

**Summer Training at
Apollo BSR Hospitals
Bhilai, Chhattisgarh
(April 1, 2014 –May 31, 2014)**

**Bio Medical Engineering and Maintenance –Basic Safety Measures of Bio
Medical and Non Clinical Equipments**

**By
Arvind Mishra**

**Under the guidance of
Mr. Abhishek Dadhich**

**MBA- Hospital & Health Management (MBA-HM)
2013-2015**



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CERTIFICATE

This is to certify that **Dr. Arvind Mishra**, a student of Post Graduate Diploma in Hospital and Health Management, Institute of Health Management Research, Jaipur, batch 2013 – 15 has done his summer training for the period of **April 1st to May 31st, 2014 with Apollo BSR Hospital, Bhilai** under my guidance. During this period he has completed his study as a part of partial fulfillment of the course requirements, recommended for the Post Graduate Diploma in Hospital and Health Management. Topic of study given by Apollo BSR Hospital during his summer training was **“Bio Medical Engineering and Maintenance - Basic Safety Measures of Bio Medical and Non Clinical Equipments”**. All the data related to the study is the Primary data. His approach to the projects has been sincere, scientific and analytical.

I wish him all the best for his future endeavor.


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**SUMMER TRAINING AT
APOLLO BSR HOSPITALS
BHILAI CHHATTISGARH
(1th APRIL, 2014 – 31st MAY, 2014)**



**BY
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ACKNOWLEDGEMENT

I extend my sincere gratitude to **Mr Sanjay Shrivastav**, for giving me the opportunity to do this study and undergoing the process of learning at APOLLO BSR BHILAI. I thank them for all the trust and faith they posed in me and I only hope that I have been able to live up to their expectations. Their guidance and support was helpful in enhancing my work.

I extend sincere gratitude towards **Mrs Shreekala** who has been my mentor for the summer internship program & has been instrumental in helping me shape this study in a desirable way.

I would also like to thank **Mr. Sanjay Borkar** Quality department, for supporting my work all along. I would also like to extend my thanks to **Mr. Sunil (HOD Biomedical department)**, **Mr. Jafar** (engineers at Bio medical department), **Mr. Jakir Ahmd Hossain (HOD Maintenance)** and Apollo BSR Bhilai for helping me through my study.

Last but not the least; I would like to thank the entire **staff of APOLLO BSR HOSPITALS BHILAI** for their support and guidance.

I would like to express my sincere thanks to **Dr. S.D. Gupta**, Director, IHMR, **Dr. Ashok Koushik**, **Mr. Abhishek Dadhich (mentor)** and all my faculty members for the proper guidance and cooperation extended by them. I am also grateful to my parents, my family and my friends for giving me moral support.

However, I accept the sole responsibility for any possible error of omission and would be extremely grateful to the readers of this project report if they bring such mistakes to my notice.

Dr. Arvind Mishra

TABLE OF CONTENTS

S. NO.	TITLE	PAGE NO.
1.	PREFACE	4
2.	INTRODUCTION AND ORGANIZATION PROFILE	5
3.	SPECIFIC PROJECT– OBJECTIVES	9
4.	INTRODUCTION	10
5.	DATA COLLECTION	12
6.	DATA ANALYSIS,INTERPRETATION	13
7.	CONCLUSION AND RECOMMENDATIONS	39
8.	REFERENCES	40
9.	ANNEXURE	41

PREFACE

Summer internship is an integral part of the PGDHM curriculum. As a part of the course; students of first year are required to undergo summer placement at any reputed organization to get in depth exposure of various departments in the organization and better understanding of the health care delivery system and its functions.

The major objectives of the summer training program are as follows:

1. To assess the knowledge of the staff regarding the maintenance and safety.
2. To find out the basic safety measures followed by the operator.
3. To find out the procedure followed during the break down of any equipment.
4. To find out the causes of delay in repairing of the equipment if applicable.
5. To identify the training needs if any for the operating technician.

During the training period I had an **Overview of various departments of the hospital.** I also carried out a study titled “**Bio Medical Engineering and Maintenance - Basic safety measures of bio medical equipment and non clinical equipment.**”

The aim of the study was to identify the various medical equipments needed in various departments and to assess the operating technician's knowledge of basic safety measures for patient and operator's safety while working with the equipment and to assess the maintenance of the equipment done by technician for some critical and high end equipment.

ABOUT THE ORGANISATION

Apollo BSR is a multi specialty hospital with a motto to provide quality healthcare at affordable cost. It has a fully equipped centre of international standard for cardiac intervention and surgeries.

VISION:

“To be the most preferred Health care service provider in the community by continuously improving the existing standard of Medicare”

MISSION:

“Apollo BSR Hospitals always provide comprehensive and modern healthcare solutions to patients with a humane approach”

The Journey:

The group started with a diagnostic centre in the year 1993 at Bhilai. Over a period of time all modern diagnostic facilities like 1.5 T MRI, 64 slice cardiac CT, Multi slice spiral CT scan, 4-D real time color Doppler, Ultra modern Pathology, Endoscopy, Bronchoscope, mammography, echocardiography, UltraSonography , Digital X-Ray etc. have been installed at our various centers. Thereafter similar centers have been established at other locations such as Nagpur, Raipur, Korba and Rajnandgaon.

In the year 2000 the group ventured into establishing ultra modern super specialty cancer hospital in Bhilai- BSR Cancer hospital which is the only comprehensive cancer management centre in Chhattisgarh. After 17 year into being called a pioneer and leader in diagnostics in central India and 8 years in comprehensive cancer management, BSR health care is now well known name in healthcare sector.

BSR realized the need for a multispecialty Tertiary care hospital in Central India and prompted by desire to extend high quality Medicare beyond the confines of the rich class . BSR Healthcare has set up Super specialty Hospital at Bhilai, Apollo BSR hospital,Bhilai became operational from September 2007.

Commitment to the community.

“Caring for the community”

Those simple words describe the past, present, and future of Apollo BSR hospitals Bhilai. Their roots run deep in the community, starting with the 1st high tech diagnostic centre in 1993. After 15 years of being pioneer in diagnostics in entire central India , BSR healthcare started comprehensive cancer management hospital- BSR Cancer hospital and Research centre at Bhilai in June 2001. Apollo BSR is 175 bedded Super Specialty Hospital providing secondary and tertiary level healthcare at affordable cost in association with Apollo Hospitals Chennai. The inpatient beds are classified into deluxe suite, private room, double bed wards, shared wards and dedicated cancer wards.

The hospital enjoys the reputation of being the first and only hospital to have a digital flat panel Cath lab and 4 modular OTs with laminar air flow and HEPA filters for coronary Bypass surgeries, Coronary Angioplasty and other special surgeries. They are having 42 bedded ICU including cardiac, surgical, Medical, neonatal and pediatric ICU.

Apollo BSR at bhilai is an attempt to integrate the best and most qualified medical professionals and doctors by providing them the best infrastructure, latest technologies in Biomedical engineering and health care services along with a dedicated team of nurses, technicians, staff and professional management in such a way that our super speciality hospital can provide the best health care services so that the patients in C.G. as well as neighboring states could be benefited.

Already they have got a very good response from the patients in this region and they are regularly getting the patients not only from C.G. but also from neighboring states. They are recognized and empanelled by Govt. Of Chhattisgarh, CSEB, NSPCL, FCI, BSNL, CISF, NMDC, SECL, and various insurance companies\TPAs. They have also started more departments like Infertility clinic, , cosmetology, joint replacement surgery, high end ophthalmology etc.

They have plans to increase beds from 175 beds to 200 beds which will include 10 more beds in ICU, since bhilai is very well connected by air (nearest airport Raipur 40 kms), Rail (nearest Railway station Durg 5 kms), and Road (on main National Highway NH6).

Various departments in the hospital are

Clinical Services:

- 24-hour Accident & Emergency Services (Trauma Unit)
- Anaesthesia
- Cardiology
- Cardiothoracic Surgery
- Dental
- Dermatology and Venrology
- Endocrinology & Diabetology
- ENT
- Gastroenterology
- General & Laparoscopic Surgery
- Health Check-Ups
- Infertility Clinic-(IVF,IUI)
- Internal Medicine
- Medical Oncology
- Nephrology
- Neurology
- Neurosurgery
- Obs. & Gyanaecology
- Ophthalmology
- Orthopaedics
- Paediatrics/ Neonatology
- Pain Management
- Plastic Surgery/Cosmetic Surgery
- Psychiatry & Psychotherapy
- Respiratory Medicine
- Surgical oncology
- Urology

Critical Care Units

- Medical Intensive care unit
- Cardiac Intensive unit
- Surgical intensive care unit
- Neonatal Intensive care unit
- Intensive Cardiac care unit

Diagnostic Services

- Laboratory
- Radiology (MRI Service delivery at BSR Diagnostic centre)
- Radiotherapy Department (Service delivery at BSR Cancer Hospital)
- Nuclear Medicine Department (Service delivery at BSR Cancer Hospital)

Therapeutic services

- Clinical consultation services
- Clinical inpatient service
- Operation theatres
- Labour room
- Digital Cath Lab
- Dialysis Unit
- Bronchoscopy
- Endoscopy
- ECG, Echo, TMT, EEG, EMG, PSG, Spirometry

Ambulatory Care Area

- Outpatient services
- Emergency services
- Pharmacy services (IP- 24 Hrs, OP Pharmacy)
- Physiotherapy Department

Auxiliary Services

- Dietary services
- Central Sterile and Supplies Department
- Laundry
- Stores (general, medical) & Substores
- Mortuary
- MGPS (Cylinders and piped medical gases)
- Engineering services
- Housekeeping
- Security
- Medical record department
- Hospital Management Information System
- Administrative Office
- Ambulance & Non ambulances

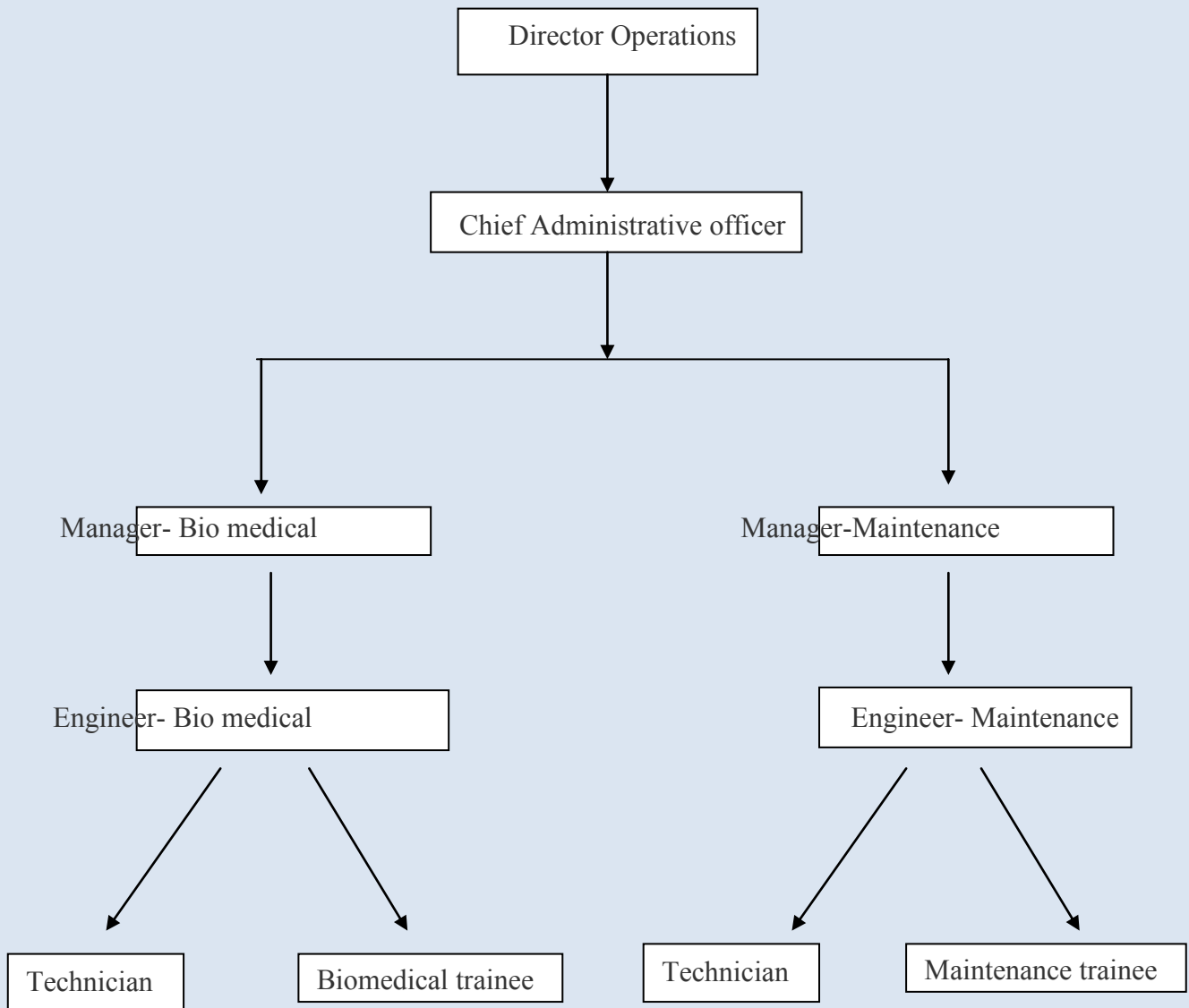
INTRODUCTION

Biomedical engineering department generally known as BMD has its strong presence right from Equipment planning to obsolescence. BMD helps in optimizing the equipment usage and in-house maintenance saves a lot on after sales service's cost. A strong MIS/database is generated which help the management to decide about future purchase/up gradations/obsolescence. The BME dept. is located in the basement and its services are available 24x7x365 days.

Activities of BME and Maintenance dept are:

- Preparing and formulating pre installation requirement and commissioning of new equipment in following points:
 1. Site preparation.
 2. Shipment verification for shipment, damages and wrong shipment.
 3. Recording minute details of installation.
 4. Commissioning of equipments by test runs and heat run tests.
 5. Awarding ownership and assuring accountability of the complete sets of equipments,
 6. Handing over the equipments.
 7. Assuring proper user and technical training from suppliers and principals.
- Routine maintenance
- Periodic maintenance
- Attending breakdown calls.
- Co-ordination and liasioning with vendors for speedy supply of spares and consumables required for day to day working of equipments.
- Vendor development for cost effective solutions in repairs and consumables.
- Documentation of service reports, installation reports, history sheets for each equipment i.e. filling of all relevant documentation to track the history of each equipment.
- Computerization of relevant information regarding breakdown and repair costs involved.
- AMC/CMC management.
- Conceptual training to users.
- To prepare a data bank of all major and minor equipments covering the technical specifications, market perception, installation base, after sales services etc. this will help in future up gradation and purchases of equipment in hospital benefit.

