

**KNOWLEDGE AND PRACTICE OF PREVENTIVE
MAINTENANCE OF ANAESTHETIC EQUIPMENT AT MUHIMBILI
NATIONAL HOSPITAL AND MUHIMBILI ORTHOPAEDIC
INSTITUTE TANZANIA.**

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**MMed (Anaesthesiology and Critical Care) Dissertation
Muhimbili University of Health and Allied Sciences
October, 2020.**

**Muhimbili University of Health and Allied Sciences
School of Medicine.**



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TANZANIA.**

By

John Joseph Kweyamba.

**A Dissertation Submitted in (Partial) Fulfillment of the Requirements for the
Degree of Masters of Medicine (Anaesthesiology) of**

**Muhimbili University of Health and Allied Sciences
October, 2020.**

CERTIFICATION

The undersigned certify that, they have read and hereby recommend for examination of thesis dissertation entitled **‘knowledge and practice of preventive maintenance of anaesthetic equipment at Muhimbili national hospital and Muhimbili orthopaedic institute Tanzania.’**, in (partial) fulfillment of the requirement for the degree of Master of Medicine (Anaesthesiology) of the Muhimbili University of Health and Allied Sciences Muhimbili University of Health and Allied Sciences a dissertation entitled,

.....

Dr. Edwin Lugazia
(Supervisor)

Date:

DECLARATION AND COPYRIGHT

I, **Dr. John Joseph Kweyamba**, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

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Date_____

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AKCNOWLEDGEMENT

First and foremost, I would want to thank my supervisor and mentor Dr Edwin Lugazia for his guidance and mentorship during the preparation of this thesis. He continuously supported me even in times when I lost faith he brought the best out of me. His true devotion on this thesis has brought it to its timely completion.

My sincere thanks goes to my classmates MMED Anaesthesiology class of 2020 who devoted their time in hearing out my ideas and their constructive criticism to this thesis. I am honoured to be part of this class.

Thanks to the department of Anaesthesiology MUHAS as they were the first to say yes to the proposal and their constructive ideas that has brought this work into completion,

Thanks to my research assistants Dr Sharifu H Luena registrar department of anaesthesiology MOI, Dr Franco Henjewele registrar department of anaesthesiology MNH for their continuous support especially during data collection, and readiness to be part of this thesis.

Thanks to Anaesthesia providers who willingly agreed to participate in this research without them my thesis would have had no meaning, Thanks to Biomedical department of MNH and MOI for their immense support during data collection.

I am grateful to MUHAS CARDIOVASCULAR CENTRE OF EXCELLENCE for their sponsorship in developing this thesis.

Last but not least I would want to thank my family, my late Father Burchardus Wilbard Ngaiza Kacholi, my Mother Petronilla Anthony Ngaiza, siblings who have raised me to be hard working and being able to fulfil my responsibility.

DEDICATION

To my mother Petronilla Anthony Ngaiza for her continuous guidance since I was a child to date, lately for her immense encouragement on pursuing Mmed degree. I am forever thankful to her.

To my late Father Burchardus Ngaiza, who left me with a dream of graduating as medical doctor, I still carry on your advice and now I am soon graduating as Anaesthesiologist in this noble profession.

To my siblings, Hortensia, Leonalda, Editha, Alistidia, Benedicto, Bernard, Magreth, Luckresia, Jovitha. I am forever grateful.

Last but not least to my fiancée Dr Grace Kazana as you are the first to encourage me on pursuing this MMED, thanks for your support.

ABSTRACT

Background; Anaesthesia devices are used extensively and make contact with many different patients on the daily basis. Maintenance, calibration and cleaning of these devices are of vital importance. There are many mechanisms for the control of anaesthesia devices and equipment. Routine maintenance is by authorised service centres, weekly maintenance by anaesthesia technician and daily checks. Checklist is always applied for the procedures or the maintenance is included in the automatic controls that are done by the device itself. The anaesthesiologist and anaesthesia technician are responsible for control of these parts at appropriate time intervals ensuring 6 month and annual maintenance requirements are met.

Objective; Assessment of knowledge and practice of preventive maintenance of anaesthetic equipment at Muhimbili National Hospital (MNH) and Muhimbili Orthopaedic Institute (MOI) 2019.

Methodology; Hospital based cross sectional study was done at MNH and MOI from June 2019 to August 2019. Data was collected from study subjects by use of questionnaires and checklist to the specific work stations. Sample size of 60 anaesthesia providers was calculated, but total number of 85 anaesthesia providers consented to this by study convenient sampling technique. All the anaesthetic equipment which in use were included. Data analysis was done using SPSS.

Results; total number of 85 anaesthesia providers consented to participate in the study, and 28 anaesthesia machine were included, mean duration of practise of anaesthesia providers was 1.82 years. Around 51.7% of the anaesthesia providers had good knowledge on preventive maintenance, 33% of them responded that the preventive maintenance was of mutual responsibility of the practitioner and hospital management, higher cadre providers demonstrated good knowledge on the preventive maintenance compared to lower cadre providers with P value < 0.05. The most performed Daily checks was proper function of the suction machine at the beginning of the day 92% and the least performed check was setting monitors and alarms by 41.2%. The leak test in between cases was least done by providers mounting to 17.6 %. More than half of the providers in the study (51.7%)

demonstrated good practise at the beginning of the day and 61.7% had good practise in between cases. Only 67% of the anaesthesia machine was fully checked on all the aspects of preventive maintenance by the biomedical engineer.

Conclusion and recommendations; Lower cadre providers lacked knowledge and good practice on preventive maintenance of anaesthesia equipment. Having a dedicated biomedical department has shown to increase awareness and the importance of annual preventive maintenance of the anaesthesia equipment. We recommend Training on preventive maintenance to anaesthesia providers, establishment of dedicated biomedical department at MOI and efficient implementation of the standard practice of planned preventive maintenance of all equipment.

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LIST OF ABBREVIATIONS

MOI	:	Muhimbili Orthopaedic Institute
MNH	:	Muhimbili National Hospital
MUHAS	:	Muhimbili University of Health and Allied Sciences
PPM	:	Planned Preventive Maintenance
PM	:	Preventive Maintenance
WHO	:	World Health Organization
ASA	:	American Society of Anesthesiologist

DEFINITIONS

Anesthesia provider Any healthcare worker who provides anesthesia care, irrespective of professional background or moderate or deep training

Anesthesia Refers to the administration of general or regional anesthesia or moderate or deep sedation independent of who provides the care

Anesthesiologist A graduate of a medical school who has completed a nationally recognized specialist anesthesia training program

Nurse anesthetist A graduate of a nursing school who has completed a nationally recognized nurse anesthetist training program

Non-specialist physician anesthetist (Registrar) A graduate of a medical school who has not completed a specialist training program in anesthesia but has undergone some anesthesia training

Non-anesthesiologist providers Includes non-specialist physician anesthetists, nurse anesthetists, and other providers

Good knowledge of Anaesthesia provider, defined by the provider who got right all questions pertaining knowledge above 50% of the questions that were asked.

Good Practise; is defined by anaesthesia provider who performed above 50% of the tasks present at the checklist at the beginning of the day and in between cases.

Cleaning of anaesthesia machine; this variable includes, cleaning of interior components and exterior with vacuum or compressed air Inspection exterior of equipment for damage or missing hardware, Clean exterior of unit including all accessories, cables, controls and displays and exterior of unit including all accessories, cables, controls and displays.

Inspection of anaesthesia machine; this variable includes Inspection of; interior for signs of corrosion or missing hardware and repair as required, electrical components for signs of excessive heat or deterioration, all external quick disconnect O-rings, condition of all tubing, replace if necessary, all cables for excessive wear, inspiratory and expiratory flow valves, internal circuits by leak testing and the power cord, strain relief and plug/s for any signs of damage.

Verification of function of units of anaesthesia machine; this variable incorporates verification of; correct operation of gas scavenger systems, correct vaporizer calibration, correct flow meter calibration, correct operation of ventilator (rate, volume, flow), correct operation of all buttons, controls, displays and/or indicators and correct operation of unit in all functional modalities.

