A STUDY TO ASSESS THE UTILIZATION OF SELECTED PORTABLE MEDICAL EQUIPMENT IN CRITICAL CARE AREAS

Submitted to

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CONTENTS

LIST OF TABLES

LIST OF FIGUARES

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The importance of efficient utilization of expensive imaging equipment has been brought to full public attention by the current health care debates. In the present health diagnostic care, increasing operational efficiency and reducing costs, whilst improving service provided to the patient, are a constant challenge. Advances in engineering and information technology, particularly during the last few decades, have revolutionized medical care. The availability and utilization of various healthcare equipment, at all levels, in the health system for effective and efficient service delivery was amply emphasized in the Alma – Ata declaration at the International Conference on Primary Healthcare in 1978, which was later introduced in the strategy paper of Health for all by 2000AD.

The sophistication in the medical field has led to the development of specialized care centers in an attempt to provide high quality care. Medical equipment plays a significant role in the health care delivery system. The equipment has become more complex and requires regular specialized 'maintenance and repair, which is very expensive. Hospital equipment falls into an extremely wide spectrum ranging home a simple patient trolley to Hi -tech PET, MRI, and CT scanner. The term 'equipment' in the context of a hospital, generally means any instrument, apparatus, tool, appliance, machine, or any other related article, used for various preventive, diagnostic, therapeutic, supportive and control procedures for day-to-day patient care activities. All these account for a major part of any hospital project cost, which could go up to almost 60 percent. Of this, biomedical equipment could account for nearly 50 percent of the cost. Keeping this in view, it is essential to ensure maximum utilization of the equipment. With the adaptation of proper maintenance techniques and management systems one can utilize resources optimally. It should be an earnest endeavor of the management and users to optimize the equipment utilization to obtain maximum return on capital invested. In an era of cost-intensive medical care, every equipment being installed in healthcare institutions need to be fully and properly utilized. Critical care areas are areas of the hospital where seriously ill patients receive specialized care such as intensive monitoring and advanced life support. They are staffed by highly trained physicians, nurses and respiratory therapist who specialize in caring for critically ill patients. Common equipment in critical care areas includes mechanical ventilators to assist breathing; cardiac monitors for monitoring cardiac condition; equipment for constant monitoring of bodily functions, suction pumps, drains and catheters, feeding tubes and a web of intravenous tubes.

CHAPTER 2

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1 UTILIZATION OF EQUIPMENT

Utilization essentially means the use of the equipment to its full potential. Utilization index or use coefficient is one of the important parameters to monitor the functional status of the equipment. It is the parameters to assess the productivity of a service or equipment.

In the present healthcare scenario, increasing operational efficiency and reducing costs, whilst improving service provided to the patient, are a constant challenge. Advances in engineering and information technology, particularly during the last few decades, have revolutionized medical care. The availability and utilization of various healthcare equipment, at all levels, in the health system for effective and efficient service delivery was simply emphasized in the Alma-Ata declaration at the International Conference on Primary Healthcare in 1978, which was later included in the strategy paper of Health for all by 2000AD.The sophistication in the medical field has led to the development of specialized care centers in an attempt to provide high quality care. Medical equipment plays a major in the healthcare delivery system. The equipment has become more complex and requires regular specialized maintenance and repair, which is very expensive.

Hospital equipment falls into an extremely wide spectrum ranging from a simple patient trolley to a Hi-tech PET, MRI and CT scanner. The term 'equipment' in the context of a hospital, generally means any instrument, apparatus tool, appliance, machine or any other related article. Used for various preventive, diagnostic therapeutic, supportive and control procedures for day-to-day patient care activities.

Important Factors Affecting Utilization of Equipment

Medical equipment is expensive to procure and maintain. There are various factors which must be considered for their optimal utilization. The important factors are,

- **Training of the staff:** Timely and appropriate training of the staff handling and operating the equipment is a prerequisite for effective and optimum utilization of equipment.

- **Equipment installed on turn-key basis:** Turnkey equipments are those equipment ready to be used immediately by the person who is buying or renting it. It has been observed that costly equipment installed on turn-key basis have better utilization. Thus ensures the equipment is fully functional when handed over to the hospital. Prior to the commissioning of the facility, adequate numbers of personnel are already trained by the firm installing the equipment.
- **Preventive maintenance and after-sales services:** Insisting on regularafter-salesservicesoftheequipmentandapropersystemofpreventive maintenance, downtime of costly and essential equipment can be considerably reduced thereby increasing utilization. Normally the annual maintenance cost of equipment varies from 1-4 percent of the capital cost of the equipment. By ensuring availability of repairs, maintenance and necessary spares, equipment utilization can be significantly increased.
- **Facility for backup power supply:** As most of the vital and essential equipment are functional on electricity or rechargeable battery supply, facility, for backup power supply should be ensured. Some arrangement has to be made in the form of standby generator or if possible uninterrupted power supply (UPS)units.
- **Time scheduling of the hospital:** Hospital timing should be scheduled in such a way that there is optimum utilization of the costly equipment. Usually in government hospitals, the facilities work only 8 hours or one shift which amounts33percentutilization.Ifthefacilities are made available for two shifts, high-cost equipment nay be utilized for 50-60 percent of their capacity.
- **Use coefficient:** Use coefficient was applied to assess the utilization of equipment, i.e., whether the equipment was optimally utilized or underutilized. Use coefficient of equipment may be measured by the following formula:

Use Coefficient = N/M *1OO

Were,
N = Total minutes the equipment was used
M= Total minutes the equipment was observed

2.2 EQUIMENT

2.21 X-RAY MACHINE

X-rays are types of electromagnetic radiation probably most well-known for their ability to see through a person's skin and reveal images of the bones beneath it. Advances in technology have led to more powerful and focused X-ray as well as ever greater applications of these light waves, from imaging microscopic biological cells and structural components of materials like cement to killing cancer cells.

X-ray are roughly classified into soft X-rays and hard X-rays. Soft X -rays have relatively short-wave lengths of about 10 nanometers (an anometerisone-billionth of a meter), and so they fall in the range of the electromagnetic (EM) spectrum between ultraviolet (UV)light and gamma rays. Hard X-ray shave wave lengths of about 100 picometers (a picometre is one trillionth of a meter). These electromagneticwavesoccupythesameregionoftheEMspectrumasgammarays.

