

Inventory Management Practices for Biomedical Equipment in Public Hospitals : An Evaluative Study

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ABSTRACT

Inventory keeping is an important dimension for the efficient and effective management of medical equipment in the hospital. A lot of capital is invested for the purchase and installations of costly medical equipment in a public hospital. Ironically, documentation and inventory keeping of these assets mostly remains an ignored area. In this study, secondary data was collected on the inventory keeping practices of costly medical equipment in the public hospitals. The study area included one teaching public hospital and one general public hospital of north India. Independent sample 't' test was conducted to find the difference and Pearson's correlation coefficient was calculated to find the correlation of practices of two hospitals. The study found that there was a statistical significant difference in the average mean scores. However, a high degree of correlation existed between the scoring pattern of two hospitals. The study also found that two elements of inventory keeping practices kept under study were totally lacking in both the hospitals. These were absence of any standardized format and absence of a centralized record system covering all aspects for biomedical equipment.

Keywords: Inventory-keeping, best practices, biomedical/ medical equipment, medical equipment management system.

I. INTRODUCTION

Record-keeping and documentation of inventory items are important components of any management system in every organization. These practices help in maintaining the authenticity & accountability, monitor and control financial investments & profits and also help in resolving various legal matters. Without these practices, business venture or project management cannot be successful. An updated inventory is an integral component for the quality management of medical equipment. It was enlisted as one of the key performance indicators for measuring the performance of MEMS/ MEMP (Medical Equipment Management System/ Plan) of public hospitals in Indian scenario. [1]

Government is investing approximately 50-60% of its budget on purchasing medical equipment in public hospitals. [2] Ironically, most of the time, the question of record-keeping remains unattended. As per guidelines of WHO for the inventory management of the medical

devices, record-keeping is an important part of the management cycle of the medical equipment. Maintaining the inventory of medical devices and equipment is the foremost step in the implementation of MEMS. [3]

In order to identify and track the equipment in the hospital, records must provide the information related to its basic details including name and type of medical equipment, make (manufacturer), model & serial number, purchase cost, date & place of installation, maintenance schedule, warranty & guarantee period and the details of its supplier and service engineer. [4]

Importance of Inventory -Keeping Practices for the Management of Bio-Medical Equipment in the Hospital:

An updated inventory/ stock register accompanied with a log book/ history sheet of every piece of costly medical equipment is essential due to following reasons:

1. Planning, Organization and Control

Right from the process of planning for the procurement of any medical equipment till its final disposal, it passes through various stages of its life cycle. This includes preparing the technical specifications, selection, procurement, checking & acceptance, installation, inspection, preventive maintenance, repair and finally the decommissioning/ condemnation. To organize all these phases efficiently and for controlling the expenses, it is very important that complete records and documents must be available instantly and comprehensively at any point of its life cycle.

2. To Help Understand/ Introduce to the Users of the Medical Device

Before using a medical device, it is essential that the user must be well acquainted about its complete details. An updated documentation will help to understand the device and important aspects of its life cycle. This is also important to manage, maintain and utilize the device in an optimum manner.

3. To Eliminate Misunderstandings and Confusions

It's a common practice in the hospitals that the staff as well as the medical experts work on shift-basis or they are posted at different places. Under these circumstances, it's very important that an updated inventory of the medical devices must be available, preferably maintained in a standardized manner.

4. To Maintain the Honesty of Users and Managers

A scientific and systematic documentation helps in organizing the records, which not only supports in developing a professional work environment but also maintains the integrity and honesty of administrators, managers and workers. A lot of funds are dedicated for the purchase, maintenance and repair of medical equipment in the hospitals. If these all records are maintained completely in a scientific way, the possibilities of ignoring the facts, manipulations and involving errors are reduced. A proper management of records and documents help to establish a firm base for making sound choices subsequently.

