June **2019**

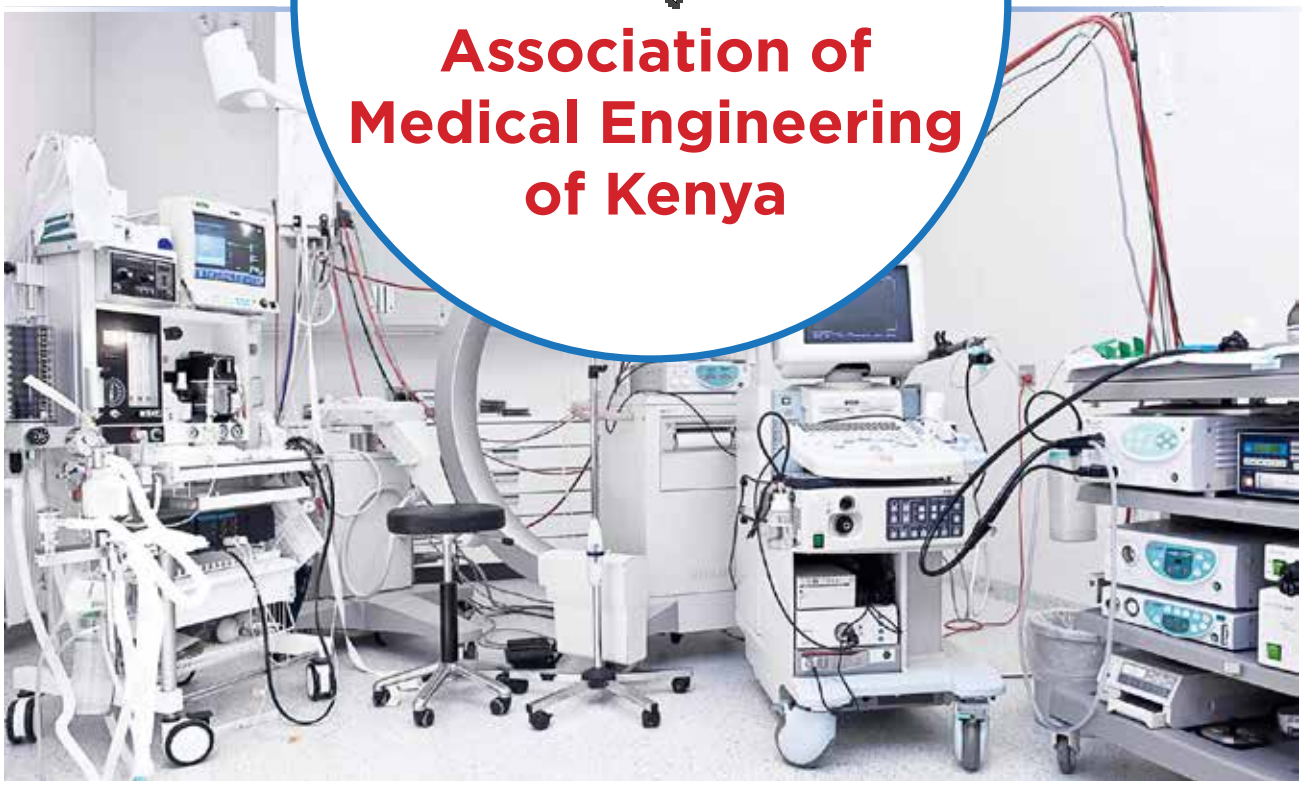
Volume **5**
Issue **01**

BIOMED ESSENCE

Strengthening Healthcare Delivery Services Through Appropriate Technology

AMEK

Association of Medical Engineering of Kenya



AMEK (Association of Medical Engineering of Kenya)
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Some of AMEK members in Hotel Africana in Kampala Uganda during the 6th East Africa regional Conference, 2018.

Editor's **Note**

I take this opportunity to welcome you to the fith Volume, Issue 01 of Biomed Essence that is exciting and rich in content.

We have looked at the Managed Equipment Service (MES) in Kenya that has improved service delivery in Kenya. In addition an exciting requirement of tools required for test and calibration have been elaborated in depth. The magazine also looks at the classes of Electrical Safety.

The room requirements for X-Ray and MRI has now been put in black and white by professionals in this area and I am sure most of you have been looking for this information.

The Magazine also looks at the need for continuous professional development in the growth of the Biomedical Engineering profession. The duties of a Biomed in a hospital, Role of Biomeds in the fighting corruption and also their role in UHC has been discussed explicitly.

We cannot forget to appreciate our partners for being with us and walking with us in seeing the success of our programs without hesitation. For this issue, we recognise the support of GE and Crown Healthcare. We hope their support has found favour from our publications. May you all be blessed and continue supporting AMEK programs.

I encourage Members to be sending articles that are exciting, Educative and informative for publishing to amekenya@yahoo.com

I thank you all as your read, remember to critic as well.

Annarose Gitau

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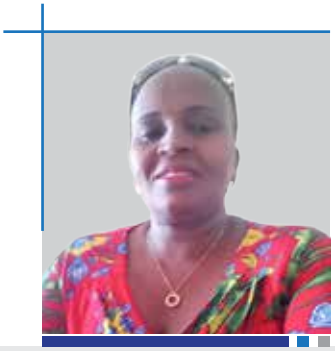

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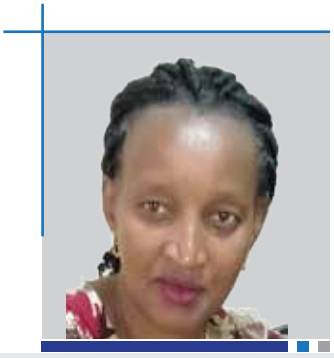

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Council Member

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Council member

Chairman's **Statement**

I take this opportunity to salute you all members for a myriad of reasons. Firstly, for the Contributions that you are giving at your various working institutions, Secondly for availing yourselves to participative in AMEK activates that we have always organized, thirdly for playing an important role in our health facilities in managing of the Medical Equipment and finally for being your brothers and Sisters keepers at all-time as you have been responding very well in supporting colleagues and their families who in one way or the other been bereaved.

Ladies and Gentlemen, Last year we all travelled to Uganda the 6th East African Conference where Most of us turned up for the great Event. We were well represented and I believe that the conference outcomes have made some remarkable impact in your work and life as well. May you continue with the same spirit in the upcoming AMEK activities with the same vigor.

AMEK PARTNERS

AMEK is engaging various Partners in order to improve on our programs and soon you will see the outcome. I urge all of you to be vigilant and utilize every opportunity that comes your way through these initiatives. As AMEK family we salute you all for moving with us, may you be blessed and when we come knocking again do not hesitate to do it again in a higher Notch.

AMEK COUNCIL

As a council, I take this Opportunity for electing me as your Chair for my second and final term and for giving me office bearers of your choice for the Next three years. The team in place will for sure delivery on our mandate as agreed in our last AGM. It is my hope that you shall be able to judge us at the opportune time. In the new set up we now have the office of the Organizing Secretary that is now held by Khalif Dekow for the first time. It is my believe that this office will be of value to us all.

INTERNATIONAL BODIES

AMEK is an affiliate Member of the International federation of Engineers (IFHE), the International Federation for Medical and Biological Engineering (IFMBE), these organization usually organize for training and conferences. Kindly keep on checking our communication so that you can enjoy these opportunities.

FEAHEA CONFERENCE

The 6th East African Regional Conference was held in hotel, Africana in Kampala, Uganda and I must applaud you for the high Number of early attendance and next year the 7th FEAHEA conference be done in Tanzania at a date and Venue to be announced by the host.

Lastly as wind up, may I take this opportunity to ask you to take every opportunity and move with Technology in order to improve on your performance and outputs.

May God Bless AMEK

Edward Muyekho Matekwa

Chairman, AMEK

Hon Secretary **General's Report**

WELCOME NOTE

Honorable members, Ladies and Gentlemen,

Let me begin by once again thanking you for electing me as your Secretary General for the period running the year 2019-2021 together with my other colleagues mentioned in this Newsletter ,I would wish to assure you that this the Association is in very capable hands.

Just to let you know that our theme of the year 2019 is "Focusing on AMEK Members and Biomedical Fraternity" as i look forward to working together for progress on all our areas of work.

Our Career faces serious threats and major challenges -- from lack of training facilities to No jobs

Biomedical Engineers around the country are rightly demanding change and looking for governments and institutions to deliver. We all agree that AMEK must do even more to adapt and deliver. That is the aim of the reform proposals that this Association will consider.

I look forward to working with you more, distinguished AMEK members, to strengthen our association to better support our Country and to produce better results for the people we serve.

One key change in healthcare technology management within and beyond this country must be to empower the worlds Biomedical Engineers. That's why we have series of educational forums like Biomedical excellence day Sponsored by GE healthcare, just to mention but a few.

Despite today's conflicts and the grinding daily impact of technological poverty, I remain convinced that this is far more an era of transformational potential.

