

# **Materials Management in Voluntary Hospitals**

## **A. INTRODUCTION**

Professionalisation of hospital management has been receiving much attention in recent times. This is because, more and more a more, it is becoming obvious that sound managerial practices are necessary for effective delivery of hospital care. Hospitals of today are being viewed as industries: they have objectives that require to be achieved, quality work to be turned out in an organized manner, and industry norms to be maintained in terms of work flow, profitability of capital, labour relations and payment of wages. However, unlike other industries, hospitals, especially in the voluntary sector, have a commitment to provide care and function within the above framework of an industry irrespective of the consumer's ability to pay. There is therefore a continuous pressure on hospital managers (Directors, Superintendents, Administrators) to make ends meet and ensure financial viability. Since the resources voluntary hospitals can generate are fairly limited, emphasis naturally has to be placed on control of expenditures so that financial commitments can be met. The professional manager therefore has to constantly adopt varied management tools and techniques so as to effect substantial savings in costs.

Of the total casts of a hospital, materials costs approximate 40-45% of the annual operating budget. Set on the task of cost containment, a hospital manager's attention is thus drawn first to reduction of material costs. Efforts in this area usually bring quick results as all that is required is application of certain well defined principles and concepts which invariably are well accepted in the organisation, unlike reduction of personnel costs, which generally result in much turmoil because of its sensitive ness to the individuals who are likely to be affected.

## **B. OBJECTIVES OF MATERIALS MANAGEMENT**

The purpose of materials management is to bring about control over the acquisition, storage, retrievability, distribution, use and disposal of supplies and equipment in order to carry out the primary responsibilities of the organization in an efficient, effective and economical manner. Materials management seeks to ensure availability of the right materials, at the right time, to the right place, at the least cost.

## **C. ORGANIZATION OF A MATERIALS MANAGEMENT DEPARTMENT**

Materials management entails two basic functions: Purchase and stores. These two functions may be carried out independently (but in coordination) through a separate stores department and a purchase department, or the two functions may be integrated into a single stores-purchase department.

Separate departments for purchase and store functions ensure minimization of collusion, formalization of data necessary for making effective purchase and specialization (hence greater efficiency) of each of the two functions which intrinsically are independent in nature.

An integrated stores-purchase department however has the following advantages:

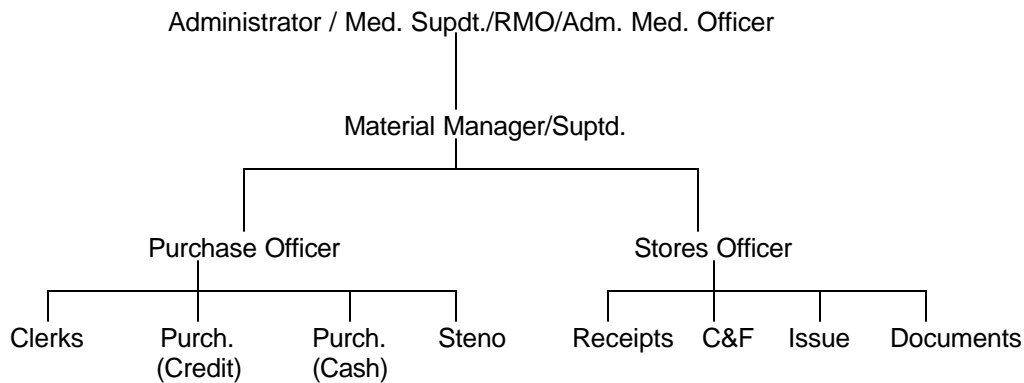
- A single authority can be held responsible for the availability and control of materials. Thus there is less chance for shifting blame from one department to another (eg: because of

delays, procurement of the right materials, etc.) and there will be better coordination between the purchase and the stores functions. The latter will lead to timely purchase (resulting in reduction of inventory level), better knowledge about materials required in terms of their quality, annual quantity, variation in demand, application, standardization (resulting in better purchase, lower safety stock and reorder levels), and unutilized materials (dead stock) can be disposed off more easily. Besides, a single authority can handle queries from the accounts department or users more effectively.

- Less paper work as common records can be maintained (eg: stock control cards can also serve for purchase history record, purchase and receipt registers can be combined, etc.) and there will be a reduction in internal correspondence between the stores and purchase staff.
- The speed of transactions can be expedited as common information can be shared easily and informally between purchase and stores personnel, and there will be minimal movement of goods from purchase area to storage area (both the above resulting in decrease in procurement lead time). Further, with an integrated department, issue of goods after receipt can be rapid as also quicker return of rejected goods is facilitated.

The organization chart of a materials management department in a large voluntary hospital could be represented schematically as hereunder:

Administrator/Med.supdt./RMO/Adm.Med.Ofrr.



#### **D. PROCESS OF MATERIALS MANAGEMENT**

The process of materials management involves planning, review and control of:

- |                                    |                       |
|------------------------------------|-----------------------|
| - budgeting and materials planning | - issue, distribution |
| - demand forecasting               | - usage               |
| - procurement                      | - maintenance         |
| - receipt, inspection, payment     | - disposal            |
| - inventory control                | - pilferage           |

## **1. Budgeting and Materials Planning:**

Based on data of past levels of performance and on anticipated activity/plans, capital equipment, consumables and supplies to be procured during the year ahead can be projected department wise. Such a listing of materials in terms of units required and their cost estimates would constitute the materials budget which should be prepared annually. Once this is done, it is possible at periodic intervals to carry out a budgetary appraisal and determine the variance between actuals and the budget. Variances may result from difference in unit cost of materials and/or deviations in their usage. The former is the responsibility of the materials manager and the latter is the user's. Intensive monitoring and cost-reduction reports become necessary where actual costs grossly exceed budgeted costs. Both for budgetary planning and appraisal, actuals and budgets must be compared, wherever possible, with standard material costs as predetermined based on assumption of a standard quantity of the material at a standard unit cost.