CHAPTER ONE

1.0 INTRODUCTION

Anaesthesia devices are used extensively and make contact with many different patients on the daily basis. maintenance, calibration and cleaning of these devices are of vital importance.(1) There are many mechanisms for the control of anaesthesia devices and equipment. Routine maintenance is by authorised service centres, weekly maintenance by anaesthesia technician and daily checks.(2) Checklist is always applied for the procedures or the maintenance is included in the automatic controls that are done by the device itself. The anaesthesiologist and anaesthesia technician are responsible for control of these parts at appropriate time intervals, ensuring 6 month and annual maintenance requirements are met. The Canadian Anaesthetists' Society has published a document entitled "Guidelines for the Minimal Standards of Practice of Anaesthesia", which emphasizes that the anaesthetist is responsible for doing. "A thorough inspection of the anaesthetic gas machine and all other anaesthetic equipment".(3) Thus, although equipment can be serviced by manufacturers' representatives and hospital technicians, the anaesthetist is ultimately responsible for its safe use. (1)

1.1 Background

1.1.2 Anaesthesia Equipment

International Standards for a Safe Practice of Anaesthesia 2018 also reviews the anaesthetic equipment that would be expected to be available within hospitals, depending on the level of service that a hospital provides such as;

- I. Adequate lighting Tilting operating table Supply of oxygen (e.g., oxygen concentrator, cylinders or pipeline)
- II. oropharyngeal airways Facemasks Laryngoscope and appropriate sized laryngoscope blades for both adult and pediatric patients
- III. Appropriate sized endotracheal tubes for adult and pediatric patients Intubation aids (e.g., Magill forceps, bougie, stylet)
- IV. Suction device and suction catheters Adult and pediatric self-inflating bags

- V. Equipment for IV infusions and injection of medications for adult and pediatric patients
Equipment for spinal anesthesia or regional blocks
Sterile gloves.
- VI. Access to a defibrillator
Stethoscope
Pulse Oximeter
Carbon dioxide detector
Non-invasive blood and anaesthesia work station.

. Appropriate facilities and equipment meeting the standards in this document should be present wherever anesthesia and recovery are undertaken, including locations outside the operating room (e.g., radiology suites, outpatient facilities, or offices).(4)

The maintenance, calibration and cleaning of these devices are of vital importance. Today, anaesthesia devices are electronic and computerised and work with microprocessors, making their maintenance and cleaning more complex.(5) . Checklists are often applied for these procedures or the maintenance is included in the automatic controls that are done by the device itself Each model of anaesthesia device may have different parts and different characteristics of maintenance. The anaesthetist should play a part in the following activities relating to equipment, Listing and review, Justification of need, Selection Acceptance, Training, Servicing and maintenance, Replacement and disposal.(3)

Anaesthetic equipment which is not serviced regularly is liable to break down with potentially life-threatening consequences. A planned preventative maintenance programme is essential. A record of all breakdowns should be kept. These can be linked to the departmental inventory to produce a record of maintenance(5). Regular review of each class of item should reveal the incidence of breakdowns which could indicate a need for further user training, modification of equipment or its urgent replacement. However, the maintenance of the device may also be required because of reasons such as contamination or malfunction of the device. The anaesthesiologist and anaesthesia technician are responsible for the control of these parts at appropriate time intervals and for ensuring that the 6-month and annual maintenance requirements are met If not well cleaned. All the respiratory equipment used in an operating room can lead to infection from patient to patient. Microorganisms, produced in any part of the breathing apparatus used, may spread to the lower respiratory tract with the aerosol effect and can lead to serious cases of infections. The cleaning and sterilisation of these parts vary depending on the brands and models.(6)

1.1.2 Preventive Maintenance

This refers to regular safety and performance inspection carried out on medical equipment to evaluate risk and reduce failure so as to enhance its safety, efficiency and reliability. It involves cleaning, regular function/safety tests and making sure that any problems are picked up before they cause a breakdown. PM is recommended for most of the medical equipment. It will enhance the efficiency, effectiveness and reliability of medical equipment and must be carried out at appropriate frequency as suggested by the manufacturer or workload.(7)

1.1.3 Daily Practise of Preventive Maintenance

In 2008 the American Society of Anesthesiologists, developed new Recommendations for Pre-Anesthesia Checkout Procedures(PAC). To provide guidelines applicable to all anesthesia delivery systems so that individual departments could develop a PAC specific to the anesthesia delivery systems currently used at their facilities that could be performed consistently and expeditiously. Specifically, for newer anesthesia delivery systems that incorporate automated checkout features, items that are not evaluated by the automated checkout need to be identified, and supplemental manual checkout procedures included as needed. A complete anesthesia machine and circle system function checkout procedure should be performed each day before the first case. An abbreviated checkout should be performed before each subsequent use that day. ASA (American society of Anaesthesiologists) 2008 Recommendations for Preanesthetic Checkout Procedures

Checklist 1; ASA guideline on daily preoperative checks by Anaesthetists**To Be Completed Daily**

Item 1: Verify that auxiliary oxygen cylinder and self-inflating manual ventilation device are available and functioning.

Item 2: Verify that patient suction is adequate to clear the airway.

Item 3: Turn on anesthesia delivery system and confirm that ac power is available.

Item 4: Verify availability of required monitors, including alarms.

Item 5: Verify that pressure is adequate on the spare oxygen cylinder mounted on the anesthesia machine.

Item 6: Verify that the piped gas pressures are ≥ 50 psi.

Item 7: Verify that vaporizers are adequately filled and, if applicable, that the filler ports are tightly closed.

Item 8: Verify that there are no leaks in the gas supply lines between the flowmeters and the common gas outlet.

Item 9: Test scavenging system function.

Item 10: Calibrate, or verify calibration of, the oxygen monitor and check the low oxygen alarm.

Item 11: Verify that carbon dioxide absorbent is not exhausted.

Item 12: Perform breathing system pressure and leak testing.

Item 13: Verify that gas flows properly through the breathing circuit during both inspiration and exhalation.

Item 14: Document completion of checkout procedures.

Item 15: Confirm ventilator settings and evaluate readiness to deliver anesthesia care.

(ANESTHESIA TIME OUT)

To Be Completed before Each Procedure

Item 2: Verify that patient suction is adequate to clear the airway.

Item 4: Verify availability of required monitors, including alarms.

Item 7: Verify that vaporizers are adequately filled and if applicable that the filler ports are tightly closed.

Item 11: Verify that carbon dioxide absorbent is not exhausted.

Item 12: Perform breathing system pressure and leak testing.

Item 13: Verify that gas flows properly through the breathing circuit during both inspiration and exhalation.

Item 14: Document completion of checkout procedures.

Item 15: Confirm ventilator settings and evaluate readiness to deliver anesthesia care.
(ANESTHESIA TIME OUT)(8)

1.1.4 Periodic Preventive Maintenance

Preventive maintenance includes periodic revision of the machines according to the recommendations defined by the manufacturer. The curative maintenance includes the repair of machines after failure. Operations are performed by biomedical engineers or those manufacturers (or a third-party company under contract. It is also possible to entrust all of the maintenance to the manufacturer through a contract but this solution is often expensive. Through a rigorous maintenance strategy, anesthesia machines failure rate and cost do not increase with age machines(9).

Anaesthetic equipment which is not serviced regularly is liable to break down with potentially life-threatening consequences. A planned preventative maintenance programme is essential. A record of all breakdowns should be kept. These can be linked to the departmental inventory to produce a record of maintenance. Regular review of each class of item should reveal the incidence of breakdowns which could indicate a need for further user training, modification of equipment or its urgent replacement.(10).