Allow me to give you an overview of what AMEK has been up to for the last six months beginning January 2019 to June 2019;

NEW MEMBERS 2019

To our new members you are our strength, as you come with lots of energy and new ideas, welcome on board, we value the bold step you took to join us in this Ship called AMEK, once again welcome.
A political analyst one time talked of "Tyranny of Numbers", yes this is our focus. We need as many members as possible, not a single biomed should be left out.

We have so far registered 100 new members since beginning of the year and many more members are promising to Join us before end of the year.

EMPLOYMENT OPPORTUNITIES

AMEK has been in communication with the Ministry of Health and other private institutions to ensure that the Jobless members are given the absorbed in the system.

So far quite a number have gotten opportunities have been given to AMEK members , the exact number of these opportunities will be reported in our Annual newsletter in November 2019.

KENYA BIOMEDICAL ENGINEERS BILL

AMEK is in constant follow up of this bill which has been in the parliament for over two years now ,it has gone through its first and second reading through our able AMEK member Hon Stephen Mule the MP for Matungulu.

This year we have had series of discussion with the MP on the Bill progress and all we can report is that we have seen the at the end of the tunnel. We request for patients of our mebers even as we all a wait for this mega outcome.

UPCOMING EVENTS

AMEK has organized the following upcoming main events this year 2019.

1. Biomedical excellence day-Amek has partnered with GE healthcare Kenya, one of the Major Medical equipment manufacturers and suppliers in Kenya to educate Biomedical engineers on various emerging technologies and Medical equipment management plan. This event is to take place in 8th Aug 2019
2. 7th Annual Africa Hospital Expansion Summit-AMEK is an association partner in this event which will take place in Uganda Kampala on 18th to 19th sept 2019. For more information on the members who would wish to attend please go to http://africa.hospitalexpansionsummit.com
3. AMEK Annual conference which is to take place in November 2019 in Mombasa ,this is where different Vendors exhibit their product as AMEK conference continues.

IN CONCLUSION

AMEK will be better with new ideas and positive mindset coupled with positive attitude. This profession needs more than just being a biomedical engineer but it needs an innovative and inventive individual to bring it to a better beginning. Lets work together to create the AMEK we want.

Eng. Millicent Alooh

Hon Secretary General
Association of Medical Engineers of Kenya
AMEK

Managed Equipment **Services Project (MES)**

WHAT IS MANAGED EQUIPMENT SERVICE

Managed Equipment Service (MES) project refers to a flexible, long-term contractual arrangement that involves outsourcing the provision of specialized, modern medical technology and equipment to private sector service providers ("MES Provider"). The project comprises 7-year contracts between the Ministry of Health and various contractors for the supply, installation, maintenance, replacement and disposal of various equipment, as well as training and reporting for the entirety of the contract period.

LEGAL AND REGULATORY FRAMEWORK

President Uhuru Kenyatta and Deputy President William Ruto are shown medical equipment by radiographer Daniel Simiyu during the Commissioning of the equipment at Hola Referral hospital in Tana River County.

GOVERNING HEALTHCARE IN KENYA

The Constitution of Kenya, 2010 ("Constitution") is the supreme law of the land and it contains a progressive Bill of Rights, including the right to health. It provides that 'every person has the right to the highest attainable standard of health, which includes the right to health care services, including reproductive health care.' According to Kenya's Health Policy, the government aims to attain the highest possible standard of health in a manner that is responsive to the needs of the people, through provision of equitable, affordable and quality health and related services at the highest attainable standards. One of the ways through which Kenya plans on achieving its health goals is by involving the private sector in health services provision and finance.

WHAT MAKES KENYA MES SPECIAL

Kenya is an East African country with an estimated population of 43 million, according to the Kenya National Bureau of Statistics. Over the years, Kenya has progressively continued to make structural and economic reforms that have contributed towards sustained growth. As the business hub of East Africa, Kenya has been highlighted in the World Bank's Doing Business Report, 2017 as one of the economies making the biggest improvements in its business regulations. In addition, Kenya has over the years taken important steps to improve the socio-economic status of its citizens, including health.

According to the Strategic Investment Plan for Kenya's Ministry of Health for the period 2014 to 2018, one of the goals towards building a progressive, responsive and sustainable health care system is to strengthen collaboration with the private sector. In this regard, Kenya is arguably the first country, not only in Africa but possibly globally, to enter into one of the largest sustainable healthcare projects through the MES arrangement involving the provision, management and servicing of state of the art medical equipment in approximately ninety-eight (98) hospitals throughout the country.

Machakos Level Five nurse in charge of theatre Halima Adan shows President Uhuru Kenyatta, his deputy William Ruto and Megascope managing director Richard Ngatia how Maternity equipment works.

stories from its growing youthful population, a dynamic private sector, a new constitution, and its pivotal role in East Africa. The implementation of the MES Project in Kenya was the first time such a structure was being used in Africa to equip health facilities.

MES IMPLEMENTATION

According to the Parliamentary Research Services (PRS), the programme, which is now in its Fifth year, has been implemented in 98 hospitals across the 47 counties, with a focus on theatre, central sterile services department (CSSD), renal, ICU and radiology equipment. Contracts under the MES project were signed on 5th February, 2015 by the Ministry of Health, respective counties and the MES provider(s). The term of the MES contract is seven (7) years with a possibility of an extension for an additional three (3) years.

In February 2015, the Ministry of Health awarded leasing agreements for the provision of specialized medical equipment to counties worth KShs. 38 Billion. According to the Ministry of Health, the type of equipment prioritized under the MES project was informed by a Needs Assessment conducted in March 2014. Following the assessment, seven categories (LOTS) of equipment were prioritized as follows:

1. Theatre equipment
2. Theater, CSSD equipment
3. Laboratory equipment (Category 1)
4. Laboratory equipment (Category 2)
5. Renal equipment
6. ICU equipment
7. Radiology equipment

Leasing contracts under the MES agreements were awarded to the following firms:

a) **Shenzhen Midray Bio-medical LTD of China** – Lot 1 dealing with Theatre equipment for equipping 96 hospitals
b) **Esteem Industries Inc of India** – Lot 2 dealing with CSSD and surgical equipment for equipping 96 hospitals.
c) **Bellco SRL of Italy** - Lot 5 dealing with Renal and Dialysis machines. One hospital per 47 Counties and 2 national referral hospitals
d) **Phillips Medical Systems of Netherlands** – Lot 6 dealing with ICU equipment. Equipping 11 Hospitals with ICU facilities
e) **General Electric(GE) of USA** – Lot 7 dealing with radiology equipment for 98 hospitals equipping with digital X-ray, ultrasound and other imaging equipment.

THE SCOPE OF SERVICES OFFERED TO RECEIVE THE MES EQUIPMENT

The scope of services offered under the MES contracts included:

a) Fitting out works to the rooms designated for equipment
b) During the term, replacement of old infrastructure, furnishings and fittings
c) Supply of equipment
d) Delivery and instalment of equipment
e) Testing of equipment
f) Commissioning of equipment
g) Maintenance (both scheduled and reactive)
h) Repairs and replacement of spare parts
i) Upgrading of equipment software
j) Supply of consumable and reagents
k) Insurance over the equipment
l) Replacement of equipment upon expiry of its useful lifespan
m) Decommissioning of equipment
n) Training of staff using the equipment in the

hospitals (both User and Technical Team-Biomedical Engineers

THE OUTCOMES OF THE MES PROJECT

- This project has indeed brought services closer to the Citizens
- The cases that used to be a preserve of the National hospitals have now been seen in level 4 and 5 hospitals such as Renal services and ICU services
- The project has opened up training opportunities for Biomedical Engineers and the Users in both Factory and at Site
- Medical Services have been improved and thus reduced Mortality cases
- Staff have been motivated as environment and modern equipment are at their disposal
- There is no down time reported so far since the project commenced thus improved services and performance
- Old technology has been faced out such in X ray departments where darkrooms have been replaced by Digital printing, Radiographers should keep smiling all through
- There is an upsurge of Training in the Field of Biomedical engineering and also Most universities and colleges have opened training courses in this field.

THE ROLE OF BIOMED IN THE MES PROJECTS

The Biomeds in each beneficial hospital are expected to carry the following:

1. Be trained on the MES equipment
2. Have an inventory of the MES equipment
3. Have a PPM schedule for the MES equipment
4. Have all the Contacts for the Vendors for the MES equipment
5. Have a quarterly status report on the MES equipment presented to the Administration of the Facility
6. Report all issues pertaining delays through the Head office
7. Accompany the Vendors Technical teams during service and PPM and any other activity
8. Keep monitoring the performance of the MES equipment to avoid any down town

GAPS

- The Training is still inadequate for the Biomeds and the Users across the board to improve on capacity Building for perpetuity.
- There is an acute shortage for Biomeds as well as users for the MES equipment across all counties
- PPM adherence is required to be followed close to 100%
- Spare parts should be ex stock for the machines for quarterly use.
- Limitation on Biomed accessing the MES equipment

PARTING SHOT?

