

ABC, VED and Lead Time Analysis in the Surgical Store of a Public Sector Tertiary Care Hospital in Delhi

Mansoor Hussain¹, Vijaydeep Siddharth², Sanjay Arya³

¹Master Student, School of Public Health and Social Work, Faculty of Health, Queensland University of Technology, Brisbane, Australia,

²Assistant Professor, ³Professor, Department of Hospital Administration, All India Institute of Medical Sciences, New Delhi, India

Abstract

Background: An efficient inventory control system would help optimize the use of resources and eventually help improve patient care. **Objectives:** The study aimed to find out the surgical consumables using always, better, and control (ABC) and vital, essential, and desirable (VED) technique as well as calculating the lead time of specific category A and vital surgical consumables. **Methods:** This was a descriptive, record-based study conducted from January to March 2016 in the surgical stores of the All India Institute of Medical Sciences, New Delhi. The study comprised all the surgical consumables which were procured during the financial year 2014–2015. Stores ledger containing details of the consumption of the items, supply orders, and procurement files of the items were studied for performing ABC analysis and calculating the lead time. A list of surgical consumables was distributed to the doctors, nursing staff, technical staff, and hospital stores personnel to categorize them into VED categories after explaining them the basis for the classification. **Results:** ABC analysis revealed that 35 items (14%), 52 items (21%), and 171 items (69%) were categorized into A (70% annual consumption value [ACV]), B (20% ACV), and C (10% ACV) category, respectively. In the current study, vital items comprised the majority of the items, i.e., 73% of the total items and essential (E) category of items comprised 26% of all the items. The average internal, external, and total lead time was 17 days (range 3–30 days), 25 days (range 5–38) and 44 days (range 18–98 days), respectively. **Conclusions:** Hospitals stores need to implement inventory management techniques to reduce the number of stock-outs and internal lead time.

Key words: Always, better, and control analysis, inventory control, inventory management, lead time, surgical store, vital, essential, and desirable analysis

INTRODUCTION

With the advent of advanced medical technology and drugs, the expenditure on health-care delivery is increasing disproportionately as compared to the resources available.^[1] The modern system of medicine has transformed into a more complex, effective, sophisticated, and expensive treatment modality in terms of cost of medicines, consumables, and equipment. In any tertiary care hospital, approximately 33% of the annual operating budget is spent on buying materials and supplies, medicines being of the prime category.^[2]

An inventory is a detailed itemized list of assets held by an organization or institution like goods in stock, drugs, and equipment. It is a method of maintaining stock of drugs at a level of lowest purchasing and stocking cost and without interference with supply.^[3] 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.^[4] Inventory control helps to protect against the fluctuation in supply and demand, uncertainty, and minimize waiting time.^[5] An efficient inventory control system would help optimize the use of resources and eventually help improve patient care, by ensuring the availability of essential stocks and preventing stock-outs.^[6] This is of particular importance in a resource-constraint setting like India, where resources are limited, and existing resources must be utilized appropriately.^[7] Multiple published studies have shown that inventory control techniques when made a routine practice in health care could

Address for correspondence: Dr. Vijaydeep Siddharth, Room. No. 11, Department of Hospital Administration, All India Institute of Medical Sciences, Ansari Nagar, New Delhi - 110 029, India.
E-mail: dr.siddharthmamc@gmail.com

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How to cite this article: Hussain M, Siddharth V, Arya S. ABC, VED and lead time analysis in the surgical store of a public sector tertiary care hospital in Delhi. *Indian J Public Health* 2019;63:194-8.

Access this article online

Quick Response Code:



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DOI:
10.4103/ijph.IJPH_282_18

bring about substantial improvement in patient care as well as optimal use of resources.^[2-4] Advantages are that inventory management and surveillance are easy and cost reduction decisions are facilitated.

Some of the relevant inventory control techniques include always, better, and control (ABC) analysis, fast-moving, slow-moving, and nonmoving (FSN) analysis, economic order quantity (EOQ), and vital, essential, and desirable (VED) analysis.^[8,9] FSN analysis is based on the speed of consumption of the items, for EOQ, it is the optimal order quantity, and for VED analysis, it is based on how critical the items are for the functioning of the organization, ABC analyses the costs involved in purchasing the items.^[8,9] These techniques, though variable in their methods, are all aimed at improving the efficiency of the operations. The rationale behind using the ABC-VED techniques in this study is that the items, for which lead times are to be determined had to be prioritized. Of the available range of techniques, a couple of them could be used as a practical measure. ABC-VED uses the cost of items and criticality in patient care, both of which are important for health-care organizations.