Checklist 2: revised by WHO for biomedical engineering technician in doing PPM is as follows;

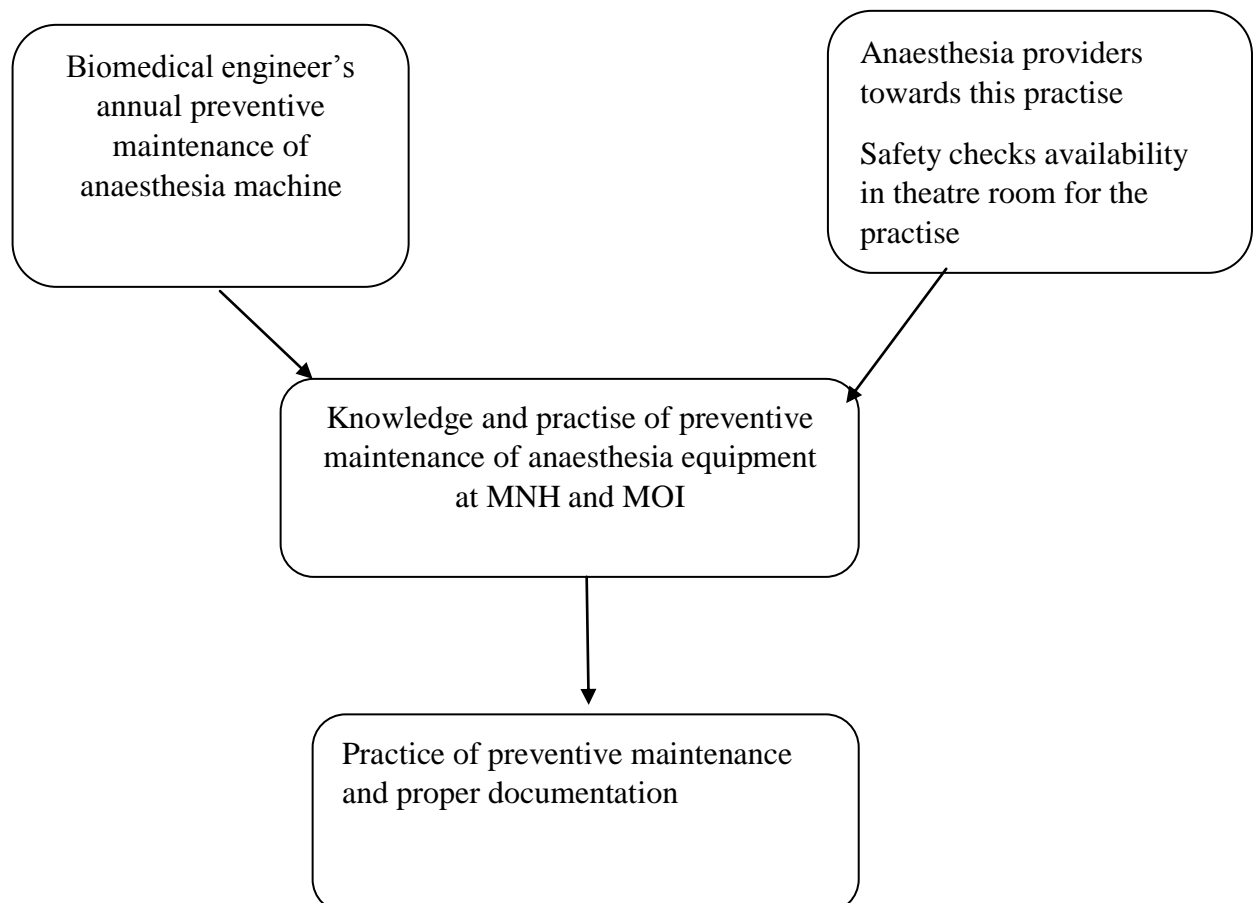
1. Inspect exterior of equipment for damage or missing hardware.
2. Inspect the power cord, strain relief and plug/s for any signs of damage.
3. Turn unit off, open user-accessible covers and inspect unit for damage.
4. Clean unit interior components and exterior with vacuum or compressed air.
5. Inspect interior for signs of corrosion or missing hardware. Repair as required.
6. Inspect electrical components for signs of excessive heat or deterioration.
7. Inspect all external quick disconnect O-rings.
8. Inspect condition of all tubing, replace if necessary.
9. Inspect all cables for excessive wear.
10. Inspect inspiratory and expiratory flow valves.
11. Inspect internal circuits by leak testing.
12. Verify correct operation of gas scavenger systems.
13. Verify correct vaporizer calibration.
14. Verify correct flow meter calibration.
15. Verify correct operation of ventilator (rate, volume, flow).
16. Verify correct operation of all buttons, controls, displays and/or indicators.
17. Verify correct operation of unit in all functional modalities.
18. Clean exterior of unit including all accessories, cables, controls and displays.(10)

This should be performed at least twice a year to each anaesthetic machine by biomedical technician for their proper functioning.

1.2 Problem Statement

Anaesthesia equipment failure can lead to adverse or life threatening incidents during anaesthesia and surgeries. A comprehensive system for risk management of anaesthesia equipment is necessary. It is frequently reported in different studies. A retrospective study on anaesthesia critical incidences indicated equipment failure as the second reason of adverse events in anaesthesia activities(6). Although the increased usage of new technologies has proved to be an effective step in reduction of anaesthesia risks due to equipment failure, it has led to little attention to assessing, evaluation and monitoring of performance and safety of older equipment. A different study indicated that a programme for solving this problem and probably complications in them is necessary. (2) In our settings we are faced with similar situation of using both ultramodern and old anaesthetic equipment, thus posing a risk to patients safety if standard preventive maintenance is not practiced. Thus it was important to assess our status at the national hospital in respect this important aspect of practise of anaesthesia so as to improve our services

1.3 Conceptual Framework



1.4 Rationale

ASA has issued guideline of daily preventive maintenance that should be performed anaesthesia providers during the start of the day, and in between cases, we currently need to know the extent of our adherence to these guidelines at our National hospital, as it is used to train future anaesthesia providers and most of the patients from the other regions are referred to this tertiary hospital for the surgeries. Our national hospital from this research will benefit to know the current practise, of our providers and this will prompt emphasis on this in our theatres.

Every machine from its provider has its required annual maintenance by biomedical engineers of the provider. We need to know if this annual visits by the manufacturer or third part and preventive maintenance by calibration of devices on the anaesthesia machine and replacement of worn out parts is done; or by biomedical engineer of the institution, this will provide information on the safety of the anaesthesia machine we are using to our patients. The information will help in improving and adding quality to our conduct of anaesthesia.

1.5 Research Questions

- i. Do anaesthesia providers at MNH and MOI have enough knowledge to practise daily machine checks and preventive maintenance of anaesthesia equipment?
- ii. What is the extent of practise of daily preventive maintenance at MNH and MOI?
- iii. Are anaesthesia machine periodically maintained by biomedical engineers and Authorised firm at MNH and MOI

1.6 Objective

1.6.1 Broad Objective

To assess knowledge and practice of preventive maintenance of anaesthetic equipment at MNH and MOI 2019

1.6.2 Specific Objectives

- i. To assess the daily practise of preventive maintenance by anaesthetic providers at MNH and MOI at August 2019
- ii. To assess the periodic maintenance of anaesthetic machine and biomedical engineers at MNH and MOI from August 2018 to August 2019
- iii. To assess knowledge to of Anaesthesia providers at MNH and MOI towards daily preventive maintenance of anaesthesia machine.

CHAPTER TWO

2.0 LITERATURE REVIEW

Admission to hospital is associated with significant risk of harm from mistakes made by healthcare professionals. While anaesthesia-related mortality appears low (2.79 deaths per million populations per annum³), in study risks of anaesthesia could be further reduced with an increased emphasis on quality. In a study of nearly 100,000 anaesthetics, an anaesthesia-related incident, event or complication was observed in 22% of patients a study done in Australia (11) , and it appears that many of these occurrences could be avoided by checking equipment(6)In a study where 1000 anaesthesia accidents were evaluated through the notification system of anaesthesia accidents, it was reported that 395 incidents were found to be associated with the anaesthesia device and equipment.(6).

However, there are studies reporting that 75% of the cardiac arrests during the intervention can be prevented and 12% of these situations result from faults related only to anaesthesia devices. While the responsibility of the maintenance of anaesthesia equipment has legally been given to the anaesthesia technician, the follow-up of this is the duty of anaesthesiologist. In the survey conducted in Turkey 2016 while 11.5% of the anaesthesiologists considered it as the mutual responsibility of the anaesthesia technician and the anaesthesiologist, the rate of those who said that it was the responsibility of the anaesthesiologist was 62.4% and the rate of those who said it was the responsibility of the anaesthesia technician was 46.9%.It is important to stress out the importance of anaesthesia provider to be responsible to daily machine preventive maintenance and to adhere to the planned preventive maintenance by the manufacture so as to reduce the critical incidences that can be avoided . (3).

There is limited data on the survey done in third world countries on the practise of safe anaesthesia, daily checks have no established data, in Tanzania this will be the first research of its kind to evaluate the practise of our anaesthesia providers on their practise of daily preventive maintenance of anaesthesia work station.