The only difference between the is their source-rays are produced by accelerating electrons, whereas gamma rays are produced by atomic nuclei in one of four nuclear reactions.

X-ray imaging

Due to their ability to penetrate certain materials, X-rays are used for several non-destructive evaluation and testing applications, particularly for identifying flaws or cracks in structural components. According to the NDT Resource Centre, Radiation is directed through a part and on to film or other detector. The resulting shadowgraph shows the internal features and whether the part is sound. This is the same technique used in doctors and dentist's offices to create X-ray image of bones and teeth, respectively.

2.22 USG (ULTRASONOGRAPHY)

Medical ultrasound (also known as **diagnostic sonography** or **ultrasonography)** is a diagnostic imaging technique based on the application of ultrasound. It is used to create an image of internal body structures such as tendon, muscles, blood vessels, and internal organs. Its aim is often to find a source of a disease or to exclude pathology. The practice of examining pregnant women using ultrasound is called 0bestic ultrasound and was an early development and application of clinical ultra-sonography.

Ultrasound refers to sound waves with frequencies which are higher than those audible to human's ultrasonic images, also known as sonograms, are made by sending pulses of ultra sound into tissue using a probe.

The ultrasound pulses echo off tissues with different reflection properties and are recorded and displayed as an image.

Anultrasoundmachineconsistsofahandleddevicethatproducesultrasonicsound waves (above the range of human hearing) that reflect of different layers of body tissue. The transducer converts the echoes into electrical signals that are used to create an image and display it on a screen. The image is based on the frequency and strength of the sound signal and the time it took for the echoes to return.

"Ultrasound imaging has many uses in medicine, from confirming and dating a pregnancy to diagnosing certain conditions and guiding doctors through precise medical procedures."

DAIGNOSTIC IMAGING

Ultrasound is also used to diagnose a wide variety of conditions that affect the organs and soft tissues of the body, including the heart and blood vessels, liver, gallbladder, spleen, pancreas, kidneys, bladder, uterus, ovaries, prostate, thyroid, testicles and breast.

"You can see images in real time, as opposed to a single snap-shot image such as an X-ray image", Byrne said. "This means that we can see the heart beating, the arteries pulse rating and the bowel's peristalsis (the waves of muscle contraction that move food through the digestive tract"

With ultrasound, doctors can easily reposition the patient during imaging, which is especially important when checking for the movement of gallstone.

2.2.3 DEFIBRILLATOR

Defibrillators are devices that restore a normal heartbeat by sending an electric pulse or shock to the heart. Defibrillation is a process in which an electronic device sends an electric shock to heart to stop an extremely rapid, irregular heartbeat and restore the normal heart rhythm. They are used to prevent or correct an arrhythmia, a heartbeat that is uneven or that is too slow or too fast. Defibrillators can also restore the hearts beating if the heart suddenly stops. Defibrillators can be used in children's, teens, and adults. The purpose of defibrillation is performed to correct life-threatening fibrillation of the heart, which could result in cardiac arrest. It should be performed immediately after identifying that the patient is experiencing a cardiac emergency, has no pulse, and is unresponsive. There are mainly three types of defibrillators; Automated external defibrillators (AED), Implantable cardioverter defibrillators (ICD), Wearable cardioverter defibrillator (WCD). Automated external defibrillators are seen in many public spaces, were developed to save the life of people experiencing sudden cardiac arrest. Even bystanders can use these devices in an emergency. They are light weight, battery operated, portable device

that checks the heart rhythm and sends a shock to heart to restore a normal rhythm. Sticky pads wit sensors, called electrodes, are attached to the chest of someone who is having cardiac arrest. The electrodes send information about the person heart rhythm to a computer in the automated external defibrillators. The computer analyzes the heart rhythm to find out whether an electronic shock is needed. Implantable cardioverter defibrillators are surgically placed inside your body, where it checks for arrhythmias. Arrhythmias can interrupt the blood flow from the heart to stop; it sends a shock to correct the arrhythmias. Wearable cardioverter defibrillators have seen that attach to the skin. They are connected by wires to a unit that checks your hearts rhythm and deliver sock when needed.

2.2.4 ECG (ELECTROCARDIOGRAM)

An electrocardiogram (ECG) is a simple test that can be used to check your heart's rhythm and electrical activity. Sensors attached to the skin are used to detect the electrical signals produced by your heart each time it beats. These signals are recorded by a machine and are looked at by a doctor to see if they're unusual.
An ECG may be requested by a heart specialist (cardiologist) or any doctor who thinks you might have a problem with your heart. An ECG is often used alongside other tests to help diagnose and monitor conditions affecting the heart. It can be used to investigate symptoms of a possible heart problem, such as chest pain, palpitations (suddenly noticeable heartbeats), dizziness and shortness of breath.

An ECG can help detect:

- **Arrhythmias–** where the heart beats too slowly, too quickly, or irregularly
- **Coronary heart disease –** where the heart's blood supply is blocked or interrupted by a build-up of fatty substances
- **Heart attacks** – where the supply of blood to the heart is suddenly blocked
- **Cardiomyopathy –** where the heart walls become thickened or enlarged

A series of ECGs can also be taken over time to monitor a person already diagnosed with a heart condition or taking medication known to potentially affect the heart. There are 3 main types of ECG:

1. **A resting ECG –** It is carried out while you're lying down in a comfortable position
2. **A stress or exercise ECG –** It is carried out while you're using an exercise bike or treadmill
3. **An ambulatory ECG** – the electrodes are connected to a small portable machine worn at your waist so your heart can be monitored at home for one or more days

The type of ECG you have will depend on your symptoms and the heart problem suspected.

CHAPTER 3
METHODOLOGY

3.1 TITTLE

A study to assess utilization of selected portable Medical Equipment in Critical care areas of Lisie hospital, Ernakulam.

