Chapter 5

Biomedical Engineering in Ethiopia

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Introduction

The field of biomedical engineering is fairly new to Ethiopia, where its history is based in meeting the need for maintenance of medical devices. In early 1997, a techno centre was established at one of the largest hospitals in the country, Black Lion Hospital, by a group of technicians and electrical engineers, primarily to address major maintenance problems throughout the country. These professionals were not biomedical engineers but had certifications on medical devices like X-ray scanners, autoclaves, anaesthesia machines and suction machines. At the time, the available health facilities comprised around 96 hospitals, 282 health centres and 802 health posts (El-Saharty et al., 2009). The number of technical professionals was inadequate to service all the health facilities. In addition, spare parts for equipment were not readily available. Most of the devices were imported donations, many of which were not functional. A study published in 2011 revealed that around 39% of the hospital medical equipment in Ethiopia was out of service in 2008, the three main causes being lack of training, lack of health technology management, and lack of infrastructure (Perry & Malkin, 2011).

In the early 2000s, the number of health facilities increased significantly. In 2004–5, there were around 130 hospitals, 600 health centres and 4,210 health posts (El-Saharty et al., 2009). This increase in the number of health facilities increased the interest of donors to provide support in equipping these facilities. Developing the equipment list and specifications was a challenge, as were installation and maintenance. None of the universities at the time had programmes to train the needed technical work force. In 2006 the Ministry of Health entered an agreement with Tegbare-id Polytechnic College, Addis Ababa, for the latter to train diploma level biomedical technicians to handle basic installation and maintenance. Training related to biomedical engineering in Ethiopia has mainly focused on equipment maintenance. In 2008 Jimma University launched a biomedical engineering programme at undergraduate level. The Center of Biomedical Engineering at Addis Ababa University was established in 2012 and runs both undergraduate and graduate programmes.

Drivers of biomedical engineering in Ethiopia

The ambitious Growth and Transformation Plan (GTP) of Ethiopia developed in 2010 incorporated a number of strategic directions (MoFED, 2010). One of these is import substitution. It was projected in the GTP that import substitution of pharmaceuticals (a category that includes medical devices in this instance) would reach 50% in 10 years. The plan was to drive manufacturers to establish an industry in Ethiopia for production and assembly of medical

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devices. Establishing a medical device industry would need to be supported by biomedical engineers, and is one of the drivers of the expansion of biomedical engineering education in Ethiopia.

Government departments playing a role in the development of biomedical engineering in Ethiopia include the Ministry of Education, the Ministry of Science and Technology and the Ministry of Health. The Ethiopia Society of Biomedical Engineers and Technologists also plays its role, by providing specialised information, mentoring, contributing to curriculum development, and contributing to policy formulation. The society has organised professional meetings and workshops to create awareness of the profession and has worked closely with the government for the development of the field. The society has also been working closely with international partners like the World Health Organisation, the International Federation for Medical and Biological Engineering and UNICEF. Professional peer to peer support has also been implemented in universities and health facilities.

Another factor supporting the production of biomedical engineers is service expansion in the health facilities. Over the past four successive rolling five-year health sector development programmes which started in 1997–8, the number of hospitals in Ethiopia has increased to 146 referral hospitals, more than 3200 health centres and 16,000 health posts (MoH, 2010, 2012). The health sector expansion in infrastructure and service coverage has put a major focus on the need for medical devices and their management at facilities in the three-tier health service delivery system. New and emerging health services like cardiology, oncology and transplantation also drive the introduction of advanced technologies to Ethiopia. Universities and other educational institutions are aligning their fields of study in accordance.

Radiation emitting medical devices, standardisation issues, and calibration and control of medical devices have been substantial concerns associated with the expansion of the health facilities. Services in quality assurance, calibration and standardisation have become driving forces for the development of biomedical engineering education. The government focus on research and innovation has also included the field of biomedical engineering, with four young biomedical engineering innovators being recognised by the Ministry of Science and Technology at the 8th National Science, Technology and Innovation award ceremony held in November 2017.

University programmes

The number of universities running biomedical engineering degree programmes has now reached four. Two of these, Addis Ababa University and Jimma University, have both undergraduate and graduate level programmes while Hawassa University and Gondar University recently launched their BSc level programmes. Addis Ababa University will soon launch a PhD programme in biomedical engineering in partnership with universities in Finland and South Africa. One of the oldest technical and vocational education and training (TVET) colleges in Ethiopia, Tegbare-id Polytechnic College, runs a biomedical technician programme while other TVET colleges are also following in its footsteps.

The undergraduate programme at AAU is a generic one while the graduate programme is focused on three aspects of biomedical engineering being run under its three research chair groups: biomedical instrumentation & imaging, biomedical rehabilitation, and biomedical computing. The objectives of the graduate programmes include: laying the foundation for an education system that can produce a new generation of biomedical engineers to meet the challenges of the future; improving quality of service in the health sector; producing experts that could run the proposed biomedical manufacturing industries to be erected in the coming years, thereby accelerating national development; providing leadership in creating interdisciplinary academic programmes that are fundamental to addressing the problems facing the country; and providing national and international leadership to the biomedical engineering profession.