Important in budgetary control and reduction of material costs is the concept of standardization. This involves grouping together similar items depending on their specifications/use/application so as to choose one (or a few) of these more universally acceptable for the purpose. It does not imply just cutting down on the number of sizes (which is generally termed as 'simplification'), but adoption of standards leading to specification of quality, reduction in sizes and varieties, facilitation of interchangeability of components, etc. Standardization ensures greater relative use of the standard item in relation to similar items available in the market, non-duplication of inventories lower purchase costs and more efficient use of materials. In a hospital, standardization is possible through preference for ISI approved items, limitation in the brands of a drug to be stocked (based on generic name, potency, company reputation, user acceptability and cost), choice of equipment and furniture built with standard and easily available components, etc. The responsibility for standardization rests not only with the stores purchase department but also with the user departments and management.

Related to standardization is the technique of value-analysis, which examines all the facets of the function and cost of a product/item in use in order to determine whether the cost can be reduced or altogether eliminated, while retaining all the features of performance and /or quality of the product/item, it entails studying each item/component in use with a view to introducing lower-priced and more durable substitutes of equivalent quality which fulfill the same objective. Value analysis attempted at addressing the following issues:

- What is the item/component?
- What is it intended to do?
- What does it cost?
- What else can do the same job?
- What does the suggested alternative cost?

(Introduction of non-disposable, autoclavable plastic syringes in lieu of easily breakable, more expensive glass syringes in based on the value analysis Principle.)

Value engineering, though often used interchangeably with value analysis, specifically refers to what the user/engineering department is doing to develop a cheaper alternative.

So that standard items only are indented and also to ensure that items purchased are fully in conformity with the requisitioner's need, it is necessary for the institution to make available to the user departments manuals detailing the name, code number, specification, unit and pack size of

each item in regular use. For the Pharmacy this will be in nature of an approved formulary for the hospital, while for the stores a manual of indents may be prepared.

## **2. Demand Forecasting:**

Materials in a hospital may be requisitioned.

- for an urgent/immediate use or in anticipation of a need
- on a one-time basis or repeatedly and continuously to replenish the stock
- as a single unit or as a bulk requirement

The greater the crisis situation and immediate need for the item and the smaller the quantity required, the greater will be the procurement price and the incidental costs of purchase. It is therefore necessary to anticipate the need for the item ensuring that bulk purchases can be effected with maximum price discounts. Anticipation of future need is done through demand forecasting, which involves application of statistical techniques to predict future requirements based on past consumption patterns.

Several techniques of forecasting exist: trend line, semi-average method, moving average method, least-square method, weighting through exponential smoothing, application of trend/seasonality indices, etc.

The moving average method is the one used most widely. It involves summing past actual demand/consumption values for a defined period of time, dividing this sum by the number of values used so as to obtain a forecast of the next period, dropping the first actual value and adding the next in the series and dividing the new sum by number of values used so as to obtain a forecast for the second next period, and so on. Although such a moving average obtained strictly corresponds to the middle of the time span, over which it is calculated, it serves as a forecast of the immediate next period in the time series with the proviso that there is a time-lag equivalent to half the time-span less one period. Thus, when a moving average is taken to forecast demand which is showing an upward trend, it will lag behind actual demand, which is a disadvantage, and will give consistently low estimates, and vice versa.

A moving average which uses a large time span will effectively neutralize the sudden temporary surges in demand and it will also decrease the standard deviation of the error. However, the greater the time span, the greater will be the time-lag resulting in a greater error of forecasts. A very short time span will be however sensitive only to recent demand values which may be biased because of short-term random fluctuations,. The choice of a time-span is therefore done on the basis of experience and review as to how closely the forecasts correspond with the actual demand values.

Besides the time-lag bias, another major disadvantage of the moving average method is that it involves storage and manipulation of a long historical record of data. Both these problems can be overcome by weighting through exponential smoothing, which involves heavier weighting of current usage to overcome the time-lag and storage/recall of just the old average/ forecast. Thus:

New forecast = old average + (current demand – old average)

The alpha factor to be used depends on the weight age to be given to recent consumption values and the time span of choice in a moving average.

$$\text{Alpha factor} = \frac{2}{\text{No. of periods in the moving average} + 1}$$

An alpha factor of 0.1 is roughly equivalent to a 19 period moving average and an alpha factor of 0.2 approximates a 9 period moving average. It is important to choose the value for the alpha factor that approximates the length of a moving average that makes sense. Thus, where trends in current usage are more important for forecasts as compared to old consumption patterns, a factor of 0.3 may be more appropriate.

### **3. Procurement:**

An effective purchasing system aims at procurement of items of acceptable quality, in appropriate quantities, at the minimum price, and with in the available time.

Purchases may be made by the individual departments of the hospital (decentralized purchasing) or by a single purchase department. Centralized purchasing has advantages in that quantity discounts are possible because of standardization and bulk orders, purchasing costs are decreased because of consolidation and non-duplication of orders, lower inventory costs result because centralization makes possible a lower safety stock, and there is better management control as all aspects of purchase can be screened by the administration. However, because of the specialized nature of certain items, it is usual for hospitals to provide for departmental purchasing by the Pharmacy and Dietary departments in addition to centralized purchasing by the main Stores-Purchase department. A group of hospitals having common interest (eg. Run by the same management, located in the same region, etc.) may also get together and constitute an agency to effect bulk purchases on their behalf. Such a form of purchasing, termed group purchasing, has advantages similar to centralized purchasing though on a much larger scale. Such purchases however have to be planned well in advance and hospitals forming part of the group must restrict the nature of their indents to standards approved by the group.

Purchasing entails the following steps: drawing up specifications; inviting quotations; making a comparison of offers based on basic price, freight and insurance charges, taxes and levies, quantity and payment discounts, payment terms, delivery period, guarantee, vendor reputation; short-listing offers and negotiating for better terms; issuing purchase orders taking care to list out all requirements of the institution; seeking an order acknowledgement and following-up for early supply.

