Application and Preventive Maintenance of Neurology Medical Equipment in Isfahan Alzahra Hospital

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Date of Submission: Feb 23, 2013

Date of Acceptance: Feb 27, 2013

How to cite this article: Alikhani P, Vesal S, Kashefi P, Pour RE, Khorvash F, Askari G, *et al*. Application and preventive maintenance of neurology medical equipment in Isfahan Alzahra Hospital. Int J Prev Med 2013;Suppl 2: S323-9

ABSTRACT

Background: Nowadays Medical equipment plays an important role in the treatment and in the medical education. Using outdated preventive maintenance (PM) system may cause problems in the cutting edge medical equipment, Nervous system disease's equipment (In diagnosis and treatment) which are crucial for every medical center. Based on above facts we focused on nervous system treat units' equipment and informed the supervisors and their colleagues about the latest equipment maintenance status and promoted methodical and correct method to be used for medical equipment maintenance.

Methods: This research is an analytical descriptive and has been done on the base information from a particular time to past. We gathered our required information of 2009 from Alzahra Medical Center. We divided this research info 2 main phases. In the first phase, we picked out Neurosurgery and Neourology diseases medical equipment (diagnosis and therapy equipment) and in the second phase, we need to implement a methodical PM for every equipment.

Results: Research has shown that there are 19nervous system equipment in Alzahra Medical center, categorized in diagnostic (13 pcs), therapeutic (4 pcs) and diagnostic-therapeutic (2 pcs). As we declare in methods part of this research, we categorized medical equipment in Food and Drug Administration (FDA) segmentation. Capital-scarce equipment: Magnetic resonance imaging, Eco Doppler, Kamalaarak ultrasonic surgical aspirator, Stereotactic, computed tomography-scan, euroendoscope/vital-scarce equipment: Coblation, Sonoco, vaterjet/ scarce equipment: Transcranial color Doppler, electroencephalogram, electromyography, surgical microscope.

Conclusions: Survey of application and preventive maintenance of neurology medical equipment in Isfahan Alzahra hospital show there is no P.M system. Implementing a complete P.M system for this medical center is crucial to preventing cause problems for these medical equipment and decreasing maintenance costs and gaining uptime. Researchers of this article have tried to provide PM, use of texts, web and experts. .

Keywords: Hospital, neurology medical equipment, preventive maintenance

Short Communication

INTRODUCTION

Every medical center is one of the most important part for every city that is serving medical services, medical research, educational services, and many other crucial services.[1]

Every successful medical center requires large number of medical equipment to provide proficient services to its clients and requires proficient operators for working with this equipment which helps the medical center to be success in every aspect. Every medical center should provide cutting edge medical equipment that is suitable based on their needs and their operators from prominent companies. They should also take care about its prices and installing time for every equipment in medical center to get proper and effective results.[1,2] Reducing costs and proper maintenance will effect on total medical center costs.[3] The best method to get best result in reducing medical equipment maintenance cost and getting more in uptime is a proper preventive maintenance (P.M).

P.M is abstract of P.M and an explanation for a service of task to prevent down for every equipment and post-pone in repair cycle. These tasks consist of control, investigation, checking every medical equipment operation, and calibration test and reducing equipment fault that may cause dangerous problems for and operators. It also consists of other tasks such as replace caused parts, cleaning, lubrication. Although, there are many activities for medical equipment maintenances, lack of proper instructions, lack of official catalogues, and integrated education causes national capital losses.[4]

Based on a practical research, results about the effects of using a P.M system for medical equipment on reducing costs in Velars medical center in Arak (a big center of Iran) shows that while installing for 21.7% of medical equipment after maintaining a proper P.M system they could reduce 36% of their costs.[4] Another research was to understand the P.M status in Iranian medical university Hospitals. It shows that status of every parts of P.M. system based on statistics view is weak. Approximately, 60% of medical equipment were not maintained properly and evaluated by medical equipment inspectors.[3,5] Haloes' shows that in all the developing countries effective working time of every medical equipment is related to having a scheduled standard maintenance.

He found working time for medical equipment with a scheduled maintenance program has been doubled in comparison with medical equipment that is not.[6]

Based on society, industrialization neurological diseases has been increased and on the other hand using unsafe vehicles particularly in developing countries, due to accidents', movement diseases, traumatic brain and spin cord injury has been increased. A patient with those diseases in the past would been diagnosed as incurable. Now-a-day's treatment is based on new medical equipment and brand new medical diagnostic methods and every past diagnosis method and equipment has changed. Particularly, using diagnostic medical equipment such as magnetic resonance imaging (MRI) and computed tomography (CT) scan and computer based processes help doctors discuss the disease and for this these medical equipment are playing a substantial role in diagnosis and treatment.[7]

Based on above reasons, this research has been done to inform and educate supervisors and operators that having a proper P.M. system for neurology unit's such as: Electroencephalogram (EEG) unit, operation room, neurosurgery unit, neurology unit, Intensive Care Unit (ICU) is not only crucial but also can learn the correct method in medical equipment maintenance in medical center.

