##### **ARDHI UNIVERSITY**



**SCHOOL OF EARTH SCIENCE, REAL ESTATE, BUSINESS STUDIES AND INFORMATICS**

**DEPARTMENT OF COMPUTER SYSTEMS AND MATHEMATICS**

**BSC. COMPUTER SYSTEMS AND NETWORKS**

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**TITLE: DIGITIZATION OF ANTENATAL AND CHILD HEALTH CARDS**

1. **INTRODUCTION**

**1.1General Introduction**

Antenatal care is one of the maternal health services important for preventing maternal deaths as it provides a platform for delivering several maternal and newborn babies’ interventions (Kimei & Kalegele, 2017). Antenatal care is the care that a woman gets from health professionals during her pregnancy. After the delivery there is a systematic health care for the child up to five years old so as to monitor his or her growth and well-being. In the context of this dissertation title,

In Tanzania, the recording of Antenatal and Child Health visits is still done manually, which leads to the following challenges; inaccurate, incomplete and inconsistency of data, inaccurate and unreliable reports, data redundancy in different locations, data may be inaccessible when in use by someone else or if misplaced, there may be missing data in the records due to oversight, and the data may be difficult to read as records grow so large over time. Furthermore, the process is tedious and difficult to extract data from it for clinical research and reporting. Typically, pregnant women take their Antenatal and Child Health cards home. This means there is a high risk of losing information and failed continuity of the care when the cards are either misplaced or lost (Kimei & Kalegele, 2017).

Therefore, this research aims to come up with a digitized Antenatal and Child Health care cards which will help to reduce the problems associated with the current manual system. Many scholars have tried to solve the problem of inefficient clinic attendances by creating the systems that send SMS reminders to the mothers not to miss the visits.

**1.2 Problem statement**

In Tanzania, the Antenatal and Child Health care is recorded manually during parents clinic visits, which leads to the following challenges: inaccurate, incomplete and inconsistency of data, inaccurate and unreliable reports, data redundancy in different locations, data may be inaccessible when in use by someone else or if misplaced, there may be missing data in the records due to oversight, and the data may be difficult to read as records grow so large over time. Furthermore, the process is tedious and difficult to extract data from it for clinical research and reporting.

Typically, pregnant women and mothers take their Antenatal and Child Health cards home. This means there is a high risk of losing information and failed continuity of the care when the cards are either misplaced or lost. During care seeking practice, pregnant women are allowed to obtain Antenatal Care services from different health facilities and in such cases, healthcare workers have to decide whether or not to record the patient in the Antenatal Care register. Hence, even though a pregnant woman actually had, for example, four visits in her health Antenatal Care card, the register would only have 3 visits thereby affecting the accuracy of the report. This paves a way for the use of electronic Antenatal and Child Health (e-ACH) system for improving service delivery, reporting process and record keeping and mobile technology in sending and receiving of data on Antenatal and Child Health visits on the pregnant mothers’ mobile phone.

**1.3.1 General Objective**

The general objective of this dissertation is to a digitized Antenatal and Child Health care cards for efficient record keeping.

**1.3.2 Specific Objectives**

1. To identify the requirements for digitized Antenatal and Child Health care cards.
2. To develop an electronic Antenatal and Child Health care system and mobile application.
3. To implement the Antenatal and Child Health care system.
4. To test and validate the Antenatal and Child Health care system.

**1.4 Research Question**

1. How do health workers and pregnant women perceive digitization of Antenatal and Child Health care cards?
2. How does digitization of health cards improve the efficiency and accuracy of data collection during antenatal and child health check-ups?
3. What are the key technological challenges associated with implementing a digital system for managing antenatal and child health information?
4. How can the digital transformation of health cards enhance the integration of antenatal and child health services within existing healthcare systems?

**1.5 Significance of the Study**

The study will help to provide accurate, complete and consistent data, accurate and reliable reports, overcoming the problem of data redundancy in different location as well as allowing data to be accessible when in use with someone else or if misplaced, generally the study will help to reduce the tedious activity faced by health officers when filling the manual cards.