Beyond one-time orders (fixed quantity contract, where a firm is called upon to supply a fixed quantity of an item at an agreed price within a specified date), hospitals may also enter into purchase contracts determined prices. In committed volume/ running contracts, the vendor firm is assured of a fixed volume of purchases during the year and hence offers a fixed rate irrespective of the delivery schedules agreed upon. In rate contracts, the vendor firms offer a fixed rate if assured that the approved items will be purchased from it.

Purchase orders, to be legally valid and complete, should include the following:

- order reference number, date;
- purchaser's name, address (especially when purchaser is not the consignee);
- supplier's name, address;
- quotation reference, date (where repeat order placed, the previous order reference to be given)
- description of goods (specifications, brand name, catalogue number, as per sample);

- quantity (units, pack size, weight, each/pair, quantity per bag/drum);
- price (unit price, quantity discount, payment discount, handling charge, sales tax, excise duty, surcharge);
- freight and insurance charges (FOB / FOR/ CIF, freight paid / to pay, insurance by supplier / buyer);
- total value (helps comparison with other suppliers offer, ensures review of order size and availability of cash );
- packing (free / extra, special packing to ;be used, case markings);
- shipping instructions (dispatch mode by air / rail / road/ sun / post, name of port / railway station / post office);
- delivery date (definite date to be specified, vague terms like exstock / immediate / urgent not to be used, for bulk orders, specify quantity required at various intervals);
- order acknowledgement (ensures receipt of order, binds supplier legally);
- terms and conditions (specify if printed on reverse);
- inspection (at supplier's site / at hospital);
- invoicing instruction (number of copies of invoice, purchase order copy to be attached, to whom to be submitted);
- mode of payment (through bank documents, draft, cheque, cash);
- part supply (permissible / prohibited);
- warranty (right to reject, undertaking for replacement / repairs within certain time limit);
- signature of authorized purchaser, designation

In effecting purchases, it is necessary to bear in mind the following:

- Forecast requirements and plan purchases in order to avoid stock outs and high costs associated with emergency purchases, and to obtain quantity discounts.
- Draw up product specifications to ensure clarity and to avoid rejections because of wrong supplies.
- List vendors for each item. Contact manufactures and avoids trading firms wherever possible. Prefer local to out-station suppliers as waters of dispute can be discussed and settled without delay. Each vendor should also be assessed for his reputation, capabilities, etc.
- Refuse advance payments, negotiation of documents through bank, V.P.P, etc. as with such forms of payment hospitals practically lose their right to reject incorrect supplies.
- Insist on delivery at the hospital premises.

Purchase of drugs and hospital supplies from abroad is done in the following manner:

- Obtain the product literature and proforma invoice listing the POB and CIF price, mode of shipment, payment terms, etc.
- Import licence generally not required as Government recognised hospitals are covered by Open General License, appendix 6, item 5 and can import, without a specific licence, goods of unlimited value. Other hospitals are permitted to import drugs of value upto Rs. 25, 000 at any one time (item 19) and instruments, sutures, etc. of value up to Rs. 2 lakhs in a financial year (item 20).
- Import of drugs requires a test licence from Drug Controller of India. Drugs can be imported only through major ports in India: Delhi, Bombay, Calcutta and Madras.
- Seek duty exemption if items not listed for duty free import. Duty exemption can be obtained with a Not Manufactured in India Certificate (from DGTD) and Customs Duty Exemption Certificate from (DGHS).
- Send bank draft for minor purchases. Establish letter of Credit for major imports.

- Clear items through Customs on intimation of receipt to avoid demurrage

The following customs notifications are applicable for duty free clearance of hospital supplies:

- CN 208/81: Life saving drugs and equipment.
- Chapter 99: Duty free medicines
- CN 279/83: Equipment for hospitals rendering free care to 40% of out-patients and 10% of in-patients
- CN 70/81: Equipment for approved research institutions.
- CN 85/82: Gifts from abroad to Charitable organisations for free distribution to poor
- CN 105/86: Aids for physically handicapped, blind
- CN 204/76: Reimport of equipment after repairs.

If customs duty is payable, then rates detailed in Chapters 30, 90, 94 and 98 of Customs Tariff apply.

A hospital may wish to acquire certain expensive equipment but may not have the funds immediately available for the purpose. Such equipment however can still be acquired through deferred payment schemes or through leasing. Deferred payment involves a commitment on the part of the hospital to pay a portion of the costs immediately, the balance amount being payable to finance such a venture, the interest and other overhead costs so incurred are included in the price of the equipment. (Leasing enables a hospital to make use of an equipment without actually owning it, though rent is payable by the lessee to the lessor as per the contractual terms. There are several types of leases: short term ( of a short duration), long-term, straight-term ( covering the estimated life-period of the equipment, where rents over time equal the original purchase price of equipment plus normal carrying charges), and lease-purchase ( with option to purchase equipment treating all prior rent installments as down-payments).

#### **4. Receipt, Inspection, Acceptance, Payment:**

Items ordered from suppliers should be received at a common receiving area. Receiving clerks should attempt to detect mistakes of the vendor, the supplies and/or the purchasing department. Once supplies pass these stages, the costs of remedying the mistakes are much higher.

The procedure for receipt, inspection and acceptance of supplies includes the following:

- While taking delivery from the road transporter/railway / customs, check containers for deficiency and damage. If packing damaged, insist on 'open' delivery, checking quantity of package, individual items, weights, etc. against packing slip / challan. Any damage / loss should be registered immediately through a 'claims statement'.
- On receipt at the hospital, check supplies for discrepancies in quantity, quality, product specifications, etc. Record shortages, incorrect or damaged material, out-dated supply and take action accordingly.
- All supplies should be inspected and certified by the Purchase / Stores department, though in the case of technical items, the requisitioner/ user should also certify. In the case of bulk orders, random sampling may suffice. Samples of drugs should also be analysed and certified by the Drug Analytical Laboratory.
- The necessary documentation should be carried out: day book of receipts, goods inward note, stock ledger, purchase register, bin card.
- Indentors of special purchase requisitions should be notified regarding arrival of materials.

