

Design of Mobile Application for Community Health Workers: A Case Study in Rwanda

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Gahizi Emmanuel, Andi W.R. Emanuel ^(✉), Djoko Budiyanto Setyohadi
Universitas Atma Jaya Yogyakarta, Yogyakarta, Indonesia
andi.emmanuel@uajy.ac.id

Abstract—Community health workers (CHWs) are the basis of public health services that aim to connect the gap between public health and the human service system. This gap can be bridged entirely by navigating the health aspects of human service systems and educating communities on disease prevention. Unfortunately, the way of sharing, accessing information, and delivering health services is still non-digitalized in Rwanda. Community Health workers use a manual system in their daily activities, which is prone to error and falsification. Moreover, these people selected to perform these activities often do not have adequate knowledge about diseases and health systems since they are not professional health workers. To address the above problem, we designed a prototype mobile application to enable these workers to automatically submit reports, transfer knowledge, share information, and receive training from professionals. The design process followed a User-Centered Design approach to meet the users' requirements. The evaluation of the design showed that 91.7% of the CHWs agreed with the designed application prototype. This finding indicates that CHWs has an interest in using the mobile application in their work. Using the mobile application will help CHWs to improve data collection, the reporting process, and ease of receiving training.

Keywords—Health Systems, mobile application, community health workers, User-Centered Design.

1 Introduction

Over the last decade, mobile applications based on Community Health Workers (CHWs) activities have played a significant role in communities to promote community health. About 95% of the aggregate masses right now are presently connected with a flexible mobile network[1]. The number of mobile users is expected to pass 4.8 billion, with over 67 percent mobile phone penetration in 2019. As a consequence, Mobile Health is encountering a developmental incline as clients request a great deal of access to their medicinal wellbeing experts. A good percentage of aid customers believe that mobile application services can reduce a person's own health care costs [2][3].

Rwanda's CHWs are still facing difficulties in their daily health works. They collect data and make reports by filling hard copies given to them by health professionals. This

method is not trustworthy as it is prone to mistakes, and sometimes the hard copies can get lost or get damaged. Workers also encounter high expenses by making phone calls since there is no easy way of accessing and sharing information. Above all, they don't have an automated system to be used by health professionals such as data managers, supervisors, and doctors. To overcome all the above challenges, we designed a mobile application using the User-Centered Design method to address the above problems. This application is expected to be effective communication media between health care professionals and community health workers. The application is designed based on five stages, namely; identifying user needs, specifying the context of use, specifying requirements, producing design solutions, and evaluating design. Hopefully, sharing and reporting of information for Rwanda CHWs will have a new automated method that suits several difficulties and will make increased confidentiality.

2 Literature Review

2.1 Mobile users detail illustration in Rwanda

Rwanda, located in the East of Africa, is predicted to adopt a 4G network and drop the use of 2G by the year 2023. The use of 4G will rise to 23% of connections by 2025[4]. Rwanda has a mobile penetration of 29.8% of the population, according to Rwanda Utilities Regulation Administrative (RURA) [5]. This amplified accessibility of mobile devices that has an intersection rectifier to the occasion of the circle of versatile wellbeing (mHealth).

2.2 Community health workers

In Rwanda, the CHW program was started in 1995 after the 1994's Tusti Genocide to strengthen the coordination of community health services since the number of professional medical workers was not enough. CHWs play the role of reporting problems caused by the difficulty of accessing the base health care[6]. In Low Middle-Income Countries (LMICs), CHWs help in family-based prenatal and postpartum care directions [7]. WHO estimates that there are a lack of 7.2 million Healthcare laborers, and this crisis will reach 12.9 million by 2035[8]. General CHWs are grouped into several categories, such as community health professionals, volunteer medical examiners, community health educators, and Frontline Health Workers (FHWs) [9].

According to global health, CHWs play an enormous role in the standard of living in middle-income countries[10]. They measure the key to accomplishing the development of the health's Sustainable Development Goals by enrolling essential health services toward Universal Health Coverage (UHC) [11].

2.3 Solutions to challenges faced by CHWS

The challenges faced by CHWs can be handled by putting into consideration the use of technologies, financial support, and strong organizational structure. The CHWs programs should include training for supervisors and other health staff to ensure appropriate support. The support must concentrate mainly on the projects that utilize innovative help [12]. The health system should not keep behind since new versatile data innovations increasingly being produced, tried, and steered with CHWs. The utilization of automation by CHWs can enhance medicinal service administrations with instinctive attraction [13].

