Communiqué of the 3rd International Conference On Biomedical Engineering (ICBME 2019), Abuja, Nigeria

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Preamble

The ICBME 2019, which had as its theme: ***Regulation for Safe Use and Application of Biomedical Equipment and Techniques*** was the 3rd International Conference on Biomedical Engineering organised by the Association of Biomedical Engineers and Technologists of Nigeria (NABET). The conference held at the National Hospital Abuja, Nigeria between October 15 and 18, 2019 and was endorsed by International Federation for Medical and Biological Engineering (IFMBE) withminor support from Gijuwie Biomedical Engineering Ltd, Dr Barth Okey Ibeh and Dr Tunde Alaofin.

1. Introduction

The conference attracted participants from across Nigeria, Ethiopia, Belgium, among others. It was constituted of Biomedical Engineers, Technologists and Scientists; Medical Doctors; Public Health Scientists; Dental Technologists; Academia; Other Scientists; Public Servants; Top government functionaries and Students.

2. The Conference

2.1 Biomedical Engineering as an Interdisciplinary Profession

Biomedical engineering is an interdisciplinary and unique amalgam of professions composing of the following professional and subject areas: Medical & Neurological Sciences, Consciousness Engineering, Artificial Intelligence, Micro/Nano Electronic Engineering, Mechatronics, Computer Science, Mathematics, Physics, Chemistry, Biology.

The interdisciplinary nature of biomedical engineering has provided many areas of specialization. Some of these areas of specialization within biomedical engineering include: bioinstrumentation; biomaterials; biomechanics; cellular, tissue, and genetic engineering; clinical engineering; medical imaging; orthopedic surgery; rehabilitation engineering; and systems physiology.

A case study of the interdisciplinary nature of biomedical engineering is seen in tetraplegia. Tetraplegia is paralysis caused by illness or injury that results in the partial or total loss of use of all four limbs and torso.20% of traumatic cervical spinal cord injuries result in tetraplegia. To manage this condition and thus improve the lives of patients, neuro-prosthetics are developed by biomedical engineers.Neuro-prosthetic is a semi-invasive technique that uses brain signals to drive an exoskeleton.

2.2 Biomedical Engineering as an Engineering Profession

Biomedical Engineering is a vast multidisciplinary engineering field that combines the fundamental knowledge of biology with the application of engineering principles and materials to medicine and healthcare. Biomedical engineers collaborate with doctors and researchers to develop medical systems, equipment or devices that can solve clinical problems.

As an engineering profession, biomedical engineering incorporates the knowledge of each and every field of engineering to provide solutions to medical problems using technology. As an example, aspects of mechanical engineering, electrical engineering, chemical engineering, materials science, chemistry, mathematics, computer science, and engi-

neering are all intertwined with human biology in biomedical engineering to improve human health.

2.3 Regulation of Biomedical Engineering Practice in Nigeria

Nigeria as of 2019 is estimated to be populated approximately 200,960,000. Total Engineering faculties in Nigerian Universities is 55. Total Regulated Engineering Programmesis 23. There are 132 Polytechnics (29, 48 and 55 Federal-, State- and Privately-owned Polytechnics). And 119 technical Colleges. Thereare millions of non formal, not regulated training programmes.

It is the responsibility of the Council of Regulation of Engineering in Nigeria (COREN) to regulate the practice and activities of engineering in Nigeria. As of June 2019, 50,450 engineers, 4,966 technologists, 836 technicians and 2,634 craftsmen are registered with the Council of Regulation of Engineering in Nigeria (COREN).

There are the direct and indirect roots of the Requirements for Registration of Biomedical Engineers. Direct root is for B.Eng holders in COREN accredited universities, while indirect root is for those with HND in engineering + COREN accredited PGD as well as those with B.Sc. (Science) + M.Eng. (in relevant field).Registered Engineering Technologists (RET) are for those with HND in Engineering from COREN accredited Polytechnics or Monotechnic. Registered Engineering Technicians are for those with ND in Engineering from accredited polytechnics or Monotechnic. Then Registered Engineering Craftsmen are for holders of WAEC Technical, NABTEB (Engineering related) or Trade Test Class/Grade I with minimum of 2 years relevant professional engineering experience.

