

Chapter 7

EQUIPMENT MANAGEMENT

- **Introduction :**

- With advancement in medical science now the hospital equipment are getting more sophisticated and involve huge funds.
- Health administrator is least aware about the complexities involved in the right selection, procurement, installation, utilization, maintenance of equipment.
- The situation is even worse when it comes to condemnation and disposal of this equipment.
- As a result of the same, the health care centers and hospitals end up procuring equipment, which may not be the best. Besides, we also end up paying more.

- The basic facilities for maintenance and repair of such equipment are non-existent.
- This not only leads to long down time but also gross under-utilization and inefficiency.
- Some surveys and studies have indicated that non-functional equipment is a major contributory factor for wasteful expenditure in hospitals / health care center
- Therefore when a new machine is installed in a hospital set up, a good hospital administrator will sign also annual maintenance contract.

- Timely maintenance and repair of the equipment, therefore, assumes vital importance.
- Management, per se, is defined as the purposeful and effective utilization of resources for accomplishing a pre-determine objective.
- Extending the same to equipment management, it would mean that we not only ensure greater utilization of the equipment, but also maximize their uptime and ensure the reliability, validity, efficiency and safety in their day-to-day functioning.

- Large variety and diversity of equipments are used in the district health organization.
- The nature and type of this equipment within the district health system vary at different levels depending upon the competencies and expertise available.



- **Exiting Situation :**

- The existing situation of the health center / hospital equipment particularly their maintenance and repair is rather gloomy.
- According to a survey by the Department of Electronics (DOE). Government of India, high tech medical equipment worth Rs. 50 core are lying idle in government hospitals in Delhi and nine other States due to lack of spares, and non-availability of funds.
- This reflect lack of proper planning, before buying and installing the machines, also shows, lack of mobilization of the fund towards repairs of theses machines.

Table Nation-wide Survey of Status of Medical Equipment

State	No. of hospitals visited / survey carried out	Cost of equipment surveyed	Cost of equipment not working (Rs. In crores)
Madhya Pradesh	240	28.00	10.00
Orissa	4	10.50	4.60
Bihar	2	25.00	7.00
Punjab	NA	50.00	10.00
Uttar Pradesh	19	38.00	9.60
Maharashtra	24	3.20	1.14
Assam	39	10.00	2.00
Haryana	15	5.00	2.00
Tamil Nadu	5	10.88	2.77
Delhi	3	24.67	2.00
Manipur	17	0.20	0.04
Total		205.45	50.65

- The most common factors contributing to this wastage are:

<p>Purchase of sophisticated equipment which is under-utilized or never used due to lack of technical expertise to maintain and use it. For example, lack trained radiologist and technician without whom machines can not be operated, also reflect the lack of trained service & bio-medical engineers who can carry out annual maintenance contracts, and do the timely repair of the machines.</p>	<p>Estimated wastage 20-24 per cent.</p>
<p>Reduced lifetime (shelf life) of equipment due to mishandling and lack of maintenance and repair.</p>	<p>Estimated to affect 50-80 per cent of equipment value.</p>
<p>Additional purchases of accessories, extra spares and modification to facilities initially unforeseen due to lack of expertise in choosing appropriate equipment.</p>	<p>Estimated to affect 10-30 per cent of equipment value.</p>

<p>Lack of standardization, increased cost of spare parts or additional purchases and extra workload on limited competent staff. So before purchasing any machines, it is important to know the repair protocols procedures and also note the agencies supplying the spare parts.</p>	<p>Estimated to affect cost by extra 20-30 per cent.</p>
<p>Excessive down time of equipment due to lack of preventive maintenance inexperience in repairs and lack of spare parts.</p>	<p>Estimated to affect cost by extra 20-30 per cent.</p>
<p>Shortage of foreign exchange compounds the problem of unfavorable purchasing contracts.</p>	<p>Estimated to add 10-30 per cent of equipment and spares.</p>

• **Equipment Selection :**

Steps for equipment selection:

- As and when we plan to have equipment, we should carry-out a survey before hand and justify the need of particular equipment to be provided.
- In many countries before a new facility is to come up a team comprising health administrators, biomedical engineers, epidemiologist, financial experts visit the particular installation and assess the need and thereafter they issue a Certificate of Need (CON) before allowing new facilities to come up.

