Chapter 7

Problem Identification and Needs Assessment for Healthcare Technologies

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Introduction

Appropriate healthcare technologies are important tools to improve health and are broadly defined as "methods, procedures, techniques and equipment that are scientifically valid, adapted to local needs and acceptable to those who use them and to those for whom they are used" (WHO, 2004). Several characteristics are vital to the success of healthcare technologies, particularly in resource-limited settings. They must be accurate, effective, safe and affordable (Ren et al., 2015). Studies on health technology in low resource settings have emphasised the challenges impeding access including capacity constraints resulting from lack of physical, financial and human resources (Chandrasekhar & Ghosh, 2001; Malkin, 2007; Clifford et al., 2008). Understanding previous internal and external barriers to development and implementation of health technologies is extremely important for resource-limited settings as we advance scientific progress in this area.

A key skill that requires training and practice is the ability to identify a biomedical problem and perform a diligent and multi-disciplinary local needs assessment for that problem (Sinha & Barry 2011). Understanding user needs is critical, as complex health technologies are often impractical and unusable in resource-limited countries. Thus, there is a mismatch between problems and identified and procured technologies. Proper identification of the problem and needs assessment can also be helpful to minimize wasteful and inappropriate use of precious local resources (WHO, 2001).

There is consensus on the importance of problem identification and needs assessment for healthcare technologies, but what is less clear, is the process. There is no 'one size fits all' approach for health technology needs assessment; as argued by the World Health Organisation (WHO, 2011), needs must be assessed according to different scenarios and under varying circumstances for specific communities. The World Health Organisation has proposed initiatives towards a scheme for needs assessment to increase access to appropriate and well-developed healthcare technologies.

Problem identification

The first step in developing healthcare technology is to identify a clear biomedical problem with a potential engineering solution and creating a clear statement of the problem that the

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intended technology will address. This problem statement must be accessible and easy for even a novice to understand and must clarify the objective of the engineering design task.

A first step in identifying a biomedical problem is what is referred to in a biomedical engineering design course at the University of Lagos as "disease hunting." This entails identifying a medical condition requiring diagnosis, therapeutic management or disease monitoring, as well as its presentation or symptoms. Problem identification often requires consultation with physicians or public health officials aiming to improve individual or population health. Multidisciplinary brainstorming meetings between healthcare providers, clinical laboratory leaders, and engineers can be helpful to identify biomedical problems with potential local technology solutions. Often, ideas are generated based on personal experience or interest. A review of the literature can aid in refining the problem to be addressed.

An example from the biomedical engineering programme at the University of Lagos, was an engineering graduate student who had experienced football injuries. Cryotherapy emerged from the student's literature review as a treatment for pain (MacAuley, 2001; Hubbard & Denegar, 2004; Mars et al., 2006), and timing of application of this therapy was key to success. After identification of this general problem, the student consulted with local family medicine and orthopaedic doctors who recognised a lack of immediate (on-field) treatment options for football soft tissue injuries. Having established cryotherapy as a possible solution, other considerations suggested by medical experts were device wearability and portability, maintenance of a pre-set steady temperature, and capacity to be monitored remotely by a third-party device in real time. Finally, the student determined a specific problem to be solved: immediate cryotherapy for treatment of soft tissue injuries on the field. The student aimed to answer the following engineering question – can we locally design a novel technology that immediately utilizes cryotherapy to treat soft tissue injury in an athlete? In response to the requirements identified, a simple low-cost device, namely an electronic ice cuff, was developed (Ajibola & Folorunso, 2017).

The biomedical problem is relative to the local environment and must be conceptualised in conformity with local resources, biomedical ethics, socio-cultural factors, and ergonomic and other situational parameters. Ultimately, a well-considered, well-researched and challenging biomedical problem will have compelling engineering design questions that will demand to be answered.

Approaches to needs assessment

Once the biomedical problem has been identified, a proper needs assessment should be performed. A well-executed needs assessment for a healthcare technology involves the identification and definition of prioritised requirements as well as considerations of potential impacts on users, with the aim of improving health or health service delivery (Wright, Williams, & Wilkinson, 1998; WHO, 2011). In the context of health technology design, an excellent needs assessment enhances biomedical problem identification and guides design choices to solve the problem and answer engineering design questions.

In general, when conducting a needs assessment, it is imperative to consider unique diagnostic, treatment, and preventative approaches in the context of the problem and its solutions (Söderback, 2015; Saidi & Douglas, 2018). Health technology must fit local circumstances and conditions in the light of available national resources, infrastructure, knowledge and skills. Thus, a location-specific needs assessment is vital to ensure that appropriate technologies are effective, appropriate, cost-effective and do not consume resources from other critical healthcare areas (Sinha & Barry, 2011; van Niekerk et al., 2017).