3.2 OBJECTIVES

A) GENERAL OBJECTIVE

To assess utilization of selected portable medical equipment in critical care areas of Lisie hospital, Ernakulam.

B) SPECIFIC OBJECTIVES.

- To study various activities involved in the usage of the selected portable medical equipment at Lisie hospital, Ernakulam.
- To find out the time taken for the completion of each activity involved in the usage of the selected portable medical equipment.
- To identify utilization of selected portable medical equipment in critical care areas.
- To provide suggestions, if any, for better utilization of portable medical equipment.

3.3 RELEVANCE OF STUDY

All Hospitals are spending considerable amount of its budget per year on the installation, implementation, maintenance & repair of various portable medical equipment for providing immediate point of care to patients; but most of the time the economic aspects behind the usage of the same are not being explored. Hence it is essential to find out the utilization statistics of the portable medical equipment for knowing their economic efficiency.

3.4 RESEARCH DESIGN

This study was descriptive in nature as it is concerned with describing and identifying the usage of selected portable medical equipment in critical care areas of Lisie hospital Ernakulam.

3.5 DEFINITION

THEORETICAL DEFINITION

A) MEDICAL EQUIPMENT

The term medical equipment is used for the specific purpose of diagnosis and treatment of disease or rehabilitation following a disease or injury, it can be used either alone or in combination with any accessory, consumable or other piece of medical equipment

- WHO (World Health Organization)

B) PORTABLE EQUIPMENT

Portable equipment is electronic equipment that can easily be moved from one place to another while in operation or while connected to supply.

-Collins Dictionary

C) MEDICAL EQUIPMENT UTILIZATION

Equipment utilization is the evaluation of necessity, appropriateness, and efficiency of medical equipment in diagnosing and treating a patient.

D)CRITICAL CARE

It is the specialized care of patients whose conditions are life-threatening and who require comprehensive care and constant monitoring with the support of medical equipment.

-Medicine Net

3.6 OPERATIONAL DEFINITION

A) PORTABLE MEDICAL EQUIPMENT

Portable medical equipment is an electronic equipment like x-ray, ultrasound, defibrillator, and ECG machines used for the purpose of diagnosis and treatment of diseases, can be used either alone or in combination with any accessory, consumable or other piece of medical equipment and which can be moved from one place to another while in operation or connected to supplies at Lisie hospital Ernakulam.

B) MEDICAL EQUIPMENT UTILIZATION

Portable medical equipment utilization is the evaluation of necessity, appropriateness, and efficiency of the use of selected portable medical equipment such as X-ray, ultra sound machine, Defibrillator and ECG's in diagnosing and treating a patient at Lisie hospital Ernakulam.

C) CRITICAL CARE

Critical care is the specialized care of patients whose conditions are life-threatening and who require comprehensive care as well as constant monitoring with the support of medical equipment in Lisie hospital, Ernakulam

3.7 TIME FRAME

Total duration of the study was 15 days

3.8 UNIVERSE

The universe of the study was the selected portable equipment (X-ray, ultra sound machine, Defibrillator and ECG machines) at Lisie hospital Ernakulam during the study period from 28th June to 15thJuly 2021.

3.9 SAMPLING DESIGN

The study was broadly census study as the data were collected from all selected portable medical equipment in critical care areas at Lisie hospital Ernakulam. The researcher prepared the list of equipment and its order to be observed. The researcher conducted the observations on shift-wise basis, as per the order of the equipment mentioned in the list.

3.10 EQUIPMENT SELECTION

The equipment selected for the study was portable X-ray, ultra sound, defibrillator and ECG machines in critical care areas of Lisie hospital Ernakulam.

3.11 EQUIPMENT ORDER

1.XRAY.
2.ECG.
3.USG.
4.DEFIBRILLATOR**.**

3.12 PILOT STUDY

Pilot study was conducted prior to data collection to find out the time taken for completion of each activity while using selected portable medical equipment in critical care areas. The researcher took 1 sample each from the four categories of selected portable medical equipment. The total time for observation both morning and evening shift was10 hours. The researcher has observed each sample 2.5 hours during the study. The time taken for the completion of each activity of sample from respective category was recorded in the observation diary.

3.13 SOURCES OF DATA

A) PRIMARY SOURCE/S:

The primary source of data were intensivist, bio-medical engineers and technician who are making use of selected portable equipment for patients and the activities involved in the usage of portable equipment in critical care areas of Lisie hospital Ernakulam during the study period from 28th June to 15th July 2021.

B) SECONDARY SOURCE/S:

Secondary source of data were hospital records, registers and hospital website related with portable medical equipment under study

3.14 METHODS OF DATA COLLECTION

A) UNSTRUCTURED INTERVIEW:

An unstructured interview was conducted with the intensivist, technicians, and biomedical engineers to list out the various activities involved in the usage of selected portable medical equipment in critical care areas.

B) DIRECT OBSERVATION

Observations were recorded based on the time taken for the completion of each activity involved in the usage of selected portable medical equipment in critical care areas of Lisie hospital. The researcher has observed all selected portable medical equipment in a predetermined order.

3.15 TOOLS FOR DATA COLLECTION

OBSERVATION DIARY

An observation diary was used to record the data collected. The list of equipment and the order of observations were included in the observation diary. Separate pages were used for each equipment and its location. The observation diary has arranged with vertical columns and horizontal rows. Horizontal rows were used to represent each activity and vertical columns were used to record the time for completion of each activity.

DIARY:

Various activities involved in the usage of selected portable equipment under each category were collected through unstructured interview and it was recorded in a diary.

3.16 DATA PROCESSING AND ANALYSIS

3.16.1 CODING

The equipment and activities involved in the usage of portable equipment in critical care areas were coded as follows:

A) CODING OF PORTABLE EQUIPMENT

- X-ray – X1
- USG machine – U1
- Defibrillator – D1
- ECG machine – E1

B) CODING OF ACTIVITIES

All activities in the utilization of selected portable medical equipment were coded as A1, A2, A3, A4, A5 & A6 for X-ray, ECG and USG, for Defibrillator it was coded as B1, B2, B3, B4, B5 & B6.

