# Inventory Control Techniques for Materials Management of Dental Stores in Clinical Dental Set-up's: A Review Materials Management of Dental Stores in Clinical Dental Settings

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## Abstract

To run successfully and profitably any kind or type of health-care set-up, it is mandatory that the basic principle of practice management are referred, analyzed, applied, evaluated and adapted. In any health-care organization/set-up, medical or dental, a major portion of the financial budget is spent on the acquisition, storage, and distribution of supplies and equipment's i.e. materials management. Materials management aims at providing an effective and efficient management of supplies and equipment's, so that there is availability of the right materials, at the right time, to the right place, at the least cost. The inventory control techniques (ICT's) are among the commonly applied principles/techniques for materials management. These techniques ensure that there is adequate stock of the required essential items; to maintain their uninterrupted supply. These techniques have been applied and are being followed successfully for the management of pharmacy/medical stores in hospitals. This article reviews these ICT's and emphasizes their equivocal importance, practical application and proposed implications in dental practice management; for an efficient management of dental stores/inventory in any type of dental-associated health-care set-up.

Keywords — ABC Analysis, Dental Stores, Inventory Control Techniques, Materials Management, VED Analysis

## 1. INTRODUCTION

In any health-care set-up, public or private, a large amount of money and the proposed financial budget is spent on the acquisition, storage, retrievability, distribution, use and disposal of supplies and equipment, including medicines [Devnani et al .,2010; Kant et al., 1996-1997]. This is done to carry out the primary responsibilities of an organization in an efficient, effective and economical manner. Materials Management includes culmination of the above mentioned tasks, entailing the two basic functions related to supplies and equipment: purchasing and storage/ supply [Francis and Souza, 2004]. Materials management seeks to ensure availability of the right materials, at the right time, to the right place, at the least cost [Francis and Souza, 2004; Salamle, 2001] so that adequate stocks of the required essential items are maintained; for the uninterrupted supply of the items [Francis and Souza, 2004; Beier; Duclos, 1993]. It has been demonstrated that maintenance of proper

inventory levels, using inventory control techniques' (ICT's) can avoid the issues like, low inventory and high inventory turnover, excessive procurement cost, high carrying/maintaining costs, greater risks of obsolescence and higher frequency of stock-outs [Francis and Souza, 2004; Srinivasan, 2002; Ambrose, 1980]. Controls in materials management is a two-edged sword as both, a stricter or a more lenient control, can be undesirable and costly [Srinivasan, 2002]. For example, a system that saves hundreds of rupees, but costs thousands to install and operate is obviously neither desirable nor profitable. The ICT's have been applied and followed successfully in the management of pharmacy/medical stores in hospitals [Kant et al., 1996-1997; VanDerlinde, 1983] and are equivocally important, practical and applicable for the management of dental (materials and equipment's) stores/inventory. The management of dental materials items/stores, in a dental health set-up i.e. dental school/college, multispecialty dental center, private clinic (specialist/general practitioner), is managed via three basic approaches:

• *Centralized Approach*

In this approach the overall procurement, distribution and storage of dental materials is managed by a single appointed central committee and/or body. This is commonly observed in dental schools/colleges (public/private) and postgraduate teaching institutes.

• *Individual Ownership Approach*

The individual owner and/or the employed assistant of a particular health set-up manage the procurement, distribution and storage of dental materials. This approach is quite effective for the management of small-size inventory as found in private clinics (specialist/general practitioner)

• *Third Party approach*

The management of dental stores/inventory is outsourced to a third party; usually the local distributors and dealers of dental material items that periodically update and supply the items as per the pre-decided requirements. Adopted commonly by multispecialty (private) dental clinics.