- After the Seven (7) years when the contract comes to an end, precisely the year 2022, what will happen?
- This is because the Equipment Shelve life will be over 80%
- The cost of PPM will have shot up due to wearing out of parts and technology degradation
- The project will now be under the County Government, will there be Muscles for the continuity, our appeal is that the ministry should ensure that there is perpetuity in this initiative.

(References: See Goal 4,5 &6 of the Millenium Development Goals, See Goal 17 of the Sustainable Development Goals, Kenya National Bureau of Statistics, 'Kenya Facts and Figures, 2015' p. 1, Senate committee of health reports, Ministry of Health website and field experiences of the author as a Biomedical engineer)

Symon Mbakah

Biomedical Engineer
Association of Medical Engineering of Kenya

A Must Have Test Tools for **Biomedical Equipment Calibration**

WHAT IS MEDICAL EQUIPMENT CALIBRATION?

Medical Equipment Calibration is the process of ensuring the output quality of said equipment is at par with the industry defined standards. This is done to ensure that the functionality of the item, as well as the result/reading it provides, is accurate at the point of delivery.

Medical equipment like any other equipment is prone to wear and tear over time which directly impacts its performance accuracy. And the only way to retain the equipment's effectiveness and minimize risks or uncertainty is through regular calibration. This is especially important as the accuracy provided by such medical equipment is crucial to the overall output, with respect to both quality and profitability. Apart from this, regular calibration of medical equipment is also required to receive the necessary certifications and licenses from regulatory authorities.

HOW FREQUENTLY SHOULD MEDICAL EQUIPMENT BE CALIBRATED?

The simple answer to this question: it depends. Each piece of equipment has a different requirement based on its scale of use. For this reason, it is highly recommended to create a calibration schedule for each piece of equipment. Although this seems like a tedious task, it is the best way to ensure all equipment is calibrated when it needs to be. When creating a schedule for medical equipment calibration, you should also consider the following:

1. **Manufacture recommendations**
   Nine times out of ten medical equipment will come with a manufacturer recommendation of when to calibrate the instrument. For example, many manufacturers recommended calibrating a pipette every 6 months depending upon usage.

   Before and after Large project
   Ensuring your instrument is performing accurate is extremely important before starting a big project. It is advised to have any medical equipment calibrated before use of any project, but especially those that require sharp precision. Keep in mind, equipment that has undergone any major project for an excessive period of time should also be calibrated. This is because frequent and heavy use cause performance and accuracy drifts.

2. **Equipment Trauma**
   Sometimes equipment trauma is hard to avoid. For example, a piece of medical equipment could endure a large fall or physical impact that could interfere with equipment performance. If anything, similar were to happen to your piece of medical equipment, it is crucial for you to re-calibrate prior to usage.

   Equipment can also undergo trauma from internal overloads. These overloads can occur due to a high volume of usage. To ensure that

the equipment is performing to its highest ability after an overload, it is important to re-calibrate the equipment before continued use.

3. Amount of Usage

Ideally, medical equipment should be re-calibrated based upon the amount it is used and for how long it has been used. This amount varies dependent upon the equipment owner; therefore, it is

LIST OF ESSENTIAL CALLIBRATION TOOLS INCLUDES

- Tachometers for speed calibration i.e In Centrifuge
- A set of F1 and M1 masses for mass/ weight calibration.
- Pressure gauges for both positive and negative pressure.
- Dosimeter or radiation survey meter.
- Electrical safety analyzers
- Patient monitor testers (simulators)
- Incubator / radiant warmer analyzers
- Defibrillator / AED / pacemaker analyzers
- Infusion device analyzers
- Electrosurgical unit testers
- Ventilator / gas-flow analyzers
- Pressure / flow meters.

To augment a good number of this parameter some companies have developed a multi-function calibration that is able to do more than 3 or 4 parameters at once incorporated in a multi-calibration bench.

Temperature calibration Tools; Temperature calibration is very wide within the hospital set up and quite a range of standards are required to fully cover this area. They include:

- Set of thermocouples sensors
- Pt 100
- Data loggers
- Dry-blocks

Volumetric flow; For a hospital set up one is required to have a pipette calibrator. Pipette calibration has become a challenge for many laboratories set ups, but with a pipette calibrator all uncertainties related to pipette becomes minimal.

Felix Karbolo

(karbolo23@gmail.com)
Biomedical Engineering Technologist 1
Moi Teaching and Referral Hospital

General Clinical Safety **and Test Requirement**

Clinical safety deals with performing safety test for Hospital & medical Equipment. This is necessary because some of these devices produces outputs which can prove fatal if applied to patient i.e. Electrosurgical Diathermy, Defibrillators hence trained personnel should carry out these tests.

Electrical Safety: Electrical Safety is the best possible limitation of hazardous electrical Macro and/or Micro shocks, sustained by patients, as well as explosion, fire or damage to equipments and buildings.

SAFETY OF MEDICAL EQUIPMENT

The purpose of safety testing medical equipment is to ensure that a device is safe from electrical hazards to patients, maintenance personnel's and users.

Electric shock are caused by electricity flowing through the body when in contact with damaged electrical device and results muscle spasms, burns, cardiac and respiratory arrest and Ventricular Fibrillation

WHY ELECTRICAL SAFETY?

- Electrical safety is NOT dependent on voltage but on Leakage Current.
- At low voltage, leakage current flow through body may be fatal to us.
- Patient may be connected to several devices simultaneously (ventilator-ECG,...) in ICU.
- Contact directly to internal tissue. (Natural orifices or break in the skin).

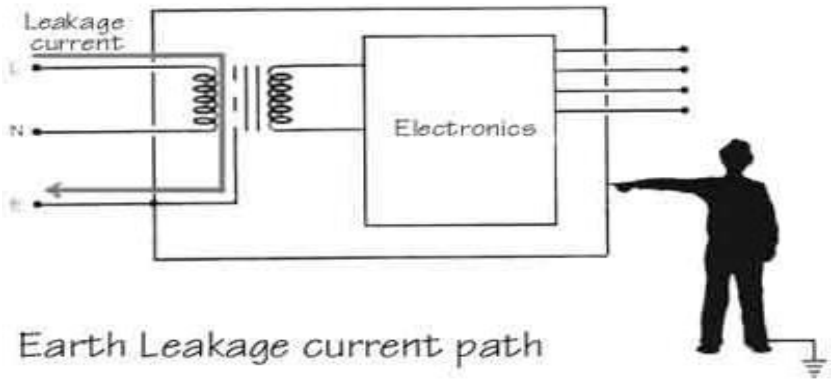
LEAKAGE CURRENT

Causes of leakage current- If any conductor potential is raised above earth potential some current is bound to flow from conductor to earth. It is difficult to have conductors which are well insulated since there is no such a thing as perfect insulation. Amount of current that flows depend on:-

- Voltage on conductor
- Capacitive reactance between conductor & earth.
- Resistance between conductors to earth.

Leakage currents that flow from or between conductors which are insulated from earth:-

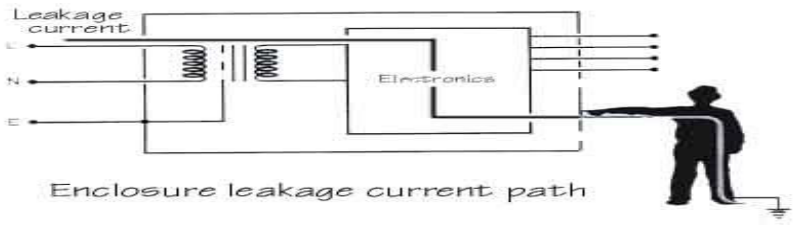
1 Earth leakage current (ELC) - current which flows in the earth conductor of a protective earthed piece of equipment. In medical electrical equipment mains is connected to a Transformer having an earthed screen. Most of earth leakage currents finds its way into earth via impedance of insulation between Transformers & inter winding screen since impedance 'Z' at its lowest.



Earth Leakage current path

2 Enclosure leakage current (EnLC) – current that flows from an accessible conductive part of equipment through body to earth through a conductor other than the protective earth conductor. For hospital, laboratory equipments Enlc is measured from exposed conductive part of enclosure regardless whether such point is protectively earthed or not. For medical electrical equipment Enlc is measured from exposed conductive part of

enclosure which is not intended to be protectively earthed.