3.16.2CLASSIFICATION

The classification was based on;

- Equipment wise utilization.
- Shift wise utilization.
- Activity wise utilization.

3.16.3TABULATION

Tables for tabulation includes:

- Equipment wise utilization.
- Shift wise utilization.
- Activity wise utilization of portable medical equipment under selected category

3.16.4CALCULATION

Use coefficient = N/M*100

N: Total minutes the equipment was used

M: Total minutes the equipment was observed.

- Any equipment having use coefficient value less than 40% was considered as underutilized.
- Any equipment having use coefficient value between 40% and 60% was considered as moderately utilized.
- Any equipment having use coefficient more than 60% was considered as well utilized.

3.16.5ANALYSIS

Analysis was done as follows:

- **Equipment wise analysis** was calculated by dividing total time the equipment is used by the total time the equipment is observed * 100.
- **Shift wise utilization** rate was calculated by dividing the total time the equipment is used during that shift by total time the equipment is observed in that shift *100.
- **Activity wise utilization** was calculated by total time taken for the completion of each activity under selected category divided by the total time the equipment was used *100

3.17 LIMITATION OF THE STUDY

Only two shifts were taken for the study - morning shift and afternoon shift.

3.18 REPORT WRITTING

The report is divided into six chapters:

Chapter 1	Introduction & profile of the hospital
Chapter 2	Review of literature
Chapter 3	Methodology
Chapter 4	Analysis & interpretation
Chapter 5	Findings and suggestions
Chapter 6	Conclusion

3.19 TIME FRAME OF THESTUDY

- Selection of topic- 5 days
- Preparing methodology - 10 days
- Pilot study- 1 day
- Data collection- 14 days
- Report writing –10 days

CHAPTER 4
ANALYSIS AND INTERPRETATIONS OF DATA

4.1.1 The list of selected Portable medical equipment& activities is as follows:

SL. No	Equipment	Coding Given	Equipment No	Areas
1.	X-ray	X1	BME/PXRAY/06	MICU &selected critical care areas*
2.	X-ray	X2	BME/PXRAY/07	CCU
3.	ECG	E1	BME/PECG/01	Selected Critical care areas*
4.	ECG	E2	BME/PECG/02	Selected critical care Areas*
5,	ECG	E3	BME/PECG/03	Selected critical care Areas*
6.	USG	U1	MIDRAY M-8	Selected critical care Areas*
7.	Defibrillator	D1	BME/DEFIB/50	CCU
8.	Defibrillator	D2	BME/DEFIB/36	CCU
9.	Defibrillator	D3	BME/DEFIB/39	CCU
10.	Defibrillator	D4	BME/DEFIB/19	CCU
11.	Defibrillator	D5	BME/DEFIB/01	MICU

Activities involved in the usage of portable medical equipment in critical care as follows:

A. For X-ray, ECG and USG:

Activity 1 (A1)	Travelling time of equipment
Activity 2 (A2)	Waiting time before procedure
Activity 3 (A3)	Preparation of the patient
Activity 4 (A4)	Procedure
Activity 5 (A5)	Post procedure
Activity 6 (A6)	Return of the equipment

B. For Defibrillator:

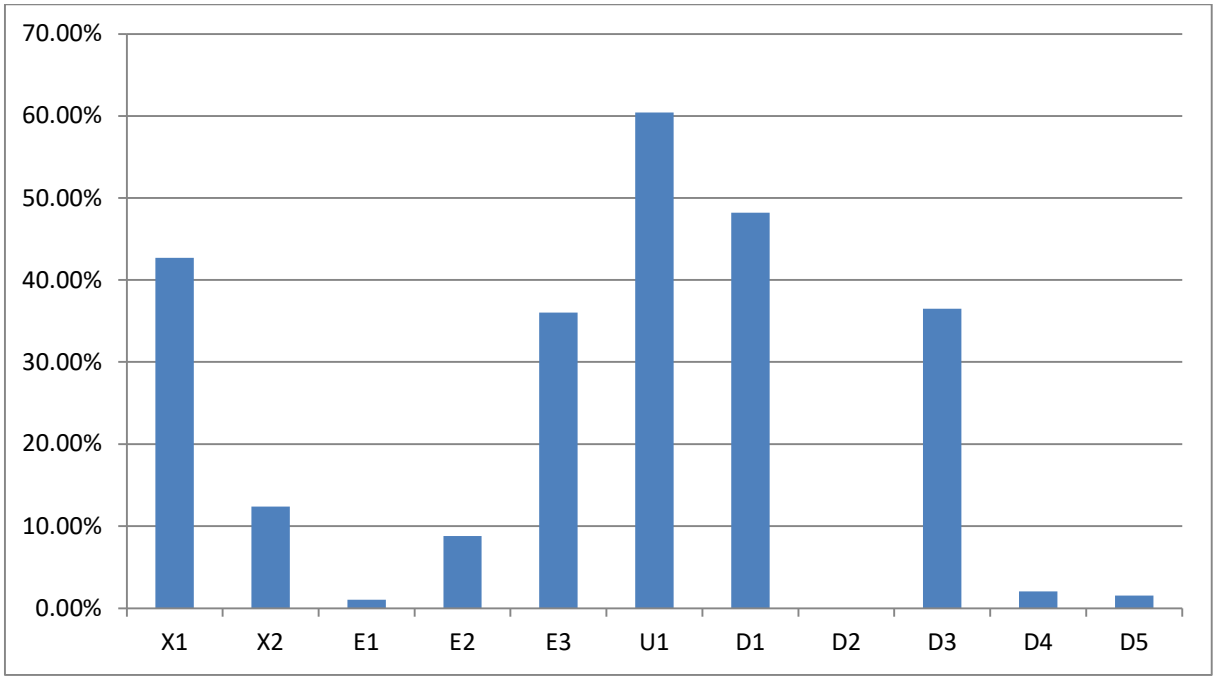
Activity 1 (B1)	Travelling time of equipment
Activity 2 (B2)	Preparation of the patient
Activity 3 (B3)	Monitoring & equipment on standby
Activity 4 (B4)	Procedure
Activity 5 (B5)	Post procedure
Activity 6 (B6)	Return of the equipment