ORGANOGRAM:



SPECIFIC PROJECT:

MEDICAL EQUIPMENTS-Analysis of break down time and basic safety measures:

OBJECTIVES

1. To assess the knowledge of the staff regarding the maintenance and safety.
2. To find out the basic safety measures followed by the operator.
3. To find out the procedure followed during the break down of any equipment.
4. To find out the causes of delay in repairing of the equipment if applicable.
5. To identify the training needs if any for the operating technician

The areas covered for this project are as follows:

1. All ICUs (Medical, Surgical, Cardiac)
2. Casualty
3. Pathology
4. Linen and Laundry

EQUIPMENTS:

(a) Critical care equipment:

1. Defibrillator (Heartstart XL)
2. Ventilator (Engstromcarestation)
3. Infusion pump (Plenum aspire)
4. Monitor (Philips, schiller)
5. Dialysis machine
6. ECG (Electro Cardio Gram)

(b) Diagnostic equipment:

1. Cell counter (Sysnex XS 1000i)
2. Biochemistry Analyser (EM-360)

(C) Linen and Laundry machine:

1. Washing machine (vision)
2. Dryer (vision)

DATA COLLECTION & METHODOLOGY

Data Collection:

The procedure followed is enumerated below:

- i. A study of the duties of each individual was conducted to understand the roles and responsibilities of the technician and nursing staff.
- ii. Nursing and operating personnel in each department was interviewed in detail to know about the procedures carried out by them while operating the equipment, in addition observation of the staff while operating the equipment was done whenever possible.
- iii. A semi-structured equipment specific questionnaire was prepared by referring to the operating manual and discussion with the biomedical staff which was used to interview the staff of the respective departments, which is given in the annexure. In addition a general checklist was also prepared for observation, containing records of EPM, IPM, Safety measures and trainings performed.

Methodology:

Study Type – Cross-sectional study.

Study Area – various ICUs of the Hospital (medical, surgical, cardiac, ITU), casualty, Pathology, linen and laundry.

Study Participants: staff of the respective departments.

Sample size – 50 staff directly involved with operating and maintenance of equipment.

Study Technique – Interview, observation (checklist).

Study Tool – Semi- structured questionnaire, Checklist.

Data Collection Plan – This study surveyed 50 staff members. For collecting the data interviews and observation of the equipment was carried out after taking authorization from concerned authorities of these departments.

Data analysis – done with the aid of MS-Excel sheets. The data was entered in sheets equipment wise and then analyzed with the help of graphs.

Ethical Considerations - purpose of the study was clearly explained. The respondents were assured of the data confidentiality.

Data Analysis, Compilation and Interpretation:

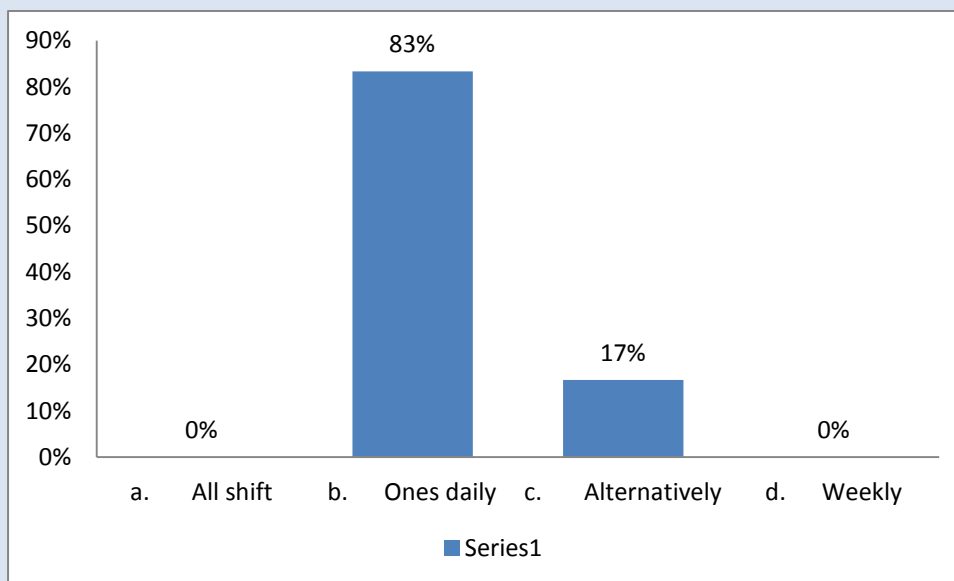
Equipments were categorized into Critical equipments, Diagnostic equipments and laundry equipments for analysis through interview and observation. The equipment wise analysis of the data is as follows:

INTERVIEW and GENERAL OBSERVATION:

i. Critical Care Equipments:

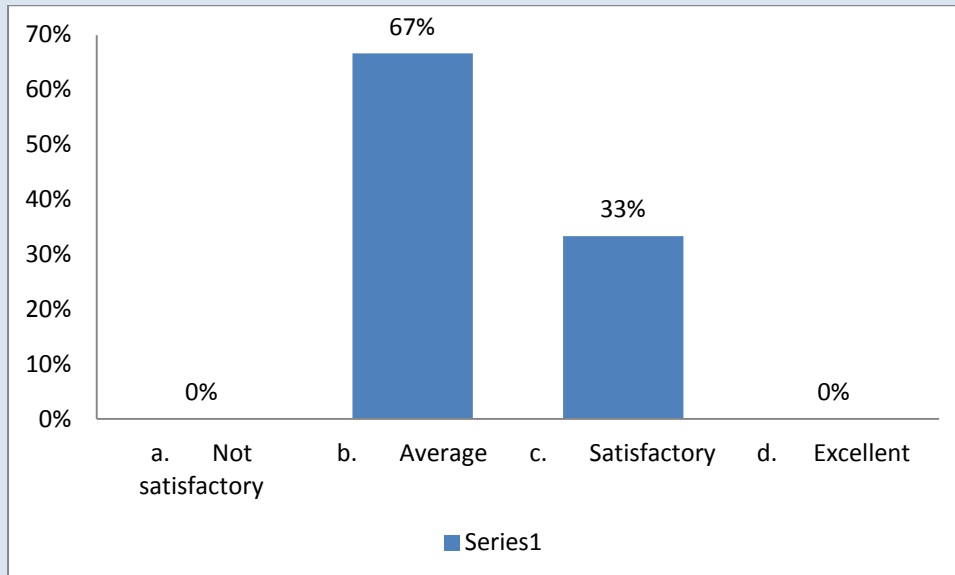
1. Defibrillator:

Q.1 If equipment checked at every shift?



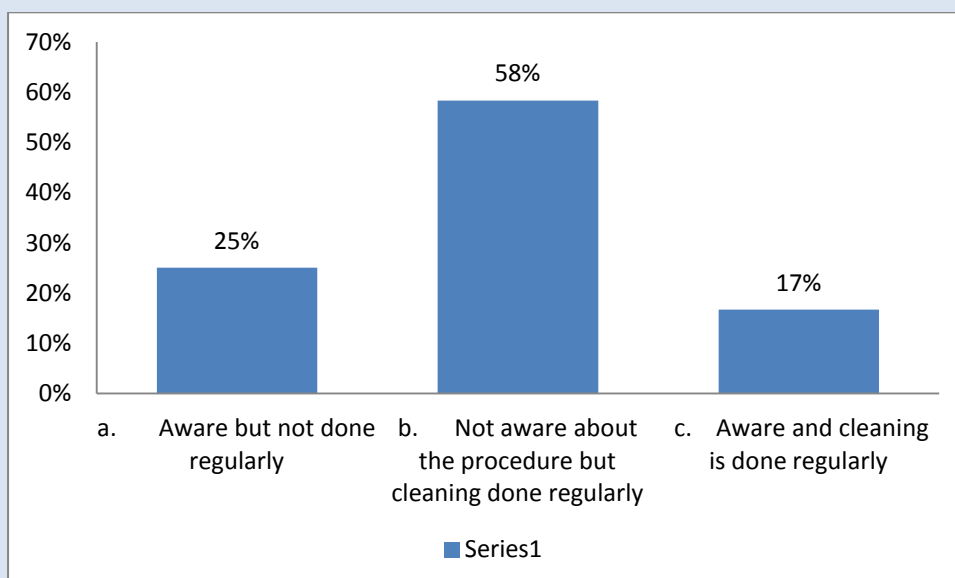
- 83% of staff check the equipment once daily.
- 17% of staff check alternatively but as recommended it should be checked in every shift.
- This can lead to patient discomfort and medical error.

Q.2 Are you aware about battery charge?



- On the basis of interview 67% of staff is average which may lead to in proper battery charge leading to equipment breakdown.

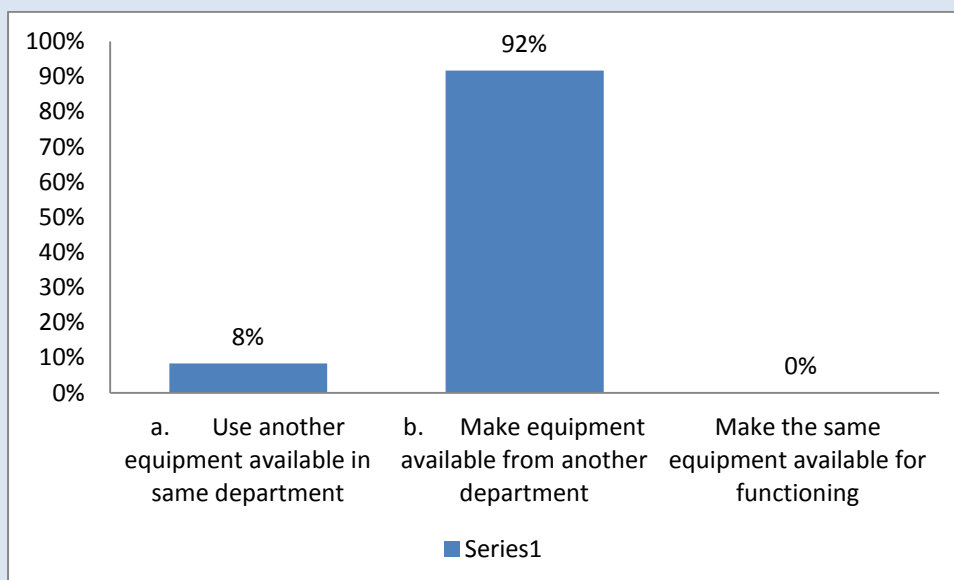
Q.3 Are you aware about the cleaning/ disinfection procedure of the equipment, is it done regularly?



-from the above interview, due to lack of awareness of 58% of staff results in proper cleaning

Which lead to equipment breakdown and high maintenance cost.

Q.4. . What is the first step often the break down of equipment in emergency?

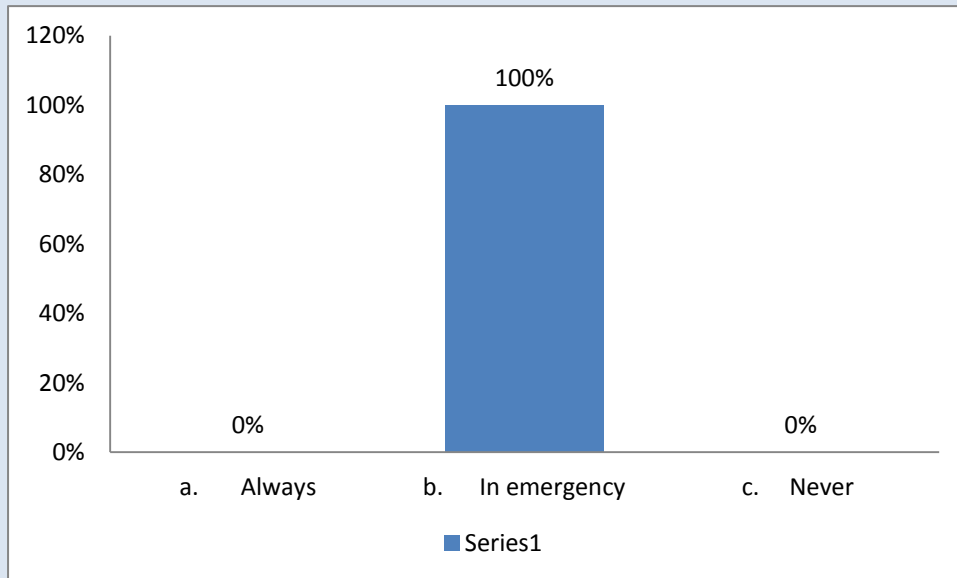


-during interview 92% of staff said that make equipment available from another department.

OBSERVETION: Beside the staff is completely aware about the cleaning, handling, and maintenance of the equipment (defibrillator) – where observed, it was seen that the staff does not apply practically during their working hours.

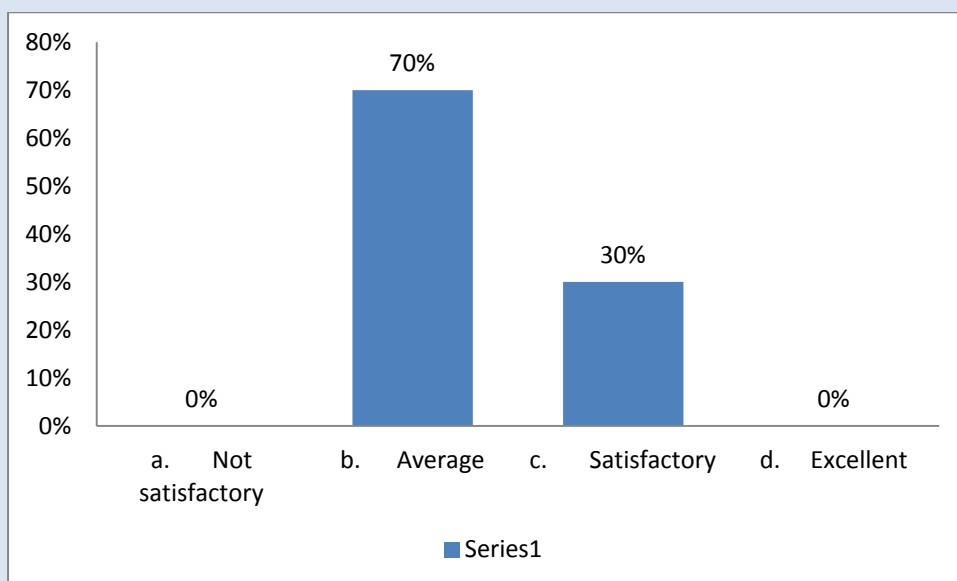
2. VENTILATOR:

Q.1 Do you use mobile phone near equipment?



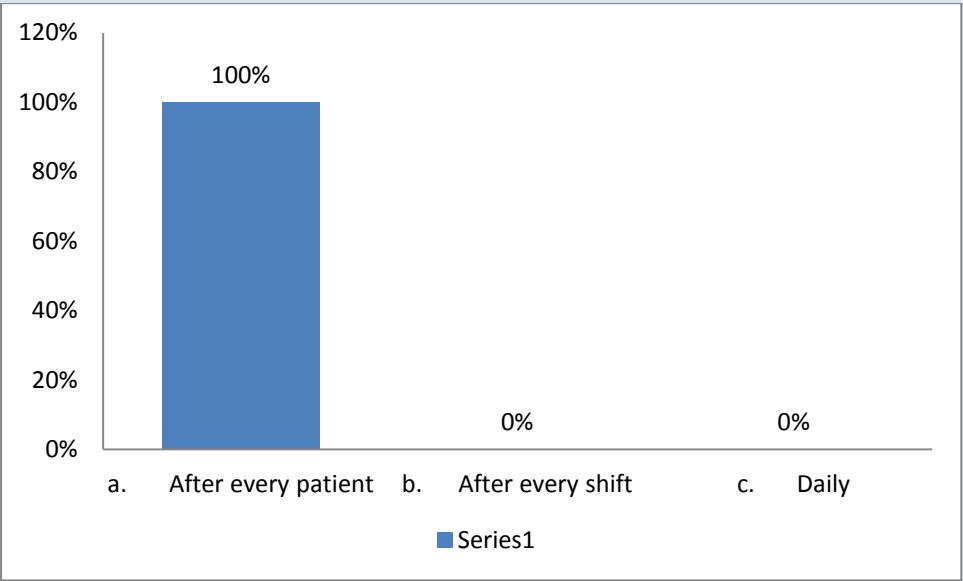
When interviewed 100% of staff used mobile phones near ventilator According to the manual can be harmful for the equipment and patient as it can lead to inaccurate readings by the equipments

Q.2 Does the operator have knowledge regarding proper handling of the equipment?