The rationale for conducting the study was that there were incidents of stock-outs in the consumable items of surgical stores in Main Hospital, All India Institute of Medical Sciences (AIIMS). Stock-outs of important items could lead to severe hampering of patient care and hospital operations. This can lead to unacceptable negative impact on patient outcomes. Stock-outs can be due to longer lead time.^[10] Therefore, to address this issue of stock-outs, the study was conducted to determine high-priority surgical consumables by using the ABC and VED analysis techniques, to calculate the lead time of specific high cost and vital surgical consumables after performing ABC and VED analysis, and the causes for longer lead times, if any, were investigated.

The reason for using ABC and VED analysis is to prioritize from the thousands of available items in the surgical stores of this hospital. This will be done by first classifying the items according to their cost and criticality. After the classification of these items in this manner, the lead times of those items which form the most expensive and critical items will be determined.

MATERIALS AND METHODS

The study was descriptive in nature and was done for a period of 3 months from January to March 2016. It was a record-based study and secondary data analysis was performed as well. The study comprised all the surgical consumables which were procured during the financial year 2014–2015 in the Surgical stores of the Hospital at AIIMS, New Delhi. Certain items had to be excluded. First, those items whose consumption was very low, i.e., <1000 units/annum were excluded because their impact on overall figures of ABC analysis would be inconsequential overall since most other items were consumed in hundreds of thousand quantities.

Second, those items were excluded too whose prices could not be ascertained as the ABC-VED analysis required prices to for us to determine the annual consumption value (ACV) of the items. Stores ledger containing details of the consumption of the items, supply orders, and procurement files of the items were studied for performing ABC analysis (ACV was calculated by multiplying the unit price of the item with the annual consumption of the item) and calculating lead time (internal and external).

A tool was distributed to the doctors (general surgeon, urologist, surgical gastroenterologist, orthopedic surgeon, obstetrician and gynecologist, general physician, nephrologist, and anesthetist), nursing staff (Sr. nursing officer in charge – surgical stores operation theater and Sr. nursing officer in charge — surgical stores intensive care unit), technical staff (technical officer – OT), and hospital stores personnel (Storekeepers) to categorize the surgical consumables into VED categories after explaining them the criteria for the classification. Majority opinion was used to categorize an item and in case of a tie, i.e., an item being considered vital (V) and essential (E) by equal number of people then such an item was classified as vital. Similar logic was used in case of an item receiving equal votes *vis-à-vis* essential (E) and desirable (D). This was done as the items are used to deliver health care and availability/nonavailability of an item can, at times, be a question of life and death.

An analysis was done to find out the AV category of items. The lead time of these items was then found out by perusal of procurement file of every item of AV category. To calculate the lead time for AV category of items, all the steps involved for procurement of an item were studied by reviewing the procurement records. The time consumed from the initiation of purchase pro forma till the generation of purchase order was considered to be the “internal lead time.” The external lead time was taken from the issue of purchase order till the receipt of that item in hospital store. This was then followed by determining the instances of stock-outs of these items in a financial year by perusal of online records from the Management Information System known as e-Hospital. For determining the reasons for prolonged lead time and causes for stock-outs, qualitative methods were used by interacting with the store personnel. Only those store personnel were spoken to individually who were responsible for the operations of the stores in a managerial capacity. They all had been working for more than 10 years in the stores section. Focus group discussions (FGDs) and similar techniques could not be used based on various practical considerations at the time of the study such as paucity of time, nonavailability of respondents, and interpersonal dynamics of the persons involved in the operations of stores. MS-Excel 2013 was used to collect the consumption data of the items.

Some of the limitations were that due to various practical reasons FGD could not be done. Furthermore, the results are

not inclusive of 100% of the items as some items had to be excluded from the study due to the reasons mentioned above.

RESULTS

A total of 247 surgical consumable items were included in the study. The total expenditure on procurement of these surgical consumables was calculated to be INR.27,87,94,651/-. The following tables summarize the results of ABC and VED analysis [Tables 1 and 2].

A composite matrix was prepared using the results of ABC and VED analysis. The items which fell under “A” category as well “Vital” category were included in the AV category. A total of 29 items comprise of AV category and the ACV for these items was calculated to be 1,68,175,990/- [Table 3].

Lead time was calculated as internal lead time, external lead time, and the total lead time in days [Table 4]. The various steps involved in the procurement of surgical consumables and time entailed in each step are enumerated in Figure 1.

The average internal lead time was 17 days (range 3–30 days). The average external lead time was 25 days (range 5–38 days). However, the median external lead time was 14 days. The maximum allowable external lead time as per the terms of

contract is usually 45 days for Indian make items and 60 days for imported items. The average total lead time (internal and external) was 44 days (range 18–98 days).