2.4 Africa as the Cradle of Biomedical Engineering

Historically, the origin of biomedical engineering globally has been traced through the continent of Africa, specifically, to Egypt, with uncovering of a 3,000-year-old mummy from Thebes with a wooden prosthetic toe tied to its foot as a big toe. Ancient Egyptians are also said to have used hollow reeds as biomedical engineering technologies, for endoscopy, stethoscopy and dental abscess drainage, for instance. Though, the origin of modern biomedical engineering is often linked to pioneering electrophysiology studies of Volta and Galvani, some 200 years ago, it was not until world wars 1 & 2 that biomedical engineering emerged visibly. And by late 1950s, biomedical engineering effectively evolved as a distinct profession, culminating in the formation of IFMBE in 1959, France.

2.5 IFMBE 1959 – 2019

2019 marked the 60th anniversary of the International Federation for Medical and Biological Engineering (IFMBE). The objectives of the IFMBE are scientific, technological, literary, and educational. Its mission is to encourage, support, represent and unify the world-wide Medical and Biological Engineering community in order to promote health and quality of life through the advancement of research, development, application and management of technology. Within the field of medical, clinical and biological engineering its aims are: to encourage research and the application of knowledge; to disseminate information and promote collaboration.

When it was founded in Paris, June 1959, IFMBE started with the name: International Federation for Medical Electronics with the founder and first President as Prof V. K. Zworykin, and only about 31 Society. In the early days its official journal was the *Medical Electronics and Biological Engineering.* However, IFMBE has come a long way.

Current, IFMBE is structures suchthat the affairs of the Federation are administered by an Administrative Council, whose voting members are: five officers (President, Pres-Elect, Secretary General, Treasurer, the Immediate Past-President); Four members, elected by the General Assembly from the membership of the Member Organisations; four members selected by regional groups (Asian–Pacific, Europe–Africa, Latin–America, North-America); four exofficio chairs {International Academy of Medical and Biological Engineering (IAMBE Chair), a Clinical Engineering Division (CED Chair) , a Health Technology Assesment Division (HTAD Chair), a Council of Societies (CoS Chair)}

IFMBE joined with IOMP to form the

IUPESM. The IUPESM has formal links with the UN Organisation including United Nations Educational, Scientific and Cultural Organization (UNESCO), World Trade Organization (WTO), World Health Organization (WHO).

The UNESCO and WHO are affiliated to the International Organizations of Medical Sciences (CIOMS) through the UNESCO. IUPESM is affiliated to International Science Council (ICSU)

2.6 HeathCare Equipment Management with ICT Tools in Burundi and Rwanda

The WHO has provided a series of guidelines for managing health care equipment. A classical guideline is the six-prong approach represented graphically by a building with the foundation composed of Guide 6: Ensuring efficiency (Financial management of HTM Teams) and the Roof top composed of Guide 1: Framework/structure (Organizing a network of HTM Teams); inside the building is composed of Guides 2 - 5 (Chains of activities in the equipment life cycle)

The experience in Rwanda shows that there is a well organized health care system in place with a strategy for ICT based management of medical devices. This entails a Medical Equipment Management and Maintenance Scheme (MEMMS) deploymentthrough the Clinton Foundation Support by donors amongst which is 'Enabel'. There is the presence of biomedical engineering technicians in hospital workshops. And since 2018, there has been decentralisation plan for maintenance with the central entity given to supervision and regulatory tasks.

Also *the experience in Burundi* shows that there is a well organized health, a Ministry of Health with a medical devices division. There is strategy for ICT based management of medical devices, support from donors, amongst which is 'Enabel'. Also, ICT deployment in public hospitals. There is biomedical engineering technicians in hospital workshops with requirements of central database, equipment and infrastructure.

So in both countries, there is great awareness regarding medical equipment; inventories are ok. There is management of the maintenance depending on sites. However, both spare parts and decommissioning are problematic

2.7 Equipment Maintenance and Technology Management

Organisations such as Healthcare facilities require appropriate maintenance repair organization (MRO) to ensure optimal functionality of their equipment; this is important considering the role of Technology in Modern healthcare delivery. Any equipment which directly or indirectly contributes to fulfill the organization objective requires maintenance. The importance of equipment maintenance cannot be overemphasis: A good maintenance policy will: increase equipment efficiency; increases productivity; create confidence and satisfaction; safe cost.

When equipment maintenance is to be done should be captured in organization maintenance policy which spells out times for: routine maintenance; preventive maintenance; and predictive maintenance.

2.8 Research State of the Redoxive Stress Paradigm

A cell is a homeostatic redox equilibrium system. A displacement of this redox equilibrium; by the preponderance of one or other of the redox equivalents results to redoxive stresses described by the model: $Sr = k\{(r - 1)2 + 1\}$. Sr = intensity of redoxive stress; k = proportionality constant and r = absolute oxidant or reductant equivalents. In some disease states, such as sickle cell disease (SCD), which data yielded the unifying model, both oxidative and reductive stresses can co-exist, across different redox couples, at the same time.