*Selected critical areas include – Emergency, MDICU, MICU, CTVS, Transplant ICU and Gastro ICU

4.1.2 Table showing machine wise utilization.

SL. No	Equipment	Total minutes used (N)	Total minutes observed (M)	Overall Utilization (N/M x 100)
1.	X1	384.36 (6hr,24min,21.6s)	900 (15hr)	42.70%
2.	X2	111.49 (1hr,51min,29.4s)	900	12.39%
3.	E1	9.29 (9min,17.4s)	900	1.03%
4.	E2	79.01 (1hr,19min,0.6s)	900	8.78%
5,	E3	324.14 (5hr,24min,8.4s)	900	36.02%
6.	U1	543.63 (9hr,3min,37.8s)	900	60.40%
7.	D1	434.02 (7hr,14min,1.2s)	900	48.22%
8.	D2	0	900	0
9.	D3	328.38 (5hr,28min,22.8s)	900	36.49%
10.	D4	18.32 (18min,19.2s)	900	2.04%
11.	D5	13.87 (13min,52.2s)	900	1.54%

4.2.1 Bar diagram showing machine wise utilization



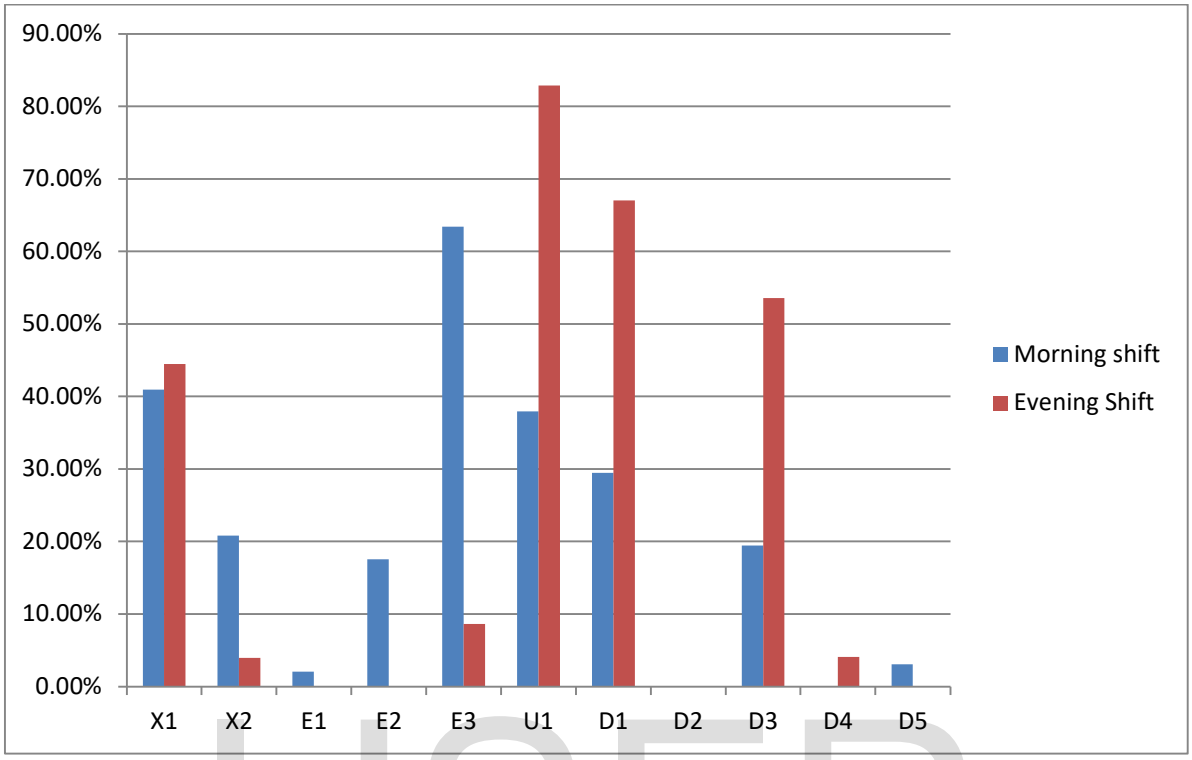
Interpretation:

Equipment X1 and D1 have moderate Utilization as use coefficient is between 40% to 60%. Equipment U1 has good utilization as use coefficient is more than 60%. The equipment X2, E1, E2, E3, D2, D3, D4, D5 have underutilization as use coefficient is below 40%. The equipment D2 and E1 have least utilization.

4.1.3 Table showing shift wise utilization:

SL. No	Equipment	Morning shift	Evening Shift
1.	X1	40.95%	44.46%
2.	X2	20.82%	3.95%
3.	E1	2.06%	0
4.	E2	17.56%	0
5,	E3	63.39%	8.64%
6.	U1	37.95%	82.86%
7.	D1	29.44%	67.01%
8.	D2	0	0
9.	D3	19.42%	53.55%
10.	D4	0	4.07%
11.	D5	3.08%	0