5. To Ensure Risk Management

During the entire life cycle of any medical device, many critical decisions are required to be taken from time to time. For revealing the facts, a history sheet of the

medical equipment will lead to proper risk analysis as well as cost-benefit/ effectiveness analysis. Proper documentation of the details of the medical device shall help to provide a current view of risks involved in the biomedical devices/ equipment. It also enables health workers to manage the situations of emergency and disasters. [5]

To Enhance Accountability and Save Time:

An organized inventory management and updated records help in maintaining the accountability of persons involved in handling and using the devices. It provides a quick overview and tracking of the equipment inventory and hence helps in saving time too.

To Become Eligible for Certification and Accreditation:

Proper documentation and records are essential prerequisites to enter into the processes of ISO certification, licensing of healthcare services and accreditation for quality management system and further improvement initiatives.

For Efficient Management of Maintenance Schedules and Related Functions:

Record- keeping of equipment inventories provide a quick reminder of the planned preventive maintenance and inspections. It must also provide the contact details of service personnel involved in the procedures.

For Timely Procurement of Consumables

Every medical equipment requires some sort of consumables or accessories to put them into use for the patient and related services in the hospital. An economic order quantity (EOQ) of accessories and consumables can be maintained if accurate data and information related to the medical equipment is available well in time.

For Establishment of a Biomedical Engineering Department and HIS

An updated inventory of medical equipment acts as a firm base for establishing the biomedical engineering wing in the hospital as well as for supporting hospital information system (HIS).

The World Health Organization and The Commission on Patient Safety and Quality Assurance stressed the importance of adopting standards and guidelines as a key element of effective governance. [6]

Moreover, A proper updated medical equipment inventory provides a quick assessment of the technology on hand, giving details of the quantity and category of equipment and its current operating status. [7]

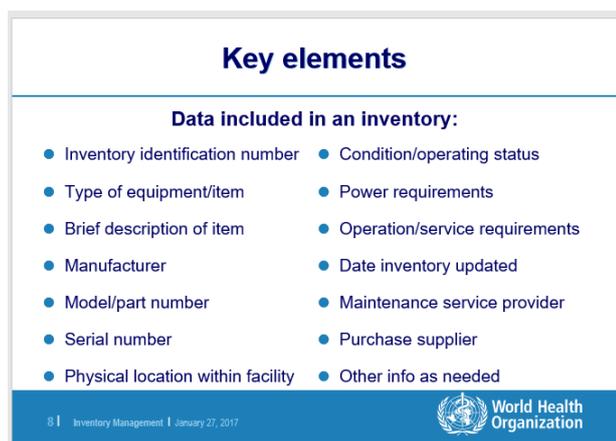


Image Source: WHO Medical Device Technical Series, 2017

Figure 1. Key Elements for Record Keeping of Medical Devices/ Equipment

II. METHODS AND MATERIAL

Aim : To assess the record-keeping practices of biomedical inventory management at public hospitals.

Objectives

1. To calculate scores of inventory-keeping practices in public hospitals for biomedical equipment.
2. To find the correlation between the scoring pattern of public hospitals under the study.

On the basis of above objectives, following two null hypotheses were tested

H_{01} : There was no significant difference in the scores of inventory-keeping practices for medical equipment in the public hospitals under study.

H_{02} : There was no significant correlation between the scoring pattern of two hospitals

Research Design

This was an observational study conducted from June 2016 to December 2016 by analyzing the records of medical equipment maintained in the hospitals. The study was conducted in two premier healthcare institutes in one of the cities of North India i.e. one multispecialty tertiary care teaching public hospital and another multispecialty non-teaching general hospital. The analysis for the medical equipment inventory-keeping was based upon a validated structured checklist.

Methodology

The checklist was prepared after in-depth literature survey to find the best practices being followed for the record-keeping of costly medical equipment in the hospital. World Health Organization, Medical Device Technical Series and Inventory Guidelines, (Fig. 1) and Ministry of Health and Family Welfare (MOHFW), Government of India [5,8] were taken into account. These guidelines were adapted by keeping in consideration the prevailing scenario of public hospitals in India and ten basic elements/ items were selected (Table 3) for getting the relevant information for study. These selected items/variables were subjected to experts' opinions (in the field of health and hospital management) in Indian healthcare institutes. Their consensus was achieved with 95% agreement, the checklist thus finalized was put for further application in the present study. (1)

The selected items of checklist for evaluation were related to the basic details of medical device, its operational/ functional status, details of maintenance & service arrangement, warranty period, its accessories & consumables and date of inventory maintained. Last two items were based on the observation of the researcher whether there was a standardized format for inventory-keeping and availability of the centralized records.