Annual periodic maintenance includes periodic revision of the machines according to the recommendations defined by the manufacturer. The curative maintenance includes the repair of machines after failure. Operations are performed by biomedical engineers or those manufacturers (or a third-party company) under contract. It is also possible to entrust all of the maintenance to the manufacturer through a contract but this solution is often expensive.

Through a rigorous maintenance strategy, anesthesia machines failure rate and cost do not increase with age machines in real practise preventive maintenance is always not done adequately, in hospital based survey done in hospitals in France only half of the anaesthesia workstation were fully maintained which give us the gap of what should be done in this part of the world. Between- and within-case gram-negative bacteria transmission occurs frequently and is linked by pulsed-field gel electrophoresis to 30-day postoperative infections. Provider hands are less likely than contaminated environmental or patient skin surfaces to serve as the reservoir of origin for transmission events, this was the conclusion made from the study done on transmission dynamics of gram negative bacteria on anaesthesia workstation.(12)

In a study done in 2007 in Great Britain by Langford et allonym one undertook a complete check and 39/41(95%) performed partial checks (omitting one or more steps in the guidelines). Steps most commonly omitted were additional monitoring, ventilator function, availability of an alternative means of ventilation and function of ancillary equipment such as laryngoscopes. Only 5/41 subjects performed any check between cases(13).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

Hospital based cross sectional study

3.2 Study Area

It was Muhimbili National hospital and Muhimbili orthopaedic institute in Dar es Salaam, Ilala district, Upanga West. Muhimbili National hospital has a total of 19 theatre rooms that is obstetrics, main theatre paediatrics, and ophthalmology which was my main focus on data collection. Muhimbili orthopaedic institute has total of 9 theatre rooms which were used for data collection.

Muhimbili national hospital has a total of 7 anaesthesiologists, who on daily basis supervise the quality of anaesthesia service at the hospital, there are 54 anaesthetic nurses who on daily basis are involved in anaesthesia service provision at the hospital, and there are always two in theatre rooms for emergence and elective patients. All these were assessed on the level of practise and knowledge on daily and annual preventive maintenance. Always there are residents rotating in the two institutions rooms that are also provide anaesthesia Muhimbili Orthopaedic Institute has a total of 5 anaesthesiologists and 36 anaesthetic nurses who are involved in daily anaesthetic service.

Each institute has a biomedical department responsible for annual and planned preventive maintenance.

3.3 Study Population

All anaesthesia service providers at Muhimbili National Hospital and Muhimbili Orthopaedic Institute were involved. All Anaesthetic machines which were in use were included by obtaining the information from biomedical engineers and from anaesthesia department on the scheduled preventive maintenance from the proper documentation.

3.4 Study Duration

Duration of the study was October 2019 to January 2020

3.5 Sample Size

The estimated sample size was calculated from this formula

$$n = z^2 p(1-p)/d^2, \text{ Margin of error } 5\%$$

Where;

N is sample size

Z is the standard normal deviation at the required confidence level (95%), in this case 1.96

P is the proportion of anaesthesia providers in the national hospital which is 4% by MNH 2018 sample size was 60.

All the anaesthetic machines were involved.

3.6 Inclusion Criteria

- i. All anaesthesia service providers were included at MOI and MNH
- ii. All anaesthetic machines which were in use were included.

3.7 Exclusion Criteria

- i. Newly purchased anaesthetic machine at the time of the study were not included
- ii. Anaesthetic nurse students were not involved
- iii. First year residents were excluded in the study
- iv. Disposed anaesthetic machine which were not in use were excluded

3.8 Sampling Technique

Convenient sampling was used to get my sample. Whereby the all the anaesthesia providers who consented to be involved in a study were included. All the anaesthetic machine which were in use were included.

3.9 Data Collection

Two research assistants' registrars, who had experience of more than one year in the anaesthesia department, were recruited from one from MNH and one from MOI. They were trained on the way to collect data, and basic concepts of preventive maintenance.

Informed consent from all the anaesthesia providers who were involved in the study was obtained. Questionnaires were available to assess their level of practise and level of knowledge on daily preventive checks on their daily basis and self-administered way of collection.

Checklist for daily practise was there to assess the daily practise on daily checks of anaesthesia work station at the beginning of the day and in between cases which was corrected by observation of a participant while doing the checks.

Another checklist (standard WHO checklist) was used to assess the practise of biomedical engineers and at the level of the department of anaesthesia at each institution, looking on proper documentation on preventive maintenance done on the previous year.

Data was collected by both research assistants and primary investigator; data was cleaned and entered into SPSS.

3.10 Data Analysis

Data was entered into a computer and analysed using Statistical Package for Social Scientists (SPSS) from IBM SPSS Statistics Version 23 computer program by the primary investigator.

Continuous variable was summarised by mean and standard deviation. Variable such as knowledge were computed and scored and the ones who had scores above 50% categorized as good knowledge and, and below 50% with poor knowledge with a reference to the pass mark of MUHAS. Knowledge variable was summarized in the two by two table with professional cadre, chi square test was performed to compare the proportions between good and poor knowledge and p value of <0.05 was used to determine the statistical

significance crosstab with professional cadre and measure of association calculated by chi square test.

Practise variable on daily checks was computed and categorised as poor and good practise by the margin of 50% those who at least performed half of the parameters present on the standard checklist.

Practise by biomedical engineers was computed on three aspects on cleaning, inspection and verification of performance of each unit as defined with their parameters in the definition of terms of performance of each unit and categorized as performed or not performed, chi square test performed on the basis of machine ownership by institution either MOI or MNH.

3.11 Ethical Issues and Clearance

The ethical clearance was obtained from MUHAS ethical review board. The permission to conduct the study was also sought from the executive directors of MNH and MOI. Aim of the study was explained to the study participant and informed consent was obtained.

CHAPTER FOUR

4.0 RESULTS

Table 1: Demographic characteristics of the anaesthesia providers

Variable	Frequency	Percentage (%)
Institution of The Anaesthesia Providers		
MOI	41	48.2
MNH	44	51.8
	85	100
Gender		
Male	62	72.9
female	23	23.1
	85	100
Cadre of Anaesthesia Provider		
Resident	12	14.1
Anaesthesia registrar	3	3.5
Anaesthetic Nurse	62	72.9
Amo Anaesthetists	1	1.2
Anaesthesiologist	7	8.2
	85	100
Duration of Practise By Anaesthesia Providers		
0-5 Years	44	51.8
6-10years	21	24.7
11-20years	15	14.6
21-30 Years	1	1.2
31+ Years	4	4.7

Nurse anaesthetist are the majority of the anaesthesia service provision with 72.9% of all the providers, the profession is dominated by male by 72.9. the number of participant from the two institution were almost the same. mean duration of practise of the anaesthesia providers was found to be 1.82 with standard deviation of 1.071

Table 2: Knowledge on preventive maintenance of anaesthesia equipment of anaesthesia providers

Profession Cadre	Knowledge		P Value
	Good	Poor	
Residents	12(100%)	0(0%)	0.00
Registrars	2(67%)	1(33%)	
Nurse Anaesthetist	23(37%)	39(67%)	
Amo Anaesthetist	0(0%)	1(100%)	
Anaesthesiologist	7 (100%)	0	
	44 (51.7%)	41(49.3%)	

. Table 2 summarizes knowledge of anaesthesia providers toward preventive maintenance measures whereby n (44/85)51.7% of the providers had good knowledge and in accordance to the professional cadre of the provider's anaesthesiologist and residence inn (7/7), (12/12)100% had good knowledge compared to other anaesthesia providers, anaesthetic nurses (23/62) (37%) and anaesthetic registrar with p value of 0.00 statistically significant