During informal discussion with store personnel, fund booking was emerged to be a major bottleneck by the store personnel. The other causes for increased internal lead time, according to these discussions, were due to nonavailability of staff to process the documents as well as nonavailability of officials causing delay in the signing of the required documents. The causes for increased external lead time were nonavailability of material with vendor, lack of storage space leading to placing of order of small quantities which in many cases are below the optimal level for the vendor leading to reluctance of the vendor to supply such short quantities. The mean number of stock-outs in AV category items were determined to be 5, i.e., in a financial year, there were 5 stock-outs on average per AV category item.

DISCUSSION

Extensive review of literature revealed such studies related to medical stores only. The study has classified all the surgical consumables into the A, B, and C categories based on their ACV which corresponded to 70%, 20%, and 10% of their ACV, respectively.

Table 1: Always, better, and control analysis of surgical consumable items

Category of items	Number of items (n), total sample size	Percentage of total items	Percentage of ACV as compared to total ACV (%)	ACV (Indian Rupee)
Category A	35	14	70	194,103,510
Category B	52	21	20	56,631,357
Category C	160	65	10	28,059,784

ACV: Annual consumption value, ABC: Always, better, and control

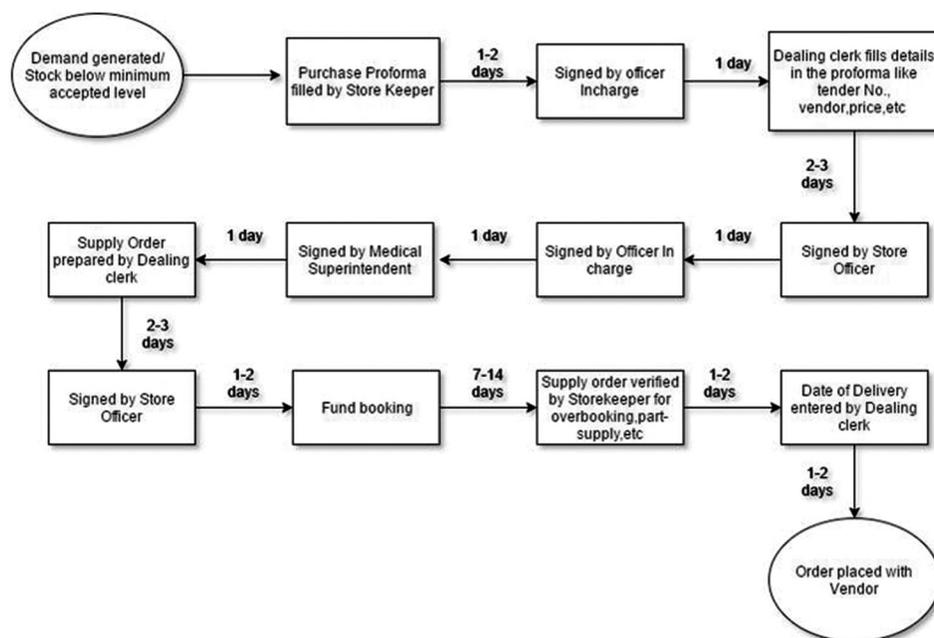


Figure 1: Steps comprising internal lead time.

Table 2: Vital essential and desirable analysis of surgical consumable items

Category of items	Number of items (n), total sample size	Percentage of total items
Vital	178	73
Essential	64	26
Desirable	5	2

Table 3: List of AV category items and their annual consumption value

AV category of items	ACV (Indian rupee)
Gloves surgical (powder free)	23,782,421
Silicon tape	19,006,389
Gloves surgical prepowder	16,561,808
Gown disposable	15,181,352
Gown reinforced	11,549,286
Catheter triple lumen	8,413,297
Optimal malaria kit	5,743,067
Gown viral barrier (wrap band)	5,714,100
Gloves examination	5,189,608
Safety venous cannula	4,762,182
Gown viral barrier	4,203,360
Absorbent cotton 1 P	3,835,415
Dispo syringe with needle 10 ml	3,764,899
Bedsheet (disp)	3,655,323
Micropore without dispenser 3×9	3,418,455
Gauz than	3,340,053
Safety IV cannula 24 G (paed)	3,295,880
Safety venous cannula 20 No	3,280,349
Test tube plain L.F.T 5 ml	2,963,142
Lab sponges 30×30	2,688,336
Gelatin sponge	2,462,487
Apron plastic	2,028,945
Neoflon 24 G	1,985,907
IV sets	1,973,670
Close circuit (adult)	1,972,916
Test tube EDTA HB	1,969,443
Dispo syringe without needle 50 ml	1,888,942
Dispo syringe with needle 5 ml (plain) (brand aids)	1,839,668
IV cannula 20 G	1,705,288