METHODS

This research is an analytical descriptive and has been done on the on the basis of some way back information gathered. We gathered our required information of 2009 from Alzahra Medical Center and divided this research information into 2 main phases.

In the first phase we picked out Neurosurgery and internal diseases medical equipment (diagnosis and therapy equipment).

We categorized medical equipment in 4 categories:

- Capital equipment
- Vital
- Scarce
- Versatile.

This categorize was based on FDA standards. Explanation of every of the above category are:

Capital

These are equipment that include majority part of every medical center capital. By using P.M system for each and every equipment in this

category, we can reduce lots of medical center's costs.

Vital equipment

This equipment is purely therapy equipment and having problem on this equipment may cause adverse result to the patient. This equipment is offensive and based on standards are categorized into high-risk equipment. Calibrations are crucial for this equipment.

Scarce equipment

Equipment which is less than 3 are categorized as scarce equipment.

In case of failure, P.M. should do a faster process or company has to provide backup equipment for medical center.

Versatile equipment

Equipment that exists in 20 or more is categorized in the versatile equipment. The importance of P.M. for these equipment is because: Most of these equipment are same in brand and model and creating a checklist and P.M system can be used for many equipment in every medical center and it will reduce costs.[8]

Gathering information tools in the stage was a self-made check list.

RESULTS

Results show that abundance of neurological equipment (diagnosis and therapy) from all of Alzahra medical equipment is 19.

CONCLUSIONS

Results show the total status of P.M system in comparison of good condition in 65% studding different text shows author has created questionnaires and check lists for obtaining P.M system in Alzahra Medical Centre. In fact, there is a standard method for obtaining a comprehensive P.M system and every scientist uses own particular method to produce result for their study medical equipment.

As we declare in methods part of this research, we categorized medical equipment in FDA segmentation.

Capital-scarce equipment: MRI, Eco Doppler, Kamalaarak ultrasonic surgical aspirator, stereotactic, CT-scan, neuroendoscope.

Vital-scarce equipment: Coblation, Sonoco, vaterjet scarce equipment: Transcranial color Doppler (TCD), EEG, electromyography (EMG), surgical microscope equipment FDA classification described in section methods and need not repeat. In continue, we provide brief description of each of the devices used in these groups.

Capital-scarce equipment

MRI a non-invasive nuclear procedure for imaging tissues of high fat and water content that cannot be seen with other radiologic techniques. The MRI image gives information about the chemical makeup of tissues, thus making it possible to distinguish normal, cancerous, atherosclerotic, and traumatized tissue masses in the image. An MRI scanner is a device in which the patient lies within a large, powerful magnet where the magnetic field is used to align the magnetization of some atomic nuclei in the body, and radio frequency magnetic fields are applied to systematically alter the alignment of this magnetization. This causes the nuclei to produce a rotating magnetic field detectable by the scanner – and this information is recorded to construct an image of the scanned area of the body.[9]

The results show for each part of this device defined different control periods [Table 1] and total P.M on MRI device requires control in 4-8-16-24 month periods.

Eco Doppler

This device is diagnostic equipment and the results show for P.M on Eco Doppler device requires control in annual periods.

Kamalaarak ultrasonic surgical aspirator

KUSA is intended for use in the selective removal of unwanted soft tissues during surgery. The basic operating principle in ultra-sonic surgery is the vibration of the hollow tip of the hand piece at ultra-sonic frequency against tissues. Action of the tip is mechanical and the effect on tissue can be described as a tiny "surgical hammer." Fluid filled cellular tissue in contact with the tip is disputed by the mechanical action of the "hammer." Emulsified tissues are aspirated through the center of the hand piece.

