Enabling Access to Medical and Health Education in Rwanda Using Mobile Technology – Preliminary Results

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ABSTRACT
Lack of access to health and medical education for doctors in the developing world is a serious global health problem. In Rwanda, with a population of 11 million, there is only one medical school. Shortages in properly trained medical staff, involvement of private sector, and computer and mobile technologies for continuous medical education are major factors in poor healthcare quality. Developing a mobile computing for medical and health education programs has potential to bring continuous medical education to doctors in rural and urban areas of Rwanda. However to appropriately reach this goal, a user-centered development approach is needed to ensure any mobile medical education developments are relevant and useful. This paper describes preliminary findings from the baseline study that aimed at determining the nature, content and format for development of a mobile medical education application that is usable in the Rwandan circumstances.

Categories and Subject Descriptors
K.3.1 Computer Uses in Education

General Terms
Design, Human Factors

Keywords
User-centered design, application, medical education, Rwanda.

1. INTRODUCTION
Since some time ago, there has been interest in many countries in improving the health system through Continuing Professional Development (CPD), Continuous Medical Education (CME) and web based education system for medical professionals and patients; one of the efficient ways that have been used in other countries, however, currently not used in Rwanda, is a web-based system. The Internet and worldwide web have expanded opportunities for the provision of a flexible, convenient and interactive form of CME. Larger numbers of doctors are accessing and using the Internet to locate medical education information and knowledge. It has been suggested that a significant proportion of this usage is directly related to questions that arise from patient care.

A variety of Internet technologies are being used to provide both asynchronous and synchronous forms of web-based CME[5][3]. Various models for designing and facilitating web-based CME learning have also been reported [4], medical records management[14], furthering education and guiding diagnosis basing on clinical symptoms. The role of the Internet as a source of information for healthcare professionals is very significant whether accessed on computers, tablets or phones. One factor that has contributed to this growth is the increasing and complex information needs of doctors. The tremendous growth in medical knowledge through research is a challenge for the majority of healthcare professionals, who are expected to maintain their knowledge on the most recent advances in medicine. It has been estimated that 1.4 questions per patient arise on a daily basis in inpatient settings, while 1 question is generated for every 15 patients seen in primary care practice[1]. A study of general internists found that seeing patients in an office setting generated 12 patient management questions per day[12]. The main challenge for most doctors involves accessing and locating the right information at the right time to satisfy the questions that arise from their practice[2].

Rwanda has taken significant steps toward not only providing comprehensive medical care for every citizen but also improving the quality of healthcare care provided. Examples of the latter include a revision of the medical school curriculum, initiation of post-graduate specialty training in the major medical specialities, and providing the legal mandate for physician licensing and specialty certification to the Rwanda Medical Council. Since 1995, some continuing medical education has been available through the annual
conferences of the Faculty of Medicine of the National University of Rwanda and the Rwanda Medical Association, together with occasional conferences sponsored by professional medical associations. However, many physicians have not been able to participate in these conferences, and there have not been any structured and ongoing educational activities based on identified needs of Rwandan physicians. Given the rapid pace of new research and developments in all areas of medical care, physicians, nurses and other health professionals must continue to update their knowledge and skills on a regular basis to keep up with the benefits of medical innovations and research findings as well as applying evidence based medicine (EBM). In order to enhance its preparedness to identify and respond to outbreaks and prevent epidemics, the Government of Rwanda has developed and deployed an electronic Integrated Disease Surveillance and Response (eIDSR), building on the already Rwanda’s existing national phone and web-based HIV-reporting system, “TRACnet” that has been operating nationwide since 2004 and it was proven to improve timeliness and completeness of reporting and extremely supports early detection and notification of outbreaks for timely response[9].

Since the revolution of ICT with the emergence of the Internet as a global connectivity tool, the emergence of the World Wide Web (WWW) as a virtual domain where individuals can post digital content for public access, and the spread of commercial web browsers that can retrieve documents or pages stored in websites[8], information technology has provided medical students and professionals with easier and more effective access to a wider variety and greater quantity of information. However, not only the availability of local resources but also computing skill levels has impeded the use or adoption of ICT and computer based tools. Worldwide but less in Rwanda, medical educators now use technology more than ever to deliver learning resources, hence increased publications and conference presentations related to educational technology[8]. With the increase of computer literacy and medical knowledge available on internet in our communities, health care experts and physicians must be well prepared to cope with changing patient behaviors and knowledge[8].