An understanding of technology and its implementation as being socially shaped and influenced by values, beliefs and culture, demands that the gap between science and society be bridged to enable technology to be configured for different contexts (Saidi & Douglas, 2018). The extent to which a health technology can successfully be deployed in society, depends on the extent to which it is integrated into the healthcare community, in a manner that informs its design (Webster, 2002) and draws on the different knowledge systems of health technology stakeholders (Sorensen & Iedema, 2008). The relevance of health technology can be improved by extending the boundaries of the knowledge systems that feed into their development beyond clinicians and managers. The nature of healthcare technology requires a network consisting of a wide variety of stakeholders in society, such as regulatory agencies, patient advocacy groups, bioethics committees and physicians. These groups can, if given the opportunity, scrutinise healthcare technology from varying perspectives before it is deployed for use, and ideally during the design phase. Early engagement of these groups is crucial as technological development in healthcare is rapidly evolving as a collective, multi-professional and multi-disciplinary process which challenges the entrenched traditional, individualist, 'taken-as-given' culture (Sorensen & Iedema, 2008). Patients, caregivers and others with relevant lived experiences can offer valuable insights that help characterize the challenges and assess the healthcare needs these technologies should address.

Figure 1 suggests an iterative approach to problem refinement and needs assessment, as these steps are not clearly separable in practice.

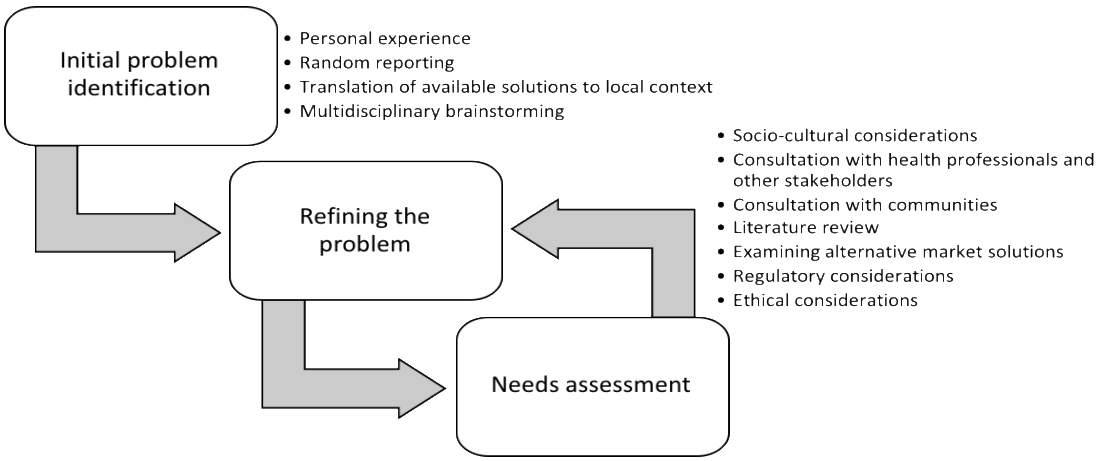

Figure 1: Problem identification and needs assessment

Implications for biomedical engineers

Efforts must be made to ensure that biomedical engineering research, design and practice does not neglect the needs of vulnerable groups. Examples include children, pregnant women and the elderly who have particular medical requirements. Consideration should also be given to persons with disabilities. For example, for individuals with visual and hearing impairments, conventional means of communication may be a critical barrier when stakeholder views are solicited to inform design decisions. In addition, the healthcare needs of those who have poor access to health facilities due to geographical location, limited financial resources and other forms of marginalisation are pertinent in the African context. Therefore, biomedical engineers should communicate and engage with society and health-related stakeholders to determine engineering design problems, questions and needs. In practice, a biomedical engineer should understand the actual need for the product and the potential implications of the new product as well as its suitability for the user with regard to their level of education, gender, cultural preferences, religious sentiments, ethnic peculiarities, and interests.

Conclusion

Problem identification and needs assessment are important for ensuring that users are able to access healthcare technologies that meet the realities of their local circumstances. These considerations are aimed at closing the design-implementation gap that emerges when healthcare technologies are designed and built to satisfy assumed demands or needs that may not exist. Engineers can accomplish these goals through public engagement, incorporation of different knowledge systems, situating technology in their social context, and customisation. Problem identification and needs assessment are pro-active steps in the development of technology that is inherently responsive to the specific needs of local users and stakeholders.

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