Design mHealth prototyping to Eliminate Mother to Child HIV Transmission (EMTCT) in Indonesia

K N Siregar¹, R Rikawarastuti²,* and M Yusro³

¹ Faculty of Public Health, Universitas Indonesia, Indonesia
² PhD candidate, Faculty of Public Health, Universitas Indonesia, Indonesia
³ Faculty of Engineering, Universitas Negeri Jakarta, Indonesia

*rikawarastuti@ui.ac.id

Abstract. Mobile health (mHealth) is the proposed solution from digital health intervention to improve the service quality to eliminating mother to child HIV transmission (EMTCT) in Indonesia. The purpose of this study is to develop a mHealth prototype for EMTCT. This study used prototyping Rapid Application Development (RAD). The external entities of the mHealth prototype consist; pregnant women as the main data sources midwives as program implementers who also work as information producers, contact person for EMTCT at the primary health center and health office, as the program manager for dashboard users. Nine data on longitudinal EMTCT services are antenatal visits, pre-test counseling, HIV testing, the results of HIV status, post-test counseling, antiretroviral therapy (ART), adherence for ARV therapy, viral load, and HIV status in children.

1. Introduction

The rate of Human Immunodeficiency Virus (HIV) transmission from mother to child in Indonesia is the highest in the world according to the 2017 UNAIDS report [1]. This condition results in increasing transmission of HIV from mother to child, which is the main mechanism of HIV transmission to children. It is estimated that there are 430,000 new HIV-infected children in the world where more than 90% occur through mother to child transmission [2].

Government policies regarding EMTCT exist since 2013 [3]. This gives the question, whether the policy was there before, why was EMTCT’s coverage still low until now. If this keeps happening, then the target program will always not be achieved. With the continuation of HIV transmission from mother to child, it means that Indonesia has not been able to break the chain of transmission, which impacts the transmission continues to the next generation [4]. The implementation of the EMTCT program does have many obstacles such as high stigma [5], low levels of maternal knowledge about HIV and EMTCT [6,7], negative perceptions of HIV sufferers [8], and the cost of HIV testing and ARV [9].

Dealing with the problem above, it is necessary to find a choice of solutions so that the scope of the EMTCT program can be increased and can also improve the quality of the program. Recently, WHO issued a digital health intervention recommendation for strengthening the health system. Digital health interventions are a form of applying digital technology to achieve health goals [10]. This research hopes that digital health interventions in this technological era can be an opportunity to overcome the low coverage and quality of the EMTCT program, so that in the future there will be no more HIV transmission from mother to child. The technology that will be developed is the use of mobile health for...
prevention services for HIV transmission from mother to child. Therefore, this study aims to develop a mHealth prototyping design for prevention of HIV transmission from mother to child

2. Methods
Digital health interventions can begin with the development of prototypes of digital health systems to lead to the possibility of implementing digital health interventions at the national level.

2.1. Rapid application development
The development of the EMTCT mHealth prototype was carried out by the Rapid Application Development (RAD) prototyping method with a software development process that was classified as an incremental technique. RAD emphasizes short, short and fast development cycles. Short time is an important limitation for this model. RAD uses an iterative method in developing systems in which business processes are constructed at the beginning of the development phase with the aim of establishing user requirements [11].

2.2. Design prototype mHealth
The prototype mhealth design consists of:

2.2.1. Desired functioning system
- Has Risk Prediction
- Provide health recommendations
- Provide reminder notifications for taking medication
- As a media for counseling
- Provider-client communication (midwife-pregnant women)
- Recording and reporting of EMTCT coverage and quality
- Monitoring and evaluation of material availability and budget for HIV testing
- Operating system: Android
- Tools for User Interface (UI), User Experiments (UE): Android Studio
- Programming Language: Python
- Database storage: MySQL database

3. Results and discussions
At the development stage of the mHealth EMTCT prototype a context diagram, Entity Relationship Diagram (ERD), Table Relationship Diagram (TRD,) and Data Dictionary (DD).

Context diagram illustrates the scope of the system associated with external entities can be seen in Figure 1. External entities consist of pregnant women, midwives, those responsible for the manager HIV program at the puskesmas and health offices. For pregnant women, the mHealth prototype provides an output schedule for taking medication and a health recommendation message after inputting pregnant women data is included in the mHealth. Midwives input data of pregnant women who come during ANC services and the mHealth prototype can directly provide HIV risk prediction based on machine learning. If a pregnant woman at risk of HIV is detected in an ANC service midwife without EMTCT services, the midwife can refer her to an ANC service midwife with EMTCT services through electronic referrals. If pregnant women at risk of HIV come to the ANC referral service, then when the midwife enters the identity of the pregnant woman will be immediately notified by the midwife's mHealth device that the patient is a referral patient with HIV risk so that certain treatment needs to be done.

mHealth is also made smart because it can record coverage and quality reports of EMTCT services in real-time and comprehensively. Real-time recording and reporting can be accessed anytime and anywhere and comprehensively includes 9 steps of the EMTCT service cascade which will be very useful for monitoring and evaluation for EMTCT service program managers in puskesmas and in health offices which so far have not been maximized.
mHealth will be made smart because it is equipped with alerts and reminder features. If the mHealth provider (midwife) gets input in the form of HIV risk prediction, the mother's data does not test HIV, HIV status data, does not comply with medication, the midwife's mHealth device will issue an output alert in the form of text and audio on the smartphone. Likewise, when a pregnant woman's personal mHealth device encounters input of non-compliance in taking medication, it quickly detects this and provides a reminder to the pregnant woman's personal mHealth device and provides an alert to the midwife's mHealth device.

![Diagram of mHealth EMTCT context](image1)

**Figure 1.** mHealth EMTCT context diagram.

Table Relationship Diagram is a model that consists of tables containing data and relationships between data can be seen in Figure 2. mHealth TRD illustrates the relationship between the data available to midwives, pregnant women, program managers in community health centers and health offices.

![Table relationship diagram](image2)

**Figure 2.** Table relationship diagram.
Data Dictionary (DD) is an explanation of the meaning of data in TRD, can be seen in Figure 3.

![Data Dictionary Diagram]

**Figure 3.** Data dictionary.

Entity Relationship Diagram (ERD) shows a visualization of the flow of relationships between entities, can be seen in Figure 4. ERD starts from puskesmas receiving ANC visits from pregnant women, then puskesmas midwives provide EMTCT services that are integrated with ANC services starting with pre-counseling, and HIV testing. If HIV positive, counseling is given post-HIV testing to get ARV therapy. HIV positive pregnant women log into mHealth and will get medication schedules to be compliant with ARV therapy. Viral load checks were performed periodically, and HIV status checks were performed on the ankle born.
4. Conclusion

We have successfully developed a prototype mHealth EMTCT involving external entities (midwives, pregnant women, and EMTCT program managers in puskesmas and health services) to improve the scope and quality of EMTCT services. It is hoped that the prototype developed meets level 5 readiness technology, which can be demonstrated in relevant environments.

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