Though all the three approaches are feasible in any kind of set-up, whether based on ownership or size, the examples just highlight the commonly observed trends. However for an efficient and cost-effective management of items, via any mentioned approach, requires the implacable knowledge and practical application of inventory control techniques. A number of inventory control techniques (ICT), like ABC analysis, VED (Vital-Essential-Desirable) Analysis, ABC-VED Matrix, FSN (Fast-Slow-Non-moving) Analysis, XYZ Analysis, HML (High-Medium-Low Cost) Analysis, SDE (Scarce-Difficult-Easy to procure) Analysis, have been designed, recommended and applied for the management of medical pharmacies and pharmacy stores in hospitals and associated health set-ups [Devnani et al .,2010; Francis, 2004; Salamle, 2000; Srinivasan, 2002]. These ICT's are equally applicable to consumable, durable and other items (like, stationery). Among these the ABC, VED and the ABC-VED Matrix analysis are the most commonly used and universally applied. ABC analysis classifies the items or activities based only on their monetary value and the rate of consumption. ABC analysis is an important tool used worldwide, to identify the items that need greater attention for control [Devnani et al.,2010; Ballentine,1976; Murphy and Yemen, 1986]. However, it misses an important parameter of material selection and procurement i.e. the criticality of an item [Das, 2001]. VED analysis is based on the criticality and shortage cost of the item. A combination of ABC and VED analysis (ABC-VED matrix) categorize the items in three categories (Category I, Category II, Category III),

which is considered to be more gainful and meaningful for controlling the dental material supplies (materials and equipment's) [Devnani et al .,2010].

This article describes and explains the application of some of the ICT's that may be highly useful for the management of dental materials and equipment's in dental schools/colleges, post-graduate teaching institutes, tertiary care hospitals, research and referral dental health set-ups including private dental clinics; for a stringent, economical and a highly efficient management of dental inventory/stores.

## 2. Inventory Control Techniques

The right approach to inventory control utilizing the modern inventory control processes and the new and more refined techniques can provide for a dynamic optimization of inventories to maximize customer service with decreased inventory and at lower costs. The inventory stocks are usually maintained using two systems [Francis and de Souza, 2004]:

*1. Periodic/Cyclic System*

The stocks are reviewed at periodic/fixed intervals. Thus the ordering interval is fixed, but the ordered quantity is varied. The orders are placed depending on the stock in hand and the rate of consumption.

*2. Two-bin System*

It is a perpetual inventory system where each item stock is held in two bins. A larger bin, containing sufficient stock for the time interval between arrival of an ordered stock and the placement of the next order, and the other bin containing stocks large enough to satisfy probable demands during the period of replenishment. When the first bin is empty, an order for replenishment is placed, and the stock in the second bin is utilized until the ordered material is received. This system is able to work well for low consumption value items.

As resources are limited, it is essential that the existing resources be appropriately utilized taking into account the overall market competitiveness and the attainment of the highest level of customer service delivery ICT's have been developed so that they can favorably impact the profits of an organization. Thus it becomes imperative for health managers to use scientific methods for maximizing their returns from investments made at a minimal cost [Devnani et al., 2010; Ramanathan, 2006]. These ICT's are not only effective in drug management in a hospital pharmacy, but are equally imperative for the materials management of dental stores/inventory. If rational utilization and improved management practices can be applied to the dental inventory (materials & equipment's), a higher number of patients can be served without thinking about the common management issues like, cost containment and quality control.

## 3. Types

There are a variety of ICT's available to gain an efficient and optimum control of materials management [Devnani et al., 2010; Francis, 2004; Salamle, 2000; Srinivasan, 2002].

### 3.1 ABC Analysis

It involves analyzing the inventory items on the basis of annual consumption cost of an item i.e. annual usage times cost, rather than the unit price of the item. The analysis states that approximately 5-10% of the total inventory/stock items ("A" category items) account for 70% of the annual consumption costs, another 10-20 percent of the items ("B" category items) account for 20-30% of the costs, and the remaining 70% of items ("C" category items) account for about 5-10 percent of the costs [Hotaling,1990]. Thus if the prime focus is

given to the "A" category items, 70% of the inventory cost can be managed with just 10% of the effort and with attention to another 10-20 percent of "B" 90% control is achievable. It also aids in easy identification and differentiation of items, so as to minimize purchase costs and control consumption in a more effective manner. The main application is in controlling the total value of the inventory and enables executive managers to expend their efforts and energy where the results will be the best.