- **7.2.1 Use coefficient:**

This coefficient is applied to assess the utilization of equipment i.e. whether the equipment is optimally utilized or underutilized. Additional demands of the equipment may be assessed by use of the formula:

$$\text{Use Coefficient} = \frac{N}{M} \times 100$$

Where, N = Average number of hours the equipment is used per day.

M = Maximum number of hours the equipment can be used per day.

If the used coefficient is less than 50 %. It is considered to be underutilized and hence a bad investment.

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- **Cost consciousness:**

- While procuring new equipment the total cost of the equipment must be kept foremost in mind during the entire cycle of equipment planning and procurement.
- Cost containment procedures may be thought at every stage of the procurement procedures.

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• **Specifications and not the brand:**

- There should be exact specifications of the equipment.
- Tenders floated with the exact specifications will set about a healthy competition which works to advantage.
- Functional requirements should be known and based on these, technical specifications should be developed.
- Based on these one shall be able to negotiate sometimes an unimaginative price.
- The clinician's requirement of equipment may thus be obtained at a lesser cost

- **Planning a hospital equipment:**

Hospital equipment covers a broad range of items necessary for functioning of all the services. However, for universal application the equipment in the hospital can be classified as :

- Physical plant
- Hospital furniture and appliances
- General purpose furniture and appliances, and
- Therapeutic and diagnostic equipment

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• **Physical / Hospital Appliances :**

- Lifts
- Refrigeration and air-conditioning
- Fixed sterilizers
- Incinerators
- Boilers
- Pumps
- Kitchen equipment
- Mechanical laundry
- Central oxygen, suction
- Generator

• Hospital furniture and appliances :

- Beds
- Stretchers
- Trolleys
- Wheelchairs
- Bedside lockers
- Dressing drums
- Kitchen utensils
- Bedside lamps
- Movable
- Hand wash stands
- Operation theatre
- Instrument trolleys
- Bedpans
- Waste bins
- Hospital linen

• **General purpose furniture and appliances :**

1. Office machines

- Intercom sets
- Typewriters
- Calculators
- Cash registers
- Filing systems
- Electronic exchange
- Computer

2. Office furniture

3. Crockery and cutlery

• Diagnostic and therapeutic Hospital appliances :

1. Equipment for general use :

- Surgical instruments
- BP instruments
- Suction machines
- Rehabilitation department equipment
- Physiotherapy department equipment
- Sterilizers
- Equipment for clinical laboratory
- Glassware washers
- Voltage stabilizers
- Refrigerators
- Chemical analyzers – microscopes

2. Equipment interacting with patients during diagnostic and therapeutic procedures :

- Short-way diathermy machines
- Electric cautery machine
- Defibrillators
- X-ray machines
- Monitoring equipment
- Respirators
- Incubators
- ECG machines
- USG machines

• **CIF (customer clearance, insurance & freight) destination:**

- Normally insurance and freight are covered up to nearest port with customer clearance facility.
- In case of procurement of very sophisticated, expensive and imported items moving the equipment to the institution with custom clearance may cost an additional 1-2% of the value of equipment.
- This should be confirmed at the time of negotiation.
- Most of the suppliers would be willing to absorb the additional cost and the burden of custom clearance. This forms the part of business transactions.

- **Service contracts / after sale service:**

- It is important to ensure continuous and an uninterrupted functioning of the equipment.
- Services contract must be conceived and planned at the time of purchase.
- The supplier may dictate the terms and price if plan for service contract is done at the end of the warranty period.
- Accepted norms for the service charged are 1-2% of the cost of equipment for the first year and after warranty with a 10-15% increase each year.

• **Preparation / Selection of site:**

- It calls for teamwork to plan for a proper site which does not required any modification later.
- The team consists of an architect, civil, electrical and A.C. engineer, including the installation engineer.
- Their recommendations can be critically evaluated suitably by the administrator since the expert and engineers are known to be over-ambitious in demanding space

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• Facility for back up power supply:

- As most of the vital and essential equipment are functional on electricity or chargeable battery supply, facility for back up power supply should be ensured.
- Some arrangement has to be made in the form of stand by generators or if possible Uninterrupted Power Supply (UPS).
- Electric shock is mostly due to improper maintenance of electric equipments, so inspect the hospital wiring regularly.
- Use of rubber sheaths which is water proofs, is must. All technicians should know the location of fuse boxes or circuit breakers.
- In case of an electric fire, use only carbon dioxide fire extinguisher. Never throw water.

