BIOMEDICAL ENGINEERING PROFESSIONAL SERVICES STANDARD

Department of Medical Services

Ministry of Health

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Contents:

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Introduction

The advancement in medical technology is inevitable and has been embraced by the health care service providers as a means to provide better, faster, safe and reliable patient care and services.

All the hospitals around the country have been introduced with hundreds and thousands of high-end multi-parameter, user friendly, safe and multi programmable devices and equipment. The implementation of CT and MRI scanners at JDWNR Hospital and with the proposals to introduce Cathlab, oncology, urology, neurology, mammography and Radiotherapy services clearly shows the rapid development and improvement in medical technology and services. For a small developing country like Bhutan, with limited budgetary resources for replacement, proper management and timely maintenance of this equipment is essential and vital to assist and support health service providers in giving quality care. At the same time the safety, life and efficiency of these equipments can be maintained and many precious lives can be saved.

Over the years the procurement and installation of medical equipment have increased in all the hospitals due to introduction of new services and up-gradation of the existing health centers. It is therefore within the mandate of Biomedical engineering services to manage and maintain all the medical equipment in all health facilities including traditional medicine units in the country

MISSION AND POLICIES:

The mission of the Biomedical engineering services is to facilitate and support the delivery of quality health care by ensuring the functioning of all medical equipment in the country.

- Increase the efficiency and safety of all medical equipment.
- Increase and maintain the up-time of all equipment above 95%.
- Reduce cost on spares, consumables and accessories through planned preventive maintenance.
- Enhance the efficiency and professional service.
- Ensure timely replacement of medical equipment.
- Deliver safe, standard and reliable medical equipment and services.
- Provide guidance and technical assistance to all relevant organizations.

Objectives of Biomedical engineering services in Bhutan

- To improve quality of Biomedical engineering services.
- To enhance and expand the existing service facilities.
- To man all district hospitals with trained junior Biomedical Engineer.
- To improve coverage of Biomedical engineering services upto BHU level.

- To handle and manage medical equipment projects as and when required.
- Periodic up-gradation of professional skills and career enhancement through trainings, seminars, conferences, CME and symposiums, held within and outside country.
- To initiate and conduct Annual Biomedical engineering conference.
- Equip all maintenance units conforming to latest technology tools and test instruments.
- Strengthen research activity in Biomedical engineering.
- To participate in teaching students of RIHS.
- To develop Biomedical engineering Act and Regulations.

Biomedical engineering professional services standard.

The Biomedical Engineer works with other health care professions, doctors, nurses, therapist and technicians. Biomedical Engineers may be called upon in a wide range of capacities.

The Biomedical engineering field is so vast that it covers all the specialties in a hospital i.e Surgical, medical, anesthetic, dental, pediatric, laboratory, CT/MRI, physiotherapy etc. The Biomedical Engineers not only have to know the hands on technical expertise on the maintenance and management of these medical equipment, they also have to know the

functionality and the operation of these medical equipment, for which they have to know the basic anatomy and principles of human body. Therefore, the Biomedical Engineers need sound knowledge of engineering and medical science, high level of skill and a very good sense of aesthetics.

Subjects / syllabus covered in an undergraduate program:

- Principles of chemistry.
- Computational methods in engineering.
- Social science or Humanities elective.
- Introductory to technical Physics.
- Principles of biology
- Biomechanics
- Calculus
- Biomedical Electronics and Measurements.
- Modeling cellular and molecular systems.
- Biomaterials.
- Linear Algebra and Differential Equations.
- Transport Phenomena in Biological Systems.
- Signals and Systems.
- Ordinary and partial differential equations.
- Electro biology
- Probability and statistics for Engineers.

- Medical instrument design.
- Medical equipment Management project.