4.2.2 Bar diagram showing shift wise utilization of Portable equipment:



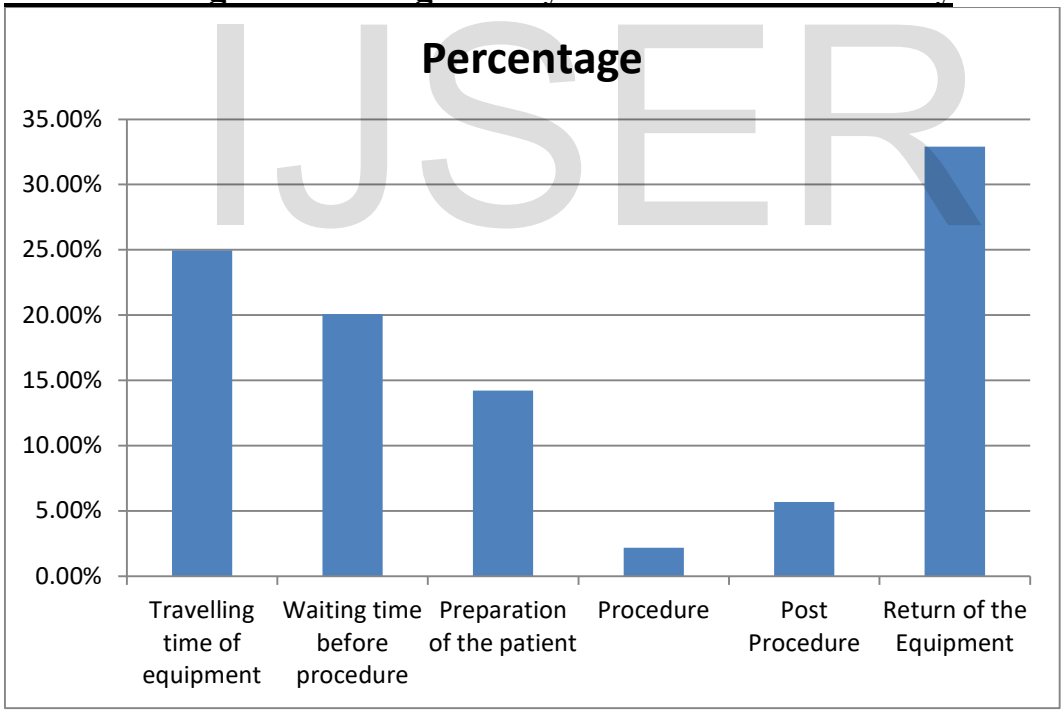
Interpretation:

Portable X-ray machine X1 has more utilization during the evening shift and X2 has more utilization during the morning shift. All 3 ECG machines have utilization more during the morning shift, among them E3 machine has high utilization. Ultrasound U1 machine has more utilization during the evening shift. Defibrillators D1, D3 and D4 has more utilization during the evening shift among which D1machine has highest utilization. D5 was found to have more utilization during the morning shift.

4.1.4 Table showing Activity wise utilization of Portable X-RAY

SL. No	Activity	Total minutes taken for the activity	Total minutes the equipment was used	Percentage
1.	Travelling time of equipment	123.714 (2hr,3min,42.84s)	495.85 (8hr,15min,51s)	24.95%
2.	Waiting time before procedure	99.61 (1hr,39min,36.6s)	495.85	20.09%
3.	Preparation of the patient	70.46 (1hr,10min,27.6)	495.85	14.21%
4.	Procedure	10.80 (10min,48s)	495.85	2.18%
5.	Post Procedure	28.16 (28min,9.6s)	495.85	5.68%
6.	Return of the Equipment	163.11 (2hr,43min,6.6s)	495.85	32.90%

4.2.3 Bar diagram showing activity wise utilization of X-ray



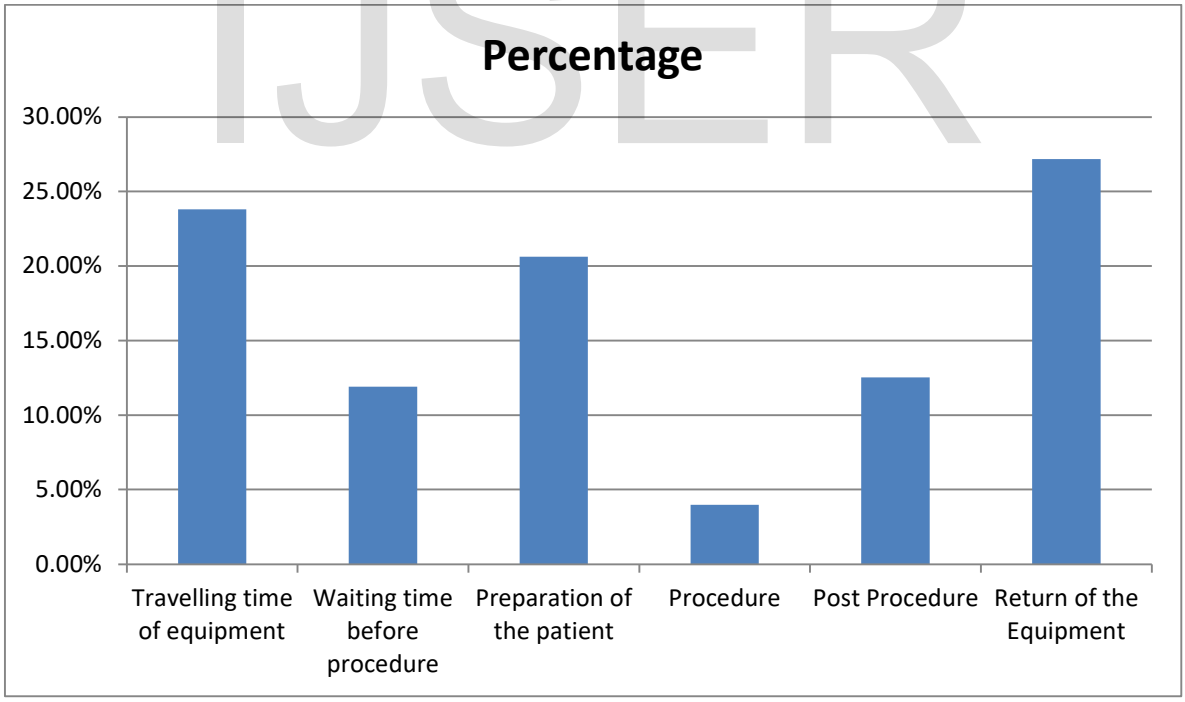
Interpretation:

The activity ‘Return of equipment’ (A6) has taken more time and ‘Procedure’(A4) has taken least time among activities identified.