For long, the focus of redoxive stress research has been on oxidative stress. This asymmetric focus has, sometimes, resulted to treatment protocols that over-treat acidosis, without considering alkalosis as an equally debilitating disease.

More recently, an increased amount of research attention has been paid to reductive stress. Better knowledge of the two and the dynamic linkage of their functions should help improve redoxive stress management as a holistic process.

3. Conference Recommendations

Following critical analysis of the above needs and challenges as discussed in the conference, the Conference made the following recommendations to emphasize *Regulation for Safe Use and Application of Biomedical Equipment and Techniques*.

3.1 On Biomedical Engineering as an Interdisciplinary Profession

#Nature is interdisciplinary. Science is interdisciplinary. Engineering is interdisciplinary. Then in addition, biomedical engineering is both inter-disciplinary and multi-specialty, unique and the fastest growing profession in the world today!

Just as in most other fields, inter-disciplinarity means that innovation originates from many directions at the same time.

Government and other stakeholders must see and respect biomedical engineering for what it is: an inter-disciplinary field and most importantly a multi-specialty profession; appropriating this status to biomedical engineering gives it the professional leverage it needs to impact positively on the health of the populace.

3.2 On Biomedical Engineering as an Engineering Profession

Ultimately, the future of biomedical engineering is tied to both the issues and obstacles we discover, and advances and achievements in fields like chemistry, materials science, and biology.

Biomedical engineering as an engineering profession making enormous contributions to the health and healthcare positions it really as inter-disciplinary.

It is an engineering discipline among others that should be given much attention by Nigeria to reduce medical tourism and safe the huge capital flight resulting from it.

Seeing biomedical engineering as an engineering profession demystifies the engineering family as a closed-circuit field of endeavour that cannot be touched.

3.3 On Regulation of Biomedical Engineering Practice in Nigeria

Training institutions as well as graduates and individuals practising or that intend to practice biomedical engineering are encouraged to avail themselves of the opportunity of the openness of the COREN to properly register their engineering activities and so legally practice such.

3.4 On Africa as the Cradle of Biomedical Engineering

Although the BME profession traditionally originated in the African continent, subsequent development and advancemt of modern biomedical technology and its management occurring globally has posed significant development challenges for biomedical engineering in Africa.

Consequently, the African biomedical engineering professionals are called upon to come together to reclaim this original *global* biomedical engineering leadership mandate

3.5 On IFMBE 1959 – 2019

Engineering jobs are present in medicine and health care, primarily through research, development and manufacturing of medical products, devices and systems, but is increasingly encountered in clinical settings.

#Unintended consequences of medical devices are rare due to safe production and maintenance, but concern about the immediate security and safety of the device is necessary and appropriate to the care of biomedical, biological or clinical engineering profession.

#Early introduction of research methods and encouraging innovativness in students through problem based learning and design competitions is promising.

Developing an African biomedical engineering is sacrosanct if biomedical engineering development globally will be even.

3.6 On Heath Care Equipment Management with ICT Tools in Burundi and Rwanda

In both Burundi and Rwanda, there is great awareness regarding medical equipment.

Although, inventories are Ok and management of

the maintenance depend on sites
Yet Spare parts and decommissioning are still problematic
African biomedical engineering professionals must consider seriously the issues of spare parts procurement with decommissioning of medical equipment

3.7 On Equipment Maintenance and Technology Management

The Effective Monitor Procedure (Plan) for every maintenance management include: Create a plan, Inventory of facility equipment, Create pm procedure, Create pm schedule, Train your team, Analyse - adjust improve
This must be a routine for every biomedical engineering department or unit in any organization.

3.8 On Research State of the Redoxive Stress Paradigm

Oxidative and Reductive Stress Phenomena are best seen and Treated, Holistically, as Redoxive Stress
Further studies should be facilitated in this area as part of the cure for the sickle cell disease.

4. Conclusion

In concluding, the Conference called on all those involved in science, engineering, technology, health and economic policy formulations and implementations in Nigeria and Africa to adopt / adapt these recommendations in order to enhance the regulation for safe use and application of biomedical equipment and techniques.

These will also minimize unnecessary disabilities and preventable deaths in Nigeria and Africa emanating from poor use and application of these equipment and techniques.