Subjects/syllabus covered in a Postgraduate Diploma in Biomedical engineering are:

- Physiology and Anatomy
- Clinical Measurement.
- Principles of Biology.
- Medical Equipment Management.
- Radiology and Applications.
- Medical Electronics.
- Medical Signals and control systems.
- Computing (Signals and Processes)
- Projects

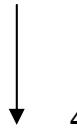
Masters / PhD in Biomedical engineering course:

- By research
- By Course work:

Based on both duration of training and nature of work, and the amount of work load, the career ladder for Biomedical Engineer is proposed as under:

1. Biomedical Engineer Career Ladder

Stage one: Biomedical Engineer (P4)



4 yrs

Stage two: Dy. Executive Biomedical Engineer (P3)

4 yrs

Stage three: Executive Biomedical Engineer (P2)

4 yrs

Stage four: Chief Biomedical Engineer (P1)

4yrs

Stage five: Technical Director (Specialist) (ES 3)

Qualification and Experience

Stage one (P4): Possess a minimum of Bachelor degree or Diploma with PG diploma in Biomedical engineering with 4 years experience

Stage two (P3): Qualification same as above but with 4 years experience in stage one.

Stage three (P2): In addition to above must posses masters degree in

Biomedical technology / engineering.

Stage four (P1): Above plus 4 years experience in stage three.

Stage five (ES3): above plus four years in stage four and after fulfilling the criteria as set in the PCS.

Generic job description of Biomedical Engineer:

Generic Job Description for: Biomedical Engineer.

- Provide after sale services on medical equipments around the country.
- Monitor the stock of spares and consumables of medical equipments.
- Provide technical guidance, assistance and expertise to the medical equipment evaluation and selection committee.
- Undertake quality inspection of high end medical equipment.
- Undertake installation, commissioning and demonstration works of medical equipment.
- Provide training to the Junior Biomedical Engineers and also to the doctors and nurses on medical equipment management.
- Assist the Executive and the chief Biomedical Engineers on setting standards.

Generic Job Description for: Dy. Executive Biomedical Engineer.

Above plus the following

- Provide after sale services on medical equipment.
- Finalize and procure spares, accessories and consumables of medical equipment.
- Develop standards for the management of medical equipment in the country at par with the international standards.
- Develop safety standards and procedures on the after sale services.
- Coordinate and undertake establishment of services and replacement policies.
- Coordinate and provide in-house training on medical equipment management to the staff of BES (Biomedical engineering services), nurses and doctors.
- Assist in research activity in Biomedical engineering.
- Assist the Executive Biomedical Engineer in conducting Biomedical engineering conferences and meetings.
- Provide technical assistance, guidance and expertise to the medical equipment procurement agencies.
- Participate in teaching activities of RIHS.
- Assist the Executive Biomedical Engineer on the services.

Generic Job Description for: Executive Biomedical Engineer.

Above plus the following

- Overall management and after sale services of Biomedical engineering.
- Provide after sale services on specialized medical equipment.
- Provide technical specification of medical equipment for all the departments.
- Design and set standards on the medical equipment technology.
- Develop safety standards on medical equipment.
- Modify and develop indigenous medical equipment and software's.
- Develop quality control methods and standards for medical equipment.
- Monitor and conduct in-house Biomedical engineering training.
- Strengthen planned preventive maintenance and strategies.
- Assist the Superintendent Biomedical Engineer on the Biomedical engineering activities.
- Handle and manage medical equipment project.
- Conduct CME for the staff, nurses, technicians and doctors on Biomedical engineering technology.
- Participate as a member in the Quality Assurance Group of the ministry of health.

- Lead and initiate research activity in Biomedical engineering field.

Generic Job Description for: Chief Biomedical Engineer , general.

Above plus the following

- Provide after sale services on specialized medical equipment.
- Monitor the Quality of Biomedical engineering services.
- Design and develop specific medical equipment, devices and soft wares as per need and requirement.
- Analyze and solve problems related to application of advanced technology to the complex problems of medical care.
- Conduct Annual Biomedical engineering conference.
- Develop strategies and methods on the scope of cost sharing for financial sustainability.
- Develop Biomedical engineering act and regulation in consultation with the chief Biomedical Engineer.
- Assist the Chief Biomedical Engineer on the Biomedical engineering activities.
- Technical head of the Biomedical engineering services of a region.

