A Mobile App for Illiterate and Semi-illiterate Pregnant Women- A User Centered Approach

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Abstract. Mobile technology is utilized in health care to improve service delivery, but researchers and developers have mainly focused on developing applications that are usable by people who can read and write. While it is relatively easy for literate women to access maternal health information via mHealth apps and search engines like Google, it is almost impossible for their illiterate counterparts to enjoy such privileges. We present an android based mobile health application designed for illiterate and semi-illiterate women, that provides personalized maternal health information, a reminder functionality and a call functionality. To get user requirements for the application, we conducted a field study in form of semi-structured interviews and focused group discussions with illiterate and semi-illiterate pregnant women and health practitioners in maternal health care from Uganda, and designers/developers of applications for low resource settings. The design of the application follows a user centered iterative process. The application was tested for functionality and usability by the pregnant women.

Keywords: Maternal health · Mobile health · Illiteracy · User centered design

1 Introduction

Mobile technology continues to gain popularity globally. There were 4.57 billion mobile phone subscribers in 2018 which is estimated at 63.5% of the global population [1]. There is a high number of mobile phone subscribers observed in developing countries as well [1]. The popularity of mobile phones has created opportunities in health care. There have been mHealth interventions developed for maternal health. Some of these interventions have indeed been successful, for instance Mobile Moms and MomConnect [2] but despite these interventions, maternal mortality remains a big challenge especially in developing countries [3]. Maternal mortality is the death of women during pregnancy, childbirth or within 42 days after delivery due to pregnancy related complications. Maternal mortality is estimated at 216 deaths per 100,000 live births globally and the highest maternal mortality rates are in developing countries [4]. There are various indirect factors that contribute to high maternal mortality rates in developing countries such as scarcity of health workers, limited access to health information and high illiteracy levels [5, 6]. Illiteracy prohibits illiterate women from

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accessing available text-based interventions such as Mobile Moms and MomConnect, yet it is illiterate women that are prone to maternal mortality mostly.

Despite global reduction of illiteracy, gender-based illiteracy persists and this is evidenced by higher levels of illiteracy among women compared to men [7]. Some cultures are characterized by male dominance which puts females at a disadvantage in attaining education. Illiteracy contributes to maternal mortality by limiting illiterate women from accessing maternal health information and using the available text based digital artifacts that support maternal health care. Therefore, there is a need to empower illiterate and semi illiterate women with interventions that support maternal health care, are secure and usable by them.

We propose a multimedia (video, audio) based mobile app that provides personalized maternal health information to pregnant women based on the maturity of their pregnancy. It also has a reminder functionality for appointments and a call functionality for the pregnant women to contact their health practitioners.

2 Method

To gather user requirements, we conducted a field study in form of semi-structured interviews and focused group discussion (FGD) with 25 illiterate pregnant women, 10 health practitioners in maternal health care and 10 designers/developers of applications for low resource settings. The pregnant women and health practitioners were recruited from the department of Obstetrics and gynaecology of Mbarara Regional Referral Hospital in Southwestern Uganda while the designers/developers were recruited through referrals of those who already knew about the study. Areas discussed in the interviews and FGD included access to digital technologies and health information, and user requirements for the app. The user requirements were used to design the app which was tested for functionality and usability by 10 pregnant women following an iterative process. The women were given phones with the app pre-installed, trained on how to login in and access videos and audios. They were then allowed to use the app for not more than one hour. This was followed by an FGD about the app.

3 App Design

The android app is designed based on four core requirements, following a user centered design approach, which emphasizes involvement of users in all design phases. (1) Multimedia based: The app should enable users to retrieve multimedia (video and audio) maternal health content. (2) Have a reminder functionality to remind the women to go for their antenatal appointments. (3) Have a call functionality to enable women contact their health practitioners when they are away from the hospital. (4) Easy to use and secure: (4) The app should protect the information in the app from unauthorized access and should be easy to navigate.

3.1 App Functionalities and Challenges Faced

The login: The user taps a combination of four images (pictorial password) to login (Fig. 1). Provision of a wrong password triggers a vibration. Pictorial password was used because the illiterate users are unable to use the conventional text-based username

and password. Biometric mechanisms such as face and voice recognition were also not possible because the users have low processing phones that are unable to process biometric information. It is important to note that the login was crucial because most of the users reported that they share the mobile phones.

