Chapter 2

The Case for Biomedical Engineers in African Hospitals: A Clinician's Point of View

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Introduction

This chapter explores the roles that could be played by a biomedical engineer to enhance patient care in the African context through medical device innovation. The need for strengthening cooperation between clinicians and biomedical engineers is emphasised, and some common opportunities that create a platform for building this cooperation are demonstrated. The term "clinician" is used to represent a range of health workers, such as doctors, clinical officers, nurses, and therapists.

Needs and opportunities

The largest needs-based shortages of health workers are in South-East Asia and Africa, with the global shortage projected to be over 14 million health workers in 2030 (WHO, 2016). This human resource constraint within African health systems is further compounded by limited availability of medical equipment. Limited health financing in African countries is the main driver of these constraints, and is a serious obstacle to improving health outcomes on the continent.

In addition, the World Health Organization estimates that more than 50% of medical and related equipment in developing countries are defective (WHO, 2011). This is typically because health facilities are unable to perform adequate maintenance and repairs. The consequences of broken or defective medical equipment include: delays in diagnosis and treatment, over or under-treatment, long-term risks to health, high out of pocket healthcare costs, long hospital stays and, the worst of all, loss of life. The proportion of this unusable equipment is even higher in countries where biomedical engineering has not been fully integrated into the health sector. There is a major problem of inadequate maintenance capability and lack of appropriate human resources to design, develop, and manage medical equipment in less developed countries.

Such a landscape not only creates a challenge in ensuring adequate patient management, but also creates an environment where improvising and innovation becomes part of daily patient care practice. Not only is the training to enable such innovation not included in curricula for healthcare workers, but also the effectiveness of improvised biomedical materials and equipment is rarely evaluated and generally not known. The risks of unevaluated and inappropriate improvisation are high, as they cause harm to patients. Appropriately trained biomedical engineers have the potential

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to fill the equipment gaps that exist in African hospitals by transforming the needs of the clinician into practical solutions that meet prevailing standards and requirements.

Potential contributions of biomedical engineers

Could the impoverished health service delivery landscape in Africa offer an opportunity for building a stronger link between clinicians and biomedical engineers for addressing medical equipment needs? Would clinicians embrace this interdependence? The scenarios that follow explore the potential of biomedical engineers to enhance day-to-day patient care in hospitals in Africa. While clinicians are trained in patient care and in using medical equipment, biomedical engineers are trained in maintenance, design and development of such equipment. Biomedical engineers use the principles of both engineering and life sciences in a wide range of applications, for example to design devices and software, to integrate knowledge from many technical sources to develop new procedures, products and methods, or to apply technological research to clinical problems. In the hospital setting, biomedical engineers have a role to play in identifying challenges related to patient care, in innovating and developing customised devices and processes, and evaluating these new devices or processes.

The following are hypothetical situations to illustrate the roles that biomedical engineers may play in enhancing patient care and clinical service in resource limited settings, particularly with a view to addressing the problem of inadequate medical equipment.

Scenario 1: In a certain hospital, the paediatric ward has a neonatal care unit with maximum capacity of 10 beds. This unit only has two oxygen cylinders that can be used on two neonates only at any particular time. On a certain day, four preterm babies with life-threatening conditions requiring pure oxygen are brought to the neonatal unit. Referral is not possible since the next hospital with such facilities is at a distance of 140 km. The clinical records show an increasing rate of neonatal mortality at this unit. An engineering solution that would enable limited available oxygen cylinders to accommodate more infants might be a lifesaving solution.

Scenario 2: An orthopaedic surgeon working in a rural African hospital is frustrated by the poor outcomes of her fracture management procedures. She blames it on the lack of suitable equipment for rehabilitation. Patients are discharged with hardly any equipment to support their early mobility. As a result, bone deformities and contractures are common. Access to a biomedical engineer able to design and build low-cost rehabilitation devices would improve patient outcomes.

Scenario 3: An orthopaedic surgeon at a certain hospital has had much success in managing limb fractures. However, due to the high cost of orthopaedic implants, some of his patients who would otherwise be candidates for implants, are managed using external fixation and require extended limb traction. This results in longer hospital stays due to complications like pressure sores. The design and manufacture of customised mattresses and other devices to reduce the risk of pressure

sores would be of great benefit to patients, would liberate hospital beds by reducing length of hospital stay, and consequently would reduce costs of care.

Scenario 4: The maternity ward of a hospital in a densely populated urban area records about 20–30 deliveries per day, of which 2–5 new-borns are preterm and in need of incubation. The neonatal ward has a premature unit with only one incubator that was donated following a research project conducted in previous years. Neonatal mortality is increasing, with many preterm babies dying of hypothermia due to the shortage of incubators. The purchase of imported incubators has not been prioritised due to the prohibitive cost. Low cost, locally designed and manufactured incubators are likely to reduce neonatal mortality.

The above scenarios demonstrate not only the need for biomedical engineers to address the shortage and high cost of imported medical devices, but also the need for them to work closely with clinicians to assess clinical needs and design context-appropriate devices in response. The scenarios also illustrate the need for scalable devices that can be manufactured in Africa to meet local needs.

Some initial steps to integrate clinical practice with biomedical engineering practice are outlined below.

- Having both groups of personnel agree on the unified goal of establishing good patient outcomes.
- Fostering mutual understanding and respect for the unique roles and skills each group brings in working towards achieving the common goal.
- Ensuring good communication in problem solving activities related to patient care.
- Raising awareness with hospital management and health system administrators of the benefits of clinician–biomedical engineer cooperation in order to garner their support.

Conclusion

If I, as a medical doctor, had been asked six years ago about the role of biomedical engineers in the hospital, my immediate answer would have been: repairing broken beds. This was before I had the opportunity of working with biomedical engineers. Even in the present time, there are many clinicians and policy makers in Africa whose perception of the role of biomedical engineers in hospitals may not be different to mine six years ago. This has hampered the integration of biomedical engineers into the healthcare systems in African countries, causing them to escape into private business, industry and general engineering. It is time for biomedical engineers to be recognized as critical in addressing Africa's healthcare deficits.

References

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