**2.0 LITERATURE REVIEW**

This section gives the overview of related works from different scholars pertaining Antenatal and Child Health Care. The advancement of information and communication technology …………

The Antenatal care is one of the maternal health services important for preventing maternal deaths as it provides a platform for delivering several maternal and newborn babies’ interventions (cite). However, developing countries in Sub-Saharan Africa are struggling to provide quality maternal health services including antenatal care (ANC). Studies reveal that there is a substantial quality gap in the provision of ANC with fewer women receiving the full range of interventions during pregnancy. The Antenatal and Child Health (ACH) cards are used by health workers as a medical record for recording patient data. These records are retained by the patients after the service. The information recorded in the ACH card is transcribed to clinic registers so that health facilities can have a record of the encounters. The data in these registers form the basis for compilation of required routine report. In this research, we looked into how to digitize the ACH card, develop a mobile application and integrate with OpenMRS. The methodology used to conduct this study is a mixed approach involving qualitative methods whereby facts regarding the existing systems and requirements were investigated to give a clear understanding of the problem. The requirements and fact finding was done through literature review, field observations and interviews. Field observations and interview of health stakeholders were undertaken during service delivery to get an understanding of their work practices and use of existing data collection tools such as registers, ACH cards and reports. Extensible Markup Language (XML), module, report module, MYSQL and OpenMRS platform were used in designing and developing the electronic ACH system. Agile development technology was used to design the mobile applications, Android, MySQL and Java. Agile development technology was adapted because mobile applications need to be frequently revised to meet the end-user expectations while providing the intended functionality.

ANC supervision can be conducted several times during pregnancy ideally monthly, half monthly and weekly based on timeline of pregnancy and different set of data would be gathered by medical officer, auxiliary nurse midwife, accredited social health activist (ASHA) worker and multi-purpose worker (female) to track mother’s health during pregnancy period (cite). Processor combining IOT with ANC starts with data gathering in which past medical history of mothers should be taken carefully. Physical examination records also gathered for analysis and reporting purpose. Date gathering is done with paper based forms which will later converted to digital using health information system by data entry operators posted on primary health centers respective area. mHealth system used to store and process initial examination records of mothers’ health for further activity tracking. Clinical decision support system provides determinations, judgments, and courses of action to doctors and ANMs based of gathered records and current situation of mother’s health. To track their activity smart wrist bands can be used to collect data about their activities and rest cycles which will led medical staff to give her knowledge about risk of situation and direct her to maintain healthy pregnancy. A mobile application can be also used to store details of mothers and statistics that can used to generate alerts, warnings, reminders, based on real-time health records for mother and medical staff respectively, using this application doctor can recommend telemedicine for primary treatment and id required then emergency service could be dispatched to mothers’ location.

Applying mobile phones in healthcare is increasingly prioritized to strengthen healthcare systems. Antenatal care has the potential to reduce maternal morbidity and improve newborns’ survival but this benefit may not be realized in sub-Saharan Africa where the attendance and quality of care is declining (Cite). We evaluated the association between a mobile phone intervention and antenatal care in a resource-limited setting. We aimed to assess antenatal care in a comprehensive way taking into consideration utilisation of antenatal care as well as content and timing of interventions during pregnancy. The wired mothers’ intervention consisted of an automated short messaging service (SMS) system providing wired mothers with unidirectional text messaging and a mobile phone voucher system providing the possibility of direct two-way communication between wired mothers and their primary health care providers. While only women with registered phone numbers received text messages, all women in the intervention group were given mobile phone vouchers to contact their local primary health care provider. The aim of the SMS component was to provide simple health education and appointment reminders to encourage attendance at routine antenatal care, skilled delivery attendance and postnatal care. A wired mothers’ software was developed to automatically generate and sent text messages to registered phone numbers throughout the pregnancy until six weeks after delivery.