• **Good economics:**

- Other factors to be taken into consideration like cost and availability of consumables, consumption of water, electricity, need for air-conditioning, service contract facility and availability of spares at least for ten years.
- Equipment may be offered at a very low price but the consumables required may have to be imported later at a phenomenal cost.
- It may be wiser to purchase more expensive equipment which can be operated with much cheaper consumables available locally.

• **Supplier selection and purchase procedure:**

- It is essential that the specifications, other terms and conditions, should be given in purchase order.
- The equipment should be received by a responsible knowledgeable person.
- Technical and users manual should accompany the equipment. The equipment should be adequately utilized and the performance monitored and evaluate.

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- **Maintenance of Equipment and Present Scenario :**
 - Health care equipment including hospital equipments are now based on sophisticated and high cost technology involving huge funds.
 - Now we will discuss
 - (i) the existing situation and arrangements for maintenance of equipment,
 - (ii) outline the plan of bio-medical engineering operations for maintenance, and
 - (iii) the need for developing master maintenance plan. For example open flames is one of the sources of fire hazard in hospital laboratory.

Existing Situation and Arrangements for Maintenance :

WHO has drawn the action plan on management, maintenance and repair of health care equipment, which is to be launched globally?

The main objectives of the plan are:

- Formulation and adoption of policies and approaches specifically related to health care equipment. *For example never do the mouth pipetting, especially if handling blood samples taken from serpositive patients.*
- Establishment of information system capable of receiving, assimilating and disseminating technical information to the health sector. *For example the establishment of HIS (hospital information system)*

- Strengthening of national health care technical services infrastructure. (*proper collection of data, proper analysis of collected data, proper maintenance of hospital records*)
- Training of national staff, including technical managers, engineers, technicians, operators and users. (*training in how to use AED machines, mock drill about disaster preparedness and fire control, proper use of recording keeping and disease classification according to ICD classification*)
- Strengthening national training, capabilities, including establishment of nation / inter-country training centers. (*ICMR, NIHF – New Delhi, All India institute of physical medicines and rehabilitation, national institute of occupational health, etc*)
- Strengthening mechanisms for exchange of information expertise and training facilities at inter-country, sub-regional and inter-regional levels.

- We, in India, have not subscribed to WHO's action plan in its letter and spirit. Neither there is any serious effort to take up this problem on priority basis. Some attempts are being made by the Bureau of Indian Standards in formulating the norms of health care equipment for institutions of health of different sizes. But so far the exercise has been done for only a 30-bedded Community Health Centers/F.R.U./rural hospital. Another effort has been made by NIHFV in developing guidelines for norms of equipments for hospital ranging from 50-500 beds.

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As a result of the rapid advances in medical sciences and technology:

- The physicians are becoming more and more equipment oriented for example the new era interventional radiologist and treating the complication which can arise from thrombo-embolic episodes.
- The patients are much informed of the modern facilities available in our country and abroad. They start expecting and demanding the same. this because of used of internet, ISO certification, medical tourism
- There is at present a flair for introduction of computer technology in the medical field.

• **Outline of the Plan of Bio-Medical Engineering Operations for Maintenance :**

- There are enormous variations between health care and Medicare centers according to different climate, location, the size of the States, the form of care provided and the type of community seeking care.
- Still there are number of parameters common to almost every institution. In order to provide efficient maintenance by bio-medical engineering units to health institutions / hospitals, it is important to develop a routine plan and guidelines.
- This plan should focus the attention on the common elements in the organization, related to procurement and maintenance of medical equipments in a medical institution in order to optimize and get the most out of the limited amount of money and other scarce resources.
- In planning of the bio-medical engineering equipments for operation / use in health institutions, the elements to be included in the plan are discussed below:

a. Requirement of Equipments :

- At the very outset a realistic estimation of the requirement of equipment for different medical institutions would be the most important step for all future activities related to equipment.
- This exercise has not only to identify the bio-medical equipment, but also assess the quantity in which they are required based on estimated patient beneficiary load needing the equipment,