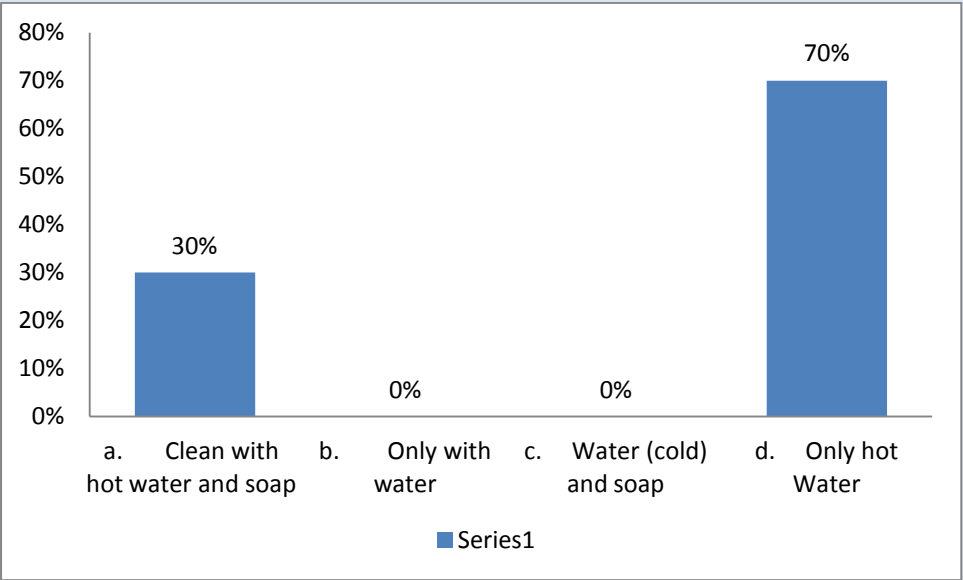
From the above data 70% of staff having average knowledge which can be harmful for the patient and the equipment and also shows lack of training among staff.

Q.3.Is regular flow sensor cleaning done?



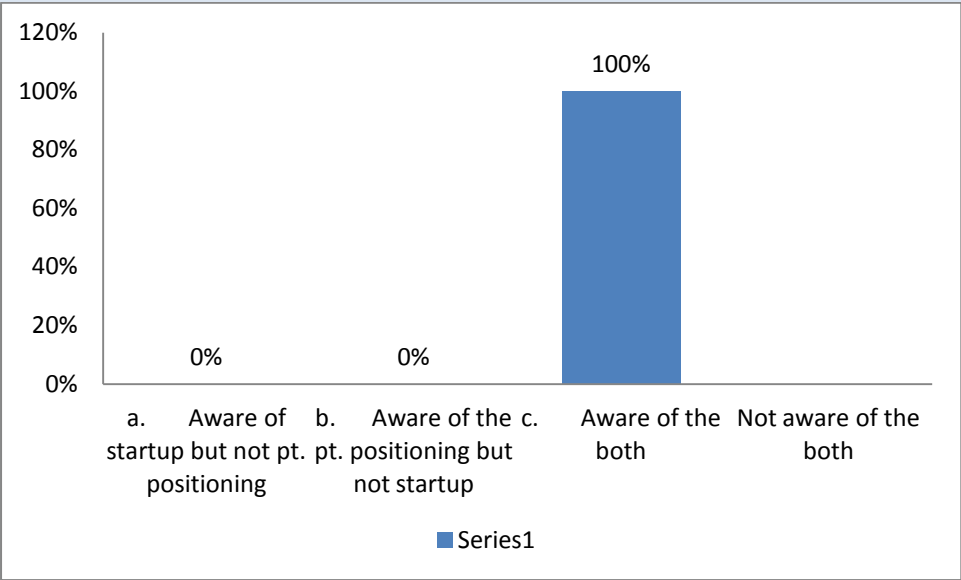
-according recommendation flow sensor should be cleaned after every patient, which is followed resulting proper functioning is the equipment and less patient infection.

Q.4. If yes then all the steps of flow sensor cleaning is followed?



All of the staff interviewed had knowledge about regular cleaning of flow sensor. But 70% of staff are uses only hot water which is wrong and 30% of staff are uses hot water and soap which is correct.

Q.5 Is the operator aware of the startup of the equipment and patient positioning ?

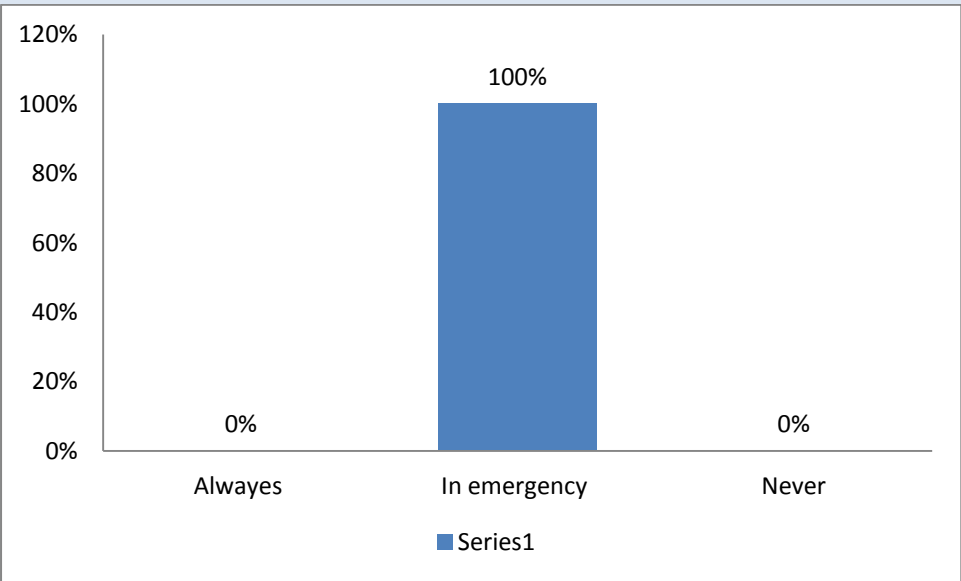


-from the above data is reflex knowledge and proper training

GENERAL OBSERVATION: During observation, the observe that staff uses their mobile phone oftenly and not only in emergency. Beside the awareness of the cleaning of the equipment, the equipment is not cleaned after every patient which leads to blood stains and brakeage of the sensor.

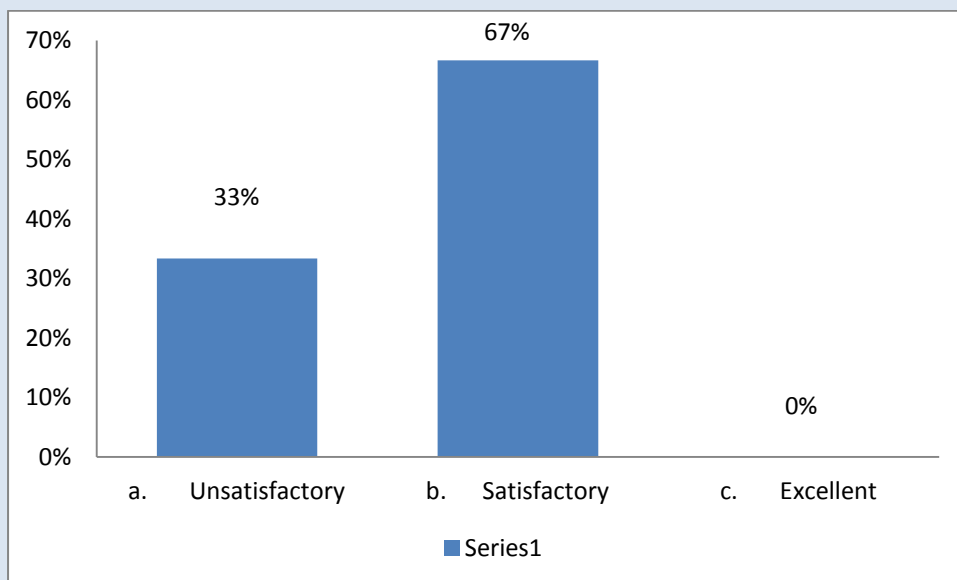
3. SYRINGE PUMP:

Q.1 Do you use mobile phone near equipment?



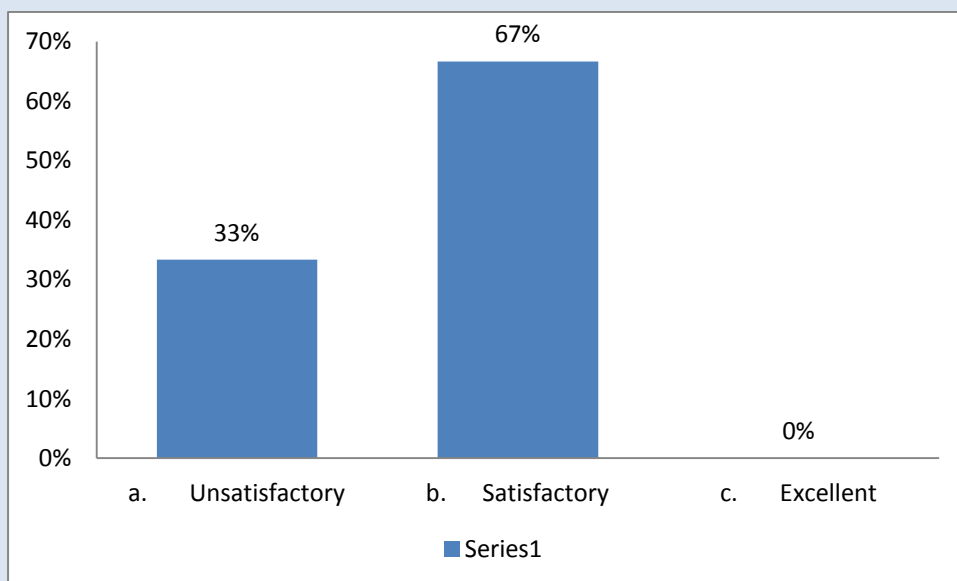
- When interviewed 100% of staff used mobile phones near ventilator According to the manual can be harmful for the equipment and patient as it can lead to inaccurate readings by the equipments

Q.2. Do you perform startup test (plenumtech aspire)?



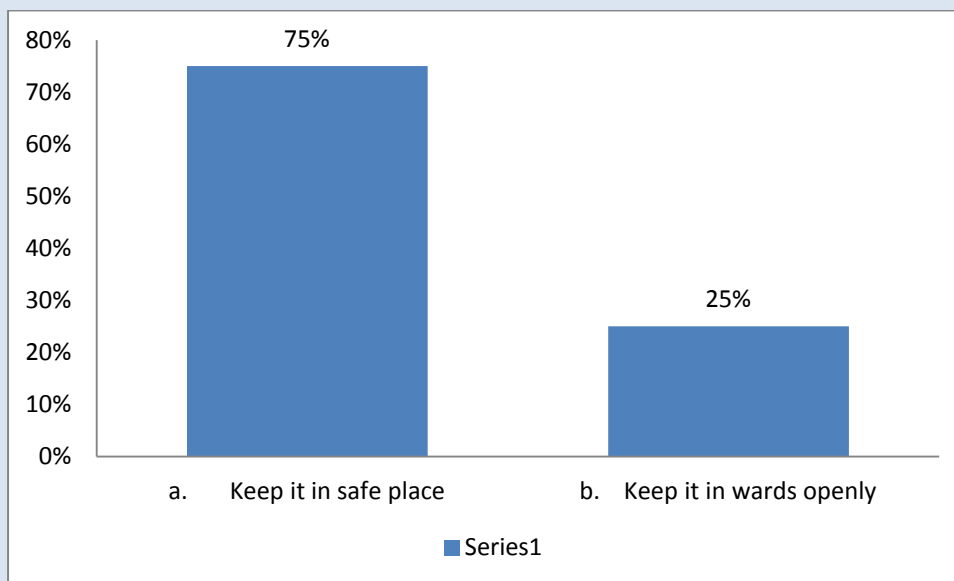
- As seen 33% do not perform start up test can trouble the patient during the emergency.

Q.3. Do you perform all the steps of startup test for syringe pump of injectomalagilia model?



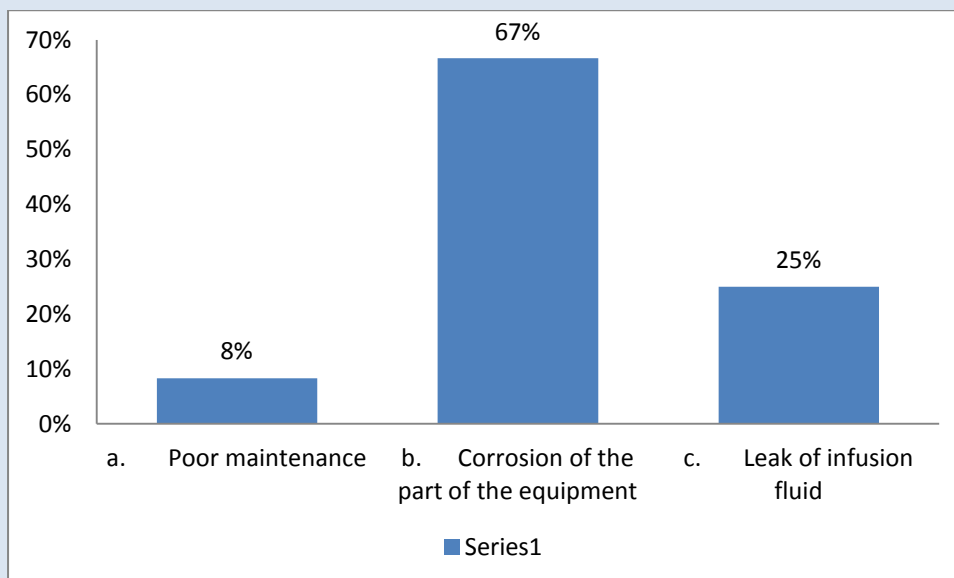
- As seen 33% do not perform start up test can trouble the patient during the emergency.

Q.4. what you do when the syringe pump is not under use?



- decreases the frequency of breakdown and thus, maintenance cost

Q.5 . In your observation, what is the common cause of break down of equipment?



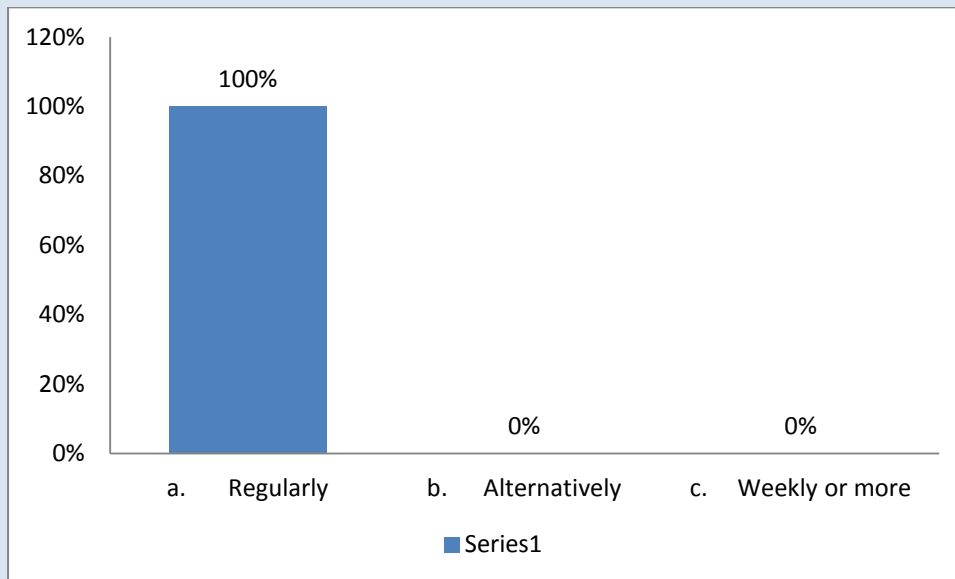
Due to poor maintenance increase in equipment breakdown.