On accepting the goods and certifying correctness, the bills may be sent to the accounts department for payment. Before releasing payment, the accounts department should ensure that the bill bears proof of receipt of goods, certification of acceptance, and completion of purchase documentation. Early payment enables the hospital to avail of payment discount and establishes the credibility of the hospital for better terms from vendors.

### **5. Storage:**

The object of storage is to ensure that, till the time of issue for usage, the supplies are adequately preserved to prevent loss or damage.

The stores department should be conveniently located to facilitate easy receipt of materials from suppliers and easy dispatch of supplies to the wards and departments. It should be of sufficient size to accommodate all the supplies and must provide for separate areas for receipt of materials, their inspection, storage and issue as well as office space for stores personnel. Special storage facilities include a fire-proof room for storage of inflammable materials, and air-conditioned room for storage of rubber goods and plastics, refrigerators for certain drugs and biological preparations, safe cabinets for narcotics and expensive drugs / materials, slotted-angle racks with adequate floor clearance for most other items. The materials should be adequately protected from fire, pests, water seepage, etc.

While there is no uniform rule as to the layout of the stores, the following principles may be kept in mind:

- The stores should be divided into homogenous sections and separate areas earmarked for different groups of items – eg. Stationery, furniture, surgical consumables, minor hospital equipment, maintenance spares, etc.
- Items in a group should be categorized based on their generic name / application and similar items must be stored contiguously.
- The available floor and vertical space must be used as judiciously as possible. Vertical space utilization can be maximized by having racks up to 10-12 feet height or by mezzanine floors. The layout of racks should conform to the shape of the floor space, the kind of material to be stored, the type of bin in which the items are to be kept, convenience for taking materials in and out of the bins, work flow involved in retrieval of items, material handling equipment in use, etc. Provision should be made for suitable aisles, tables, serving counter, etc. aisles between racks are recommended for large stores.
- Heavy items should be kept as low and as near to the aisle / door as possible for easy retrieval. Bulky but light items may be placed on top shelves. Items frequently required must be as near the aisle / counter as possible for easy access.

Each bin and each portion of a rack that is allotted for a particular item should be given a location number which serves as a means of finding out precisely where a particular material in stock can be found in the stores. A modern method of allotting location numbers involves numbering each side of a bin / block of bins/ rack as 1, 2, 3, etc., vertical lettering of each shelf in the bin / rack as A, B, C, etc. and horizontal numbering of pigeon holes in a shelf as 1, 2, 3, etc. Thus a location number of 1A1 and 6C4 will relate to the 4<sup>th</sup> pigeon hole in the 3<sup>rd</sup> shelf of the 2<sup>nd</sup> side of rack 3. The location number should be noted on the pigeon hole / bin / rack and also on the bin card of the respective item.

Based on the nature of the material and on the basis of its generic name / application, each item purchased and stocked should be given a code-identifying number. Such a number should be



unique for each item and must be marked out in the bin card of the item and at its permanent location. One classification and sodification system feasible ffor a general stores-Purchase department of a hospital may be illustrated through the following example:

1.00.00.00 Major items

1.01.00.00 Furniture

1.01.01.00 Steel Rack

1.01.01.01 Rack of size 3'x3'x1'

1.01.01.02 Rack of size 6'x3'x1 ½'

1.02.00.00 Medical Equipment

1.02.01.00 Blood gas analyzer

1.02.01.01 Model BGA-3

1.02.01.02 Model ABT-30

1.02.02.00 Boyles apparatus

1.02.02.01 IOL painted model

1.02.02.02 IOL SS model

1.03.00.00 Non-medical equipment

1.03.01.00 Voltage stabilizer

1.03.01.01 0.5 KVA non-servo controlled

1.03.01.02 1 KVA non-servo controlled

1.03.01.03 1 KVA servo controlled

2.00.00.00 Minor items

2.01.00.00 Ward supplies

2.01.01.00 Sputum cup

2.01.01.01 Enamel type

2.01.01.02 SS type

2.02.00.00 Medical instruments

2.02.01.00 Artery forceps

2.02.01.01 Ultrafine baby mosquito forceps, 3 ½'

2.02.01.02 Ultra fine halstead mosquito forceps, 4 ¾'

2.03.00.00 Non-medical appliances

2.03.01.00 Dietary

2.03.01.01 spoons of S.S

2.03.01.04 forks of S.S

3.00.00.00 Consumables

3.01.00.00 Stationery

3.01.01.01 Patient record proforma

3.01.01.01 Doctors order sheet

3.01.01.02 Nurses medication record

3.02.00.00 Medical and surgical supplies

3.02.01.00 Catgut

3.02.01.01 Plain surgical gut, 38 cml 6-0(1)s, 8mm  
needle, 3/8 circle reverse cutting.

3.02.01.02 Chromic surgical gut, 76cm.L, 5-0(1.5),  
12mm needle, 3/8 reverse cutting

3.02.01.77 Synthetic absorbable (vicryl), 30 cmL, 7-0.  
(0.5)S, 6mm eyeless needle, 3/8 circle  
spatulated.

3.03.00.00 Miscellaneous supplies

3.03.01.00 Maintenance

3.03.01.01 Stainless steel wire 0.5mm diameter

3.03.01.45 Wood planks 1" thick, 3'x 4'

For every item in stock there should be a corresponding bin card. The name 'bin card' arose from the now obsolete practice of keeping such a card in the bin of the respective item or on a metal holder attached to the bin. Such a card details the name of the item, its description, code-identifying number, location number, minimum and maximum stock levels, as also transactions relating to receipts (invoice ref. and date, supplier's name, quantity purchased, unit rate, total value), issues (indent ref. and date, requisitioning department, quantity supplied, value) and stock balance (quantity and value) of the respective item as and when such transactions occur. Bin cards are arranged according to the classification and code number system adopted for materials and inserted in kardex cabinets for easy reference and updating.