A sample size of 180 medical equipment (on proportional basis in ratio of 3:2 from teaching public hospital and general public hospital respectively) were selected based on random sampling. However, inclusion criteria for the costly medical equipment (procurement cost equal or more than five lacs) was adopted.

A list of medical equipment (consisting of diagnostic, therapeutic, monitoring and miscellaneous biomedical equipment) was prepared from the central stores and their record-keeping practices were observed in the user departments where the equipment have been installed. Log books were also examined to get complete information if this was lacking in stock/inventory registers. The data collected were compiled in terms of scores. A positive observation (Yes) for the stated item was given the score 1 (one). Finally, the total scores and their mean values were calculated (Table 2). The data were analysed on SPSS version 23. Independent sample 't' test and bivariate correlation techniques were applied for hypotheses testing.

III. RESULTS AND DISCUSSION

As illustrated in the fig. 2 and table 1, the total scores of teaching public hospital were 644 out of maximum scores of 1080 with an average score of 5.96 and standard deviation of 1.6. Similarly, the total scores achieved by general public hospital was 347 out of maximum scores of 720. The mean score for this hospital was 4.85 with standard deviation of 1.41.

Type of Hospital	N	Mean	Std. Deviation	Std. Error Mean
Teaching Hospital	108	5.96	1.579	.153
General Public Hospital	72	4.85	1.406	.172

Table 1. Descriptive Statistics: Inventory-Keeping Practices

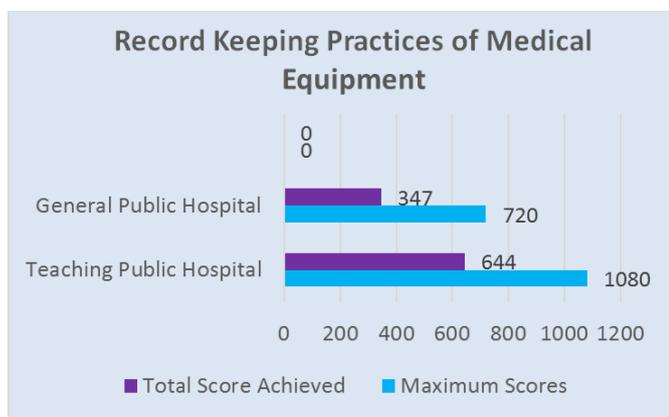


Figure 2. Total and Maximum Scores of two Hospitals under study

Results of Objective 1: “An independent-samples t-test (Table 2) was conducted to compare the mean inventory scores for teaching public hospital and general public hospital. There was a significant difference in the scores for teaching public hospital (M= 6.0, SD=1.6) and general public hospital (M= 4.9, SD= 1.4) conditions; $t(179) = 4.7, p = 0.00$.

Thus, first null hypothesis was rejected.

Table 2. Independent Samples ‘T’ Test for Hypothesis Testing

Inventory Score	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	1.815	.180	4.702	179	.000
Equal variances not assumed			4.826	152.322	.000

A detailed list of checklist items and total score of both hospitals are summarized in table 3 and the observations under study are graphically presented in fig. 3.