With the expansion into bachelor's and master's programmes in biomedical engineering at Ethiopian universities, there is potential to shift the focus from equipment maintenance to innovation, design, research and development.

Challenges for the field of biomedical engineering in Ethiopia

Regulation

Proclamation 661/2009 of the Food, Medicine and Health Care Administration and Control Authority (FMHACA) of Ethiopia, which regulates the safety, quality and efficacy of medicines in this country, has presented a challenge to biomedical engineering. Article 6 of the proclamation categorises medical instruments as a type of medicine and Article 32 defines a "medicinal professional" to be pharmacist, druggist, or pharmacy technician with the appropriate license (FDRE, 1993; FMHACA, 2009). Thus the proclamation has excluded the biomedical engineering role, despite the inclusion of medical instruments, with a negative impact on professional recognition for biomedical engineers. Government policy changes are underway to accommodate biomedical engineering more vigorously.

Awareness about biomedical engineering

Due to the scarcity of biomedical engineers in Ethiopia until recently, the public and in some cases members of the government and health care professionals do not have clear knowledge of what biomedical engineers do. The roles and responsibilities of biomedical engineers and biomedical technicians are sometimes not clearly delineated. The contribution of professional societies and the universities has improved awareness considerably in recent years. In addition, the recent publication by the World Health Organization on the role of biomedical engineers (WHO, 2017) should improve recognition and awareness of biomedical engineering as a profession.

Career path

The lack of knowledge and awareness about biomedical engineering translates into the absence of a clear career path for biomedical engineers. Organisations that might benefit from employing biomedical engineers do not necessarily recruit them. The absence of biomedical engineers from the categorisation of medical professionals by the FMHACA compounds this problem. With changes underway in the FMHACA policies related to biomedical engineering, career paths may become clearer.

Training

Biomedical engineering curricula are varied, with the result that graduates do not leave their undergraduate programmes with a standard set of skills and competencies that is recognised by employers. This has a negative impact on employment of biomedical engineering graduates.

Ethiopian universities have limited availability of teaching laboratories and equipment as well as inadequate research facilities to build sustainable research programmes. The relatively recently established biomedical engineering programmes further strain the universities' ability to provide practical laboratory experience. As a result, universities have shared facilities and have collaborated with better-equipped institutions such as the Tegbare-ed Polytechnic College and the National Metrology Institute, for access to equipment. For practical placements in health facilities, students are sent both to government and to private hospitals, and also to companies operating in the health sector. However, the health facilities lack workshops and equipment for students to gain hands-on experience.

More than 1300 students are currently enrolled for biomedical engineering studies in the four universities running such programmes. Addis Ababa University has 24 teaching staff for more than 600 biomedical engineering students, Jimma University has 30 teaching staff for more than 550 students, Hawassa University has 8 teaching staff for more than 40 students, and Gondar University has 5 teaching staff. These numbers exclude part-time staff on which universities rely given their staff shortages. The universities also have programmes to hire expatriate staff to respond to the chronic shortage in some subject areas.

Academic staff trained to PhD level in biomedical engineering are particularly in short supply, and universities have difficulties in recruiting academics to teach graduate-level courses. Addis Ababa University introduced a master's degree in biomedical engineering in 2012, while Jimma University did so in 2017. Supervision of research projects has been a challenge, which universities have alleviated through the appointment of joint external supervisors and by hiring expatriates. Other than Addis Ababa University, which is to launch a PhD programme shortly, no other PhD programmes in biomedical engineering have been introduced in Ethiopia. Research activity in biomedical engineering at Ethiopian universities is therefore limited, but may be expected to increase gradually as more PhD graduates are produced and employed by Universities. More research in biomedical engineering is likely to lead to the type of innovation

required to establish the medical device industry envisaged by the Growth and Transformation Plan.

Addis Ababa University, Jimma University and Tegbare-ed Polytechnic College are involved in different capacity building projects with local and foreign partners to alleviate the capacity problems described above.

Conclusion

The need and supply of biomedical engineers in Ethiopia is not yet balanced, with need outstripping supply. At the same time, the profession isn't yet well recognised. A number of improvements are underway, with the professional society, universities and government playing a role. Curriculum harmonisation, programme expansion and programme diversification are required. Integration of strategic planning across educational institutions, the industry and health service providers needs careful attention. Universities and technical schools running biomedical programmes should align their strategic capacity development with the long-term health sector development plans of the country. With universities now running undergraduate programmes and expanding into postgraduate programmes, it is expected that the focus of biomedical engineering will shift from equipment maintenance to innovation, design, research and development.

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