the annual consumption cost of the B category and C category that accounted to 27.25% and 22.55% respectively of annual consumption cost. This gives an indication that the priority of procurement and thereby the sales of items in pharmacy was not just confined to those drugs with high monetary value and high rate of consumption but also to drugs which had low monetary value and low rate of consumption as they may include drugs that are essential in nature and need to be available to the public at all times.

The limitation of ABC analysis is that it is based only on monetary value and the rate of consumption of the item. In a hospital, an item of low monetary value and consumption may be very vital or even life saving. Therefore giving management prioritisation to only those items belonging to A category would result in running the pharmacy as only on a business point of view and the service motto of the pharmacy will be neglected. Hence arises, the need for an inventory control analysis that focuses on the essentiality and criticality aspects of an item.

Step 2: VED analysis

In VED analysis, the vital (V) items took a share of 5% of the total items in pharmacy, essential items (E) had a share of as much as 91% of the total items and the desirable (D) items took a share of 4% of the total items in pharmacy.

Fig. 3: Percentage of items in each of the VED category

Plotting the percentage of VED category items used during the year on X axis and its value of annual consumption cost on the Y axis, yields a graph as shown in Fig. 4.
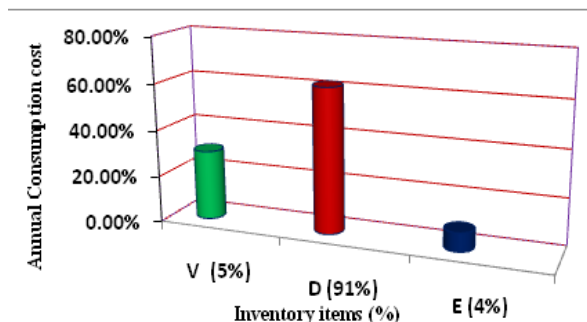
Fig. 4: Annual consumption cost of VED categories

From the above graph, it can be analysed that the 5% of vital (V) items took a share of 30% of the annual consumption value, the 91% of the essential (E) items took a share of 62% of the annual consumption value, and 4% of desirable (D) items took a share of 8% of the annual consumption value.

The comparison with similar studies in India showed high variation in the percentage of vital, essential and desirable items. This could be because different institutes have different service profiles, depending on the specialty services available.

As VED analysis categorises the items of pharmacy on the basis of essentiality, criticality and utility of items, it is not possible for managing the inventory only on the basis of VED analysis on an economic point of view for the pharmacy, as consideration of cost criteria is an important factor for better economic management of the pharmacy. Hence arises the need for an inventory management technique that can have both the aspects of cost criteria and public health impact taken into consideration for proper scientific and economic management of an item in pharmacy. This can be achieved by the combination of ABC and VED analysis known as ABC-VED matrix analysis.

Table 1: Occurrence of drugs in each of the ABC-VED categories

| ABC-VED Category	AV	BV	CV	AE	BE	CE	AD	BD	CD	Total
No. of Drugs	41	42	71	251	563	2034	22	17	82	3123
% of Drugs	1.31	1.34	2.27	8.04	18.03	65.13	0.70	0.54	2.63	100

Step 3: ABC-VED Matrix Analysis

In ABC-VED matrix analysis, the percentage occurrence of the drugs in nine different subcategories obtained namely AV, AE, AD, BV, BE, BD, CV, CE

These nine were further grouped into three main categories, categories X, Y and Z. There were 427 (13.67%) items in category X, 2614 (83.70%) items in category Y and 82 (2.62%) items in category Z.

and CD were studied. They are as follows; AV (1.31%), BV (1.34%), CV (2.27%), AE (8.04%), BE (18.03%), CE (65.13%), AD (0.70%), BD (0.54%) and CD (2.63%).
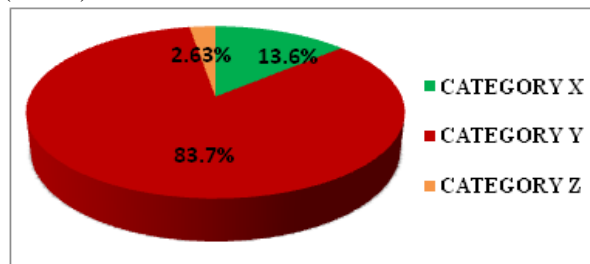
Fig. 5: Percentage of items in each of the ABC-VED matrix category