Generic Job Description for: Technical Director (Specialist).

Above plus the following

- Administrative Head of the Biomedical engineering services in the country.
- Evaluate the equipment safety standards.
- Evaluate and monitor quality control methods and standards for medical equipment in line with international norms and regulations.
- Evaluate and monitor the Quality of Biomedical engineering services.
- Evaluate and guide on the designs and development of medical equipment and devices.
- Evaluate and guide on the Development of Biomedical engineering Act and Regulation.
- Advise the health ministry and other relevant agencies on standards, quality and the importance on the advancement of medical equipment technology.
- Chair the Annual Biomedical engineering conference.
- Evaluate and guide on the strategies and methods on the scope of cost sharing for financial sustainability.
- Consultant to the Ministry of Health and other ministries on medical equipment technology.

Career Ladder for Junior Biomedical Engineer and Assistant Engineer.

Entry Qualification: Diploma in Mechanical / Electrical engineering.

Stage 1: Junior Biomedical Engineer. (S2)

↓ Four Years

Stage 2 : Assistant Biomedical Engineer II. (S 1)

↓ Four Years

Stage 3 : Assistant Biomedical Engineer I (P5)

↓ Four Years

Stage 4 : Biomedical Engineer (P4)

Qualification and Experience:

Stage 1: Diploma in Electrical / Mechanical engineering or RTI[1] graduate with 4 years experience.

Stage 2: Above plus additional 4 years in stage one.

Stage 3: Above plus 4 years experience in stage two.

[1] **Note: No more RTI graduate exists from RTI . RTI five years course in different fields has been abolished and converted into different group of trade like VTI Civil maintenance, Electrical maintenance, NDTI etc..**

Stage 4: 16 years experience/ 12 months Diploma / Bachelors degree .

GENERIC JOB DISCRIPTION

Generic Job Description: Junior Biomedical Engineer

- Manage the stock of spares, consumable accessories for all the medical equipments.
- Conduct repair and maintenance of hospital equipment.
- Carry out quality inspection of general equipments.
- Carry out installation and commissioning of general medical equipments.
- Carry out safety procedures as per standard.
- Fabrication, welding and modification of medical equipment.
- Assist the senior Biomedical Engineers.

Generic Job Description: Assistant Biomedical Engineer II.

Above plus the following.

- Responsible for attending to the daily routine works on calibration/ repair and maintenance, servicing of all types of basic medical equipment, devices, instruments and hospital equipment.
- Responsible for attending the emergency duties 24 x 7.

- Responsible for keeping records of obsolete medical equipments/devices/instruments/hospital equipment in coordination with the central medical stores and handing over to the Department of National Properties for disposal.

Generic job description: Assistant Biomedical Engineer I

Above plus the following:

- Provide planned preventive maintenance on dental, anesthetic, dialysis and other medical equipments, devices and instruments.
- Technical guidance on the selection of medical equipments, devices and instruments.
- Repair and maintenance of medical equipments/devices of other agencies and hospital outside the ministry of health.
- Drafting, designing and fabrication of equipment spare parts.
- Drafting, designing and laying out of electrical conductors and wiring during installation and commissioning of equipments and devices.
- Teaching and training of subordinate staff on the operation and management of medical equipment/devices/instruments.
- Teaching end user on prevention, care and operational guidance of medical equipments, devices and instruments.

BIOMEDICAL ENGINEERING SERVICES: FACILITY STANDARDS

The Biomedical engineering services render a variety of mechanical, electrical and technical services related to medical instruments and equipments in all the health centers of the country. It not only carries out repair and maintenance but also designs and produces accessories and spare parts. It endeavors to improve the quality and efficiency of all life saving and diagnostic equipments and thereby allowing health centers to utilize these important equipments optimally. It strives to set a uniform standard that is consistent and equitable.