3 Patient leakage current (PLC) for medical electrical equipments is leakage current that flows through patient connected to an applied part or parts i.e. flows from applied part via patient to earth in an external source of higher potential via patient via applied parts to earth

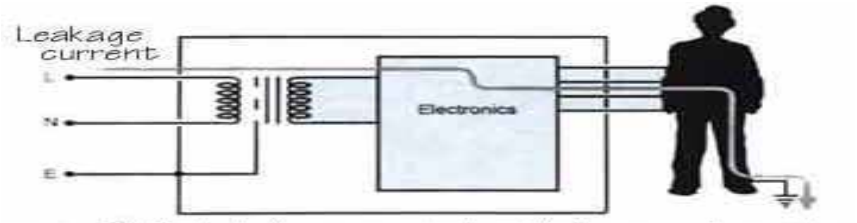


Fig 3a Patient leakage current path from equipment

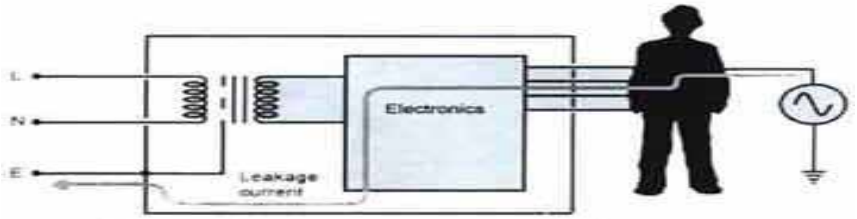
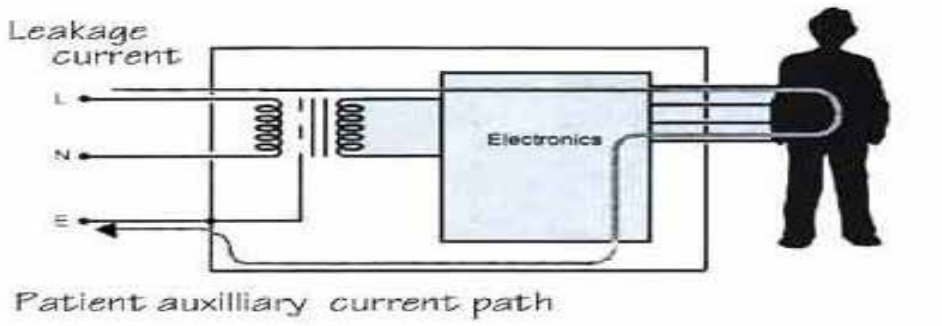


Fig 3b Patient leakage current path to equipment

4 Patient auxiliary current (PAC) current that flow between applied parts through patient which is not intended to produce a physiological effect.



Prepared By

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Classes and Types of **Electrical Equipment**

Normal condition & single fault conditions
In the event of failure of single means of protection against a hazard or single abnormal external condition (SFC's). No safety hazard should arise.

ELECTRICAL SAFETY TESTS

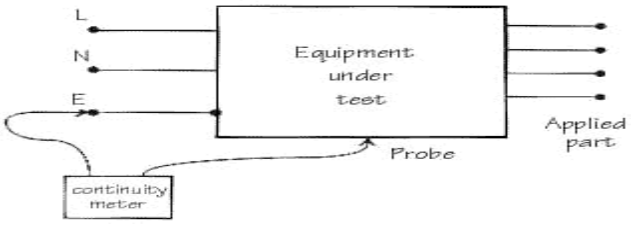
- Protective Earth Continuity
- Insulation Tests
- Earth leakage current
- Enclosure leakage current
- Patient leakage current
- Patient auxilary current
- Mains on applied parts

PROTECTIVE EARTH CONTINUITY

Measurement between earth pin from mains plug & protective earth point on the equipment enclosure. Reading should not exceed 0.2Ω.

Resistance of test leafs to be deducted from the reading. If PEC is satisfactory then insulation test can be performed. Limit 0.2 Ω mains plug to enclosure and 0.1 Ω main terminals to enclosure. Both HEI 140 & HEI 95 recommends tests to be carried out at current of 1A.

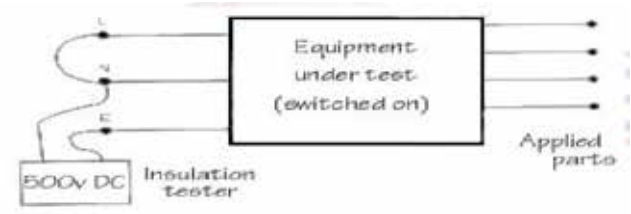
Applicable to Class1, all types Limit 0.2 ohms



INSULATION TEST

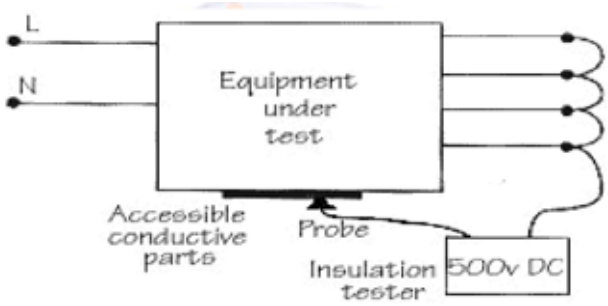
Test described in BS 5724 & BSEM 61010 are type test & should not be used as routine test. Further test on insulation called 'Dielectric strength' test are detailed in the standard.

Insulation resistance measured at mains plug between L&N connected together & earth pin using 500vdc insulation tester. Limit not less than 500M Ω for medical equipment and not less than



100 M Ω for laboratory equipment.

Applicable to Class 1, all types Limit Not less than 2Mohms.



Applicable to Class II, all types having applied parts Limit : > 2 MOhms

Note: measurement in excess of 1MΩ is acceptable in equipment containing mineral insulated heaters HEI recommends. It further recommends for class II medical equipment resistance be measured between all applied parts connected together & any other accessible conductive parts of equipment. Limit not less than 50 M Ω.HEI 95 recommends more probe to find worst case.

LEAKAGE CURRENT MEASURING DEVICE

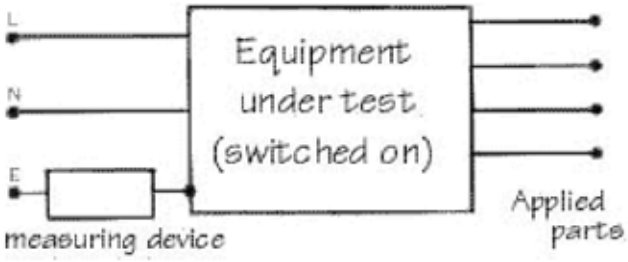
Device loads leakage current source with a resistive impedance of about 1KΩ and have half power point at about 1KHz. mV meter used should have input impedance greater than 1mv for each µA LC.

EARTH LEAKAGE CURRENT

Applicable to: Class 1 equipment all types Limits: 0.5mA in NC, 1mA in SFC or 5mA and 10mA respectively for permanently installed equipment. Note: Measures with reverse polarity ensure equipment is switched on.

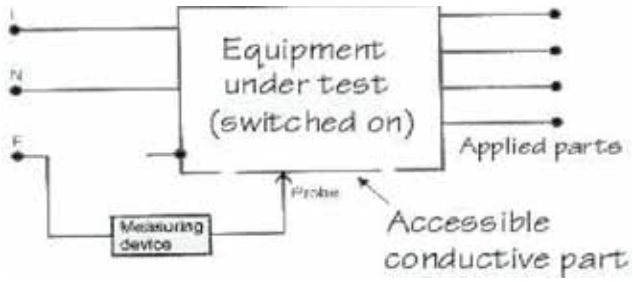
Enclosure Leakage Current for Hospital Laboratory equipment

ELC is measured between any accessible conductive part of the equipment and true earth as shown below. Test applicable to both class I & II & performed with mains polarity both normal & reversed. Limits for ELCs vary between standards. Class II leakage should not normally exceed 0.4mA. Class I limit is 0.75mA



ENCLOSURE LEAKAGE CURRENT FOR MEDICAL ELECTRICAL EQUIPMENT

This is measured between exposed parts which is not protectively earthed and true earth as shown below. Safety tested allows the SFC's of interruption of live or neutral conductors to be selected. Applicable to medical equipment class I&II types B, BF & CF. Limits are 0.1mA in NC, 0.5mA in SFC. (HEI recommends 0.01mA for class II type CF in NC).



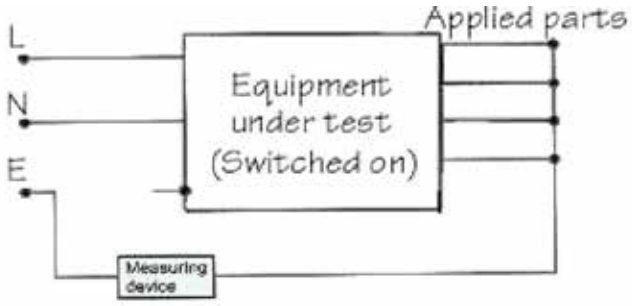
PATIENT LEAKAGE CURRENT

This test involves patient applied parts. Class I & II type B & BF measured from all applied parts having the same function connected together & true earth. For type CF measured from each applied part in turn and leakage current must not exceed any one applied part. Great care must be taken when performing test to ensure outputs are inactive. i.e. Diathermy, Simulators can be fatal and can damage test equipment.

Applicable to medical equipment only, class I & II type B & BF equipment having applied parts. Limits are 0.1mA in NC, 0.5mA in SFC.

Note: Equipment on but outputs inactive normal & reverse mains polarity.

Applicable to medical equipment only class I & II type CF equipment having applied parts 0.01mA in NC, 0.05mA in SFC. Limits HEI 95 recommends yes class I SFC earth open circuit class II normal condition.



