Economic analysis of drug expenditure in Government Medical College hospital, Nagpur


ABSTRACT

Objective: To conduct the economic analysis of drug expenditure in the Government Medical College Hospital, Nagpur and to identify the categories of drugs needing stringent management control.

Material and Methods: A matrix based on the coupling of cost (ABC) analysis and vital/essential/desirable (VED) criticality analysis was formulated for prioritization, to narrow down the group of drugs requiring greater managerial monitoring. The difference between actual expenditure and the inflation factor-derived expenditure was found. Expenditure for forthcoming years was forecasted by regression analysis using NCSS software.

Results: The annual drug expenditure was found to be only 11.59% of the total hospital budget. The division of the drug inventory into two priority categories resulted in identifying the priority I drugs (56) for stringent control. The percentage cost of each drug helped in determining the economic order quantity and the schedule of placing the purchase orders for drugs of high value but low criticality. Using the cost inflation index, it was observed that the overtly seen increase in annual drug expenditure was just 2.84% when the inflation factor-based expenditure was derived.

Conclusion: Categorization of drugs by the ABC-VED coupling matrix model helps to narrow down on fewer drugs. The application of the cost inflation index justified the increased annual budget.

KEY WORDS: ABC analysis, VED analysis, ABC-VED matrix, drug inventory management.

Introduction

About one-third of the annual hospital budget is spent on buying material and supplies, including medicines. A study from a 1500-bedded, state-funded, teaching hospital, like ours, has claimed that review and control measures for expensive drugs brought about 20% savings. It has been suggested that with six months of data, the performance and functioning of a current inventory system can be estimated.

Cost analysis (ABC analysis) has been found to be effective in the management of a medical store. In this, 10% items consume about 70% of the budget (Group A). The next 20% inventory items take away 20% of the financial resources (Group B) and the remaining 70% items account for just 10% of the budget (Group C). With the use of ABC, costing was found to be more detailed and precise and overhead costs diminished drastically. Among various inventory control models, Economic Order Quantity (EOQ) has been commonly used, which attempts to balance the carrying cost of inventory with the cost of running out of an item. EOQ in conjunction with ABC has been proposed to be effective and efficient. Most of the savings with the ABC-EOQ were reported with the low-value items (B and C items) which were being purchased too frequently. Automated capital budgeting systems have been claimed to reduce capital spending by identifying utilization trends. Analysis based on the vital, essential and desirable (VED) criticality need of drugs has been commonly used in hospital inventory management.

Drug inventory management stresses on cost containment and improved efficiency. Continuous quality management in medical stores strives not only for the absence of adverse events but also for the extension of ever-increasing value-added services. We undertook this economic analysis of drug expenditure to identify areas for further improvement as well as to find corrective interventions. Our team effort simultaneously served the purpose of data retrieval, compilation, entry and
storage in the process of the computerization of medical stores. The exercise lasted for more than a month, since all the hard data had to be first fed into the computer and then processed to generate the desired information.

Inventory analysis seeks to achieve maximal output with minimal investment input, based on the economic principle of stretching the limited means to meet unlimited ends. We attempted to narrow down the areas, where management supervision and control measures are needed for optimal utilization of the available resources. To achieve this end result, the economic analysis of drug expenditure for the last completed financial year, 2001-2002, of the Government Medical College Hospital, Nagpur was undertaken. This exercise had the following broad objectives:

1. Analysis of the annual drug expenditure (ADE) using ABC and VED analysis.
2. Evolution of the priority system based on the ABC – VED matrix.
3. Identification of the drug categories requiring greater supervisory monitoring.
4. Application of the Cost Inflation Index (CII) to find the influence of inflation on ADE.
5. Comparison of the actual ADE with indexed cost to know the variation.
6. Assessment of the expenditure for the current financial year (FY) using regression analysis.
7. Suggestion of measures for quality improvement.

In this report, we present the ABC analysis in an unconventional way, with explanation for the variation from routine expression.