To minimize obsolescence and to ensure that previously purchased items are issued and consumed before recently acquired items of the same type, the latter must be placed behind / below the former so as to facilitate the first-in-first-out rule during issues.

Beyond the main Stores, each ward / department will have a sub-store. It is necessary to keep down the quantity of stock in each sub-store to the bare minimum to minimize inventory costs, obsolescence and pilferage. Thus maximum stock levels need to be fixed at department / ward

levels taking into consideration the periodicity of issues and the rate of consumption. Periodic physical checks by the material sanctioning authority may also be necessary to prevent hoarding of stock in sub-stores.

## **6. Inventory control:**

Inventory control principles seek to minimize investment on materials so that sufficient working capital is made available for other more important activities of the organization. The primary purpose of inventory control is therefore to decrease material costs by minimizing stock-out costs while at the same time preventing over-stocking of materials which results in locking up of capital, possible pilferage and obsolescence. In controlling inventory costs, the most crucial question to be asked is, “ Is it more economical to maintain an item in inventory than to purchase it on demand?”

The following concepts are relevant in control of inventory costs:

a) **Cyclic System:**

This is a periodic inventory system where the physical stock position is reviewed at periodic / fixed intervals and orders are placed depending on the stock on hand and rate of consumption. In this system, the ordering interval is fixed but the quantity ordered varies each time. The time interval (cycle / review time) to be chosen depends on the lead time for procurement of the item, criticality / stock-out costs, degree of control required (more for A class items), etc. Where bulk orders are placed, with instructions to effect supply at predetermined fixed intervals, this time interval between deliveries is treated as the cycle time.

b) **Two-Bin System:**

This is a perpetual inventory system where, conceptually the stock of each item is held in two bins, one larger bin containing sufficient stock to meet the demands during the interval between arrival of an order quantity and placing of a next order, 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. There is thus a maximum stock level and a predetermined point for placing an order (which depend on average consumption rate, lead time for procurement, criticality, costs of storage, purchase costs, etc.). In contrast to the cyclic system, in the two-bin system the order quantity is fixed but the time for placing orders is not at definite intervals. The most desirable quantity to reorder is the E.O.Q. Since the quantity to reorder is fixed in advance, initiation of replenishment action can be delegated to lower-level staff and there is no need to take physical counts of inventory periodically. When to initiate the replenishment order is immediately known once the storekeeper dips his hand into the second bin. The system is useful for C category items of low consumption value where close monitoring and control is not required.

c) **Lead Time:**

This is the time required to obtain the supply once the need is determined, i.e. it is the average number of days between placing an indent and receiving the material. Lead time is composed of (i) administrative lead time or buyer's time (time required for raising purchase requisitions, obtaining quotations, preparing comparative schedules, raising purchase order, order to reach supplier, transit and clearing time when goods are sent from out-station, checking and inspection of materials after arrival, sending of materials to appropriate stores, recording receipt before issue), and (ii) delivery lead time or supplier's time (time for getting

materials ready if they are not in stock, shipping / transporting them from supplier's godown to buyer's receiving section).

Lead time is specific for each item and for each supplier and is dependent upon factors such as availability in the market, form of availability, location of the manufacturer / supplier, vendor response time, etc. To start with, lead time may be fixed by a rough guess, but in due course this must be reviewed by actual experience, such information being recorded on stock control / purchase cards.

Lead time is important in determining the average inventory need, the longer the lead time the higher the inventory level. Attempts must therefore be made to cut down the lead time, especially for high consumption value (A category items).

d) Minimum Stock or Safety / Buffer Stock:

This is the amount of stock that should be kept in reserve to avoid a stock-out in case consumption increases unexpectedly or in case the lead time turns out to be longer than normal. It is also the level at which fresh supply should normally arrive and expediting action should commence if delivery is not effected. (Expediting here does not refer to routine follow up, but the special effort necessary to obtain supplies before the stock reaches zero.)

Where data are maintained of the maximum demand at various points in time with the frequency of such occurrences, it is possible to specify the quantum of risk to be protected against depending on the criticality of the item, and then:

$$\text{Safety stock (SS)} = (D_{\max} - D_{\text{avj}}) \times L$$

Where  $D_{\max}$  is maximum demand on any day at the specified risk level.

$D_{\text{avj}}$  is average daily demand

L is lead time in days

Where information on maximum demand is not available, safety stock may be estimated as follows:

$$S.S = K \sqrt{(D_{\text{avj}} \times L)} \quad \text{where } K = 1, 2, 3, \text{ or } 4 \text{ depending on criticality of item}$$

The above listed factors should additionally be considered while fixing minimum stock:

- Investment: In order to minimize investment on inventory, high value (A category) items should have very low /nil minimum stock and stock-outs can be avoided by close follow-up of orders, weekly / monthly review of stock position, close rapport with suppliers, etc. Medium value items can have slightly higher minimum stock (say 1 month consumption) and C category items of low value can have a good minimum stock. ( eg. 2 months consumption).
- Lead Time: If lead time short, minimum stock may be small; but if lead time is long, minimum stock may be higher as time required to expedite supplies often varies according to lead time.
- Cycle Time: Where bulk orders are placed and delivery is staggered, safety stock may be fixed on the basis of cycle time (interval between 2 deliveries) and not lead time.
- Form of availability: If item not a standard product and is to be specially manufactured, it is advisable to keep a higher minimum stock.
- Country of supply: Higher buffer stock is necessary to provide for import procedures when items require to be imported.

- Stock-out cost: Higher minimum stock required for critical items whose stock-out costs are high, particularly if it is difficult to obtain such items.
- Shelf life: If shelf-life is short (eg. RIA kits, reagents, vegetable provisions), minimum stock to be altered accordingly.
- Rank of obsolescence: In case of items which are liable to modification from time to time, the minimum stock should be kept low or even eliminated to avoid loss.

