A STUDY OF THE ROLE OF PREVENTIVE MAINTENANCE IN OPTIMAL UTILIZATION OF EQUIPMENT RESOURCES IN THE ALL INDIA INSTITUTE OF MEDICAL SCIENCES HOSPITAL

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SUMMARY

There is hardly any equipment in the hospital which does not require maintenance; only the complexity of maintenance varies with the criticality of the equipment in various functional areas of the hospital. A high degree of reliance on such equipment demands a high standard of maintenance to assure satisfactory performance, reliability and safety.

There are quite a few approaches to equipment maintenance in hospitals. Preventive maintenance is one such approach.

Preventive maintenance is viewed as a systematic procedure wherein the condition of the equipment is constantly watched through a systematic inspection programme and preventive action taken to reduce the incidence of breakdowns. Preventive maintenance incorporates adjustments, repair or component replacement prior to equipment failure, with the action scheduled for an off shift, if possible.

The importance of preventive maintenance has not fully appreciated by equipment users. The non-existence of preventive maintenance in hospitals could be due to a lack of motivation on the part of hospital administrators, lack of trained maintenance manpower and shortage of funds. The superficial impression of maintenance as a burden to be borne without regard to its true function is reflected by the scant attention it has received so far.

The present study was undertaken with the aim of focussing on the role and applicability of preventive maintenance on improved better utilization of equipment resources in the All India Institute of Medical Sciences Hospital.
The study has been conducted on equipment in the main operation theatre complex of the hospital.

The objectives of the study were to assess the improvement in the availability of equipment as revealed by the reduction in breakdowns and idle time after application of a planned preventive maintenance programme analyse the organization and procedures of the Central Workshop in relation to its contribution to hospital equipment maintenance; suggest enlarging the scope and function of the Central Workshop and administrative actions by the hospital to undertake planned preventive maintenance of hospital equipment.

A retrospective study of the pattern of breakdowns and idle time was done from the available records, supplemented by discussions with the functionaries in both these areas. In the prospective study norms for preventive maintenance were chalked out in a meeting of the technicians of the Central Workshop. These norms were applied in the form of a planned preventive maintenance programme and the results of this programme were compared with the retrospective data. The methodology also incorporated a questionnaire to equipment users on some sampling of the technical staff of the Central Workshop.

The observations and discussion revealed that the equipment under study registered a downward trend in the number of breakdowns and downtime over the observation period on institution of the preventive maintenance programme. A very significant achievement has been the completely trouble-free performance of some equipment which did not suffer a single breakdown.

The effectiveness of planned preventive maintenance programme has also been established in case of other equipment also whose no-operational time due to breakdowns was considerably brought down. However, problems and short-comings were identified in respect of certain facets of equipment management having bearing on equipment maintenance.

Although the number of breakdowns and the idle time of equipment prior to the institution of preventive maintenance programme were considerable, there were no serious hold-ups in the hospital’s work suggesting the availability of sufficient number of stand-by equipment in each category. However, the absence of standardization of equipment and spares resulted in a large variety of equipment for similar functional requirements, creating difficulties in maintenance.

Ignorance of equipment users is proper handlings, operations and user maintenance, lack of monitoring and control on the outside servicing agencies, shortage of funds for maintenance by the Central Workshop, the need for better standard of keeping equipment inventories and records, and the need for a coordinated equipment management system have all been brought into relevant focus.
The Central Workshop of the A.I.I.M.S. has a significant role to play in the maintenance of hospital equipment as the bulk of its job input is provided by the hospital. The need to improve the quality of its performance of breakdown maintenance and the need to augment certain of its manpower and material resources for undertaking preventive maintenance has also been brought out.

Based on the conclusion that planned preventive maintenance has a positive role to play in the optimal utilization of hospital equipment, a suitable design for the preventive maintenance programme by the Central Workshop and the administrative support required have been suggested.

**RECOMMENDATIONS**

1. At present there are no guidelines on the acquisition of equipment. It is recommended that the stores purchase committee should be reorganised to consist of the Stores Officer, Assistant Stores Officer of Hospital, Chairman or Secretary of Hospital Management Board and a representative of the Central Workshop. This Committee should consider standardization, maintainability and availability of vital spares besides considerations of cost and availability of trained operators. The Central Workshop should render technical advisory service for selection and purchase of equipment.

2. Standardization of equipment and spares should be considered to achieve reduction in the variety of equipment. Advice of the central workshop should be sought while laying down specifications for equipment before calling for rate enquiries or tenders from suppliers.

