Enabling Secure Maternal Health Information Exchange using Blockchain

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Introduction

The achievement of universal health coverage in Kenya has been prioritized by the current government for the period 2017 – 2022. In line with this the use of ICT's in the form of eHealth and mHealth solutions has been identified as a key strategic direction towards achieving this goal and is ably captured in the Kenya National eHealth policy 2016 – 2030. Policy objective number two in particular addresses the means by which the government seeks to utilize eHealth towards the attainment of universal health coverage. Key priorities under the objective include; **(i)** Improving health literacy levels by providing materials including but not limited to written, printed and spoken words to patients on how to use eHealth, **(ii)** Promoting availability, accessibility and affordability of ICT infrastructure, devices and connectivity, and, **(iii)** Ensuring deployment of user-friendly eHealth platforms for ease of use.

eHealth Universal Health Coverage

To address the challenges facing the effective application of eHealth for universal health coverage the Kenya Government through the ministry of health has outlined the following key measures in the eHealth policy 2016 – 2030

(i) The provision of eHealth platforms for patients and physicians that are multilingual, multicultural, multi-professional, and multijurisdictional,

(ii) Provision of broadband internet connectivity to all parts of the country to enable online access to eHealth services and information,

(iii) Development of a variety of eHealth access platforms including but not limited to mobile devices and community digital centers.

(iv) Adoption of telemedicine in geographically isolated communities and regions, and

(v) Development of platforms for cross-border and inter facility sharing of health information about the medical incidences and history of patients without compromising privacy.

The problem

According to UH2030 (2018), medical facilities in Kenya have made efforts to adopt Electronic Health Records systems. However, lack of secure means to share the sensitive personal health records curtails the potential inherent in the shared electronic health records which includes provision of historical health information that is critical to facilitate better informed medical decisions. Concerns for confidentiality of patients' records must be adequately addressed through measures such as data encryption and patient mediated records access. *A cloud based blockchain solution accessed using mobile devices would reliably address these concerns and result in access to better quality maternal healthcare services in Kenya.*

Main Study Objective

To develop a Blockchain distributed ledger model for Enabling Secure Maternal Health Information Exchange.

Specific objectives

1. To develop a maternal health information system for the collection, storage analysis and dissemination of maternal health data and information.

2. To design and implement a secure framework for sharing of maternal health records between medical facilities.

3. To integrate the secure block chain framework with internet of things (IOT) data collection devices for secure real-time collection of maternal health data

4. To pilot the proposed solution

Justification of Application Area

1. Pregnant women and their fetuses have long been regarded as vulnerable, where being vulnerable indicates a likelihood of suffering harm (Ballantyne & Rogers, 2016). This can happen from anywhere regardless of whether they have carried their prenatal cards or not. It would therefore be prudent to ensure that their health records are accessible through a secure and interoperable system without impediments. This can be achieved through a blockchain distributed ledger.

2. With regard to social implication, secure centralized access to patient's records eliminate delays in health record access thus potentially reducing maternal mortality and morbidity. The time taken to make a decision by health experts is reduced and this can make a major difference in saving a patient's life. Patient's follow-up is much easier since decision makers don't have to make disjoint decision upon every new diagnosis.

3. Economically a distributed ledger makes sense since a patient who was diagnosed at one facility and the results uploaded in the ledger will not have to undergo the same test again. This improves the cost of health care for the expectant mothers.

4. A blockchain distributed ledger transcends health facilities and inter country boundaries. Since the proposed solution targets inter health facilities within Kenya then the data protection and access to information acts of Kenya would suffice at this stage..

Proposed solution and justification

Parties involved:

1. *The Ministry of Health*
2. *The patient*
3. *Health service providers*
4. *Auditors*
5. *Certificate Authority*
6. *Blockchain Network Operator*

Justification of Proposed Solution

Current approaches:

In Kenya the current process of ANC visits is still done manually, resulting in incomplete and inconsistency of data collection, inaccurate and unreliable reports, data redundancy in different locations, data inaccessibility if the card is misplaced, there may be missing data in the records due to regular oversight, and the data may be difficult to read as records grow large over time.