2.4 The advantage of using the mobile health system

mHealth is defined as medical service delivery with the help of mobile phones and other associated remote gadgets. mHealth empowers CHWs to give wellbeing administrations a long way from the clinical setting and has many frames like operator interaction and feedback [14]. The use of mobile technology makes a trusted method of data gathering by using a mobile phone to send data and receive check out a request by CHWs [15]. The mobile phone is chosen because it improves outcomes for CHWs in their daily activities. It also enhances the value of responsibility, provides coherence and capacity of program monitoring[16]. The studies incorporated in this research allow the accumulation of patient information, encourages leaders to make decisions towards patient status according to their data and also preparing for a future crisis by giving alerts and updates[17].

2.5 Related research

We have respectively returned to the initial existing research for application and collection of data, resulting in good research results. It was necessary to know what is found in other studies on the same field on the use of mobile technologies. Both theoretical and technical methods were reviewed to contributed to this study. Therefore, in Table 1, concerning the study, their goals are listed as follows:

Table 1. Research and objectives related to this research

Research	The aim of the study
Orawit <i>et al.</i> [18]	To develop a pharmacy assistant mobile application for primary medication
Ferreira <i>et al.</i> [19]	To collect data and to help CHWs to achieve their goal
Angula.N <i>et al.</i> [20]	To examine how information relating to healthcare can be distributed and accessed through mobile technologies
Orawit <i>et al.</i> [21]	To support users in the initial medication
Stathopoulou, A. <i>et al.</i> [22]	To assess the use of the mobile application for health services
Dahri <i>et al.</i> [23]	To Investigate the usability of evaluation of the Mobile Health application by patients' task performance evaluation and satisfaction.

The mobile application has excellent advantages for data collection in different fields of activities. As shown in Table 1, the use of mobile applications motivates CHWs in their daily activities. Mobile application usability has useful features that users can learn and use [23]. Furthermore, Stathopoulos *et al.* state that mobile devices are the best technology for accessing knowledge as they are quite attainable and accessible to use mainly by those who have learning difficulties[22]. This research aims at designing a mobile application that will help to collect, report, share, and access information related to health care service delivery for Rwandan society. After reviewing the related research presented in table 1, we get more insight into what should be considered for designing the application.

3 Research Methodology

3.1 Data collection methods

In this research, we used data from secondary sources such as related research done related to CHWs and Mobile application design, WHO report, and Rwanda Ministry of Health (MoH) report. Primary data sources are gathered using questionnaires in Google form. The primary data also included socio-demographic information such as age, sex, education level. The survey composed of 20 items, and assessed the reliability and validity based on the five-point Likert scale from Strong disagree=1, Disagree=2, Less agree =3, Agree=4, and Strong agree=5. Details regarding the question were articulated adequately to the respondents before filling the questionnaire.

3.2 Participant and sample size of the study

The participants of the study were 210 participants with a population size of 137 participants are CHWs from Ngarama hospital. Ngarama Health center was chosen because it is covering both urban and City regions. In determining the sample size, a table for determining the number of samples from a particular population was developed from Isaak and Michael [24], for an error rate of 5% so that it can obtain 95% confidence.

4 Data Analysis and Application Design and Analysis

The Cronbach's alpha, Pearson Correlation (r.p.n) was used to analyze various characteristics of the sample population, such as gender, age, education level. The results of the questionnaire were used to test the reliability and validity of mobile application design. In the design of a mobile application for CHWs, Adobe XD desktop application, Adobe creative cloud, and adobe XD Mobile application because they are open-source software, and make it easy to test the designed prototype over the android mobile phone.

4.1 Application design

The application prototype has several icons; each icon represents the task to be completed by both stakeholders of the application stated above.

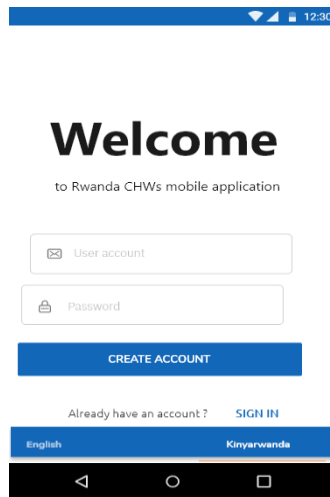


Fig. 1. Login page

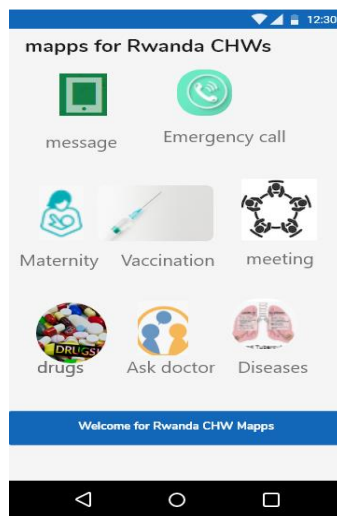


Fig. 2. Home page

Figure 1 and figure 2 are the main pages of an application prototype. Figure 1 enables the accessibility of the application, and it allows the user to login. As in Figure 1, the form checks if the user valid and password, then he /she will proceed to the home page. Figure 2 is the main page of an application. Where it has sub icon such as message

which allow information sharing through text, maternity, vaccination, drugs, meeting, diseases, emergency call and ask the doctor. The CHWs will be able to interact with both the presented icon within the application in their daily activities. They will be able to collect and report maternity, vaccination, diseases, and meeting information; furthermore, they will be able to consult the doctor for advanced help when it is an emergency.

