DEVELOPMENT AND EVALUATION OF A NOVEL INVENTORY MANAGEMENT SOFTWARE FOR COMMUNITY PHARMACY PRACTICE

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Abstract

Computer software programs play an important role in the inventory management of a pharmacy. The objective of the study was to develop a novel inventory management software for a better economic management of community pharmacy services. A novel software program named ‘MedZ’ was developed using the programming language, visual basic 6.0 after specific formulas, settings, desired outlook and environment was explained by the investigator to a team of software engineers. MedZ, version 1.0 was then installed in the computers of In-House Drug Bank, after the master coding and product coding of all the items in the pharmacy was set by the investigator. The economic management of all the items in the pharmacy was done by the software by using the combination of conventional inventory control techniques such as ABC analysis, VED analysis, ABC-VED matrix analysis, SOS analysis, EOQ and ROL method. After running the software for a period of 1 year, it was found that 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. 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 1 year. The novel software ‘MedZ’ helped in giving a better priority management and economic forecasting of all the items in a community pharmacy.

Key words: MedZ 1.0, ABC, VED, SOS, EOQ, ROL, AVSER Matrix.

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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]

Inventory can be defined as “an itemized list of goods with their estimated worth; specifically an annual account of stock taken in any business”.[3] In the case of pharmacies, inventory is the list of stock of medicines, surgical goods and other patient care items. Inventory control in hospital pharmacy is very essential in a developing country like India.[4] 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.[5], [6], [7]

Computer software programs play a crucial role in the appropriate inventory management of a pharmacy. With the help of suitable inventory control formulas incorporated into the computer software programs, an efficient and scientific economic management of community pharmacy can be achieved. For developing an inventory control formula to be incorporated into the software, initially 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 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 AVSER matrix analysis model was then incorporated into the novel pharmacy software developed. The objective of the study was to develop a novel inventory management software for Community Pharmacy Practice.
METHODOLOGY

The development of the novel software MedZ was carried out in In-house Drug Bank (IHDB), attached to SAT hospital, Government Medical College, Thiruvananthapuram. The software program ‘MedZ’, was developed by a software development company that specialised in pharmaceutical field, named ‘Expert Infosys Solution’. Specific formula and settings for all the conventional inventory control techniques and a desired overall outlook and working environment for the software was explained by the investigator to a team of software engineers of Expert Infosys Solution, who then coded for the software Medz by using the programming language, Visual Basic 6.0. The study duration was 2 years.

All the conventional inventory control techniques studied, were then used for the prospective development of a novel software named ‘MedZ’ for achieving a better inventory management in In-House Drug Bank (IHDB).

MedZ software, version 1.0 was installed in the computers of IHDB and the program was run officially in the IHDB from 1st April, 2013. Initially all the master coding was done by investigator and the complete product coding of all the items in IHDB (3123) in MedZ software was started by the investigator with effective from 5th April, 2013. In order for logging in to the MedZ software, the user has to type in the username and a unique password. The permission for the access into the MedZ software has been restricted to only the staff of IHDB and the investigator.

Fig. 1: For logging in to the MedZ 1.0 software, the user has to type in the username and a unique password
The MedZ software chiefly consists of four sections namely: General Information, Extra Information, Extra Information 1 and Extra Information 2.

Section 1: General Information

The general section contains all the basic information of the product such as the name of the product in brand and generic name, its strength, unit, dosage form and manufacturer details, inventory management information, schedule to which it belongs, location of the product in the pharmacy, current status (expiry, ROL, product and sales return) of the product in pharmacy, pharmacological information, service charge taken for the product and the storage conditions at which the product has to be maintained for the optimal use for human consumption.

It also contains the creation date of the database, name of the pharmacist who has accessed the software for entering/editing the information in the fields of each item and the date and time at which the last edition has taken place.

![Fig. 2: The general information section of MedZ 1.0](image)

Section 2: Extra Information

The extra information contains the details of the re-order level, emergency re-order level and EOQ (Max Issue Qty) that will be automatically displayed, based on the consumption rate of the item in the pharmacy. Whenever a drug reaches the re-order level and emergency re-order level, specific colour changes are displayed in the respective fields to alert the pharmacist.
Fig. 3: Showing the ROL and E-ROL levels of an item in the Extra Information section

The EOQ, ROL and EROL (emergency ROL) values are set for each item by using the AVSER matrix analysis model. 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.
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. [3],[6],[7],[8],[13],[14],[15]

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. [8],[12],[16],[17],[18],[19],[20],[21]

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;

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

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 categorized 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.

1. 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;

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

2. 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 = \left\{ \frac{\text{Actual consumption of an item for the last 30 days}}{30 \text{ days}} \times 30 \text{ days} \right\}

3. 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 = \left\{ \frac{\text{Actual consumption of an item for the last 45 days}}{45 \text{ days}} \times 30 \text{ days} \right\}

Step 8: Role Fixation for Each Item
The re-order level (ROL) for an item was fixed as half the value of EOQ for that item. The emergency re-order level (E-ROL) was fixed as half the value of ROL for that item, indicating the pharmacist that immediate procurement of that item is necessary to prevent the occurrence of ‘No Stock’ for that item.

Section 3: Extra Information 1
This section of the software contains additional information of the item selected, such as the dose, indications, contraindications and precautions that has to be taken before administering the drug. Besides it also gives an insight about the route of administration of the drug and the excipients present in the drug formulation. The information in this section of the software can be effectively used by a pharmacist for proper patient counseling.
Section 3: Extra Information 2

This section contains the following information about the item selected:

1. Whether the item is breakable or not.
2. Whether the item is allowed to sell/issue/bill from the counter.
3. Whether the item can be procured in the pharmacy through local purchase.
4. The ABC and VED category to which the item belongs.
5. Information about the licence number.
6. Any specification/description about the item.
7. Number of prescriptions required to purchase an item by the patient from the pharmacy.
RESULTS AND DISCUSSION

All the pharmacist reported the usage of MedZ software as user friendly. The excellent feedback was supported by the fact that the average total time required for dispensing a prescription came down considerably by 30%. The software was also recommended by the chief pharmacist to the clinical pharmacists for usage in the patient counselling centre.

Before the installation of the software, it was found that only about 35% of the items were accurately predicted, 25% of the items were predicted in excess and 40% of the items were predicted in lesser quantity than the actual consumption.

After successful installation and running the software for a period of 1 year, it was found that 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.

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 1 year. The results suggest that a better inventory management was achieved with the help of the novel inventory management software MedZ, version 1.0.

CONCLUSION

The novel inventory management software MedZ, version 1.0, when implemented in IHDB, helped in giving a better priority management and economic forecasting of the items in a community pharmacy.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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