OBSERVETION: Beside complete awareness and knowledge among staff their increase frequency in the breakdown of the equipment. Because

- (1) The equipment not kept safety (is always handling after use)
- (2) Due to leakage of the residual saline solution on the syringe pump.

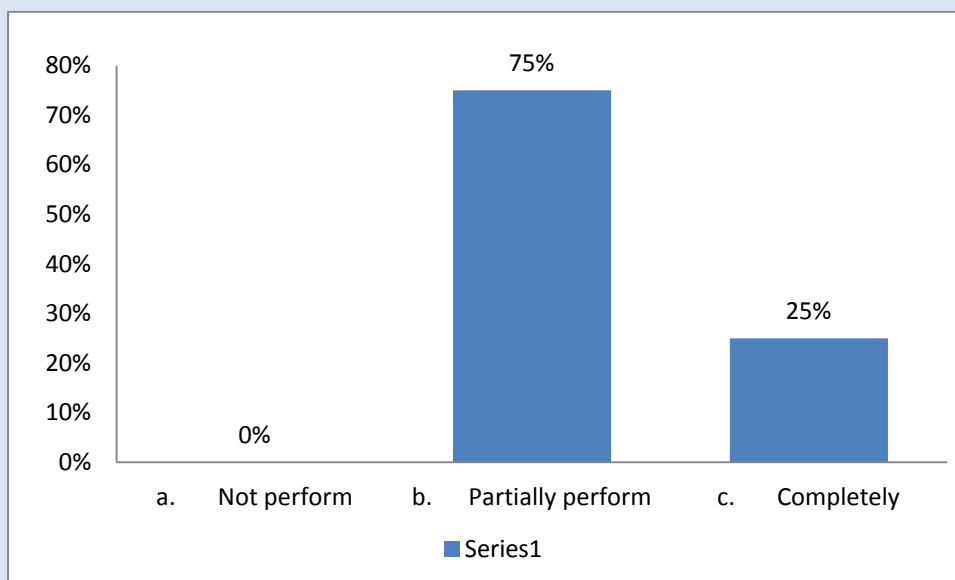
4. MONITOR:

Q.1 Do you clean and disinfect the monitor?



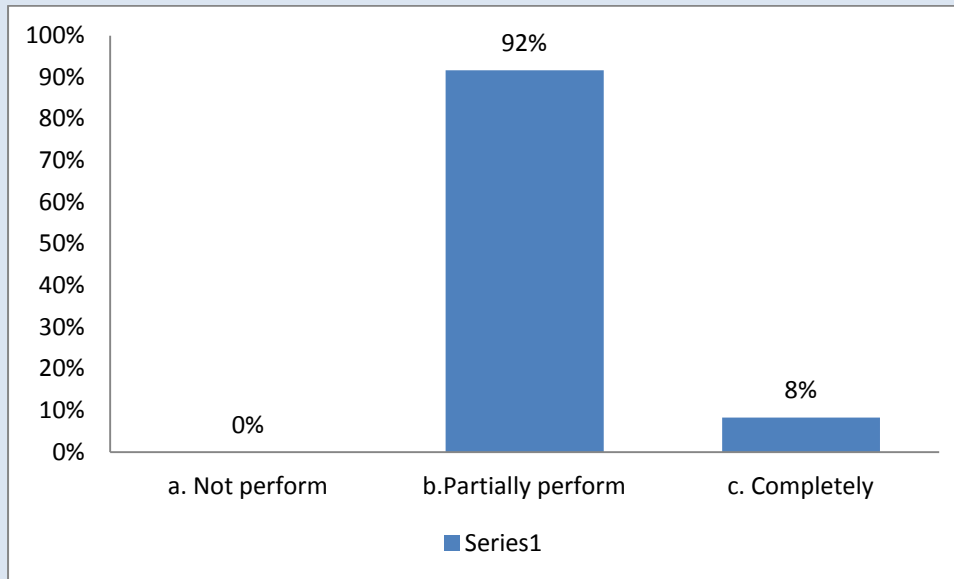
- Infection control for the patient and staff.

Q.2. Do you perform daily visual test?



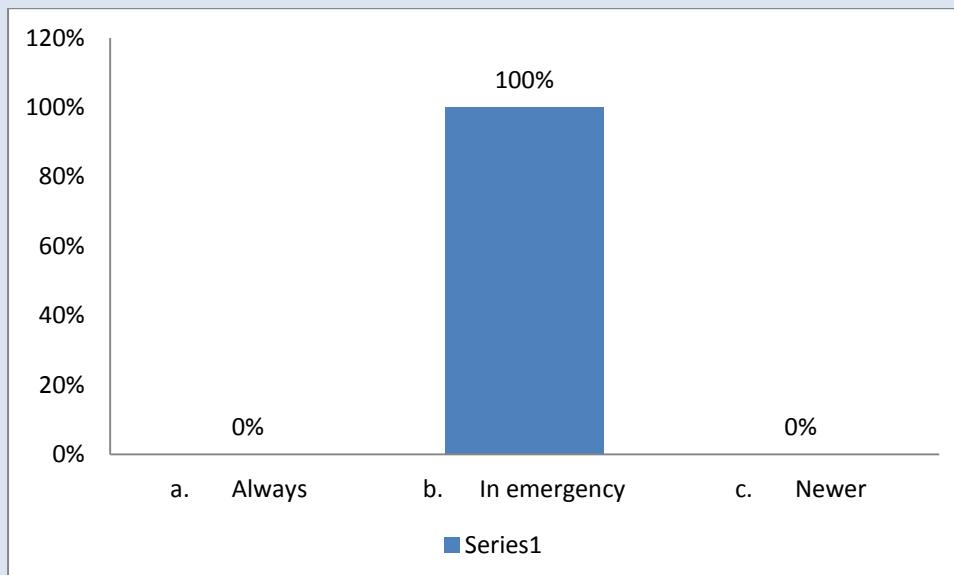
- 75 % are partially performing. They are giving the excuses that patient feeling discomfort , so they are performing once in day.

Q.3. Do you follow startup and shutdown procedure?



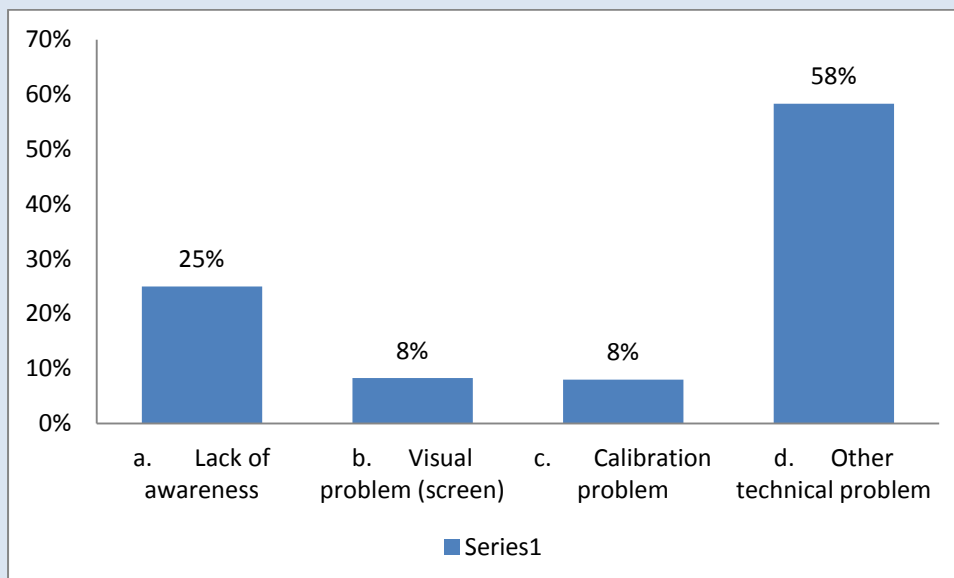
- Due to this equipment can leads to improper functioning and increases equipment breakdown.

Q.4. Do you use mobile phone near monitor?



- When interviewed 100% of staff used mobile phones near ventilator According to the manual can be harmful for the equipment and patient as it can lead to inaccurate readings by the equipments

Q.5. What is the common cause of break down in monitor?

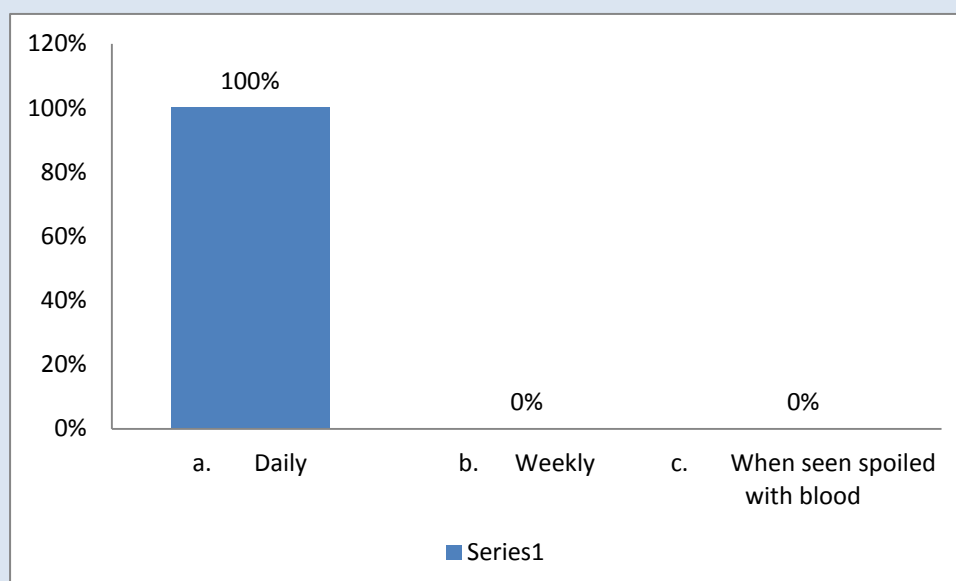


- According to nursing staff 58% of breakdown happening due to technical problems. 25% agreeing that they are not aware about the cause of breakdown.

OBSERVETION: When observed, staff continually uses mobile phone near monitor. Which may produce wrong reading and may also affect the display of the monitor was not cleaned regularly, Due to negligence of the staff.

5. HEMO-DIALYSIS :-

Q.1. When do you perform external cleaning?



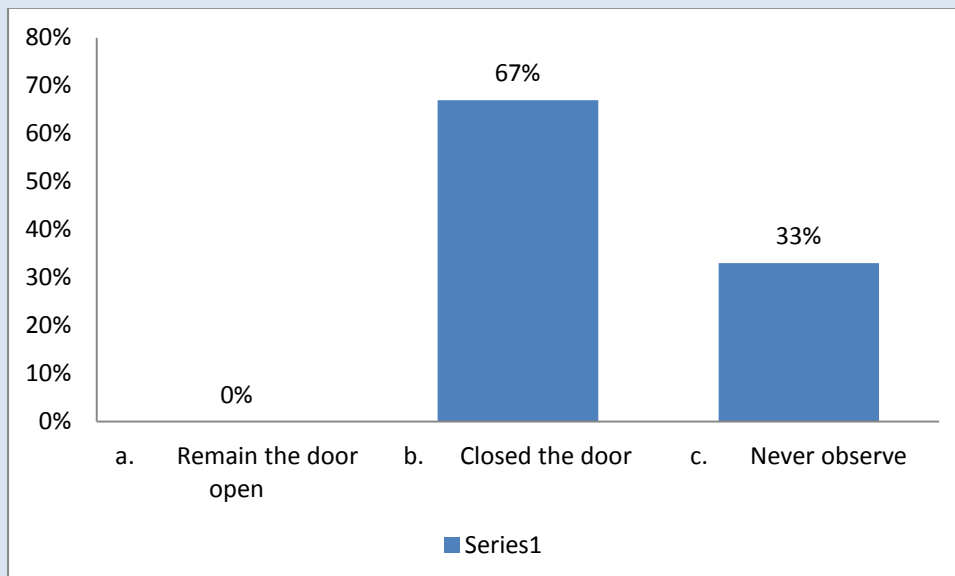
-As per staff interview they are following 100%.

Q.2 Who perform internal cleaning?



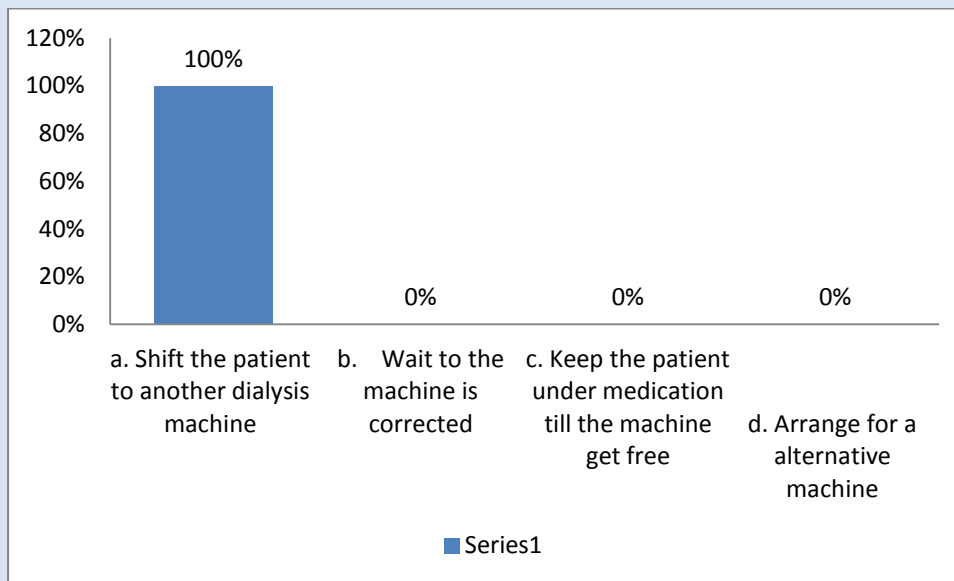
- As per staff interview they are following 100%.

Q.3. Do you know about shunt door. If yes what will you do if you see then open during cleaning?



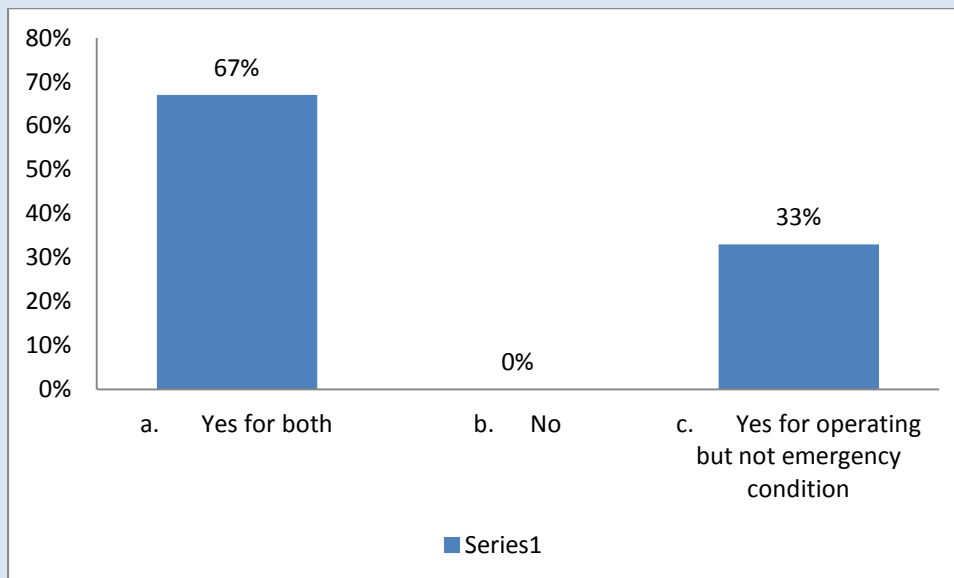
- 67% of employee closed the door which is the batter for the equipment. 33 % staff are not aware about this process

Q.4. What will you do if the dialysis machine goes under a break down during the procedure?