Note: equipment on but output inactive, normal and reverse mains polarity

PATIENT AUXILIARY CURRENT

This is measured between any single patient connection and all other patient connectors connected together. Applicable to medical equipment only, class I & II types B, BF & CF having applied parts. Limits for type B & BF is 0.1mA in NC, 0.5mA in SFC. HEI 95 recommends NO.

Notes: ensure outputs are inactive, normal & reverse polarity.

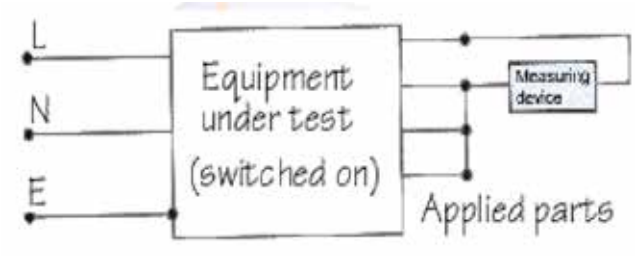


Figure Measurement of patient auxiliary current.

Mains on Applied Parts

Measuring arrangement identical to patient leakage current except one side of leakage current connected to mains voltage. Purpose of this test under BS5724 is to ensure no danger of electric shock to patient. Standard require leakage current limits specified not exceeded.

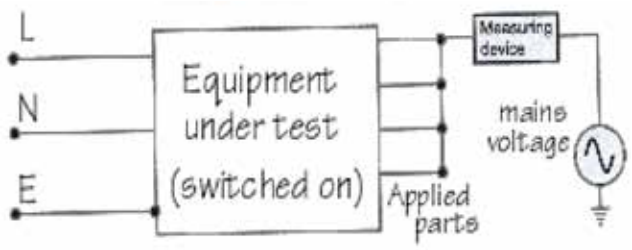
Applicable to medical equipment only class I & II, types BF & CF having applied parts. Limits for type BF are 5mA, type CF is 0.05mA per electrode .HEI 95 recommends NO.

Note: ensure output inactive in normal and reverse polarity. Caution especially on physiological measurement equipment.

MAINS ON APPLIED PARTS

This is applicable to Class 1 and class II equipment, types BF&CF equipment having applied parts. Limits BF 5mA; CF 0.05mA per electrode. The diagram below illustrates.

Table below summarizes these



Prepared By

Fredrick Raphael Simwata

Biomed Eng
Kenyatta National Hospital

The Need for Continuous Professional **Development in Biomedical Engineering**

(Lessons from Laboratory Equipment In-service Training)
By: Anyango P Amoko (AIHA)

The revolution in medical electronics technology has created a special need need of a biomedical engineer/technicians (BMETs) with the following orientations.

1. A thorough understanding of concepts involved in the application of Biomedical Instrumentations and Systems.
2. An ability to maintain equipment in good operating condition even when only second-rate test equipment is available
3. A talent for communication effectively with physicians, describing both the capabilities and limitations of the hardware, to help physicians make the most of their biomedical devices (electronic tools) *Joseph Dubovy, Biomedical Electronics*

Two decades ago the trouble shooting of a medical instrument was up to components level, we were talking of diodes and transistors. This are the days we would know the color coding of a resistors (Yellow, Black, Red, Orange, Violet Gray White), the microscopes were using filament bulbs, the X-Rays Generators were quite huge that they were put in a different room. In todays technology equipment come with double printed boards with very little option to solder, LEDs lamps has replaced filament, halogen and mercury ones and many others. This fast changing trends means for a Biomed to remain relevant in today's technology oriented world he/she must have a continuous professional development.

Our universities and colleges do a great job of teaching the theoretical topics with little emphasis on practicals due unavailability of practical teaching devices.

IN-SERVICE TRAINING ON NON-AUTOMATED LABORATORY MEDICAL EQUIPMENT

In the last three years National Public Health Laboratories in partnership with American International Health Alliance and Association of Public Health Laboratories has been Implementing PEPFAR (President Emergency Program For Aids Relief) funded program through CDC (Centre of Disease Control) on medical laboratory equipment management. The Aim was to address the gap in the laboratory network within Kenyan public health facilities. Biomeds had limited limited skills on calibration of laboratory Equipment. The program was being implementation in twenty four counties based on HIV/Aids burden.

The objectives were;

1. To develop a centre of excellence based at the National Public Health Laboratory on Equipment Training, certification and calibration,
2. Develop a train manual and train hospital based biomeds on equipment management including calibration.

The program has trained forty seven Biomeds country wide on; service, maintenance, repair and calibration of Microscopes, Micro-pipettes, centrifuges, Hot air ovens, Laboratory incubators,

Biomeds undergoing Pipette maintenance Training at NPHL, Nairobi

Autoclaves, Timers, Thermometers and Analytical Balances.

RESULTS TO DATE

Under WHO Guide for the Stepwise Laboratory Improvement Process towards Accreditation in the African Region (SLIPTA) checklist, the equipment score is thirty –Five (35). The score of most these laboratories were between five and ten and they were at star two or three, but with implementation of the training the scores improved to above thirty and labs consequently to star five and eventually accredited. The Centre of Excellence is up and running, calibrating all the equipment mentioned. In addition Biomeds have been trained on Biosafety Cabinet Certification, a service that was initially outsourced from South Africa.

Kenya today has over ten locally trained BSCC technicians/Engineers with five sets of test equipment.

LESSON LEARNT

One major lesson learnt is that In-service training program has boosted the technical capability and performance of Biomeds.

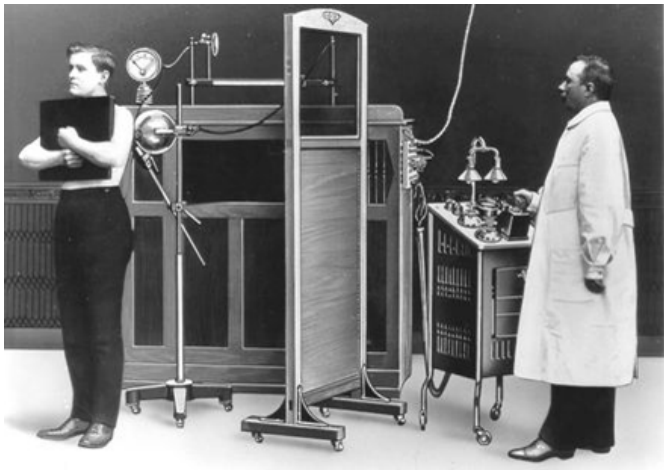
CONCLUSION

Continuous professional Development (CPD) is very vital for Biomedical Engineering, therefore there is a need for short in-service training programs.

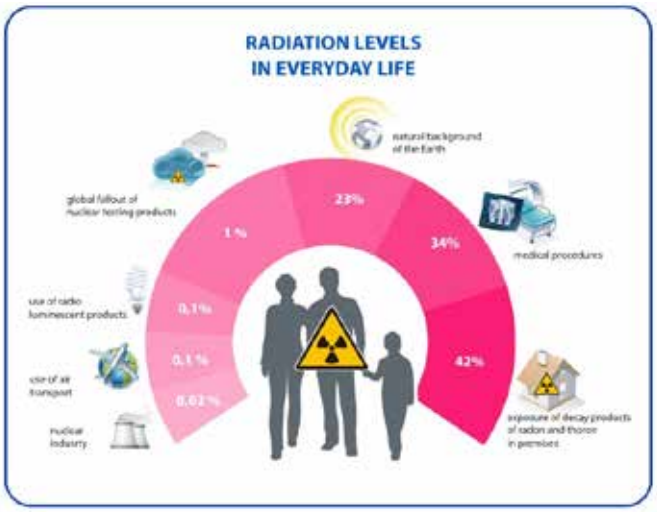
Room Requirements for **X-Ray and MRI Facilities**

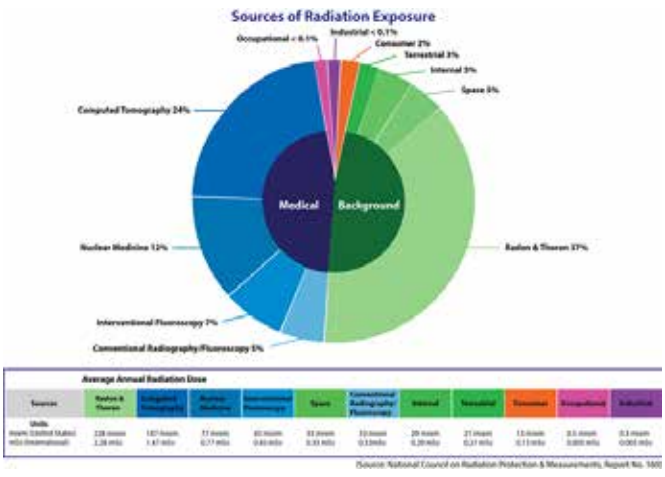
By: Joseph Rugut, BSc Hons, CHAK HCTS Workshop and Medical Equipment Project;

Importance of background and Radiation safety information
Protection of patients
Brief on biological effects
Occupational radiation protection.
Requirements of Radiology rooms for a health care setting;
Infrastructure must include;
electrical power
heating, ventilation and air conditioning (HVAC)
floor space and floor loading
links/corridors and paveways to other critical areas e.g., emergency
Features to be considered in a radiology room
Physical
Access, and access restriction
Separation of work and public areas
Radiation signs (tri-foils, illuminated signs)
Shielding construction and materials
Protective equipment during irradiation.
Operational considerations;
QC program
Local rules
Staff qualifications and training



Chest X-ray in 1910





Sources of ionizing Radiation – note that natural sources and medical procedures are leading against the public notion that its nuclear industry!