2. CONTEXT
Rwanda is facing a problem of insufficient medical education institutions, Information and communication technology (ICT) based tools and training. There is only one medical school with insufficient qualified medical educators. The doctor/population ratio was 1/15428, in 2012 with an annual population growth of 2.9%[10]. In addition to the geographical distribution of healthcare facilities and insufficient resources for continuous medical education, the mentioned above factor play a big role in poor quality of healthcare. There is great need in continuing professional development by which health professionals are kept updated to meet the needs of patients, the health care service, and their own professional development.

We believe that this can only be achieved as result of efficient interactive technology based continuous medical education and access to needed information and updates. However, in order to develop the tools that will serve the most, it is important to determine the nature, characteristics and content of the web based tool in continuous acquisition of new knowledge, skills, and attitudes for graduated and future healthcare professional[11]. In this regard this study is being undertaken, and at the end we will have as end product, a well functioning technology based user centered-tools allowing continuous medical education in Rwanda. A team of professionals and students from the University of Rwanda and the Rochester Institute of Technology (RIT) is conducting this interventional study.

3. METHODS AND MATERIALS

3.1 User-centered development process
The user-centered development process of the application will consist of the following phases: 1) Baseline analysis of the users and their context, 2) A needs assessment to identify the requirements of the users, 3) Development of the prototype and 4) testing the prototype with some users, 5) Redesigning according to the testing experience and feedback and 6) Evaluation of the usability and accessibility of the application in-lab. (Figure1). A key principle of user-centered design is that the process should be iterative[7]. This is the case in the development process because the different phases, often referred to as iterations, are to be repeated until the desired results are obtained. Each phase delivers the inputs for the next phase and at the end of each phase the research team will check whether the results are compatible with those of the previous phase. Other key principles of user-centered design, such as active user involvement and working in multidisciplinary teams are to be followed as well throughout the development process to ensure that the application would fit the preferences and requirements of the potential users.

Phase 1: Baseline analysis of the users and their context
With a total of 591 doctors working in district hospitals in Rwanda, 46 doctors work in conditions with easily accessible online tools for medical education. With confidence interval of 95%, the baseline sample was calculated to be 94 doctors.

Phase 2: A needs assessment to identify the requirements of the users: A literature search was conducted regarding currently available tools for medical education in Rwanda. In addition to that interviews with doctors were conducted.

Phase 3: Development of the prototype: First prototype of the application will be developed by technical engineers of RIT based on the user requirements formulated in phase 2.

Phase 4: Testing the prototype with some users: Doctors in Rwanda who are part of the research team will try the application and give feedback.

Phase 5: Redesigning according to the testing experience and feedback: Second prototype will be developed based on the new and unmet requirements that were identified.

Phase 6: Evaluation of the usability and accessibility of the application in-lab: Heuristic evaluation of second prototype by non-users, mainly healthcare developmental partners.

Figure 1: User centered development process
3.2 Phase 1: Baseline analysis of the users and their context

With the main aim of developing mobile computing for medical and health education programs, our research team conducted a baseline survey of our targeted end-users.

It was crucial to understand the group of users who are the center of the application to be developed and identify various technical and skill issue that might potentially need to be accounted for in the design of a mobile medical education tool. In this regard, responders were asked to provide their age, years of practice as Medical Doctor and their gender. Responders were also asked about the hospitals in which they worked, the availability of Internet in those hospitals, their use of email address and frequency of Internet use specifically for medical or clinical purposes. The research team also explored the use of social media (Facebook, Twitter, Youtube) and relatively the use of these channels for clinical purposes, frequency and available platforms. Part of the focus were also to determine mostly used websites, on and offline resources that are used throughout the country, and this information is important not only to determine the divergence in practices but also define opportunities to develop a synchronized system that will guarantee common best practices throughout the whole country. Libraries are important to know about and our team made an effort to explore current hard copy sources such as medical books that are used throughout the country and their years of edition were recorded. Additionally, access to these resources was an important factor to be looked at. Medicine is a very dynamic field and it is important to keep track of years of edition of books used. Responders were asked to rate their satisfaction in matter of accessing computers and hard copy documents (books and journals) for medical resources. Considering the current advancement of ICT, computers are playing a big role in doctors and patients education. Hence, it was important that the research team also explores the availability of computers in computer labs throughout different hospitals.