**3.2 VED Analysis**
Items may also be classified as vital, essential or desirable based on their criticality, stock-out costs and the possible inconvenience caused due to their absence. It helps in controlling the inventory/stocks of spare items.
**3.3 ABC-VED Analysis**
    Table I shows the combination of ABC and VED analysis (ABC-VED matrix) that can be gainfully employed to evolve a meaningful control over the material supplies. Category I includes all vital and expensive items (AV, BV, CV, AE, AD). Category II includes the remaining items of the E and B groups (BE, CE, BD). Category III includes the desirable and cheaper group of items (CD)[Vaz et al., 2008].

**Table I.  A-B-C & V-E-D Matrix Analysis**

|   | V | e | d | |
|---|---|---|---|---|
| a | **AV** Constant stocks | **AE** Moderate stocks | **AD** Nil stocks | **Category I** ~17% Items |
| b | **BV** Moderate stocks | **BE** Moderate stocks | **BD** Very low stocks | **Category II** ~45% Items |
| c | **CV** High stocks | **CE** Moderate stocks | **CD** Low stocks | **Category III** ~38% Items |

**3.4 XYZ Analysis**
X-Y-Z classification is based on value of items and/or value of inventory available on a particular date in the store. This classification is required to be done at least once in a year. X items are those items whose stock value is high, Y items have moderate stock value and Z items are those whose stock values are low. It is mainly helpful for the reviewing of the inventories and identifying the items that are extensively stocked to control obsolescence. It also indicates how the stock values are distributed amongst the materials in the stores.
**3.5 FSN Analysis**
Items are classified as fast moving, slow moving and non-moving (F-S-N) based on their frequency of issue or consumption pattern or their movement from the store. Fast moving items are those which are used at a rapid rate, slow moving items are used in lesser frequency, while non-moving items remain in stock for several months without being issued. If there is a rapid change in technology, this classification should be updated more often. It is especially useful to control obsolescence, spillage, date-expiry and deterioration of items. Cut-off points for fast-, slow- and non-moving items usually depend on the characteristics of

the items, their value and utility for operations. A thumb rule for F-S-N classification is as follows:

- *Fast-moving:* Items which have moved at least once in a year.
- *Slow-moving:* Items which have moved at least once in a period of one to two years.
- *Non-moving:* Items which have not moved even once during a two-year duration.

## 3.6 Combination of XYZ & FSN Analysis

The combination of X-Y-Z and F-S-N can be applied for the timely prevention of obsolescence and to control the piling up of obsolete items. For example items which are in the XF category requires a tight and strict inventory control, as these are fast utilized items having high stock value; whereas the items of ZN category should be disposed of at the earliest, if required even at low prices, to avoid over-stocking of non-utilized items. This will also reduce the overall cost of the inventory.

## 3.7 HML Analysis

This method is similar in the A-B-C classification and stands for High, Medium and Low cost items i.e., based on unit cost of an item. It is useful to develop the purchasing strategy appropriate to control the purchases. The procedure is to list out the items in descending order of unit value and fix the cut-off points as per the management policy or the individual user.

## 3.8 SBE Analysis

Depending on procurement difficulty and market availability, the materials are classified as Scarce to procure, Difficult to procure, Easy to procure (S-D-E). It is again helpful for the development of purchasing strategies

## 4. ABC Analysis

ABC analysis is one of the most effective tools in materials management. Also known as Selective Management Principle or Always Better Control and is based on "Pareto's Law", which states that "*80 per cent of the total value will be accounted by 20 per cent of the items*" [Salamle, 2000]. This was based on the observation of *Vilfredo Pareto* that a very large percentage of the total national income and wealth was concentrated in a small percentage of the population. Similarly the ABC analysis classifies items according to their relative importance so as to "separate the vital few from the trivial many" because, for any group of things that contribute to a common effect, a relatively few number of contributors account for a majority of the effects.