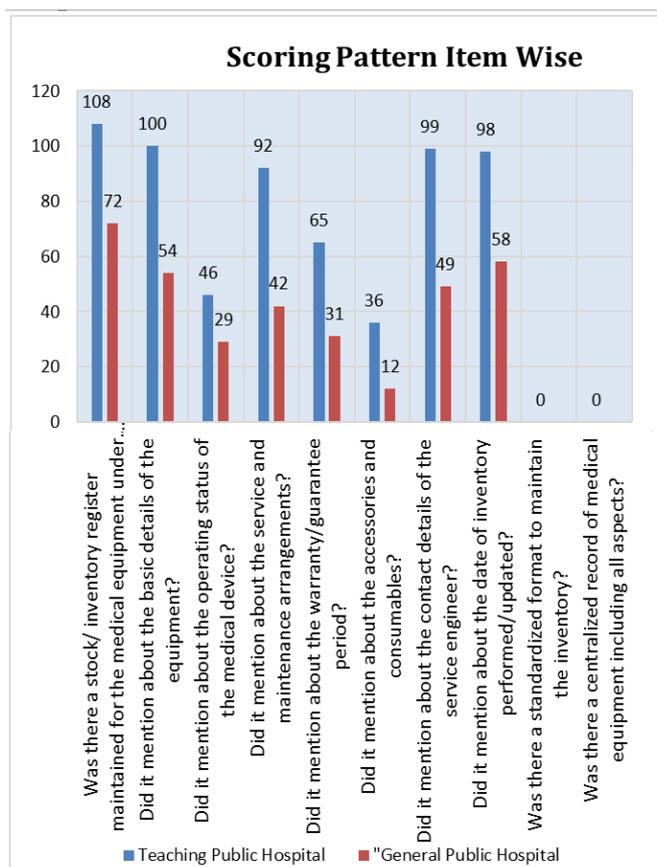


Figure 3. Scoring Pattern: Inventory Management

Table 3. Checklist and Total Scores of Public Hospital

Items of Inventory Management	Teaching Public Hospital	General Public Hospital
Was there a stock/ inventory register maintained for the medical equipment under study?	108	72
Did it mention about the basic details of the equipment?	100	54
Did it mention about the operating status of the medical device?	46	29
Did it mention about the service and maintenance arrangements?	92	42
Did it mention about the warranty/guarantee period?	65	31
Did it mention about the accessories and consumables?	36	12
Did it mention about the contact details of the service engineer?	99	49
Did it mention about the date of inventory performed/updated?	98	58
Was there a standardized format to maintain the inventory?	0	0
Was there a centralized record of medical equipment including all aspects?	0	0
Total Scores Achieved	644	347

The results of correlation coefficient between the scoring pattern of two public hospital is depicted in fig. 4

Results of Objective 2 : For the testing of second null hypothesis, Pearson’s Correlation Coefficient (Table 4) between the scoring pattern of two hospitals was found to be 0.97 (p value of .00), showing a high degree of correlation between the scoring pattern of two hospitals.

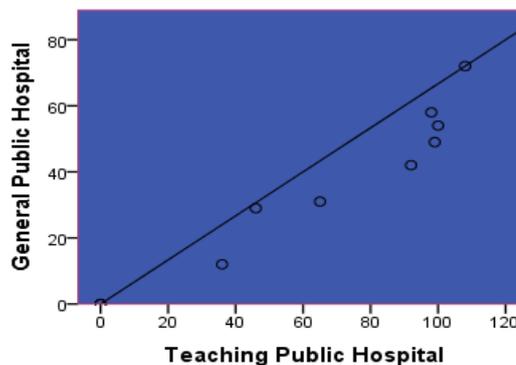


Figure 4. Correlation of Scoring Pattern

Thus, the second null hypothesis was also rejected.

Table 4: Results of Hypothesis 2 Testing

		Teaching Public Hospital	General Public Hospital
Teaching Public Hospital	Pearson Correlation	1	.967**
	Sig. [2-tailed]		.000
	N	10	10
General Public Hospital	Pearson Correlation	.967**	1
	Sig. [2-tailed]	.000	
	N	10	10
**. Correlation is significant at the 0.01 level [2-tailed].			