Fixing of minimum stock is an intricate work. The best way to proceed is to decide first whether the item falls in the A, B or C category and thereafter apply the formulae given above and consider the other factors enumerated.

e) Reorder Point / Level: ROP is the predetermined stock level at which an item is to be reordered for replenishing the stock. At this level a fresh recouplement purchase requisition is raised so that the supplies will survive when the stock reaches the minimum level. This reorder level is equivalent to minimum stock plus requirements during lead time and is calculated as follows:

$$\text{ROP} = (D_{\text{avj}} \times L) + S.S$$

In case information on average daily demand is not available, reorder level can be fixed in an 'arbitrary' manner by ensuring maintenance of 'n' months supply. Such an arbitrary fixation in fact takes account of ht stock on hand, the average consumption rate and time involved in procurement.

f) Maximum Stock: This is the predetermined limit beyond which the stock of an item should not be allowed to go in the normal course. It is equivalent to the minimum stock level plus the quantity of supplies received at any point of time.

Maximum level is used for controlling investment. Therefore, it is generally applied to materials whose value is comparatively high and where bulk orders are placed with staggered deliveries. Once the maximum stock level is fixed, it is possible, at periodic intervals ( as in the cyclic inventory system) to review the actual stock on hand and reschedule the deliveries whenever the maximum level is about to be exceeded.

g) Economic Order Quantity: EOQ is that quantity at which the cost of ordering the annual requirements of an item and the inventory carrying cost are equal, i.e. when the total of the two costs is the lowest. It seeks to strike a balance between purchase costs and the costs of holding inventory.

Ordering cost is the cost which can be associated with buying an item and includes those incidental costs involved in obtaining quotations, clerical work of making comparative quotations; placing personnel required for receipt, inspection and payment (salary being the main items to be considered), etc. The total of ordering costs in a certain period divided by the number of orders of that item gives the average cost per order ( $C_p$ ). In India, the ordering costs per item vary from Rs. 5 to Rs.15. If R is the annual requirement of an item, Q the quantity of each order, and  $C_p$  the cost of each order, then the total annual ordering cost for that item is  $(R/Q) C_p$ . The unit costs per order can be brought down by increasing the quantity Q thereby spreading the cost of an order over more units of the item purchased each time. Hence, for a given annual requirement, the greater the quantity Q ordered at a time, the lesser will be the number of ordering costs for that item.

Inventory carrying / holding cost is the cost incurred in connection with the physical storage of an inventory plus the opportunity cost of money tied up in holding it. It includes interest on investment, interest foregone because of unnecessary inventory, storage, obsolescence, insurance, administrative costs, etc. Holding costs ( $C_H$ ) varies between 10 to 25 per cent per annum and is expressed as a percentage of the unit cost of the item (i.e. unit purchase cost  $\times$  (percentage rate / 100)). The total holding cost is equivalent to average inventory  $\times C_H$ . If  $Q$  is the quantity ordered each time, then  $Q/2$  is the average inventory and total holding cost is  $Q/2 \times C_H$ . As can be seen from the formula, the greater the quantity  $Q$  ordered at a time, the higher will be the holding cost.

Economic order quantity (EOQ) seeks to determine that optimum quantity that should be ordered such that both the ordering cost and holding cost are lowest; i.e. when ordering cost equals holding cost:

$$R/Q \times C_p = Q/2 \times C_H$$

$$\therefore Q^2 = (2 \times R \times C_p) / C_H$$

$$Q = \frac{\sqrt{(2 \times R \times C_p)}}{C_H}$$

Where  $R$  = annual requirement of an item in units

$C_p$  = Costs of processing the order

$C_H$  = unit price  $\times$  percentage cost of investment per annum

Thus if:

- i. Annual requirement of 6 " gloves = 2400 pairs
- ii. Cost per pair of gloves = Rs.5
- iii. Cost of processing an order = Rs.7
- iv. Inventory carrying cost = 20% of unit cost

$$\text{Then: EOQ} = \sqrt{(2 \times 2400 \times 7)}$$

$$\frac{5 \times .20}{}$$

$$= \sqrt{(33600)} = 183.30$$

or approximately 180 – 200

The number of orders to be processed each year =  $R$

$$\frac{R}{\text{EOQ}}$$

In this example: 2400

$$\frac{2400}{183.3}$$

= 13 orders or approximately

12 equal orders each of 200 gloves.

Fixation of order quantity through EOQ is however subject to availability of cash, availability of space for storage, variation in pattern of consumption, likelihood of obsolescence, economic manufacturing quantity, lead time for deliver, government regulations, convenience possible through reduction of work, seasonal availability, etc. Further, modification of this formula exists to provide for quantity discounts.

EOQ automatically ensures that 'A' category items, for which the annual consumption value is high, are ordered frequently and in smaller quantities to keep the inventory value low.

(h) A B C Analysis: Classification of stock using A B C analysis involves analyzing, all inventory items on the basis of annual usage times cost. It is an aid to always better control.

In A B C analysis, all items issued during the year are listed out, the unit cost of each item is multiplied by the number consumed to obtain the consumption value, and items are then ranked in order of their annual consumption value. It will then be seen that 5-10% of the number of items account for 70% - 80% of material consumption costs ('A' items), the next 10-20% of annual consumption value ('B' items), and the balance 70 - 80% of the number of items account for just 5 - 10% of annual consumption expenditure ('C' items).