- It is correct.

Q.5. Are you given training regarding operating the dialysis maintenance and handling in emergency condition?

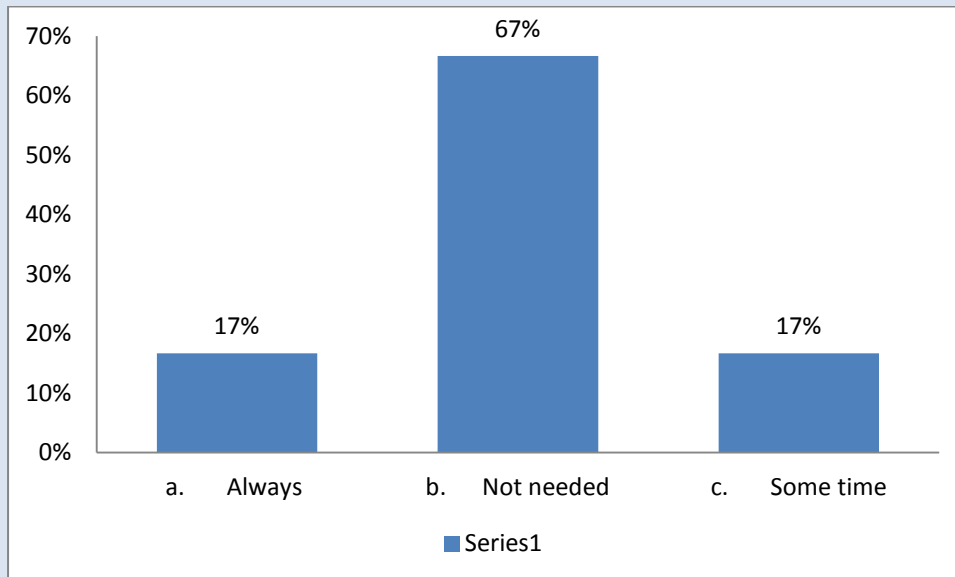


- 67% of staff have taken proper training.

OBSERVETION: The main cause of the breakdown of the dialysis machine is cleaning beside the staff is completely aware about the external and internal cleaning. That to be performed after Every patient. This leads to defect in the pressure pump and thus increase in maintenance cost.

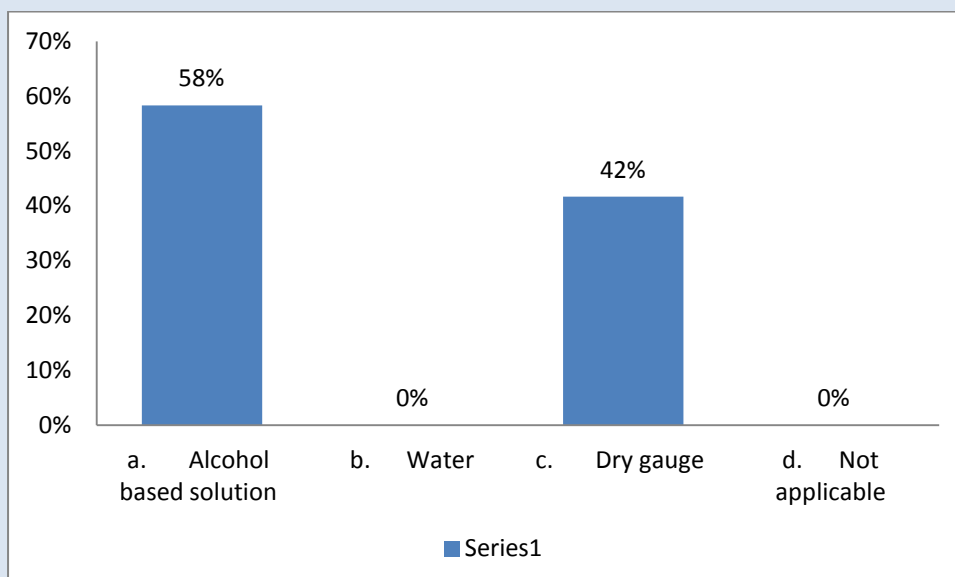
6. ECG (Electro Cardio Gram):

Q.1. Do you ask patient to keep their electronic gadgets (mobile, watch, tab etc) away?



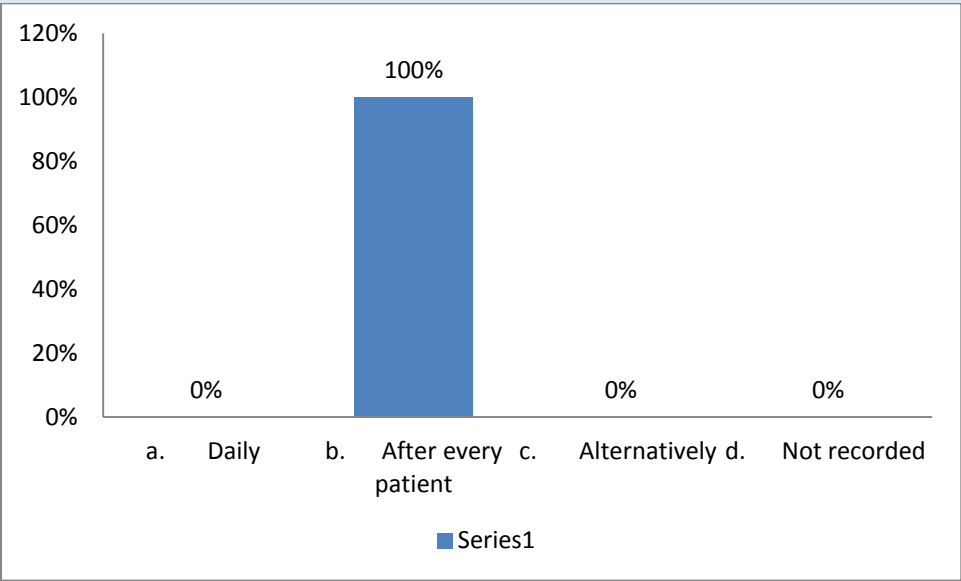
- As per hospital protocol, patient valuables are not allowed in ICUs.
- **67%** of staff said not needed to ask.

Q.2. Do you get training for cleaning and operating ECG machine? If yes then how do you clean the ECG machine?



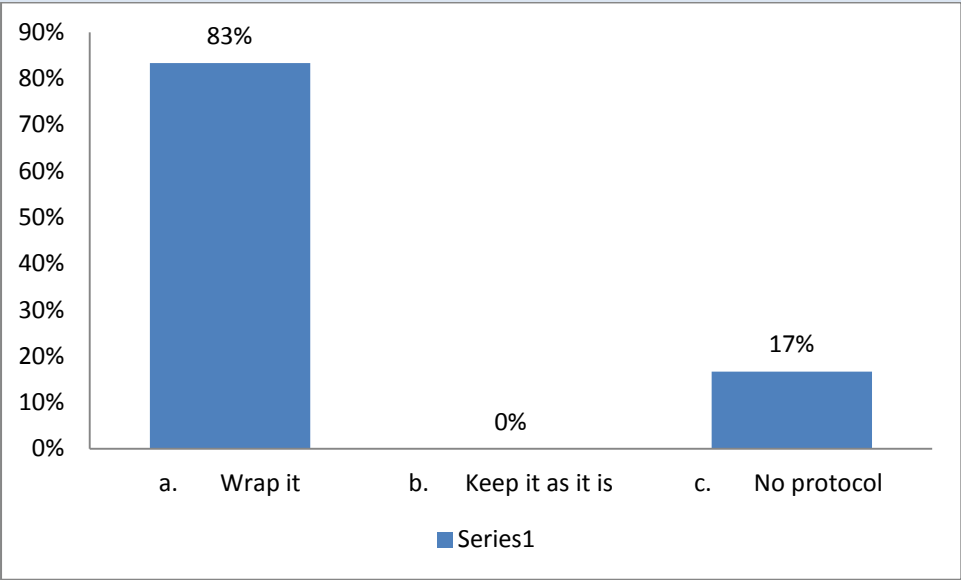
- Main reason for frequent break down of equipment as the cleaning recommended is dry gauge. 58 % are not aware about this.

Q.3. How often do you clean the electrodes (leads)?



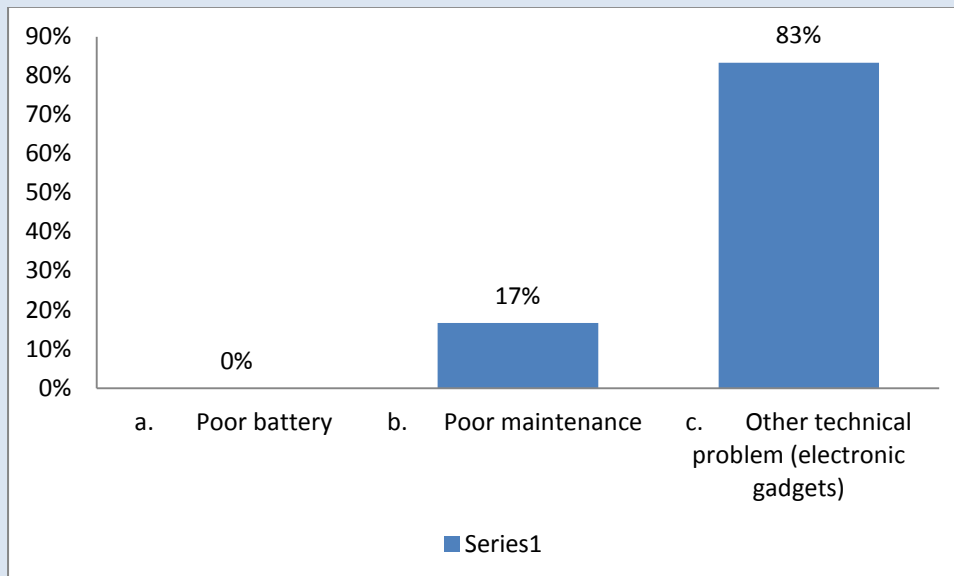
- 100% followed as recommended.

Q.4. How do you keep the machine after it's used?



- 83% followed the rule.

Q.5. What is the most common cause of machine break down?



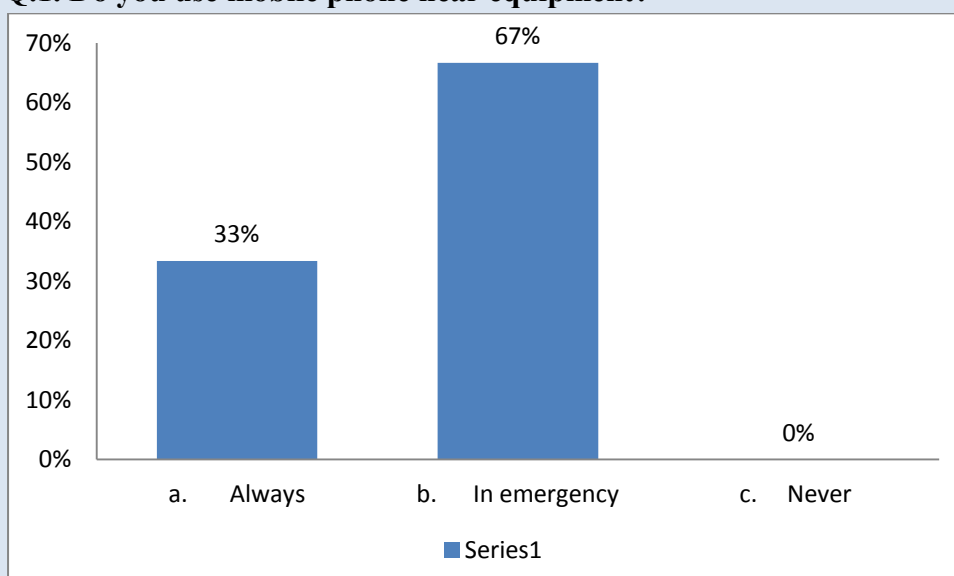
- Lack of awareness and knowledge.

OBSERVATION: During observation, it was seen that electrodes were not cleaned after every patients which lead to deposition and felling of the gel in to electrodes and thus it disturbs the reading of the patients and increases patient discomfort.

ii. DIAGNOSTIC EQUIPMENTS:

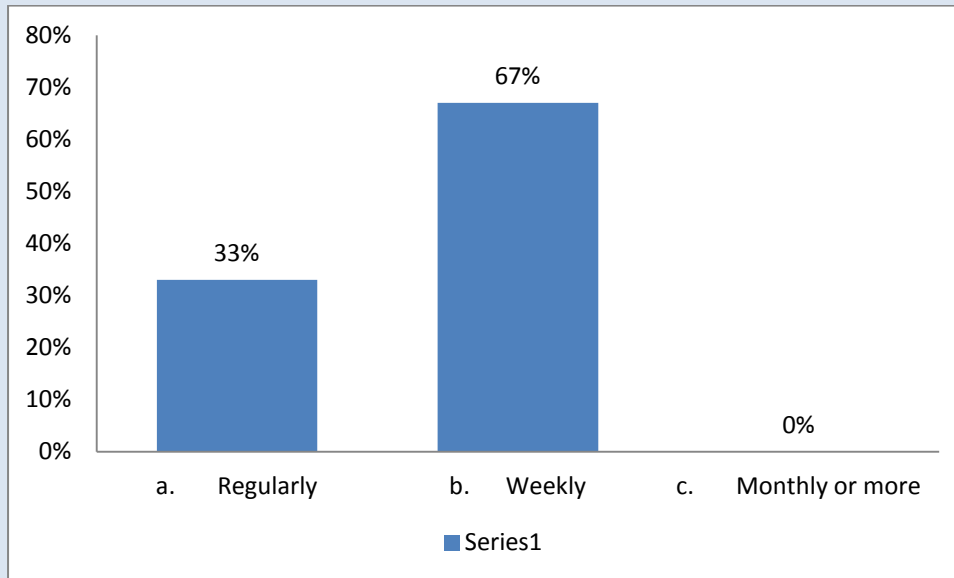
1. CELL COUNTER SYSMEX XS 1000i:

Q.1. Do you use mobile phone near equipment?



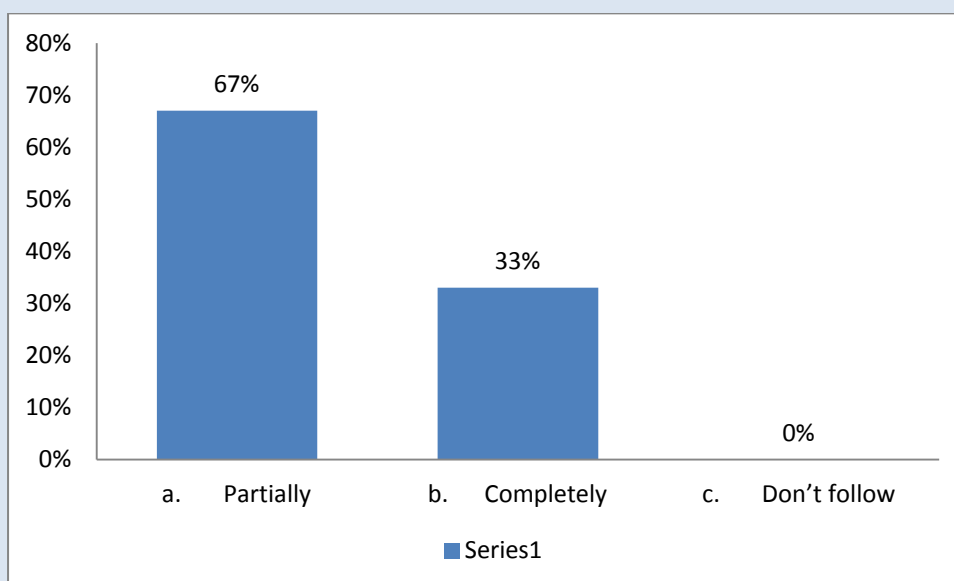
- When interviewed 100% of staff used mobile phones near ventilator According to the manual can be harmful for the equipment and patient as it can lead to inaccurate readings by the equipments

Q.2. Do you perform quality check?



