

Biomedical Engineering in Nepal: Opportunities and Challenges

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INTRODUCTION

Biomedical Engineering (BME) is one of the branches of science and technology that integrates the use of various field of engineering knowledge in medical sector. BME has been introduced as a fusion course between medicine and engineering.¹ This field in the present world plays a vital role in improving the medical diagnosis and treatment. Different from other discipline of engineering, BME have the knowledge of both electrical circuits and components as well as human anatomy, physiology and biomechanics.² This allows the biomedical engineers to involve in the manufacture, installation and repair of various medical devices along with design and develop various implantable materials such as pacemakers, stents, bone substitutes that can be used as human organ substitutes.³ However, the field of work for biomedical engineers have expanded from device and implant design to biomolecular research, neural networking, bioinformatics etc.¹

HISTORY OF BME

Although the research and experiments including the concepts of physics and engineering in biological models started in the 18th century, the BME as a separate field of study started in the 1950s.⁴ The first study to incorporate engineering in medical field was performed in 1780 with the study of "Animal Electricity", research based on electrophysiology.⁵ The German Physicist Hermann Von Helmholtz is considered to be the first biomedical Engineer,

ABSTRACT

Biomedical engineering is the blend of engineering and medical science, professional with a combination of knowledge of various engineering discipline to improve health care and quality of life. While biomedical engineering formally came up as major course in 1950s, the course started in Nepal just a decade back with its importance being acknowledged and biomedical engineers have been recruited by various institutes. Accounting for artificial intelligence, robotic surgery, 3-d printing, which are believed to be the future of medical science, it is necessary to strengthen the biomedical engineering. This article aims to highlight the overview as well as opportunities and challenges of biomedical engineering in Nepal.

Keywords: Biomedical engineering; Medical devices, Technology.

with several inventions and discoveries like nerve conduction velocity, ophthalmoscope and ophthalmometry. Biomedical Instrumentation really kicked off in the early 1900s, the invention of X-ray in 1895 revolutionized the medical imaging and diagnosis. Later in the year 1920 and 1930, Electrocardiogram (ECG) and Electroencephalogram (EEG) respectively were developed.⁴ This was the time when engineering had a real influence in medicine through the invention of biomedical instruments and imaging modalities. In 1952, biomedical engineering emerged as a separate entity and the progress and improvement of the same boomed in late 1900s when the advanced technologies such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and Positron Emission Tomography (PET) were introduced in medical sector.⁶

PRESENT CONTEXT IN NEPAL

Biomedical Engineering has bloomed internationally in medical diagnosis and treatment but Nepal has lacked behind. Biomedical Engineering formally started in Nepal after establishment of College of Biomedical Engineering and Applied Sciences in 2005. However, engineers from electronics and communication field have been taking care of medical devices since long, actual biomedical engineering profession have been practised since last decade only.

various modern and advanced technologies in medical field. With mushrooming hospitals and health care centres, the demand of qualified biomedical engineers is ever increasing. However, there is only one institute that has been providing the course of bachelor in biomedical engineering. Roughly fifty graduates pass out from the institute yearly, which is not enough for the ever-growing medical industry. To cover up the gap, a vocational program has been started by Nick Simons Institute (NSI), 18 month Diploma course that helps the trainee to operate, install and repair various medical equipment, through which 24 graduates are produced. Although two different program are being conducted to generate the required human resources for biomedical engineering, lack of opportunity and facility have forced most of the graduates to migrate abroad in seek of better jobs. Additionally, lack of higher education in Nepal, has caused the brain drain. Among those who have been working in Nepal as biomedical engineer are either associated in hospitals or they have been engaged in sales and service in association with different organizations.