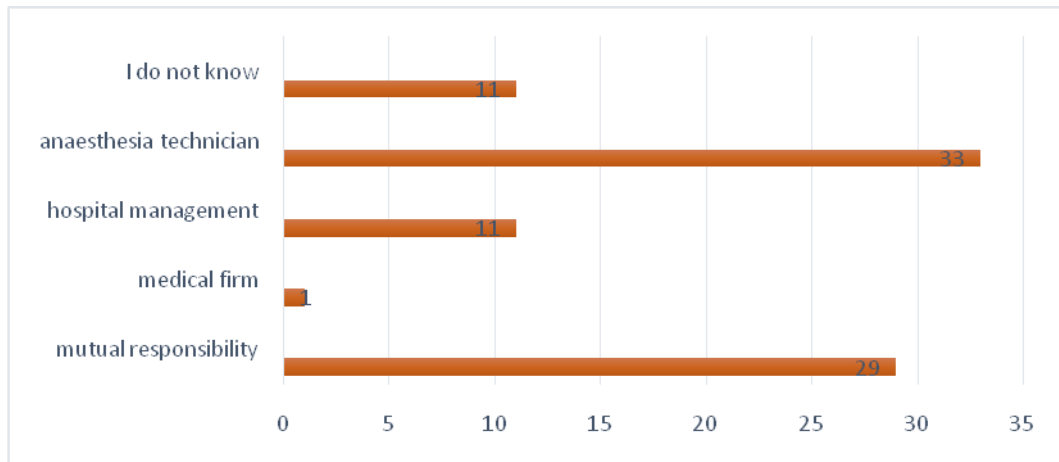


Figure 1: bar chart; responses of anaesthesia providers on who is responsible on the maintenance of anaesthesia machine

38% n (33/85) responded that it was the anaesthesia technician responsible for the maintenance with 33% n (29/85) showing the importance of mutual responsibility, 12.9 %n (11/85) did not know whose responsibility it was to do the preventive maintenance and checks.

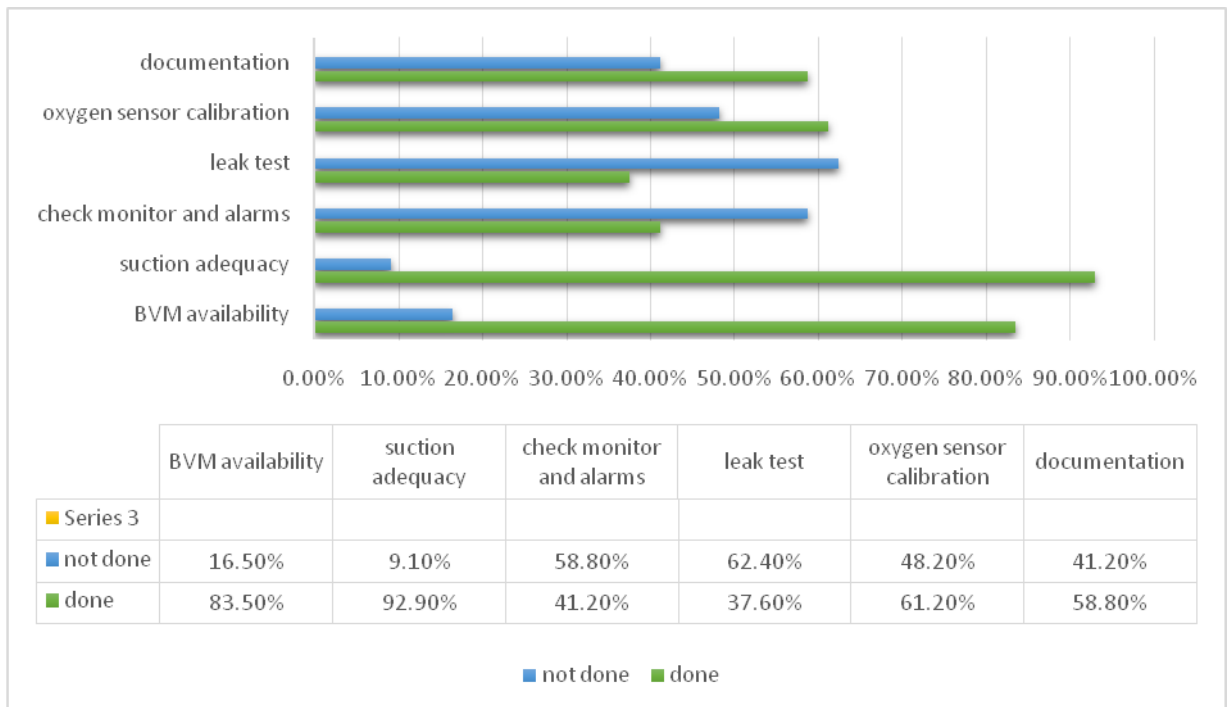


Figure 2: clustered bar chart ; Parameters of practise of machine check at the beginning of the day by anaesthesia providers

The clustered bar chart summarizes the few parameters that were checked at the beginning of the day on the anaesthesia work station, whereby the presence of BVM and working suction were checked by higher percentage 83.5% and 92.9% respectively, while other parameters such as setting monitors and alarms was done by 47.1%, leak tests was the least done procedure by 37.6%, oxygen sensor calibrated by 61.2% of the anaesthesia providers, and 58.8% of the anaesthesia providers.

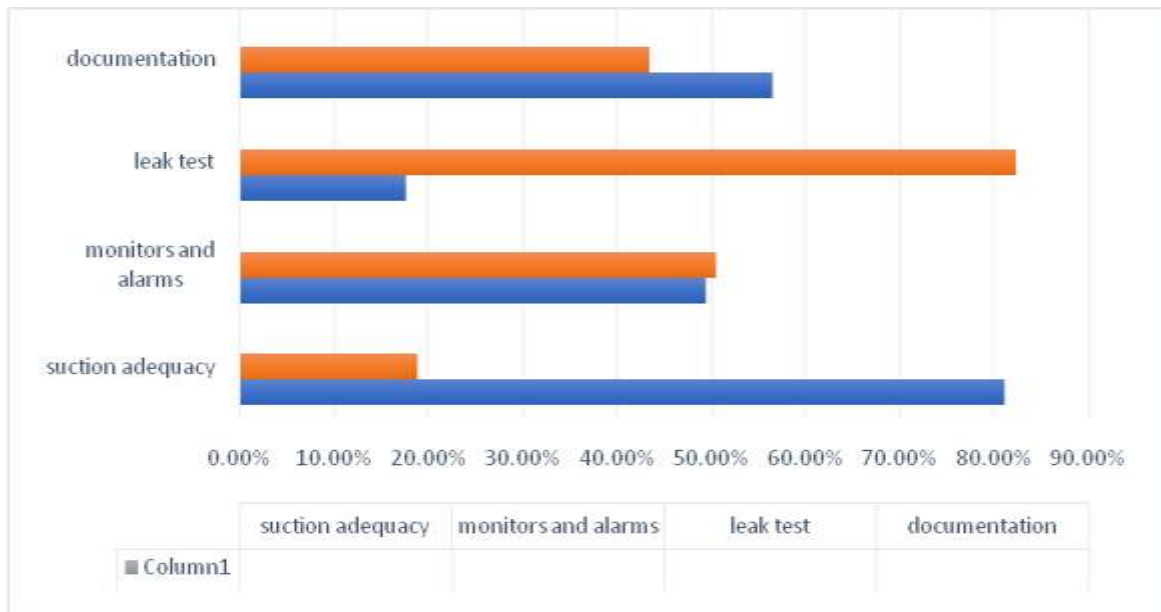


Figure 3: Clustered bar chart; Practise of machine check in between cases among the anaesthesia providers

Clustered bar chart presents important variables to be checked in between cases whereby 81.2% of the providers did verify the adequacy of suction available, leak test was least done by 17.6%.

Documentation of the anaesthesia check done was by 56.5%

Table 3: Daily practise of preventive checks of anaesthesia equipment at the beginning of the day by the anaesthesia providers

Professional Cadre	Daily Checks At The Beginning Of The Day		
	Good Practise	Poor Practise	P Value
Resident	12(100%)	0	0.00
Registrar	2(66.7%)	1(33.3%)	
Nurse Anaesthetist	23(37.1%)	39(62.9%)	
Amo Anaesthetist	0	1(100%)	
Anaesthesiologist	7(100%)	0	
Total	44(51.7%)	41(48.3%)	

N(44/85)51.7% of the anaesthesia providers had overall good practise of pre anaesthesia machine check whereby residents and anaesthesiologist had 100% good practise while the nurse anaesthetist had 37.1% of good practise of pre anaesthesia checklist

The higher the professional cadre showed to have good pre anaesthesia checklist at the beginning of the day with P value of < 0.05.