4.1.5 Table showing activity wise utilization of ECG

SL. No	Activity	Total minutes taken for the activity	Total minute the equipment was used	Percentage
1.	Travelling time of equipment	98.18 (1hr,38min,10.8s)	412.44 (6hr,52min,26.4s)	23.80%
2.	Waiting time before procedure	49.07 (49min,4.2s)	412.44	11.90%
3.	Preparation of the patient	85.09 (1hr,25min,5.4s)	412.44	20.63%
4.	Procedure	16.36 (16min,21.6s)	412.44	3.97%
5.	Post Procedure	51.62 (51min,37.2s)	412.44	12.52%
6.	Return of the Equipment	112.12 (1hr,52min,7.2s)	412.44	27.18%

4.2.4 Bar diagram showing activity wise utilization of ECG



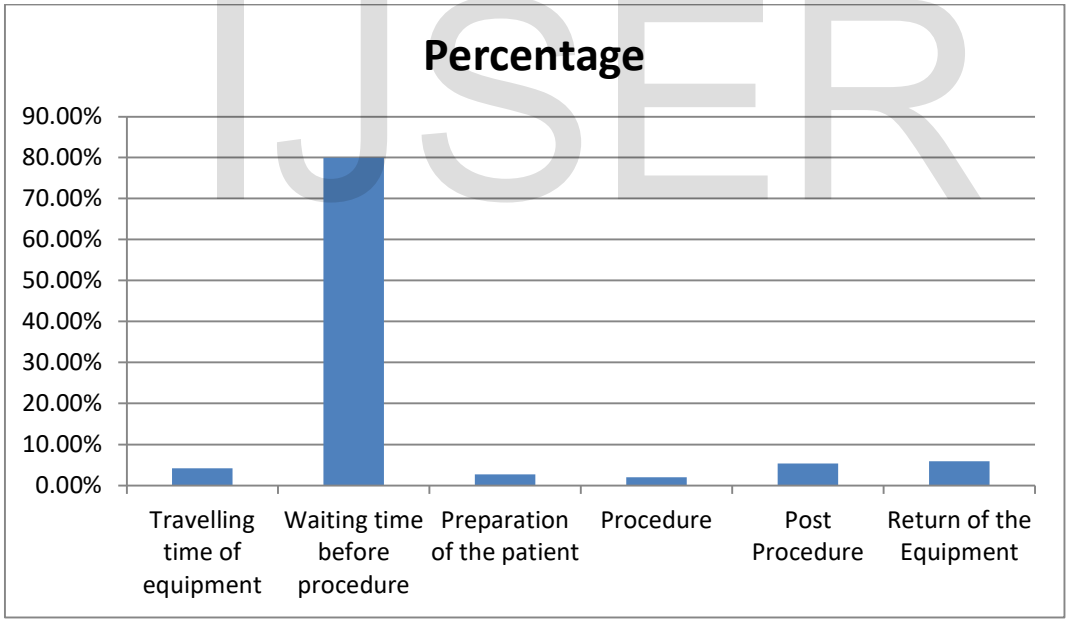
Interpretation:

The activity ‘Return of the equipment’(A6) has taken more time and ‘Procedure’ (A4) has taken least time than other activities.

4.1.6 TABLE showing activity wise utilization of USG

SL. No	Activity	Total minutes taken for the activity	Total minute the equipment was used	Percentage
1.	Travelling time of equipment	22.81 (22min,48.6s)	543.63 (9hr,3min,37.8s)	4.2%
2.	Waiting time before procedure	434.64 (7hr,14min,38.4s)	543.63	79.95%
3.	Preparation of the patient	14.48 (14min,28.8s)	543.63	2.66%
4.	Procedure	10.86 (10min,51.6s)	543.63	2%
5.	Post Procedure	28.95 (28min,57s)	543.63	5.33%
6.	Return of the Equipment	31.89 (31min,53.4s)	543.63	5.87%

4.2.5 Bar Diagram showing activity wise utilization of USG



Interpretation:

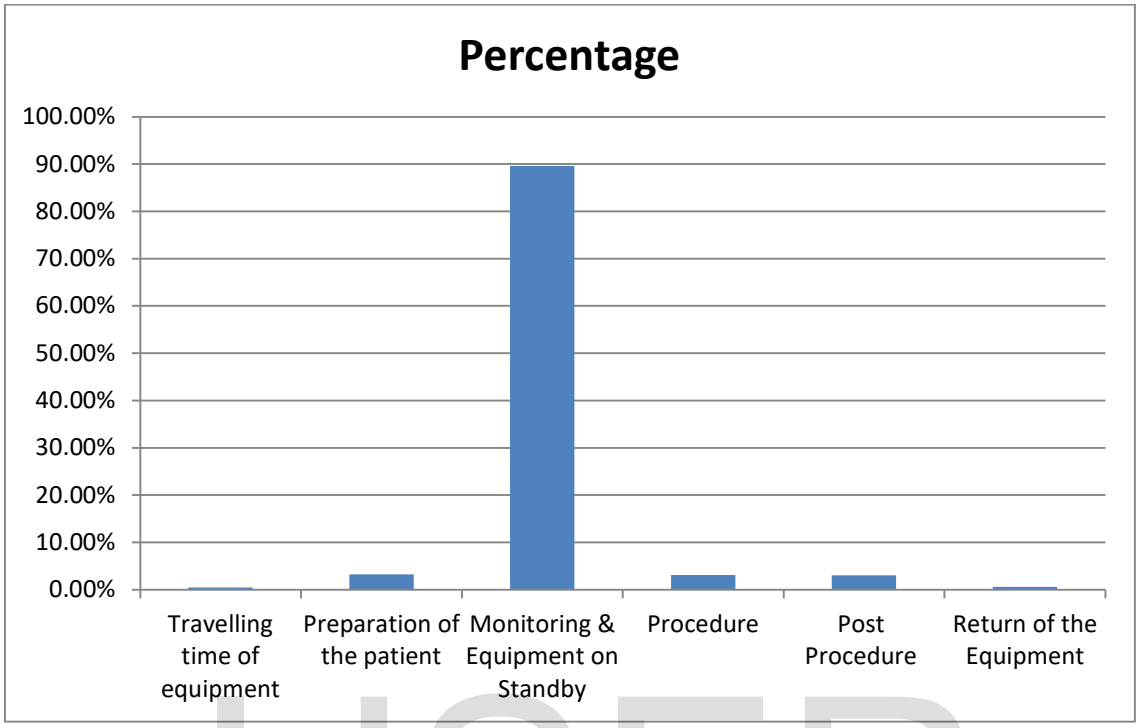
The activity 'Waiting time before procedure' (A2) has taken more time and 'Procedure'(A4) has taken least time while using USG.