Why DLT:

Distributed Ledger Technologies (DLT), and specifically blockchain, have the potential to address these and more challenges in the following ways(Gupta, 2017);

1. Information security
2. Cost savings
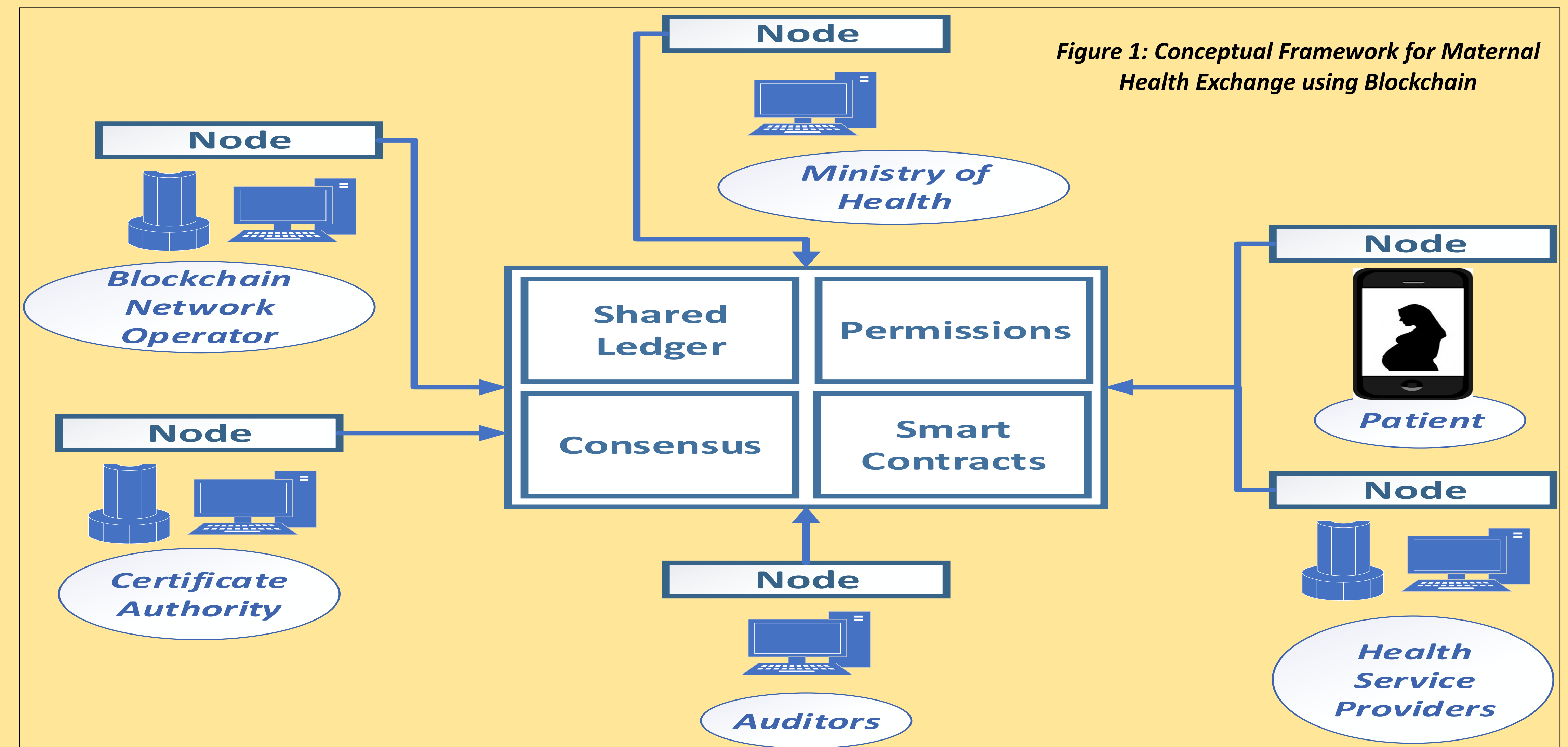*3. Enhanced Privacy*
4. Improved Auditability

Methodology

The overall process to be adopted for the study will be that developed by the Kenya Ministry of Health for the development of mHealth solutions presented in figure 2.