Wearable devices are used in maternity to foster remote medication and monitoring. Monitoring the mother and child's well-being has its application with IoT devices. The use of smartphones and mobile health sensors in wearable devices has been on the increase. This trend is particularly significant in the development of wearable IoT technology for maternity care, which encompasses a wide range of applications (Cite). These applications include preconception care, managing gestational diseases, remote health monitoring, providing prenatal care, offering patient education, predicting foetal health status, predicting preeclampsia, and detecting prenatal depression. By leveraging wearable IoT technology, healthcare providers can offer more personalized and efficient care to pregnant women, reducing the risk of complications and improving maternal and foetal outcomes. Wearables are increasingly used to monitor patients with chronic illnesses who require continuous monitoring. In major mobile application stores like Play Store, there are thousands of mHealth applications available that can be used for wellness management, disease management, self- diagnosis, and notifications for medical consultations. During antenatal care management, health applications such as Band by Scripts, OpenSRP, PANDA, PotM, and mHealth Guatemala are commonly used. These apps include features such as foetal age, maternal age, blood type, delivery number, and some illnesses that are related to pregnancy age in other to provide comprehensive monitoring and management of pregnant women.

The focus of this study is to analyze information flow and design a health information technology solution to address gaps in the last mile supply chain associated with MCH in the Ugandan health system(cite). The system we proposed is an all-in-one solution that can be used without access to the Internet. We created a local network that can exchange information within the facility. The system is a local cloud-based system coded in PHP, HTML, JavaScript, and CSS backed with SQL databases. The proposed architecture uses a cloud-based centralized database. Data collection is done on Android tablets using an open-source application, OpenDataKit. Compared to computers/laptops, tablets are cheaper and more portable. They have longer battery lives, lasting more than 10 hours. This is critical in places with limited power resources. Multiple tablets can be issued to enter data simultaneously. They are all connected to a local wi-fi network via multiple routers that cover different departments/wards. Data collected on those Android tablets are pushed automatically to the centralized SQL database located in a laptop. The laptop is hosting a web server with SQL database, and an OpenDataKit server using Apache TomCat. Data is then visualized on a website that is accessible from any device connected to the wi-fi network. The routers can be connected to a 4G modem to connect to the Internet, so that we can remotely troubleshoot the system and access reports via TeamViewer or other remote-control applications.

MomConnect is a text service provided to pregnant women and new mothers. From the date that the pregnant woman registers her pregnancy at the clinic, she begins to receive messages in the language of her choice (Cite). There are standardly one to three messages a week, depending on the stage of the pregnancy. The messages continue until the child is 1year old. It was expected that MomConnect would provide a valuable service to new mothers when registering their pregnancy at the local clinic, complementing the current set of services in empowering mothers to take care of their children. MomConnect was modelled on a similar texting intervention in South Africa, whereby text messages covering broad areas of child care and health were sent to pregnant mothers from the time they presented at the clinic. The registration is done at the clinic, and if no problems occur this can be done quickly. There is no cost to the mother. If the mother does not have her own phone, she can have the messages sent to another phone where she can read them. The service should be provided at all public health clinics in South Africa by health workers who have been trained, backed by public education about the service. There is an attached service, Help Desk, that allows mothers to phone in and ask questions.

The work by () sought to design and implement a mHealth data model with an intention of improving mothers’ knowledge of Reproductive and Child Health (RCH) services in rural environments and to remind mothers who do not have access to mobile phones to attend antenatal care. The model was implemented as a module using District Health Information System (DHIS) Tracker computer application which is a free and open source software. Health service providers define and enter SMS into content providers. Messages are sent in form of Hypertext Transfer Protocol (HTTP) query from the computer application to SMS gateway. The gateway converts HTTP messages into particular Short Message Service Centre (SMSC) format of a particular mobile operator and sends to the SMSC. The SMSC then forwards message to the final destination (mobile phone terminal of a particular community member). Similarly, messages can be sent from mobile terminals to the computer application. Messages are sent to the SMSC using SMSC protocol and then the SMSC forwards the messages to the SMS gateway. The SMS gateway converts the messages into HTTP format and send to the computer application. However, information flow from mobile terminals (mothers, relatives, TBAs, CHWs and community leaders) to health facilities was not explored. In addition to relatives and spouses, community leaders and CHWs were also registered into the computer application as contact persons of mothers. Reminder messages were then sent to mothers and their contact persons. If the mother owned a phone, an SMS was directly sent to her, otherwise it was sent through another person whom she had decided.