Table 1: Frequency of studied devices according to control period, application and the FDA classified

Row	Device name	Parts	Control period (Month once)	Type of device (Application)	Type of device (FDA)	Department	Number
1	Magnetic resonance imaging	-	4-8-16-24	Diagnostic	Capital-scarce	Para clinic	1
		Magnetic system	4-8-16				
		Flat	16				
		Measurement and regulation system	4-8				
		Operator console and observations	4-8				
		Heat exchanger	4-16-24				
		Computer system	4-20				
		Gradient system	8				
		Cooling system	4-8-16				
2	Eco Doppler	-	12 and after each use	Diagnostic	Capital-scarce	Para clinic	2
3	Transcranial color doppler	-	12	Diagnostic	Scarce	Para clinic	1
4	Kamalaarak ultrasonic surgical aspirator	-	12	Therapeutic	Capital-scarce		1
5	Electroencephalogram	-	12 and after each use	Diagnostic	Scarce	Para clinic	2
6	Electromyography	-	12 and after each use	Diagnostic	Scarce	Para clinic	3
7	Stereotactic	-	12	Diagnostic-therapeutic	Capital-scarce	Operation room	1
8	CT- scan	Gantry	4-8	Diagnostic	Capital-scarce	Para clinic	3
		Flat	4-8				
		Operator console	4-8				
		Control unit, X-ray	4-8				
		Collector tube, X-ray	4				
		Scanner	4-8				
		High voltage converter and heating of filaman	4				
9	Neuro endoscope	-	12 and after each use	Diagnostic-therapeutic	Capital-scarce	Operation room	1
10	Surgical microscope	-	1-12	Diagnostic	Scarce	Operation room	1
11	Coblation	-	12	Therapeutic	Vital-scarce	Operation room	1
12	Sonoco	-	12	Therapeutic	Vital-scarce	Operation room	1
13	Waterjet	-	12	Therapeutic	Vital-scarce	Operation room	1
Total							19

FDA=Food and drug administration, CT=Computed tomography

Flow of irrigation fluid from the annular space surrounding the assists the removal of the waste tissues. The selective action of the instrument arises from the difference between fluids containing cellular tissue which is effectively disputed by the vibrating tip.

Fibrous tissue (such as nerve, blood vessels and membranes) is relatively unaffected by the vibration at the set frequencies.[10]

The results show KUSA is therapeutic device and P.M on this device requires control in annual periods.

Stereotactic

Stereotactic surgery or stereotaxy (not to be confused with the virtuality concept of stereotaxy) is a minimally invasive form of surgical intervention which makes use of a 3-dimensional (3-D) coordinate system to locate small targets inside the body and to perform on them some action such as ablation, biopsy, lesion, injection, stimulation, implantation, radiosurgery etc., Stereotactic surgery works on the basis of three main components: A stereotactic planning system-including atlas-multimodality image matching tools-coordinates calculator, etc., Modern stereotactic planning system is computer based. The stereotactic atlas is a series of cross sections of anatomical structure (for example, a human brain), depicted in reference to a two-coordinate frame. Thus, each brain structure can be easily assigned a range of three-coordinate numbers, which will be used for positioning the stereotactic device. In most atlases, the three dimensions are: Latero-lateral (x), dorso-ventral (y) and rostro-caudal (z). Guide bars in the x, y and z directions (or alternatively, in the polar coordinate holder), fitted with high precision vernier scales allow the neurosurgeon to position the point of a probe (an electrode, a cannula, etc.) inside the brain, at the calculated coordinates for the desired structure, through a small trephined hole in the skull.[11]

The results show Stereotactic is diagnostic-therapeutic device and P.M on this device requires control in annual periods.

Computed tomography scan

A CT scan stands for CT scan and it is also known as a (computer axial tomography) scan. It is a medical imaging method that employs tomography where tomography is the process of generating a two-dimensional image of a slice or section through a 3-dimensional object (a tomogram).The CT scanner uses digital geometry processing to generate a 3-D image of the inside of an object. The 3-D image is made after many 2-dimensional (2-D) X-ray images are taken around a single axis of rotation– in other words, many pictures of the same area are taken from many angles and then placed together to produce a 3-D image. A scan of the head can provide the doctor with important information about the brain-he/she may want to know whether there is any bleeding, swelling of the arteries, or tumors.[10]

The results show for each part of this device defined different control periods [Table 1] and total P.M on MRI device requires control in 4-8 month periods.

Neuro endoscope

Endoscopy has since been applied to many disciplines of medicine and its application to the nervous system was initially slow and not widely accepted and mainly involved the biopsy of tumors and the treatment of hydrocephalus. Several reasons for neuroendoscopy's limited use include inadequate endoscope technology; high skill level required the advent of the surgical microscope, and the development of other treatments such as ventricular shunting. Neuroendoscopy uses a tiny telescope and a high resolution video camera to look into the skull, brain and spine. It greatly improves our ability to see exactly where the problem area is and to treat it more effectively. Neuroendoscopy is used for treating complex hydrocephalus and other neurological diseases.[12]

The results show Neuroendoscopy device is diagnostic-therapeutic device and P.M on this device requires control after each use and annual periods.