Plotting the various ABC-VED matrix category items on X axis and its percentage occurrence on Y axis, yields a graph as shown below;
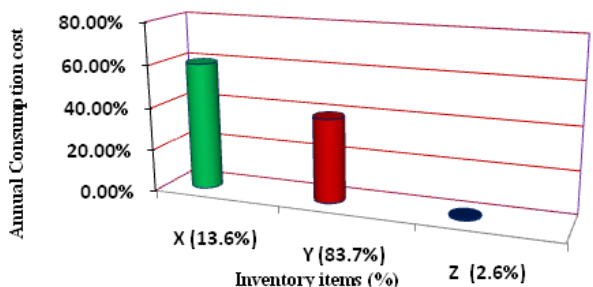
Fig. 6: Annual consumption cost % of ABC-VED matrix categories

In the combination of ABC and VED analysis, the resultant matrix makes it possible to focus on 427 (13.67%) items belonging to category X for strict managerial control as these items are expensive and vital. The annual expenditure of these items was 60% of annual consumption cost of the pharmacy. AV, AE and BV subgroups of category X consist of 334 items (10.69%) that are expensive, and their being out of stock is unacceptable. To prevent locking up of capital due to these items, low buffer stock needs to be maintained while keeping a strict vigil on the consumption level and the stock in hand. CV drugs that took a share of 71 items (2.27%) in the pharmacy are drugs of low cost but of high criticality. Hence these items can be procured for a longer duration and stocked as their carrying cost is low. AD category that took a share of 22 items (0.70%), should be monitored for economic order quantity, and their order placement must be made after careful study of the need. Rational use of items in this subgroup, including their removal from the list if possible, can bring substantial savings without affecting the patient care needs.

Category Y items (2614, 83.70%) consumes 39.4% of the annual consumption cost of the pharmacy. These items can be ordered less frequently, thereby saving ordering cost and reducing management hassles at a moderate carrying cost and without blocking substantial capital.

Category Z items (82, 2.62%) consume 0.6% of annual consumption cost of the pharmacy. These items should be order very less frequently, thereby saving on ordering cost and without blocking substantial capital.
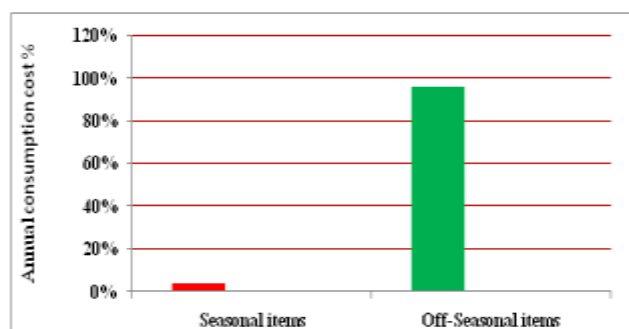
Step 4: SOS Classification

From SOS classification, it was found that seasonal items and off-seasonal items contributed to share of 3.39% and 96.91% of the total items respectively in the pharmacy.
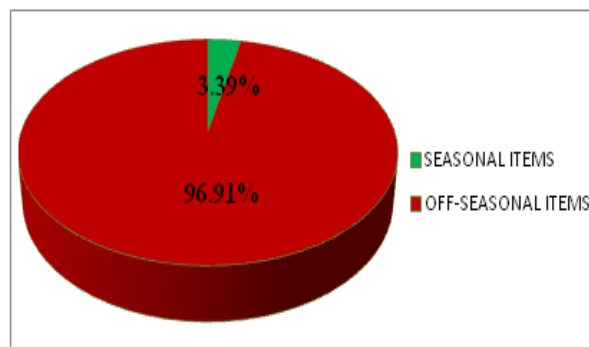
Fig. 7: Percentage of items in SOS classification

Plotting the SOS categories on X axis and the annual consumption cost % on the Y axis, yields graph as shown below;

Fig. 10: Annual consumption cost % of SOS categories

From the above graph, it can be analysed that seasonal and off seasonal items take a share of 4% and 96% of the annual consumption cost respectively.