The implementation process provides for stakeholder involvement in the identification of priority issues and areas of intervention as well as their subsequent involvement in the development and system testing activities.

Study focus: The proposed system will focus on the automation of the antenatal care process with the ability to access care at different facilities using the same system.

Study Design: The study design to be adopted is a mixed methods approach. There will be the collection and analysis of quantitative and qualitative data, systems development as well as experimentation with the solutions in the study environment.

Systems Development: The system development aspects of the study will adopt the rapid prototyping system development approach.

Stakeholder Engagement: Stakeholder engagement will be undertaken using the Collaborative Requirements Development Methodology (CRDM) approach developed by the Public Health Informatics Institute in the year 2009 and has been previously utilized by Taylor *et al*(2012) in the development of the common requirements for maternal health systems.
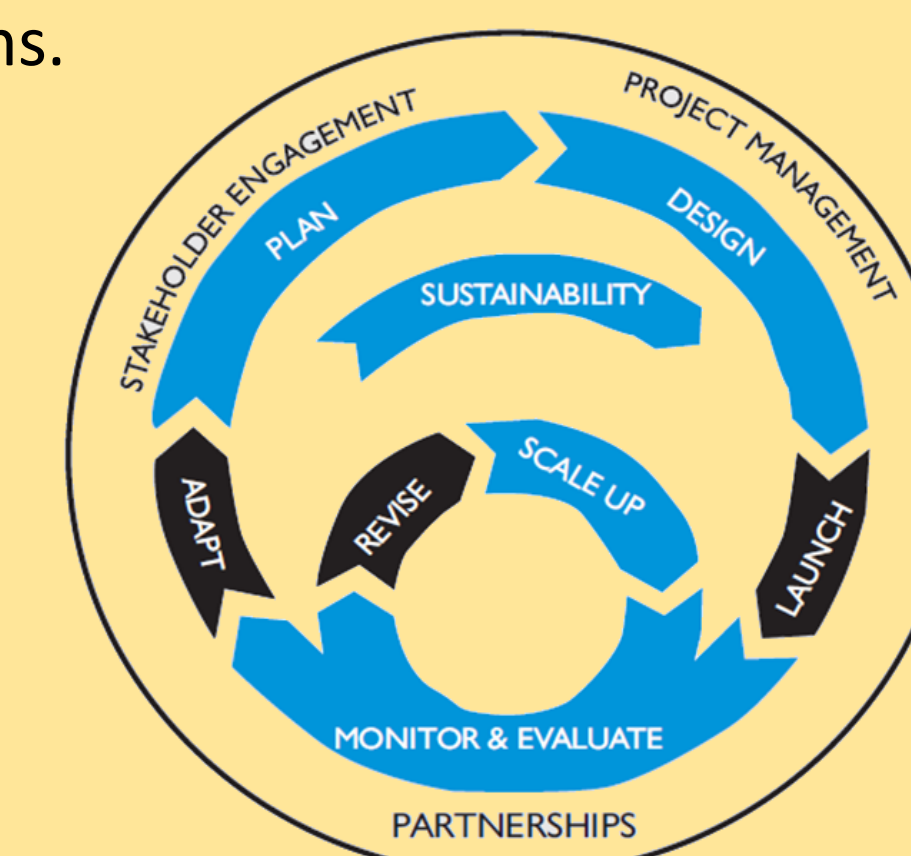