Table 4: Practise of daily checks by anaesthesia providers in between cases

PROFESSIONAL CADRE	DAILY CHECKS IN BETWEEN CASES		
	Done	Not done	P value
RESIDENT	10(83.3%)	2(16.7%)	0.34
REGISTRAR	3(100%)	0	
NURSE	36(58%)	26(42%)	
ANAESTHETIST			
AMO ANAESTHETIST	1(100%)	0	
ANAESTHESIOLOGIST	7(100%)	0	
TOTAL	57(67%)	28(33%)	

Table presents practise of pre anaesthetic machine check in between cases which shows n (57) 67% of anaesthesia providers had good practise compared to n(28) 33% Higher anaesthesia cadres had good practise anaesthesiologist, resident's registrar having 100%, 83.3% and 100% respectively. 58% Anaesthetic nurses had good practise compared to 42%.

The higher the anaesthetic cadre showed to have good practise compared to lower cadre though it was not statistically significant.

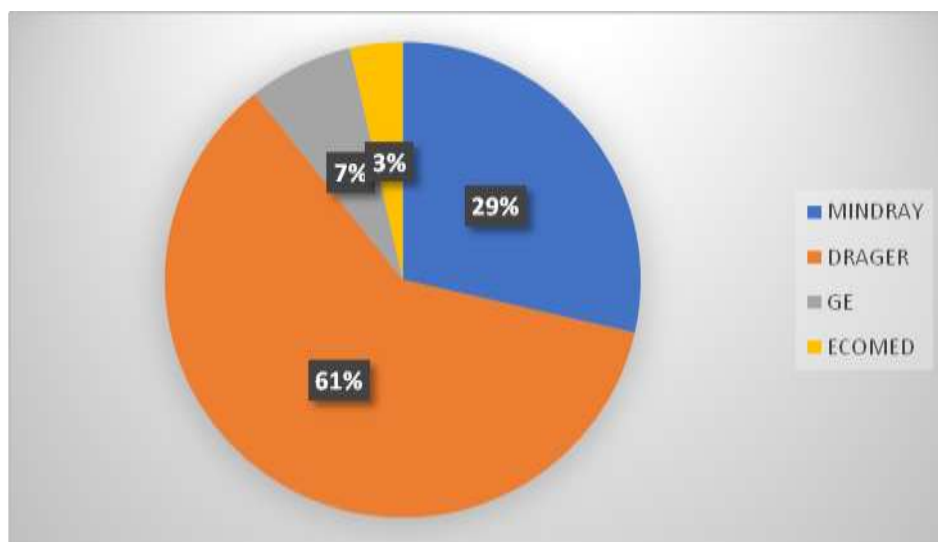


Figure 4: pie chart; brand of anaesthesia machine found in the institution (MOI and MNH)

Drager brand of anaesthesia machine is the commonest in the two institutions comprising of 61% of the anaesthesia machine followed by mind ray comprising of 29% of the machine 7% of the machine was GE.

Table 5: Practise of biomedical engineers on annual preventive maintenance of anaesthesia machine

VARIABLE	INSTITUTION	PRACTISE		TOTAL	P VALUE
		Done	Not done		
CLEANING OF ANAESTHESIA MACHINE	MOI	0	9	9	0.00
	MNH	19	0	19	
INSPECTION OF THE WHOLE UNIT OF ANAESTHESIA MACHINE	MOI	0	9	9	0.00
	MNH	19	0	19	
VERIFYING OF FUNCTIONING OF EACH UNIT	MOI	0	9	9	0.00
	MNH	19	0	19	
TOTAL		19(67.8%)	9(32,2%)	28(100%)	

The table summarizes the parameters of annual preventive maintenance done at the anaesthesia work station by biomedical engineers whereby it shows that all the anaesthesia work station stationed at MNH 67.8% were maintained in the past year while all those at MOI the annual preventive maintenance was not done 32.2%.

The machine being at MNH had a schedule of preventive maintenance of anaesthesia machine compared to MOI who had not, and therefore they followed the schedule of maintenance. There was no documentation on preventive maintenance at the department of anaesthesia.

CHAPTER FIVE

5.0 DISCUSSION

This was a cross sectional study among the anaesthesia providers working at MNH and MOI on the knowledge and practice of preventive maintenance of anaesthesia machine which included evaluation of annual preventive maintenance practices by biomedical engineers of the two institutions

5.1.1 Practice of anaesthesia providers on daily preventive maintenance

The study looked on practice of daily checks by the anesthesia providers on daily preventive maintenance checks, whereby 51% and 57% had good practice at the beginning of the day and In between cases respectively. In the study done in Saudi Arabia though it was done on daily basis on form audit, the finding was there was higher compliance on anaesthesia check by the anaesthesia providers by 98%, this can be explained by difference in the cadres in the institution involved in Saudi Arabia whereby their study involved the Anaesthesiologists only (14).

We found higher good practice of anesthesia checklist by anesthesia providers of higher cadre such as anaesthesiologist by 100% at the beginning of the day and in between cases, residents with 100% at the beginning of the day and 83% in between cases. The nurse anaesthetist had good practice by 37% at the beginning of the day and 58% in between cases whereby the higher the professional cadre had better practice than lower cadres. In an audit checking on level 2 and level 3 check of anaesthesia delivery system done at three hospital in Australia had found low compliance to anaesthesia consultants(15). This finding can be to the lower number of anaesthesiologist we have in this set up, and they are the ones to set example to non-physician anaesthetist to have better practice. Also the timeline difference of these two studies can explain the difference.

On the parameters checked in daily practice of anaesthesia check by the providers whereby at the beginning of the day availability of Bag valve mask was checked by 85% of the providers, working suction by 92.2% of the provider. Leak test performed by 37%, checking and setting monitors and alarms by 41.2%, oxygen analyzer calibration by 61.2%

documentation was done by 58%, in the audit done in 2007 by Langford et al some of the parameters were observed where the oxygen analyzer was calibrated by 79% the leak test by 85% but the documentation of the process was done poorly by only 26% of anaesthesia providers(13). This finding differs may be due to the time difference when these studies were taken and the emphasis on machine check has been changing over time

5.1.2 Periodic maintenance of anaesthesia machine by biomedical engineer

A standard checklist by WHO standard checklist was used and the findings were that 67.8% of the anaesthesia machine were maintained on the past year with 100% of the machine from MNH which were maintained, on the aspects of Inspection of whole unit, Verification of functioning of different unit, vaporizer calibration, and cleaning of the whole anaesthesia machine. Comparing to survey done in France in 1996 on periodic maintenance of the anaesthesia equipment was found that 50% of the work stations were maintained on that time, the discrepancy with our institution may be brought on the difference of timeline of the study and at MOI, there was no documented preventive maintenance at the level of the department and there is no biomedical department specifically working at MOI(9).

5.1.3 Knowledge of anaesthesia providers on preventive maintenance

Knowledge was evaluated on the aspect of frequency of maintenance, disassembly of the equipment, part of machine that is sterilized and its frequency, 51% of the anaesthesia providers were found to have good knowledge whereby by looking at their cadre, anaesthesiologist and residents had good knowledge by 100%. The nurse anaesthetist had good knowledge by 37%, on similar type of study looking on knowledge and practise by anaesthesia providers on preventive maintenance in Turkey 71% were found to have profound good knowledge in most of the questions, in the institutions 99% responded that they needed training on preventive maintenance while those in Turkey 85%,(3) no studies were found to be done in Africa settings of this magnitude.

5.2 Dissemination of the Results

A copy of dissertation will be found at the MUHAS repository for future references. Manuscript will also be prepared to be published in peer reviewed journal. Also the institutions involved in this study that is MOI and MNH will have their copy at the department of anaesthesia and biomedical department.

5.3 Strength of the Study

This was the first study done at the tertiary hospital to assess the practise of anaesthesia providers on their daily and annual practise on preventive maintenance. This study also used the standard tools used by Who on looking on annual preventive maintenance of anaesthesia machine. The tool for pre anaesthesia check was the one adopted from ASA.

5.4limitations of the Study

Absence of the part of hospital management to be audited if there are work plans on preventive maintenance in their institutions. We also assessed the two centres in this study whereby more is needed, to assess all levels of health facility for more concrete data.