**Material and Methods**

The data of annual hospital expenditure (AHE) of our 1400-bedded hospital was obtained from the office of the Superintendent of the hospital. The annual consumption of each drug and the expenditure incurred thereon were calculated from the records of the Medical Stores. ABC cost analysis of all the drugs in the inventory was done. For this the ADE of individual drugs was arranged in descending order and then cumulative cost calculated. The cumulative total being 100% of ADE, percentage spent on each drug was found. Then this list was divided into three groups based on cumulative cost, sequentially. Roughly, 10% drugs consuming about 70% of ADE constituted Group A, 20% drugs consuming nearly 20% value made up Group B, and the remaining 70% drugs consuming about 10% of ADE formed Group C. The cutoffs were not exactly at 10/20/70% and differed marginally, which is permissible.

The VED criticality analysis of all the drugs was done to classify the drug inventory into vital (V), essential (E), and desirable (D) categories. The drugs from the hospital formulary, critically needed for the survival of the patients, which must be available in the hospital at all times, were included in the vital category. Drugs with a lower criticality need, which may be available in the hospital, were included in the essential group. The remaining drugs with lowest criticality, the absence of which will not be detrimental to the health of the patients, were included in the desirable group. The VED status of each drug was discussed / debated with justification by the study group till a collective consensus was reached. Thus, all drugs in the medical stores list were included in the V, E or D category.

Then a matrix was formulated by combining the ABC and VED analysis to evolve a management system, which can be used for prioritization. From the resultant combination, we prioritized two categories to direct the supervisory monitoring. Category I was the high priority group, needing greater attention, comprising the AV, AE, AD, BV, and BE groups of drugs. Category II of lower management priority constituted drugs belonging to the BD, CV, CE and CD groups of drugs. Whereas the first alphabet denotes its place in the ABC analysis the second one stands for its place in the VED analysis.

Cost inflation index (CII) as determined by the Government of India was applied as suggested to find the indexed cost of acquisition of annual drugs. The difference between the actual ADE and the derived indexed cost was calculated and the percentage difference found. Linear regression function (NCSS software) was used to assess the expenditure for the forthcoming years.

**Results**

The AHE of our hospital, with annual OPD attendance of 6,69,083 and 73,592 indoor admissions, during the financial year 2001-2002 was Rs. 27,18,63,746 out of which ADE was Rs. 315,00,749 which is about 11.59 % of the AHE. The drug expenditure includes indoor use as well as outdoor dispensing which is usually done for 3 days, except in specialty clinics (diabetes, cardiology, tuberculosis, psychiatry, epilepsy and ANC) where patients are dispensed drugs for 15 days per visit.

Table 1 shows the split of the ADE incurred on ABC and VED categories of drugs.

Figure 1 gives findings of the ABC analysis in which the percentage cost of individual drugs with respect to ADE has been shown. It can be appreciated that the obtained curve is concave as against the conventional plotting of the cumulative cost which is convex and does not show individual drug expenditure as a percentage of the total, which is the advantage with the variant used by us.

Inflationary economy progressively reduces the purchasing power of the currency. Hence mere increase in ADE does not reflect the true expenditure on drugs since the value for money (VFM) is lower as compared to previous year. Due to inflation, the same quantity of drug will cost more in the subsequent year, unless the cost of drug comes down, which is rare. The application of CII overrides this fallacy, justifying increased ADE. Hence the indexed cost of acquisition of the drugs by applying the index factor was calculated for FY 2001-02 using the following expression with the previous year’s ADE as baseline:

The ADE for 2000-01(considered as base) being Rs. 307,79,353; Index factor for 2001-02 being 426 and that for indexed cost of acquisition of ADE for 2001-02 = $ \frac{\text{ADE of 2000-2001 X Index factor for 2001-02}}{\text{Index factor for base year 2000-2001}}$
Table 1