3. It is recommended that a detailed inventory of all the equipment in the hospital should first be completed.

   (i) The equipment inventory should include the following information –
   (a) Technical classification: electrical, mechanical, electronic etc.
   (b) Make, model and identification numbers.
   (c) Central inventory control number.
   (d) Description.
   (e) Location.
   (f) Original cost.
   (g) Date of purchase.
   (h) Date of entry into service.
   (i) Condition: Serviceable, repairable, beyond economic repairs, awaiting imported spare part, etc.
   (j) Agency for maintenance.
(ii) From this inventory the C.W.S. can extract and tabulate the equipment under the technical categories, such as electrical, mechanical, electronic, refrigeration, laundry, glass apparatus, X-ray equipment, steam sterilization equipment etc. for the purpose of maintenance classification and prepare record cards for each equipment.

(iii) It is recommended that the task of preparing such an comprehensive inventory be taken up by the hospital store section with the help of the C.W.S.

4. All the hospital equipment currently under the maintenance cover of C.W.S. be also covered by preventive maintenance.

(a) The post of the Chief Technical Officer of the C.W.S. which is vacant for last two years should be immediately filled up by a sufficiently senior engineer with experience of working in a hospital situation to provide direction and exercise control in the execution of planned preventive maintenance.

(b) The post of technical Assistant, Sheet Metal Worker and Plumber in the mechanical section which are vacant be converted into that of a Technical Officer, Mechanic and Mechanical Fitter respectively, and then filled up with suitably qualified and experienced personnel to strengthen the mechanical section to take up preventive maintenance of mechanical equipment.

(c) The post of Electrical Instrument Maker also has been vacant which should be filled up for the electrical section to help in taking up preventive maintenance of electrical equipment.

(d) The task of operation and maintenance of all the cold rooms and refrigerators in the Institute was transferred from the engineering services unit to the C.W.S. in 1971 in addition to their responsibility of maintaining scientific refrigerated devices, without necessary additional inputs in the form of technical maintenance manpower. The refrigeration section of the C.W.S. should be provided with additional operators cum mechanics to supplement its maintenance effort. This section has to provide round the clock maintenance cover to the refrigerated devices. Addition of operators cum mechanics will relieve the other technicians of the C.W.S. for preventive maintenance.

(e) For preventive maintenance of a large number of various types of trolleys and wheel chairs in the hospital, one person from the hospital’s pool of unskilled labour should be trained by the C.W.S. and provided with the necessary equipment and materials to carry out cleaning, oiling and greasing of casters, wheels and bearings of all such trolleys. The periodicity of tasks to be carried out should be laid down by the C.W.S. which should monitor this maintenance.
The C.W.S. should lay down the frequency of inspection of each type of equipment depending upon technical considerations only.

To start with, the preventive maintenance should be undertaken in the critical patient care areas viz. main operation theatre complex, intensive care ward, nurseries, casualty department and the two emergency wards. With the experience gained in these areas, the preventive maintenance programme should then be extended to the other parts of the hospital.

One person from the user department specified by name, should act as liaison man between the inspection teams of workshop on their preventive maintenance inspection round in each of the above-mentioned areas.

Training of equipment handlers in correct handling and operation should be conducted by the C.W.S. This training should cover the salient points of the functioning of the equipment, the do’s and don’ts in its operation, and the details of maintenance to be carried out at the users level. The Hospital Administration should provide all facilities for such a training. This training should preferably be carried out in the premises where the equipment is located.

The control of preventive maintenance of hospital equipment carried out by outside firms should be vested in the C.W.S. All future servicing contracts with such firms should be drawn up in consultation with the C.W.S. whose technical representative should be present at the time of periodic inspections and servicing to monitor and provide feedback to the hospital administration.

Enough funds for procurement of materials and spares for preventive maintenance should be made available to the C.W.S. by the hospital. For this a revolving fund can be created and placed at the disposal of the C.W.S. which can draw the requirement for materials and spares for preventive as well as breakdown maintenance. Funds for procurement of testing calibration and maintenance equipment for preventive maintenance should also be made available to procure such equipment in the beginning.

LONG TERM PLAN

In view of the growing need of developing sub-specialities and consequent dependence on sophisticated equipment, a long term plan to expand the maintenance scope of C.W.S., incorporating all equipment in the institute is recommended. Such a plan has already been submitted by the Faculty Coordinator for consideration of the Institute. The long term plan should cover –

1. Specialization of staff of the electronic and refrigeration sections.
2. Expansion of the electrical section to cover all motorised devices and undertake winding of motors.