CHAPTER SIX

6.0 Conclusion

The lower cadres that is Nurse anaesthetists, anaesthesia registrars had low knowledge and poor practise on preventive maintenance.

Anaesthesia machine at Muhimbili Orthopaedic institute had not been maintained on the previous year.

6.2 Recommendations

Anaesthesia providers should be trained on preventive maintenance strategies so as to have better compliance and knowledge, and lower cadre be instructed on the preventive maintenance.

MOI should establish its biomedical department to carter the needs on preventive maintenance.

REFERENCES

1. World Health Organization. Medical equipment maintenance programme overview WHO Medical device technical series WHO MEDICAL DEVICE TECHNICAL SERIES: TO ENSURE IMPROVED ACCESS , QUALITY AND USE OF MEDICAL DEVICES DEVELOPMENT OF MEDICAL DEVICE POLICIES WHO MEDICAL DEVICE TECHNICAL S. 2011;
2. Bothner U, Georgieff M, Schwilk B. Building a large-scale perioperative anaesthesia outcome-tracking database: methodology, implementation, and experiences from one provider within the German quality project. *Br J Anaesth* [Internet]. 2000 Aug [cited 2019 Apr 1];85(2):271–80. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/10992838>
3. Erbas M, Altinisik HB, Simsek T, Toman H, Kiraz HA, Sahin H, et al. Evaluation of the Approaches of the Anaesthesiologists on Maintenance of Anaesthesia Machines. *Influ Oral Carbohydr Solut Intake Stress Response before Total Hip Replace Surg Dur Epidural Gen Anaesth*. 2016;44(3):134–41.
4. Merry AF, Gelb AW, Morriss WW, Johnson W. World Health Organization-World Federation of Societies of Anaesthesiologists (WHO-WFSA) International Standards for a Safe Practice of Anesthesia Normes internationales pour une pratique sécuritaire de l'anesthésie de l'Organisation mondiale de la santé e. *Can J Anesth Can d'anesthésie*. 2018;65(6):698–708.
5. Sweney N, Owen H, Fronsko R, Hurlow E. An audit of level two and level three checks of anaesthesia delivery systems performed at three hospitals in South Australia. *Anaesth Intensive Care*. 2012;40(6):1040–5.
6. J.A. W, R.K. W, A. S, W.B. R. Human failure: An analysis of 2000 incident reports. *Anaesth Intensive Care* [Internet]. 1993;21(5):678–83. Available from: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed6&NEWS=N&AN=23311306>
7. WHO. Guide To Infrastructure and S Upplies. 2012;4–5.

8. Brockwell RC, Dorsch J, Holland CG, Aana MSN, Driscoll C. No Title. 2008;1–16.
9. Bourgain JL, Coisel Y, Kern D, Nouette-Gaulain K, Panczer M. What are the main “machine dysfunctions” to know? *Ann Fr Anesth Reanim* [Internet]. 2014;33(7–8):466–71. Available from: <http://dx.doi.org/10.1016/j.annfar.2014.07.744>
10. Britain G. EQUIPMENT.
11. Bothner U, Georgieff M, Schwilk B. No Title Building a large-scale perioperative anaesthesia outcome-tracking database: methodology, implementation, and experiences from one provider within the German quality project. *Br J Anaesth*. 2000;85–2:271–80.
12. Loftus RW, Brown JR, Patel HM, Koff MD, Jensen JT, Reddy S, et al. Transmission Dynamics of Gram-Negative Bacterial Pathogens in the Anesthesia Work Area. *Anesth Analg*. 2015;120(4):819–26.
13. Langford R, Gale TCE, Mayor AH. Original Article Anaesthetic machine checking guidelines : have we improved our practice ? 2007;1050–6.
14. Suhaibani M Al, Malki A Al, Dosary S Al, Barmawi H Al, Pogoku M. Anesthesia : Essays and Researches Pre-use anesthesia machine check ; certified anesthesia technician based quality improvement audit. :354–61.
15. Centre FM. Audits An audit of level two and level three checks of anaesthesia delivery systems performed at three hospitals in South. 2012;40(6):1040–5.

APPENDICES**I QUESTIONNAIRE TO ANAESTHESIA PROVIDER**

1) How long have you worked as an Anaesthesia provider?

- a. 0–5 years
- b. 5–10 years
- c. 10–20 years
- d. 20–30 years

2) How often is the maintenance of the anaesthesia device performed by the ‘authorised firm’ in your hospital?

- a. Daily
- b. Weekly
- c. Once in 3 months
- d. Once in 6 months
- e. Once a year
- f. I do not have enough knowledge *

3) How often is the cleaning performed by anaesthesia professionals’ in your hospital (except for times after active contamination) by removing the parts of the anaesthesia device?

- a. Daily
- b. Weekly
- c. Once in a month
- d. Only when they get contaminated
- e. I do not have enough knowledge

4) Who do you think is legally responsible for the maintenance and Control of the anaesthesia device and equipment? (More than 1 option

Can be selected)

- a. Medical firm
- b. Hospital management
- c. Anaesthesiologist
- d. Anaesthesia technician
- e. I do not have enough knowledge

5) Have you ever disassembled the anaesthesia device(s) that you use?

- a. Yes
- b. No

6) Do you use bacteria filters in your institution?

- a. Yes
- b. no

7) How often do you use bacteria filters in your institution?

- a. We use for each patient
- b. We generally use
- c. We rarely use
- d. We do not use

8) What do you think that the bacteria filter is protective against? (More than 1 option can be selected)

- a. Bacteria
- b. Viruses
- c. Fungi
- d. I do not have enough knowledge

9) Which parts of the anaesthetic device should be sterilised after surgery of a patient with a contagious infection in the respiratory tract? (More than 1 option can be selected)

- a. Breathing circuit
- b. Canister
- c. Vaporiser
- d. Inhalation and exhalation valves
- e. Flow sensors
- f. Oxygen sensor
- g. Humidifier (humidifier)
- h. Water trap
- i. Waste gas system

10) Do you know the location of the soda lime canister in the anaesthesia Device that you use?

- a. Yes
- b. No

11) When do you consider replacing the soda lime canister? (More than option can be selected)

- a. Routine daily/weekly replacement
- b. Replacement upon colour change
- c. Replacement when the EtCO₂ values rise
- d. I do not have enough knowledge

12) Do you know the location of the flow sensor in the anaesthesia devices (s) that you use?

- a. Yes
- b. No

12) How do you clean the flow sensor in the anaesthesia devices you use after contact with an infected patient?

1. It is removed and sterilised in an autoclave (in the appropriate temperature and duration in accordance with the user guide).
2. It is removed and sterilised with liquid disinfectants (keeping in solutions like glutaraldehyde, OPA and others for the appropriate time).
3. Hydrogen peroxide is vaporised through the respiratory system.
4. The flow sensor is not a part that is removed and sterilised
5. I do not have enough knowledge

13) Do you know the location of the oxygen sensor in the anaesthesia device(s) that you use?

- a. Yes
- b. No

14) What is your maintenance procedure for the oxygen sensor in the anaesthesia device(s) that you use after contact with an infected patient?

- a. It is removed and sterilised in an autoclave (in the appropriate temperature and duration in accordance with the user guide).
- b. It is removed and sterilised with liquid disinfectants (keeping in solutions like glutaraldehyde, OPA and others for the appropriate time).
- c. Hydrogen peroxide is vaporised through the respiratory system.
- d. The oxygen sensor is not a part that is removed and sterilised
- e. I do not have enough knowledge

15) Do you routinely control 'how long the anaesthesia device you use works only with battery' during power outage?

- a. Yes
- b. No

16) How is the calibration of the vaporisers performed in your organisation?

- a. By the anaesthesia technician
- b. By the biomedical employees of the hospital
- c. By the authorised firm
- d. I do not have enough knowledge

17) How do you transport the vaporiser? (More than 1 option can be selected)

- e. There is no consideration about it
- f. We pay attention to keeping the vaporiser perpendicular.
- g. We put the device in T (transport) mode in appropriate vaporisers
- h. We carry after it is fully discharged
- i. I do not have enough knowledge

18) Have you read the user guide of the anaesthesia device(s) that you use?

- a. Yes
- b. No
- c. partially

19) Do you think that you need training on the maintenance of anaesthesia devices and equipment?