ABC and VED analysis of the drugs during financial year 2001-2002

<table>
<thead>
<tr>
<th>Category of drugs</th>
<th>Actual expenditure</th>
<th>Percent</th>
<th>No. of drugs</th>
<th>Actual expenditure</th>
<th>Percent</th>
<th>No. of drugs</th>
<th>Actual expenditure</th>
<th>Percent</th>
<th>No. of drugs</th>
<th>Actual expenditure</th>
<th>Percent</th>
<th>No. of drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>9837465.0</td>
<td>30.3</td>
<td>12.0</td>
<td>2342933.0</td>
<td>7.2</td>
<td>12.0</td>
<td>912199.0</td>
<td>2.8</td>
<td>29.0</td>
<td>13092979.0</td>
<td>40.4</td>
<td>53.0</td>
</tr>
<tr>
<td>E</td>
<td>8792022.0</td>
<td>27.1</td>
<td>5.0</td>
<td>2657.678</td>
<td>9.1</td>
<td>22.0</td>
<td>1203568.0</td>
<td>3.7</td>
<td>58.0</td>
<td>12948108.0</td>
<td>39.9</td>
<td>85.0</td>
</tr>
<tr>
<td>D</td>
<td>3747634.0</td>
<td>11.6</td>
<td>7.0</td>
<td>1038.436</td>
<td>4.5</td>
<td>12.0</td>
<td>1179701.8</td>
<td>3.6</td>
<td>66.0</td>
<td>6382390.8</td>
<td>19.7</td>
<td>85.0</td>
</tr>
<tr>
<td>Total</td>
<td>22377121.0</td>
<td>69.0</td>
<td>24.0</td>
<td>6039.047</td>
<td>20.8</td>
<td>46.0</td>
<td>3295468.8</td>
<td>10.2</td>
<td>153.0</td>
<td>32423095.8</td>
<td>100.0</td>
<td>223.0</td>
</tr>
</tbody>
</table>

Figures in parenthesis show number of drugs in respective category. Actual expenditure is given in Indian Rupees. Percent is of the total expenditure.

![Figure 1: ABC analysis showing expenditure on individual drugs of A and B category as percentage of total annual drug expenditure](image)

Table 2

Forecasting of annual drug expenditure using regression analysis

| Predicted values and confidence limits section | Predicted annual drug expenditure in Rs.(Yhat) | Standard error of Yhat | Lower 95% confidence limit of Y|X | Upper 95% confidence limit of Y|X |
|------------------------------------------------|-----------------------------------------------|------------------------|--------------------------------|------------------------|--------------------------------|
| Year (X)                                       |                                               |                        |                                |                        |                                |
| 2003                                           | 33087759                                      | 756612.2               | 31343008                       | 34832509.6             |
| 2004                                           | 34482598                                      | 845169.2               | 32533634                       | 36431561.8             |
| 2005                                           | 35877438                                      | 936175.3               | 33718613                       | 38036261.5             |

Discussion

In spite of Internet search on multiple engines, we could not find any matching study, hence our data lacks the opportunity for comparison.

We found that the ADE for the year under study was 11.59% of the AHE in our hospital, which is lower than the reported range of 25 to 45% in other studies.

In material management “cost/use variance” software, can find out whether increase in inventory costs is due to higher vendor costs or due to expanded use of products, and
what percentage each represents. Here too the natural extension is ABC analysis, to identify the groups deserving more or less intense management. The combination of two systems like ABC-EOQ has been tried by some. A multi-unit selective inventory control three-dimensional (MUSIC 3D) approach has been advocated. This approach considers criticality of the usage, consumption value and lead-time in supply, with each factor having two variants—critical and non-critical usage, high and low consumption and long and short lead-time, respectively. This approach may be suitable for material management in general but does not seem good for drug management. In case of drugs, besides the criticality factor, the cost factor also must be taken into consideration, as can be seen from our study, where about 10% of the drugs consumed about 70% of the drug budget. This is the group requiring greater monitoring because it has fewer drugs consuming most of the drug budget. We also noted that not all the drugs in this group were vital or essential. It also had drugs from the desirable category like benzylkonium chloride, ciprofloxacin tablet, framycetin+dexamethasone eyedrops, B-complex tablet, cloxacillin injection, etophylline+theophylline injection and purified chick embryo cell rabies vaccine. Thus it was realized that merely cost or criticality factor could not be the basis of our classification of the drug inventory.

The cost factor is important for us since Governmental hospitals have to manage the year-round performance in allocated budgets, sanctioned in advance, which is a tightrope walk. Most of the drugs used in the hospital have to be either purchased from the companies, which have entered into rate contract with the Maharashtra Government for a specified period of supply or from the Governmental firms producing these drugs. This system selects the lowest bid from the approved bidders with applicable terms. Thus there is hardly any freedom for us in selecting the supplier of the drug. Autonomous hospitals have the advantage of being the decision-makers in determining the source of supply and therefore exercising price/ supply period control.