** . Correlation is significant at the 0.01 level [2-tailed].

From the scoring pattern summarized in table 3, it can be observed that for the item no. 9 and 10, there was zero score for both of the hospital since there was neither standardized format of record keeping nor a centralized system for maintaining the records related to the inventory management of costly medical equipment. To provide the best healthcare services, there is a need of quality medical equipment for the purpose of diagnosis, treatment and monitoring of the diseases. Many of them are also used for teaching and research purposes. However, a quality record-keeping of these biomedical equipment is equally important. WHO and MEMS/ MEMP of various developed countries have framed guidelines for this purpose. Keeping in mind the importance of record-keeping practices of equipment inventory in the hospital, especially in the public sector, this study was conducted. The results of hypotheses testing in the present study concluded that if public

hospitals adhere to best practices, the asset management of the medical equipment can be improved further. Secondly, as per our observations as explained in the statistical data obtained, there was neither a standard format to maintain the records nor a centralized record system in either of the hospitals under study. The information was available in a fragmented manner from multiple sources in the same organization. Surprisingly, not even at one level the complete information of the equipment was available. Maintaining the records of a single piece of medical device at multiple sites leads to wastage of time and resources including man power. Michael and Laura (Managing Public Sector Records: A Study Programme, 1999) also found in their study that in the public organizations, most of the data/ information is lost due to decentralization of records. This also adversely impacts patient care services directly or indirectly. [9] A study (Patil et. al., 2015) at a tertiary care teaching hospital found that there was absence of best practices for record-keeping. Not even a single (out of 52 pieces of medical equipment under study) item of biomedical equipment accompanied with a log book or history sheet. The need of maintaining a comprehensive record was also realized by them. It becomes highly critical when a machine lands into failure due to maintenance problems. Under such circumstances, history sheet of a medical equipment becomes that much important as a patient history for correct diagnosis and clinical management of the patients. [10]

IV. SUMMARY AND CONCLUSIONS

This study was conducted in two public hospitals of north India. Ten important items of inventory-keeping related to best practices of medical equipment management system were selected keeping in mind the scenario of public hospitals in India. A checklist was prepared on the basis of these ten items after getting experts' agreement from the field of healthcare and hospital management. For data collection, 108 items of costly medical equipment (of and above the cost of five lacs) were selected from teaching public hospital and 72 items from general public hospital on random basis. The mean scores of inventory-keeping practices in both hospitals were found to be statistically significant different based on the results of independent sample t test. So, the first null hypothesis of the study was rejected. However, there was a significant correlation

between the scoring pattern of both hospitals since the Pearson's correlation coefficient was of high degree. Thus, the second null hypothesis was also rejected. These results suggest that type of hospital really does have an effect on scores for maintaining inventory of medical equipment. High degree of correlation signifies the common tendencies (practices in use as well as deficiencies) for inventory-keeping.

A structured and effective records for inventory management of all biomedical equipment covering all departments should be the aim of every hospital. This must also ensure that staff and managers have access to administrative records pertaining to medical equipment on a wide range of issues, including policy and guidelines, maintenance and service arrangements, operating status and other important issues related to any stage of equipment life cycle. It is strongly recommended to implement inventory management guidelines in every hospital along with a tag identification for every piece of medical equipment to ensure traceability. During this study, we strongly realized that in the public hospitals, a biomedical wing must be created where complete information of each piece of medical equipment is available, other than providing the clinical engineering services. This will also lead to cost containment, since lot of resources can be saved by avoiding multiple record-keeping activities. In this era of advance technologies, it is equally important to implement information technology services in the management of medical devices to achieve optimized results. This will not only save time and energy but also enhance the accuracy level while keeping a track record. Dedicated software, bar-code readers and RFID (Radio frequency identification) are some of the methods to maintain and manage the records of costly medical devices in an efficient, economical and effective manner.

Recently, NHSRC (National Health System Resource Centre, a WHO collaborating centre for priority medical devices) under National Health Mission, Government of India has taken initiatives for streamlining biomedical equipment facilities in public hospitals. Under such circumstances, an updated inventory and implementation of best practices in this area will help in creating a sound and systematic biomedical equipment inventory mapping of the country. [11]

V. REFERENCES

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