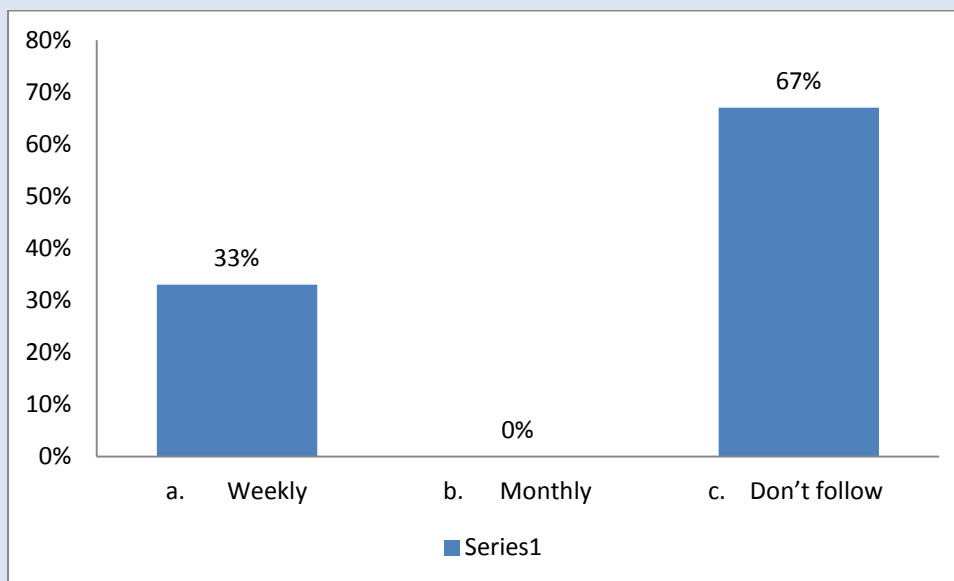
- 67% of staff said weekly and 33% said regularly.

Q.3. Do you follow proper shut down and start up procedure?



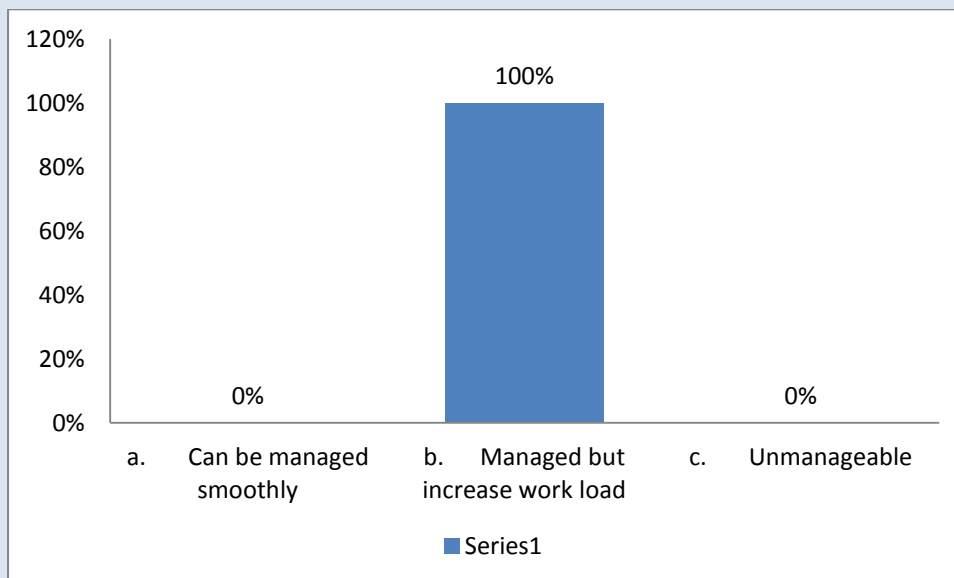
-All operators followed proper startup and shutdown procedure

Q.4. Do you perform rinsing procedure?



The operator had knowledge about the monthly rinse procedure and replied that they carry it out regularly.

Q.5. What are the after affix machine break down?



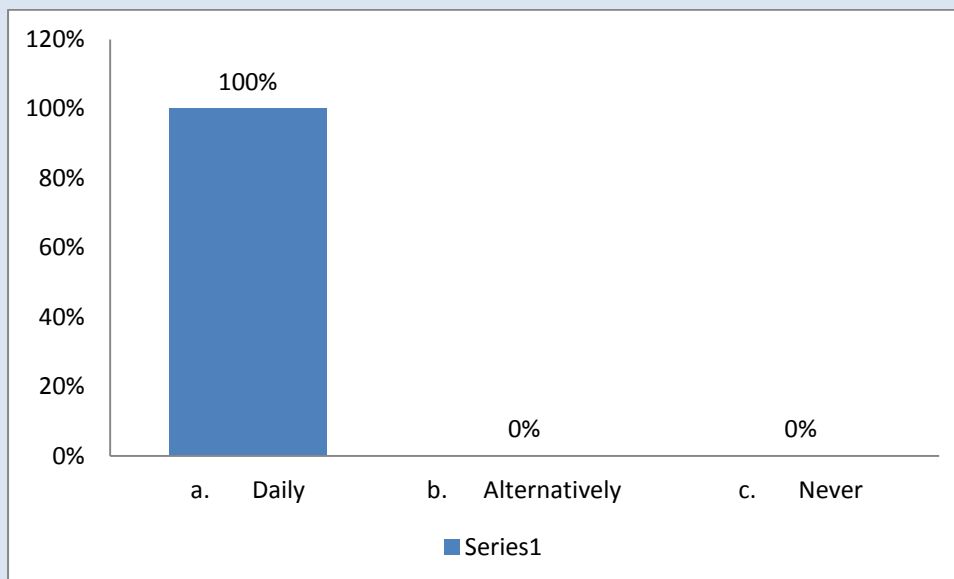
- 100% said that managed but increase work load because they have alternative for uses.

OBSERVETION: The staff is completely aware about the recommendations that are to be followed but when observed.

- (1) No rinsing is done (100% not followed)
- (2) No shut down procedure followed .

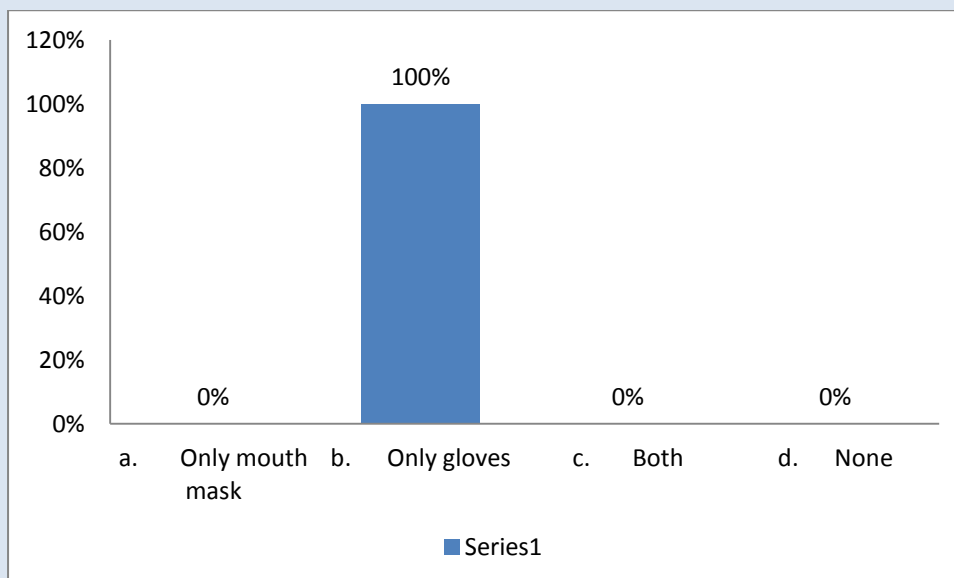
2. BIOCHEMISTRY ANALYSER (EM 360):

Q.1. Do you check water supply of machine before starting?



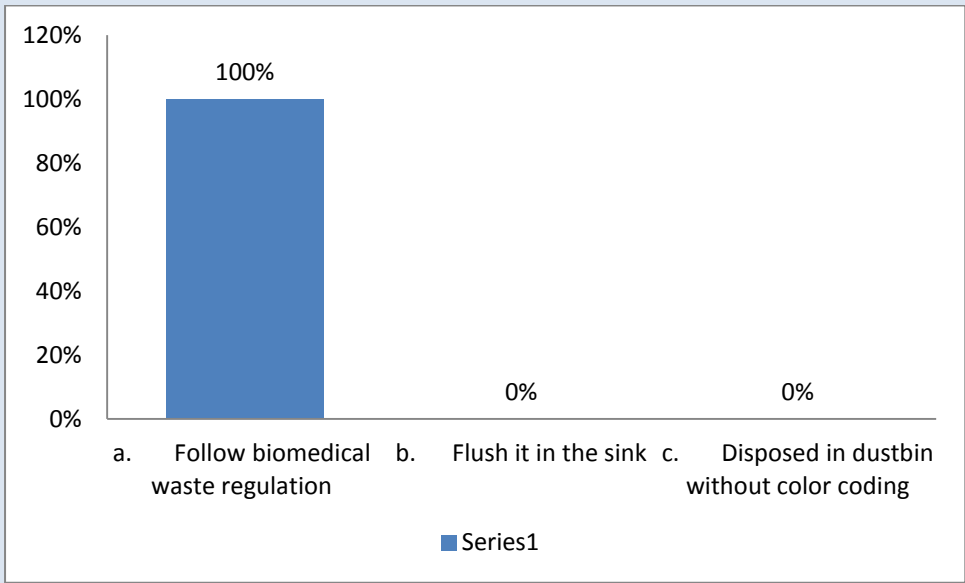
The operator performed checking of water supply before starting the machine

Q2. Do you use PPE while working with the sample?



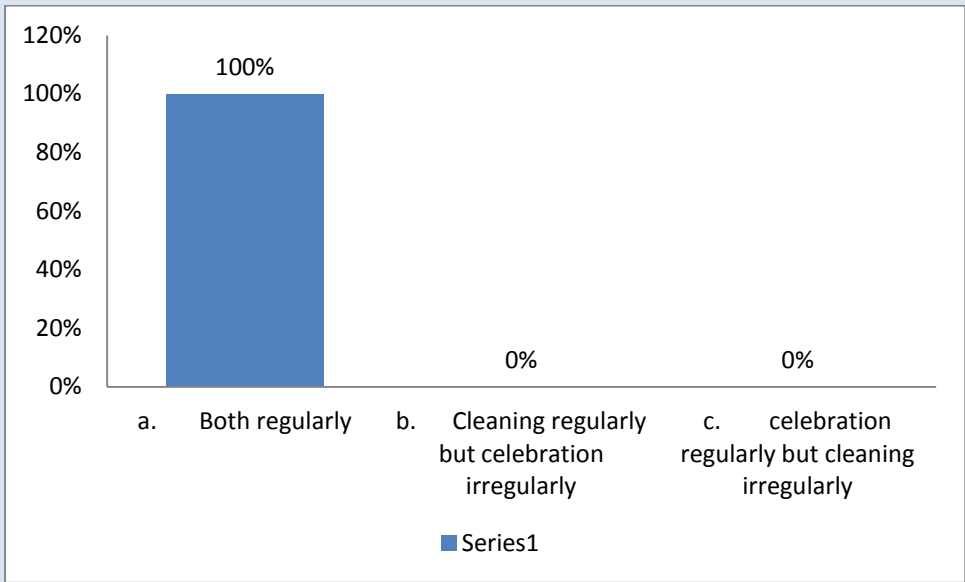
The operator didn't used PPEs while working with the samples although the samples were of human blood and serum and possibly contaminated.

Q.3. How do you dispose the biomedical waste?



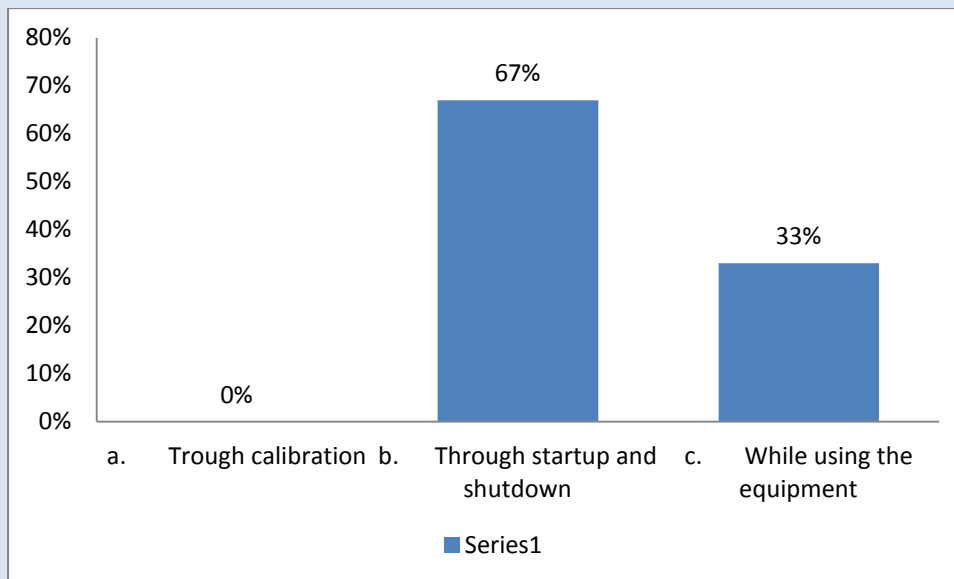
The operator didn't disposed BMW properly and flushed it out directly in the sink used for hand washing.

Q.4. When do you perform calibration and cleaning/ disinfection?



The operator performed daily calibration regularly.

Q.5. How do you find out that the equipment has under gone any break down?



- 67% of staff said that through startup and shutdown.

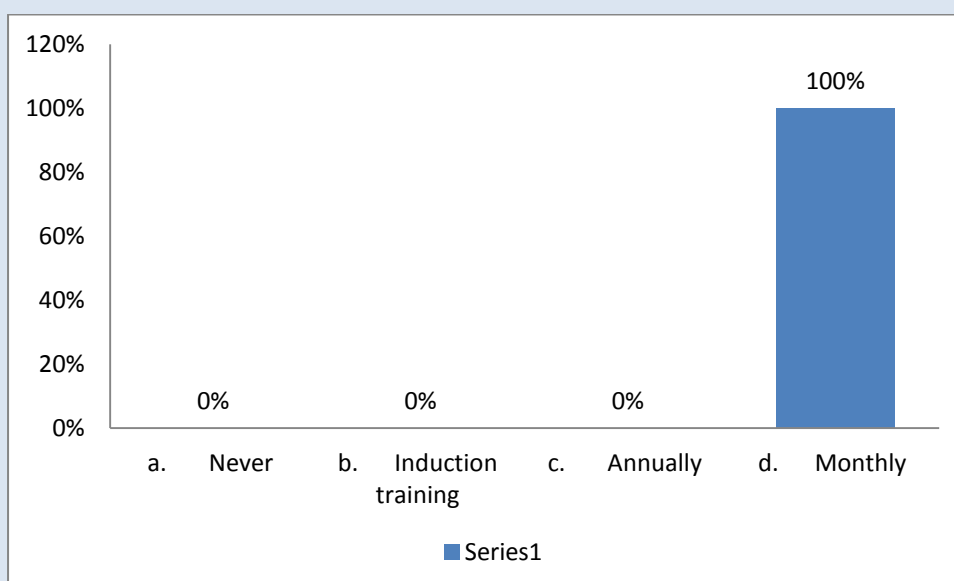
OBSERVETION: During observation it was seen,

- (1) No cleaning performed.
- (2) Bio medical waste color coding is not followed.
- (3) Beside the complete awareness of PPE it is 100% not followed.