ACV: Annual consumption value, HB: Hemoglobin, EDTA: Ethylenediaminetetraacetic acid, IV: Intravenous, L.F.T: Liver function tests

Table 4: Summary of lead time analysis in procurement of surgical consumables

	Internal lead time (ideal=15 days)	External lead time (ideal=45 days)	Total lead time (ideal=60 days)
Minimum	3	5	18
Maximum	30	38	98
Average	17	25	44
Median	16	14	39

In the current study, vital items comprised the majority (73%) of the total items and essential category of items comprised 26% of all the items, while desirable category comprised only 2% of items. A study^[3] reported that 31.9% of the drugs were classified as vital, 53.3% essential, and 14.85 as desirable. In contrast, another study^[11] reported only 7.3% as vital, 49.3% as essential, and 43.45 as desirable. Similarly,^[4] 12% of the drugs were vital, 59% were essential, and the rest were desirable in another study. The reason for the glaringly significant contrast findings could be because the current study was conducted in the surgical store, whereas above-mentioned studies were conducted in the drug store. Drugs usually have multiple actions and even a single drug may help in treatment of multiple conditions, whereas for the performance of a single procedure, especially surgery, multiple items might be required.

Lead time is defined as the time that elapses between the placement of an order and the receipt of the order into inventory.^[11] Cost and quality are still crucial to world-class operations, but today, the focus is squarely on speed. Nearly, all manufacturers today are under pressure from customers to cut lead times. The result is that companies have been putting in significant effort to reduce their lead times.^[12]

A study^[13] reported an internal lead time of 10–20 days and an external lead time of 1–5 days. The current study reported an internal lead time of 3–30 days and an external lead time of 5–38 days. In the context of AIIMS, an external lead time of even 38 days is acceptable which is below the 45 days of allowable time given to the vendors under rate contracts. The reason for internal lead time being low (example 3 days) for some items was because the requirement for that item, at that time, was urgent, and the store personnel had to expedite the entire process through extra efforts which is not feasible for every item.

To decrease the internal lead time, the process for from generation of demand for an item to the ordering of the item from the vendor can be reengineered by eliminating the duplications like signing of officer in charge and store office twice. To decrease the external lead time, the maximum allowable external lead time can be further decreased at the time of tendering itself. Further studies can be conducted to determine the time gap between the time when stock falls to reorder levels to the time when process for purchase of the item starts.

The reorder levels need to be calculated afresh by factoring in the consumption patterns as well as the maximum allowable total lead time. As the total lead time which can be considered to be acceptable emerged to be 60 days approximately, i.e., 2 months, the store needs to order items when the stock available is adequate for 2 months or more. The instances of stock-outs point out that it is not the case presently as orders, being placed, with the current reorder levels/minimum stock levels have resulted in stock-outs. However, the hindrance to such an approach could be limited availability of space in the

stores to stock the required inventory for 2 months. In such instances, part supply orders can be placed with the vendor. The problem which arises from such an approach is that vendors refuse to supply such smaller quantities of items. To obviate this trouble, the maximum allowable external lead time can be reduced to 30 days or 15 days according to the consumption pattern and space available during the tender process itself. The time gap between the time when stock falls to reorder levels to the time when process for purchase of the item starts was not calculated in this study, but there is a possibility that an unacceptable gap could be in existence. This needs to be determined from further studies.

In summary, prioritization of inventory can be done using ABC-VED analysis. This ensures that items are both high cost (in terms of overall cost based on volume and unit cost) and highly critical. As stock-outs indicate that there could be some issues in any of steps in the procurement process, each of the steps must be thoroughly evaluated. Every organization follows its unique procedure of procurement. The current study found that there are few unnecessary steps in the procurement procedure of the organization where it was conducted. Furthermore, the 45 days of the time given to the vendor for sending the items can be investigated. Other organizations may conduct such analyses in their settings and may be able to find the reasons for stock-outs in their respective organizations.

CONCLUSIONS

Hospitals stores need to implement inventory management techniques to reduce the number of stock-outs and internal lead time. The methodology of combining ABC-VED techniques to focus on the most important part of the inventory can advise hospital managers the means of prioritizing their inventory. Such prioritization may enable them to concentrate their efforts on the “vital few.” Hospitals need to look at their own processes and determine steps are redundant and can be eliminated. This can decrease the internal lead time. On the other hand, tenders and contracts should be designed in such a manner that the external lead time is minimized to the most tolerable duration. This will ensure that stock-outs are avoided in hospitals.

Recommendations

It is recommended that the store procurement processes be modified appropriately to decrease the lead time to the possible extent and prevent stock-outs. The use of electronic softwares should be considered which can help store personnel

in monitoring stocks real-time and addressing issues in the process.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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