1. National Referral Hospital.
2. Regional referral Hospital.
3. Districts Hospitals.
4. BHU I

Standard Services Facility: BHU I .

- Planned Preventive Maintenance and Emergency maintenance.
- Troubleshooting, servicing, repairing and replacement of spare parts.

Existing medical equipments: BHU Gr I

- Sphygmomanometers.
- Stethoscopes.
- Microscope.
- Suction Machine.
- Diagnostic sets.
- Laryngoscope.
- Portable electric and non electric autoclave
- Sterilizers.
- Dressing drums.
- Portable fiber optic light.
- Centrifuge.
- Centrifugal Timer.
- Hemoglobinometer.
- High Pressure MOX regulator.
- Digital weighing scale.
- Solar powered gynecological fiber optic lights.

Biomedical engineering services at Districts hospitals.

Above plus the following

- Regular maintenance through mobile workshop.

- Provide lay out design for installation or dismantling of medical equipment.
- Demonstration and training on the management of medical equipment to the end users.
- Prepare, stock and replace spare parts for medical equipments existing at the district hospitals
- Modification, fabrication and servicing of medical equipments.
- Attend emergency maintenance calls.
- Member of quality assurance committee.
- Member of disposal committee.
- Supervise electrical and civil maintenance of the hospital.
- Refer sophisticated service to the regional Biomedical engineering service.

The above equipments available at BHU I and as follows:

- X - Ray machine.
- Ultra sound machine and printer.
- X-ray digital drier
- Film processor.
- Dental chair.
- Ultrasonic scalar.
- High pressure compressor.
- Amalgamator

- High pressure steam sterilizer.
- Micromotor
- Dental X-ray
- Dental lathe
- Dental Laboratory equipments
- Electric muscle stimulator
- Short wave diathermy
- Ultrasonic therapy unit.
- Cycle trainer.
- Tread mill.
- Traction unit.
- Wax bath
- Cold pack and hot pack machine.
- Rehabilitation equipments.
- Centrifuge
- Haematology analyzer.
- Binocular microscope.
- Laboratory incubator
- Hot air oven
- Microtome
- Blood bank refrigerator
- Blood shaker
- Electrolyte analyzer.

- PH meter
- Water bath
- Haemoglobinometer.
- Digital weighing scales.
- Infant incubator
- Resuscitation trolley.
- Radiant warmer
- Phototherapy unit.
- Suction machine
- Anesthetic machine
- Cardiocap
- Plethymosgraph
- Pulse oximeter
- Diathermy machine
- OT light
- Glucometer
- Operation theatre electronic controlled table
- Horizontal and vertical autoclave.
- Fetal Doppler.
- ECG machine
- Conventional X-ray machine
- Steam sterilizer
- Mocom automatic

- Swing roll mixer
- Others

HRD proposed: Assistant Biomedical Engineer (1) with 4 numbers of assistants including Junior engineer and support staff.

HRD Existing: Nil

Biomedical engineering services to BHUs will be covered by the concerned district hospital.

Biomedical Engineering services at the Regional Referral Hospital.

Above plus the following:

- Provide 24X7 duty.
- Provide technical assistance and guidance to the Disctrict and BHU level Hospital.
- Provide technical expertise to the Hospital administration.
- Provide specialized dialysis calibration and maintenance service.
- Provide specialized service on reverse osmosis plant.
- Provide specialized service on Intensive Care Unit equipments, which are life saving e.g. Ventilators, Arterial blood gas machines, Cardiac pulmonary monitors and defibrillators.

- Provide specialized service on Neonatal and Pediatric equipments, which are also life saving e.g. Neonatal ventilator, incubator and neonatal / pediatric monitors.
- Refer sophisticated services to the center.
- Monitor and maintain medical equipment log book.
- Undertake research activity.