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The antenatal care management system’s primary goals are to make it simple for users to enter data and store it in the database. Both healthcare professionals and expectant mothers themselves may access it whenever required because it displays essential information about the mother from prior visits (cite) . Therefore, the antenatal care management platform (ANCMP) proposed in this design research is a web-based system that routinely warns and notifies physicians, nurses, and midwives in case of crises and provides reminders to attend the hospital. Users of the portal can submit and change clinical data and test results in addition to browsing medical material. The major goal of this project was to create a platform for managing antenatal care to enhance the Ethiopian antenatal care management system. To achieve the design goals for ANCMP, many users have to engage with the system using various computers and cell phones. This web-based antenatal care management platform is designed using XAMPP, PHP, HTML and CSS. It involves designing the stoner interface and identifying the inputs, outputs, and processes of the designed system. The configuration involves the use of case diagrams, sequence diagrams and class diagram tools to achieve the physical consummation of the antenatal care management platform and positive living information system. The purpose of this work was to create a web-based platform for managing antenatal care.

**Summary of literature review**

The table below provides the list of literatures and the technologies which were used to implement the studies in comparison with the study that will be conducted to fill the gap.

Table 1: Literature review comparison table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **SN** | **Author’s name & year** | **Technologies used** | | | | |
| **IoT** | **wearable** | **Web** | **Mobile** | **GSM** |
| 1 | (Kimei & Kalegele, 2017) | x | x | √ | √ | x |
| 2 | (Maheshwari & Maheshwari, 2019) | √ | √ | x | √ | x |
| 3 | (Lund et al., 2014) | x | x | x | x | √ |
| 4 | (Elei et al., 2023) | √ | √ | x | √ | x |
| 5 | (Wang et al., 2022) | x | x | √ | x | x |
| 6 | (Skinne et al., 2017) | x | x | x | x | √ |
| 7 | (Thobias & Kiwanuka, 2018) | x | x | x | x | √ |
| 8 | (Aliyi et al., 2023) | x | x | √ | x | x |
| 9 | Digitization of Antenatal and Child Health cards | x | x | √ | √ | x |

1. **METHODOLOGY**

Methodology is a system of methods used in particular area of study or activity, including the techniques and procedures to identify and analyze information regarding the research.

Table 2: Methodology table

|  |  |  |  |
| --- | --- | --- | --- |
| SN | SPECIFIC OBJECTIVE | METHODOLOGY | DELIVERABLE |
| 1 | To identify the requirements for digitized Antenatal and Child Health care cards | Interview, Observation, Literature review | User requirements specification document |
| 2 | To design and develop an electronic Antenatal and Child Health care system and mobile application | Modified waterfall model | System design |
| 3 | To implement the Antenatal and Child Health care system | Computer | Electronic card and mobile application |
| 4 | To test and validate the Antenatal and Child Health care system | System testing | Testing results |

1. **SCHEDULE OF ACTIVITIES**

This section is comprised of the list of tasks to be done to accomplish the dissertation and the duration in terms of weeks to accomplish a specific task by using Gantt Chart.

GANTT CHART

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tasks/ Weeks | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 | W13 | W14 | W15 |
| Gathering requirements |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Designing electronic Antenatal and child Health cards |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Designing and developing mobile application |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Implementation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Testing and validation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Report writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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