A hypothetical ABC analysis may be carried out in the following manner:

A B C analysis helps draw the attention of the management to 'A' category items so that, by monitoring purchase, stocking and issue of just 5-10% of the items, 70-80% of costs can be controlled. The A B C technique is particularly useful in inventory control as:

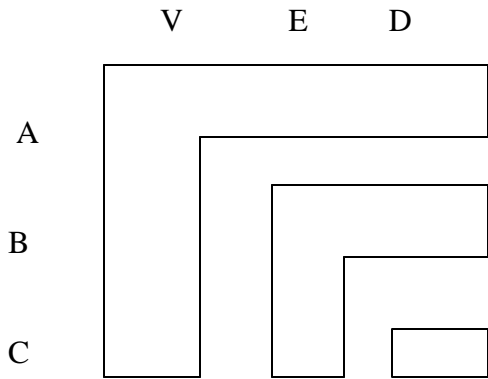
- (i) it helps keep the investment low, and
- (ii) it helps avoid stock outs of critical items.

Hence 'A' items of either high value or critical nature should receive the personal attention of the department head, while other items can be handled by juniors. For 'C' category items general policies for ordering and stocking will suffice, stock outs being prevented by having a fairly high stock.

- (i) V E D Analysis: Items may also be classified as vital, Essential or Desirable based on their criticality, stock-out costs and inconvenience caused to work of the hospital because of their absence.

V category items require a large safety stock, whereas D items require a small safety stock.

A B C and V E D analysis can be integrated into a matrix as follows:



Group I, constituting 17% of the items, are vital and/or of A type. These require to be monitored most closely for stock availability, over-stocking and usage. Group II, constituting 45% of items as in the diagram above require less intensive monitoring. Group III, constituting 38% of the items, that fall in the desirable – C matrix hardly require to be watched.

(j) F S N Analysis: Items in stock may also be classified on the basis of their frequency of issue/consumption. Fast moving items are used at a rapid rate (eg, 5,000 units per month), slow moving items are used consistently, but at a slow rate (eg. 10 units per month), non-moving items should be reviewed periodically to prevent date-expiry, obsolescence, damage in storage, etc.

(k) Turnover of Inventory: Inventory turnover is the quantitative measurement of the number of times that the total inventory value (in rupees) is issued and replaced. The turnover rate is calculated by dividing the total annual rupee value of supplies issued by the rupee value of closing stock. Example, if the consumption value of items issued through the Central Stores amounts to Rs.47,64,000 for a particular year and the closing stock value at the end of that year is Rs. 5,60,470 then the inventory turnover for that period is  $47,64,000/5,60,470 = 8.5$

A turnover rate of 12 times per year is considered ideal, though 8 – 10 turns per year is more realistic. Turnover rate may be increased by eliminating surplus stock, reducing non-moving and slow-moving items, increasing turnover of 4 items, reducing amount of safety stock and reducing lead time involved in stock replacement.

(i) Physical Inventory: This involved a physical verification of inventory for comparison of the actual stock units on hand versus the number of documented in the records. The variance may then be expressed in terms of rupee value of stock for each item.

Physical inventory should be carried out at least once a year. Since no stock (except the most urgent and vital requirements) is issued during the time of stock verification, the process of physical inventory should take as little time as possible so as to cause as minimal interference with the ongoing hospital work.

Physical inventory is the best means of evaluating the efficiency of stores personnel in material handling and record keeping. It also provides an opportunity for identification of damage, shrinkage, stock obsolescence, pilferage. Not only should this process be carried out in the stores, but a physical verification of capital items in departments/wards is also necessary for control of pilferage, follow-up on long standing repairs, identification of excess stock, stock etc.



## **7. Issue/Distribution:**

Items held in inventory by the stores may be issued through indents to user departments on a periodical basis (example, once a week/fortnight) or as and when necessary. The latter is preferable for expensive drugs and consumables, especially if the costs are to be debited to the particular patient.

Systems of stock replenishment to wards/departments are of the following types:

(a) Requisition or Drug-basket system: At definite intervals or as and when the departmental stock level gets low, a requisition is prepared for replenishing the stock and sent to the Stores/Pharmacy. The 'drug-basket' involves sending an empty container/trolley to the Pharmacy with the requisition. The Stores/Pharmacy then issues items in compliance with the requisition. In this system, each department keeps track of its own inventory levels.

(b) Par-level or Topping-up system: The maximum stock level for each ward/department is predetermined on the basis of usage rate and frequency of replenishment. This departmental stock is stored in an assigned location. At periodic intervals, stores personnel visit the ward/department, carry out a physical inventory of what is available and arrange to replace the stock to the predetermined maximum level.

(c) Exchange-cart system: This system is similar to the par-level system in that there are predetermined maximum stock levels and predetermined intervals for stock replenishment. The departmental stock however is stored in a cart and a duplicate of each cart in the user area is maintained by the stores. At predetermined intervals, the full cart from the stores is taken to the user area and exchanged for the depleted cart.

Whatever the system of stock replenishment, it is necessary that adequate controls be established for issue of consumables. Nursing supervisors, having intimate knowledge of departmental work-load and supplies required, should monitor and regulate the supplies to be replenished by the stores. Special emphasis should be laid on control of 'A' type items. While sanctioning indents, nursing supervisors should also ensure that wards are not allowed stock, supplies and build up 'unofficial inventory' for such stock, beyond locking up capital, is more prone to obsolescence, damage and pilferage.

When issuing to the departments capital items such as equipment and furniture, wherever possible, the item code number should be painted or embossed on the article to facilitate easy identification. Such items should also be documented in the department assets-register at the time of issue itself.

## **8. Usage:**

Inventory control techniques can bring about substantial savings in material costs, but these savings are a relatively small percentage when compared to the savings that can accrue through economical and efficient use of materials. Every effort must therefore be made at all levels in the organisation to utilize supplies in the most conscientious manner avoiding any form of wastage. Particular care should be taken to ensure that there is no over-preparation of food, chemicals, etc. which have a limited shelf-life. Monitoring of consumption should be effected through monthly 'supply-usage reports' which summarize (both in stock-keeping units and rupee value) items consumed department wise. By relating these reports to workload and by identifying high-volume users, effective management control is possible.