Radiation protection – RP, Biological effects of ionizing radiation: aims of radiation protection:

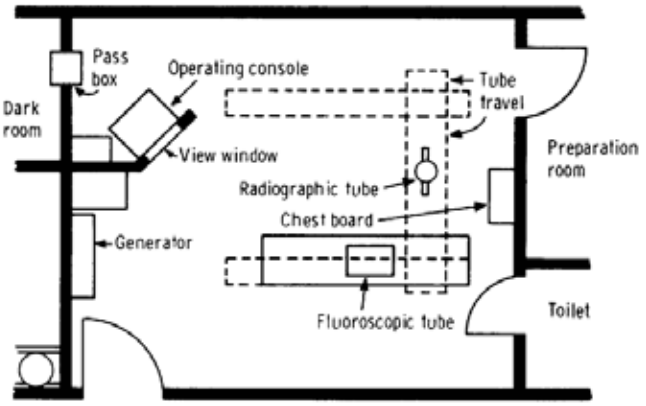
Radiation Protection (RP) is a tool for the management of measures to protect health against the risks (for people and environment) generated by the use of ionizing radiation

Detriment: The total harm that would eventually be experienced by an exposed group and its descendents as a result of the group's exposure to radiation from a source

Always consider BENEFITS Vs RISKS

Guiding design principles;
For a safe radiation environment, there are certain principles and considerations:
"Separation" of different functional areas helps control access :
Public areas (waiting, change etc.)
Staff areas (offices, meeting rooms etc.)
Work areas (radiation rooms, dark rooms, labs.)
Internal features to consider:
X-ray tube(s) and table
Chest stand
Change room(s)
Operator's console
Darkroom and film storage
Surrounding areas (use, occupancy)

Shielding
Working areas will normally be controlled or supervised and not free entry or pass through.
Typical room design of X-ray rooms
Must be large enough for the equipment (remember a chest stand, table and generators)
Must have sufficient space for patient transport (wheel chair, gurney or trolley, etc.) and for staff to transfer patient to x-ray examination table (if inpatient facility)
Should have at least one patient change cubicle accessible from outside the room
Must locate the operator's console where the primary beam will NEVER be directed towards it, but where the patient can be easily observed
Must be able to accommodate large beds and trolleys, and any anaesthetic equipment likely to be used, especially when sizing the doors.
Must locate holes in floors for cables away from radiation beams, or be shielded
Should have radiation warning signs on all doors
Should have radiation warning lights outside for fluoroscopy, angiography and CT



General basic economical and easy to design rooms layout.

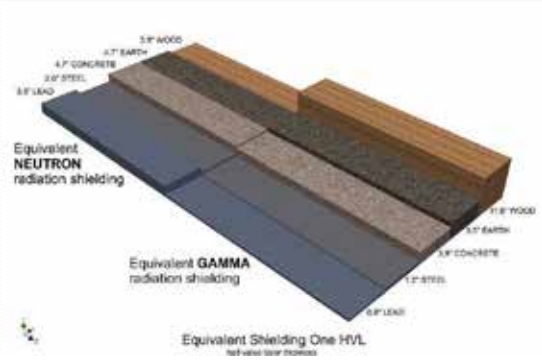
Lead glass with clear view and adequate lighting

Protection materials
The following are protection materials to be cladded on aprons/collars/skirts, curtains etc to enhance protection in multiuser rooms.
Lead vinyl materials, especially gowns

Lead vinyl is 0.3 - 0.5 mm + equivalent
Front is more important than rear
Can be partially open at rear (only high Pb) if staff member is not standing with back towards patient
Must be tested new and ~ every 12 months (using fluoroscopy)

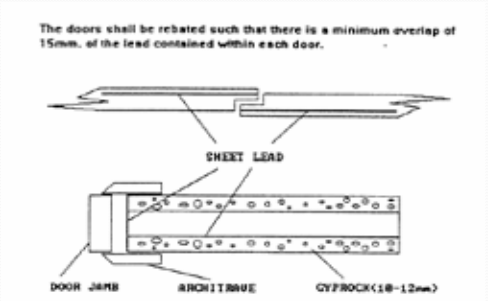
Fig. Racks for gowns, not to be folded as they tend to crack and leakage occurs eventually

Various bulding materials' hielding comparizons



Emerging modern radiological interventions requiring advanced multidisciplinary levels of designs and construction due to their complex

Shielding of Doors and Frames finishing fool proof techniques.



Lead glass shielding verification

and varied shielding requirementsare:
Radiothreaphy
Nuclear medicine
Chemotheraphy.
MRI.
The future and capacity building:
Medical and health physics curriculum to be entrenched in the BME/CE syllabi

Training on hospital systems designs and management way of thinking, Radiology as a health system and not just a diagnostic centre
To be able to pass on knowledge of safety, the benefits and also the dose limits to operators and public..

Availability of shielding design software

Glossary and References

Where to Get More Information (I)

- Radiation shielding for diagnostic X Rays. BIR report (2000) Ed. D.G. Sutton & J.R. Williams.
- NCRP 151
- National Council on Radiation Protection and Measurements, Report No. 147, "Structural Shielding Design for Medical X-Ray Imaging Facilities" Bethesda, MD 2004.
- IAEA Safety report 13, POP 066.
- rugkip@gmail.com

BME Contribution to **Universal Health Coverage**

According to World Health Organization (WHO) Universal Health Coverage (UHC) means that all individuals and communities receive the health services they need without suffering financial hardship. It includes the full spectrum of essential, quality health services, from health promotion to prevention, treatment, rehabilitation, and palliative care.

UHC enables everyone to access the services that address the most significant causes of disease and death, and ensures that the quality of those services is good enough to improve the health of the people who receive them.

Achieving UHC is one of the targets the nations of the world set when adopting the Sustainable Development Goals in 2015. Countries that progress towards UHC will make progress towards the other health-related targets, and towards the other goals. Good health allows children to learn and adults to earn, helps people escape from poverty, and provides the basis for long-term economic development.

UHC is not just about health financing. It encompasses all components of the health system: health service delivery systems, the health workforce, health facilities and communications networks, health technologies, information systems, quality assurance mechanisms, and governance and legislation.

Improving health service coverage and health outcomes depends on the availability, accessibility, and capacity of health workers to deliver quality people-centred integrated care. Investments in quality primary health care will be the cornerstone for achieving UHC around the world. Investing in the primary health care workforce is the most cost-effective way to ensure access to essential health care will improve. Good governance, sound systems of procurement and supply of medicines and health technologies and well-functioning health information systems are other critical elements.

What would therefore be the role/contribution of the Biomedical Engineer in the health facilities towards achievement of UHC?

Biomedical Engineers play a critical role in ensuring availability and accessibility of essential, quality health services, from health promotion to prevention, treatment, rehabilitation, and palliative care.

This is achieved through:-

- Maintaining a comprehensive medical equipment inventory for all existing & incoming equipment. Equipment inventory is an essential part of an effective Healthcare Technology Management (HTM) system. Inventory must be updated continually so that it provides at any given moment a correct look at the status of medical equipment at the healthcare facility.
- Appropriate procurement of medical equipment through writing of technical specifications. Technical specifications play an important role in identification, selection and procurement of appropriate and cost effective medical equipment.
- Inspection of all incoming medical equipment

& machinery and doing pre-acceptance checks before official acceptance & payment.
- Proper maintenance of records related to medical equipment; for e.g. Medical Equipment & plants inventory, Medical equipment PPM schedules, job cards, spare parts and consumables, equipment history sheets, service contracts etc.
- Setting standard operating procedures & ensuring their compliance.
- Maintaining the medical equipment to the best of its performance by organizing a planned preventive maintenance (PPM) program for all equipment and attending to emergency breakdowns and repairs. Proper maintenance is important to obtain sustained benefits and to preserve capital investment in medical equipment (WHF, 1989). Also proper maintenance of medical equipment has a direct impact on the delivery of healthcare and has economic implications.
- Arranging for training programs for personnel in the medical engineering department as well as the end users. User training is important for effective and safe use of medical equipment, to reduce fault density and improve the lifespan.
- Advising & providing technical expertise to the medical staff & administration.
- Monitoring and evaluation of medical equipment service contracts and advise accordingly.

It is therefore of utmost importance for health facilities whether public, private, Faith Based and others to ensure that they have adequate professional Biomedical engineers in place to ensure for proper management, use & maintenance of medical equipment in the achievement of UHC.

Nelson Kariuki

Council Member
AMEK

Role of BME in **Fighting Corruption**

Kenya's competitiveness is held back by high corruption levels that penetrate every sector of the economy. A recent headline designating Kenya's heath sector as the most corrupt, reminded me this as a global cancer-after all corruption has been described as a disease.