(3) LINEN AND LAUNDRY:

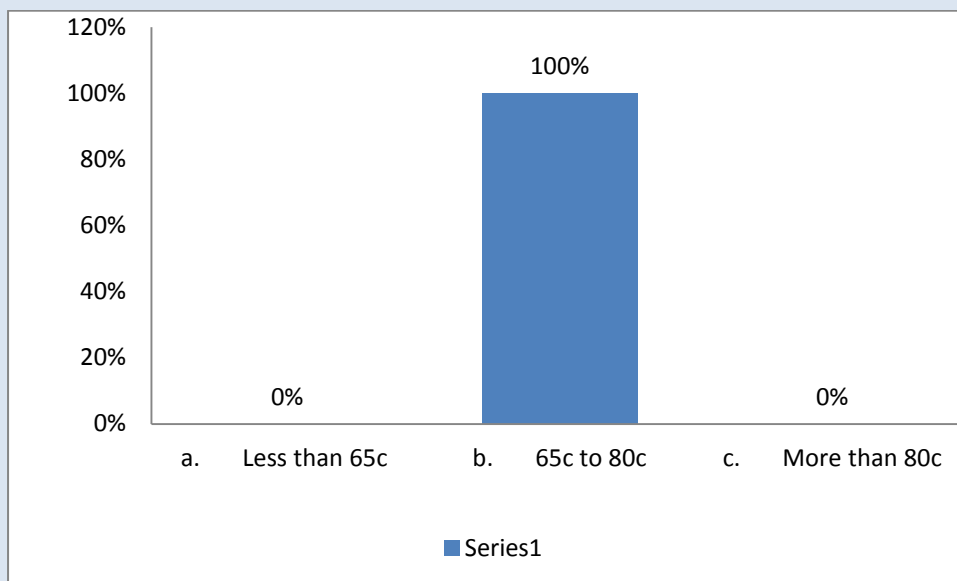
1. WASHING MACHINE :

Q.1. How frequently do you receive training regarding laundry?



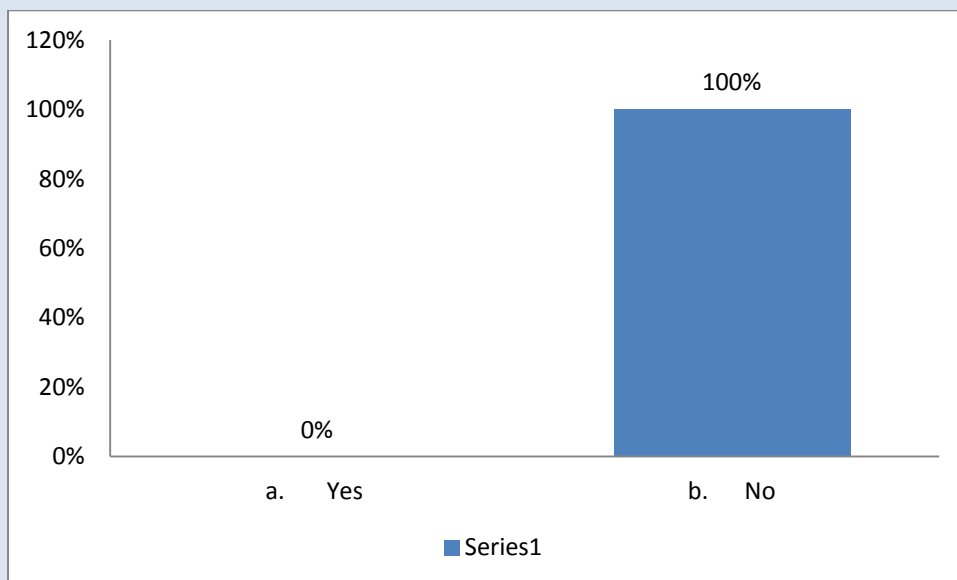
- 100% said that they attend monthly training

Q.2 At what temperature do you wash cloths?



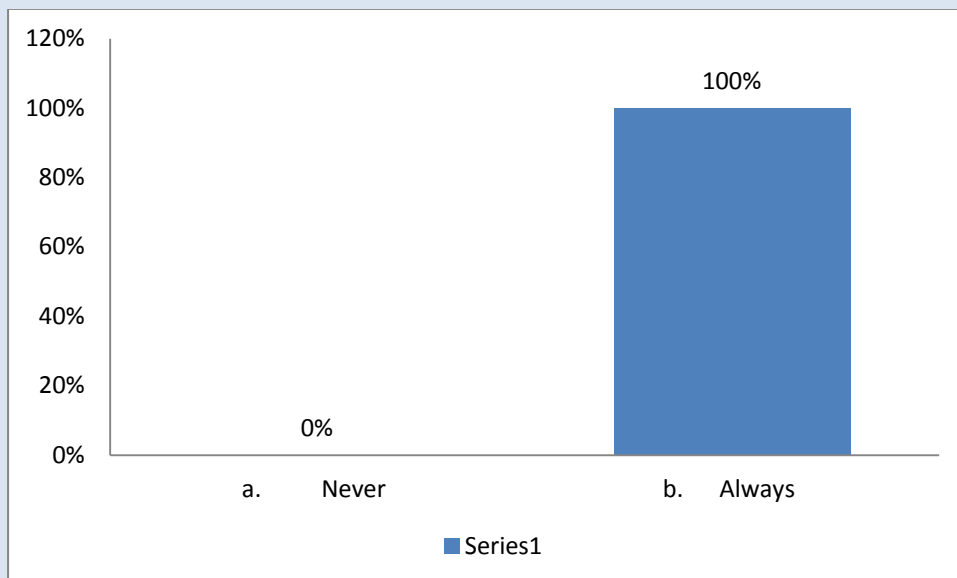
- 100% of staff said that, they maintain 65c to 80c temperature. It was correct.

Q.3. Do you keep damp textiles overnight?



100% said that, they do not do.

Q.5. Do you sort laundry at dirty area – syringe , needle, patient property?



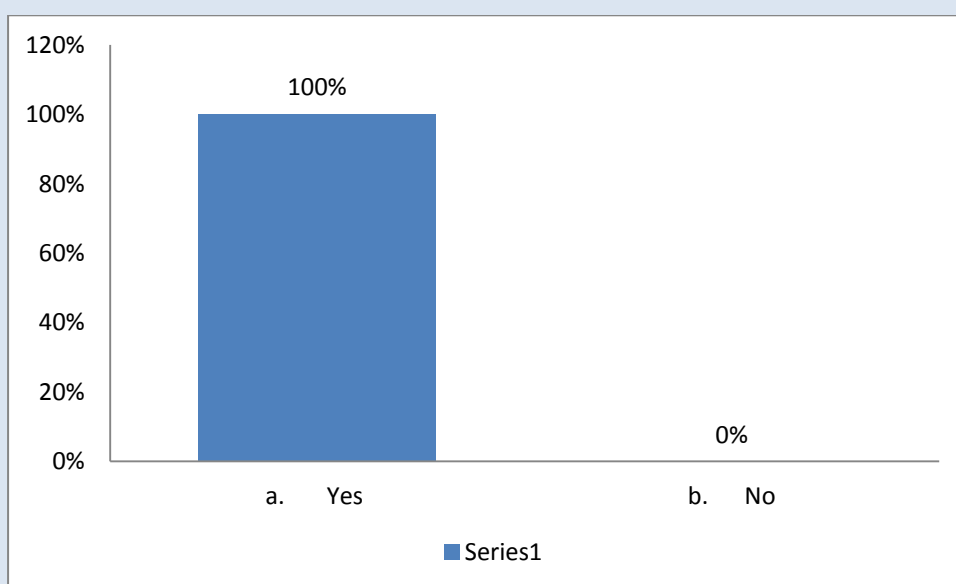
-100% said that they sort laundry at dirty area.

OBSERTION: When observed it was seen:

- (1) Temperature followed regularly in every wash.
- (2) Shorting not done (100% not followed) may lead to machine damage due to needle, syringe etc.
- (3) Training – conducted regularly and attend regularly.

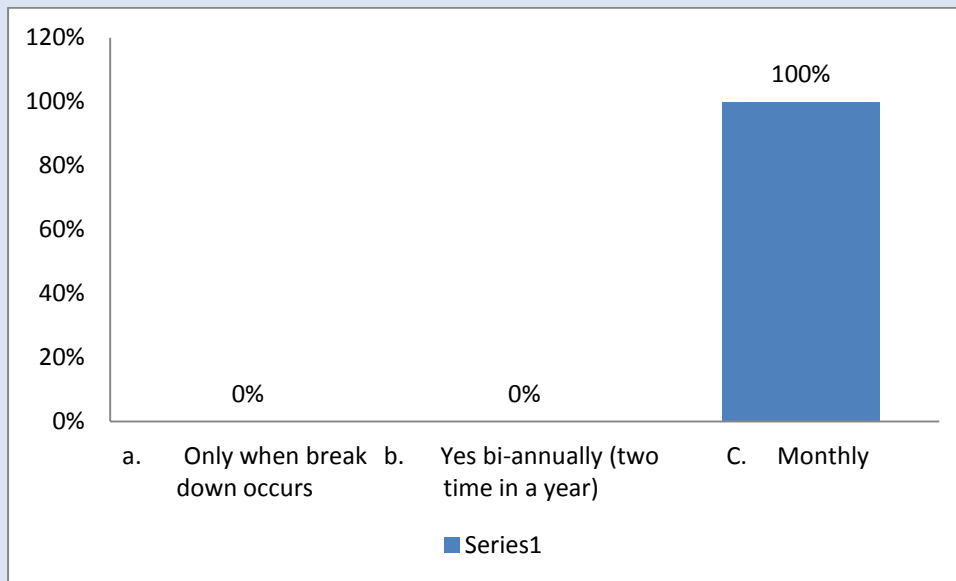
2. DRYER :

Q.1. Is any professional person with adequate skills serve you as a trainer?



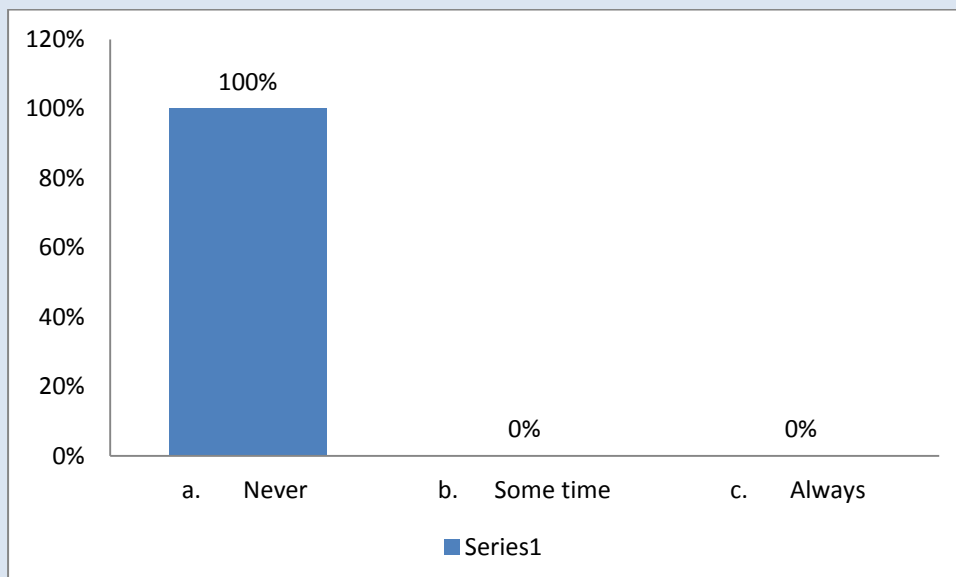
- Always trained person served training.

Q.2. If dryer serviced?



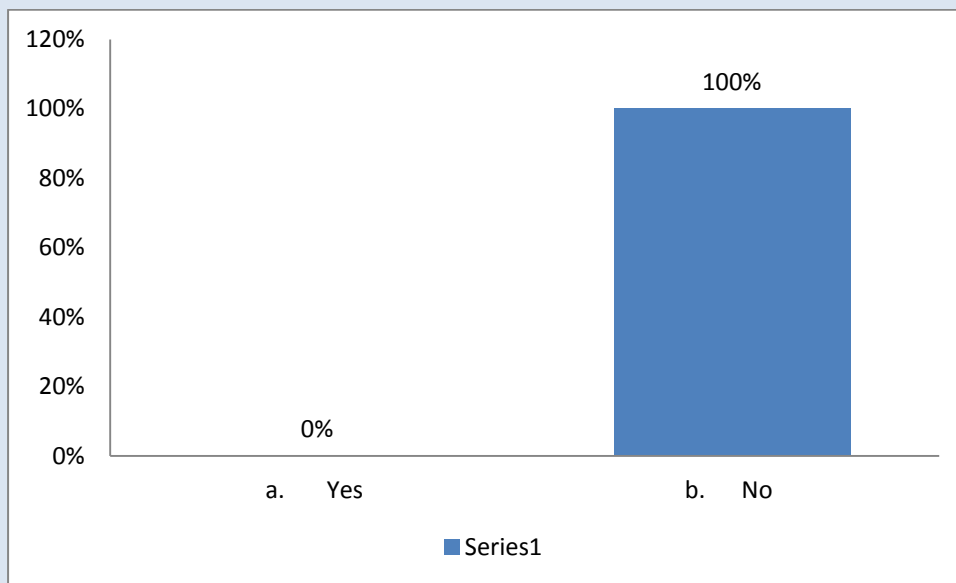
- Maintenance and serviced is performed on monthly.

Q.3. Do you keep any laundry items on the top or beside of the machine?



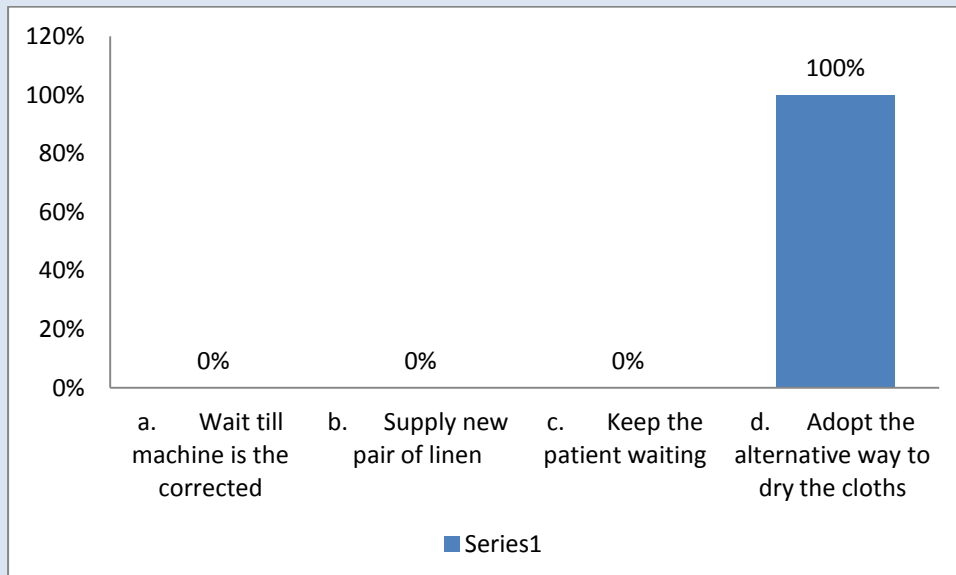
- They never kept any laundry items.

