REVIEW

Biomedical engineering at the University of Cape Town – challenges and opportunities

Tania S Douglas

The biomedical engineering programme at the University of Cape Town has the potential to address some of South Africa's unique public health challenges and to contribute to growth of the local medical device industry, directly and indirectly, through research activities and postgraduate education. Full realisation of this potential requires engagement with the clinical practice environment and with industry.

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Achievements in medicine and engineering that have improved living conditions and life expectancy in the developed world over the past 150 years include diagnostic, therapeutic and rehabilitative medical devices. These are tangible outcomes of the practice of biomedical engineering. The Whitaker Foundation, dedicated to the promotion of biomedical engineering education and research, defined biomedical engineering as 'a discipline that advances knowledge in engineering, biology and medicine, and improves human health through cross-disciplinary activities that integrate the engineering sciences with the biomedical sciences and clinical practice'.

Biomedical engineering history at the University of Cape Town (UCT) and Groote Schuur Hospital goes back to the 1950s, with work in nuclear medicine by Alan Cormack that led to computer-assisted tomography and the Nobel Prize in Physiology or Medicine in 1979.[1] In 1969 the Department of Medical Physics and Bioengineering was formed. Soon after the establishment, 4 years later, of the Department of Biomedical Engineering as a separate entity, postgraduate programmes in biomedical engineering were introduced. When in 1982 the School of Biomedical Sciences was established in the Faculty of Medicine, Biomedical Engineering was one of its central departments. The endowed Hyman Goldberg Chair of Biomedical Engineering was filled in 1983. In 2000 Biomedicacl Engineering merged with Anatomy (including Cell Biology), and Physiology (including Sports Science) to form the Department of Human Biology. Alan Cormack's legacy was honoured in 2000 with the establishment of the MRC/UCT Medical Imaging Research Unit within the Department of Human Biology.

Innovation in medical devices is considered key to progress in public health,[2] but offers limited accessibility to most of the world's population, particularly in low- and middle-income countries.[3] Over 95% of medical equipment in developing countries is imported, and often does not meet the needs of the healthcare facilities using it.[4] Typically designed for use in the developed world, such equipment is often unused owing to inadequate needs assessment, inappropriate design, lack of robust infrastructure, lack of spare parts/consumables, lack of information on procurement and maintenance, and a shortage of trained healthcare staff.[3]

The literature concerning health innovation in low-income settings is sparse, but also neglects contextual influences on implementation and adoption, perhaps because technology is regarded as a freely available public good which can be assimilated without cost.[5] However, technology is not neutral, but is impacted by the contextually determined relationships between innovations and people.[6] While biomedical engineering provides a framework within which to develop medical devices and health technologies, awareness of context is crucial to their successful implementation.

Opportunities exist for medical device research and development in South Africa, to address local healthcare needs. Despite a strong engineering base and clinical environment at UCT and in the country, the medical device industry is underdeveloped, leaving market needs unmet by existing devices, in terms of price and utility.[7] The UCT biomedical engineering programme faces two inter-related challenges: (*i*) developing, through its research activities, medical devices and other technologies that are suited to the South African context; and (*ii*) educating biomedical engineers who can contribute to such development. How can the programme address these challenges?

First, it must create awareness in the clinical community of biomedical engineering as a resource. Second, it must expose biomedical engineering students and researchers to real-world situations, in which they can learn to understand local healthcare needs as well as the context in which technological solutions will be implemented. Mutual appreciation between engineers and clinicians can be achieved by providing biomedical engineering students with opportunities to visit and undertake internships in clinical facilities.

But the development of devices that meet clinical needs is not sufficient to ensure implementation. Students must also understand the industry that will manufacture and distribute devices, and be aware of drivers and constraints in the business environment. Linked to understanding of the business environment is knowledge of the regulatory framework that governs the approval of medical devices and the practices surrounding the protection of intellectual property. Internships should therefore also be available in the medical device industry.

Tania Douglas is Associate Professor of Biomedical Engineering, University of Cape Town and Director of the MRC/UCT Medical Imaging Research Unit.

Corresponding author: *T S Douglas (tania@ieee.org)*

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