3. Designing of research equipment, import substitution and prototype development by the glass-blowing section.

4. Installation, design, preventive maintenance, prototype development and micro-mechanical work by the mechanical section in addition to the routine repairs.

5. Development of teaching programme in operation and maintenance for equipment users, and for bio-medical technicians of other medical institutions.

6. Procurement of testing, calibration and repair equipment to suit the long term requirements of specialization and expansion of the scope of each section of the central workshop.

7. Provision of additional space to cover the growing needs of the presently existing sections and future expansion.

8. **Hospital Engineering** – The problems of hospital planning, organization and maintenance are entirely different and not amenable to the yardsticks applied according to the C.P.W.D. standards. Every aspect of hospital organization needs to be considered as a system – such as buildings, water supply, power supply, waste disposal, steam generation, laundry and linen service, food service, sterilization facilities, and the installation and maintenance of the equipment needed for all these, primarily oriented towards patient care.

There is therefore, a need to create awareness amongst engineers and hospital administrators for a unified approach to the maintenance problem. At present there is a dearth of qualified hospital engineers in India. But those who have already been working in the hospital field can make a beginning by acquiring specialized training in hospital engineering. A hospital engineering department can then be gradually built up, on the pattern available abroad and at P.G.I., Chandigarh with suitable modifications to suit the requirements of the A.I.I.M.S.

**CONCLUSIONS**

The following conclusions have been drawn from the study of preventive maintenance of hospital equipment carried out in the main operation theatre (M.O.T.) complex of the All India Institute of Medical Sciences Hospital.

**Effectiveness of Preventive Maintenance**
a) The equipment in the main operation theatres placed on preventive maintenance registered a downward trend in the frequency of breakdowns and quantum of idle-time. The effectiveness of the planned preventive maintenance programme has been established.

b) As a part of effective preventive maintenance, the positive role of user-maintenance under proper technical guidance has also been substantiated.

c) The impact of the planned preventive maintenance programme has been felt more or less equally and not specifically on particular category of equipment viz. Mechanical, Electrical, Electromedical, Refrigeration or Mechanical.

d) The need for instituting a planned preventive maintenance programme for better utilization of hospital equipment has been reiterated by the present study.

**State of Equipment**

a) The number of breakdowns of the equipment has been considerable. However, there have been no serious hold-ups in the hospital’s work which suggests that sufficient number of stand-by equipment in each category was available.

b) The idle-time of equipment due to breakdowns has also been enormous in most of the cases. Some equipment had to keep waiting for repairs for months on end.

c) Absence of standardization and consequently the variety-reduction of equipment or their spares resulted in large number of items lying idle for want of correct materials and spares for repairs.

d) Knowledge and motivation about proper equipment handling, operation or user-maintenance has been revealed to be poor even by those who handle such equipment every day and also in case of very costly, sophisticated and vital equipment.

e) The state of equipment serviced by outside agencies on rate contracts was also not satisfactory because of the general lack of coordination and control on this method of maintenance.

f) Shortage of funds provided to the central workshop for repairs, an imbalanced workload: technician ratio resulting in larger idle time of some categories of workers than others, lack of certain testing and repair equipment, lack of history cards and record cards of equipment, lack of motivation of technicians, and the equipment acquisition procedures which do not take into consideration availability of spare parts, maintenance capability, availability of trained operators, standardization or maintainability contributes to the large number of breakdowns and long idle time of hospital equipment.
Role of Central Workshop (C.W.S.)

a) The C.W.S. carries out only the breakdown maintenance of hospital equipment within its current technical capability. However, the minimum organizational infrastructure, in the form of trained technicians, physical facilities and test and repair equipment and machinery can form the base for a preventive maintenance programme with suitable modifications and inputs. The mechanical, glass-blowing and wood working section are very well equipped in comparison to other sections.

b) Major part of the job output of the C.W.S. pertained to the hospital including its supportive services. Mechanical jobs account for the single largest category of repairs (40.6%) as against electronics, electrical, refrigeration, glass blowing or others, all combined. This however does not reflect the output in terms of cost of works different sections which could not be undertaken under the present conditions.

c) The contribution of the C.W.S. to be breakdown maintenance and quality of repairs has not been to the satisfaction of the equipment users as well as the hospital administration. Insufficient funds for materials and spares and low motivation of workmen for this, besides others already enumerated previously.

d) The productive time of the technicians in general has been found to be about 60 percent leaving about 40 percent of the time under-utilized.