Corruption is a complex phenomenon and a difficult problem. It is complex because of its deep roots in the social, cultural, economical, political, legal and ethical value systems of individuals, communities, cultures and a country as a whole. Corruption is undeniable reality in heath sector and is arguably the most serious ethical crisis in medicine today. However it remains poorly addressed in scholarly journals and by our professional association (AMEK).

Biomedical engineering is profession that profoundly affects the patient directly. Our critical role is to design, manufacture, install and maintain medical equipment. Thus every engineer and design professional needs a foundation in bioethics. Our job description put in consideration the crucial role of not only diagnosis but also treatment in cases such as

machine dependent treatment like radiotherapy, surgery and dialysis.

In most cases, there is always a controversy that surrounds the procurement. This is where 'grand coalition' always occurs between the management and the biomedical in- charges in our counties. It is always good to ensure that our clients (patients) get value for their money. We also need to know that corruption traps millions of people in poverty, perpetuates the existing inequalities in income and health, drains the available resources, undermines peoples' access to healthcare, increases the cost of patient care and by setting up vicious cycle, and contributes to ill health and suffering. No public health programme can succeed in a setting in which scarce resources are siphoned off, depriving the disadvantaged and poor essential health care.

As BMEs we should avoid all forms of corruption, such as bribery, kickbacks and informal payments to health personnel and administrations,fraud,abuse involving payments of healthcare goods and services that are not rendered, collusions and bid rigging in healthcare procurement and contract awards,absenticeeism and many others. People who handle patients like us need to account for our time, training and actions.

"In history of Nations, generations have made their mark by appreciating critical turning points and seizing the moment. A better life will achieved only if we take the opportunities that beckon-so let's take that road", as we endeavor to achieve a profession free from corruption.

Eng. Christine Kibet

Do you dutifully play your role to ensure proper procurement of:

The Right goods and services, **WITH**
The Right quality, **IN**
The Right quantity, **FROM**
The Right supplier. **AT**
The Right place, **AND DELIVER TO**
The Right place, **AT**
The Right time?
The' Rights of Procurement"

Quotes and Proverbs

1. "One beam, no matter how big, cannot support an entire house on its own". ***Chinese Proverb.***
2. "If you can't explain it simply, you don't understand it well enough". ***Albert Einstein.***
3. "If you want cooperation of humans around you, you must make them feel they are important, and you do that by being genuine and humble". ***Nelson Mandela.***
4. "Try not to become a man of success, but rather try to become a man of value". ***Albert Einstein.***
5. "Manufacturing is more than just putting parts together. It's coming up with ideas, testing principles and perfecting the engineering as well as final assembly". ***James Dyson.***
6. "What we usually consider as impossible are simply engineering problems, there's no law of physics preventing them". ***Michio Kaku.***
7. "A Scientist can discover a new star but he cannot make one. He would have to ask an engineer to do it for him". ***Gordon Lindsay Glegg.***
8. "Engineering is quite different from science. Scientists try to understand nature. Engineers try to make things that do not exist in nature. Engineers stress invention". ***Yuan Cheng Fung.***
9. "It always seems impossible until it's done". ***Nelson Mandela.***
10. "I always tell my students that a good idea or a solution to a problem is worthless unless it is shared". ***Christopher M. Konosi***

Duties and Responsibilities **of BME in a Hospital**

(Workplan Daily, Weekly, Monthly, Quarterly)

Today, 'Hospital engineering' is an important branch of hospital management. Biomedical, Operation and Maintenance Engineers of any Hospital have a vital role in ensuring maximum equipment utilization and minimum downtime.

Hospital equipment fall into an extremely wide spectrum ranging right from a hi-tech MRI and CT scanner to a simple patient trolley. Yet hospital equipment can be broadly classified into:

- Biomedical equipment
- Laboratory equipment
- Ward equipment
- Service support equipment
- Utilities and hospital furniture

All these account for a major part of any hospital project cost, which could go up to almost 60 per cent. Of this, biomedical equipment could account for nearly 50 per cent of the cost. Keeping this in view it is essential to ensure maximum utilization of the equipment with minimum downtime.

Thus Preventive maintenance is an extremely important work schedule that is required to keep any plant and machinery in a near original state of functioning for as long a period of time as possible. This is different from repairs, which is the restoration of such an asset to a condition as close to its original, by replacements of parts and overhauling of the asset.

Over the last decade the changing healthcare environment has required hospitals and specifically Biomedical Engineering to critically evaluate, optimize and adapt their operations. The focus is now on new technologies, changes to the environment of care, support requirements and financial constraints.

Physicians and nurses care for patients and administer treatments. Pharmacists measure and deliver medications. Lab techs perform tests using intricate equipment. Administrators ensure the facility is running smoothly. Healthcare facilities tend to have several staff, most of which the roles are easy to understand- save the biomedical engineer.

Like any engineer, a biomedical engineer is primarily concerned with solving problems; thus, specializing in the fields of biology and medicine, biomedical engineers focus on analyzing challenges and designing efficient and effective solutions to improve quality of patient care. Biomedical engineers therefore keep hospitals, clinics, and care facilities running and helping patients. It is the application of engineering principles and techniques to the medical field which combines the design and problem-solving skills of engineering with medical and biological sciences to improve healthcare diagnosis and treatment.

This team of professionals in the health facilities focus on a number of activities including systems designs and development, Installations, Calibrations, Preventive and curative maintenance. Systems design and development and Installations happen in the early stages of the healthcare technologies but throughout the useful life of the systems, maintenance is critical hence the need to have this support team in hospitals.

There are several benefits of a properly operated preventive maintenance program:

- Equipment downtime is decreased and the number of major repairs are reduced
- Better conservation of assets and increased life expectancy of assets, thereby eliminating premature replacement of machinery and equipment
- Reduced overtime costs and

more economical use of maintenance workers due to working on a scheduled basis instead of a crash basis to repair breakdowns
- Timely, routine repairs circumvent fewer large-scale repairs
- Improved safety and quality conditions for everyone

Flipside of the above is that if we do not give our equipment much thought when they are working just fine and not broken, in terms of Preventive maintenance, this mindset boils down to cost. Simply put, you're going to spend significantly more money if your strategy is to simply react when an issue comes up with your equipment.

A successful preventive maintenance program improves the performance and safety of the hospitals' valuable assets. Equally important, regularly scheduled maintenance helps you avoid unplanned downtime. Without consistently having your equipment go through Preventive Maintenance, you run the risk of being out of compliance and be subject to liability if it is used on a patient and any issues arise involving that patient.

Preventive maintenance is an important part of facilities management. The goal of a successful preventive maintenance program is to establish consistent practices designed to improve the performance and safety of the equipment at the facility. Moreover, the planned maintenance of equipment will help to improve equipment life and avoid any unplanned maintenance activity. A successful preventive maintenance program is dependent on the cooperation of all the parties involved. Engineering managers must rely on the knowledge, ideas, and contributions of all the maintenance personnel at the property.

According to Plant Engineering's 2017 Maintenance Report, 69% of respondents indicated that there was decreased downtime with a preventive maintenance program, 66% reported a reduced probability of equipment failure, 63% experienced improved overall equipment effectiveness and 62% had improved plant's safety.

Proactive preventive maintenance approach will reduce your costs and improve overall operations which will further lead to institutions

1. Saving Money
2. Maximizing Efficiency
3. Prolonging Equipment Life
4. Reducing Maintenance Costs and
5. Improving Safety and Reliability

As observed from research carried out in 2016 at Biomedical devices Technology department of Istanbul University on "Two Different Maintenance Strategies in the Hospital Environment: Preventive Maintenance for Older Technology Devices and Predictive Maintenance for Newer High-Tech Devices", two different strategies are required to increase the efficiency of device management within the hospital: preventive maintenance for older technology devices and predictive maintenance for newer high-tech devices.

Medical technology includes all medical equipment used by health organizations for diagnosis, therapy, monitoring, rehabilitation, and care. Therefore, medical technology management plays a key role in health care. Effective medical device management is required to ensure high-quality patient care. Efficient and accurate equipment provides a high degree of patient safety. Accomplished medical device management will greatly assist in the reduction of adverse incidents and medical device-related accidents.

For medical technology management, hospitals must have activities for maintaining, inspecting, and testing all medical equipment in the inventory. These activities must be performed within the scope of a maintenance program. The maintenance activities and their intervals should be planned in accordance with the manufacturers' recommendations or strategies listed in an alternative equipment maintenance program.

These alternative program strategies must be based on valid standards of practice.

A maintenance program, generated by considering the characteristics and failures of medical equipment, is important with regard to usability and efficiency. However, it is inefficient to use the same strategies for the management of older technology devices and newer high-tech devices because of their different characteristics. The new high-tech devices functional control activities planned in accordance with the manufacturers' recommendations and daily programmed self-tests should be done. These devices are tested against their specifications presented by their manufacturers. According to the 2007/47/EC Directive, these tests must be planned by the manufacturers. The directive states that "The instructions for use must contain details of the nature and frequency of the maintenance and calibration needed to ensure that the devices operate properly and safely at all times".