Step 5: EOQ Method

A percentage error within 20% in the EOQ formula with respect to that of the actual consumption was considered to be accurate prediction. About 36% of the items were almost accurately predicted.

A percentage error greater than (+) 20% in the EOQ formula with respect to that of the actual consumption could result in purchasing excess of items that can result in stocking of static capital, which could be utilized for other purposes in hospital/pharmacy. About 18% of the items were predicted in excess by the conventional EOQ formula followed in IHDB.

A percentage error lesser than (-) 20% in the EOQ formula with respect to that of the actual consumption could result in early depletion of the item in the pharmacy that could affect both the economics and the patient care services of the pharmacy. As much as 46% of the items were predicted in lesser quantity than the actual consumption by the conventional EOQ formula followed in IHDB.

Of the seasonal items in IHDB, as much as 61% of the items were predicted in lesser quantity than the

actual consumption, 22% of the items were almost accurately predicted and 11% of the items were predicted in excess by the conventional EOQ formula followed in IHDB.

These results suggest the need for modifying the EOQ formula for the seasonal and non-seasonal items as suggested in the methodology section for each of the categories in the SOS-ABC-VED matrix. The need for modifying the EOQ formula is further enhanced by the fact that the drug consumption is higher in the first 10 days of a month (about 50%), when compared to the rest of the month, as most of the people draw their salary within the first week of the month and use it for drug purchase.

Step 6: SOS-ABC-VED Matrix Analysis
From SOS-ABC-VED matrix analysis, it was found that category **I**, **II and III** accounted for 106 (3.39%), 2934 (94%) and 82 (2.62%) of the items in IHDB.
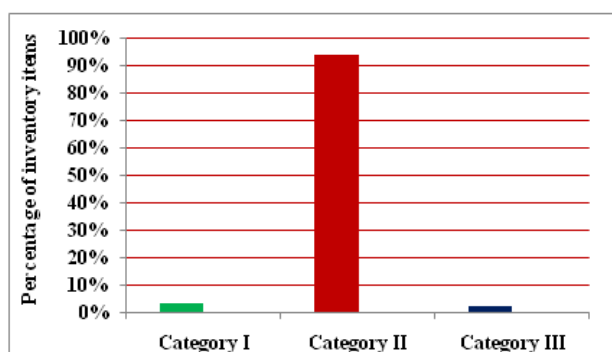

Fig. 11: Percentage of inventory items in each SOS-ABC-VED category

Step 7: Evaluation of EOQ designed for each ABC-VED-SOS Matrix Category
A percentage error within 20% in the EOQ formula with respect to that of the actual consumption was considered to be accurate prediction. About 85% of the items were almost accurately predicted. About 10% of the items were predicted in excess and 5% of the items were predicted in lesser quantity than the actual consumption by the AVSER matrix analysis of inventory control.

Step 8: Evaluating the ROL fixation for each item
When the ROL level for each item was fixed as half the value of EOQ, the reordering of all the items was found to be done at the appropriate time and none of the items in pharmacy reached the level of "No stock" over a period of 4 months.

CONCLUSION
The AVSER matrix analysis model, when implemented in IHDB helped in giving a better priority management and economic forecasting of the items in a community pharmacy.