The analysis categorizes items on the basis of annual consumption cost/value of an item i.e. annual usage times cost, and roughly classifies the inventory items into three categories as:

*"A" category items*

These are the first 10-15% of the items that account approximately for 70% of cumulative annual consumption cost (value)

*"B" category items*

This include the next 20-25% items of the total inventory stocks that account for a further 20% of the cumulative annual cost (value)

*"C" category items*

The remaining 65-70% of the items just amount for 10% of the total value.

Thus according to the analysis, controlling the small number of items amounting to 10 per cent of the total number of items will result in the control of 70 per cent of the monetary value of the inventory. As the identification of items is based on their annual consumption (monetary) value rather than the unit cost-of an item, it avoids wasting one's time in trying to

manage simultaneously all the items of regular use and priority is given to only those items that can maximize the profit and minimize the inventory cost. Thus, it helps in economizing the input efforts to achieve greater output results.

**4.1 Mechanics**

The step-wise mechanics/methodology of classifying items into A, B and C categories is as follows:

*Step 1:* Calculate the annual consumption cost, in monetary value, for each item in the inventory by multiplying the unit cost of the item by the number of units issued or estimated to be consumed during the year.

*Step 2:* Prepare a list of all the items, in descending sequence, based on their annual consumption cost i.e., the costliest item forming the top of the list and the least expensive item of the end of the list (last item).

*Step 3:* Starting at the top of the list, compute the cumulative cost of each item. The cumulative cost of the first item is the annual consumption cost itself. The cumulative cost of the second item is the cumulative cost of the first item plus the annual consumption cost of the second item, i.e. the sum of the annual consumption cost of the first two items. Similarly, the cumulative cost of the third item is the summation of the cumulative cost of the second item and the annual consumption cost of the third item and so on. Cumulative cost percentage can also be calculated by dividing the cumulative cost of an item by the total expenditure incurred for the procurement of the items (summation of annual consumption cost of all the items), multiply by 100.

*Step 4:* Compute and print for each item the cumulative percentage for the item count (cumulative item %) and the cumulative annual cost (or the cumulative cost %). Cumulative cots of the last item will also be the total expenditure incurred.

*Step 5:* Classify/Categorize the items as A, B, C items as follows:

• 5 to 10 per cent of the top number of items usually account for about 70 per cent of the total value of the items consumed. These are called "A" items.

• 15 to 20 per cent of the next number of items account for 20 per cent of the total consumption value. These items are called "B" items.

• The remaining 70 to 80 per cent of items roughly account for 10 per cent of the total consumption value. These items are called "C" items.

Usually, based on the principle of A-B-C analysis, the normal consumption pattern for most of the items follows a similar pattern of categorization as discussed above.

While working on an A-B-C analysis, the following points should be kept in mind:

1. While classifying the items the annual (total) consumption value is considered and not the unit price of the item.

2. The period of consumption need not necessarily be one year; it can be six months, four months, or even a month [Srinivasan, 2002].

3. There is no hard and fast rule that the materials must be classified in only three groups as A, B and C items only. Depending on the nature of the industry, the controlling authority and the standard of control that can be effectively applied, items can be categorized into 4 or more groups. It is also possible that a single group of items can be further subdivided like, A1, A2, A3... groups [Srinivasan, 2002].

4. Similarly based on the ownership, the procurement policy, the annual budget and the convenience of the management and rationality, the line of division or the cut-off points between the three categories of items (A, B, C items) can be altered for a more efficient control and profitable result. It is not always necessary to apply a fixed division of items at

70%, 20% & 10% mark-up lines. Though various authors have recommended a wide variance in the cut-off points, the fundamental concept is to focus on the management of the few critical inventory items and not on the many trivial items [Berger, 1989; Heizer and Rende, 1999].

## 4.2 Example

Table II lists the commonly used 21-items in dental clinics, mentioning their Unit Cost and the Estimated Annual Consumption. The A-B-C analysis is done based on the steps discussed above.