This project has as end goal to develop software that will contribute in reducing the mortality rate in hospitals, through promoting evidence based healthcare practices and patient-centered care. Hence, it was imperative to know the baseline mortality rates in different hospitals. It was also important to know the total number of annual hospital consultations in different hospitals, hence being able to estimate the total number of people who may benefit from better informed healthcare practices and the technology under development in general. The team explored different tools that Doctors use for quick check up of medical information in consultation or daily ward rounds. Doctors were also asked to rate access to online updated medical resources and quick checks when needed. Furthermore, the team explored the current average length (days) of inpatients stay in different hospitals and it was hypothesized that with better information and easy access the length of stay may reduce.

3.3 Preliminary baseline survey findings

A total of 581 medical doctors work in different districts throughout the country. The majority of them are young with age that varies between 20-30 years of age. All of doctors who have filled the online form reported daily Internet use. They all use email but not all of them use social media, though the majority does. Youtube is the most popular followed by Facebook then Twitter. The tools used to access Internet vary a lot but laptops and smartphones are mostly used and tablets are the least used (Figure 2). Almost all hospitals do not have libraries and the most widely used information resources are the Ministry of Health (MOH) clinical guidelines books. However many survey respondents indicated they are not satisfied with these resources. Accessibility to computers is also a big challenge considering that the majority of hospitals do not have computer labs. However, most doctors think that smartphones are good tools for quick information checks for evidence-based practice.

![Figure 2: Devices used for medical information help.](image)

3.4 Need for Locally Produced Content

Usability cannot be achieved without a user-centered process. It was vital for the research team to determine currently available tools, gaps and opportunities for improvement. The team found that the main available online tools are Medscape, up-to-date and Wikipedia (Figure 3), however these three applications do not avail the above-mentioned MOH clinical guidelines. Most of responders were unsatisfied with the availability of Internet on computers in their respective hospitals. Hence, availing resources on phones or tablets would be ideal for health care professionals. Information about mortality ratio in respective hospital was not found but the number of patients per doctor was found to be between 25-40 patients per day.

![Figure 3: Online resources used for medical purposes.](image)

4. DISCUSSION

Despite great efforts by the government of Rwanda in availing computers and Internet in different hospitals, the need is still far
from being satisfactorily addressed. However, smartphones are widely used and there are some good tools accessible. Numerous apps are now available to assist healthcare providers with many important tasks, such as: information and time management; health record maintenance and access; communications and consulting; reference and information gathering; patient management and monitoring; clinical decision-making; and medical education and training[13]. There is a great opportunity of advancing technology in the medical field in Rwanda, considering that the majority of Rwandan doctors are mainly young, the willing of the government to invest in technology and the end users need of tools that may ease their access to the MOH guidelines and updated medical resources. The number of specialized doctors is far less to cover the need, and one option to offer support especially to doctors in remote areas would be through technology based tools, that may be able to overcome the challenge of Internet that those doctors also face. Mobile technology-based diagnosis and management have been found most relevant to health care providers in developing countries where mobile phones potentially allow clinical support and evidence-based guidance to be delivered to health care professionals working remotely and in circumstances where senior health care professional support or other infrastructure is lacking[6].

5. CONCLUSION
In Rwanda, health care providers use mobile devices to access a variety of tools. However, none of the resources avail local resources such the MOH clinical treatment guidelines. A use-centered design approach is needed in the development of our planned mobile medical education application and will allow us to develop a usable first national mobile medical education platform for Rwanda. Considering the number of patients that doctors see in Rwanda, our application will provide many benefits such as making more rapid decisions with a lower error rate, increasing the quality of data management and accessibility, and improving practice efficiency and knowledge, especially in areas where access to internet by computer is compromised. Reforming medical education and practice from a traditional lecture/discussion system to a more learner centered and evidence based type of education has many benefits. For example, enhanced creativity changes in the way physicians interact, learn and practice. Our interface will address different aspects and will offer services that emerged from our survey with Rwandan doctors, such Communications and Consulting, Reference and Information Gathering, Reference and Information Gathering, Medical E education and Training. The results of this survey will inform the development of the application and experiences from this work will be shared in order to encourage private and governmental investment in medical related Information and Communication Technology.

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7. REFERENCES AND CITATIONS