The above equipments available plus as follows:

- Adult ventilator
- Pediatric ventilator
- Dialysis machine
- Reverse osmosis plant
- Dialyzer cleaner.
- Remote controlled dialysis chair
- Multi parameter monitors.
- Electric cautery machine.
- Laparoscopy equipment.
- Colonoscopy equipment.
- Ophthalmology operating microscope.
- Ophthalmology optical equipment
- ENT equipment
- Laser equipment
- Endoscope.

- Fiber optic bronchoscope
- Slit lamp
- Hysteroscope
- Colour Doppler.
- Vaccum extractor
- CTG machine
- Anesthetic ultrasound machine
- Nebulizer.
- ENT light source
- Tourniquet machine.
- Electric bone drill.
- LEEP equipment.
- Insuffilator.
- Cryo-therapy unit.
- X-ray machine with fluoroscopy and screening facility.
- Multi-programmable dental chair.
- Medical gas manifold systems.
- OPG Machine
- Others

HRD proposed: Executive Biomedical Engineer (1) with 8 numbers of assistants including Dy. Executive Biomedical Engineer, Biomedical engineers, Assistant Biomedical Engineers, Junior Biomedical Engineer

and support staff (3) (Computer operator – 1, VTI Painter – 1, Store keeper – 1)

Total = 12

HRD existing: Assistant Biomedical Engineer - I (1) + Junior Biomedical Engineer (1)

Biomedical engineering services at the National Referral Hospital.

Above plus the following:

- Provide specialized maintenance service on CT and MRI.
- Provide specialized maintenance service on Echocardiography machine.
- Management of Biomedical engineering service activities.
- Provide technical expertise to the Department and the Ministry of Health on medical equipment technology.
- Be a member of the medical equipment evaluation committee.
- Be a member of the medical equipment selection committee.
- Service and repair referred medical equipments.
- Participate as a member of quality assurance group.
- Provide technical specification and details on medical equipment to the relevant agencies.
- Handle and manage medical equipment projects.
- Organize CME to the staff, nurses and doctors.
- Design and develop medical equipments.

- Develop medical equipment standards, guidelines and acts.
- Develop quality control and safety standards.
- Conduct in-house Biomedical engineering trainings.

The above equipments available plus as follows:

- Computerized Tomography machine.
- Magnetic resonance imaging.
- ECHO cardiograph machine.
- High frequency X-ray machine with IITV, Fluoroscopy and screening services.
- Digital processor.
- Dental IOPA machine.
- Dental OPG with lateral Cephelometery machine.
- Gas plasma sterilizers.
- Operation theatre pendent equipment.
- High frequency ventilators.
- Cathlab
- Mammography
- Radiotherapy machines.
- Oncology and neurology equipment.
- Urology Equipment.
- Others

HRD proposed: Technical Director (Specialist) with 17 numbers of assistants including Chief Biomedical Engineer, Executive Biomedical Engineer, Dy.Executive Biomedical Engineer, Biomedical Engineer, Assistant Biomedical Engineer, Junior Biomedical Engineer and support staff (3) (Computer operator – 1, VTI Painter – 1, Store keeper – 1)

Total = 20

HRD existing: Biomedical Engineer (1) + Assistant Biomedical Engineer (1) + Junior Biomedical Engineer (4)

Conclusion:

This proposal seeks to provide a frame work within which approaches to organizing an effective, standardized and sustainable Biomedical engineering service can be established. The roles, responsibilities and functions of the services have been clearly outlined and thus can be used by policy makers and administrators in planning and managing the organization.

As seen from this document personnel working in the Biomedical engineering services are not only accountable but also equally responsible in the management and care of patients in health centers. Therefore, it is relevant that this group of professionals be categorized under the Medical services group. This is also in keeping with Chapter 1 article 2 (h) and Chapter 11 Schedule II of the Medical and Health Council Act 2002, under whom it is registered and directly responsible in maintaining standards, ethics and regulations.