4.1.7 TABLE showing activity wise utilization of DEFIBRILLATOR

SL. No	Activity	Total minutes taken for the activity	Total minute the equipment was used	Percentage
1.	Travelling time of equipment	3.57 (3min,34.2s)	794.59 (13hr,14min,35.4s)	0.45 %
2.	Preparation of the patient	25.7 (25min,42s)	794.59	3.23%
3.	Monitoring & Equipment on Standby	711.93 (11hr,51min,55.8s)	794.59	89.60%
4.	Procedure	24.79 (24min,47.4s)	794.59	3.12%
5.	Post Procedure	24.15 (24min,9s)	794.59	3.04%
6.	Return of the Equipment	4.45 (4min,27s)	794.59	0.56%

4.2.6 Diagram 7

Bar diagram showing activity wise utilization of Defibrillator



Interpretation:

'Monitoring & equipment on standby' (B3) has taken more time and 'Travelling time of equipment' (B1) along with 'Return of the equipment'(B6) has taken least time while using defibrillator.

CHAPTER 5
FINDINGS AND SUGGESTIONS

5.1 FINDINGS

1. Activities in the usage of portable medical equipment

The researcher identified six activities in the usage of equipments. X-ray, USG, ECG and Defibrillator.

2. Equipment wise utilization

The Equipment U1 (60.40%) has well utilization, whereas X1(42.70%) and D1 (48.22%) have moderate utilization. The remaining equipment are underutilized as the values are less than 40%.

3. Shift wise utilization

- **X-ray**

Portable X-ray machine X1 has more utilization during the evening shift and X2 has more utilization during the morning shift.

- **ECG**

All 3 ECG machines have utilization more during the morning shift, among them E3 machine has high utilization.

- **USG**

Ultrasound U1 machine has more utilization during the evening shift.

- **Defibrillator**

Defibrillators D1, D3 and D4 has more utilization during the evening shift among which D1machine has highest utilization. D5 was found to have more utilization during the morning shift.

4. Activity wise utilization

- **X-ray**

The activity 'Return of the equipment' A6 (32.90%) has taken more time and the activity 'Procedure' A4 (2.18%) has taken least time during the usage of X-Ray machines.

- **ECG**

The activity 'Travelling time of equipment'A1 (23.80%), and 'Return of the equipment'A6 (27.18%) have taken more time and 'Procedure'A4 (3.97%) has taken less time during the usage of ECG machines.

- **USG**

The activity 'Waiting time before procedure'A2 (79.95%) has taken more time whereas the activity 'Preparation of the patient'A3 (2.66%) and 'Procedure' A4 (2%) have taken least time during the usage of Ultrasound.

- **Defibrillator**

The activity 'Monitoring & equipment on standby'B3 (89.60%) has taken more time whereas the activity 'Travelling time of equipment' B1 (0.45%) and 'Return of the equipment'B6 (0.56%) have taken least time during the usage of defibrillator machines.

5.2SUGGESTIONS

- In order to improve the utilization of those portable medical equipment which have use-coefficient value less than 40%, the management can match the inventory and utilization with actual patient needs.
- The criteria of use coefficient of equipment under the scope of this study can be considered, if new purchase request is generated for such category of equipment.
- Time taken for each activity other than the 'Procedure' can be re-worked to improve the use coefficient of portable medical equipment.
- Management can conduct a study to identify the probable cause of delay in activities and suggest methods of reducing the delay in activities.
- Since it was found that travelling and return of equipment requires more time, it would be beneficial to conduct a transportation study to find the ideal transportation route with minimum time requirement.

CHAPTER 6
CONCLUSION

6. CONCLUSION

We all know that medical equipment has an important role to play in the healthcare sector and also it has become an unavoidable part of every healthcare organization. Hectic and stressful lifestyle has resulted in multiple health disorders. In today's fast-moving world, people prefer to have access to monitoring and diagnostic devices. Potable medical equipment has revolutionized the way in which people monitor and determine their own health and wellbeing. The term 'equipment 'in the hospital scenario generally means any instrument or tools used for various preventive, diagnostic, procedures for patient care activities.

All Hospitals are spending considerable amount of its budget per year on the installation, implementation, maintenance & repair of various portable medical equipment for providing immediate point of care to patients; but most of the time the economic aspects behind the usage of the same are not being explored. Hence it is essential to find out the utilization statistics of the portable medical equipment for knowing their economic efficiency.

After the study, the researcher has identified six activities under each four category of equipment such as X-ray, ECG, USG, Defibrillator among which equipment USG-U1(60.40%) has well utilization, X-ray X1(42.70%) and Defibrillator D1 (48.22%) has moderate utilization and other shave underutilization.

The researcher can suggest that it is good to consider the criteria of use coefficient to improve the activities other than procedure involved in the utilization of portable medical equipment.

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APPENDIX

1. TABLE SHOWING ORDER OF OBSERVATION OF EQUIPMENT

Date	Morning Shift		Evening Shift	
	9:00am – 11:30 am	11:30am - 2:00pm	2:30pm – 5:00 pm	5:00pm – 7:30pm
28/06/2021	X1	E3	U1	D1
29/06/2021	X2	E3	U1	D5
30/06/2021	D1	X1	E1	E3
01/07/2021	E2	D2	D3	D4
02/07/2021	X2	E1	U1	X1
03/07/2021	D4	U1	X2	D2
04/07/2021	D4	U1	D3	X1
05/07/2021	E1	D3	E3	X2
06/07/2021	X2	D5	D4	D3
07/07/2021	X1	E3	D2	D1
08/07/2021	D5	D1	E3	X1
09/07/2021	E1	D1	E2	D2
10/07/2021	D2	E2	E1	D1
11/07/2021	D3	D4	E2	X2
12/07/2021	U1	D2	D4	D5
13/07/2021	D3	E2	D5	E1
14/07/2021	NIL	NIL	NIL	NIL
15/07/2021	NIL	D5	E2	NIL