- a. Yes
- b. No

**II CHECKLIST OF ANAESTHESIA MACHINE TO BIOMEDICAL ENGINEERS
AND HEADS OF DEPARTMENT OF ANAESTHESIA OA THE INSTITUTION**

1. INSTITUTION.....
2. THEATRE NO.....
3. MANUFACTURER.....
4. BRAND OF THE MACHINE.....
5. HOW LONG HAS IT BEEN IN USE.....

PPM ACTIVITY	Records by biomedical technician	Records at the level of department
Inspection exterior of equipment for damage or missing hardware.		
Inspection the power cord, strain relief and plug/s for any signs of damage.		
Turn unit off, open user-accessible covers and inspect unit for damage		
Clean unit interior components and exterior with vacuum or compressed air.		
Inspect interior for signs of corrosion or missing hardware. Repair as required.		
Inspect electrical components for signs of excessive heat or deterioration		

Inspect all external quick disconnect O-rings.		
Inspect condition of all tubing, replace if necessary.		
Inspect all cables for excessive wear.		
Inspect inspiratory and expiratory flow valves.		
Inspect internal circuits by leak testing		
Verify correct operation of gas scavenger systems.		
Verify correct vaporizer calibration.		
Verify correct flow meter calibration.		
Verify correct operation of ventilator (rate, volume, flow).		
Verify correct operation of all buttons, controls, displays and/or indicators.		
Verify correct operation of unit in all functional modalities		
Clean exterior of unit including all accessories, cables, controls and displays		

III CHECKLIST ON REAL DAILY PRACTISE OF ANASTHESIA PROVIDERS

INSTITUTION.....

THEATER NO.....

PRACTIOPNER CADRE.....

CHECKS AT THE BEGINNING OF THE DAY	
Verify Auxiliary Oxygen Cylinder and Self-inflating Manual Ventilation Device are Available & Functioning	
Verify patient suction is adequate to clear the airway	
Turn on anesthesia delivery system and confirm that AC power is available	
Verify availability of required monitors and check alarms.	
Verify that pressure is adequate on the spare oxygen cylinder mounted on the anesthesia machine.	
Verify that piped gas pressures are ≥ 50 psig.	
Verify that vaporizers are adequately filled and, if applicable, that the filler ports are tightly closed.	
Verify that there are no leaks in the gas supply lines between the flowmeters and the common gas outlet.	
Test scavenging system function.	
Calibrate, or verify calibration of, the oxygen monitor and check the low oxygen alarm.	
Verify carbon dioxide absorbent is not exhausted.	
Breathing system pressure and leak testing.	
Verify that gas flows properly through the breathing circuit during both inspiration and exhalation	
Document completion of checkout procedures.	
Confirm ventilator settings and evaluate readiness to deliver anesthesia care. (ANESTHESIA TIME OUT)	

IN BETWEEN THE CASES	
Verify patient suction is adequate to clear the airway	
Verify availability of required monitors, including alarms	
Verify that vaporizers are adequately filled and if applicable that the filler ports are tightly closed.	
Verify carbon dioxide absorbent is not exhausted	
Breathing system pressure and leak testing.	
Verify that gas flows properly through the breathing circuit during both inspiration and exhalation.	
Document completion of checkout procedures.	
Confirm ventilator settings and evaluate readiness to deliver anesthesia care. (ANESTHESIA TIME OUT)	

IV CONSENT FORM

Consent Form

I am Dr John Joseph Kweyamba a student from Muhimbili University of Health and Allied Sciences (MUHAS) I am conducting a study titled '**PREVENTIVE MAINTAINANCE OF ANAESTHETIC EQUIPMENTS AT MUHIMBILI NATIONAL HOSPITAL AND MUHIMBILI ORTHOPAEDIC INSTITUTE 2019.**'

Participation in the Study

You are kindly requested to be part of this study, if you accept to participate your particulars /information will be taken and used for the purpose of this study and this involve the following: giving you questionnaire on your practice of preventive maintenance of anesthesia machine, and direct observation of your practice by direct observation.

Confidentiality

You are strongly assured of the confidentiality of the information obtained that will only be used for the purpose of this research and anonymity will highly be observed when collecting data and compiling report. To assure you even your name will not be acquired to appear in the questionnaire.

Risks of Participating

No anticipated or harm that may result from participating in this study. Your participation is absolutely voluntary and there is no penalty for refusing to participate. You are free to ask questions and you may stop to participate in this study at any time.

Contact person

The principle investigator, Dr. John Joseph Kweyamba (0754092507) is a key contact person with regard to any queries about this study.

If you have any question/concern about you rights as a participant, you may contact

Director Research and Publications Muhimbili University of Health and Allied Sciences (MUHAS)

P. O. BOX 65001, Dar es Salaam

Tel; +255 754757577

If you agree to participate in this study, please sign this consent form.

I (initials)..... Have read and understand the contents of this form and I have been given satisfactory explanation with all my questions answered. I therefore consent to participate in this study

Signature of interviewee

Date.....

Signature of interviewerDate

V ETHICAL CLEARANCE LETTER

**MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES**

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Direct Line: +255-22-2151378
Telefax: +255-22-2150465
E-mail: dpgs@muhas.ac.tz

Ref. No. DA.287/298/01A/

27th June, 2019

Dr. John Kweyamba,
MMed. Anaesthesiology,
MUHAS.

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED: " KNOWLEDGE AND PRACTICE OF PREVENTIVE MAINTENANCE OF ANAESTHETIC EQUIPMENT AT MUHIMBILI NATIONAL HOSPITAL AND MUHIMBILI ORTHOPAEDIC INSTITUTE "

Reference is made to the above heading.

I am pleased to inform you that, the Chairman has, on behalf of the Senate, approved ethical clearance for the above-mentioned study. Hence you may proceed with the planned study.

The ethical clearance is valid for one year only, from **26th June, 2019 to 25th June 2020**. In case you do not complete data analysis and dissertation report writing by **25th June, 2020**, you will have to apply for renewal of ethical clearance prior to the expiry date.


Dr. Emmanuel Balandya
ACTING: DIRECTOR OF POSTGRADUATE STUDIES

cc: Director of Research and Publications
cc: Dean, School of Medicine, MUHAS

VI INTRODUCTION LETTER TO MUHIMBILI NATIONAL HOSPITAL

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

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Tel G/Line: +255-22-2150302/6 Ext. 1015
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Telefax: +255-22-2150465
E-mail: dpgs@muhas.ac.tz

Ref. No. HD/MUH/T.654/2017 13th August, 2019

Executive Director
Muhimbili National Hospital,
P.O. Box 65000,
DAR ES SALAAM.

Re: INTRODUCTION LETTER

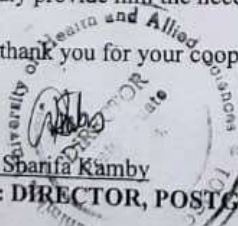
The bearer of this letter Dr. John Kweyamba is a student at Muhimbili University of Health and Allied Sciences (MUHAS) pursuing MMed Anaesthesiology.

As part of his studies he intends to do a study titled: *"Knowledge and practice of preventive maintenance of Anaesthetic equipment at Muhimbili National Hospital and Muhimbili Orthoaeedic Institute."*

The research has been approved by the Chairman of University Senate.

Kindly provide him the necessary assistance to facilitate the conduct of his research.

We thank you for your cooperation.




Ms. Sparifa Kamby
For: DIRECTOR, POSTGRADUATE STUDIES

cc: Dean, School of Medicine, MUHAS
c.c. Dr. John Kweyamba

VII INTRODUCTION LETTER TO MUHIMBILI ORTHOPAEDIC INSTITUTE

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

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Telefax: +255-22-2150465
E-mail: dpgs@muhas.ac.tz

Ref. No. HD/MUH/T:654/2017 29th June, 2019

Executive Director
Muhimbili Orthopaedics Institute
P.O. Box 65474
DAR ES SALAAM.

Re: INTRODUCTION LETTER

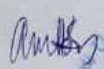
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The research has been approved by the Chairman of University Senate.

Kindly provide him the necessary assistance to facilitate the conduct of his research.

We thank you for your cooperation.


Ms. Sharifa Kamby
For: DIRECTOR, POSTGRADUATE STUDIES

cc: Dean, School of Medicine