Based on our researches, we found all of capital equipment catalo yes in Alzahra Hospital; however, those catalogues are in complete. Defects including lock of completing P.M information on these catalogues by service man and lock of warranty or guaranty renovation. In capital category, CT scan has highest priority for obtaining a P.M system. Based on researches in developed countries for example in Germany 5% of espials allocated to maintenance purposes refunds 30% of costs, based on these researches.[13]

Vital-scarce

Unfortunately, in relation to definition and application of Coblation, Sonoco, vaterjet devices was not found information.

The results show these devices are therapeutic and P.M on them requires control in annual periods.

Results show vital equipment is better place in comparison of capital equipment; however, every problem is for bidden due to importance of this equipment. The difference of current P.M level of vital equipment to standard is due to lack of operator education. Operator educated for only lower than 50% for these equipment.

Scarce equipment

Transcranial color doppler

TCD is a new technology none-injury examining encephalic, outside blood vessels pathological changes. It uses low-frequency pulse ultrasonic, penetrates through thin parts and natural skeletal pore of skull to get basis encephali big blood vessel' blood flow signal directly. Single-channel testing, double ultrasonic probe 2 MHz (pulse wave) 4 MHz (continuous wave), it can meet the examination to encephalic, neck and body outside blood vessels.

Standard configuration: Probe frequency-display-printer-two stereo loudhailer-Solid streamline slide work station-transmitting power-continuous wave power-sampling depth-sampling volume-scanning speed-staff gauge set-display modes-plus – frequency. Clinical application: Blood vessel of brain straitness and obstruction-cerebral arteriosclerosis-temporary cerebral ischemia outbreak (Transient Ischemic Attack, TIA)-cerebral infarction (thrombus or embolism)-artery blood supply shortage-encephalic vasculitis pathological changes-migraine-internal diseases blood vessel of brain damage-cerebral arteries and vena encephali malformation-moyamoya disease.

The results show TCD is Diagnostic device and P.M on this device requires control in annual periods.[10]

Electroencephalogram

An EEG machine is a device used to create a picture of the electrical activity of the brain. The main diagnostic application of EEG is in the case of epilepsy-coma-encephalopathies-brain death-studies of sleep and sleep disorders-sometimes more diagnosis of tumors, stroke, and other focal brain disorders. The essential components of an EEG machine include: Electrodes-amplifiers-a computer control module-a display device.[14]

The results show EEG is Diagnostic device and P.M on this device requires control after each use and annual periods.

Electromyography

EMG is an electrical recording of muscle activity that aids in the diagnosis of neuromuscular disease. EMG can help diagnose many muscle and nerve disorders, including: Muscular dystrophy-congenital myopathies-mitochondrial myopathies-metabolic myopathies-myotonias-peripheral neuropathies-radiculopathies-nerve lesions-amyotrophic lateral sclerosis-polio-spinal muscular atrophy-Guillain-Barré syndrome-ataxias – myasthenias. This electrical activity is detected by a needle electrode inserted into the muscle and connected to a recording device. During an EMG test, a fine needle is inserted into the muscle to be tested. The needle may be repositioned in the same muscle for further recording. Other muscles may be tested as well. A typical session lasts from 30 min to 60 min.[15]

The results show EMG is diagnostic device and P.M on this device requires control after each use and annual periods.

Surgical microscope

Microscope used to obtain good visualization of fine structures in the operating field; in the standing type of microscope, a motorized zoom lens system operated by hand or foot controls provides an adjustable working distance.[10]

The results show surgical microscopeis diagnostic device and P.M on this device requires control in monthly and annual periods.

P.M of the devices in the scarce group is bad. Due to the scarcity of devices and need to be to reserve, now for any of these devices has not been to arrangements reserve in Alzahra Hospital. EMG set must be priorities groups of P.M. As you see the results, none of the devices were not studied in the versatile group.

CONCLUSIONS

We can say there are no P.M system for any of nervous equipment' (diagnosis and therapy) or is in complete. Based on high sensitivity of these medical equipment vulnerability of patient in this unit obtaining a comprehensives P.M system is crucial.

We hope Alzahra Hospital can preserve medical equipment and reduce costs by obtaining new P.M system, by cooperation of medical equipment unit and entire colleague.

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Source of Support: This article is the result of a research project, supported by the Isfahan University of Medical Sciences, **Conflict of Interest:** None declared.