**Table II. List, Unit cost and Estimated Annual Consumption of 21-items used in dental clinics**

| Sl. No. | Item Name | Unit Cost (RM) | Estimated Annual Consumption Cost (RM) |
|---|---|---|---|
| 1. | ALGINATE | 27 | 9950 |
| 2. | BI-FLOURIDE | 160 | 800 |
| 3. | BONDING ADHESIVE | 301 | 1510 |
| 4. | BROACHES (1pkt) | 10 | 1040 |
| 5. | BUR (Diamond points) | 5 | 340 |
| 6. | CALCICURE | 105 | 3030 |
| 7. | CERAMIC REPAIR KIT | 450 | 900 |
| 8. | CHLORHEXIDINE | 12 | 1510 |
| 9. | FLOWABLE COMPOSITE | 105 | 210 |
| 10. | COMPOSITE - LIGHT CURE | 65 | 10300 |
| 11. | DENTAL FLOSS | 5 | 83 |
| 12. | DYCAL | 52 | 1190 |
| 13. | ENHANCE COMPOSITE POLISHING KIT | 260 | 2070 |
| 14. | ETCHANT | 11 | 160 |
| 15. | FIBRE POST (1 post) | 109 | 650 |
| 16. | FIBRE SPLINT | 315 | 630 |
| 17. | GLASS IONOMER - TYPE II | 90 | 12550 |
| 18. | GLASS IONOMER - LIGHT CURE | 345 | 4680 |
| 19. | GUTTA PERCHA POINT (1pkt) | 12 | 4100 |
| 20. | HEDSTROM FILES (1pkt) | 14 | 720 |
| 21. | KERR-FILES (1pkt) | 15 | 7540 |

*<u>Note:</u> The items list and the unit cost mentioned are just for explanation purpose and represent the approximate values*

Table III shows the cumulative annual cost (cumulative cost %), the item % (cumulative) and the categorization of the 21-items into "A", "B", and "C" category items.

**Table III. A-B-C Analysis**

| Sl. No. | Item Name | Estimated Annual Consumption Cost (₹) | Cumulative Cost (₹) | Cumulative Cost (%) | Cumulative Item (%) | A-B-C Analysis |
|---|---|---|---|---|---|---|
| 1. | Glass Ionomer - type II | 12550 | 12550 | 19.46 | 4.76 | A |

| No. | Item | | | | | |
|---|---|---|---|---|---|---|
| 2. | Composite-Light cure | 10300 | 22850 | 35.44 | 9.52 | A |
| 3. | Alginate | 9950 | 32800 | 51.40 | 14.28 | A |
| 4. | Kerr Files (1pkt) | 7540 | 40340 | 63.09 | 19.04 | A |
| 5. | Glass Ionomer - light cure | 4680 | 45020 | 70.35 | 23.81 | A |
| 6. | Gutta-percha points | 4100 | 49120 | 76.78 | 28.57 | B |
| 7. | Calcicure | 3030 | 52150 | 81.48 | 33.33 | B |
| 8. | Enhance composite polishing kit | 2070 | 54220 | 84.70 | 38.09 | B |
| 9. | Bonding adhesive | 1510 | 55730 | 87.12 | 42.85 | B |
| 10. | Chlorhexidine | 1510 | 57240 | 89.46 | 47.61 | B |
| 11. | Dycal | 1190 | 58430 | 91.31 | 52.38 | B |
| 12. | Broaches (1pkt) | 1040 | 59470 | 92.93 | 57.14 | C |
| 13. | Ceramic repair kit | 900 | 60370 | 94.34 | 61.90 | C |
| 14. | Bi-flouride | 800 | 61170 | 95.64 | 66.66 | C |
| 15. | Hedstrom files (1pkt) | 720 | 61890 | 96.76 | 71.40 | C |
| 16. | Fibre post | 650 | 62540 | 97.77 | 76.19 | C |
| 17. | Fibre splint | 630 | 63170 | 98.75 | 80.95 | C |
| 18. | Bur (Diamond points) | 340 | 63510 | 99.28 | 85.71 | C |
| 19. | Flowable composite | 210 | 63720 | 99.61 | 90.47 | C |
| 20. | Etchant | 160 | 63880 | 99.86 | 95.23 | C |
| 21. | Dental floss | 83 | **63963** | 100 | 100 | C |

In Figure I, analysis shows that approximately 23% of the items, categorized as "A" items, constitute about 70% of the cumulative cost of the inventory and the 8% of the "C" items sums up to 43% of the inventory cost.