Having considered various options, we found that cost as well as criticality of the usage of the drug was paramount to us. Hence we derived the matrix by coupling of ABC and VED for drug inventory, which has been implemented successfully in our hospital. We found that after the introduction of this system, there was noticeable improvement in the inventory as well as financial management. With improved monitoring and control there was a reduction in expenditure and an improvement in the availability of the drugs. Improved availability resulted in substantial decrease in emergency local purchases.

For drug inventory if we consider ABC analysis alone, we will effectively control the recommended 23 drugs from Group A, but will be compromising on the availability of drugs of a vital nature from B and C categories (12+29). Similarly if only VED analysis is considered, ideal control can be exercised on the identified vital and/or essential group. But we found that our Group A also contained seven desirable drugs. Hence it was not possible to ignore the desirable group totally. If we consider both A as well as V group of drugs i.e. AV, AE, AD, BV and CV, we would have to concentrate on 64 drugs for vigilance. However, if the suggested ABC-VED coupling matrix model is used for prioritization, with focus on the matrix group of drugs consuming more than 5% of ADE, we can narrow down to AV, AE, AD, BV and BE i.e. 56 drugs in our case, which is more rational for repeated order placement and effective vigilance.

According to Government of Maharashtra directives, we hold three months stocks of all the drugs in medical stores. Thus for us order placement is more or less a quarterly affair; initiated a fortnight in advance to cover the processing time. The exception to such order point of three and half months is in the case of drugs with seasonal variation in drug consumption like antimalarial, antidiarrheal, anti snake venom, to name some. The CV group with 29 drugs consumed merely 2.9% of the annual budget (Table 1). This contains drugs of low cost but high criticality. We suggest that these can be procured once a year and shelved to save management efforts, ensure year-round availability, and avoid stockouts, without locking substantial capital in the stock-carrying cost and this would mean less loss to the government even if these expire. This is possible for the drugs where there is not much change in the pattern of usage and which have shelf life. Annual change in the pattern of usage is considered at the end of the FY when drug formulay is updated with the incorporation of new drugs on the rate contract list. Group AD, which has just 7 drugs but consumes a significant budget of about 11%, should be monitored for EOQ and order placement must always be justifiable and rational for its constituent drugs.

To decide the EOQ and the time of order placement, the economic picture of each drug can be speedily sighted by viewing the percentage cost of each drug with respect to ADE. The cumulative cost expressed in conventional ABC analysis projection does not give information about the actual amount consumed by individual drugs. The concave graph, as used by us, has that advantage; hence we recommend that the ABC analysis be expressed as actual percentage of the total ADE.
One of the secondary objectives of inventory management is financial forecasting for the year ahead. Knowing the financial resources which will be required to manage inventory, surely gives that extra edge to the planning exercise. It tones and braces the management in advance so that the provisions for the future are based on the sound economic data of today. However, it is accepted that such forecasting cannot consider the arrival of new drugs and their inclusion in the inventory, extension of hospital facilities if any, and unknown pressure in the form of epidemics.

Often, the demand for increased allocation of financial resources for purchasing drugs for the forthcoming year is seen with skewed eyes, due to the limitation of economic resources and the pressing demands from other hospital services. The application of CPI incorporates the inflation factor, thereby giving one additional justification for the increased claim for higher allocation of the drug budget. Even though the inflation is not uniform in all commodities, it reflects the general trend and therefore is relied upon as an important index by the economic planners. The application of CPI makes sense as it proves that the increased expenditure on drugs is a result of the all-pervasive inflation. For a developing country like India, such inflation is going to be there till we achieve the status of a developed economy, when the value for money (VFM) will be constant after the rupee gets stabilized. Till then the medical store managers will do well to adapt to and adopt CPI. Even if the expensive innovative drugs may medically offer VFM, budget-sanctioning authorities cannot afford the required Money for Value. Since the inflation factor for future years cannot be known in advance, the prediction of the drug expenditure can be done better by using regression analysis. The justification for hiked budget allocation, based on such hard economic data, reasons out the need scientifically and improves the chances of acceptance of the claim for greater budgetary allocation for drugs.

Such economic analysis will go a long way in the efficient management of the medical stores. It will help in policy framing, prioritization and allocation of resources for vital and essential drug purchase.

Acknowledgments

We thank Ms Hetal Sampat, Chartered Accountant, for her free professional services and financial analysis of our data.

References