Q.4. Do you maintain the service log of the machine?



- 100% said that they maintain service log of the machine.

Q.5. What do you do when any break down occurs?



- 100% of staff said adopts the alternative way to dry the cloths.

OBSERVATION: When observed:

- (1) Servicing is done by maintenance department in every month and records are maintained.
- (2) They always use PPE.

GENERAL FINDINGS DEPARTMENT WISE:

The department wise general findings based on the general checklist are as follows:

(The highlighted areas are excerpts from the general checklist used for observation, showing the criteria with 0 score i.e. the criteria not followed)

CASUALTY:

In casualty the cleaning and disinfection of defibrillators, ECG and monitors was not being done on a regular basis. It has been found that staff fairly aware about standard procedure

PATHOLOGY:

In the pathology department staff didn't used any PPEs while working with the specimens and sample although their working area was in continuous contact with blood and body fluid. When asked they replied that they don't feel comfortable with the PPEs while working. Also the training for the equipment was not conducted regularly for the staff interviewed. (As per records regular trainings happened till feb14)

MICU:

In MICU problem was not observed related to equipment maintenance, training and safety measures during the study period, although the compliance of the staff there is very poor for maintenance of equipments and staff is more careless than other departments.

CCU:

In CCU problem was observed related to equipment maintenance, training and safety measures during the study period.

SICU:

in SICU no problem was observed related to equipment maintenance, training and safety measures during the study period.

ITU:

In ITU during discussion with the staff it was found that training for Ventilator was not conducted and if conducted it was not frequent and they learned it from each other and by doing on their own

BMD:In BMD problem was observed related to equipment maintenance, training and safety measures for new technician, during the study period.

CONCLUSION AND RECOMMENDATIONS:

1. In Critical Care equipments (Defibrillator, Ventilator, Syringe pump, and Monitor) the staff needs to be trained for performing startup test, cleaning (flow sensor cleaning for Ventilator) and preliminary inspection.
2. There should be proper mobile phone usage policy in place clearly specifying the area where they should not be used and staff should be made accountable to not use mobile phones in these areas containing sensitive equipments like ECG, Ventilator, Monitor etc. as it may lead to inaccurate measurement by these machines which could be life threatening to the patient.
3. In Diagnostic equipments (cell counter, and Biochemical analyzer) the staff needs to be trained for use of PPEs and safe disposal of Biomedical Waste.
4. The quality and frequency of training given to the staff should also be looked over and if the training is found lacking then it should be improved and trainers should also be trained “(Train the Trainers).” Trainings should be closely monitored to ensure trainers adherence to the training schedule
5. In the training feedback forms name and employee code of the employees should not be taken as it may lead to biased feedbacks from the employees.
6. Positioning and storage of the equipment during and after use should be specified and staff should be made accountable to carry out this task as incorrect positioning and storage of the equipment could lead to damage and inefficiency.

REFERENCES

1. Equipment operating and installation manual for Defibrillator- HEARTSTART XL.
2. Equipment operating and installation manual for ventilator- ENGESTROM CARESTATION.
3. Equipment operating and installation manual for monitor- PHILLIPS AND SCHILER.
4. Equipment operating and installation manual for syringe pump and infusion pump of- PLENUM TECH ASPIRE AND INJECTOMAT AGILIA.
5. Equipment operating and installation manual for Cell Counter- SYSMEX XS 1000i.
6. Equipment operating and installation manual for Biochemical Analyzer-BS-400.
7. Equipment operating and installation manual for Hemodialysis machine- FRESENIUS MEDICAL CARE.
8. Equipment operating and installation manual for ECG (Electro Cardio Gram).
9. Equipment operating and installation manual for Industrial Washing Machine- VISION.
10. Equipment operating and installation manual forDrying Machine- VISION.

ANNEXURE

List of activities carried out in the hospital:

Date	Departments
01/04/2014- 25/04/2014	Observation of various departments of hospital and their working.
26/04/2014- 04/05/2014	Preparation of questionnaires and checklist for individual equipments. Listing of individual Medical equipments in each and every department of hospital, noting down their BME id and IPM and EPM schedule.
05/05/2014- 21/05/2014	Interview and observation of the operating staff for the equipments selected, discussion with the BMEs, recording the breakdown records and training records and discoing the results of the interview with BMD staff.
22/05/2014- 31/5/2014	Data analysis and Interpretations and preparation of report.

ACRONYMS AND ABBREVIATIONS:

OT	Operation Theatre
ICU	Intensive Care unit(Medical, Surgical, Neonatal, Cardiac)
BME	Biomedical engineer
BMD	Biomedical department
ITU	Intensive therapy Unit
PPE	Personal Protective Equipments
EPM	External preventive maintenance
IPM	Internal Preventive Maintenance

Questionnaire and checklists used:

CRITICAL CARE EQUIPMENTS

1. Defibrillator Heartstart XL:

1. If equipment checked at every shift?
 - a. All shift
 - b. Ones daily
 - c. Alternatively
 - d. Weekly
2. Are you aware about battery charge?
 - a. Not satisfactory
 - b. Average
 - c. Satisfactory
 - d. Excellent
3. Are you aware about the cleaning/ disinfection procedure of the equipment, is it done regularly?
 - a. Aware but not done regularly
 - b. Not aware about the procedure but cleaning done regularly
 - c. Aware and cleaning is done regularly
4. Do you have any idea regarding ASI (Active status indicator)? If yes , then which color does it flash?
 - a. Red
 - b. green
 - c. yellow
5. What is the first step often the break down of equipment in emergency?
 - a. Use another equipment available in same department
 - b. Make equipment available from another department
 - c. Make the same equipment available for functioning

2. Ventilator (EngestromCarestation):

1. Do you use mobile phone near equipment?
 - a. Always
 - b. In emergency
 - c. Never
2. Does the operator have knowledge regarding proper handling of the equipment?
 - a. Not satisfactory
 - b. Average
 - c. Satisfactory
 - d. Excellent
3. Is regular flow sensor cleaning done?
 - a. After every patient
 - b. After every shift
 - c. Daily
4. If yes then all the steps of flow sensor cleaning is followed?
 - a. Clean with hot water and soap followed by cleaning with normal water
 - b. Clean with cold/normal water and soap followed by cleaning with normal water
 - c. Only with water
 - d. Water (cold) and soap
 - e. Water (hot) and soap
5. Is the operator aware of the startup of the equipment and patient positioning ?
 - a. Aware of startup but not pt. positioning
 - b. Aware of the pt. positioning but not startup
 - c. Aware of the both
 - d. Not aware of the both
6. What is the most appropriate way to handle ventilator break down?
 - a. To inform in the department and wait
 - b. To use another ventilator
 - c. To wait for senior person to take an appropriate action

3. Infusion pump (Plenum aspire, InjectomatAgilia):

1. Do you use mobile phone near equipment?
 - a. Yes oftenly
 - b. In emergency
 - c. Never
2. Do you perform startup test (plenumtech aspire)?
 - a. Regularly
 - b. Weekly
 - c. Monthly or more
3. Do you perform all the steps of startup test for syringe pump of injectomalagilia model?
 - a. Unsatisfactory
 - b. Satisfactory
 - c. Excellent
4. what you do when the syringe pump is not under use?
 - a. Keep it in safe place
 - b. Keep it in wards openly
5. In your observation, what is the common cause of break down of equipment?
 - a. Poor maintenance
 - b. Corrosion of the part of the equipment
 - c. Leak of infusion fluid

4. MONITOR (PHILIPS, SCHILLER):

1. Do you clean and disinfect the monitor?
 - a. Regularly
 - b. Alternatively
 - c. Weekly or more
2. Do you perform daily visual test?
 - a. Not perform
 - b. Partially perform

- c. Completely
- 3. Do you follow startup and shutdown procedure?
 - a. Not perform
 - b. Partially perform
 - c. Completely
- 4. Do you use mobile phone near monitor?
 - a. Always
 - b. In emergency
 - c. Newer
- 5. What is the common cause of break down in monitor?
 - a. Lack of awareness
 - b. Visual problem (screen)
 - c. Calibration problem
 - d. Other technical problem

5. Hemodialysis machine- (Fresenius Medical Care):

- 1. When do you perform external cleaning?
 - a. Daily
 - b. Weekly
 - c. When seen spoiled with blood
- 2. Who perform internal cleaning?
 - a. All
 - b. Trained person
 - c. Maintenance
- 3. Are you given training regarding operating the dialysis maintenance and handling in emergency condition?
 - a. Yes for both
 - b. No
 - c. Yes for operating but not emergency condition
- 4. Do you know about shunt door. If yes what will you do if you see then open during cleaning?
 - a. Remain the door open
 - b. Closed the door
 - c. Never observe
- 5. What will you do if the dialysis machine goes under a break down during the procedure?

- a. Shift the patient to another dialysis machine
- b. Wait to the machine is corrected
- c. Keep the patient under medication till the machine get free
- d. Arrange for a alternative machine

6.ECG (Electro Cardio Gram):

1. Do you ask patient to keep their electronic gadgets (mobile, watch, tab etc) away?
 - a. Always
 - b. Not needed
 - c. Some time
2. Do you get training for cleaning and operating ECG machine? If yes then how do you clean the ECG machine?
 - a. Alcohol based solution
 - b. Water
 - c. Dry gauge
 - d. Not applicable
3. How often do you clean the electrodes (leads)?
 - a. Daily
 - b. After every patient
 - c. Alternatively
 - d. Not recorded
4. How do you keep the machine after it's used?
 - a. Wrap it
 - b. Keep it as it is
 - c. No protocol
5. What is the most common cause of machine break down?
 - a. Poor battery
 - b. Poor maintenance
 - c. Other technical problem (electronic gadgets)

DIAGNOSTIC EQUIPMENTS:

1. CELLCOUNTER (SYSMEX XS 1000i):

1. Do you use mobile phone near equipment?
 - a. Always
 - b. In emergency
 - c. Never
2. Do you perform quality check?
 - a. Regularly
 - b. Weekly
 - c. Monthly or more
3. Do you follow proper shut down and start up procedure?
 - a. Partially
 - b. Completely
 - c. Don't follow
4. Do you perform rinsing procedure?
 - a. Weekly
 - b. Monthly
 - c. Don't follow
5. What are the after effect machine break down?
 - a. Can be managed smoothly
 - b. Managed but increase work load
 - c. Unmanageable

2. BIOCHEMICAL ANALYSER (BS-400):

1. Do you check water supply of machine before starting?
 - a. Daily
 - b. Alternatively
 - c. Never
2. Do you use PPE while working with the sample?
 - a. Only mouth mask
 - b. Only gloves
 - c. Both
 - d. None
3. How do you dispose the biomedical waste?
 - a. Follow biomedical waste regulation
 - b. Flush it in the sink
 - c. Disposed in dustbin without color coding
4. When do you perform calibration and cleaning/ disinfection?
 - a. Both regularly

- b. Cleaning regularly but celebration irregularly
 - c. celebration regularly but cleaning irregularly
5. How do you find out that the equipment has under gone any break down?
- a. Trough calibration
 - b. Through startup and shutdown
 - c. While using the equipment

LINEN AND LAUNDRY:

1. INDUSTRIAL WASHING MACHINE (VISION) :

1. How frequently do you receive training regarding laundry?
 - a. Never
 - b. Induction training
 - c. Annually
 - d. Monthly
2. At what temperature do you wash cloths?
 - a. Less than 65c
 - b. 65c to 80c
 - c. More than 80c
3. Do you keep damp textiles overnight?
 - a. Yes
 - b. No
4. Do you sort laundry at dirty area – syringe , needle, patient property?
 - a. Never
 - b. Always
5. According to you what is the common cause for the breakdown?
 - a. Due to frequent use
 - b. Due to overload of machine
 - c. In proper water drainage

2. DRYING MACHINE (VISION):

1. Is any professional person with adequate skills serve you as a trainer?
 - a. Yes

- b. No
- 2. If dryer serviced?
 - a. Only when break down occurs
 - b. Yes bi-annually (two time in a year)
 - c. Monthly
- 3. Do you keep any laundry items on the top or beside of the machine?
 - a. Never
 - b. Some time
 - c. Always
- 4. Do you maintain the service log of the machine?
 - a. Yes
 - b. No
- 5. What do you do when any break down occurs?
 - a. Wait till machine is the corrected
 - b. Supply new pair of linen
 - c. Keep the patient waiting
 - d. Adopt the alternative way to dry the cloths

GENERAL CHECKLIST USED:

1.GENERAL OBSERVATIONS

- 1.1.Is the equipment functioning properly (with less or no complaints)?
 - a. No, repeated complain within a week
 - b. No , repeated complain 7-15 days
 - c. Yes , no complain
- 1.2.Whether training performed/conducted regularly?
 - a. No , only induction training
 - b. Yes , induction followed by regular training (at least annually)
 - c. None of the training performed (induction , regular)
- 1.3.Is the operator/technician has knowledge about the use of PPE (personal preventive equipment) while working with the equipment?
 - a. Yes , follow
 - b. Yes but not follow
 - c. No knowledge

- 1.4. Is the operator following the proper way of handling the equipment?
- Yes, aware and follow
 - Aware but don't follow
 - Not aware thus don't follow
- 1.5. Is the equipment checked before using it for any patient?
- Yes, both by personnel of same department and other department
 - Yes, checked by personnel of same department and not by other department
 - Yes, checked by personnel of other department and not by same department
 - None of them check the equipment
- 1.6. Whether the external preventive maintenance is performed on schedule?
- 1.7. Whether the internal preventive maintenance is performed on schedule?
- 1.8. Whether the calibration is performed on schedule?
- Yes, annually
 - Yes, more than one year
 - No
- 1.9. Is the equipment disinfected/cleaned regularly?
- Yes, aware of protocol and is followed
 - Yes, not aware of protocol but cleaning is done regularly
 - Yes, aware of protocol but Not followed
 - No, cleaning is not done regularly
- 1.10. Whether infection control measures are followed by the employees while working with the equipment?
- Yes, aware and followed
 - Yes, followed but not aware
 - No, not aware and thus not followed
- 1.11. Is proper documentation maintained?
- Yes, but not regularly
 - Yes, regularly
 - No, no documents

2. Compliant handling

- 2.1. Whether department recording reporting time & action taken of complain?
- Yes, recording of both is done
 - Yes, but recording of complaint attended not done
 - Yes, but recording of time not done
 - None

2.2. Was complained register and generation of complain number?

- a. Yes , was registered with generation of complaint number
- b. Yes , but complaint number was not generated

2.3. Was the complaint attended by the same person who received the complaint?

- a. Yes
- b. Yes , but after arrival of another person
- c. No

2.4. Was the problem: technical or lack of awareness/training?

- a. Technical
- b. Lack of awareness
- c. Lack of training

2.5. Action taken by: in sources or out sources?

- a. In source
- b. Out source
- c. None

2.6. Time taken to solve the break down?

- a. Less than three hour
- b. Three to eight hour
- c. Eight to twenty four hour
- d. More than twenty four hour

2.7. Whether analysis is done on regular basis?

- a. No
- b. Yes, but not regularly (not on busy days)
- c. Yes , done regularly

Thank you