**Fig I. Graphical representation of A-B-C Analysis for the 21-items listed**
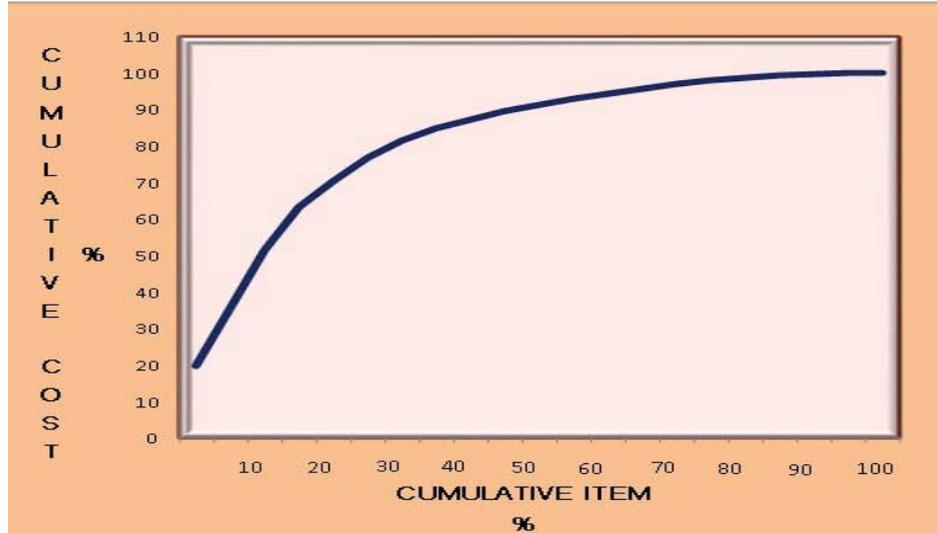


### 4.3 Advantage

a. It allows for an effective selective control on the items (Table IV) as giving equal attention to all the items will be very expensive, leading to the dilution of the effect of control and misalign priorities. Thus, the purchasing policy and procedure are so formulated, that the "A" items are ordered more frequently and in small quantities, while "C" items are ordered just once or twice a year for the entire year.

**Table 4. Selective control for A-B-C items**

| Control Procedure | Item Category | | |
|---|---|---|---|
| | "A" items *High consumption value* | "B" items *Moderate consumption value* | "C" items *Low consumption value* |
| *Type Of Control* | Very strict control | Moderate control | Low control |
| *Quantity Of Safety Stock* | Low to nil | Low | High |
| *Ordering Frequency* | Frequent | Monthly/Quarterly | Half yearly/Annual |
| *Consumption Control* | Daily/Weekly | Monthly | Quarterly |
| *Controlling Authority* | Senior level management | Middle level management | User department level |
| *Number Of Sources Of Supply* | More sources Centralized purchase | 2-4 sources Combined purchase | 1-2 sources Decentralized purchase |

b. This analysis helps to rationalize the number of orders and reduce the average inventory during a specific period.

c. As the 'vital few' are separated from the 'trivial many', control is relaxed because less emphasis is put on the items ("C") that represent the bulk of the inventory.

### 4.4 Limitation

a. The limitation of ABC analysis is that it is based only on monetary value and the rate of consumption and criticality of an item is not considered. In a practical situation an item of

low consumption value (like, metal matrix band) may be vital and/or critical for a clinical procedure (like, proximal surface restoration). However their importance may be simply overlooked due to their absence in category "A".

b. To be fully effective it should be carried out with standardization and codification.

c. Required to be reviewed periodically so that changes in prices and consumption are taken into account.

## 5. VED Analysis

It stands for Vital-Essential-Desirable. V-E-D classification is based to a large extent on the management of spare parts. Spare parts are classified as vital, essential and desirable based on their usefulness to the operation of equipment [Francis and de Souza, 2004; Srinivasan, 2002].