Multimedia messages: During the first antenatal visit, the maturity of the woman's pregnancy and due date are determined. The pregnancy begin date is then set in the app calendar. The app counts down and pops up a video and/or audio tailored to the current maturity of her pregnancy every month. Tapping the watch button takes the user to the saved videos which are presented as scrollable thumbnails for easy accessibility (Fig. 1). Tapping the Listen button takes the user to the list of audio files which are saved with emojis to indicate the content of each file. Each video or audio is one to two minutes long. Messages were inbuilt in the app and pre-installed on the mobile phones because the users had no internet to dynamically download them.

Appointments and reminders: During the antenatal visit, the next appointment date is decided and input into the app by the health practitioner via the calendar module. The day before the appointment date, the app triggers an audio reminder reminding the woman to go for her appointment. This reminder is an audio voice in the local language stating, "*Your next antenatal appointment is tomorrow, please do not forget to go to the hospital.*" The reminder was designed this way to enable illiterate women differentiate it from other reminders that may be set in the shared phone

The call functionality: The app has a call icon which the woman can tap, and her call is directed to the health care provider's pre-set phone number. If the call is not picked, the woman can leave an audio message for the health provider. The call button appears on all app screens for easy access because the illiterate women are unable to navigate to the contact list and choose the desired number or text-based contact.

3.2 App Workflow

After starting the app, the user is prompted to input a pictorial password. Upon successful login, the user has access to three options: watch video, listen to audio, or set pregnancy begin date and appointment date (Fig. 2). Choosing any of the options takes the user to the respective menu displays. The user can terminate the application by navigating away from it.

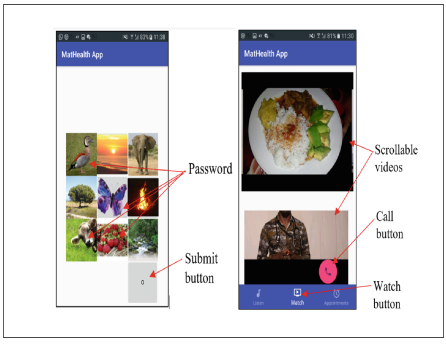

Fig. 1. Login and multimedia screen

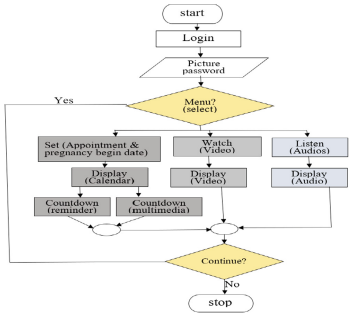

Fig. 2. App workflow diagram

4 Discussion and Lessons Learnt

We found that designing for illiterate people follows the same design guidelines but presents a unique set of requirements such as exclusive use of multimedia. Artefacts for this category of users require constant user involvement. Participants in the design process of the app felt they owned the app and readily accepted it. However, engaging other stakeholders such as spouses and community leaders is also paramount.

Participants who were HIV positive or had sensitive conditions, and shared mobile phones were more concerned about privacy of the information and their communication with the health practitioners compared to those without.

There is a need to create a balance between the design trade-offs when designing for the illiterate. We faced two major trade-offs: (1) The conflict between allowing the illiterate users to be in control of the app and the need for prescriptive guidance/training on how to use the app. (2) The conflict between making the app easy to use versus keeping it secure. The more usable the application got, the less secure it became.

The strength of this intervention is that it is based on participants' contributions and needs, who are the end users, and this makes it acceptable to a similar category of users. Also, the requirements, design perspectives and procedures from this study are transferrable to other similar cases of designing for illiterate users.

In conclusion, Illiterate people can utilize mHealth systems, but they need to be involved in all the design phases if secure and usable systems are to be developed for them. Our next step is to roll out the intervention in real life settings and do more empirical studies to determine its impact on maternal healthcare. We also intend to add a sharing functionality to the app where the users can share their experiences.

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