OPPORTUNITIES

In the past few years, different private hospitals and health care centre have been recruiting biomedical engineers in their core team. In most of the hospitals biomedical engineers involve in procurement, installation and preventive maintenance of the medical devices, while some biomedical engineers team up with doctors in various surgeries and other diagnostic systems with Neuronavigation, deep brain stimulation, radio frequency ablation, nerve-monitoring. In collaboration with doctors and surgeons different tools needed during diagnostic and surgical procedure have been designed and developed using the locally available materials. The 3D printed bone graft have been designed and is being used in patients with cranial defects, this start-up has made the patients able to get such implant at low cost. To add on to the use of locally available materials and tools, National Innovation Centre (NIC) has been hiring biomedical, electrical and electronics engineers to design and develop different devices used in medical sector. NIC have actively involved biomedical engineers during the covid-19 pandemic as well to repair ventilators, produce sample collection booth, and other essential equipment to tackle with the adverse situation.

Recently, the infant warmer has been developed, this is now being used in various hospitals in rural areas. Such centre has promoted and motivated the biomedical engineers to involve in research and development related activities. Other than this, graduates can work for various suppliers and distributors, where they are trained for a

specific device. Once trained they travel to different hospitals for installation, maintenance and service of the same device. Biomedical instrument supplier often provide various technologies on rental basis as well, in such case biomedical engineers travel with such devices and provide case support in different hospitals. The Neuro-monitoring system can be taken as an example, such system helps to identify nerve and preserve those nerve during brain surgery. Similar kind of technological support for complicated surgery and diagnosis have been provided by biomedical suppliers.

CHALLENGES AND LIMITATIONS

Though BME is considered one of the integral part of hospital and health care system in different countries, Nepalese health care system has not been able to utilize biomedical engineers efficiently. Many hospitals and institutes including governmental hospital do not have biomedical engineering department. Only few hospitals have been hiring biomedical engineers. This scenario compels the graduates to work in marketing, sales and servicing department in various suppliers.

Taking a look at international scenario, biomedical engineers mainly involve themselves in three general categories: clinical engineering (work with collaboration with doctors and involve in surgical planning, implant design and placement), biomedical design engineer in manufacturing industry and research activities. But unfortunately in Nepal, manufacturing industries and research centres are not available, so work of biomedical engineers is limited to installation, servicing, preventive maintenance and repair of medical devices. However, repair of many devices is also limited within few organization and companies. For repair, once the problem has been identified and diagnosed, the device needs to be exported to India or other country or call engineers from abroad to complete the repair procedure. The problem with repair and maintenance is due to lack of proper practical training and exposure during the engineering course. Engineers are exposed to few and limited laboratories based medical devices during the practical training. Many expensive and large devices like CT, X-rays, MRI ventilators etc. are taught theoretically only.

Although few institutes have initiated manufacturing devices in Nepal in low scale, research based activity in the field of biomedical engineering is almost null. The research in bio-nanotechnology and tissue engineering is limited to thesis and projects. Kathmandu University and Nepal Academy for Science and Technology (NAST) have got laboratories for such research but has not been able to promote and motivate biomedical engineers to

involve in research activities. With just two institutes producing biomedical professionals, the number of biomedical engineers is obviously lower. Out of those few graduates, many choose not to work in Nepal because of less opportunities and facilities. Almost 50% of the graduates have opted for higher education and attractive jobs in foreign countries. With higher rate of brain drain professional biomedical engineers are very few in Nepal.

CONCLUSION

Biomedical engineers are the bridge between the doctors and engineering. BMEs could identify the needs of doctors and help in production of those devices and equipment. The collaboration of engineering with medical field could help in generating various innovative tools that could vastly improve the health care facility. However, less opportunities have made students to think before they join this course. Good job opportunities and research facility will encourage students to join biomedical engineering. Also, the need of higher education and masters in biomedical engineering has to be started in Nepal with enough practical and exposure to various medical device is necessary to produce qualified biomedical engineers. The future of medical science as predicted by World health organization is robotic surgery, 3-D printing and artificial intelligence. Biomedical engineers are the key to introduce or develop such technologies. So, there is strong need to enhance biomedical engineering in Nepal.

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