Figure 1: Conceptual Framework for Maternal Health Exchange using Blockchain

Figure 2 : mHealth Implementation process by the Kenya Ministry of Health 2017
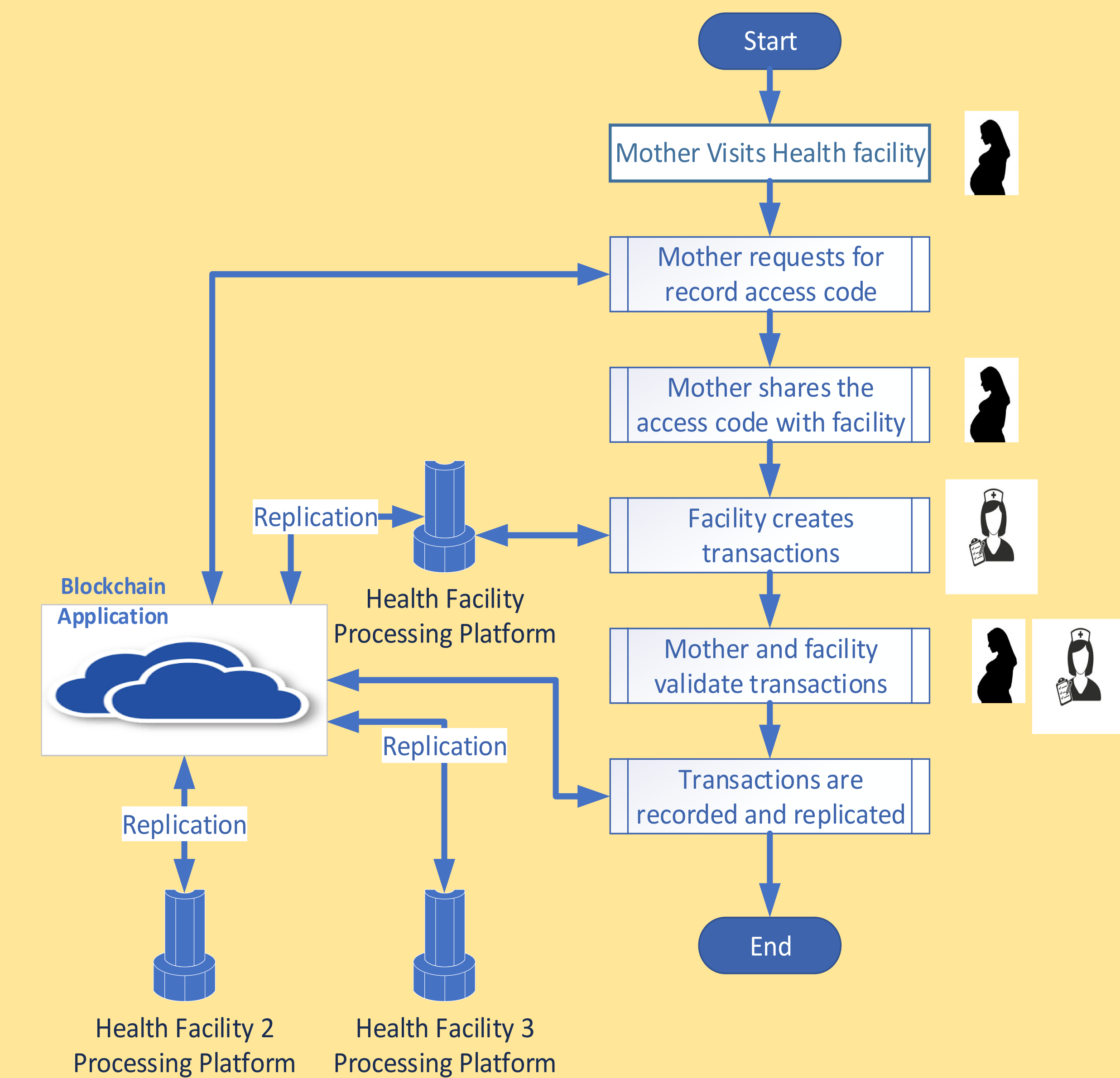

Figure 3. : Proposed system workflow

References

1. UHChao, A. C. (2016). The impact of electronic health records on collaborative work routines: A narrative network analysis. *International journal of medical informatics,*, 94, 100-111.

2. Gupta, M. (2017). *Blockchain for Dummies*. Hoboken, New Jersey: John Wiley and Sons, Inc.

3. Kakamega County Government. (2018a). Kakamega County Factsheet. In K. C. Government (Ed.), *https://kakamega.go.ke/county-fact-sheet-2018/#* (pp. 4).