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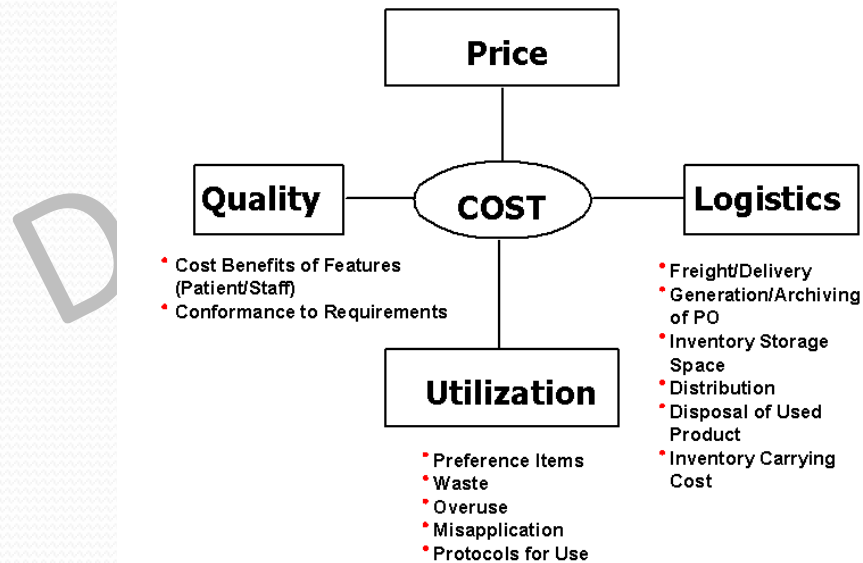
b. Workload in terms of Patients / Beneficiaries :

- The need of these equipments would be directly related to the load of inpatient, outpatients and those attending the emergency services in the hospital casualty and intensive care units.
- The workload of patients would also help in assessing the requirement of equipments in the other diagnostic, therapeutic supportive and ancillary services.

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• **Budget Planning :**

- The hospital and health care equipments are based on high technology and are therefore expensive.
- The meager resources compel us to take only major important and essential equipments at different levels.
- The health budget of the district should take into account not only the equipments, but its maintenance as well.



• Preventive Maintenance :

- As regards the preventive maintenance is concerned care should be taken that the new equipments / machines are under warranty for a sufficient period to test its performance.
- The spares are obtained for five years and the machine is also under service-contract for at least five years.
- The company should undertake to service the equipment after five years also.
- Some penalty clause should also be included in the purchase contract. For electronic equipments following safeguards should be carefully observed:

- Built in alternate voltage stabilizers to bear the fluctuation in voltage gradient.
- In high priority areas like operation theatre, radiology, medicine and radiotherapy, voltage stabilization should be done area wise.
- In areas where the fluctuation is not very high single point stabilization is required.
- Separate line should be laid where voltage fluctuation is considerable.
- Automatic switch-over for emergency should be provided for the hospital / health centers (rural) with a diesel generator, especially in PHC level, where there is no continuous power supply and cold chain has to be maintained to preserve the stored vaccine.

- **The Master Maintenance Plan :**

The master maintenance plan for different hospital machinery & equipment the whole year and for future should be drawn in consideration of the load of the department.

The master maintenance plan includes both the short-term plan and the long-term plan for:

- Maintenance within the institution
- Maintenance outside the institution
- Maintenance outside the State but within the country
- Maintenance outside the country



• **Short-Term Plan :**

The short-term plan includes the following aspects of equipment maintenance and repair:

- Recruitment of skilled manpower - radio-logic technicians, medical lab technicians,
- Establishing a bank of spare parts and crucial components - hospital central medical store and repair shop
- Arranging training program mess on maintenance and repair of equipment for the skilled and semi-skilled personnel which may be in house (i.e. within the hospital) and outside (i.e. Out side the main hospital)

• Long-term Plan :

The long-term plan would focus on:

- Developing a 'Maintenance Organization in the form of a Central Cell for maintenance and repair.
- Establishing a nucleus of communication between this Central Cell and the seller of equipment.
- Establishing detailed records of the purchase, procurement and maintenance of equipment.
- Regular training, teaching programme. As the training programmes in India for the bio-medical maintenance of equipment are lacking, in-service training wherever available should be utilized.
- Besides, the training programmes on equipment maintenance for concerned personnel would also form part of the master maintenance plan.
- The periodic checks and repairs would go a long way in ensuring the optimum use of equipment.

- **Repair of Equipment :**

- Maintenance as well as repair are the two terms which are closely related to each other and are also used combined.
- It is necessary for every hospital / health care institution to have basic in-house facilities for the routine repairs of the common equipment.
- It has been generally seen that many a times the health and hospital equipment are not working for want of simple repairs, such as, faulty switches and plugs, loose wiring and sparking, fuse problems, lack of training in handling the sophisticated equipment and many other factors.