Medical Equipment Preventive Maintenance, also known as PM, is: "the care and servicing by trained personnel for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects." (US Department of Defense, 2005)

If your equipment/company is not under any type of accreditation system, then according to the FDA: PM inspections on your equipment should follow the manufacturer's recommendations for routine maintenance. If you are under an accreditation system, the PM inspection guidelines will be outlined in your program. Preventive Maintenance should be routine on medical equipment because it is making human contact, saving lives, and helping to determine diagnoses, just to name a few reasons.

The following considerations should be made while working on the PPM plan for the equipment:

- Liability Insurance
- Training of the biomeds with a proof of training
- Availability of Test Equipment for the PM
- Clear indication of the Test Equipment used
- Calibration of the Test Equipment, with the clear indication of the last time that they were calibrated and due date for next calibration
- Upgrading of the equipment's software to the latest version if applicable
- Following of the manufacturer's guidelines/ requirements for Preventive Maintenance of your equipment
- Test documentation for each PM?
- Confirmation if there are any parts included with the PM, if so what?
- Confirm the frequency of the PM for your equipment required.

Taking these recommendations into consideration and keeping Medical Equipment on a routine PM cycle will not only protect you and your hospital but will also ensure the safety of the patients being used on. Preventive Maintenance of your equipment is what will give you piece of mind, ensuring that the equipment will do its job when needed most.

In conclusion, it is inevitable to state that Hospital Engineers will continue to form a most important arm of the hospital staff and team. With the adaptation of proper maintenance techniques and management systems one can utilize resources optimally and reduce the breakdown and related maintenance workload. The role of engineers in hospitals as well as those coming from representative vendors of equipment supplies needs to be appreciated and the hospital management should encourage them and give them maximum support.

Uoka Kenneth M

Biomedical Engineer
Kenyatta University

MES Project
Implementation *(Lessons learned and way forward)*

Consider a case involving a father and a son; for a long time, the son has been struggling to raise money to put up a house for his family but he does not appear to make any headway due to other family commitments. To make matters worse, his income is very low as he only depends on his civil servant salary. His father has noted that the son needs a better house but is also aware of the son's limitations. The father therefore decides to assist the son. He makes an offer of a soft loan to his son without specifying the terms. All he tells the son is, "I will source for the materials but you make arrangement to pay for the labour and other overheads. Once the house has been build, we will arrange on how you will pay me back".

The above scenario is an analogy of the National Government of Kenya's arrangement with the county governments for the supply of modern medical equipment to the county hospitals; the Managed Equipment Services (MES) project. Being aware of the challenges faced by the county governments in offering medical care to the citizens, the national government (with approval of the Senate) decided to take the responsibility of leasing equipment for the county hospitals; the agreement being that the counties will pay for the lease annually (there appears to be no specific figure mentioned at the initial stages). A feasibility study was conducted to determine the capacities of the various hospitals to be targeted for the project. In the hospitals where it was noted that there is a deficit (both in infrastructure and human resource), arrangements were to be made to update the facilities and recruit the required human resource. The project which had clear guidelines was adopted towards the end of 2013 with timelines set for the roll out. The project has successfully been implemented in some counties but has failed to take off in a number of counties. Obviously it was not expected that all counties would be at the same level in the implementation process due the huge difference in the already existing infrastructures. But we must answer the following questions: How come after about six years, implementation in some counties is almost at 100 percent while in others it is at almost at zero percent? What went wrong? I will try to answer these questions as an academic observer; based on my observations without any interrogation of any of the players on the ground. I will also give comments based on what has been covered on the print and electronic media as regards the MES project.

Looking at the whole process, starting from how it was initiated and going through the steps necessary for such a project, it can be concluded that due diligence was followed (to a large degree). The project appears to have been handled professionally from the start. Then why failure in implementation in some counties? Let us briefly go back to the analogy used at the start of this article. In the analogy, it is assumed that the son is capable of meeting his obligations once the father provides building materials. So it can be concluded that if the son fails to meet his obligations, then we will end up with heaps of building materials and no construction activities taking place. Similarly, for the MES project, there might have been an oversight in following through on some critical areas. It could have been assumed that once the counties were made aware of the

requirements, action will be taken (at county level) to meet these requirements. Thus, because the affected counties failed to take action, we have equipment lying idle in a store because the room where it was to be installed has not been build, or installed equipment is not being used because the required manpower has not been recruited. One thing that we must always remember is that devolution is a political process and hence when it comes technical/professional aspects, politics tend to affect how things are done. Politicians are always interested in the end result/product but are not keen in the process of achieving that result. If the professionals concern do not know how to manoeuvre through the political landscape, things may not work as required. Remember that the major decision makers at county level are politicians.

The failure in implementation of the project in some counties could be attributed to a number of reasons. The following could be some of these reasons:-

(i) Failure to make budgetary allocations for infrastructure improvement.
(ii) Failure to recruit the required personnel.
(iii) Failure to understand and appreciate the concept at county level.
(iv) Lack of adequate feedback system in the implementation process.
(v) The respective counties could have had other priorities but never came out to say so.
(vi) The feasibility team could have overlooked some of the weaknesses/difficulties in these counties.
(vii) Introduction of politics in the project implementation process.
(viii) Failure to educate the stakeholders (hospital personnel and other related staff) at county level so that they own the project.

Considering the level of development of counties across the country, the first two reasons come out as the main reasons for poor implementation (this is also confirmed from related articles that have appeared in the media). It can be noted that the counties which have already implemented the project are those which had a good infrastructures before devolution took place. It is also in these developed counties where most of the highly specialized medical professionals are based (the majority being in the capital city, Nairobi). It should also be noted that for some of counties which are yet to implement the project, levels four and five hospitals were build after the introduction of devolution. Most of these under-developed counties are in the arid and semi arid areas of the country where infrastructure development is very poor. Provision of stable power supply and clean water are some of the infrastructure challenges in the affected counties. Considering that equipments leased under the MES project require skilled/specialized personnel to operate and manage, getting the required manpower in these counties is quite difficult (in most cases, it meant recruiting and training them to the required level). It can therefore be concluded that maybe there was need to carry out the implementation of the MES project in two clusters/categories: Cluster one to cover the already developed counties with a shorter timeline and lower level of funding and cluster two to cover the "under-developed" counties with a longer timeline and enhanced funding.

There is talk that the cost of leasing the medical equipment is exaggerated. It is the responsibility of the National government to get rid of this notion by openly sharing the contract documents with the county governments. Too much secrecy tends to create unnecessary propaganda.

Looking at the positive impact of the project on medical service delivery to the citizens in the counties where it has been successfully implemented, it can be concluded that there is urgent need for the National government and the Council of Governors to move with speed to ensure that the difficulties experienced (in those counties where it has not taken off) are sorted out as soon as possible.

It is said that one learns from past mistakes; it is from our mistakes that we learn how to do things better. But this does not appear to be the case with public health services because going back in history, we have had situations where equipment have been procured without first ensuring that the required infrastructure and human resource is available. It appears that sometimes things are done in hurry to an extent of overlooking the laid down procedures. We tend to ignore the little things that matter. The end result is that time and money is wasted in the process. We may need to benchmark from the Japanese or Chinese who never proceed to implement a project until they are sure that everything is in order. They are meticulous in their approach in doing things. This kind of approach makes it possible to successfully carry out tasks which otherwise looked impossible. There is no good reason of rushing to the implementation stage (unless it is an imergency) until all aspects have been thoroughly analyzed. Critical analysis ensures that implementation is done smoothly. This then ensures that what is commonly refered to as "white elephant" is avoided. The following are my suggestions as what should be done so as to have the MES project successfully implemented in the counties where it has not taken off:

(i) Identify the problems (find out what is lacking) county by county.
(ii) Develop a critical path analysis for each county based on the identified problems.
(iii) Cost the activities required per county (list the activities and their cost to implement).
(iv) Source and allocate funds to carry out the activities (these activities could be allocating space/room or building a room to accommodate equipment and recruiting required staff).
(v) Install and commission the equipments.

It should be noted that a number of the equipments have already been delivered to the counties; therefore the above should be done as fast as possible so as to reduce the equipment down time.

There has been some remarks attributed to the Counsel of Governors to the effect that it could have been cheaper to purchase the equipments instead of leasing. It is not clear whether they (governors) are able to justify their reasoning or they are simply comparing the sale price of the equipment against leasing cost, forgetting that cost of leasing also covers maintenance and repair services of the equipment plus provision of consumables where required.

The benefits of leasing medical equipment outweigh those of outright purchase. This is more pronounced in the Kenyan situation where maintenance of medical equipment has been a great challenge. For the MES project, the contractors are required NOT only to supply, install and train users but also to provide maintenance, repair and replacement services for specialized medical equipment for the duration of the MES contract. If well implemented, with proper co-ordination between the county governments and national government, the MES project will be a game changer in the provision of health services in Kenya.

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