REFERENCES
1. Kant S, Pandaw CS, Nath LM; A management technique for effective management of medical store in hospitals. Medical store management technique. J Acad Hosp Adm., 1996 and 1997; (8-9): 41-47.
2. Kunders GD, Gopinath S, Katakam A; Planning and designing supportive services-Pharmacy. In: Hospitals: Planning, Design and Management. New Delhi: Tata McGraw-Hill Publishing Company Limited, 2000: 273-281.
3. Kidwai M; Inaugural address. Logistics and supply management for health and family planning programme: A report of inter-country course. New Delhi: National Institute of Health and Family Welfare, 1992: 66-70.
4. Pillans PI, Conry I, Gie BE; Drug cost containment at a large teaching hospital. Pharmacoeconomics, 1992; 1(5): 377-382.
5. Revikumar KG, Miglani BD; A Textbook of Pharmacy Practice: Procurement, storage, inventory control and distribution of medicines. Career Publications, 2009: 311-332.
6. Hasssan WE; Hospital Pharmacy: Purchasing and Inventory control. Lea & Febiger, 1986: 193.
7. Gupta S, Kant S; Inventory control. In: Hospital stores management - An integral approach. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd., 2000: 60-72.
8. Ramanathan R; ABC inventory classification with multiple-criteria using weighted linear optimization. Comput Oper Res., 2006; 33(3): 695-700.
9. Das JK; Inventory Control. In Kaushik M, Agarwal AK, Arora SB editors; Essentials of Logistics and Equipment Managemnt. Manual of Post Graduate Diploma in Hospital and Health Management. New Delhi, Indira Gandhi National Open University, School of Health Sciences, 2001.
10. Gopalakrishnan P, Sundaresan M; Material management: An integrated approach. New Delhi, Prentice Hall, 1985.
11. Thawani VR, Turankar AV, Sontakke SD, Pimpalkhute SV, Dakhale GN, Jaiswal KS *et al.*; Economic analysis of drug expenditure in Government Medical College Hospital, Nagpur. Indian J Pharmacol., 2004; 36(1):15-19.
12. Beier FJ; The Management of the supply chain for hospital pharmacies: A focus on inventory management practices. J Business Logistic, 1995; 16:153-177.
13. Anonymous; Supply Chain: Cost of goods grab executives' attention. Health Facil Manage, 2008; 21: 26-28, 30, 32.

14. Duclos LK; Hospital inventory management for emergency demand. J Supply Chain Manage, 1993; 29: 29-38.

15. Brown RB; Materials management systems. New York: John Wiley and Sons, 1977.

16. Bhushan B, Gupta RS, Bharat B; Materials management system in central drug stores under Delhi Municipal Committee. Health Popul Perspect Issues, 1996; 19(2): 96-106.

17. Gandhi P, Basur A; Application of ABC analysis in medical store of ESIC, Delhi. Health Administrator, 2000; 9 and10: 90-95.

18. Doshi RP, Patel N, Jani N, Basu M, Mathew S; ABC and VED analyses of drug management in a government tertiary care hospital in Kerala. IHEA 2007, 6th World Congress: Explorations in Health Economics Paper, 2007. Available from: http://www.ssrn.com/abstract=992566

19. Vaz FS, Ferreira AM, Kulkarni MS, Motghare DD, Pereira-Antao I; A Study of Drug Expenditure at a Tertiary Care Hospital: An ABC-VED Analysis. J Health Manag., 2008; 10:119-127.

20. Gupta R, Gupta KK, Jain BR, Garg RK; ABC and VED analysis in medical stores inventory control. Med J Armed Forces India, 2007; 63: 325-327.

21. Mahatme MS, Dakhale GN, Hiware SK, Shinde AT, Salve AM; Medical store management: An integrated economic analysis of a Tertiary Care Hospital in Central India. J Young Pharmacist, 2012; 4(2): 114-118.

22. Devnani M, Gupta AK, Nigah R; ABC and VED analysis of the pharmacy store of a tertiary care teaching, research and referral healthcare institute of India. J Young Pharmacists, 2010; 2(2): 201-205.

23. Manhas AK, Malik A, Rashid H, Mushtaq AS, Syed AT; Analysis of inventory of drug and pharmacy department of a tertiary care hospital. JIMSA, 2012; 25(3): 183-185.

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

25. Roy RN, Manna S, Sarker GN; Applying management techniques for effective management of medical store of a public sector undertaking hospital. Indian J Prev Soc Med., 2010; 41(1& 2): 11-14.

26. Ballentine R, Ravin RL, Gilbert JR; ABC inventory analysis and economic order quantity concept in hospital pharmacy purchasing. Am J Hosp Pharm., 1976; 33(6): 552-555.