ISSN:2249-1236
Ali S M Rababah et al.IJRRPAS,(2016) Vol.6 Issue.1 Pg:1336-1339
International Journal of Research and Reviews in Pharmacy and Applied sciences

FREQUENT FAILURES OF THE CATHETERIZATION LABORATORY EQUIPMENT AND THE BENEFITS OF PERFORMING PLANNED PREVENTIVE MAINTENANCE

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Abstract:

Introduction: A cardiac catheterization laboratory is one of the principal equipment in the cardiac department that its failure can cause a detrimental effect on its financial income and the ability to provide proper healthcare to the patient.

Method: All maintenance reports for maintaining 4 catheterization rooms in one of the medical institutes in Jordan in the period between 2010 and 2016 were collected and analyzed to identify the most frequent failures and replaced parts to maintain the equipment. Moreover, the benefits of performing proper preventive maintenance was investigated.

Results: 114 maintenance calls were ended by replacing spare parts in the 7 years periods. This satisfying figure is due to performing proper inspection and preventive maintenance as recommended by the manufacturer. Monitor, X-ray tube, view pad, and Visub were the most frequently replaced parts. The figures were 38, 12, 11, and 10 respectively.

Conclusion: the proper preventive maintenance is highly beneficial in reducing the downtime of the device and preventing the sudden failure. Furthermore, the frequently replaced part such as monitors, x-ray tube, view pad, Visub and others should be purchased quickly and easily to keep the equipment working properly.

Keywords: Maintenance reports, Spare parts, Preventive maintenance, Downtime.

Introduction:

A cardiac catheterization laboratory is an examination room that is part of the hospital's cardiac department and houses an x-ray imaging equipment to examine the wellness of the heart muscles, coronary arteries, or heart valves by performing a variety of diagnostic and interventional cardiac procedures including angiogram, angioplasty, ablation and pacemaker implantation. The catheterization laboratory consists of 3 rooms; an examination room where the cardiologist examines the patient with the help of fluoroscopic imaging, and includes C-arm, x-ray tube, detector, table, and patient monitoring display monitors. A control room which houses the main control and digital imaging consoles where the medical staff can view the cardiac structures of the patient including coronary arteries and heart valves. And a room that contains x-ray generator and power control cabinets.

According to problem reports received and investigations performed by an international health services research agency, it is found that sudden failure of medical equipment in general and radiology devices

especially is due to the reason that inspection and preventive maintenance are not performed totally or performed improperly (1). In this paper, the benefits of applying proper inspection and preventive maintenance according to the manufacturer recommendations are investigated. In addition, a thorough analysis of maintenance reports received in a period between 2010 and 2016 was performed to identify the most commonly replaced parts and the frequent failures in a catheterization laboratory equipment.

Methods:

A retrospective study was performed on 4 catheterization rooms - each room accommodate cardiovascular angiographic fluoroscopic system - in one of the medical institutes in Jordan during the period between 2010 and 2016. All maintenance reports during this period were collected for subsequent classification and analysis (2). Firstly, maintenance reports were classified into two divisions; planned preventive maintenance reports and breakdown maintenance reports. Analysis was performed to find out if the procedure and interval of preventive maintenance were done as advised by manufacturer. In addition, it was investigated if the performed planned preventive maintenance enhanced the efficiency, effectiveness, and reliability of the system and reduced the frequency of breakdown maintenance. Secondly, operational and technical faults in each catheterization room were sorted to correlate between these faults in one side and equipment age and the frequent use of the device during its lifespan in the other side. Further analysis was conducted to determine the components (parts) that deteriorate or breakdown frequently during the operation of the system in order to make them available in stock or facilitate the procedure of purchasing such spare parts to reduce the downtime of the system as much as possible.

Results and Discussion:

This study revealed that the planned preventive maintenance (PPM) was performed on a regular basis and as advised by the manufacturer. The recommendation of the manufacturer is to perform PPM every 6 months for each equipment. Table 1 shows the frequency of PPM during the last 7 years period.

Year / Room No.	2010	2011	2012	2013	2014	2015	2016
Room 1	2	3	3	3	3	4	1
Room 2	2	4	3	4	4	4	2
Room 3	1	4	1	4	4	4	2
Room 4	2	3	2	2	4	4	1

Table 1: The frequency of applying PPM for each cathlab room in each year.

The PPM involves checking all the main parts of the equipment including VISUB cabinet, system movements, table movement, cooling fan, Poly G, etc. Since the PPM was implemented regularly and according to the manufacturer guidelines during the whole period, on average, the unscheduled downtime was 7 days per year for each room. This figure is acceptable. Performing PPM was beneficial in detecting the fault before it exaggerates, ensuring the safety to the operator and patient, and reducing the downtime of the equipment.

It is clear from table 2 that the monitors whether they are in the examination room or viewing room are the main cause of failure in the Cath lab room which entails the prompt availability of them in stock by keeping this part available as standby or making the way of purchasing these parts fast and easy to avoid any increase in the downtime of the equipment. X-ray tube is the second part that deteriorate frequently. It is difficult to keep this part available in stock because of its very high cost which is between $30,000 and $45,000. Consequently the purchase process for such component should be easy enough to replace them quickly when needed.

	Faulty part	**Frequency of fault**
1.	Monitor	38
2.	Convertor	6
3.	X-tube	12
4.	Camera	7
5.	AD5 table	7
6.	Poly-G body guard	8
7.	Visub	10
8.	Footswitch	9
9.	Fiber optic cable	6
10.	Viewpad	11

Table 2 shows the main components (parts) that breakdown frequently during the period of study.

This study focused on the benefits of performing PPM on Cath lab rooms. The result of this study is consistent with previous studies in the literature. In a study performed by Southern Illinois University, it shown that preventive maintenance extends equipment life, improves equipment availability and retains equipment in proper condition (3). Bateman, Jon F revealed in his study on the benefits of preventive maintenance that it reduces the downtime of the equipment, and provide a safe working environment for patient and operator (4). These results are in good agreement with the results showed in this study.

Regarding the strategies for providing the maintenance department with the required spare parts, it is shown in this study that it is necessary to make this process easy and fast for the components that deteriorate frequently. Lappeenranta University of Technology reviewed the different strategies for developing maintenance spare part logistics. It is shown that the parts that are highly critical and those parts predicted to fail frequently should be held in stock to avoid the possibility of stock out situation in case of failure. Those parts that their prices are relatively high and the customers are not willing to hold them in stock should be supplied by making a deal with the suppliers to deliver them in a short time when necessary (5).

Conclusion:

Performing planned preventive maintenance as recommended by the manufacturer of the catheterization laboratory equipment is of important value to keep the medical device in appropriate conditions, reduce the downtime of the device, prevent any serious and sudden damage, and ensure the safety for patients and medical staff. As well as that, the hospital should find a way to purchase spare parts that deteriorate frequently including monitors, X-ray tube, viewpad, and others quickly as required by the maintenance department to avoid any delay in repairing the device.

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