- The in-house repair facility should be organized keeping the following in mind:
 - Head of the workshop / engineering unit should be completely accountable and responsible for the task under his control.
 - Head of the workshop / engineering unit should have sufficient powers to take on the spot decisions regarding repair of a particular piece of equipment.
 - He should have a small purchase and stores organization.
 - The availability of skilled manpower for the repairs.
 - Provides for a bank of spare parts and crucial components.
 - Undertakes / organizes training programmes for the personnel of the bio-medical engineering workshop.

• **Repair Procedures :**

The repair procedures must underline the following:

- The repairs should be under a unified control.
- The repair and maintenance centre / workshop should have four levels of engineering staff for the centre.
 - a. Highly skilled
 - b. skilled
 - c. semi-skilled and
 - d. ordinary
- The semi-skilled should do repairing and servicing of sophisticated equipment only under the guidance of a skilled person who should coordinate the activities of this centre.
- The personnel of the workshop should be trained either by the institution or by the company supplying that equipment by giving training in a virtual engineering work shop.

• Workshop :

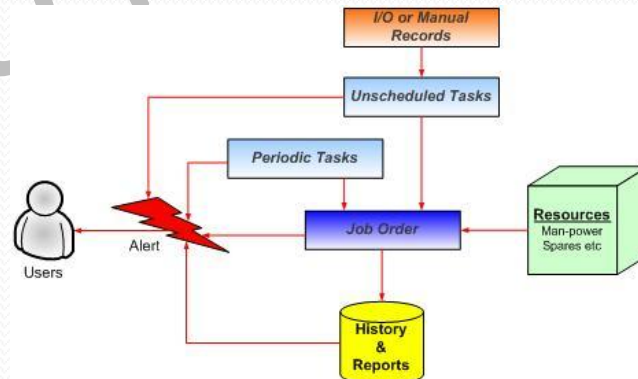
In order to set one adequately at the district / regional level, it should consist of following shops:

- Machine - instrument
- Electric - electronic
- Carpentry and wood work - glass-blowing
- Air-conditioning and refrigeration

All technicians and other workers handling important equipments should be provided with a separate tool kit which consists of all essential items required for repairs and maintenance.

• History Sheet of Equipment :

- The health and medical care equipments are both sophisticated and expensive.
- And at any given point of time large number of such equipments is found unserviceable or damaged beyond economic repairs.
- Besides, with the advent of modern and sophisticated technology a number of equipments have become obsolete, uneconomical and hazardous.
- This all calls for adequate records and documentation for the condemnation and disposal of these equipments and machinery.



- **The important records should be developed and maintained for every equipment and should incorporate the following items:**
 - Identification data of equipment, such as make, model and date of purchase
 - Identification of source
 - Details and reputation of the supplier, availability of the spares
 - Purchase cost
 - Details of breakdown and down-time of equipment
 - Repairs undertaken
 - Expenditure incurred on repairs
 - If imported details thereof
 - Details of custom clearance
 - Details of the procurement procedure i.e. tender enquiry or through DGS&D (Directorate General of Supplies and Disposal).
 - Unit of standardization such as ISI MARKS
 - Nature of building materials
 - Equipment brochure containing information about how to handle the instrument step by step.

• **Log Book of Maintenance and Repair :**

- Health and hospital equipments need great care in handling. In spite of best intentions and careful handling there is a frequent breakdown for equipments requiring minor or sometimes major repairs.
- Since most of these equipments are sophisticated and costly, their maintenance also becomes an expensive affair.
- There is a need to be more efficient on this account. For this purpose we have to have proper records of maintenance and repair with the details listed therein.
- A log book of maintenance and repair of hospital machinery should be maintained for each important and expensive equipment with following details:
 - a. Warranty period and servicing and repairs carried out during warranty period.
 - b. Annual service contract after warranty period
 - c. Expenditure incurred on annual service contract
 - d. Expenditure on other maintenance and repairs
 - e. Details of preventive maintenance
 - f. Whether in working condition or not.

• **Performance Record of Equipment :**

This type of record is very essential to recommend for condemnation and can either be developed separately or be a part of the maintenance and repair record. Following items are to be included in it:

- Period since working
- Level of utilization in terms of output (of investigators, X-ray, ECGs etc.)
- Periods when not working with reasons.
- If beyond economic repairs, a certificate from the engineering unit should be recorded.