*"V" class spares:* Absence of these spares can cause havoc and bring the machines to a grinding halt and thus have to be stocked adequately to ensure uninterrupted functioning

*"E" class spares:* In the absence of these machines may run, but perhaps at a substandard level of performance. Some risk can be taken in the case of these spares.

*"D" class spares:* Non-availability of these spares does not adversely affect the machinery performance.

It is important that this classification should be done with the assistance and concurrence of those who are responsible for maintenance of the equipment.

In the health sector, VED analysis is based on critical values and shortage cost of the item. Based on their criticality, the items could be classified into three categories as:

- *Vital items*

There could be serious functional dislocation of patient care services if the vital items are not available even for a short period.

- *Essential items*

If only the items are not available beyond a few days or a week, the functioning may be adversely affected.

- *Desirable items*

The shortage of these items would not adversely affect patient care even if the shortage is prolonged.

The criticality of an item is identified on the basis of recommendations by a panel of dentists/doctors with different specializations. They are interviewed and the collected information is processed. Items which simultaneously appear in all categories are classified as *vital*. The items which appear in both vital and essential categories are classified as *vital*. Those which appear in both essential and desirable categories are classified as *essential,* and the items which appear in both vital and desirable, are also classified as *vital*. This is done as a particular item may be considered as *vital* for a particular dental specialist and the same item could be considered as *essential* by other dental specialists.

The degree of importance in procurement and control procedures is reduced from vital to desirable items. Thus "V" items require a large safety stock to meet the emergencies, whereas "D" items can do with little or no reserve as these items have substitutes and/or are easily available in the market.

### 5.1 Example

In Table V, V-E-D analysis of the same 21-items is done based on the consensus of three dental specialists using the defined criteria for "V"-, "E"- and "D" items. 10 items are

classified as "Vital" items, 6 are considered as the "Essential" items and the remaining 5 are the "Desirable" items.

**Table V. V-E-D Analysis**

| Sl. No. | Item Name | V-E-D Analysis |
|---|---|---|
| 1. | Bonding adhesive | V |
| 2. | Broaches | V |
| 3. | Bur (Diamond points) | V |
| 4. | Chlorhexidine | V |
| 5. | Composite - light cure | V |
| 6. | Dycal | V |
| 7. | Etchant | V |
| 8. | Glass Ionomer - type II | V |
| 9. | Gutta percha point | V |
| 10. | Kerr-files | V |
| 11. | Alginate | E |
| 12. | Calcicure | E |
| 13. | Flowable composite | E |
| 14. | Dental floss | E |
| 15. | Enhance composite polishing kit | E |
| 16. | Fibre post | E |
| 17. | Bi-flouride | D |
| 18. | Ceramic repair kit | D |
| 19. | Fibre splint | D |
| 20. | Glass ionomer - light cure | D |
| 21. | Hedstrom files | D |

## 6. ABC-VED Analysis

The ABC and VED analyses are integrated into a matrix leading to the formulation of 3 group/classes of items as follows [Devnani, 2010; Francis and de Souza, 2004; Srinivasan, 2002]:

• Category I: AV, AE, AD, BV, CV.

It includes all vital and expensive items that required to be monitored closely and with a strict control for appropriate stock availability.

• Category II: BE, BD, CE.

It basically includes items of essential category that are less expensive and thus require less intensive monitoring,

• Category III: CD

These include cheaper and desirable items whose stocks should be kept low without much monitoring.

This categorization allows for a better monitoring and control of inventory stocks (Table I).

### 6.1 Example

The deduced A-B-C and the V-E-D analysis are combined to formulate the ABC-VED matrix analysis (Table VI.) and classify the items into Category I (57.14%), Category II (23.80%), category III (19.04%).