4.2 Reliability and validity test

Based on the results of the reliability test has the Cronbach's alpha results of 0.963, which exceeded the standard limit of 0.7, so the questionnaires are reliable[26]. The question is declared valid because the total value of each item exceeds the standard value. Test results show all question scores are higher than 0.3610. The questions are declared valid because the total value of each question exceeds the standard value. Moreover, test results show all question scores are higher than 0.7.

4.3 Evaluation of the results

After collecting and analyzing data, we found that the mobile application for CHWs has the potential effect for both CHWs and Health system Mangers in Rwanda. As the result shows, we assure that if the government put into consideration, the mobile application for CHWs will bring many benefits for health care services.

The social demographics data shows that the number of women is higher compared with men; also, there is a higher number of participants with age over 36 years old, which is 79%. The educational background shows that 74.5% of CHWs only have a primary level of education.

The overall results from questionnaire for 4 and 5 categories was 91.7%. It shows that the CHWs understand and agree with the design of the mobile application.

5 Discussion, Limitation, and Conclusion

5.1 Discussion

The part of the result evaluation tended to evaluate the problems faced by Rwanda Community Health workers caused by using the non-digitalized system for sharing, accessing, and delivering health services. Therefore, the difficulties faced by CHWs can be overcome by taking into account the use of technology, financial support, and strong organizational structure. The program of CHWs must involve training for coordinators and other health staff to provide adequate support to promote health services.

The present study has also found out that most of the developing countries, including Rwanda, still use paper-based methods in collecting and reporting health data. Rwanda's two existing systems, namely Siscom and Rwanda Integrated Health management Information System are used only by the high-level health staff (Data managers, District, Health Officer) who are policymakers and decision-makers.

Based on data collected, we have seen that the majority of Rwanda CHWs are female presented by 78.1% while the rest are male. This result shows that the female is engaged more than male, even though the Rwandan government promotes the balance of gender. These gaps exist because men buffer the stress caused by economic responsibilities, family, and personal problems. The results show that Rwandan youths are not participating in community health services as the estimated percentage of 79% of CHWs presents the people aged above 36 years old. This condition is because of educational reasons since the Rwandan government calls its youth to attend the school first. The balance between each division admits that the CHWs program still has challenges to be solved. There are different types of health data collected, such as sick child care, supervision, and participation of maternal health, and disease follow-up information to improve health services in Rwanda.

5.2 Limitation of the proposed design

The application design prototype was tested on Android-based mobile phones, and the current prototype has been verified to work on Google Cloud only.

6 Conclusion

A prototype of the mobile application for Rwandan Communities Health workers has been designed to enable CHWs to submit reports automatically, transfer knowledge, share information, and receive training from professionals. The challenging features and functionalities of the prototype application were designed, evaluated, and tested on Android phones using adobe XD cloud. As a result, 91% of the respondents agreed with the developed prototype. The results show users' acceptance level and their attitude of desiring the application to continue to the next phase of implementation. The mobile application designed will create durable, imperishable answers for tending to the Rwandan CHWs' healthcare needs.

Future studies in this research area could attempt to design a mobile application that uses the data from the primary sources (CHWs). The next focus could be on policy-makers to enhance health data visualization, improve the analysis process by adding an interface page, explore ways to prevent the fragmentation of information, and enhance ICT's privacy and security of health data.

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8 Authors

Gahizi Emmanuel is currently pursuing a Master's of Informatics at University Atma Jaya Yogyakarta. His research interest is a mobile application, mobile computing and IoT. Email: thegammy2008@gmail.com

Andi W.R. Emanuel is a Full-time Lecturer at Universitas Atma Jaya Yogyakarta. His research interests in Software Engineering, Open Source Software, Open Source Communities, Software Metrics, and Software Quality. Email: andi.emmanuel@uajy.ac.id

Djoko Budiyanto Setyohadi is a Professor in Informatics at Universitas Atma Jaya Yogyakarta. His research interests are Data Engineering, Information system management, and Human-computer interaction. Email: djoko.budiyanto@uajy.ac.id

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