Material costs can also be decreased by appropriate selection of materials (durables, reusable items), cheaper substitutes, and standardization of supplies.

### **9. Maintenance :**

Proper maintenance of equipment, furniture and fixtures not only ensures their almost continuous availability for use but also an extended life and productivity for the items, thus resulting in lower material costs.

Time and costs of maintenance can be reduced by consideration of the following factors during purchase of the capital assets:

(a) Durability: Since the equipment, furniture, etc. will be handled by multiple users and will be subjected to varying forms of abuse, it is necessary to provide for an element of 'over-specification' so that the item is more sturdy than that available for single person use in the home environment.

(b) Periodical disinfection: Equipment and furniture become contaminated during use and hence must be subjected to periodical cleaning and Disinfection. The external surface of such items should therefore be washable and it should provide for sterilization by moist heat, Formalin vapour, spirit, glutaraldehyde or other chemical disinfectants.

(c) Repairability: In choosing furniture particularly, it is preferable to go in for items which are more easily repairable (eg. Welding of steel in contrast to repair of aluminum or wooden furniture).

(d) Spare-parts availability: Standardization of items and opting for those easily available in the market ensures easy availability of spare parts required for repair and maintenance. In the case of non-standard items and imports, it is necessary to procure certain critical spares and ensure availability of spare parts for the whole life of the equipment.

(e) Operation and Service Manuals: When purchasing sophisticated equipment, it is essential to obtain the operating manual. This must be duplicated and made available to the users, the original being filed in the office. It is also necessary to ensure supply of service manual, including circuit diagram, so that repairs can be attended to by the hospital maintenance department without relying perpetually on the supplier.

(f) Service-contracts: Better terms for service are possible by negotiating service contracts for maintenance prior to purchase of preventive maintenance overhaul schedules, unlimited breakdown calls service charges with escalation clauses, bank guarantee and down-time payment to ensure better performance etc.

(g) Stand-by-units: Since the hospital work must carry on even when the equipment is down, wherever possible, it is necessary to provide for replacements to tide over the period of repair.

### **10. Disposal / Condemnation:**

Indents are often improperly scrutinized and unofficially inventory builds up in wards / departments because of hoarding of supplies. Further, capital equipment, instruments and furniture are occasionally issued to departments in excess of their requirements. It is therefore necessary for nursing supervisors to periodically inspect the sub-stores attached to each ward and arrange for

return of excess stock/equipment. The stores should provide for a 'stores-return' process for documenting receipt of such items.

Each hospital should also have a condemnation committee to review used materials that are to be disposed off. At times it is possible to recycle or reuse materials (eg. IV bottles, polyethylene bags) or find some other use for the item (eg. Torn linen, bottles for sample collection). In the case of equipment, cannibalization may be possible by removing parts of a machine that cannot be repaired and fixing the same to some other unit being rehabilitated. If no further use can be found for disposables, used consumables and damaged equipment, it may still have value as scrap.

### **11. Pilferage :**

Frauds involving buyer-vendor collusion are not uncommon in purchase transactions and can account for a significant percentage of avoidable material costs. For a commission or kickback, either in cash or kind, purchase personnel often compromise the interest of the hospital. The vendor finances such payment by inflating the price, overstating the quantity, supplying substandard goods or through fraudulent payments. Such frauds can be prevented by intensive internal audit and by involving two or more departments or persons in purchase transactions – eg. The Accounts Department may release payment only on receiving the delivery challan signed by the receiving clerk of the stores or the requisitioner of the item and on receiving the invoice duly certified by the purchasing clerk. It is to prevent such buyer – vendor collusions that many hospitals set up separate departments for purchase and for stores.

Theft of materials is also not uncommon. Items may be pilfered by the shipper, by the receiver, by stores personnel and /or by the users. Pilferage from the stores shelves can be made good by short order filling of requisitions as nurses rarely count inventory that is replenished. Unofficial inventory which has accumulated in substores of wards is very susceptible to theft. Maintenance personnel are also notorious for theft of hospital fittings. Control of hospital theft is possible only with intensive vigilance, though the ultimate solution is the 'honest hospital employee'.

### **12. Conclusion**

This paper discusses the concepts of hospital material management and material cost containment techniques. However, every hospital would like to evaluate the effectiveness of its material management efforts to ascertain how well it is doing in this regard.

Charles E. Housely, in his article, "Evaluating the Effectiveness of the Material Management Efforts," "Hospital Material Management quarterly, August 1979, proposes four methods to carry out such an appraisal:

#### **1. Supply-Performance Review:**

This appraisal reflects how well material management is meeting the needs of the individual hospital and individual departments in terms of availability of materials, quality of materials supplied and stock-outs. Specific performance standards need to be set up in advance. Review of actuals versus standards should be carried out at least once a year.

#### **2. Supply-Price Comparison:**

Prices for the same product vary from hospital to hospital from region to region and from dealer to dealer. Such price variation may occur because of greater volume of purchases by a hospital, distance of the hospital from the supplier, negotiation skill of the purchaser, mode of supply, prestige or reputation of the hospital, and/or supplier's promotional offer. If a supply-price

comparison is carried out across hospitals, it is possible to identify purchasers who have paid high price, average price or low price for identical items.

### 3. Management Audit:

The stores-purchase department can set up objectives for itself in terms of recommended material management practices, a plan or proposed action and party/persons responsible for the action. These objectives may relate to material administration, purchasing, receiving, storage and issue of materials. Through the process of appraisal by objectives it is possible to evaluate the performance of the department/staff.

### 4. Material-Cost-Per-Patient-Day Formula:

The MCPPD formula involves dividing total material costs per day by total hospital patient costs per day and projecting a ratio of material costs to hospital costs. Such a formula compares uniformly across hospitals irrespective of size, location, age, etc. as the factors that make the material costs (numerator) increase also make the patient per diem costs (denominator) increase and vice versa. The MCPPD formula is probably the most objective and reliable method of evaluating the effectiveness of material management techniques.