**Table VI. Combined A-B-C & V-E-D Analysis for the 21 items**

| | V | e | d | |
|---|---|---|---|---|
| a | • Composite - light cure<br>• Glass Ionomer - type II<br>• Kerr-files | • Alginate | • Glass ionomer - light cure | **Category I**<br>12 Items<br>(57.14%) |
| b | • Bonding adhesive<br>• Chlorhexidine<br>• Dycal<br>• Gutta percha point | • Calcicure<br>• Enhance composite polishing kit | | **Category II**<br>5 Items<br>(23.80%) |
| c | • Broaches<br>• Bur (diamond points)<br>• Etchant | • Flowable composite<br>• Dental floss<br>• Fibre post | • Bi-flouride<br>• Ceramic repair kit<br>• Fibre splint<br>• Hedstrom files | **Category III**<br>4 Items<br>(19.04%) |

## 7. Other ICT's

### 7.1 First In First Out Method (FIFO)

A method of inventory accounting based on first-come, first-served (FCFS) behavior, i.e. what comes in first is utilized/handled first, what comes in next waits until the first is finished. Stocks are arranged by date received to avoid the expiry of items purchased first and maintain the supply chain throughout. It is an important concept when dealing with consumable/perishable items.

### 7.2 Last In First Out Method (LIFO)

It is a method of inventory management that emphasis on utilizing the most recently purchased items first. It is helpful for the management of items having a very short shelf life.

### 7.3 Highest In First Out Method (HIFO)

In this method, the inventory items with the highest cost of purchase are the first to be used or taken out of stock.

### 8. Implications

In actual practice, higher inventory costs and the maintenance of excessive inventories which are more than necessary, results in lower quality of customer service. Though materials management and the ICT's sound easy theoretically, in practice it is a complex management process to control and requires a precise performance of inventory management tasks. This can be achieved by an appropriate selection and application of ICT's in dental stores/inventory. Inventory control problems are usually the result of using poor processes, practices and antiquated support systems. As mentioned earlier, controls in materials management is a two-edged sword; an improper or wrong application may lead to defaulted and non-beneficial implications. Thus, the following points should be given due consideration:

I. The application of a particular ICT should be based on the uniqueness of the situation for which it being used for. The results obtained of the VED analysis for the same set of items can vary depending on the specialty of a dentist. It is quite possible that the same item, like suture material, may be considered as a vital item by an oral surgeon but a

desirable item by a prosthodontist. Thus it is important that their application should be specific and situation based.

II. The cut-off points for a particular analysis (A-B-C, F-S-N) can be customized and set as per required; to maximize the output benefits from an analysis. It is not necessary to apply a fixed cut-off for every analysis and/or category of items. As shown in the example, the cut-off point between A-B and B-C items are set at 23%- and 52% item % respectively, as opposed to the commonly used cut-off points of 10%- and 30% item%.

III. Similarly the ABC-VED matrix analysis showed that Category I, Category II and Category III consist of 57.14%, 23.80%, 19.04% of the items respectively, which is different from what is suggested in Table 1.

Thus the cut-off points can be decided based on the management policies, allocated budget, procurement procedures and on the experienced and judicious discretion of a dentist and/or a health manager.

IV. It is always better to apply more than one analysis for the materials management and the categorization of items. The application of the composite results obtained by the combination of analysis is usually more accurate, specific, evidence-based and profitable For example, one way to effectively reduce the inventory cost is to first identify the "X" items and then segregating the "non-moving N" items of the "desirable D" category for expedition, exchange or disposal. Also the results of ABC-VED matrix are more significant than the individual analysis.

V. A more careful, scrutinized and appropriate analysis of items is required when the procurement involves ordering of product/item/material that are available in more than one form. For example, gutta-percha cones and ISO standardized endodontic-files are available in a multitude of sizes ranging from No.10 to No.140. However it is not necessary that the annual consumption (ABC) of each individual size is the same and/or they have the same criticality (VED). It is possible that among the various sizes procured, No. 20 file may be vital and a No. 30 gutta-percha cone may have the maximum annual consumption cost, whereas the No. 110 file is considered as desirable having the least annual consumption. Therefore careful selection and categorization can help to avoid issues like obsolescence, overstocking, and stock-outs

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