● **Condemnation and Disposal :**

- At any given point of time one finds a large number of unserviceable equipments lying in various sections and departments of the hospital and other health care institutions.
- Many of these have become obsolete and their repairs would not be fruitful. Many others are beyond economical repair.
- All such equipments occupy lot of space in the respective departments.
- Hospital equipments may invite criticism and audit objections. An attempt has been made here to suggest procedures for condemnation and disposal of equipments.

- **Condemnation Procedure :**

The condemnation procedures should be laid down and strictly followed. The procedure may be different for routine items and different for costly equipments costing more than Rs. 2 lakhs.

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• Procedure for Routine Items :

- Items of equipment such as B. P. instruments, suction apparatus, ECG machine, small autoclaves, routine laboratory equipment and the like can be condemned on the recommendation of Head of the department, user section, and in-house engineering unit.
- These equipments are then put before the 'Condemnation Board, duly constituted by hospital / district health institution administrators.
- Accordingly the condemnation board should have health centre / hospital administrator or his deputy, Chief of the engineering unit, Nursing Officer, one or two senior clinicians and Accounts Officer as members.
- One or two more officers of the concerned departments may also be co-opted. The board should meet at least once in three months.
- All hospital sections / health centers and concerned units are intimated in advance about the date and time of its meeting so as to enable them to put-forth their respective items for condemnation. The board then physically examines the equipments and satisfies itself before condemnation the same.

- **Disposal :**

The condemned articles of equipment can then be either disposed off by auction or burning.

- i. Disposal by Auction: Normally 10 per cent of the book price is kept as reserve the minimum price.
 - a. Ask for 'sealed tenders' after deciding the minimum bid and declaring the minimum price.
 - b. Open Auction: For the open auction wide publicity is given through press, hand bills, "Kabadiwalas", and letter to sister institutions to display the auction on notice boards.

A committee is constituted as already highlighted to supervise the auction. As for tenders the minimum price of each item is also fixed in advance and declared. On the fall of the hammer 25 per cent of the money is paid by the bidder. 75 per cent of money is paid within a week and before removing the material / equipment.

- ii. **Burning:** Certain items, which can be potential health hazard or are confidential, are best disposed of by burning in the presence of the duly appointed board / committee. Burning of hospital condemn is known as incineration. Incineration is a high temperature, dry oxidation procedure that reduces organic & combustible waste into inorganic combustible matter which can not be recycled, reused and is dispose by land fill site.
- iii. **Disposal of Exceptional Items**
 - a. For Cobalt machine only BARC (Bhabha Atomic Research Centre) can advise condemnation. No price is fixed for such salvage items for disposal.
 - b. For X-ray developer and fixer the earnest money should be obtained from the contractor before disposal.

● **Minimizing loss and pilferage :**

- Pilferage is a phenomenon closely associated with materials of all types.
- Stores may be pilferage by the transporter, receiving clerk, other stores personnel and users in wards / departments.
- To minimize thefts from stores, access to all stores buildings and storage should be limited.
- Locking and unlocking of stores and the handling of keys should be limited.
- Locking and unlocking of stores and the handling of keys should be strictly controlled.
- Intense vigilance is required by all materials personnel.

• Effectiveness of the Materials Management Department :

- Materials account for a substantial portion of hospital budgets, and contribute to a great degree to patient care.
- Evaluating the effectiveness of the materials management department is therefore necessary, and should be carried out at least once in a year.
- The various methods of evaluating the effectiveness of the materials management system are as follows:

Supply performance review: It seeks to satisfy how well the materials management function is meeting the needs of the department in:

- i. Timely availability of materials,
- ii. Quality of materials, and
- iii. Number of occasions when stock-outs have occurred.

Overall review by management audit:

- The complete material management function comes under the ambit of management audit.
- The aim of good materials management has been specified in the beginning of this section.
- Management audit determines the extent to which these aims have been achieved.

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- ***Material cost per patient day (MCPPD):***
- It is arrived at by dividing the total material cost per day by the total hospital cost per day, i.e. it is a ratio of materials costs to total hospital costs.
- The MCPPD is one of the most objective methods of evaluating the effectiveness of materials management practices in the hospital.
- A high MCPPD ratio points to a scope for better materials management. A high MCPPD contributes to higher per day patient costs.

END OF CHAPTER 7

